Sampling and Analysis Plan/ Quality Assurance Project Plan Washington State Liquor Control Board Site

Prepared for
Washington State
Department of Ecology

April 15, 2011
17330-32

HARTCROWSER

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SAMPLING AND ANALYSIS PLAN/
QUALITY ASSURANCE PROJECT PLAN
WASHINGTON STATE LIQUOR CONTROL BOARD SITE

1.0 INTRODUCTION

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) was developed for the Washington State Department of Ecology (Ecology) for a reconnaissance-level investigation at the Washington State Liquor Control Board (WSLCB) site. This SAP/QAPP describes the sampling locations, field sampling procedures, laboratory analytical methods, data evaluation procedures, and quality control criteria to support the investigation.

The scope of work described in the SAP is designed to acquire reconnaissance-level characterization information to aid in determining if there is a potential for sediment recontamination from the WSLCB site.

2.0 BACKGROUND

The Lower Duwamish Waterway (LDW) is the 5.5-mile portion of the Duwamish River south of Harbor Island in Seattle, Washington. The Duwamish River is fed mainly by the Green River and smaller tributaries, and flows into Elliott Bay. The LDW was added to the US Environmental Protection Agency's (EPA) National Priorities List in 2001. Ecology added the site to the Washington State Hazardous Sites List in 2002.

Ecology and the EPA are working to clean up contaminated sediment and control sources of recontamination in the LDW. Ecology is the lead agency responsible for source control in the LDW. Source control is the process of finding and stopping or reducing, to the maximum extent practicable, releases of pollution to waterway sediment. The goal of source control is to stop ongoing sources and minimize post-remediation recontamination.

Ecology identified the WSLCB site for further evaluation and characterization because past uses on the WSLCB site and adjacent properties suggest there may have been releases of hazardous substances to soil and/or groundwater. The Summary of Existing Information Report (Hart Crowser 2011b) and Reconnaissance Plan (Hart Crowser 2011a) summarize historical use and contamination history relevant to potential LDW sediment recontamination and identify areas where further information is required.

The site is located at 4401 East Marginal Way South and is approximately 10.91 acres in size. The site was initially developed in 1948 as the distribution warehouse for the WSLCB. The original warehouse was demolished in 1997 and the current warehouse was built in generally the same location in 1999. The site has been used by the State of Washington to store liquor for distribution since its initial construction. Taxpayer information is included in Table 1.

The straightening and dredging of the LDW during the early 1900s filled a branch of the Duwamish River that cut through the eastern edge of the site. Hydraulic fill was also added to the entire WSLCB site. Although the source of the fill material was not documented, it is likely dredged material from the main channel (Harper-Owes 1985). According to logs from geotechnical investigations on the site, the upper 8 feet (up to 13 feet) of soil is typically hydraulic fill.

Contract and construction records provided by the WSLCB indicate that there were three heating oil USTs associated with the original warehouse that were removed in 1992. Two USTs were located in the southeast corner of the original warehouse totaling about 6,000 gallons. The third UST was located in the northwest corner of the original warehouse and was approximately 4,000 gallons. Impacted soil was not encountered during the removal of the two tanks in the southeast corner (WSLCB, 1992).

Seattle Public Utilities, King County METRO, and Ecology have inspected the site numerous times since 1992 with regards to water quality, source control, dangerous waste, and sanitary sewer discharges. The site regularly had materials management-related and housekeeping issues observed during these inspections.

Previous studies by the Port of Seattle (Port) found PCBs, elevated levels of PAHs, metals, and petroleum in soil and groundwater on the adjacent T-108 property and in the South Oregon Street right-of-way. The Port's investigation did not include the WSLCB site and, therefore, the extent of the impacts is unknown.

3.0 PROJECT OBJECTIVES AND SUMMARY

The purpose of the proposed reconnaissance-level investigation is to evaluate the site for the potential for sediment recontamination associated with imported dredge or fill material; past and current housekeeping and material management practices; a fuel oil underground storage tank; and past industrial uses on the adjacent T-108 property.

Investigation activities include completing soil borings, installing monitoring wells, and collecting and analyzing soil, groundwater, and catch basin samples.

All samples collected will be analyzed for the following parameters:

- Semivolatile organic compounds (SVOCs);
- Volatile organic compounds (VOCs);
- Polychlorinated biphenyls (PCBs);
- Pesticides;
- Total petroleum hydrocarbons (TPH) including gasoline, diesel, and heavy-oil ranges;
- Metals (As, Cd, Cr, Cu, Pb, Hg, Ag, Zn); and
- Total organic carbon (TOC).

In addition to the analytes above, surface soil and catch basin samples will be analyzed for the following parameters:

- Dioxins and furans; and
- Polybrominated diethyl ethers (PBDEs).

Soil analytical results will be compared to:

- Soil screening levels protective of sediment (provided by Ecology);

- Most Stringent Screening Levels Without Potable Surface Water in Site (Provided by Ecology); and

- Model Toxics Control Act (MTCA) Method B soil cleanup levels.

Groundwater analytical results will be compared to:

- Groundwater screening levels protective of sediment (provided by Ecology).

- Most Stringent Screening Levels Without Potable Surface Water in Site (Provided by Ecology);

Catch basin sediments will be compared to:

- Washington State Sediment Management Standards Marine Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSL).

A quality assurance data validation review will be performed on all analytical sample results. Validated data will be entered into Ecology's Environmental

Information Management (EIM) system. Sampling results and laboratory data will be compiled and evaluated. Sampling locations, procedures, analytical methods, and evaluation of results are discussed in subsequent sections of this SAP/QAPP.

4.0 PROJECT TEAM AND RESPONSIBILITIES

Key staff members and their project functions are listed below.

- Dan Cargill, Ecology Project Manager
- Mark Dagel, LHG, Program Manager
- Ross Stainsby, LHG, Project Manager
- Roger McGinnis, PhD, Project Chemist
- Kimberly Reinauer, EIT, Field Coordinator
- Field Geologist/Engineer – To Be Determined

Chemical analysis will be primarily performed by Analytical Resources, Inc (ARI) located in Tukwila, Washington. ARI is accredited by the State of Washington. The ARI project manager will be Kelly Bottem. ARI will subcontract to Brooks Rand Labs (BRL), LLC of Seattle, Washington for low-level mercury groundwater samples. The BRL project managers will be Amanda Fawley and Amy Durdle.

5.0 SAMPLING LOCATIONS

Sample locations, presented in the Reconnaissance Plan (Hart Crowser 2011a), were selected to further evaluate areas that are potentially contaminated from activities identified above. Proposed sample locations are shown on Figure 2. Coordinates for boring, monitoring wells, and catch basins will be surveyed relative to a known datum. Well elevations will be surveyed to Mean Lower Low Water (MLLW). Sampling locations will be cleared for underground utilities using a private utility-locating firm as well as the "one-call" utility locating system. A street use permit will likely be required for the borings in the Oregon Street right-of-way (MW-5 and MW-6). Sampling methods are described in Section 6.

5.1 Soil Sampling Locations

Eight borings (MW-1 through MW-8) will be drilled and sampled to characterize imported fill underlying the site and potential impacts from historical activities. Samples from borings MW-4 through MW-8 collected along the southern portion of the site will be used to determine if impacts extend from the adjacent T-108 property. MW-1 and MW-7 also assess potential impacts from the historical fuel oil tanks.

5.2 Groundwater Sampling Locations

Contaminated groundwater could migrate off site and potentially impact sediment, therefore, the eight soil borings will be completed as groundwater monitoring wells (MW-1 through MW-8) to assess groundwater quality and flow direction. Shallow groundwater at the site is expected to flow generally west to southwest toward the LDW.

5.3 Catch Basin Sampling Locations

The catch basins on the WSLCB site drain to the LDW, therefore, the accumulated sediment has the potential to be transported to the LDW. The catch basins will be inspected during our field investigation. If accumulated solids are present in the catch basins, we will collect a sample to represent a worst-case of the material that is present on the paved surfaces. For the purposes of this SAP, we have assumed that four catch basins will be sampled. Catch basins will be selected for sampling based on field observations including the presence of sediment.

6.0 FIELD SAMPLING METHODS

6.1 Hollow-Stem Auger Boring Procedures

The hollow-stem auger borings will be extended to approximately 5 feet into native material and/or 5 feet below groundwater, whichever is deeper. Borings will be drilled to a maximum depth of 30 feet below ground surface (bgs). The borings will use a 4-inch inside diameter hollow-stem auger and will be advanced with a truck-mounted drill rig subcontracted by Hart Crowser. Split-spoon soil samples will be collected every 2.5 feet.

The drilling will be observed by a Hart Crowser geologist or engineer. Detailed field logs will be prepared for each boring.

6.2 Soil Sampling Procedures

Soil samples will be collected for chemical analysis directly from the split-spoon sampler with a clean stainless steel spoon and/or clean (new) disposable nitrile gloves and placed in precleaned, laboratory-supplied sample jars and appropriately preserved 40-ml VOA bottles (VOC and NWTPH-Gx samples). VOC and NWTPH-Gx samples will be collected using EPA Method 5035 procedures.

Selecting samples for analytical testing will be based on field screening, including PID measurement, discoloration, and sheen using the methods described in Section 6.3. Three soil samples per boring will be selected for chemical analysis based on the following general protocol:

- When soil contamination appears present based on field screening, the soil samples exhibiting the most significant evidence of contamination from each boring location will be submitted for chemical analysis.

- If no field indications of contamination are identified in any given boring, one soil sample will be collected near the surface to characterize the fill material, one soil sample will be collected near the water table, and one sample will be collected below the water table.

6.3 Soil Screening Analysis

Soil samples will be field screened for evidence of contamination using: (1) visual examination; (2) water sheen testing; and (3) headspace vapor screening using a PID. The effectiveness of field screening varies with temperature, moisture content, organic content, soil type, and age of the contaminant.

Visual Examination. Visual examination consists of observing the soil for stains. Visual screening is generally more effective when contamination is related to heavy petroleum hydrocarbons such as motor or hydraulic oil, or when hydrocarbon concentrations are relatively high.

Water Sheen Testing. Water sheen testing involves placing a small volume of soil in a pan of water and observing the water surface for sheen. Sheens are classified as follows:

No Sheen (NS) No visible sheen on water surface.

Slight Sheen (SS) Light colorless film, spotty to globular; spread is irregular, not rapid, areas of no sheen remain, film dissipates rapidly.

Moderate Sheen (MS) Light to heavy film, may have some color or iridescence, globular to stringy, spread is irregular to flowing; few remaining areas of no sheen on water surface.

Heavy Sheen (HS) Heavy colorful film with iridescence; stringy, spread is rapid; sheen flows off the sample; most of the water surface may be covered with sheen.

Headspace Vapor Screening. Headspace vapor screening is intended to indicate the presence of volatile organic vapors and involves placing a soil sample in a plastic sample bag. Air is captured in the bag and the bag is shaken to expose the soil to the air trapped in the bag. The probe of the PID is inserted in the bag and the instrument measures the concentration of organic vapors in the air from the sample headspace. The highest vapor reading is recorded for each sample. The PID measures concentrations in ppm (parts per million) and is calibrated to isobutylene. The PID is typically designed to screen total volatile organic vapor concentrations in the range of 0 to 1,000 ppm.

The results of field screening will be recorded in the field logs and will be used to select the samples to submit for chemical analyses.

6.4 Monitoring Well Installation and Development Procedures

Two-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter, 0.010-inch machine-slotted screen will be used for the well casings and screens. The well screen and casing riser will be lowered down through the hollow-stem auger. Well screens will generally be 10 feet in length and placed across the water table. As the auger is withdrawn, No. 20/40 silica sand will be placed in the annular space from the base of the boring to approximately 2 to 3 feet above the top of the well screen. Pre-pack well screens may be used to prevent clogging the screen during installation if the water-bearing zone includes a significant amount of fine-grained material.

Well seals will be constructed by placing bentonite chips in the annular space on top of the filter sand to within 3 feet of ground surface. The remaining annular space will be backfilled with concrete to complete the surface seal. The monitoring well will be installed in accordance with Washington State Department of Ecology regulations.

Monitoring wells will be developed using a surge block and purging methods. Hart Crowser will provide oversight during well installation and development activities. Sediment thickness at the bottom of the well will be measured and recorded before and after well development. Each well will be surged for a minimum of ten casing volumes. The surge and purge equipment will be cleaned before developing each well to prevent cross contamination of wells.

6.5 Groundwater Sampling Procedures

6.5.1 Sampling Equipment

Equipment for the collection of groundwater samples include:

- pH, specific conductivity, and temperature meters;
- Water level indicator;
- Peristaltic pump with disposable polyethylene tubing;
- Laboratory-supplied pre-cleaned and preserved sample containers;
- Coolers with blue ice; and
- Hart Crowser Sample Custody Record and Groundwater Sampling Data forms.

6.5.2 Sampling Procedures

Groundwater sampling will occur at least 24 hours after the wells are developed. Upon arrival at the wellhead, field personnel will record well conditions and the depth to water in the well. Groundwater samples will be collected using low-flow sampling techniques to minimize suspended solids in the samples. The wells will be purged and sampled with a peristaltic pump using low flow procedures. Purging and sampling will be conducted at a depth representing the middle of the screened interval of each well.

Groundwater samples will be collected once the field parameters of pH, specific conductivity, and temperature are stabilized. Field parameters are stable when the measured values fluctuate less than 10 percent between subsequent readings. Dissolved oxygen concentrations and turbidity will also be measured. The final stabilized readings measured just before sampling will be recorded on the Groundwater Sampling Data form.

The sample bottles will be filled directly from the polyethylene tubing using low-flow sampling procedures. To prevent cross-contamination of the wells, new polyethylene tubing will be used for each groundwater sample and the interface probe will be decontaminated between well locations.

6.6 Catch Basin Sampling Procedures

6.6.1 Documentation

As part of the catch basin sampling process the following documentation steps will be conducted:

- Confirm any active basin best management practices such as sweeping and cleaning, frequency of activity, etc., if known;
- Record last known rainfall event(s);
- Record dimensions of catch basin; and
- Measure the depth of the solids in the catch basin and the total depth of the catch basin.

6.6.2 Sampling Procedures

Catch basin sampling will be done using hand tools or a dredge sampler. When standing water is present, care will be taken to prevent washout of sample material when the sampler is retrieved through the water column. Depending on the depth of the catch basin, an extension handle will be attached to allow sample collection. In no case will sampling personnel enter a catch basin.

Catch basin solids will be collected by using a cleaned and decontaminated sampler. The sampler will be advanced into the catch basin solids at each corner and center of the basin. After each sample is collected, the solids sample will be placed into a stainless steel bowl or tray. The material will be homogenized using a decontaminated stainless steel spoon and placed into appropriate sample container.

6.7 Equipment Decontamination Procedures

Precleaned equipment will be used for all soil sampling. All reusable or non-dedicated field equipment (e.g., sampling spoons, mixing bowls, spade/shovel) will be decontaminated prior to reuse. Equipment will be decontaminated in the following manner:

- Nitrile gloves (or equivalent) must be worn during decontamination process.
- Excess soil will be removed using paper towels or by dry brushing.

- Rinse with potable water, collecting rinse water in one of the decontamination buckets.

- Wash with a spray bottle containing a nonphosphate detergent and water and clean with the stiff-bristle brush until all evidence of soil or other material has been removed.

- Rinse with deionized or distilled water three times, ensuring that all detergent from the previous step has been removed.

- Place the equipment on a piece of aluminum foil to air dry.

- A trash bag will be provided for waste paper towels, aluminum foil, and used nitrile gloves.

6.8 Investigation-Derived Waste Management

Contaminated or potentially contaminated materials generated during field work will be managed in accordance with applicable federal, state, and local regulations. IDW will be handled in accordance with applicable regulations and in a manner consistent with ultimate disposition.

IDW is anticipated to include the following categories of waste:

- Non-hazardous solid waste, including personal protective equipment (PPE; e.g., gloves), paper towels, other disposable materials, etc.;

- Soil IDW from soil cuttings; and

- Liquid IDW, including well development/purge water and decontamination wastewater.

Non-hazardous solid waste will be double-bagged in heavy duty garbage bags, sealed with duct tape, and disposed of in an on-site dumpster for solid waste disposal in a municipal landfill.

Soil and liquid IDW will be segregated into separate, labeled 55-gallon U.S. Department of Transportation-approved drums, which will be left on site for temporary storage pending receipt of laboratory analytical testing results from the soil and groundwater samples. Hart Crowser will coordinate transportation and disposal of this waste; Ecology is the generator and will sign all manifests, bills of lading, profile sheets, and any other shipping documents.

6.9 Sample Containers and Labels

Sample container requirements vary according to analyte. Precleaned sample containers will be provided by the analytical laboratory. Sample containers shall be cleaned following the requirements described in Specifications and Guidance for Contaminant-Free Sample Containers (EPA 1992a, OSWER Directive 92.0-05a). Required sample containers, preservatives, and holding times are summarized in Table 3.

6.10 Field Documentation

Field notes will be maintained during sampling and processing operations. The following will be included in the field notes:

- Site name and location;
- Date and time;
- Names of the person collecting and logging the samples;
- Weather conditions;
- Date, time, and identification of each sample, including number of jars and tests requested;
- Details of sample collection, including GPS coordinates; actual sampling point locations will be recorded on a sketch map;
- Any deviation from the approved SAP; and
- General observations.

7.0 SAMPLE HANDLING PROCEDURES

7.1 Sample Preservation and Holding Times

Samples will be preserved according to the requirements of the specific analytical methods to be employed, and all samples will be extracted and analyzed within method-specified holding times. Required sample containers, preservatives, and holding times are summarized in Table 3.

7.2 Chain of Custody Procedures

Chain of custody forms will be used to document the collection, custody, and transfer of samples from their initial collection location to the laboratory, and their ultimate use and disposal. Entries for each sample will be made on the custody form after each sample is collected.

Sample custody procedures will be followed to provide a documented record that can be used to follow possession and handling of a sample from collection through analysis. A sample is considered to be in custody if it meets at least one of the following conditions:

- The sample is in someone's physical possession or view;
- The sample is secured to prevent tampering (i.e., custody seals); and/or
- The sample is locked or secured in an area restricted to authorized personnel.

A chain of custody form will be completed in the field as samples are packaged. At a minimum, the information on the custody form shall include the sample number, date and time of sample collection, sampler, analysis, and number of containers. Two copies of the custody form will be placed in the cooler prior to sealing for delivery to the laboratory with the respective samples. The other copy will be retained and placed in the project files after review by the Project Chemist. Custody seals will be placed on each cooler or package containing samples so the package cannot be opened without breaking the seals.

7.3 Delivery of Samples to Analytical Laboratory

After sample containers have been filled, they will be packed on ice in coolers. The coolers will be transferred to Analytical Resources Inc. (ARI) in Tukwila, WA, for chemical analysis. ARI will transfer select groundwater sample containers to BRL for low-level mercury analysis. Specific procedures are as follows:

- Samples will be packaged and shipped in accordance with U.S. Department of Transportation regulations as specified in 49 CFR 173.6 and 49 CFR 173.24;
- Individual sample containers will be packed to prevent breakage;
- Trip blanks will be included in each cooler that contains VOC or TPH-Gx samples.

- The coolers will be clearly labeled with sufficient information (name of project, time and date container was sealed, person sealing the cooler, and the Hart Crowser office name and address) to enable positive identification;

- A sealed envelope containing custody forms will be enclosed in a plastic bag and taped to the inside lid of the cooler;

- Signed and dated custody seals will be placed on all coolers prior to shipping;

- Samples will either be shipped by overnight courier or will be hand delivered to the laboratory by Hart Crowser personnel; and

- Upon transfer of sample possession to the testing laboratories, the custody form will be signed by the persons transferring custody of the coolers. Upon receipt of samples at the laboratory, the shipping container custody seal will be broken and the laboratory sample-receiving custodian will compare samples to information on the chain of custody form and record the condition of the samples received.

8.0 LABORATORY ANALYTICAL METHODS

Samples will be analyzed according to EPA methods as described in Update III to Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846 (EPA 1986) and Methods for Chemical Analysis of Water and Wastes (EPA 1983), ASTM methods, and Standard Methods as summarized below.

All samples collected will be analyzed for the following parameters:

- Semivolatile organic compounds (SVOCs) by EPA Method 8270D;

- Polycyclic Aromatic Hydrocarbons (PAHs) by EPA Method 8270D-SIM;

- Volatile organic compounds (VOCs) by EPA Method 8260C;

- Polychlorinated biphenyls (PCBs) by EPA Method 8082;

- Pesticides by EPA Method 8081;

- Petroleum hydrocarbons by Ecology's NWTPH-Gx and NWTPH-Dx methods;

- Metals (As, Cd, Cr, Cu, Pb, Ag, Zn) by EPA Method 6010B;
- Mercury by EPA Method 7471A (soil) and EPA Method 1631 (water); and
- Total organic carbon (TOC) by EPA Method 9060.

Soil samples for VOCs and NWTPH-Gx will be collected using EPA Method 5025. Groundwater samples will be analyzed for both total and dissolved metals. In addition to the analytes above, surface soil and catch basin solid samples will be analyzed for the following parameters:

- Dioxins and furans by EPA Method 1613B; and
- Polybrominated diethyl ethers (PBDEs) by EPA method 8082.

Laboratory methods, practical quantitation limits (PQL; reporting limits) and method detection limits are presented in Table 4 and Table 5. The individual analytes requested for the different tests are also listed in Table 4 and Table 5.

9.0 QUALITY ASSURANCE AND QUALITY CONTROL

The quality of analytical data generated is assessed by the frequency and type of internal QC checks developed for analysis type. The quality of laboratory measurements will be assessed by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, surrogate compound recoveries, instrument calibrations, performance evaluation samples, interference checks, etc., as specified in the analytical methods to be used. The following general procedures will be followed for all laboratory analyses:

- Laboratory blank measurements at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;
- Matrix spike (MS) analysis to assess accuracy at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;
- Matrix spike duplicate or laboratory duplicate to assess precision at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix;
- Surrogate or labeled compound spikes in each sample for organics analysis to assess accuracy;

- Laboratory control sample analysis or a certified reference material (CRM), if appropriate CRM is available, with each analytical batch to assess accuracy in the absence of any matrix effect at a minimum frequency of 5 percent or one per batch of 20 samples or fewer for each matrix. Acceptance criteria for the CRM results (based on the 95 percent confidence interval) must be provided by the laboratory. If results fall outside the acceptance range, the laboratory may be required to re-extract and reanalyze the associated samples; and

- A trip blank will be submitted for analysis with each cooler that contain VOCs and TPH-Gx samples.

Laboratory quality control procedures, criteria, and corrective action are summarized in Tables 6 through 15 for the various analyses.

9.1 Data Quality Indicators

The overall quality assurance objectives for field sampling, field measurements, and laboratory analysis are to produce data of known and appropriate quality. The procedures and quality control checks specified herein will be used so that known and acceptable levels of accuracy and precision are maintained for each data set. This section defines the objectives for accuracy and precision for measurement data. These goals are primarily expressed in terms of acceptance criteria for the quality control checks performed.

The quality of analytical data generated is controlled by the frequency and type of internal quality control checks developed for analysis type. Laboratory results will be evaluated by reviewing results for analysis of method blanks, matrix spikes, duplicate samples, laboratory control samples, calibrations, performance evaluation samples, interference checks, etc., as specified in the analytical methods to be used.

9.1.1 Precision

Precision is the degree of reproducibility or agreement between independent or repeated measurements. Analytical variability will be expressed as the relative percent difference (RPD) between laboratory replicates and between matrix spike and matrix spike duplicate analyses. RPD will be used to measure precision for this investigation and is defined as follows:

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

Where,

D_1 = Sample value
D_2 = Duplicate sample value

9.1.2 Accuracy

Accuracy is the agreement between a measured value and its true or accepted value. While it is not possible to determine absolute accuracy for environmental samples, the analysis of standards and spiked samples provides an indirect assessment of accuracy.

Laboratory accuracy will be assessed as the percent recovery of matrix spikes, matrix spike duplicates, surrogate spiked compounds (for organic analyses), and laboratory control samples. Accuracy will be defined as the percentage recoverable from the true value and is defined as follows:

$$\%\text{Recovery} = \frac{(\text{SSR-SR})}{\text{SA}} \times 100$$

Where,

SSR = spiked sample result
SR = sample results (not applicable for surrogate recovery)
SA = amount of spike added

9.1.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Care will be taken in the design of the sampling program to confirm sample locations are selected properly, sufficient numbers of samples are collected to accurately reflect conditions at the site, and samples are representative of sampling locations. A sufficient volume of sample will be collected at each sampling point to minimize bias or errors associated with sample particle size and heterogeneity.

9.1.4 Completeness

Completeness is the percentage of measurements made that are judged to be valid. Completeness will be calculated separately for each analytical group, e.g., metals or PAHs. Results must also contain all quality control check analyses

required to verify the precision and accuracy of results to be considered complete. Data qualified as estimated during the validation process will be considered complete. Nonvalid measurements will be results that are rejected during the validation review or samples for which no analytical results were obtained. Completeness will be calculated for each analysis using the following equation:

$$\text{Completeness} = \frac{\text{valid data points obtained}}{\text{total data points planned}} \times 100$$

The target goal for completeness is a minimum of 95 percent. Completeness will be monitored on an ongoing basis so that archived sample extracts can be reanalyzed, if required, without remobilization.

9.1.5 Comparability

Comparability is the degree to which data from separate data sets may be compared. For instance, sample data may be compared to data from background locations, to established criteria or guidance, or to data from earlier sampling events. There has been little consistency among historical studies used to estimate background chemical concentrations. For example, intervals defined as surface soil have varied often ranging from 1 inch to 6 or more inches in depth. In addition, analytical methods have not been consistent across studies.

Sample collection will be performed in a consistent manner by field personnel at all sampling locations to verify all data collected as part of this study are comparable. Comparability is attained by careful adherence to standardized sampling and analytical procedures, based on rigorous documentation of sample locations (including depth, time, and date).

The use of standardized methods to collect and analyze samples, along with laboratory instrument calibration against National Institute for Standards and Technology (NIST) and US EPA traceable standards will also confirm comparability, particularly for comparison of data collected from this study (within-study comparability).

Comparability also depends on other data quality characteristics. Only when data are judged to be representative of the environmental conditions, and when precision and accuracy are known, can data sets be compared with confidence.

9.2 Data Quality Assurance Review

A project chemist at Hart Crowser will perform an independent data quality review of the chemical analytical results provided by ARI. This report will assess the adequacy of the reported detection limits in achieving the project screening levels for soil; the precision, accuracy, representativeness, and completeness of the data; and the usability of the analytical data for project objectives. Exceedances of analytical control limits will be summarized and evaluated.

A data evaluation review will be performed on all results using QC summary sheet results provided by the laboratory for each data package. The data evaluation review is based on the Quality Control Requirements previously described and follows the format of the EPA National Functional Guidelines for Inorganic (EPA 2010) Superfund Data Review, EPA National Functional Guidelines for Organic (EPA 2008) Superfund Data Review, and EPA Contract Laboratory Program Functional Guidelines for Chlorinated Dioxin/Furan Data Review (EPA 2005) modified to include specific criteria of individual analytical methods. Raw data (instrument tuning, calibrations, instrument printouts, bench sheets, and laboratory worksheets) will be available for review if any problems or discrepancies are discovered during the routine evaluation. The following is an outline of the data evaluation review format:

- Verify that sample numbers and analyses match the chain of custody request;
- Verify sample preservation and holding times;
- Verify that instrument tuning, calibration, and performance criteria were achieved;
- Verify that laboratory blanks were performed at the proper frequency and that no analytes were present in the blanks;
- Verify that laboratory duplicates, matrix spikes, surrogate compounds, and laboratory control samples were run at the proper frequency and that control limits were met; and
- Verify that required detection limits have been achieved.

Data qualifier flags, beyond any applied by the laboratory, will be added to sample results that fall outside the QC acceptance criteria. An explanation of data qualifiers to be applied during the review is provided below:

U The compound was analyzed for but was not detected. The associated numerical value is the sample reporting limit.

J The associated numerical value is an estimated quantity because QC criteria were slightly exceeded.

UJ The compound was analyzed for, but not detected. The associated numerical value is an estimated reporting limit because QC criteria were not met.

T The associated numerical value is an estimated quantity because reported concentrations were less than the practical quantitation limit (lowest calibration standard).

K Ion ratios do not meet identification criteria acceptance limits for positive identification.

R Data are not usable because of significant exceedance of QC criteria. The analyte may or may not be present; resampling and/or reanalysis are necessary for verification.

10.0 DATA ANALYSIS AND REPORTING

10.1 Laboratory Reports

The laboratory data reports will consist of complete data packages that will contain complete documentation and all raw data to allow independent data reduction and verification of analytical results from laboratory bench sheets, and instrument raw data outputs. Each laboratory data report will include the following:

- Case narrative identifying the laboratory analytical batch number, matrix and number of samples included, analyses performed and analytical methods used, and description of any problems or exceedance of QC criteria and corrective action taken. The laboratory manager or their designee must sign the narrative.

- Copy of chain of custody forms for all samples included in the analytical batch.

- Tabulated sample analytical results with units, data qualifiers, percent solids, sample weight or volume, dilution factor, laboratory batch and sample

number, Hart Crowser sample number, and dates sampled, received, extracted, and analyzed all clearly specified.

- All calibration, quality control, and sample raw data including quantitation reports and other instrument output data.
- Blank summary results indicating samples associated with each blank.
- MS/MSD result summaries with calculated percent recovery and relative percent differences.
- Surrogate compound recoveries, when applicable, with percent recoveries.
- Laboratory control sample results, when applicable, with calculated percent recovery.
- Performance evaluation or certified reference material sample results, if applicable, with acceptance limits.
- Electronically formatted data deliverable (CD) results.

10.2 Hart Crowser Reports

Hart Crowser will prepare a draft report summarizing sampling procedures and laboratory testing results. The report will include a map(s) with sampling locations, tabulated analytical testing data, and laboratory analytical documentation. Groundwater contour maps and geologic cross sections will be prepared as appropriate. The report will also include an assessment of sediment recontamination potential. A final report will be completed following discussions with Ecology.

11.0 REFERENCES

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EPA 2005. Contract Laboratory Program Functional Guidelines for Chlorinated Dioxin/Furan Data Review EPA-540-R-05-001, September 2005.

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Hart Crowser, 2011a. Reconnaissance Plan, Washington State Liquor Control Board Site. Prepared for Washington State Department of Ecology. February 2011.

Hart Crowser, 2011b. Summary of Existing Information Report for Washington State Liquor Control Board Site. Prepared for Washington State Department of Ecology. February 2011.

Standard Methods for the Examination of Water and Wastewater. 17th Edition, 1989.

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Table 1 - Taxpayer Information

Site Name	Washington State Liquor Control Board
King County Parcel Number	1824049063
Site Address	4401 East Marginal Way South
Taxpayer Name	State of Washington
Taxpayer Mailing Address	Liquor Control Board PO Box 43075 Olympia, WA 98504

Table 2 - Proposed Sampling and Analysis

Media	Sample Locations	Total Number of Samples	Analytes
Subsurface Soil	MW-1 through MW-8	24	Semi-volatile organic compounds (SVOCs) Volatile organic compounds (VOCs) Polychlorinated biphenyls (PCBs) Pesticides Total petroleum hydrocarbons (TPH) including gasoline, diesel, and heavy-oil ranges Metals (As, Cd, Cr, Cu, Pb, Hg, Ag, Zn) Total organic carbon (TOC) Dioxins and furans (shallow soil only) Polybrominated diethyl ethers (PBDEs) (shallow soil only)
Groundwater	MW-1 through MW-8	8	Semi-volatile organic compounds (SVOCs) Volatile organic compounds (VOCs) Polychlorinated biphenyls (PCBs) Pesticides Total petroleum hydrocarbons (TPH) including gasoline, diesel, and heavy-oil ranges Total Metals (As, Cd, Cr, Cu, Pb, Hg, Ag, Zn) Dissolved Metals (As, Cd, Cr, Cu, Pb, Hg, Ag, Zn)
Catch Basin Solids	CB-1 through CB-4	4	Semi-volatile organic compounds (SVOCs) Polychlorinated biphenyls (PCBs) Pesticides Total petroleum hydrocarbons (TPH) including gasoline, diesel, and heavy-oil ranges Metals (As, Cd, Cr, Cu, Pb, Hg, Ag, Zn) Total organic carbon (TOC) Dioxins and furans Polybrominated diethyl ethers (PBDEs)

Table 3 - Storage Temperatures and Maximum Holding Times for Physical/Chemical Analyses

Sample Type	Sample Container	Sample Preservation Technique	Maximum Holding Time
Total solids	Included in metals or organics container	Cool, < 6°C Freeze, -18°C	14 days 6 months
Total organic carbon	Soil - 1-4 oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 6 months
Gasoline range petroleum hydrocarbons	Soil – 2-40 mL VOC vials preweighed each with 5 grams of soil Water - 2-40 mL VOA vials	Methanol; Cool, < 6°C HCl to pH< 2; Cool to < 6°C	14 days 7 days
Diesel and heavy oil range petroleum hydrocarbons	Soil - 1-4 oz wide mouth glass jar Water – 2-500 mL amber glass bottles	Cool to < 6°C Cool to < 6°C	14 days 7 days
Metals (except mercury)	Soil - 1-4 oz wide mouth glass jar Water (dissolved) – 1-500 mL HDPE Water (total) – 1-500 mL HDPE	Cool, < 6°C Freeze, -18°C Field filter; HNO3 to pH < 2; Cool, < 6°C HNO3 to pH < 2; Cool, < 6°C	6 months 1 years 6 months 6 months
Total Mercury	Soil - Included in metals container Water – 1-500 mL Pre-tested fluoropolymer or glass bottle with fluoropolymer-lined lids	Freeze, -18°C BrCl in lab within 28 days of collection (oxidation in the original sample bottle)	28 days 90 days
Volatile Organic Compounds (VOCs)	Soil – 3-40 mL preweighed VOC vials each with 5 grams of soil Water - 3-40 mL VOA vials	2 vials sodium bisulfate and one vial MEOH; Cool, < 6°C No headspace; HCl to pH < 2; Cool, < 6°C	14 days

Table 3 - Storage Temperatures and Maximum Holding Times for Physical/Chemical Analyses

Sample Type	Sample Container	Sample Preservation Technique	Maximum Holding Time
Semivolatile organic compounds (SVOCs)	Soil - 1-16 oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 1 year
- after extraction	Water – 2-500 mL amber glass bottles	Cool, < 6°C Cool, < 6°C	7 days 40 days
PCBs	Soil - 1-8 oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 1 year
- after extraction	Water – 2-500 mL amber glass bottles	Cool, < 6°C Cool, < 6°C	7 days 40 days
Chlorinated Pesticides	Soil - 1-8 oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 1 year
- after extraction	Water – 2-500 mL amber glass bottles	Cool, < 6°C Cool, < 6°C	7 days 40 days
PCDDs/PCDFs ; PBDEs	Soil - 1-8 oz wide mouth glass jar	Cool, < 6°C Freeze, -18°C	14 days 1 year
- after extraction		Cool, < 6°C	40 days

Note:
PCB - polychlorinated biphenyl
PCDD - polychlorinated dibenzo-p-dioxin
PCDF - polychlorinated dibenzofuran
PBDE – polybrominated diphenylether

Table 4 - Soil Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	SQS Criteria	Vadose Zone Soil Protective of SQS[b]	Saturated Zone Soil Protective of SQS[b]	Most Stringent Soil Standard to Protect Potable Ground Waters[c]
CONVENTIONALS:							
Total Solids in %	--	PSEP	0.1% (wet weight)				
Total Organic Carbon in %	--	9060/Ecology	0.0				
Petroleum Hydrocarbons			**mg/kg (dry weight)**				**mg/kg**
Gasoline-range hydrocarbons	NWTPH-Gx	NWTPH-Gx	5.0				30/100[d]
Diesel-range hydrocarbons	NWTPH-Dx	NWTPH-Dx	5.0				200
Heavy oil	NWTPH-Dx	NWTPH-Dx	5.0				2000
METALS			**mg/kg (dry weight)**				**mg/kg**
Arsenic	PSEP/ EPA 3050B	EPA 6010B	5.0	57			1.58E-04
Cadmium	PSEP/ EPA 3050B	EPA 6010B	0.2	5.1	26	1.3	0.001
Chromium	PSEP/ EPA 3050B	EPA 6010B	0.5	260	5201	260	42
Copper	PSEP/ EPA 3050B	EPA 6010B	0.2	390	780	39	0.053
Lead	PSEP/ EPA 3050B	EPA 6010B	2.0	450	1133	57	5.4
Mercury	EPA 7471A	EPA 7471A	0.05	0.41	0.41	0.02	2.70E-04
Silver	PSEP/ EPA 3050B	EPA 6010B	0.3	6.1	12	0.61	0.013
Zinc	PSEP/ EPA 3050B	EPA 6010B	0.6	410	327	16	2.029
Volatile Organic Compounds (VOCs)			**ug/kg (dry weight)**				**ug/kg**
Dichlorodifluoromethane	EPA5035	EPA 8260C	1				
Chloromethane	EPA5035	EPA 8260C	1				1.01
Vinyl Chloride	EPA5035	EPA 8260C	1				0.01
Bromomethane	EPA5035	EPA 8260C	1				
Chloroethane	EPA5035	EPA 8260C	1				10.55
Trichlorofluoromethane	EPA5035	EPA 8260C	1				
Acrolein	EPA5035	EPA 8260C	50				
Acetone	EPA5035	EPA 8260C	5				230.92
1,1,2-Trichloro-1,2,2-Trifluoroethane	EPA5035	EPA 8260C	1				
1,1-Dichloroethylene	EPA5035	EPA 8260C	1				0.23
Bromoethane	EPA5035	EPA 8260C	2				
Iodomethane	EPA5035	EPA 8260C	1				
Methylene Chloride	EPA5035	EPA 8260C	2				1.20
Carbon Disulfide	EPA5035	EPA 8260C	1				
Acrylonitrile	EPA5035	EPA 8260C	5				
Methyl-t-butyl ether (MTBE)	EPA5035	EPA 8260C	1				
trans-1,2-Dichloroethene	EPA5035	EPA 8260C	1				
Vinyl Acetate	EPA5035	EPA 8260C	5				
1,1-Dichloroethane	EPA5035	EPA 8260C	1				0.47
2-Butanone	EPA5035	EPA 8260C	5				1500
2,2-Dichloropropane	EPA5035	EPA 8260C	1				
cis-1,2-Dichloroethene	EPA5035	EPA 8260C	1				
Chloroform	EPA5035	EPA 8260C	1				0.05
Bromochloromethane	EPA5035	EPA 8260C	1				
1,1,1-Trichloroethane	EPA5035	EPA 8260C	1				95.73
1,1-Dichloropropene	EPA5035	EPA 8260C	1				
Carbon Tetrachloride	EPA5035	EPA 8260C	1				0.08
1,2-Dichloroethane	EPA5035	EPA 8260C	1				0.04
Benzene	EPA5035	EPA 8260C	1				0.00
Trichloroethene	EPA5035	EPA 8260C	1				0.17
1,2-Dichloropropane	EPA5035	EPA 8260C	1				
Bromodichloromethane	EPA5035	EPA 8260C	1				
Dibromomethane	EPA5035	EPA 8260C	1				
2-Chloroethyl Vinyl Ether	EPA5035	EPA 8260C	5				
4-Methyl-2-Pentanone	EPA5035	EPA 8260C	5				450
cis-1,3-Dichloropropene	EPA5035	EPA 8260C	1				
Toluene	EPA5035	EPA 8260C	1				698
trans-1,3-Dichloropropene	EPA5035	EPA 8260C	1				
1,1,2-Trichloroethane	EPA5035	EPA 8260C	1				0.08
1,2-Dibromoethane	EPA5035	EPA 8260C	1				
2-Hexanone	EPA5035	EPA 8260C	5				
1,3-Dichloropropane	EPA5035	EPA 8260C	1				
Tetrachloroethene	EPA5035	EPA 8260C	1				0.01
Chlorodibromomethane	EPA5035	EPA 8260C	1				
Chlorobenzene	EPA5035	EPA 8260C	1				11.09
1,1,1,2-Tetrachloroethane	EPA5035	EPA 8260C	1				
Ethyl Benzene	EPA5035	EPA 8260C	1				1.70
m,p-Xylene	EPA5035	EPA 8260C	1				200
o-Xylene	EPA5035	EPA 8260C	1				200
Styrene	EPA5035	EPA 8260C	1				1.17
Bromoform	EPA5035	EPA 8260C	1				
Isopropyl Benzene	EPA5035	EPA 8260C	1				
1,1,2,2-Tetrachloroethane	EPA5035	EPA 8260C	1				
1,2,3-Trichloropropane	EPA5035	EPA 8260C	2				
trans-1,4-Dichloro-2-Butene	EPA5035	EPA 8260C	5				
n-Propyl Benzene	EPA5035	EPA 8260C	1				
Bromobenzene	EPA5035	EPA 8260C	1				
1,3,5-Trimethylbenzene	EPA5035	EPA 8260C	1				50.99
2-Chlorotoluene	EPA5035	EPA 8260C	1				
4-Chlorotoluene	EPA5035	EPA 8260C	1				
t-Butylbenzene	EPA5035	EPA 8260C	1				
1,2,4-Trimethylbenzene	EPA5035	EPA 8260C	1				
s-Butylbenzene	EPA5035	EPA 8260C	1				
4-Isopropyl Toluene	EPA5035	EPA 8260C	1				
1,3-Dichlorobenzene	EPA5035	EPA 8260C	1				
1,4-Dichlorobenzene	EPA5035	EPA 8260C	1	3			
n-Butylbenzene	EPA5035	EPA 8260C	1				
1,2-Dichlorobenzene	EPA5035	EPA 8260C	1				
1,2-Dibromo-3-Chloropropane	EPA5035	EPA 8260C	5				
1,2,4-Trichlorobenzene	EPA5035	EPA 8260C	5	1	0.021	0.0011	
Hexachloro-1,3-Butadiene	EPA5035	EPA 8260C	5				
Naphthalene	EPA5035	EPA 8260C	5				0.47
1,2,3-Trichlorobenzene	EPA5035	EPA 8260C	5				
1,4-Dioxane	EPA5035	EPA 8260C					

Table 4 - Soil Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	SQS Criteria	Vadose Zone Soil Protective of SQS[b]	Saturated Zone Soil Protective of SQS[b]	Most Stringent Soil Standard to Protect Potable Ground Waters[c]
SEMIVOLATILE ORGANICS (SVOC)			**ug/kg (dry weight)**				**ug/kg**
LPAH							
Naphthalene	EPA 3540C	EPA 8270D-SIM	5	2,100	2197	114	0.47
Acenaphthylene	EPA 3540C	EPA 8270D-SIM	5	1,300	1363	69	69.09
Acenaphthene	EPA 3540C	EPA 8270D-SIM	5	500	330	17	16.75
Fluorene	EPA 3540C	EPA 8270D-SIM	5	540	468	24	23.56
Phenanthrene	EPA 3540C	EPA 8270D-SIM	5	1,500	2019	101	101.38
Anthracene	EPA 3540C	EPA 8270D-SIM	5	960	4443	223	223.09
2-Methylnaphthalene	EPA 3540C	EPA 8270D-SIM	5	670	833	43	43.21
Total LPAH				5,200			
HPAH							
Fluoranthene	EPA 3540C	EPA 8270D-SIM	5	1,700	3209	161	160.53
Pyrene	EPA 3540C	EPA 8270D-SIM	5	2,600	20058	1004	684.43
Benzo(a)anthracene	EPA 3540C	EPA 8270D-SIM	5	1,300	2201	110	0.00
Chrysene	EPA 3540C	EPA 8270D-SIM	5	1,400	2202	110	0.27
Benzofluoranthenes (b,k, j)	EPA 3540C	EPA 8270D-SIM	5	3,200			0.042
Benzo(a)pyrene	EPA 3540C	EPA 8270D-SIM	5	1,600	1981	99	0.01
Indeno(1,2,3-c,d)pyrene	EPA 3540C	EPA 8270D-SIM	5	600	680	34	0.06
Dibenzo(a,h)anthracene	EPA 3540C	EPA 8270D-SIM	5	230	240	12	0.07
Benzo(g,h,i)perylene	EPA 3540C	EPA 8270D-SIM	5	670	620	31	31.00
Benzo(b)fluoranthene	EPA 3540C	EPA 8270D-SIM	5		4601	230	0.04
Benzo(k)fluoranthene	EPA 3540C	EPA 8270D-SIM	5		4601	230	0.04
Total HPAH				12,000			
CHLORINATED HYDROCARBONS							
1,3-Dichlorobenzene	EPA 3540C	EPA 8270D	20				275.20
1,4-Dichlorobenzene	EPA 3540C	EPA 8270D	20	110	92.0	5.1	0.41
1,2-Dichlorobenzene	EPA 3540C	EPA 8270D	20	35	67.6	3.8	3.79
1,2,4-Trichlorobenzene	EPA 3540C	EPA 8270D	20	31			0.40
PHTHALATES							
Dimethyl phthalate	EPA 3540C	EPA 8270D	20	71	1631	94	40.95
Diethyl phthalate	EPA 3540C	EPA 8270D	20	200	3157	200	199.78
Di-n-butyl phthalate	EPA 3540C	EPA 8270D	20	1,400	5003	263	81.36
Butyl benzyl phthalate	EPA 3540C	EPA 8270D	20	63	100	5.1	3.95
Bis(2-ethylhexyl)phthalate	EPA 3540C	EPA 8270D	20	1,300	941	47	47.08
Di-n-octyl phthalate	EPA 3540C	EPA 8270D	20	6,200	1161	58	0.55
ACID EXTRACTABLES							
Phenol	EPA 3540C	EPA 8270D	20	420	733	43	23.88
2 Methylphenol	EPA 3540C	EPA 8270D	20	63	91	5.2	2.69
4 Methylphenol	EPA 3540C	EPA 8270D	20	670	979	56	22.13
2,4-Dimethylphenol	EPA 3540C	EPA 8270D	20	29	37	2.0	2.03
2,4,6-Trichlorophenol	EPA 3540C	EPA 8270D	100				0.82
Pentachlorophenol	EPA 3540C	EPA 8270D	100	360	381	20	2.56
Benzyl alcohol	EPA 3540C	EPA 8270D	100	57	785	55	55.02
Benzoic acid	EPA 3540C	EPA 8270D	200	650	9622	675	644.32
MISCELLANEOUS EXTRACTABLES							
Dibenzofuran	EPA 3540C	EPA 8270D	20	540			15.37
N-Nitrosodiphenylamine	EPA 3540C	EPA 8270D	20	28			9.54
PCBs			**ug/kg (dry weight)**				**ug/kg**
Aroclor 1016	EPA 3540C	EPA 8082	4		242	12	1.77
Aroclor 1221	EPA 3540C	EPA 8082	4				0.24
Aroclor 1232	EPA 3540C	EPA 8082	4				120.00
Aroclor 1242	EPA 3540C	EPA 8082	4				0.02
Aroclor 1248	EPA 3540C	EPA 8082	4		241	12	1.02
Aroclor 1254	EPA 3540C	EPA 8082	4		241	12	0.42
Aroclor 1260	EPA 3540C	EPA 8082	4		240	12	4.77
Aroclor 1262	EPA 3540C	EPA 8082	4				
Aroclor 1268	EPA 3540C	EPA 8082	4				
Total PCBs	EPA 3540C	EPA 8082	4	130	241	12	0.71
PDBEs			**ug/kg (dry weight)**				**ug/kg**
2,2',4-Tribromodiphenyl ether (PBDE-17)	EPA 3540C	EPA 8082	0.5				
2,4,4'-Tribromodiphenyl ether (PBDE-28)	EPA 3540C	EPA 8082	0.5				
2,3',4',6-Tetrabromodiphenyl ether (PBDE-71)	EPA 3540C	EPA 8082	0.5				
2,2',4,4'-Tetrabromodiphenyl ether (PBDE-47)	EPA 3540C	EPA 8082	0.5				
2,3',4,4'-Tetrabromodiphenyl ether (PBDE-66)	EPA 3540C	EPA 8082	0.5				
2,2',4,4',6-Pentabromodiphenyl ether (PBDE-100)	EPA 3540C	EPA 8082	0.5				
2,2',4,4',5-Pentabromodiphenyl ether (PBDE-99)	EPA 3540C	EPA 8082	0.5				
2,2,3,4,4-Pentabromodiphenyl ether (PBDE-85)	EPA 3540C	EPA 8082	0.5				
2,2',3,4,4',5'-Hexabromodiphenyl ether (PBDE-138)	EPA 3540C	EPA 8082	0.5				
2,2',4,4',5,6'-Hexabromodiphenyl ether (PBDE-154)	EPA 3540C	EPA 8082	0.5				
2,2',4,4',5,5'-Hexabromodiphenyl ether (PBDE-153)	EPA 3540C	EPA 8082	0.5				
2,2',3,4,4',5',6-Heptabromodiphenyl ether (PBDE-183)	EPA 3540C	EPA 8082	0.5				
CHLORINATED DIOXIN/FURAN CONGENERS			**ng/kg (dry weight)**				**ng/kg**
1,2,3,4,6,7,8-HpCDD	EPA 1613B	EPA 1613B	1				
1,2,3,4,6,7,8-HpCDF	EPA 1613B	EPA 1613B	5				
1,2,3,4,7,8,9-HpCDF	EPA 1613B	EPA 1613B	5				
1,2,3,4,7,8-HxCDD	EPA 1613B	EPA 1613B	5				
1,2,3,4,7,8-HxCDF	EPA 1613B	EPA 1613B	5				
1,2,3,6,7,8-HxCDD	EPA 1613B	EPA 1613B	5				
1,2,3,6,7,8-HxCDF	EPA 1613B	EPA 1613B	10				
1,2,3,7,8,9-HxCDD	EPA 1613B	EPA 1613B	1				
1,2,3,7,8,9-HxCDF	EPA 1613B	EPA 1613B	5				
1,2,3,7,8-PeCDD	EPA 1613B	EPA 1613B	5				
1,2,3,7,8-PeCDF	EPA 1613B	EPA 1613B	5				
2,3,4,6,7,8-HxCDF	EPA 1613B	EPA 1613B	5				
2,3,4,7,8-PeCDF	EPA 1613B	EPA 1613B	5				
2,3,7,8-TCDD	EPA 1613B	EPA 1613B	5				3.02E-05
2,3,7,8-TCDF	EPA 1613B	EPA 1613B	5				
OCDD	EPA 1613B	EPA 1613B	5				
OCDF	EPA 1613B	EPA 1613B	10				

Table 4 - Soil Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	SQS Criteria	Vadose Zone Soil Protective of SQS[b]	Saturated Zone Soil Protective of SQS[b]	Most Stringent Soil Standard to Protect Potable Ground Waters[c]
PESTICIDES			**ug/kg (dry weight)**				**ug/kg**
Hexachlorobenzene (HCB)	EPA 3540C	EPA 8081	1	22	8.1	0.4	0.24
Hexachlorobutadiene	EPA 3540C	EPA 8081	1	11	97	5.0	1281.15
Aldrin	EPA 3540C	EPA 8081	1				0.61
alpha-BHC (Benzene HexaChloride)	EPA 3540C	EPA 8081	1				2.47
beta-BHC	EPA 3540C	EPA 8081	1				10.23
gamma-BHC (Lindane)	EPA 3540C	EPA 8081	1				0.36
Chlordane	EPA 3540C	EPA 8081	1				10.32
4,4'-DDT	EPA 3540C	EPA 8081	1				36.74
4,4'-DDE	EPA 3540C	EPA 8081	1				4.70
4,4'-DDD	EPA 3540C	EPA 8081	1				3.54
Dieldrin	EPA 3540C	EPA 8081	1				0.34
alpha-Endosulfan	EPA 3540C	EPA 8081	1				20.24
beta-Endosulfan	EPA 3540C	EPA 8081	2				20.24
Endosulfan Sulfate	EPA 3540C	EPA 8081	2				20.24
Endrin	EPA 3540C	EPA 8081	2				22.20
Endrin Aldehyde	EPA 3540C	EPA 8081	2				22.20
Heptachlor	EPA 3540C	EPA 8081	1				0.19
Heptachlor Epoxide	EPA 3540C	EPA 8081	1				0.81
Toxaphene	EPA 3540C	EPA 8081	100				0.06

Notes:

a) default reporting limits may apply depending upon extraction methods

b) Soil screening levels protective of sediment provided by Ecology in Draft LDW Preliminary Screening Levels v12r7.xls on April 13, 2011

c) Most stringent soil standard to protect potable ground waters without potable surface water screenling levels provided by Ecology in Draft LDW Preliminary Screening Levels v12r7.xls on April 13, 2011

d) 30mg/kg with benzene, 100mg/kg without benzene

Table 5 - Groundwater Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	Groundwarer Concentrations Protective of SQS[b]	Most Stringent Potable Ground Water Standard[c]
Petroleum Hydrocarbons			**mg/L**		**mg/L**
Gasoline-range hydrocarbons	NWTPH-Gx	NWTPH-Gx	0.05		0.8/1.0[d]
Diesel-range hydrocarbons	NWTPH-Dx	NWTPH-Dx	0.1 to 0.2		0.5
Heavy oil-range hydrocarbons	NWTPH-Dx	NWTPH-Dx	0.1 to 0.2		0.5
METALS (dissolved and total)			**ug/L**		**ug/L**
Arsenic	PSEP/ EPA 3050B	EPA 6020	0.2		0.05
Cadmium	PSEP/ EPA 3050B	EPA 6020	0.2	2.56	0.21
Chromium	PSEP/ EPA 3050B	EPA 6020	0.5	306	50
Copper	PSEP/ EPA 3050B	EPA 6020	0.5	123	7.3
Lead	PSEP/ EPA 3050B	EPA 6020	1.0	11.3	2.5
Mercury	EPA 7471A	EPA 1631	0.02	0.0052	0.01
Silver	PSEP/ EPA 3050B	EPA 6020	0.2	1.53	1.53
Zinc	PSEP/ EPA 3050B	EPA 6020	4.0	32.6	32.57
Volatile Organic Compounds (VOCs)			**ug/L**		**ug/L**
Dichlorodifluoromethane		EPA 8260C	1		
Chloromethane		EPA 8260C	1		3.37
Vinyl Chloride		EPA 8260C	1		0.02
Bromomethane		EPA 8260C	1		
Chloroethane		EPA 8260C	1		21000
Trichlorofluoromethane		EPA 8260C	1		
Acrolein		EPA 8260C	10		
Acetone		EPA 8260C	10		800
1,1,2-Trichloro-1,2,2-Trifluoroethane		EPA 8260C	2		
1,1-Dichloroethene		EPA 8260C	1		0.73
Bromoethane		EPA 8260C	2		
Iodomethane		EPA 8260C	1		
Methylene Chloride		EPA 8260C	2		5.0
Carbon Disulfide		EPA 8260C	1		
Acrylonitrile		EPA 8260C	5		
Methyl-t-butyl ether (MTBE)		EPA 8260C	1		
trans-1,2-Dichloroethene		EPA 8260C	1		
Vinyl Acetate		EPA 8260C	5		
1,1-Dichloroethane		EPA 8260C	1		1.0
2-Butanone		EPA 8260C	5		4800
2,2-Dichloropropane		EPA 8260C	1		
cis-1,2-Dichloroethene		EPA 8260C	1		
Chloroform		EPA 8260C	1		4.3
Bromochloromethane		EPA 8260C	1		
1,1,1-Trichloroethane		EPA 8260C	1		200
1,1-Dichloropropene		EPA 8260C	1		
Carbon Tetrachloride		EPA 8260C	1		0.25
1,2-Dichloroethane		EPA 8260C	1		0.48
Benzene		EPA 8260C	1		0.80
Trichloroethene		EPA 8260C	1		0.49
1,2-Dichloropropane		EPA 8260C	1		
Bromodichloromethane		EPA 8260C	1		
Dibromomethane		EPA 8260C	1		
2-Chloroethyl Vinyl Ether		EPA 8260C	5		
4-Methyl-2-Pentanone		EPA 8260C	5		640
cis-1,3-Dichloropropene		EPA 8260C	1		
Toluene		EPA 8260C	1		1000
trans-1,3-Dichloropropene		EPA 8260C	1		
1,1,2-Trichloroethane		EPA 8260C	1		0.77
1,2-Dibromoethane		EPA 8260C	1		
2-Hexanone		EPA 8260C	5		
1,3-Dichloropropane		EPA 8260C	5		
Tetrachloroethene		EPA 8260C	1		0.02
Chlorodibromomethane		EPA 8260C	1		
Chlorobenzene		EPA 8260C	1		100
1,1,1,2-Tetrachloroethane		EPA 8260C	1		
Ethyl Benzene		EPA 8260C	1		700
m,p-Xylene		EPA 8260C	2		1000
o-Xylene		EPA 8260C	1		1000
Styrene		EPA 8260C	1		1.5
Bromoform		EPA 8260C	1		
Isopropyl Benzene		EPA 8260C	1		
1,1,2,2-Tetrachloroethane		EPA 8260C	1		
1,2,3-Trichloropropane		EPA 8260C	2		
trans-1,4-Dichloro-2-Butene		EPA 8260C	5		
n-Propyl Benzene		EPA 8260C	1		
Bromobenzene		EPA 8260C	1		
1,3,5-Trimethylbenzene		EPA 8260C	1		45.0
2-Chlorotoluene		EPA 8260C	1		
4-Chlorotoluene		EPA 8260C	1		
t-Butylbenzene		EPA 8260C	1		
1,2,4-Trimethylbenzene		EPA 8260C	1		
s-Butylbenzene		EPA 8260C	1		
4-Isopropyl Toluene		EPA 8260C	1		
1,3-Dichlorobenzene		EPA 8260C	1		
1,4-Dichlorobenzene		EPA 8260C	1		
n-Butylbenzene		EPA 8260C	1		
1,2-Dichlorobenzene		EPA 8260C	1		
1,2-Dibromo-3-Chloropropane		EPA 8260C	5		
1,2,4-Trichlorobenzene		EPA 8260C	5	1	1.13
Hexachloro-1,3-Butadiene		EPA 8260C	5		
Naphthalene		EPA 8260C	5		53.80
1,2,3-Trichlorobenzene		EPA 8260C	5		
1,4-Dioxane		EPA 8260C	200		

Table 5 - Groundwater Sample Preparation, Analytical Methods, and Quantitation Limits

Parameter	Prep Method	Analysis Method	Practical Quantitation Limits[a]	Groundwarer Concentrations Protective of SQS[b]	Most Stringent Potable Ground Water Standard[c]
SEMIVOLATILE ORGANICS (SVOC)			**ug/L**		**ug/L**
LPAH					
Naphthalene	EPA 3540C	EPA 8270D-SIM	0.01	54	53.8
Acenaphthylene	EPA 3540C	EPA 8270D-SIM	0.01	11.0	10.8
Acenaphthene	EPA 3540C	EPA 8270D-SIM	0.01	3	2.6
Fluorene	EPA 3540C	EPA 8270D-SIM	0.01	2.0	2.0
Phenanthrene	EPA 3540C	EPA 8270D-SIM	0.01	4.8	4.8
Anthracene	EPA 3540C	EPA 8270D-SIM	0.01	11	10.8
2-Methylnaphthalene	EPA 3540C	EPA 8270D-SIM	0.01	18	18.2
Total LPAH					
HPAH					
Fluoranthene	EPA 3540C	EPA 8270D-SIM	0.01	2.3	2.26
Pyrene	EPA 3540C	EPA 8270D-SIM	0.01	14.4	9.80
Benzo(a)anthracene	EPA 3540C	EPA 8270D-SIM	0.01		1.12E-04
Chrysene	EPA 3540C	EPA 8270D-SIM	0.01	0.47	1.12E-03
Benzofluoranthenes (b,k, j)	EPA 3540C	EPA 8270D-SIM	0.01	0.29	
Benzo(a)pyrene	EPA 3540C	EPA 8270D-SIM	0.01	0.13	6.59E-06
Indeno(1,2,3-c,d)pyrene	EPA 3540C	EPA 8270D-SIM	0.01	0.013	2.27E-05
Dibenzo(a,h)anthracene	EPA 3540C	EPA 8270D-SIM	0.01	0.005	2.72E-05
Benzo(g,h,i)perylene	EPA 3540C	EPA 8270D-SIM	0.01	0.012	1.16E-02
Benzo(b)fluoranthene	EPA 3540C	EPA 8270D-SIM	0.01	0.29	5.27E-05
Benzo(k)fluoranthene	EPA 3540C	EPA 8270D-SIM	0.01	0.29	5.52E-05
Total HPAH	EPA 3540C	EPA 8270D			
CHLORINATED HYDROCARBONS					
1,3-Dichlorobenzene	EPA 3540C	EPA 8270D	1		600
1,4-Dichlorobenzene	EPA 3540C	EPA 8270D	1	7.1	4.0
1,2-Dichlorobenzene	EPA 3540C	EPA 8270D	1	5.2	5.19
1,2,4-Trichlorobenzene	EPA 3540C	EPA 8270D	1		0.40
PHTHALATES					
Dimethyl phthalate	EPA 3540C	EPA 8270D	1	142.86	142.86
Diethyl phthalate	EPA 3540C	EPA 8270D	1	484.13	484.13
Di-n-butyl phthalate	EPA 3540C	EPA 8270D	1	150.68	46.58
Butyl benzyl phthalate	EPA 3540C	EPA 8270D	1	0.52	0.52
Bis(2-ethylhexyl)phthalate	EPA 3540C	EPA 8270D	1	0.28	0.28
Di-n-octyl phthalate	EPA 3540C	EPA 8270D	1	0.30	0.30
ACID EXTRACTABLES					
Phenol	EPA 3540C	EPA 8270D	1	78.36	78.36
2 Methylphenol	EPA 3540C	EPA 8270D	1	7.11	7.11
4 Methylphenol	EPA 3540C	EPA 8270D	1	77.19	77.19
2,4-Dimethylphenol	EPA 3540C	EPA 8270D	1	2.02	2.02
2,4,6- Trichlorophenol	EPA 3540C	EPA 8270D	5		3.00
Pentachlorophenol	EPA 3540C	EPA 8270D	5	5.33	0.73
Benzyl alcohol	EPA 3540C	EPA 8270D	5	181.99	181.99
Benzoic acid	EPA 3540C	EPA 8270D	10	2243	2242.93
MISCELLANEOUS EXTRACTABLES					
Dibenzofuran	EPA 3540C	EPA 8270D	1	1.33	1.33
N-Nitrosodiphenylamine	EPA 3540C	EPA 8270D	1	2.0	1.59
PCBs			**ug/L**		**ug/L**
Aroclor 1016	EPA 3540C	EPA 8082	0.1	0.44	6.41E-05
Aroclor 1221	EPA 3540C	EPA 8082	0.1		2.31E-05
Aroclor 1232	EPA 3540C	EPA 8082	0.1		
Aroclor 1242	EPA 3540C	EPA 8082	0.1		2.31E-05
Aroclor 1248	EPA 3540C	EPA 8082	0.1	0.27	2.31E-05
Aroclor 1254	EPA 3540C	EPA 8082	0.1	0.16	5.49E-06
Aroclor 1260	EPA 3540C	EPA 8082	0.1	0.06	2.31E-05
Aroclor 1262	EPA 3540C	EPA 8082	0.1		
Aroclor 1268	EPA 3540C	EPA 8082	0.1		
Total PCBs	EPA 3540C	EPA 8082		0.27	2.31E-05
PESTICIDES			**ug/L**		**ug/L**
Hexachlorobenzene (HCB)	EPA 3540C	EPA 8081	1	0.11	0.05
Hexachlorobutadiene	EPA 3540C	EPA 8081	1	3.92	0.9
Aldrin	EPA 3540C	EPA 8081	0.05		2.57E-03
alpha-BHC (Benzene HexaChloride)	EPA 3540C	EPA 8081	0.05		1.39E-02
beta-BHC	EPA 3540C	EPA 8081	0.05		4.86E-02
gamma-BHC (Lindane)	EPA 3540C	EPA 8081	0.05		2.00E-04
Chlordane	EPA 3540C	EPA 8081	0.05		2.00E-03
4,4'-DDT	EPA 3540C	EPA 8081	0.05		0.26
4,4'-DDE	EPA 3540C	EPA 8081	0.1		0.26
4,4'-DDD	EPA 3540C	EPA 8081	0.05		0.36
Dieldrin	EPA 3540C	EPA 8081	0.1		0.01
alpha-Endosulfan	EPA 3540C	EPA 8081	0.1		96.0
beta-Endosulfan	EPA 3540C	EPA 8081	0.1		96.0
Endosulfan Sulfate	EPA 3540C	EPA 8081	0.1		96.0
Endrin	EPA 3540C	EPA 8081	0.1		2.00E-03
Endrin Aldehyde	EPA 3540C	EPA 8081	0.1		2.00E-03
Heptachlor	EPA 3540C	EPA 8081	0.05		4.00E-04
Heptachlor Epoxide	EPA 3540C	EPA 8081	0.05		2.00E-04
Toxaphene	EPA 3540C	EPA 8081	5		

a) Default reporting limits may apply depending upon extraction methods
b) Groundwater screening levels protective of SQS provided by Ecology in Draft LDW Preliminary Screening Levels v12r7.xls on April 13, 2011
c) Most potable ground water standared without potable surface water screenling levels provided by Ecology in Draft LDW Preliminary Screening Levels v12r7.xls on April 13, 2011
d) 0.8mg/kg with benzene, 1.0mg/kg without benzene

Table 6 – Quality Control Procedures for Conventional Parameters

	Suggested Control Limits						
Analyte	**Initial Calibration**	**Continuing Calibration**	**Calibration Blanks**	**Laboratory Control Samples**	**Matrix Spikes**	**Laboratory Replicates**	**Method Blank**
Total organic carbon	Correlation coefficient ≥0.995	90 to 110 percent recovery	Analyte concentration ≤ PQL	80 to 120 percent recovery	75 to 125 percent recovery	20 % RSD	Analyte concentration ≤ PQL
Total solids	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	20 % RSD	Not applicable

Table 7 – Quality Control Procedures, Criteria, and Corrective Actions for TPH-Gx Analysis

Gasoline-Range Hydrocarbons NWTPH-Gx			
Laboratory Quality Control			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 20 or fewer samples	All analytes < reporting limit	Re-extract and reanalyze associated samples unless concentrations are > 5 x blank level
Initial calibration	5-point external calibration prior to analysis of samples	%RSD < 25%	Recalibrate instrument
Continuing calibration	Every 10 samples with mid-range standard	% Difference < 20% of initial calibration	Recalibrate instrument and re-analyze affected samples
System monitoring compounds (surrogates)	Bromofluorobenzene; Every lab and field sample	50 – 150% recovery	Evaluate data for useability
Laboratory duplicates	1 per batch of every 10 or fewer samples	None specified	Evaluate data for useability
Retention time windows	All samples and continuing calibration checks	±0.06 relative retention time units (sample and standard)	Reanalyze affected samples

Table 8 – Quality Control Procedures, Criteria, and Corrective Actions for TPH-Dx Analysis

Hydrocarbons NWTPH-Dx			
Laboratory Quality Control			
Quality Control Check	**Frequency**	**Acceptance Criteria**	**Corrective Action**
Method blank	1 per batch of every 20 or fewer samples	All analytes < reporting limit	Re-extract and reanalyze associated samples unless concentrations are > 5 x blank level
Initial calibration	5-point external calibration prior to analysis of samples	%RSD < 25%	Recalibrate instrument
Continuing calibration	Every 10 samples with mid-range standard	% Difference < 20% of initial calibration	Recalibrate instrument and re-analyze affected samples
System monitoring compounds (surrogates)	o-Terphenyl; Every lab and field sample	50 – 150% recovery	Evaluate data for useability
Laboratory duplicates	1 per batch of every 10 or fewer samples	None specified	Evaluate data for useability
Retention time windows	All samples and continuing calibration checks	±0.06 relative retention time units (sample and standard)	Reanalyze affected samples

Table 9 - Quality Control Procedures for Metal Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	Daily	Correlation coefficient ≥0.995	Laboratory to optimize and recalibrate the instrument and reanalyze any affected samples
Initial Calibration Verification	Immediately after initial calibration	90 to 110 % recovery for ICP-AES, ICP-MS, and GFAA (80 to 120 % for mercury), or performance-based intralaboratory control limits, whichever is lower	Laboratory to resolve discrepancy prior to sample analysis
Continuing Calibration Verification	After every 10 samples or every 2 hours, whichever is more frequent, and after the last sample	90 to 110 % recovery for ICP-AES and GFAA, 85 to 115 % for ICP-MS (80 to 120 % for mercury)	Laboratory to recalibrate and reanalyze affected samples
Initial and Continuing Calibration Blanks	Immediately after initial calibration, then 10 percent of samples or every 2 hours, whichever is more frequent, and after the last sample	Analyte concentration < PQL	Laboratory to recalibrate and reanalyze affected samples
ICP Interelement Interference Check Samples	At the beginning and end of each analytical sequence or twice per 8 hour shift, whichever is more frequent	80 to 120 percent of the true value	Laboratory to correct problem, recalibrate, and reanalyze affected samples
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples
Detection Limits	Not applicable	See Tables 4 and 5	Laboratory must initiate corrective actions and contact the QA/QC coordinator and/or the project manager immediately
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent	Analyte concentration ≤ PQL	Laboratory to redigest and reanalyze samples with analyte concentrations < 10 times the highest method blank
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent	Soil - RPD ≤ 35 % applied when the analyte concentration is > PQL Water - RPD ≤ 25 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted

Table 9 - Quality Control Procedures for Metal Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent	75 to 125 % recovery applied when the sample concentration is < 4 times the spiked concentration for a particular analyte	Laboratory may be able to correct or minimize problem; or qualify and accept data
Laboratory Control Samples, Certified or Standard Reference Material	Overall frequency of 5 percent of field samples	80 to 20 % recovery, or performance based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 10 – Quality Control Procedures for Semi-volatile Organic Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Instrument Performance Check (Tuning)	Prior to initial calibration and every 12 hours	See Method 8270D: Sections 11.3.1 and 11.4.1 and Table 4 and 5	Retune and recalibrate instrument
Initial Calibration	See Method 8270D: Sections 11.3	< 20% relative percent difference	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours	See Method 8270D: Sections 11.4 < 20% percent difference	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Internal Standards	All samples and calibration standards	Areas within - 50% to + 150% of initial calibration	Reanalyze affected samples
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 4 and 5	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 4) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Performance based intralaboratory control limits	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.

Table 10 – Quality Control Procedures for Semivolatile Organic Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Surrogate Spikes	Added to every organics sample as specified in analytical protocol	Performance based intralaboratory control limits	Follow corrective actions specified in Method 8270.
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 11 – Quality Control Procedures for PCB Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	See Method 8082, Section 11.4	See Method 8082, Section 11.4	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours or every 20 samples See Method 8082, Section 11.6.2	± 20 % difference See Method 8082, Section 11.6.2	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 4 and 5	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Compound- and matrix-specific RPD ≤ 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.
Surrogate Spikes	Added to every organics sample as specified in analytical protocol; See Method 8082, Section 7.10	Tetrachloro-m-xykene recovery - 30 to 150% Decachlorobiphenyl recovery - 30 to 150%	Re-extract and reanalyze sample unless interferences are present

Table 11 – Quality Control Procedures for PCB Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 12 – Quality Control Procedures for Chlorinated Pesticide Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	See Method 8081, Section 11.4	< 20% relative standard deviation See Method 8081, Section 11.4	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours or every 20 samples See Method 8081, Section 11.5	± 20 % difference See Method 8081, Section 11.5	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
DDT/Endrin Breakdown	Prior to analysis and every 12 hours	< 15% breakdown	Clean injector and recalibrate instrument
Analyte confirmation	Second, disimilar GC column confirmation for all detected analytes	Concentration percent difference < 15%	Qualify data
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 4 and 5	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples

Table 12 – Quality Control Procedures for Chlorinated Pesticide Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Compound- and matrix-specific RPD ≤ 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.
Surrogate Spikes	Added to every organics sample as specified in analytical protocol; See Method 8081, Section 7.10	Tetrachloro-m-xykene recovery - 30 to 150% Decachlorobiphenyl recovery - 30 to 150%	Re-extract and reanalyze sample unless interferences are present
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 13 – Quality Control Procedures for Polybrominated Diphenyl Ether Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	See Method 8082, Section 11.4	See Method 8082, Section 11.4	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours or every 20 samples See Method 8082, Section 11.6.2	+ 20 % difference See Method 8082, Section 11.6.2	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 4 and 5	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Compound- and matrix-specific RPD ≤ 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.
Surrogate Spikes	Added to every organics sample as specified in analytical protocol; See Method 8082, Section 7.10	Tetrachloro-m-xykene recovery - 30 to 150% Decachlorobiphenyl recovery - 30 to 150%	Re-extract and reanalyze sample unless interferences are present
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 14 – Quality Control Procedures for Polychlorinated Dioxins/Furans Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Initial Calibration	See Method 1613B, Section 10	See Method 1613B, Section 10 and Table 3	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours See Method 1613B, Section 15	See Method 1613B: Section 15 and Tables 4 and 5	Laboratory to recalibrate if method requirements not met
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 3	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 4 and 5	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 3) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicate	One duplicate analysis with every sample batch or every 20 samples, whichever is more frequent	Compound- and matrix-specific RPD ≤ 35 % applied when the analyte concentration is > PQL	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Surrogate Spikes	Added to every organics sample as specified in analytical protocol	See Method 1613B Table 3	Follow corrective actions specified in Method 1613B .

Table 14 – Quality Control Procedures for Polychlorinated Dioxins/Furans Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

Table 15 – Quality Control Procedures for Volatile Organic Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Instrument Quality Assurance/Quality Control			
Instrument Performance Check (Tuning)	BFB Prior to initial calibration and every 12 hours	See Method 8260C: Sections 7.3.3.1, Table 4	Retune and recalibrate instrument
Initial Calibration	As required when continuing calibration no longer meets criteria See Method 8260C: Section 7.3	< 15% relative standard deviation See Method 8260C: Section 7.3	Laboratory to recalibrate and reanalyze affected samples
Continuing Calibration	Every 12 hours	See Method 8260C Sections 7.4.4 & 7.4.5 SPCC Compound Response Factors CCC Compounds < 20% percent difference	Laboratory to recalibrate if correlation coefficient or response factor does not meet method requirements
Internal Standards	All samples and calibration standards	Areas within - 50% to + 150% of initial calibration	Reanalyze affected samples
Method Quality Assurance/Quality Control			
Holding Times	Not applicable	See Table 4	Qualify data or collect fresh samples in cases of extreme holding time or temperature exceedance
Detection Limits	Annually	See Tables 5 and 6	Laboratory must initiate corrective actions (which may include additional cleanup steps as well as other measures, see Table 4) and contact the QA/QC coordinator and/or project manager immediately.
Method Blanks	One per sample batch or every 20 samples, whichever is more frequent, or when there is a change in reagents	Analyte concentration < PQL	Laboratory to eliminate or greatly reduce laboratory contamination due to glassware or reagents or analytical system; reanalyze affected samples
Analytical (Laboratory) Replicates and Matrix Spike Duplicates	One MS/MSD duplicate analysis with every sample batch or every 20 samples, whichever is more frequent; Use analytical replicates when samples are expected to contain target analytes. Use matrix spike duplicates when samples are not expected to contain target analytes	Performance based intralaboratory control limits	Laboratory to redigest and reanalyze samples if analytical problems suspected, or to qualify the data if sample homogeneity problems suspected and the project manager consulted
Matrix Spikes	One per sample batch or every 20 samples, whichever is more frequent; spiked with the same analytes at the same concentration as the LCS	Performance based intralaboratory control limits	Matrix interferences should be assessed and explained in case narrative accompanying the data package.

Table 15 – Quality Control Procedures for Volatile Organic Analyses

Quality Control Procedure	Frequency	Control Limit	Corrective Action
Surrogate Spikes	Added to every organics sample as specified in analytical protocol	Performance based intralaboratory control limits	Follow corrective actions specified in Method 8260.
Laboratory Control Samples (LCS), Certified or Standard Reference Material	One per analytical batch or every 20 samples, whichever is more frequent	Compound-specific, recovery and relative standard deviation for repeated analyses should not exceed the control limits specified in the method or performance-based intralaboratory control limits, whichever is lower	Laboratory to correct problem to verify the analysis can be performed in a clean matrix with acceptable precision and recovery; then reanalyze affected samples

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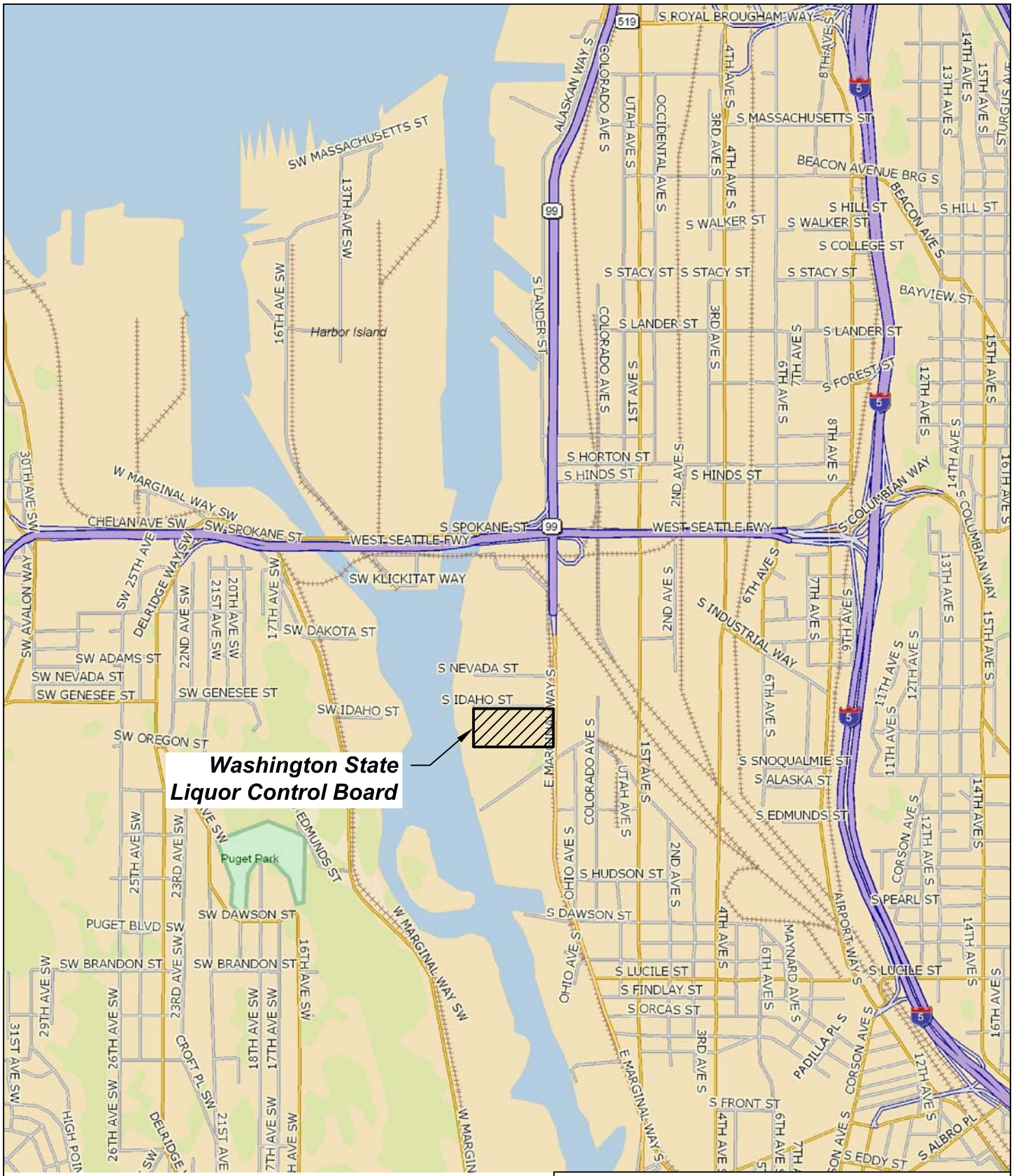

Source: Base map prepared from DeLorme Topo 7.0, 2007.

0 2000 4000

Scale in Feet

N

Washington State Liquor Control Board
Seattle, Washington

Vicinity Map

17330-32 3/11

HARTCROWSER

Figure
1

EAL 03/29/11 173303204-003.dwg

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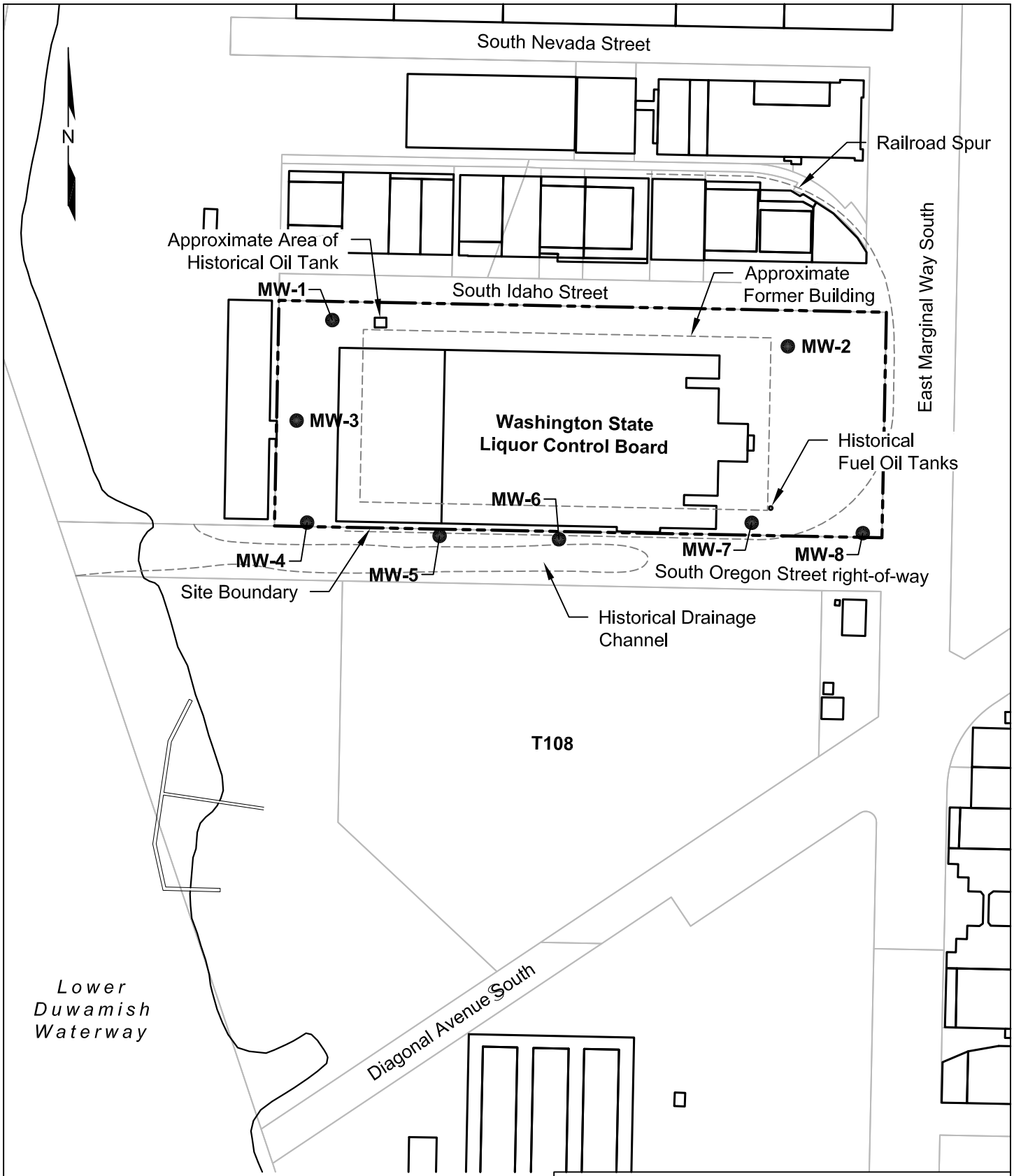

Source: Copyright 2002 Kroll Map Company, Inc. #2297 - All Rights Reserved.

MW-1 ● Proposed Boring/Well Location and Number

Note: Approximate locations of historical features compiled from various sources. See text for details.

0 250 500

Scale in Feet

Washington State Liquor Control Board
Seattle, Washington

Site and Exploration Plan

17330-32 3/11

HARTCROWSER

Figure
2

EAL 03/31/11 173303204-004.dwg

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APPENDIX A
SAMPLE FIELD FORMS AND CHAIN OF CUSTODY

Boring Location

Elevation:_____ Datum:_____

Obs. Well Install. [Yes] [No]

HARTCROWSER

Boring _____ Date _____ Sheet ____ of ____

Job _____ Job No. _____

Logged By _____ Weather _____

Drilled By _____

Drill Type/Method _____

Sampling Method _____

Bottom of Boring _____ ATD Water Level Depth _____ [No]

Size(%) G Max.	S Range	F Att. Limits	PID or other	DEPTH From	To	SAMPLE Type	Number	Sample Recovery	Penetration Resistance	DESCRIPTION: Den., moist, color, minor, MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.	REMARKS: Drill Action, drill and sample procedures, water conditions, heave,...etc.	SUMMARY LOG (Water and Date)
								0				
								1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				
								0				
								1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				
								0				

core\forms\boring log field

Figure 3-1--Boring Log

Groundwater Sampling Data - Well I.D. _____

Project _____ Date/Time Sampled _____

Job No. _____ Tidally Influenced Yes ☐ No ☐

Project Manager _____ Well Depth in Feet _____

Field Reps. _____ Screened Interval in Feet _____

1) Purging Data/Field Measurements: *All Measurements Relative to Top of Casing (TOC)*

Well Depth _____ Casing Volume in Gallons _____

Depth of Sediment (DTS) in Feet _____ [2" diameter = x .163 gal/ft]

Depth of Water (DTW) in Feet _____ Purge Volume in Gallons _____

(DTS - DTW) _____ Actual Purge in Gallons _____

SMPL

Time	No. of Gallons Purged	pH	Temp in ^{o}C	Conduct in mS/cm	Diss Oxygen in mg/L	Turbidity	ORP in mV	Comments: Quality, Recovery Color, Odor, Sheen, Accumulated Silt/Sand

Comments _____

	Method	Purging Rate in GPM	Depth of Equipment in Feet
Purge			
Sample			

Bails dry? Yes ☐ No ☐

At no. of Casing Volumes _____

Purge Water Disposal Method/Volume _____

2) Sampling Data

#	Bottle Type	Analyses	Perserv.	Filter

Total Number of Bottles _____

Duplicate Sample I.D. _____

Field Blank I.D. _____

Rinseate Sample I.D. _____

3) Field Equipment *Type/Brand/Serial No./Material/Units*

Pump Type/Tubing Type _____ Temp/pH/E.C./D.O _____

Bailer Type _____ Water Level Probe _____

Filter Type _____ Other _____

4) Well Conditions

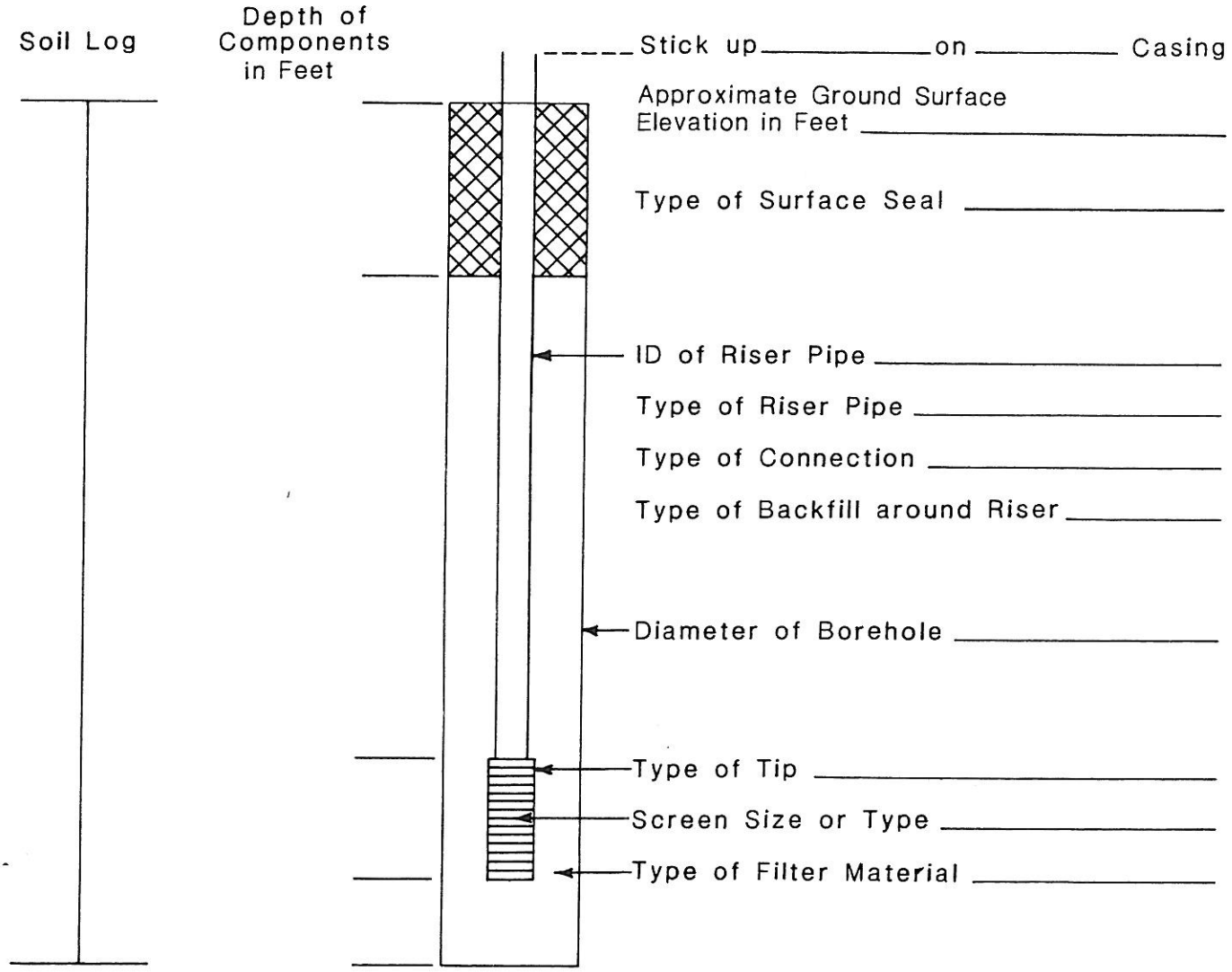
OK ☐ Not OK ☐ Explain _____

Monitoring Well Installation Report -Boring _____

Project _____ Job No._____ Date _____

Location _____ HC Observer_____ Driller_____

Type of Well (Observation, Sampling, etc.) _____



Remarks: _____

_____

_____

_____

Materials:

Sand _____ Monument _____

Cement _____ PVC _____

Bentonite _____ Other _____

Sample Custody Record

Samples Shipped to: _____

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB _____ LAB NUMBER _____

PROJECT NAME _____

HART CROWSER CONTACT _____

_____

SAMPLED BY:

REQUESTED ANALYSIS

NO. OF CONTAINERS

OBSERVATIONS/COMMENTS/
COMPOSITING INSTRUCTIONS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINT NAME		PRINT NAME	
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR
STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. _____
for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS:
☐YES ☐NO ☐N/A
GOOD CONDITION
☐YES ☐NO
TEMPERATURE _____
SHIPMENT METHOD: ☐HAND
☐COURIER ☐OVERNIGHT

TURNAROUND TIME:

☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER _____

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

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for double-sided printing.