Prepar

WORK PLAN FOR SOIL AND GROUNDWATER SUPPLEMENTAL REMEDIAL INVESTIGATION

PRECISION ENGINEERING, INC.

PRECISION ENGINEERING, INC. SITE
1231 S. DIRECTOR STREET
SEATTLE, WASHINGTON

Prepa

Project No. 8006.08.04

November 23, 2005

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PROJECT/TASK NO.: 8006.08.04/02

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DATE: November 23, 2005

RE: Work Plan for Soil and Groundwater Supplemental Remedial Investigation

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BY: Alan Hughes

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PRECISION ENGINEERING, INC. SITE
1231 S. DIRECTOR STREET
SEATTLE, WASHINGTON

Prepared for

Precision Engineering, Inc.

November 23, 2005

Prepared by

Maul Foster & Alongi, Inc.
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Work Plan for Soil and Groundwater Supplemental Remedial Investigation
Precision Engineering, Inc. Site
1231 S. Director Street
Seattle, Washington

The material and data in this report were prepared under the supervision and direction of the undersigned.

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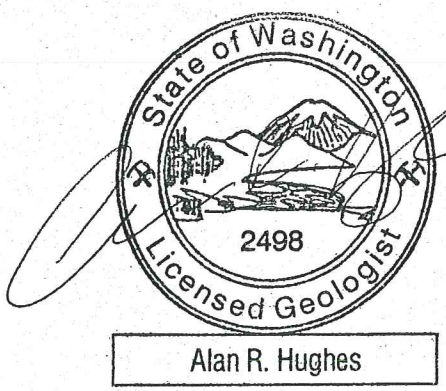

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
cis-1,2-DCE	cis-1,2-dichloroethene
CUL	cleanup level
DROs	diesel-range organics
Ecology	Washington State Department of Ecology
EP	extraction procedure
GROs	gasoline-range organics
HASP	health and safety plan
IHS	indicator hazardous substance
Metro	Municipality of Metropolitan Seattle
MFA	Maul Foster & Alongi, Inc.
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTCA	Model Toxics Control Act
OROs	oil-range organics
PAH	polycyclic aromatic hydrocarbons
POTW	publicly owned treatment works
Precision	Precision Engineering, Inc.
QA/QC	quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SAP	sampling and analysis plan
SE/E	Sweet-Edwards/EMCON, Inc.
TCE	trichloroethene
TCLP	toxicity characteristic leaching procedure
VCP	Voluntary Cleanup Program
VOC	volatile organic compound
WAC	Washington Administrative Code
WBZ	water-bearing zone

1 INTRODUCTION

On behalf of Precision Engineering, Inc. (Precision), Maul Foster & Alongi, Inc. (MFA) has prepared this work plan to conduct a supplemental remedial investigation (RI) for soil and groundwater at the former Precision site at 1231 S. Director Street, Seattle, Washington (see Figure 1). The work described in this work plan is being conducted under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). Precision entered the VCP in October 2005 after completing a focused preliminary soil and groundwater assessment at the site in June 2005. The June 2005 assessment identified diesel, hexavalent chromium, motor oil, total chromium, trivalent chromium, trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) in soil and/or groundwater at concentrations that exceed their respective Ecology Model Toxics Control Act (MTCA, Chapter 173-340 WAC) Method A, Method B, or Method C cleanup levels (CULs) for soil or groundwater.

1.1 Property Location and Description

The former Precision facility is located at 1231 S. Director Street in Seattle, Washington (see Figure 1). The approximately 3.5-acre site is in King County, Washington, section 32, township 24 north, range 4 east, Willamette Meridian. The site is approximately 1,800 feet (less than 0.5 mile) west of the Duwamish River. A single 62,000-square-foot building is located at the site. The east side of the building was constructed in 1968, and the west part was added in 1979. The building is surrounded by an asphalt parking lot (see Figure 2).

Precision operated continuously at the property between 1968 and 2005. Precision ceased operations on March 1, 2005. Precision specialized in the manufacture and repair of large hydraulic cylinders, large rolls used in the manufacture of paper and metal sheet products, and other equipment. Services included precision grinding and polishing, honing, hard-chrome plating, milling, welding, and a large number of flame- and arc-applied metal coatings. Much of Precision's work involved the use of chromic acid. Approximately 10,000 square feet of the west side of the building was leased to Baszile Metals Service, an aluminum distributorship, between approximately 1985 and 2003.

1.2 Reasonably Likely Future Site Use

The site is currently used for heavy industrial purposes. The site is zoned I (Industrial). Use of the site is likely to remain industrial. The area surrounding the site is characterized by mixed industrial and residential use.

2 ENVIRONMENTAL SETTING AND SITE BACKGROUND

2.1 Environmental Setting

The Precision facility is located at the base of a hill along S. Director Street. The site is generally flat except for the northern and western edges of the property, which consist of an excavated slope (see Figure 2). The property is located in the lowland area of the Duwamish River Estuary. The Duwamish River is approximately 1,800 feet (less than 0.5 mile) east of the site and flows north to Elliot Bay.

2.1.1 Geology

The site is underlain by localized fill up to 10 feet thick; alluvium, comprised of silt and sand (from the surface to a depth of approximately 40 feet); and dense, gravelly, sandy silt glacial till. Based on a cross section prepared by Sweet-Edwards/EMCON, Inc. (SE/E) (Precision, 1993), it appears that the silty sand fill and silt-and-sand alluvium do not extend to the southwest part of the site. The June 2005 characterization activities completed by MFA generally confirmed the past investigation's geologic findings.

2.1.2 Hydrogeology

Two groundwater systems are present beneath the project site: (1) an unconfined alluvial water-bearing zone (WBZ) beneath the eastern side of the site that flows northeasterly toward the Duwamish River, and (2) a confined sand and gravel WBZ confined beneath the low permeability glacial till (which is also referred to as the advanced outwash WBZ) (Precision, 1993). East of the facility, the glacial till appears to hydraulically separate the two groundwater systems (Precision, 1993).

Four monitoring wells (MW-1 through MW-4; see Figure 3) and two piezometers (P-1 and P-2) were installed at the site in June 1988. A 1993 Independent Remedial Action Report indicates that MW-2 and MW-3 are screened in the alluvial WBZ, which occurs only in the western half of the site, and that MW-1 is screened in the advanced outwash WBZ and MW-4 is screened in the glacial till (Precision, 1993). The piezometers could not be located during the June 2005 characterization. Historically, groundwater levels at the site ranged from 0 to 15.4 feet below ground surface (bgs) (Precision, 1993). Flow direction in the alluvial aquifer is reportedly northeasterly, and flow direction in the

confined aquifer has not been determined. MFA collected depth-to-water measurements at monitoring wells MW-1 through MW-4 during the June 2005 characterization (see Table 1). Groundwater flow direction could not be shown conclusively for either of the two WBZs at Precision, due to the limited number of wells present. MW-1 exhibited flowing artesian conditions during the June 2005 characterization.

2.1.3 Surface Water and Stormwater System

Surface water flows south from the property and into a drainage ditch on the south side of the property. Primary stormwater runoff routes are from the southeast corner of the Precision property and from a catch basin in the southern parking lot (see Figure 2). The catch basin drains south to a manhole that in turn discharges to the drainage ditch. The drainage ditch is routed away from the site through a network of pipes until it discharges to the Duwamish River (SE/E, 1990b).

2.2 Features of Interest

2.2.1 Former Plating Tanks 1 and 2

Former Plating Tanks 1 and 2 were installed in an in-ground containment vault in the southeast corner of the plating area in 1968, when the building was constructed (see Figure 2). The tanks and vaults were removed and then reconstructed during an independent remedial action completed at the site in the early 1990s (see Section 2.3.3 below for additional information on the remedial action). The tanks were removed from the site in 2005.

2.2.2 Former Plating Tanks 3, 4, 5, and 6

Former Plating Tanks 3, 4, 5, and 6 included one aboveground tank with a concrete curb around it and three in-ground tanks located in containment vaults (Neely, 2002). Two concrete-lined trenches penetrated the floor on both sides of the former tanks (see Figure 2). The tanks and vaults were removed in the early 1990s during an independent remedial action (see Section 2.3.6 below for additional information). The tanks were replaced by a small aboveground tank (Tank 3) and a long, horizontal aboveground tank (Tank 4) (see Figure 2). Tanks 3 and 4 were removed from the site in 2005.

2.2.3 Large Containment Vault Holding Plating Tank 7 and Caustic Tanks

The largest containment vault at the site was constructed in 1980 on the west side of the chrome-plating shop as part of the building expansion. The vault is approximately 24 feet

long, 8 feet wide, and 16 feet deep. The vault held Plating Tank 7, a sodium hydroxide strip tank, and a sodium bicarbonate strip tank (see Figure 2). Tank 7 measured 9 feet long, 7.5 feet wide, and 16 feet deep. The tanks in the vault were removed from the site in 2005.

2.2.4 Former Floor Trenches and Drains

Until 1985 or 1986, the floor drains and trenches throughout the facility, including those in the chrome-plating shop, discharged to the Municipality of Metropolitan Seattle (Metro) publicly owned treatment works (POTW) sanitary-sewer system. Precision was permitted by Metro to discharge chrome-plating rinse water from a small rinse tank to the POTW. By July 1986, Precision had sealed or otherwise disconnected the floor drains and trenches from the City sanitary-sewer system and rerouted them to the containment vaults.

2.2.5 Hydraulic Cylinder Test Vault

A covered in-ground hydraulic cylinder test vault measuring approximately 4 feet in diameter and 25 feet deep is located outside the building, approximately 10 feet from the west wall of the building.

2.2.6 Temporary Plating-Tank Area

Temporary aboveground plating tanks were sometimes used to plate parts in the area north of Plating Tank 7.

2.2.7 Scrubber Room and Chromic-Acid Evaporator

The scrubber room contained a cooling-water tank, a chromic-acid evaporator, a chromic-acid purification unit, and a large aboveground chromic-acid holding tank (see Figure 2). The evaporator, which was located in an in-ground containment vault, was used to concentrate chromic-acid wastes.

2.2.8 Parts Washers, Degreasers, and Other Solvent Usage

According to Precision, solvent usage at the site has included methyl ethyl ketone (MEK, also known as 2-butanone), Stoddard solvent, and TCE. Solvents were used for cleaning parts. Parts washers had been located throughout the building since operations began in 1968. Before 1986, TCE was used in a closed-loop vapor-degreaser system in the

cylinder shop. A TCE tank was reportedly located in the chrome-plating area (see Figure 2).

2.2.9 Former Steam-Cleaning Areas

A covered, outside steam-cleaning area, including a sodium-hydroxide-stripping tank, was located at the southeast corner of the building prior to 1986 (see Figure 2). Parts were cleaned and degreased in this area. Liquids from the steam-cleaning area were discharged to an oil/water separator (SCS, 1986b). The oil/water separator discharged to the sanitary-sewer system. In 1986, the oil/water separator was dismantled and filled with concrete, and the steam-cleaning operation and the strip tank were moved inside the building (see Figure 2).

2.3 Previous Investigation Activities

2.3.1 Metro Sediment Sampling in Drainage Ditch (1986)

In April 1986, Metro collected four off-site sediment samples in the drainage ditch southeast of Precision. A sample collected near the Precision facility contained total chromium at 50,530 milligrams per liter [mg/L]) compared with the upstream concentration of 143 mg/L (Ecology, 1986). Sediment samples collected downstream ranged from 289 mg/L to 384 mg/L. The units reported by Ecology are not consistent for a total chromium analysis. It is unclear whether the samples were analyzed using toxicity characteristic leaching procedure (TCLP) analysis (which is reported in mg/L) or whether the units were incorrectly reported (and should have been in milligrams per kilogram [mg/kg]).

2.3.2 Sampling near Solid-Waste Dumpster (1986)

SCS Engineers collected two composite soil samples in the southeastern corner of the facility where overland water runoff enters the drainage ditch. Oil and grease were detected at concentrations of up to 39.6 mg/L (SCS, 1986a). There is an apparent discrepancy in the reported data in that the units reported on the laboratory report for the oil and grease analyses (mg/L) are inconsistent with typical units used in analyzing soil samples (mg/kg). TCLP analyses for metals (including chromium), PCBs, and organic halogens had no detections at or above the method reporting limits. Copper, nickel, and zinc were detected at concentrations up to 1.3 ppm, 5.00 ppm, and 3.90 ppm, respectively. Benzo(a)pyrene was detected in one sample at 4.20 ppm (SCS, 1986a).

2.3.3 Former Plating Tanks 1 and 2 Investigation and Remedial Work (1988–1990)

From 1988 through 1989, SE/E investigated soil around the original Plating Tanks 1 and 2 after observing yellow-stained soil in an opening in the concrete floor near Plating Tank 1 (chrome-plating solutions are typically yellow). Thirteen hand-auger borings (HA-1 through HA-13) and five drilled borings (B-1 through B-5) were completed adjacent to Plating Tanks 1 and 2. Results of the investigation were summarized in status reports prepared by SE/E (1988, 1989, 1990a). A total of 19 soil samples were analyzed for total chromium by extraction procedure (EP) toxicity. Chromium was detected in 16 of the 19 samples at concentrations ranging from 0.02 mg/L to 184.0 mg/L. Concentrations decreased outside the footprint of Plating Tanks 1 and 2.

Precision removed the original Plating Tanks 1 and 2 after the investigation. Removal of the contaminated soil around the tanks began in 1990. The concrete vaults and adjacent soils were excavated and disposed of at a Resource Conservation and Recovery Act (RCRA)-permitted landfill (Precision, 1993). Approximately 114 cubic yards of soil and concrete was removed from an excavation that was approximately 12 to 13 feet below grade (Precision, 1993). Groundwater was encountered at the base of the fill in the excavation. Confirmation samples were collected after the excavation. Hexavalent chromium was detected in four of the five samples from the final round of confirmation at concentrations ranging from 7.3 mg/kg (west wall) to 73 mg/kg (south wall). The remedial work was described in an independent remedial action report (Precision, 1993).

2.3.4 Sediment Investigation (1989)

SE/E completed a study in 1989 to assess sediments in the drainage ditch on the south side of the property. Fifteen shallow-soil samples were collected from the drainage ditch. Arsenic, barium, cadmium, chromium, copper, lead, nickel, and zinc were detected in the samples analyzed by EP toxicity methods. EP toxicity chromium was detected in 12 of the 15 samples at concentrations ranging from 0.01 mg/L to 0.508 mg/L (SE/E, 1990b). Ecology collected a split sample and detected arsenic, barium, copper, lead, nickel, and zinc in the split sample.

2.3.5 Tank 7 Soil Investigation (1989)

In 1989, one soil boring was drilled northeast of Plating Tank 7 to a depth of 20.4 feet bgs to evaluate potential leakage of chrome-plating waste into soil and groundwater from cracks in the containment vault for Plating Tank 7. Groundwater was encountered during drilling at a depth of 9 feet bgs. Eight soil samples were collected and analyzed for EP toxicity metals and pH. Chromium was not detected in the leachate at or above the method reporting limit of 0.005 mg/L, using EP toxicity (Precision, 1993).

2.3.6 Removal of Former Plating Tanks 3, 4, 5, and 6 (1992–1993)

In 1992, Precision removed original Plating Tanks 3, 4, 5, and 6 and a 35-foot by 40-foot section of the concrete below the tanks. Visibly contaminated soils were removed, with the depth of excavation ranging from 6 to 28 inches (Precision, 1993). During the remediation work, most concrete and soil samples were analyzed using the TCLP method. Chromium by TCLP was detected in samples of the concrete floor at concentrations ranging from 3.51 mg/L to 590 mg/L, and in soil samples from 37.3 mg/L to 259 mg/L (Precision, 1993). Soil and concrete with the lowest detections were placed back into the excavation.

2.3.7 Groundwater Monitoring (1988 to 1993)

In 1988, SE/E installed four groundwater-monitoring wells and two piezometers (MW-1, MW-2, MW-3, MW-4, P-1, and P-2). The monitoring-well locations are shown in Figure 3. The results from three rounds of groundwater monitoring from June 1988 to March 1990 are described in Precision's 1993 Independent Remedial Action Report (Precision, 1993). Total chromium was detected in the monitoring wells at up to 0.923 mg/L. During the March 1990 sampling event, low levels of total copper, total lead, total nickel, and total zinc were also reported.

Groundwater samples were analyzed for polycyclic aromatic hydrocarbons (PAHs) during the March 1990 sampling event. No detections were reported for any of the monitoring wells. In addition, a hydrocarbon scan was performed on a sample from monitoring well MW-2 during the March 1990 sampling event. No detections of diesel, jet fuel, gasoline, kerosene, or mineral spirits were reported.

Groundwater samples were also analyzed for volatile organic compounds (VOCs) during the March 1990 sampling event. Acetone was detected at a concentration of 21 mg/L and methylene chloride was detected at a concentration of 12 mg/L in a groundwater sample from MW-1. These analytes may be the result of laboratory contamination, as acetone and methylene chloride are common laboratory contaminants (Precision, 1993).

2.3.8 Initial Investigation (June 2005)

In June 2005, MFA conducted an initial investigation (Washington Administrative Code [WAC]-340-310) and advanced 11 Geoprobe™ borings (GP-1 through GP-11) at the site to characterize releases of hazardous substances near former plating tanks and floor trenches and drains (see Figure 3). Soil and reconnaissance groundwater samples were collected from the Geoprobe borings. MFA also redeveloped and sampled four existing monitoring wells at the site. A report summarizing the work was prepared by MFA in August 2005 (MFA, 2005b) and an addendum was prepared by MFA in October 2005 (MFA, 2005a).

The initial investigation identified hexavalent chromium, trivalent chromium, and TCE in soil at concentrations that exceeded Ecology MTCA Method A, Method B, or Method C CULs for soil. Diesel-range organics (DROs), hexavalent chromium, dissolved total chromium, oil-range organics (OROs), TCE, and cis-1,2-DCE were detected in groundwater at concentrations that exceeded MTCA Method A, B, or C CULs for groundwater. PAHs were not detected in samples from groundwater samples at concentrations that exceeded their respective MTCA CULs for groundwater.

2.4 Preliminary Indicator Hazardous Substances

Based on historical activities and the results of the June 2005 investigation, MFA has identified preliminary indicator hazardous substances (IHSs) for soil and groundwater at the site. IHSs were selected according to the procedures outlined in WAC (173-340-703). IHSs for the Precision site were selected based on historical chemical usage and past investigations at the site. Preliminary IHSs for on-site soil and groundwater include VOCs, DROs, OROs, and metals. Preliminary IHSs for off-site soil in the drainage ditch south of Precision's property include VOCs, gasoline-range organics (GROs), DROs, OROs, metals, and PAHs.

2.5 Cleanup Levels

The relevant soil and groundwater CULs for Precision's site are those based on MTCA Method C exposure assumptions. The MTCA Method C CULs are calculated using reasonable maximum exposure assumptions with target risk levels set at the MTCA acceptable risk level. The Precision site meets WAC (173-340-745) requirements for an industrial property:

- The site is zoned industrial.
- People do not live on the property.
- Public access to the property is limited.
- Food is not grown/raised on the property.
- Operations on the property were characterized by use and storage of chemicals.
- The surface of the property is covered by a building or asphalt.
- There are no other facilities on the property.

3 SITE CHARACTERIZATION PLAN

This site characterization plan includes characterization of preliminary IHSs in on-site and off-site soil, using a Geoprobe direct-push sampling rig and a hand auger. It also includes installing four new monitoring wells in order to establish an adequate network of groundwater-monitoring wells at the site. Both the existing and the new wells will be sampled to characterize preliminary IHSs in on-site groundwater. The scope of work is described below in general terms. Specific investigative procedures are described in greater detail in the sampling and analysis plan (SAP; see Appendix A).

3.1 Soil

Soil sampling will be completed to assess the nature and extent of contamination at the site and in the drainage ditch directly south of Precision's site. Twenty Geoprobe borings will be advanced inside and outside the building on the Precision property, and five hand-auger borings will be advanced in the off-site drainage ditch south of Precision's property (see Figure 3). Boring locations are based on delineating known areas where IHSs are present and investigating other features of interest identified in Section 2 above.

Geoprobe borings will be advanced to approximately 15 feet bgs or the top of the water table, whichever is encountered first. Hand-auger borings will be advanced to approximately 5 feet bgs. Soil samples will be collected from all borings for lithologic description and possible chemical analysis. Initially, soil samples will be selected for laboratory analysis based on existing data, visual and olfactory observations, and field screening using a photoionization detector. Fieldwork will be conducted by, or under the supervision of, a professional geologist or professional engineer registered in the State of Washington. Surface-soil samples from the hand-auger borings will be selected for analysis. If observations or measurements made in the field indicate potential impacts in deeper soil samples, additional samples from the hand-auger borings may be analyzed. Duplicate soil samples will be collected and analyzed for quality assurance/quality control (QA/QC) purposes, as described in Section 8 of the SAP (Appendix A).

Soil samples to be analyzed will be labeled, placed on ice in a shipping container with chain-of-custody paperwork, and transported to the analytical laboratory for analyses. Excess soil, sediment, and groundwater produced during exploratory drilling will be containerized and secured in Department of Transportation-approved, 55-gallon drums in a designated location on the site.

After sampling is complete, exploratory borings will be backfilled and sealed with hydrated bentonite chips. Hand-auger borings will be backfilled with soil cuttings. Holes cored through concrete and/or asphalt paving will be sealed by the driller using a material similar to the original pavement.

3.1.1 Analytical Plan for Soil

Selected soil samples will be submitted to North Creek Analytical in Bothell, Washington, for possible analysis of hexavalent chromium, Priority Pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc), VOCs, DROs and OROs. In addition, selected soil samples from the hand-auger borings will be analyzed for GROs.

If GROs are detected in soil samples at concentrations that exceed MTCA Method A CULs, an appropriate number of samples will be analyzed for volatile petroleum hydrocarbons so that site-specific MTCA Method C CULs can be calculated. Similarly, if DROs or OROs are detected in soil samples at concentrations that exceed MTCA Method A CULs, an appropriate number of samples will be analyzed for extractable petroleum hydrocarbons so that site-specific MTCA Method C CULs can be calculated, and selected samples will be analyzed for PAHs.

Analytical methods are listed in Section 5 of the SAP (Appendix A). QA/QC protocols are also described in the SAP.

3.2 Groundwater

Precision will install two additional shallow monitoring wells and two additional deep groundwater-monitoring wells at the site, using hollow-stem auger drilling equipment. The new shallow monitoring wells will be placed near and downgradient of the former chrome-plating area, in the alluvial WBZ (Figure 3). Along with existing wells MW-3 and MW-2, the two new shallow wells will provide a means of establishing the groundwater flow direction and hydraulic gradient in the alluvial WBZ and will monitor groundwater quality downgradient of the former chrome-plating area. The new deep monitoring wells will be placed near existing wells MW-3 and MW-2, and along with MW-1, will provide a means of establishing the groundwater flow direction and hydraulic gradient in the advanced outwash WBZ. Additional details on well-installation techniques are provided in Section 3 of the SAP (Appendix A).

The alluvial and advanced outwash WBZs are considered to be the most likely geologic formations that could transport IHSs off site in a manner that may impact a potential receptor.

During the well installation, split-spoon samples will be collected at 2.5-foot intervals to prepare lithologic descriptions. Wells will have flush-mount completion unless flowing artesian conditions appear to be present. The completion depth of the shallow wells will be 20 feet bgs and the completion depth for the deep monitoring wells will be 40 feet bgs.

Monitoring-well-construction logs will be completed for each well that is installed. Following installation of the new monitoring wells, the wells will be developed using a combination of pumping and surging. Development water will be containerized and placed at a designated location on the site.

During the June 2005 sampling event, one monitoring well (MW-1) was observed to be a flowing artesian well and the well casing was not high enough to allow for accurate measurement of the piezometric head. During the installation of the new monitoring wells, a riser will be added to MW-1 to prevent flowing conditions. In addition, the top of the casing of MW4, which was noted to be damaged during the June 2005 work, will be repaired. Once the new wells are installed and the existing wells are repaired, all wells will be surveyed by a land surveyor licensed in the State of Washington.

Groundwater samples will be collected from each monitoring well, using low-flow sampling techniques to ensure data quality. During the sampling event, one duplicate sample will be collected for QA/QC purposes, as described in Section 6 of the SAP. All groundwater samples will be labeled, placed on ice in a shipping container with chain-of-custody paperwork, and transported to the laboratory for analyses.

3.2.1 Analytical Plan for Groundwater

Groundwater samples will be analyzed for dissolved Priority Pollutant metals, dissolved hexavalent chromium, DROs, OROs, PAHs, and VOCs.

3.3 Health and Safety Measures

Appendix B contains a site-specific health and safety plan (HASP) designed to establish policies and procedures to protect workers and the public from the potential hazards related to the proposed scope of work and the hazardous materials at the Precision site. Elements of the HASP include a description of the site, a description of known and/or suspected site contaminants, protective clothing and equipment, monitoring protocol, decontamination procedures, and emergency response actions.

4 REPORTING

An RI report will be submitted after the site investigation, laboratory analyses, data validation, and data evaluation are complete. The RI report will document the findings of the RI characterization and will include the following:

- A statement of the objective of the remedial activities
- A description of the site history, features, surrounding land use, topography, and hydrogeology
- A description of the work performed and an assessment of data collected
- Boring and well-installation logs
- Laboratory analytical reports and a data-validation memorandum
- A figure showing the locations of borings and monitoring wells relative to current features
- Groundwater elevation contour maps
- Summary tables presenting the soil and groundwater analytical data and a comparison of soil and groundwater analytical results to the appropriate MTCA CULs
- Identification of data gaps, if any
- Conclusions and recommendations addressing the likely sources of any contamination identified at the site

Precision will meet with Ecology to discuss the report and to address any issues or concerns that may have risen during Ecology's review.

LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, nor the use of segregated portions of this report.

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SE/E. 1990a. Letter (re soil sample results; Tank no. 1 and drainage ditch, Precision Engineering, Inc., Seattle facility) to B. Trejo, Washington Department of

Ecology, from K. Lakey, Sweet-Edwards/EMCON, Inc., Bothell, Washington. January 4.

SE/E. 1990b. Sediment sampling, Precision Engineering, Inc., Seattle, Washington. Prepared for the Washington Department of Ecology by Sweet-Edwards/EMCON, Inc., Bothell, Washington. February 26.

TABLE

Table 1
Groundwater Elevations
Precision Engineering, Inc.
Seattle, Washington

Well	Date	MPE (feet)	Depth to Water (feet MPE)	Water Level Elevation (feet)
MW-1	10-May-05	100.97	0[a]	100.97[a]
MW-2	10-May-05	99.03	4.71	94.32
MW-3	10-May-05	99.74	6.00	93.74
MW-4	10-May-05	100.47	6.18[b]	94.29[b]

NOTES:
MPE = measuring point elevation. The MPE is an assumed elevation.
[a]Water elevation could not be accurately calculated because the well was a flowing artesian.
[b]The depth to water may not be accurate because the casing appeared to be broken.

FIGURES

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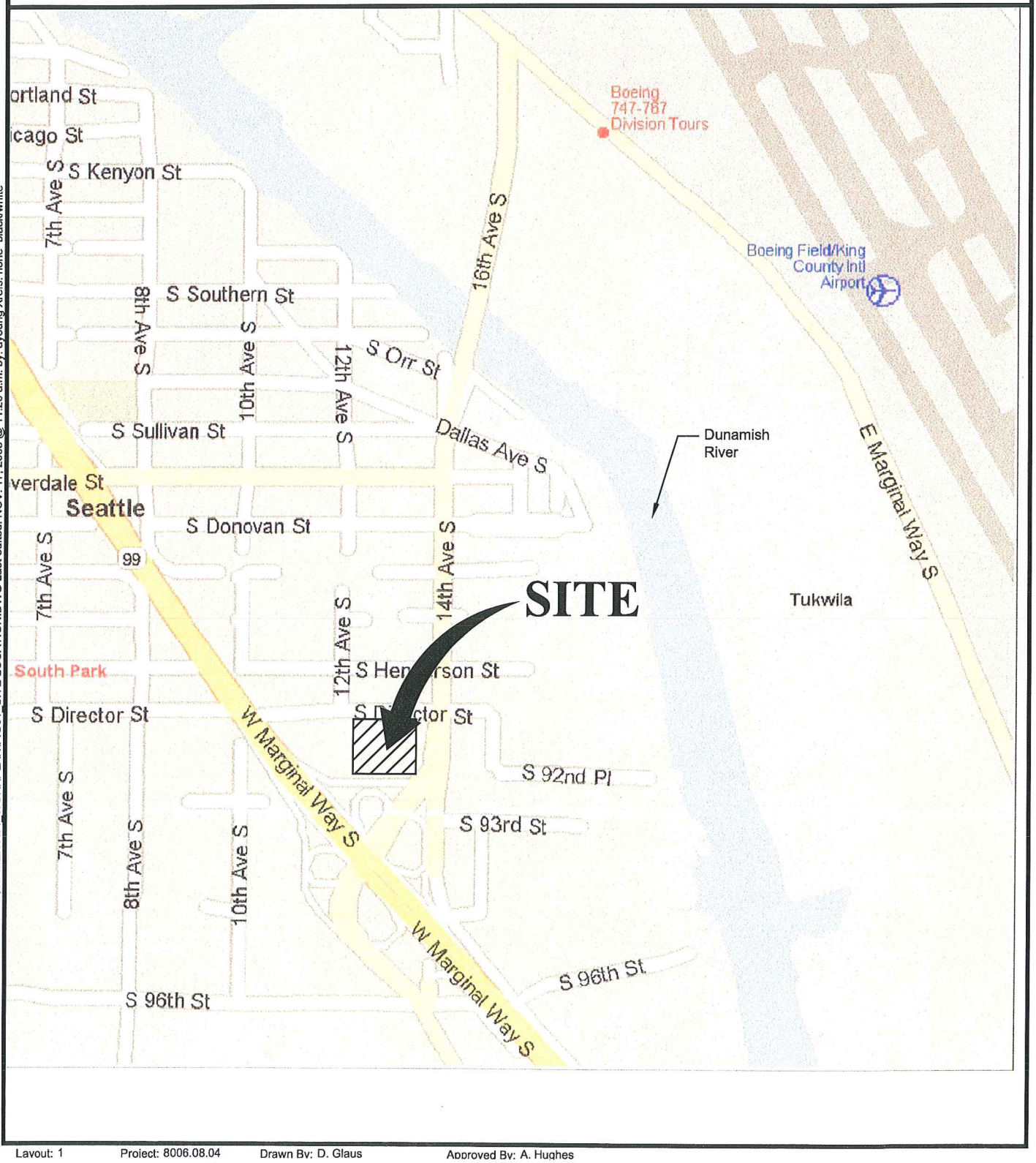
0 800 1600
FEET

N

Figure 1
Site Location

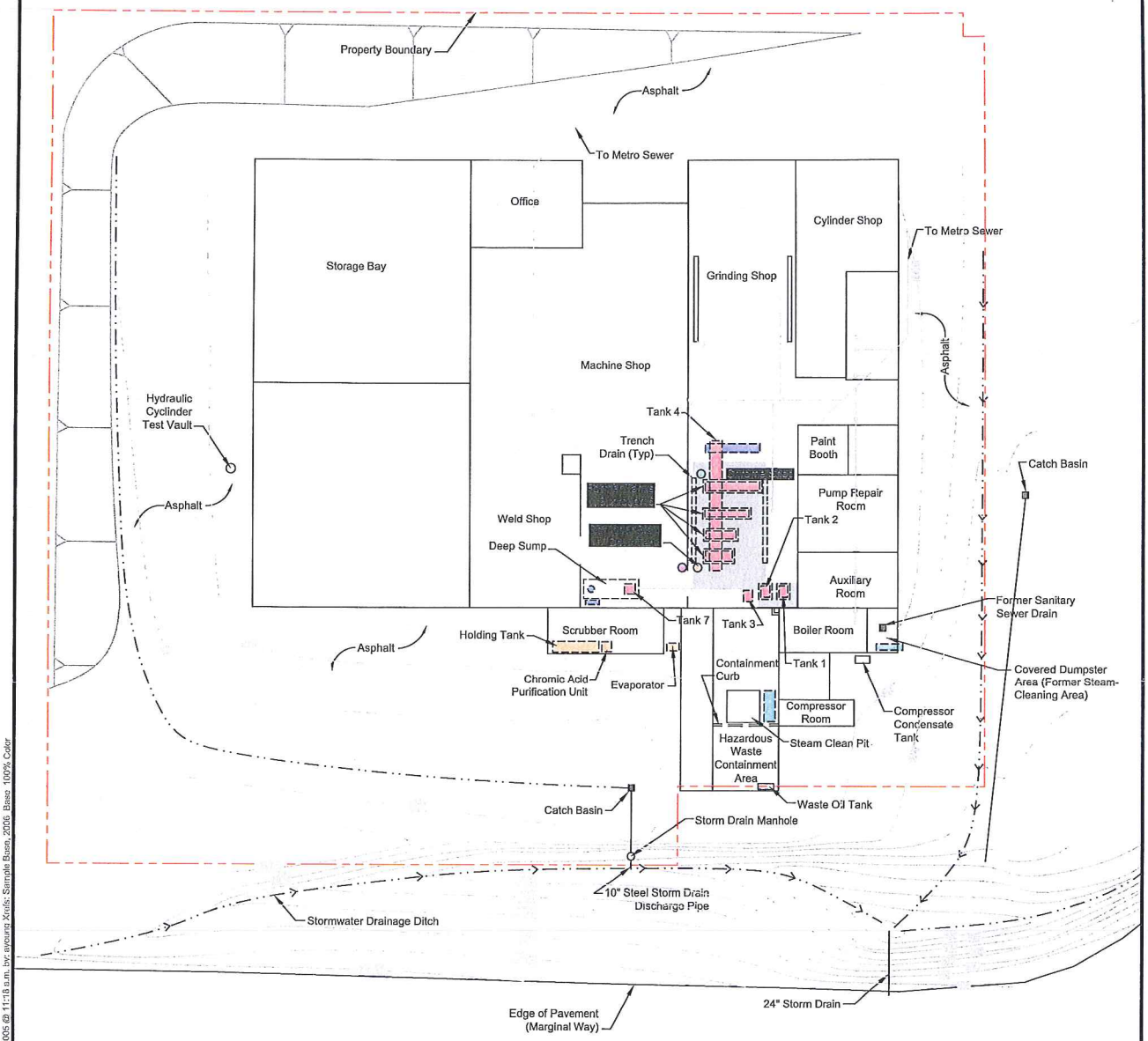
Precision Engineering, Inc.
Seattle, Washington

Source: Base map prepared from Microsoft Street & Trips 2000
Site Address: 1231 S. Director Street, Seattle, Washington
Section: 32 Township: 24N Range: 4E Of Willamette Meridian



File: G:\8006.08 STOEL RIVES-PRECISION EQUIPMENT\04_WORKPLAN\FIG01_SITE LOCATION.DWG Last edited: NOV. 17, 2005 @ 11:20 a.m. by: ayoung Xrefs: none black/white

Layout: 1 Project: 8006.08.04 Drawn By: D. Glaus Approved By: A. Hughes



Legend:
- Property Boundary
- Drainage Flow Path
- Topographic Contour Interval
- Former Features
- Former Sanitary Sewer Piping
- Chromic Acid Plating Tank
- Other Tanks Containing Chromic Acid
- Sodium Hydroxide Tank
- Sodium Carbonate Tank
- Hydrochloric Acid Tank
- TCE Tank

Legend (continued):
- 1990 and 1992 Excavation Areas (Locations are Approximate)

Figure 2
Former Site Features

Precision Engineering, Inc.
Seattle, Washington

Notes:
1) Property boundary and topography from 1989 survey by John R. Ewing and Associates.

2) Drainage patterns from 1986 drawing by SCS Engineers.

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File: G:\8006.08 STOEL RIVES-PRECISION EQUIPMENT\04_WORK\PLAN\FIG02_INVESTIGATION.DWG Last edited: NOV. 17, 2005 @ 11:18 a.m. by: aycung Xrefs: Sample Bases, 2006 Base 100% Color

Layout: 1 Project: 8006.08.04 Drawn By: D. Glaus Approved By: A. Hughes

Legend:
- Property Boundary
- Drainage Flow Path
- Topographic Contour Interval
- Former Features
- Former Sanitary Sewer Piping
- Existing Shallow Monitoring Well
- Existing Deep Monitoring Well
- June 2005 Boring Location
- Proposed Shallow Monitoring Well
- Proposed Deep Monitoring Well
- Proposed Soil Sample Location

Notes:
1) Property boundary and topography from 1989 survey by John R. Ewing and Associates.

2) Drainage patterns from 1986 drawing by SCS Engineers.

3) Existing monitoring well locations are approximate and based on drawings by Precision Engineering (1993).

4) Previous investigations by Sweet-Edwards/EMCON indicate MW-1 is screened in the advance outwash aquifer, MW-2 and MW-3 are screened in alluvium, and MW-4 is screened in the glacial till deposit.

Figure 3
Existing and Proposed Borings and Monitoring Wells

Precision Engineering, Inc.
Seattle, Washington

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FEET

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File: G:\8006.08 STOEL RIVES-PRECISION EQUIPMENT\04 WORKPLAN\FIG03 BORING AND MW LOCATIONS.DWG Last edited: NOV. 17, 2005 @ 11:21 a.m. by: ayoung Xrefs: Sample Base, 2005 Base 109% Color

Layout: 1 Project: 8006.08.04 Drawn By: D. Glaus Approved By: A. Hughes

APPENDIX A

SAMPLING AND ANALYSIS PLAN

APPENDIX A

SAMPLING AND ANALYSIS PLAN

PRECISION ENGINEERING, INC. SITE
SEATTLE, WASHINGTON

Prepared for

Precision Engineering, Inc.

November 23, 2005

Prepared by

Maul Foster & Alongi, Inc.
7223 NE Hazel Dell Avenue, Suite B
Vancouver, Washington 98665

Project No. 8006.08.04

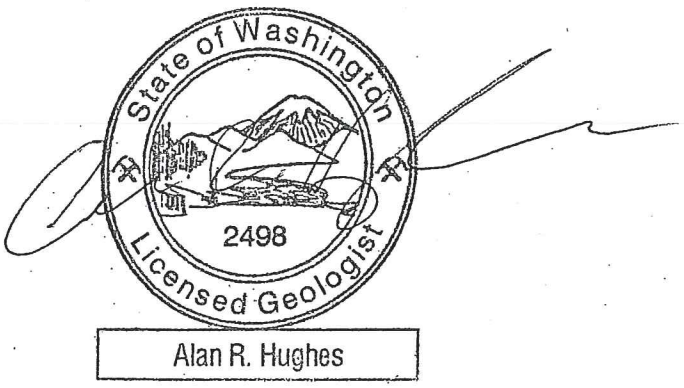
Appendix A
Sampling and Analysis Plan
Precision Engineering, Inc. Site
Seattle, Washington

The material and data in this report were prepared under the supervision and direction of the undersigned.

Maul Foster & Alongi, Inc.

James J. Maul, RG
President/Principal Hydrogeologist

Alistaire W. Clary, PE
Senior Engineer



Alan R. Hughes, RG
Project Geologist

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CONTENTS (Continued)

CONTENTS (Continued)

TABLES

Following Report:

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
COC	chain of custody
CUL	cleanup level
DOT	Department of Transportation (Washington)
DQO	data quality objective
DROs	diesel-range organics
Ecology	Department of Ecology (Washington)
FSDS	field sampling data sheet
GROs	gasoline-range organics
HSA	hollow-stem auger
i.d.	inside diameter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
MFA	Maul Foster & Alongi, Inc.
mg	milligram
ml	milliliter
MRL	method reporting limit
MTCA	Model Toxics Control Act
NCA	North Creek Analytical, Inc.
NTU	nephelometric turbidity unit
NWTPH	Northwest total petroleum hydrocarbons
OROs	oil-range organics
PAHs	polycyclic aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, completeness, and comparability
Precision	Precision Engineering, Inc.
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RI	remedial investigation
SAP	sampling and analysis plan
SIM	selected ion monitoring
TCE	trichloroethene
USEPA	U.S. Environmental Protection Agency

VCP	Voluntary Cleanup Program
VOA	volatile organic analysis
VOC	volatile organic compound
WAC	Washington Administrative Code
WBZ	water-bearing zone

1 INTRODUCTION

Maul Foster & Alongi, Inc. (MFA) has prepared this sampling and analysis plan (SAP) consistent with the requirements of Washington State Administrative Code (WAC), 173-340-820 to guide the collection of soil and groundwater samples during the supplemental remedial investigation (RI) at Precision Engineering, Inc. (Precision), located at 1231 S. Director Street in Seattle, Washington (see Figure 1 of the work plan). Precision operated continuously at the property between 1968 and 2005, and ceased operations on March 1, 2005. Precision specialized in the manufacture and repair of large hydraulic cylinders, large rolls used in the manufacture of paper and metal sheet products, and other equipment. Services included precision grinding and polishing, honing, hard-chrome plating, milling, welding, and a large number of flame- and arc-applied metal coatings.

The work described in this SAP is being conducted under the Washington State Department of Ecology (Ecology) Voluntary Cleanup Program (VCP). Precision entered the VCP in October 2005 after completing a focused preliminary soil and groundwater assessment at the site in June 2005. The June 2005 assessment identified diesel, hexavalent chromium, motor oil, total chromium, trivalent chromium, trichloroethene (TCE), and cis-1,2-dichloroethene in soil and/or groundwater at concentrations that exceeded their respective Ecology Model Toxics Control Act (MTCA) Method A, Method B, or Method C cleanup levels (CULs) for soil or groundwater.

1.1 Objectives

The primary objective of the SAP is to establish procedures for the collection of data of sufficient quality to evaluate the nature and extent of impacted soil and groundwater at the site. The work plan references relevant procedures and protocols from this SAP, and identifies specific media to be sampled and the locations, frequency, and types of field or laboratory analyses that will be conducted.

Soil will be investigated in the areas near and surrounding the containment vault holding former Plating Tanks 1 and 2; former Plating Tanks 3, 4, 5, and 6; the containment vault holding former Plating Tank 7 and caustic tanks; former floor trenches and drains; the hydraulic cylinder vault; and the drainage ditch. Additional monitoring wells will be installed in the unconfined alluvial water-bearing zone (WBZ) and the confined sand and gravel WBZ (also referred to as the advanced outwash WBZ). Following development of

the new monitoring wells, groundwater monitoring will be conducted in both established and new wells at the site.

The SAP is meant to ensure that reliable data about physical, environmental, and chemical conditions at the site are obtained in support of the development of remedial actions at the site if these are necessary to protect human health and the environment. It provides a consistent set of procedures that will be used throughout the various work phases identified in the work plan. If a phase of work or otherwise unforeseen change in methodology requires modification to the SAP, an addendum may be prepared that describes the specific revision(s), or the revisions will be documented in the RI report. Procedures are provided that will be used to direct the investigation process so that the following conditions are met:

- Data collected are high-quality, representative, and verifiable.
- Use of resources is cost-effective.
- Data are usable by Precision and Ecology to support selection and implementation of remedial actions, if necessary.

This SAP describes methods that will be used for sampling environmental media, decontaminating equipment, and managing investigation-derived waste. It also includes procedures for collecting, analyzing, evaluating, and reporting useful data. The SAP includes all currently foreseen analytical methods that may be used for analyzing environmental samples. The document includes quality assurance (QA) procedures for field activities, sampling QA and quality control (QC) procedures, and data validation.

2 ACCESS AND SITE PREPARATION

2.1 Site Access

MFA personnel will notify Precision's site coordinator and the Ecology project manager before beginning each phase of work at the site. Access to the facility by the employees, agents, and contractors of Ecology is allowed at all reasonable times for the purpose of overseeing work performed under the VCP. While on site, Ecology personnel will be escorted by MFA or Precision personnel or Precision's designated agent.

2.2 Site Preparation and Coordination

Before sampling begins at the site, public and private utility locating services and other information sources will be used to check for underground utilities, structures, or pipelines near each boring location. MFA will coordinate fieldwork with the Precision site coordinator to define the locations of possible on-site utilities and piping, or other subsurface obstructions. Before borings are completed in the drainage ditch, vegetation in the areas of the borings will be cleared to gain access. Ecology will be notified a minimum of five working days before site activities begin.

3 SOIL AND GROUNDWATER EXPLORATION TECHNIQUES

Exploratory borings and monitoring wells will be used to evaluate the nature and extent of potential surface and subsurface-soil and groundwater impacts at the site. The proposed locations of soil borings and additional monitoring wells are shown on Figure 3 of the work plan.

Soil and groundwater samples may be collected using three different exploration techniques. If possible, a truck-mounted hydraulic push-probe (Geoprobe™) unit will be used to advance all soil borings and collect soil samples. In the drainage ditch, a hand auger will be used to collect soil samples. It is anticipated that a hollow-stem auger (HSA) rig will install the monitoring wells for groundwater sampling. Additional details are provided below.

3.1 Geoprobe Borings

Continuous soil samples will be collected with the Geoprobe, using a closed-piston sampling method. Sampling will be completed as follows: coring will start at the surface with a 48- or 60-inch-long, 1.5-inch inside-diameter (i.d.) stainless-steel macrocore sampler equipped with a new acetate liner and a piston tip. The sampler will then be pushed to the top of the desired sample depth. The piston tip will be pulled back to the surface, and the macrocore sampler will then be driven 48 or 60 inches to collect the sample. If loose or saturated soils are encountered, a basket retainer will be placed inside the shoe of the macrocore sampler. When the macrocore sampler has been extracted, the acetate liner will be removed and cut open, exposing the soil sample. This procedure will be repeated until the boring is completed.

Soil samples will be collected with the Geoprobe, as described in Section 4. Borings to collect soil samples will be advanced to 15 feet below ground surface (bgs) and/or the water table, whichever occurs first.

3.2 Hand-Auger Borings

Hand-auger borings will be advanced in the drainage ditch. Before the borings are completed, the vegetation in the areas of the borings will be cleared to allow access to the drainage ditch. A decontaminated stainless-steel hand auger will be advanced to 1 foot

bgs to collect the soil samples. Soil samples will be collected with the Geoprobe, as described in Section 4.

3.3 Hollow-Stem Auger

An HSA drill rig will be used to construct monitoring wells on the site. The boreholes will be advanced with 4.25-inch i.d. (8½-inch outside-diameter) augers. If possible, soil samples will be collected at 2.5-foot intervals, using a 2-inch-i.d., 2.5-foot-long (possibly 2-foot-long) split-barrel sampler. The existing and proposed monitoring-well locations are shown on Figure 3 of the work plan. The wells completed in the unconfined alluvial WBZ are estimated to have completion depths of approximately 20 feet bgs, and the wells completed in the advanced outwash WBZ are estimated to have completion depths of approximately 40 feet bgs. The actual depths of installation for the monitoring wells will be based on observations made in the field.

3.3.1 Monitoring Well Installation

Monitoring wells will be constructed as described below.

- Monitoring wells will be constructed with 2-inch polyvinyl chloride (PVC) schedule-40 riser pipe and 10-foot-long screened sections. The well screens will consist of 0.010-inch machine slots.
- The screen filter pack will consist of graded 10 x 20 washed silica sand and will extend a maximum of 1 foot below the bottom of the screen and 3 feet above the top of the screen. A weighted line will be used to monitor the level of the filter pack during installation. The filter pack will be surged in approximate 6-foot lifts during installation.
- Bentonite grout or chips (0.75-inch minus) will be used to seal the annulus above the filter pack. Potable from a municipal supply will be used. A weighted line will be used to measure the top of the bentonite chips as they are poured into place.
- Each wellhead will be completed with a flush-mount monument approximately -inch to 2 inches above the ground surface. If flowing artesian conditions are encountered during the installation of the two deeper monitoring wells, then the monitoring wells will be completed with an aboveground monument with three traffic bollards and will be secured with a lockable steel monument set in concrete.

- At least 24-hours after completion of the wells, MFA will develop the wells by surging, bailing, and pumping to remove sediment that may have accumulated during installation and to improve the hydraulic connection with the WBZs. A minimum of five well-bore volumes of water will be removed during development.

- Specific conductance, pH, temperature, and turbidity will be measured periodically during well development. The wells will be developed until the sediment content is 10 nephelometric turbidity units (NTUs) or less, or until there is no noticeable decrease in turbidity; and specific conductance stabilizes to within 10 percent of the previous reading, pH is within 0.1 standard unit of the previous reading, and temperature is within 0.1 degree Celsius of the previous reading.

3.4 Boring Decommissioning

After each boring is completed, it will be decommissioned with bentonite chips or with cement grout in accordance with the WAC for Minimum Standards for Construction and Maintenance of Wells (WAC 173-160, 1998). The boreholes will be abandoned by filling them with bentonite chips, granules, or grout slurry through the Geoprobe rod as they are removed. When the top of the bentonite chips or granules has been brought above the static water level, water will be added to hydrate the bentonite chips or granules. The volume required to fill the borehole and the actual amount of bentonite chips, granules, or grout added will be recorded on a standard MFA boring log (see Appendix A-1).

3.5 Exploratory Boring Logging and Documentation

A log of soil samples from each boring will be prepared in the field by a geologist/hydrogeologist or engineer licensed in the state of Washington or working under the direct supervision of a geologist/hydrogeologist or engineer licensed in the state of Washington. Boring logs will include the project name and location, name of the drilling contractor, drilling method, sampling method, soil sample depths, blow counts, and description of soil encountered. Soil samples will be described using American Society for Testing and Materials designation D2488-00, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures).* The standard involves describing color, grain size, moisture content, density, organic matter, and other observed characteristics. The information will be recorded on the MFA boring log shown in Appendix A-1.

3.6 Surveying

Borings and monitoring wells will be surveyed for ground-surface elevation (to the nearest 0.1 foot) and horizontal location (to the nearest 1 foot) by a surveyor licensed in the state of Washington. Additionally, the tops of the monitoring-well casings will be measured to the nearest 0.01 foot.

4 SOIL SAMPLING

During Geoprobe drilling, continuous soil samples will be collected in acetate liners, using a closed-piston sampling method, as described in Section 3.1. During HSA drilling, subsurface soil samples will be obtained from a 2.5-foot-long, split-barrel sampler. During hand-auger drilling, continuous soil samples will be collected and removed from the hand auger into a decontaminated stainless-steel bowl. Soil samples will be collected during drilling for lithologic description, field screening, and chemical analyses, as described below. The sampling interval and depth are specified in the work plan.

4.1 Procedure

Before soil samples are collected for chemical analyses, the sample-collection device will be decontaminated according to the procedures described in Section 6. After the sampling device is retrieved from the borehole, it will be placed on clean plastic sheeting before it is opened. New disposable gloves will be used before the collection of each sample. Sample collection and handling will be consistent with procedures described below and in other sections of this SAP. Samples will be prepared, handled, and documented as follows:

- Soil sampling equipment will be decontaminated before it is used at each sampling location (see Section 6).
- Samples will be obtained from intervals specified in the work plan, using a gloved hand or decontaminated stainless-steel spoon, trowel, or knife.
- Soil that will be analyzed for volatile organic compounds (VOCs) will be transferred directly from freshly exposed soil into laboratory-supplied containers, using the appropriate 5035A sampling procedures. The samples will be collected with a new 5-milligram (mg) sampler and placed in 40-milliliter (ml) volatile organic analysis (VOA) vials. Three pre-tarred VOA vials will be collected, two with 5 mg of soil and preserved with sodium bisulfate monohydrate ($NaHSO_4 \cdot H_2O$) and one with 10 mg of soil and preserved with methanol (CH_4O). A soil jar with a minimum 4-ounce capacity will accompany the VOA vials to calculate water content.

- Soil samples that will be analyzed for constituents other than VOCs will be obtained from intervals specified in the work plan or at the discretion of the field geologist or engineer, using a gloved hand or decontaminated stainless-steel spoon, then placed in a stainless-steel bowl for removing coarse-grained material, if necessary.

- Coarse-grained particles (larger than 0.25 inch) may be removed before the sample is placed in a laboratory-supplied container. The amount of coarse-grained material will be recorded on the soil field sampling data sheet (FSDS; see Attachment A-2).

- The percentage of coarse-grained material (larger than 0.25 inch) to fine-grained material (smaller than 0.25 inch) will be estimated.

- Soil samples will be transferred directly from the sampling device or stainless-steel bowl into laboratory-supplied glass jars, using a gloved hand or decontaminated stainless-steel spoon, trowel, or knife.

- Filled containers will be labeled, packed in iced shipping containers with chain-of-custody (COC) documentation (see Section 10), and delivered to the contract laboratory.

- Sampling information will be recorded in a field notebook, on an FSDS, and on the COC form.

- QC groundwater samples will include at least one duplicate sample for every 20 samples collected.

4.2 Nomenclature

Soil samples will be labeled with a prefix to describe the type of sampling, a location identification number, and sample depth. For example, a soil sample collected from a Geoprobe boring at location 12 and at 20 feet bgs will have the sample number GP12-S-20.0. Prefixes for the type of sampling are as follows:

GP = Geoprobe
MW = HSA boring for monitoring-well installation
HA = Hand auger

Duplicate soil samples will replace the location number with "-DUP" and the sample will have the same sample time as the primary sample. A duplicate sample of the above-mentioned sample would appear as GP-DUP-S-20.0.

The depth interval will be specified as the middle of the sampling interval. Samples will be documented on an FSDS (see Appendix A-2) and the exploratory boring log (see Appendix A-1). The sample interval and the amount of material recovered will be recorded on the boring log.

4.3 Laboratory Analyses for Soil Samples

Soil samples will be analyzed for the parameters specified in the work plan, using the following methods:

Analysis	Method
VOCs	U.S. Environmental Protection Agency (USEPA) 8260B (prep. method 5035A)
Hexavalent chromium	USEPA 7196A
Total metals	USEPA series 6010B/7000
Gasoline-range organics (GROs)	Northwest total petroleum hydrocarbons (NWTPH)-Gx
Diesel-range and oil-range organics (DROs and OROs)	NWTPH-Dx
Polycyclic aromatic hydrocarbons (PAHs)	USEPA 8270C selected ion monitoring (SIM)
Extractable petroleum hydrocarbons	USEPA 8015/8021M
Volatile petroleum hydrocarbons	USEPA 8015M

5 GROUNDWATER MONITORING

5.1 Water-Level Monitoring

Depth-to-water measurements will be collected in site monitoring wells (shown on Figure 3 of the work plan), using an electronic water-level indicator. Before water levels are measured, the water-level indicator will be decontaminated as specified in Section 6. Levels will be measured to the nearest 0.01 foot from a surveyed notch or mark at the top of the PVC casing. MFA will convert measurements to an elevation relative to the surveyed datum. Water levels, as well as the date, time, reference point, and initials of the sampler, will be recorded on a water-level form or FSDS (see Appendix A-2). Measurements from each well will be collected as quickly as possible during each monitoring event to reduce the potential for external factors (e.g., rainfall or barometric pressure) to affect water levels. The groundwater elevations will be used to estimate the horizontal and vertical groundwater flow direction under the site.

5.2 Groundwater-Sample Collection

Groundwater-sampling methods are designed to obtain samples that are representative of in-situ groundwater quality. Samples will be collected according to the schedule provided in the work plan.

5.2.1 Procedures

Groundwater-sample collection and handling will be consistent with procedures described below and in other sections of this SAP. The monitoring wells will be sampled as follows:

- The depth to water will be measured with an electronic water-level indicator. The results will be recorded on an FSDS.
- Before sampling, at least three well-casing volumes will be purged from the well, using low-flow purging techniques (less than 0.25 gallons per minute) with a peristaltic pump or submersible pump.

- After each casing volume is removed, field parameters (e.g., pH, specific conductance, turbidity, and temperature) will be measured with portable meters calibrated according to manufacturers' specifications. Data will be recorded on an FSDS. The well will be purged until specific conductance measurements stabilize to within 10 percent of previous measurements, pH measurements stabilize to within 0.1 standard units of previous measurements, and turbidity is below 10 NTUs.

- If a well purges dry, the well will be allowed to recharge for no more than 24 hours before a sample is collected. At least one well-casing volume will be removed from each well before a sample is collected.

- Groundwater samples will be collected directly from the peristaltic or submersible pump discharge line, as appropriate. Each groundwater sample will be collected using the peristaltic or submersible pump equipped with new tubing. Other, nondedicated, groundwater-sampling equipment will be decontaminated before and after collection of each groundwater sample (see Section 6).

- Samples collected for hexavalent chromium, DRO, ORO, and PAH analyses will be transferred directly from the sampling equipment to laboratory-supplied containers.

- Samples collected for dissolved hexavalent chromium and dissolved priority pollutant metal (antimony, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, silver, thallium, and zinc) analyses will be filtered using 0.45-micron, in-line filters. The filters will be attached directly to the peristaltic or submersible pump discharge line. Filters will be used only once.

- After sampling is complete and the peristaltic pump tubing or submersible pump has been removed from the well, the VOC sample will be collected with a new double-checked, polyethylene, disposable bailer. The bailer will be lowered slowly to the midpoint of the screened interval. After the bailer is removed slowly, a bottom-emptying device is used to transfer the water directly into hydrochloric-acid-preserved, 40-ml VOA vials.

- Field activities and sampling data (well-purging data, type of container used for each sample, and preservatives used) will be recorded on a water FSDS (see Appendix A-2). Any deviations from the general procedures will be noted on field records and will be brought to the attention of the MFA project manager.

- Samples will be labeled, properly preserved, placed in iced shipping containers with COC documentation, and shipped to the contract laboratory.

- QC groundwater samples will include at least one duplicate sample for every 20 samples, one trip blank for every set of VOC samples transported to the contract laboratory, and one equipment rinsate blank for every 20 samples collected with nondedicated equipment.

5.2.2 Nomenclature

Groundwater samples will be labeled with a location-identification number and a six-digit representation of the date. For example, a groundwater sample collected from monitoring well MW-1 on February 23, 2005, will have the sample number MW1-022305. Duplicate groundwater samples will have the same sample time as the primary sample but the label will begin with "MW-DUP-," followed by the six-digit representation of the date. Samples will be documented on an FSDS (see Appendix A-2).

5.2.3 Laboratory Analyses for Groundwater Monitoring

Groundwater samples and associated QC samples will be analyzed for the parameters specified in the work plan, using the following methods:

Analysis	Method
13 priority pollutant metals	USEPA series 6010B/7000
Hexavalent chromium	USEPA 7196A
DROs and OROs	NWTPH-Dx
VOCs	USEPA 8260B
PAHs	USEPA 8270C SIM

6 EQUIPMENT-CLEANING AND -DECONTAMINATION PROCEDURES

Decontamination procedures are specified for the various types of fieldwork conducted. The objective for decontamination is to reduce the likelihood of cross-contaminating samples.

6.1 Drilling Equipment

The working area of the drill rig (e.g., Geoprobe, HSA) and all downhole drilling equipment will be steam-cleaned or hot-water pressure-washed both after arrival on site and after use in each borehole. The drilling equipment will be thoroughly cleaned before it leaves the site. The drilling rig and equipment will be cleaned in a designated area of the site. Decontamination fluids will be transferred to 55-gallon drums and managed according to the procedures outlined in Section 7.

6.2 Soil-Sampling Equipment

Sampling equipment and reusable materials that contact the soil will be decontaminated on site and between sampling locations. Decontamination will consist of the following:

- Tap-water rinse (may consist of high-pressure, hot-water rinse)
- Non-phosphatic detergent wash, consisting of a dilute mixture of Liqui-Nox and tap water (visible soil to be removed by scrubbing)
- Tap-water rinse
- Distilled-water rinse
- Methanol-solution rinse (1:1 solution with distilled water)
- Final distilled-water rinse

The thoroughness of equipment decontamination will be verified through the use of equipment rinsate blanks, as specified in Section 8.

6.3 Groundwater-Sampling Equipment

Groundwater-sampling equipment includes items used during monitoring-well sampling (see Section 5). Groundwater-sampling equipment will be decontaminated before its first use and between sampling locations. Decontamination will consist of the following:

- Distilled-water rinse
- Nonphosphatic detergent (e.g., Liqui-Nox) and water wash
- Distilled-water rinse
- Dilute methanol-solution rinse (1:1 solution with distilled water)
- Final distilled-water rinse

Liquid generated by decontamination will be properly handled, according to procedures specified in Section 8.

6.4 Water-Level Monitoring Equipment

Before the electronic water-level meter is used at the site, the entire reel of water-level line will be decontaminated as described below. The portion of the water-level meter that enters the water (the tip) and a 5-foot section above it will also be decontaminated after its use in each well. Equipment will be decontaminated in the following sequence:

- Nonphosphatic detergent wash
- Distilled-water rinse

7 INVESTIGATION-DERIVED WASTE MANAGEMENT

Residual soils, groundwater, and decontamination fluids will be handled as specified below. Generally, material will be placed in 55-gallon, Washington State Department of Transportation (DOT)-approved steel drums. Drums (tops and sides) will be labeled with their contents, the volume of material, the date of collection, and the origin of the material. The waste drums will be sealed, secured, and transferred to a designated, secured area on the site at the end of each workday. The waste will be stored in a designated holding area until it has been characterized. Hazardous-waste and/or risk labels will be placed on the drums after designation, if necessary.

After fieldwork is completed and analytical results are received, residual soils and liquids will be evaluated and disposed of appropriately. Precision will be responsible for profiling and disposing of the wastes, consistent with Ecology regulations.

7.1 Soil Cuttings

Soil cuttings originating from drilling will be contained in 55-gallon, DOT-approved drums and stored in a designated storage area at the site. Each drum will be labeled to include a waste-management drum number, the source of the soil, and sample-collection date and time. Hazardous-waste and/or risk labels will be placed on the drums after designation, if necessary.

7.2 Groundwater

Purge water generated during drilling and monitoring-well sampling will be contained in 55-gallon, DOT-approved drums in a designated area on site, pending analytical results. Each drum will be properly secured and labeled. The label will include a waste-management drum number, the source of the water, and sample-collection date and time. Hazardous-waste and/or risk labels will be placed on the drums after designation, if necessary.

7.3 Decontamination Water

Water generated by equipment decontamination will be properly handled. Decontamination water will be contained and transferred into 55-gallon, DOT-approved drums with sealable lids. Each drum will be properly secured and labeled. The label will include a waste-management drum number, the source of the water, and sample-collection date and time. Hazardous-waste and/or risk labels will be placed on the drums after designation, if necessary.

7.4 Other Waste

Other waste generated during field operations (e.g., acetate macrocore liners, gloves, plastic) will be contained in 55-gallon, DOT-approved drums and stored in a designated storage area at the site. Each drum will be labeled to include a waste-management drum number, the source of the soil, and sample-collection date and time. Hazardous-waste and/or risk labels will be placed on the drums after designation, if necessary.

8 DATA QUALITY OBJECTIVES

The overall QA objective is to collect acceptable data of known and usable quality. This objective will be achieved and documented using the procedures and criteria set forth in the SAP. For each measurement made to obtain quantitative data, the following quality objectives will be used to aid in collecting usable data.

8.1 Preliminary Indicator Hazardous Substances

Based on historical activities and the results of the June 2005 investigation, MFA has identified the following preliminary indicator hazardous substances for soil and groundwater at the site or in the drainage ditch south of the site:

- Metals (hexavalent chromium and the 13 priority pollutants)
- Total petroleum hydrocarbons (GROs, DROs, and OROs)
- VOCs
- PAHs

8.2 Laboratory Test Methods and Reporting Limits

In accordance with the QA/QC requirements set forth in this SAP, North Creek Analytical, Inc. (NCA) of Bothell, Washington, will perform the analyses listed in Table A-1, using SW-846 methods (USEPA, 1986) unless otherwise noted (as discussed in Section 5).

Table A-1 summarizes the method reporting limit (MRL) goals for these methods and the most stringent MTCA CULs for reference only. Based on the most stringent MTCA CULs, there is one VOC analyte (TCE) in soil for which the MRL is higher than the CUL, and five VOC analytes (1,2-dibromo-3-chloropropane; 1,2-dibromoethane; 1,1,2,2-tetrachloroethane; TCE; and vinyl chloride) in groundwater for which the respective MRLs are higher than the respective CULs.

8.3 PARCC Definitions and Objectives

Typically, data quality objectives (DQOs) are categorized under precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. Routine analytical procedures used for measuring precision and accuracy will include duplicate analyses, standard reference materials, surrogate spikes, matrix spikes (MSs), method blanks, and laboratory control samples (LCSs). Surrogate spikes, MSs, method blanks, and LCSs (blank spikes) will be analyzed at the minimum frequencies specified below. Additional spikes and duplicate analyses may be performed. For the purposes of laboratory analysis, a sample "batch" is considered to be 20 or fewer samples of a single matrix that are extracted or prepared together or are received in the same shipment.

- Surrogate spikes: every sample analyzed for organic compounds will be spiked with selected non-target analytes and analyzed to evaluate laboratory performance on individual samples.

- MSs and matrix spike duplicates (MSDs): one of every 20 samples will be spiked with selected target analytes and analyzed. MSs will be analyzed for inorganic analytes, and both MSs and MSDs will be analyzed for organic analytes. If fewer than 20 samples are analyzed, at least one sample per matrix will be spiked.

- Method blank: a method blank will be analyzed at a frequency of 5 percent of the total number of samples (i.e., one of every 20 samples), one per batch of samples, or one per day, whichever is greater.

- LCSs and LCS duplicates (LCSDs): one of every 20 samples will be spiked with selected target analytes and analyzed. An LCS will be analyzed for inorganic analytes, and both LCSs and LCSDs will be analyzed for low-concentration, organic analytes in water. If fewer than 20 samples are analyzed, at least one LCS per matrix will be analyzed.

PARCC parameters used for field measurements are generally not consistent in the relevant guidance documents. These parameters have been defined using the best available guidelines to establish field measurement QA objectives, and will be followed as closely as possible.

8.3.1 Precision

Precision is the degree of agreement between replicate measurements of the same source or sample. Duplicate measurements can be made on the same sample or on two samples from the same source. Precision is generally assessed by duplicate measurements of a subset of samples (laboratory or field duplicate samples). The analytical methods define

the percentage of the samples being analyzed for which precision must be assessed. This percentage is defined in the laboratory QA manual, included in Appendix A-3.

For comparing field duplicate analyses, MFA uses a factor of five if the results are less than five times the MRL, or a factor of two if the results are greater than five times the MRL. Acceptable laboratory duplicate precision limits are based on historical data sets, as defined by the USEPA. Laboratory duplicates will be obtained for each set of samples submitted, and will be tested for inorganic analytes only (USEPA, 1994a).

The relative percent difference is calculated as follows:

$$RPD = \frac{(c_1 - c_2) \times 100}{c}$$

where

RPD = relative percent difference

c_1 = concentration of an analyte in a sample

c_2 = concentration of an analyte in a duplicate sample

c = $(c_1 + c_2)/2$

Acceptable precision limits are based on historical databases, as defined by the USEPA. Laboratory duplicates will be obtained for each set of samples submitted, and will be tested for inorganic analytes only (USEPA, 1994a). Field duplicates will be evaluated similarly.

8.3.2 Accuracy

Accuracy measures the level of bias exhibited by an analytical method or measurement. To measure accuracy, a substance with a known value is analyzed or measured, and the result is compared with the known value.

The accuracy of laboratory analysis is assessed by measuring standard reference materials (instrument calibration) and spiked samples (surrogate recoveries, MSs, and LCSs). Standard reference materials are used to calibrate laboratory instruments. The analytical method specifies the frequency and accuracy required for a spiked sample analysis.

Spike recovery is determined by splitting a sample into two portions, spiking one portion with a known quantity of a constituent of interest, and analyzing both portions. Spike recovery is expressed as percent recovery:

$$\text{Percent Recovery} = \frac{(MC - KC)}{KC} \times 100$$

where

MC= known concentration of an analyte
KC= measured concentration of an analyte

Acceptable MS recovery limits are based on historical data sets, as defined by the USEPA methods. Acceptable surrogate recoveries for organic analyses are based on limits calculated by the laboratory, as described in the analytical method.

The accuracy of field measurements is a function of instrument and procedure. Instrumentation and procedures that are described in Appendix A-3 meet or exceed current industry standards.

8.3.3 Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of the population, the natural variation at a sampling point, or an environmental condition. There is no standard method or formula to evaluate representativeness. Specific SAPs are designed to allow collection of representative samples. Representativeness is achieved by selecting sampling locations that are appropriate for the objective of the specific sampling task, and by collecting an adequate number of samples.

8.3.4 Completeness

Completeness is commonly expressed as a percentage of measurements that are valid and usable relative to the total number of related measurements. Completeness criteria between 80 to 85 percent are identified in the USEPA's QA/QC guidance (USEPA, 1987) and will be used to determine the adequacy of the results. The percent completeness is defined by the following equation:

$$\text{Percent completeness} = \frac{N \times 100}{N_t}$$

where

N = number of samples that meet data quality goals
N_t = total number of samples analyzed

8.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. The use of standard techniques for both sample collection and laboratory analysis should make the data collected comparable to other data generated.

8.4 Quality-Assurance Samples

QA samples will be collected in the field, as specified in this SAP. Samples will include field equipment rinsate blanks and field duplicates. QA samples will be blind-labeled and preserved as if they were typical samples. QA samples will be clearly identified on the FSDSs (see Appendix A-2). Analytical results from the blanks and duplicates will facilitate data QC checks. Results will be evaluated by applying the PARCC criteria, and the evaluation will be discussed in the data-validation report.

8.4.1 Equipment Rinsate Blanks

Equipment rinsate blanks are another type of field blank. They will be obtained after nondedicated sampling equipment is decontaminated, and will involve passing deionized water through the sampling equipment and transferring the water into an appropriate sample container. Rinsate blanks will not be collected if single-use or dedicated equipment (e.g., bailers or tubing) is used for sampling. Rinsate blanks will be analyzed to determine whether decontamination of sampling equipment is adequate. One equipment rinsate blank will be collected for every 20 samples collected with nondedicated equipment, and at least one will be collected for each sampling event or more frequently, if appropriate.

8.4.2 Field Duplicates

Duplicate soil samples will be collected to assess sampling precision and analytical procedures. Duplicate samples will be obtained by alternately filling laboratory-supplied sample bottles for the two samples (original and duplicate). Duplicate samples are used to evaluate the precision of sample collection and laboratory analysis. One field duplicate sample will be collected for every 20 samples collected, or a minimum of one sample per sampling event.

9 FIELD SAMPLING QUALITY-ASSURANCE PROCEDURES

This section briefly describes how samples will be documented, handled, preserved, and shipped. Specific information as to how many samples will be collected and measured, the frequency of sampling, the target compounds to be analyzed, and analytical methods are specified in the work plan or in other sections of this SAP. Field modifications to SAP procedures will be documented in field notes and/or on FSDS sheets.

9.1 Work Documentation

The following data forms will be used for documenting specific field observations and conditions (see Appendices A-1 and A-2)

- Log of exploratory boring
- Soil FSDS
- Water FSDS

The following information will be recorded on the FSDS for each sample collected:

- Facility name
- Sample number
- Sampler's name
- Sample location (well, boring, or sample number)
- Sampling depth
- Sampling date and time
- Sampling method
- Composite or discrete sample
- Sample container size and material
- Sample preservative
- Climatic or other noteworthy conditions (e.g., nearby activities)
- Problems encountered with equipment or method
- Number of sample bottles filled
- Laboratory used

General field observations will be recorded in a field notebook.

9.2 Sample Containers, Preservation, and Handling

9.2.1 Preservation and Sample Containers

Sample containers will be supplied by the laboratory for each sampling event, and will include the appropriate preservatives (see Table A-2).

9.2.2 Sample Packaging and Shipping

To ensure that the laboratory has ample time to complete all analyses within holding-time requirements, and to reduce the potential for field degradation of samples, the samples will be shipped from the field to NCA a minimum of every two days. Holding times for specific analytical methods are included in Table A-2. Samples will be stored at 4° Celsius (as measured with a thermometer) in iced shipping containers or a refrigerator designated for samples, and then transported to NCA in iced shipping containers with a custody seal affixed.

10 SAMPLE-CUSTODY PROCEDURES

This section provides information about sample-labeling and -custody procedures.

10.1 Sample Labeling

Sample container labels will clearly indicate:

- Sample locations
- Sample number
- Depth at which sample was collected
- Date and time of sample collection
- Sampler's initials
- Any pertinent comments such as specifics of filtration or preservation

Labels will be filled out at the time of sampling. Sample-labeling information will also be recorded on the FSDS and in a field notebook.

10.2 Sample Custody

Sample custody will be tracked from point of origin through final analysis and disposal using a COC form (see laboratory QA manual in Appendix A-3), which will be filled out with the appropriate sample/analytical information as soon as possible after samples are collected. For purposes of this work, custody will be defined as follows:

- Inside a cooler that is in plain view of an MFA field representative
- Inside any locked space such as a cooler, locker, car, truck, or building

The following items will be recorded on the COC form:

- Project name
- Project number
- MFA project manager

- Sampler's name
- Sample number, date and time collected, media, number of bottles submitted
- Requested analyses for each sample
- Shipment method
- Type of data package required (Tier II in most cases)
- Turnaround requirements
- Signature, printed name, organization name, date, and time of transfer of all persons having custody of samples
- Additional instructions or considerations that would affect analysis (nonaqueous layers, archiving, etc.)

Persons in possession of the samples will be required to sign and date the COC form whenever samples are transferred between individuals or organizations. The COC will be included in the shipping containers with the samples, and the containers will be sealed with a laboratory custody seal. The laboratory will implement its in-house custody procedures, which begin when sample custody is transferred to laboratory personnel.

If samples are shipped via air or ground transportation (by a third party), the following custody procedures will be followed. Samples will be packed in shipping containers, and a custody seal will be placed on the container to reduce the potential for tampering. Proper shipping insurance will be requested and the top two copies of the COC form will accompany the samples. The person who arranges the sample shipment (typically the sampler or the project manager) will retain a third copy of the COC and shipping forms to allow sample tracking. The COC form will accompany the samples from point of origin in the field to the laboratory.

At NCA, a designated sample custodian will accept custody of the received samples and will verify that the COC form matches the samples received. The shipping container or set of containers is given a laboratory identification number, and each sample is assigned a unique sequential identification number that includes the original shipping container identification number.

Specific procedures for sample handling, storage, and dispersal for analysis are addressed in the NCA laboratory QA manual (see Appendix A-3).

11 EQUIPMENT-CALIBRATION AND -MAINTENANCE PROCEDURES

11.1 Laboratory Instrumentation

Specific laboratory instrument calibration procedures, frequency of calibration, and preparation of calibration standards will be according to the method requirements as developed by the USEPA, following procedures presented in SW-846 (USEPA, 1986). A copy of the NCA laboratory standard operating procedures is included in the laboratory QA manual in Appendix A-3.

11.1.1 Laboratory Calibration and Preventive Maintenance

The laboratory calibration ranges specified in SW-846 (USEPA, 1986) and in the method standard operating procedures (see laboratory QA manual, Appendix A-3) will be followed.

Preventive maintenance of laboratory equipment will be the responsibility of the laboratory personnel and analysts. This maintenance includes routine care and cleaning of instruments, and inspection and monitoring of carrier gases, solvents, and glassware used in analyses. The preventive-maintenance approach for specific pieces of equipment will follow the manufacturers' specifications and good laboratory practices. Maintenance will be documented in the instrument logbooks.

Precision and accuracy data will be examined for trends and excursions beyond control limits to determine evidence of instrument malfunction. Maintenance will be performed when an instrument begins to change, as indicated by the degradation of peak resolution, shift in calibration curves, decrease in sensitivity, or failure to meet any of the QC criteria.

12 LABORATORY QUALITY-CONTROL PROCEDURES

Samples will be analyzed by NCA in Bothell, Washington. NCA is qualified to perform the analyses, using standard, documented laboratory procedures. NCA has QA/QC plans and standard operating procedures that provide data-quality procedures according to the protocols for the analytical method and cleanup steps. The data-quality procedures are at a level sufficient to meet the sampling program's DQOs. NCA will perform, document, and report laboratory procedures, as described in its QA manual (see Appendix A-3).

The analytical methods and references for analyses that may be used during project implementation are summarized in Table A-2. Procedural details not specified in this SAP will follow the protocols described in SW-846 (USEPA, 1986).

12.1 Internal Quality-Assurance/Quality-Control Checks

The laboratory will demonstrate its ability to produce acceptable results using the recommended methods or their equivalent. The following criteria will be used internally by the laboratory to evaluate the data (as appropriate for inorganic or organic chemical analyses):

- Performance on test methods
  - MS
  - Gas chromatograph (tailing factors)
  - Blanks
  - Precision of calibration and samples
- Percentage recovery of surrogates (organics)
- Adequacy of reporting limits
- Precision of replicate sample analyses
- Comparison of percentage of missing or undetected substances between replicate samples

Laboratory records of standard calibration curves and all other pertinent data will be held for possible inspection at the laboratory, and will be made available on request.

12.2 Quality-Control Procedures

The laboratory QC procedures will consist of the following:

- Instrument calibration and standards as defined in the SW-846 manual for organic and inorganic analyses (USEPA, 1986)
- Laboratory blank measurements at a minimum of 5 percent or one per 20 frequency
- Data reports, including appropriate QA/QC documentation

12.3 Data Deliverables

Laboratory data deliverables required for inorganic-compound analyses are listed in Table A-3. Data deliverables for organic analyses are listed in Table A-4. Data will be recorded on standard data sheets. Electronic deliverables in Microsoft Access database format will accompany standard hard-copy reports.

13 DATA REDUCTION, VALIDATION, AND REPORTING

The laboratory performing sample analyses will be required to submit analytical data supported by sufficient QA information to permit independent and conclusive determination of data quality. Data quality will be determined by MFA, using the data-validation procedures described in this section. The results of the MFA evaluation will be used to determine if the project DQOs have been met.

13.1 Laboratory Evaluation

Initial data reduction, evaluation, and reporting at NCA will be carried out as described in appropriate sections of USEPA manuals for organic and inorganic analyses (USEPA, 1994a and 1994b), NWTPH Methods (Ecology, 1997), and SW-846 (USEPA, 1986), as appropriate. Additional laboratory data qualifiers may be defined and reported to further explain the laboratory's QC concerns about a particular sample result. All additional data qualifiers will be defined in the laboratory's case-narrative reports associated with each case.

13.2 MFA Evaluation

13.2.1 Validation

After MFA receives the analytical data, the data will be validated under the supervision of the project QA coordinator. MFA will examine the data for precision, completeness, accuracy, and adherence to standard operating procedures. The laboratory will perform internal QC checks, and MFA will validate laboratory analytical data, as described in the following sections. QC checks will be performed on laboratory information, using the sample log-in reports faxed to MFA after samples are entered into the laboratory information-management system. The reports will be assessed early in the process, which will allow QC checks to begin before sample holding times have expired or before errors are incorporated into the laboratory reports.

Validation Procedures. Laboratory analytical data will be reported in a Tier II format to facilitate data validation. The items reported by the laboratory in a Tier II package include those listed in Tables A-3 and A-4. MFA will review data and assign data

qualifiers to sample results, following appropriate sections of the USEPA procedures for inorganic data (USEPA, 1994a), organic data (USEPA, 1994b), and method-specific guidelines outlined in SW-846.

Data qualifiers are used to classify sample data as to their conformance to QC requirements. The most common qualifiers are listed below:

- J—Estimate, qualitatively correct but quantitatively suspect
- R—Reject, data not suitable for any purpose
- U—Not detected at a specified reporting limit

The sample data may be qualified due to poor surrogate recovery, blank contamination, or calibration problems. The reasons for the qualification of the data will be stated in the data-validation report.

QC criteria not defined in the guidelines for evaluating analytical data are adopted, where appropriate, from the analytical method.

For inorganic and organic analyses, the following information will be reviewed during data validation:

- Sampling locations and blind sample numbers
- Sampling dates
- Requested analysis
- Laboratory service request number(s)
- COC documentation
- Sample preservation
- Holding times
- Method blanks
- Surrogate recoveries (organic analyses only)
- MS results (inorganic analyses only)
- MS/MSD analyses (organic analyses only)
- Laboratory duplicates (inorganic analyses only)
- Field duplicates (if submitted)
- LCS (organic analyses only)
- MRLs above requested levels
- Any additional comments or difficulties reported by the laboratory
- Overall assessment

The results of the data-validation review will be summarized for each batch of samples. Data qualifiers will be assigned to sample results on the basis of USEPA guidelines. The data-validation reports will summarize the precision and accuracy for the samples. The

quality of the analytical data, as defined by precision and accuracy, will be assessed and compared to DQOs for the project.

The laboratory will routinely archive raw laboratory data, including initial and continuing calibration data, chromatograms, quantitation reports, blank sheets, and sampling logs, and will provide these data in addition to the deliverables listed above, if requested.

13.2.2 Reduction

Following data validation and assignment of data qualifiers, if any, the analytical data will be tabulated. The tabulation of analytical and field data, with the appropriate data qualifiers, will be stored on computer disk. A Microsoft Access database developed by MFA will be the primary tool for storing, organizing, and retrieving electronic data. Data may be further reduced and managed using the following computer software applications:

- Excel (spreadsheet)
- Access (database) or geostatistical database
- Word (word processing)
- Surfer (geostatistical contouring)
- Statistical applications using appropriate methods

As an extension of the data-evaluation program, data will be reduced to summarize particular data sets. In addition, statistical techniques may be applied to test results. These techniques will help assess the representativeness, comparability, precision, and completeness of the data sets. Reduced data sets will be used in reporting the overall accuracy of the assessment.

13.2.3 Reporting

After data collection, validation, and reduction have been completed, the data will be used in reports. Copies of the reports will be submitted to Precision for review and then submitted to Ecology. The original copy of reports that MFA produces will remain in MFA's project file.

14 PROTOCOL CORRECTIVE ACTIONS

The need for protocol corrective actions will be evaluated on an ongoing basis, depending on the results of internal and laboratory QC checks.

Corrective actions generally will result either from instrument failure or from nonconformance or noncompliance with QA requirements by the laboratory or field personnel. The MFA project manager will be notified as soon as practical if a field or laboratory QA problem arises that could jeopardize the use of collected data. All project personnel are responsible for reporting lapses in QA procedures.

During field operation and sampling procedures, field personnel will be responsible for reporting any changes to specified sampling procedures. A description of any such change will be entered in the daily field logbook and on FSDSs.

If QC audits result in detection of unacceptable conditions or data, the project manager, in conjunction with the project QA coordinator, will be responsible for implementing corrective actions. Specific corrective actions are outlined in each SW-846 method, or in NCA's QA manual (see Appendix A-3), and include, but are not limited to:

- Identifying the source of the violation
- Re-analyzing samples if holding time criteria permit
- Resampling and reanalyzing
- Evaluating and amending sampling and analytical procedures
- Accepting data and flagging to indicate the level of uncertainty

MFA will document all field, laboratory, or project corrective actions.

15 QUALITY-ASSURANCE REPORTS TO MANAGEMENT

The project manager will be given field and laboratory updates to ensure that the quality of the data meets the project's objectives. These updates will consist of communications, field-activity memoranda, daily field logs, and/or data-validation reports. These updates will provide a means for management to evaluate whether established QA/QC objectives have been met.

After a complete data package is received from NCA and MFA has completed the data-quality evaluation in accordance with this SAP, a summary report will be prepared and presented concurrent with laboratory results. The data-quality evaluation will summarize the overall quality of the chemical results in terms of the specific data-quality goals identified in this SAP, and will identify chemical results qualified by MFA.

Results of sample analyses will be transmitted to Ecology with a full data-validation report that indicates the usability of each reported value. Reports will be maintained in the project files and will include results of performance and system audits; periodic assessment of measurement data accuracy, precision, and completeness; significant QA/QC problems and recommended solutions; and resolutions of previously identified problems.

16 PROJECT ORGANIZATION AND RESPONSIBILITIES

Precision Project Coordinator—James Okel (Precision Engineering)

James Okel will be the project coordinator for Precision. Mr. Okel will be kept informed of the status of the project and the project work associated with the RI.

Legal Consultant—Christopher R. Hermann (Stoel Rives, LLP)

Christopher R. Hermann of Stoel Rives, LLP, is Precision's legal consultant. Mr. Hermann will assist with legal services and strategies for the project.

Project Director—James Maul

Mr. Maul will coordinate with project task leaders and will communicate with Precision as necessary. Mr. Maul will review all data, reports, and other project-related documents prepared by MFA before their submittal to Precision or Ecology. Mr. Maul will also assist task leaders with technical issues. Mr. Maul will participate in meetings and communications with Ecology.

Project Manager—Alan Hughes

Mr. Hughes will be responsible for managing overall completion of the RI activities, for writing and reviewing reports, and for regular communication of project status to the project director and the project manager for Precision.

Senior Engineer—Alistaire Clary

Ms. Clary will assist in writing and reviewing reports, and with communications to the project director and the project manager for Precision.

Project Quality Control Officer—Andrew J. Riddell

Mr. Riddell will be responsible for data evaluation and management, including generation of statistical parameters. Mr. Riddell will perform modeling tasks. Mr. Riddell will track field and laboratory samples. He will also ensure that sample collection, preservation, storage, transport, and COC procedures are followed. He will also ensure that MRLs are less than the screening criteria for each analyte, if achievable. Mr. Riddell will validate analytical data and inform the project manager when problems occur, and communicate and document corrective actions taken.

Analytical QA Officer—Jeff Gerdes (North Creek Analytical, Inc.)

Mr. Gerdes will ensure that NCA laboratory instruments are calibrated and maintained as specified, internal QC measures and analytical methods are performed, corrective action is taken and the project QA coordinator is notified when problems occur, and laboratory evaluation is complete and reported in the required deliverables.

Résumés for MFA personnel are included in Appendix A-4.

REFERENCES

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USEPA. 1994a. USEPA contract laboratory program national functional guidelines for inorganics data review. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/013. February.

USEPA. 1994b. USEPA contract laboratory program national functional guidelines for organics data review. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. EPA 540/R-94/012. February.

TABLES

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Volatile Petroleum Products by NWTPH-Gx in Soil												
NWTPH-Gx	Gasoline Range Hydrocarbons	0.335	5.00	mg/kg dry wt	-	40	42-125	40	75-125	25	8006-61-9	30
NWTPH-Gx	4-BFB (FID)			Surrogate	50-150	-	-	-	-	-	460-00-4	
Volatile Petroleum Products by NWTPH-Gx in Water												
NWTPH-Gx	Gasoline Range Hydrocarbons	12.3	50.0	ug/L	-	25	58-129	25	80-120	25	8006-61-9	800
NWTPH-Gx	4-BFB (FID)			Surrogate	58-144	-	-	-	-	-	460-00-4	
Volatile Petroleum Hydrocarbons by WDOE TPH Policy Method in Soil												
WA MTCA-VPH	C5-C6 Aliphatics	0.0310	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C6-C8 Aliphatics	0.0550	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C8-C10 Aliphatics	0.0720	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C10-C12 Aliphatics	0.0390	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C8-C10 Aromatics	0.0900	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C10-C12 Aromatics	0.0210	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C12-C13 Aromatics	0.0120	5.00	mg/kg dry wt	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	Total VPH (TVPH)		35.0	mg/kg dry wt	-	25	70-130	25	70-130	25		NA
WA MTCA-VPH	4-BFB (FID)			Surrogate	60-140	-	-	-	-	-	460-00-4	
WA MTCA-VPH	4-BFB (PID)			Surrogate	60-140	-	-	-	-	-	460-00-4	
WA MTCA-VPH	a,a,a-TFT (FID)			Surrogate	50-150	-	-	-	-	-	98-08-8	
WA MTCA-VPH	a,a,a-TFT (PID)			Surrogate	50-150	-	-	-	-	-	98-08-8	
Volatile Petroleum Hydrocarbons by WDOE TPH Policy Method in Water												
WA MTCA-VPH	C5-C6 Aliphatics	0.714	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C6-C8 Aliphatics	1.49	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C8-C10 Aliphatics	1.72	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C10-C12 Aliphatics	1.03	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C8-C10 Aromatics	2.50	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C10-C12 Aromatics	0.963	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	C12-C13 Aromatics	1.10	50.0	ug/L	-	25	70-130	25	70-130	25	NA	NA
WA MTCA-VPH	Total VPH (TVPH)		350	ug/L	-	25	70-130	25	70-130	25		NA
WA MTCA-VPH	4-BFB (FID)			Surrogate	60-140	-	-	-	-	-	460-00-4	
WA MTCA-VPH	4-BFB (PID)			Surrogate	60-140	-	-	-	-	-	460-00-4	
WA MTCA-VPH	a,a,a-TFT (FID)			Surrogate	50-150	-	-	-	-	-	98-08-8	
WA MTCA-VPH	a,a,a-TFT (PID)			Surrogate	50-150	-	-	-	-	-	98-08-8	
Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Cleanup) in Soil												
NWTPH-Dx	Diesel Range Hydrocarbons	1.60	10.0	mg/kg dry wt	-	40	45-144	40	71-120	40	68476-34-6	2,000
NWTPH-Dx	Lube Oil Range Hydrocarbons	3.19	25.0	mg/kg dry wt	-	40	50-150	40	60-140	40	NA	2,000
NWTPH-Dx	2-FBP			Surrogate	50-150	-	-	-	-	-	321-60-8	
NWTPH-Dx	Octacosane			Surrogate	50-150	-	-	-	-	-	630-02-4	
Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Cleanup) in Water												
NWTPH-Dx	Diesel Range Hydrocarbons	0.0650	0.250	mg/L	-	40	25-149	40	58-125	40	68476-34-6	0.5
NWTPH-Dx	Lube Oil Range Hydrocarbons	0.0900	0.500	mg/L	-	40	-	-	60-140	40	NA	0.5
NWTPH-Dx	2-FBP			Surrogate	50-150	-	-	-	-	-	321-60-8	
NWTPH-Dx	Octacosane			Surrogate	50-150	-	-	-	-	-	630-02-4	

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Extractable Petroleum Hydrocarbons by WDOE TPH Policy Method in Soil												
WA MTCA-EPH	C8-C10 Aliphatics	0.0270	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C10-C12 Aliphatics	0.0950	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C12-C16 Aliphatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C16-C21 Aliphatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C21-C34 Aliphatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C8-C10 Aromatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C10-C12 Aromatics	0.0720	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C12-C16 Aromatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C16-C21 Aromatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C21-C34 Aromatics	1.00	5.00	mg/kg dry wt	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	o-Terphenyl			Surrogate	60-140	-	-	-	-	-	84-15-1	
WA MTCA-EPH	1-Chlorooctadecane			Surrogate	60-140	-	-	-	-	-	3386-33-2	
WA MTCA-EPH	5,6,7,8-Tetrahydro-1-naphthol			Surrogate	0-10	-	-	-	-	-	529-35-1	
Extractable Petroleum Hydrocarbons by WDOE TPH Policy Method in Water												
WA MTCA-EPH	C8-C10 Aliphatics	0.532	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C10-C12 Aliphatics	1.90	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C12-C16 Aliphatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C16-C21 Aliphatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C21-C34 Aliphatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C8-C10 Aromatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C10-C12 Aromatics	1.44	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C12-C16 Aromatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C16-C21 Aromatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	C21-C34 Aromatics	10.0	50.0	ug/L	-	40	70-130	25	70-130	25	NA	NA
WA MTCA-EPH	o-Terphenyl			Surrogate	60-140	-	-	-	-	-	84-15-1	
WA MTCA-EPH	1-Chlorooctadecane			Surrogate	60-140	-	-	-	-	-	3386-33-2	
WA MTCA-EPH	5,6,7,8-Tetrahydro-1-naphthol			Surrogate	0-10	-	-	-	-	-	529-35-1	
Total Metals by USEPA 6000/7000 Series Methods in Soil												
USEPA 6020	Antimony	0.0310	1.50	mg/kg dry wt	-	30	20-130	30	80-120	20	7440-36-0	32
USEPA 6020	Arsenic	0.0450	0.500	mg/kg dry wt	-	30	57-125	30	80-120	20	7440-38-2	20
USEPA 6020	Beryllium	0.0110	0.500	mg/kg dry wt	-	30	75-125	30	80-120	20	7440-41-7	160
USEPA 6020	Cadmium	0.0350	0.500	mg/kg dry wt	-	30	78-125	30	80-120	20	7440-43-9	2
USEPA 6020	Chromium	0.0450	0.500	mg/kg dry wt	-	30	29-127	30	80-120	20	7440-47-3	240
USEPA 6020	Copper	0.0560	0.500	mg/kg dry wt	-	30	33-156	30	80-120	20	7440-50-8	2,960
USEPA 6020	Lead	0.0260	0.500	mg/kg dry wt	-	30	29-162	30	80-120	20	7439-92-1	250
USEPA 6020	Nickel	0.0430	0.500	mg/kg dry wt	-	30	56-135	30	80-120	20	7440-02-0	1,600
USEPA 6020	Selenium	0.0980	0.500	mg/kg dry wt	-	30	65-121	30	80-120	20	7782-49-2	400
USEPA 6020	Silver	0.0570	0.500	mg/kg dry wt	-	50	54-126	30	80-120	20	7440-22-4	400
USEPA 6020	Thallium	0.0270	0.500	mg/kg dry wt	-	30	70-125	30	80-120	20	7440-28-0	5.6
USEPA 6020	Zinc	0.830	5.00	mg/kg dry wt	-	30	20-160	30	80-120	20	7440-66-6	24,000
USEPA 7471A	Mercury	0.0140	0.100	mg/kg dry wt	-	30	70-130	30	80-120	20	7439-97-6	2

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Total Metals by USEPA 6000/7000 Series Methods in Water												
USEPA 6020	Antimony	0.0000900	0.00300	mg/L	-	20	63-135	20	80-120	20	7440-36-0	0.0064
USEPA 6020	Arsenic	0.000100	0.00100	mg/L	-	20	75-125	20	80-120	20	7440-38-2	0.005
USEPA 6020	Beryllium	0.0000700	0.00100	mg/L	-	20	75-125	20	80-120	20	7440-41-7	0.032
USEPA 6020	Cadmium	0.000140	0.00100	mg/L	-	20	75-125	20	80-120	20	7440-43-9	0.005
USEPA 6020	Chromium	0.000150	0.00100	mg/L	-	20	75-125	20	80-120	20	7440-47-3	0.05
USEPA 6020	Copper	0.000430	0.00100	mg/L	-	20	70-125	20	80-120	20	7440-50-8	0.592
USEPA 6020	Lead	0.000170	0.00100	mg/L	-	20	76-125	20	80-120	20	7439-92-1	0.015
USEPA 6020	Nickel	0.0000800	0.00100	mg/L	-	20	73-125	20	80-120	20	7440-02-0	0.32
USEPA 6020	Selenium	0.000290	0.00100	mg/L	-	20	77-120	20	80-120	20	7782-49-2	0.08
USEPA 6020	Silver	0.000170	0.00100	mg/L	-	50	21-142	30	80-120	20	7440-22-4	0.08
USEPA 6020	Thallium	0.000100	0.00100	mg/L	-	20	75-125	20	80-120	20	7440-28-0	0.00112
USEPA 6020	Zinc	0.00313	0.0100	mg/L	-	20	57-140	20	80-120	20	7440-66-6	4.8
USEPA 7470A	Mercury	0.0000500	0.000200	mg/L	-	20	70-130	20	80-120	20	7439-97-6	0.002
Volatile Organic Compounds (Special List) per USEPA Method 8260B (Low Soil Method) in Soil												
USEPA 8260B	Acetone	2.03	30.0	ug/kg dry wt	-	-	60-140	30	70-130	30	67-64-1	8,000,000
USEPA 8260B	Benzene	0.540	1.50	ug/kg dry wt	-	-	60-140	30	70-130	30	71-43-2	30
USEPA 8260B	Bromobenzene	0.540	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	108-86-1	NA
USEPA 8260B	Bromochloromethane	0.600	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	74-97-5	NA
USEPA 8260B	Bromodichloromethane	0.480	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-27-4	16,100
USEPA 8260B	Bromoform	0.420	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-25-2	127,000
USEPA 8260B	Bromomethane	0.420	10.0	ug/kg dry wt	-	-	60-140	30	70-130	30	74-83-9	112,000
USEPA 8260B	2-Butanone	1.44	15.0	ug/kg dry wt	-	-	60-140	30	70-130	30	78-93-3	48,000,000
USEPA 8260B	n-Butylbenzene	0.520	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	104-51-8	NA
USEPA 8260B	sec-Butylbenzene	0.520	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	135-98-8	NA
USEPA 8260B	tert-Butylbenzene	0.550	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	98-06-6	NA
USEPA 8260B	Carbon disulfide	0.770	3.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-15-0	8,000,000
USEPA 8260B	Carbon tetrachloride	0.520	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	56-23-5	7,690
USEPA 8260B	Chlorobenzene	0.540	2.00	ug/kg dry wt	-	-	60-140	30	70-130	30	108-90-7	1,600,000
USEPA 8260B	Chloroethane	0.470	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-00-3	NA
USEPA 8260B	Chloroform	0.510	2.50	ug/kg dry wt	-	-	60-140	30	70-130	30	67-66-3	164,000
USEPA 8260B	Chloromethane	0.410	10.0	ug/kg dry wt	-	-	60-140	30	70-130	30	74-87-3	76,900
USEPA 8260B	2-Chlorotoluene	0.500	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	95-49-8	1,600,000
USEPA 8260B	4-Chlorotoluene	0.600	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	106-43-4	NA
USEPA 8260B	Dibromochloromethane	0.530	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	124-48-1	11,900
USEPA 8260B	1,2-Dibromo-3-chloropropane	0.660	10.0	ug/kg dry wt	-	-	60-140	30	70-130	30	96-12-8	714
USEPA 8260B	1,2-Dibromoethane (EDB)	0.500	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	106-93-4	5
USEPA 8260B	Dibromomethane	0.460	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	74-95-3	800,000
USEPA 8260B	1,2-Dichlorobenzene	0.590	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	95-50-1	7,200,000
USEPA 8260B	1,3-Dichlorobenzene	0.550	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	541-73-1	NA
USEPA 8260B	1,4-Dichlorobenzene	0.580	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	106-46-7	41,700
USEPA 8260B	Dichlorodifluoromethane	0.290	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-71-8	16,000,000

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Volatile Organic Compounds (Special List) per USEPA Method 8260B (Low Soil Method) in Soil (continue)												
USEPA 8260B	1,1-Dichloroethane	0.510	2.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-34-3	8,000
USEPA 8260B	1,2-Dichloroethane	0.560	1.25	ug/kg dry wt	-	-	60-140	30	70-130	30	107-06-2	11,000
USEPA 8260B	1,1-Dichloroethene	0.510	3.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-35-4	2,860
USEPA 8260B	cis-1,2-Dichloroethene	0.500	3.00	ug/kg dry wt	-	-	60-140	30	70-130	30	156-59-2	400
USEPA 8260B	trans-1,2-Dichloroethene	0.500	2.50	ug/kg dry wt	-	-	60-140	30	70-130	30	156-60-5	1,600,000
USEPA 8260B	1,2-Dichloropropane	0.470	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	78-87-5	14,700
USEPA 8260B	1,3-Dichloropropane	0.590	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	142-28-9	NA
USEPA 8260B	2,2-Dichloropropane	0.530	10.0	ug/kg dry wt	-	-	60-140	30	70-130	30	594-20-7	NA
USEPA 8260B	1,1-Dichloropropene	0.550	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	563-58-6	NA
USEPA 8260B	cis-1,3-Dichloropropene	0.480	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	10061-01-5	5,560
USEPA 8260B	trans-1,3-Dichloropropene	0.440	1.25	ug/kg dry wt	-	-	60-140	30	70-130	30	10061-02-6	5,560
USEPA 8260B	Ethylbenzene	0.560	4.00	ug/kg dry wt	-	-	60-140	30	70-130	30	100-41-4	6,000
USEPA 8260B	Hexachlorobutadiene	0.460	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	87-68-3	12,800
USEPA 8260B	Methyl tert-butyl ether	0.710	1.00	ug/kg dry wt	-	-	60-140	30	70-130	30	1634-04-4	100
USEPA 8260B	2-Hexanone	2.35	20.0	ug/kg dry wt	-	-	60-140	30	70-130	30	591-78-6	NA
USEPA 8260B	Isopropylbenzene	0.590	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	98-82-8	8,000,000
USEPA 8260B	p-Isopropyltoluene	0.620	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	99-87-6	NA
USEPA 8260B	4-Methyl-2-pentanone	2.69	20.0	ug/kg dry wt	-	-	60-140	30	70-130	30	108-10-1	6,400
USEPA 8260B	Methylene chloride	0.510	3.50	ug/kg dry wt	-	-	60-140	30	70-130	30	75-09-2	20
USEPA 8260B	Naphthalene	0.800	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	91-20-3	5,000
USEPA 8260B	n-Propylbenzene	0.510	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	103-65-1	NA
USEPA 8260B	Styrene	0.550	1.00	ug/kg dry wt	-	-	60-140	30	70-130	30	100-42-5	33,300
USEPA 8260B	1,2,3-Trichlorobenzene	0.620	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	87-61-6	NA
USEPA 8260B	1,2,4-Trichlorobenzene	0.580	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	120-82-1	800,000
USEPA 8260B	1,1,1,2-Tetrachloroethane	0.570	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	630-20-6	38,500
USEPA 8260B	1,1,2,2-Tetrachloroethane	0.530	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	79-34-5	5,000
USEPA 8260B	Tetrachloroethene	0.560	2.00	ug/kg dry wt	-	-	60-140	30	70-130	30	127-18-4	50
USEPA 8260B	Toluene	0.540	1.50	ug/kg dry wt	-	-	60-140	30	70-130	30	108-88-3	7,000
USEPA 8260B	1,1,1-Trichloroethane	0.550	2.50	ug/kg dry wt	-	-	60-140	30	70-130	30	71-55-6	2,000
USEPA 8260B	1,1,2-Trichloroethane	0.560	1.25	ug/kg dry wt	-	-	60-140	30	70-130	30	79-00-5	17,500
USEPA 8260B	Trichloroethene	0.530	2.50	ug/kg dry wt	-	-	60-140	30	70-130	30	79-01-6	0.72
USEPA 8260B	Trichlorofluoromethane	0.500	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	75-69-4	24,000,000
USEPA 8260B	1,2,3-Trichloropropane	0.640	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	96-18-4	143
USEPA 8260B	1,2,4-Trimethylbenzene	0.550	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	95-63-6	NA
USEPA 8260B	1,3,5-Trimethylbenzene	0.540	5.00	ug/kg dry wt	-	-	60-140	30	70-130	30	108-67-8	NA
USEPA 8260B	Vinyl chloride	0.450	2.50	ug/kg dry wt	-	-	60-140	30	70-130	30	75-01-4	667
USEPA 8260B	Total Xylenes	1.68	10.0	ug/kg dry wt	-	-	60-140	30	70-130	30	1330-20-7	9,000
USEPA 8260B	1,2-DCA-d4			Surrogate	60-140	-	-	-	-	-	17060-07-0	
USEPA 8260B	Toluene-d8			Surrogate	60-140	-	-	-	-	-	2037-26-5	
USEPA 8260B	4-BFB			Surrogate	60-140	-	-	-	-	-	460-00-4	

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Volatile Organic Compounds by USEPA Method 8260B in Water												
USEPA 8260B	Acetone	0.674	10.0	ug/L	-	-	-	-	-	-	67-64-1	800
USEPA 8260B	Benzene	0.0870	0.200	ug/L	-	-	63-148	20	80-120	20	71-43-2	0.795
USEPA 8260B	Bromobenzene	0.0440	0.500	ug/L	-	-	-	-	-	-	108-86-1	NA
USEPA 8260B	Bromochloromethane	0.0730	0.200	ug/L	-	-	-	-	-	-	74-97-5	NA
USEPA 8260B	Bromodichloromethane	0.0580	0.200	ug/L	-	-	-	-	-	-	75-27-4	0.706
USEPA 8260B	Bromoform	0.0800	0.200	ug/L	-	-	-	-	-	-	75-25-2	5.54
USEPA 8260B	Bromomethane	0.117	2.00	ug/L	-	-	-	-	-	-	74-83-9	11.2
USEPA 8260B	2-Butanone	0.582	2.00	ug/L	-	-	-	-	-	-	78-93-3	4,800
USEPA 8260B	n-Butylbenzene	0.0470	0.200	ug/L	-	-	-	-	-	-	104-51-8	NA
USEPA 8260B	sec-Butylbenzene	0.0400	0.200	ug/L	-	-	-	-	-	-	135-98-8	NA
USEPA 8260B	tert-Butylbenzene	0.0520	0.500	ug/L	-	-	-	-	-	-	98-06-6	NA
USEPA 8260B	Carbon disulfide	0.0420	0.500	ug/L	-	-	-	-	-	-	75-15-0	800
USEPA 8260B	Carbon tetrachloride	0.0570	0.200	ug/L	-	-	-	-	-	-	56-23-5	0.337
USEPA 8260B	Chlorobenzene	0.0460	0.200	ug/L	-	-	80-128	20	77-120	20	108-90-7	160
USEPA 8260B	Chloroethane	0.0620	1.00	ug/L	-	-	-	-	-	-	75-00-3	NA
USEPA 8260B	Chloroform	0.0490	0.200	ug/L	-	-	-	-	-	-	67-66-3	7.17
USEPA 8260B	Chloromethane	0.102	1.00	ug/L	-	-	-	-	-	-	74-87-3	3.37
USEPA 8260B	2-Chlorotoluene	0.0440	0.500	ug/L	-	-	-	-	-	-	95-49-8	160
USEPA 8260B	4-Chlorotoluene	0.102	0.500	ug/L	-	-	-	-	-	-	106-43-4	NA
USEPA 8260B	Dibromochloromethane	0.0550	0.200	ug/L	-	-	-	-	-	-	124-48-1	0.521
USEPA 8260B	1,2-Dibromo-3-chloropropane	0.165	0.500	ug/L	-	-	-	-	-	-	96-12-8	0.0313
USEPA 8260B	1,2-Dibromoethane	0.0590	0.200	ug/L	-	-	-	-	-	-	106-93-4	0.01
USEPA 8260B	Dibromomethane	0.0720	0.200	ug/L	-	-	-	-	-	-	74-95-3	80
USEPA 8260B	1,2-Dichlorobenzene	0.0200	0.200	ug/L	-	-	-	-	-	-	95-50-1	720
USEPA 8260B	1,3-Dichlorobenzene	0.0350	0.200	ug/L	-	-	-	-	-	-	541-73-1	NA
USEPA 8260B	1,4-Dichlorobenzene	0.0350	0.200	ug/L	-	-	-	-	-	-	106-46-7	1.82
USEPA 8260B	Dichlorodifluoromethane	0.0330	0.500	ug/L	-	-	-	-	-	-	75-71-8	1,600
USEPA 8260B	1,1-Dichloroethane	0.0550	0.200	ug/L	-	-	-	-	-	-	75-34-3	800
USEPA 8260B	1,2-Dichloroethane	0.0650	0.200	ug/L	-	-	-	-	-	-	107-06-2	5
USEPA 8260B	1,1-Dichloroethene	0.0770	0.200	ug/L	-	-	59-158	30	80-120	20	75-35-4	400
USEPA 8260B	cis-1,2-Dichloroethene	0.0670	0.200	ug/L	-	-	-	-	-	-	156-59-2	80
USEPA 8260B	trans-1,2-Dichloroethene	0.0480	0.200	ug/L	-	-	-	-	-	-	156-60-5	160
USEPA 8260B	1,2-Dichloropropane	0.0650	0.200	ug/L	-	-	-	-	-	-	78-87-5	0.643
USEPA 8260B	1,3-Dichloropropane	0.0470	0.200	ug/L	-	-	-	-	-	-	142-28-9	NA
USEPA 8260B	2,2-Dichloropropane	0.0460	0.500	ug/L	-	-	-	-	-	-	594-20-7	NA
USEPA 8260B	1,1-Dichloropropene	0.0770	0.200	ug/L	-	-	-	-	-	-	563-58-6	NA
USEPA 8260B	cis-1,3-Dichloropropene	0.0590	0.200	ug/L	-	-	-	-	-	-	10061-01-5	0.243
USEPA 8260B	trans-1,3-Dichloropropene	0.0350	0.200	ug/L	-	-	-	-	-	-	10061-02-6	0.243
USEPA 8260B	Ethylbenzene	0.0410	0.200	ug/L	-	-	-	-	-	-	100-41-4	700
USEPA 8260B	Hexachlorobutadiene	0.0700	0.500	ug/L	-	-	-	-	-	-	87-68-3	0.561
USEPA 8260B	Methyl tert-butyl ether	0.0340	1.00	ug/L	-	-	60-140	30	80-120	20	1634-04-4	20
USEPA 8260B	n-Hexane	0.115	1.00	ug/L	-	-	60-140	30	80-120	20	110-54-3	NA

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Volatile Organic Compounds by USEPA Method 8260B in Water (continue)												
USEPA 8260B	2-Hexanone	0.377	2.00	ug/L	-	-	-	-	-	-	591-78-6	NA
USEPA 8260B	Isopropylbenzene	0.0330	0.500	ug/L	-	-	-	-	-	-	98-82-8	1,600
USEPA 8260B	p-Isopropyltoluene	0.0420	0.200	ug/L	-	-	-	-	-	-	99-87-6	NA
USEPA 8260B	4-Methyl-2-pentanone	0.354	2.00	ug/L	-	-	-	-	-	-	108-10-1	640
USEPA 8260B	Methylene chloride	0.281	5.00	ug/L	-	-	-	-	-	-	75-09-2	5
USEPA 8260B	Naphthalene	0.0270	0.500	ug/L	-	-	-	-	-	-	91-20-3	160
USEPA 8260B	n-Propylbenzene	0.0410	0.500	ug/L	-	-	-	-	-	-	103-65-1	NA
USEPA 8260B	Styrene	0.0400	0.500	ug/L	-	-	-	-	-	-	100-42-5	1.46
USEPA 8260B	1,2,3-Trichlorobenzene	0.0260	0.200	ug/L	-	-	-	-	-	-	87-61-6	NA
USEPA 8260B	1,2,4-Trichlorobenzene	0.0190	0.200	ug/L	-	-	-	-	-	-	120-82-1	80
USEPA 8260B	1,1,1,2-Tetrachloroethane	0.0440	0.200	ug/L	-	-	-	-	-	-	630-20-6	1.68
USEPA 8260B	1,1,2,2-Tetrachloroethane	0.0600	0.500	ug/L	-	-	-	-	-	-	79-34-5	0.219
USEPA 8260B	Tetrachloroethene	0.0400	0.200	ug/L	-	-	-	-	-	-	127-18-4	0.858
USEPA 8260B	Toluene	0.0390	0.200	ug/L	-	-	72-127	20	80-120	20	108-88-3	1,000
USEPA 8260B	1,1,1-Trichloroethane	0.0370	0.200	ug/L	-	-	-	-	-	-	71-55-6	200
USEPA 8260B	1,1,2-Trichloroethane	0.0530	0.200	ug/L	-	-	-	-	-	-	79-00-5	0.768
USEPA 8260B	Trichloroethene	0.0490	0.200	ug/L	-	-	80-126	20	80-120	20	79-01-6	0.109
USEPA 8260B	Trichlorofluoromethane	0.0500	0.500	ug/L	-	-	-	-	-	-	75-69-4	2,400
USEPA 8260B	1,2,3-Trichloropropane	0.172	0.500	ug/L	-	-	-	-	-	-	96-18-4	0.00625
USEPA 8260B	1,2,4-Trimethylbenzene	0.0400	0.200	ug/L	-	-	-	-	-	-	95-63-6	NA
USEPA 8260B	1,3,5-Trimethylbenzene	0.0390	0.500	ug/L	-	-	-	-	-	-	108-67-8	NA
USEPA 8260B	Vinyl chloride	0.0610	0.200	ug/L	-	-	-	-	-	-	75-01-4	0.0292
USEPA 8260B	o-Xylene	0.0380	0.250	ug/L	-	-	-	-	-	-	95-47-6	1,000
USEPA 8260B	m,p-Xylene	0.0730	0.500	ug/L	-	-	-	-	-	-	1330-20-7	16,000
USEPA 8260B	1,2-DCA-d4			Surrogate	70-130	-	-	-	-	-	17060-07-0	
USEPA 8260B	Toluene-d8			Surrogate	70-130	-	-	-	-	-	2037-26-5	
USEPA 8260B	4-BFB			Surrogate	70-130	-	-	-	-	-	460-00-4	
Polycyclic Aromatic Hydrocarbons by GC/MS-SIM in Soil												
USEPA 8270-SIM	Acenaphthene	0.00200	0.0100	mg/kg dry wt	-	25	67-132	50	70-125	40	83-32-9	4,800
USEPA 8270-SIM	Acenaphthylene	0.000600	0.0100	mg/kg dry wt	-	25	65-142	50	70-133	40	208-96-8	NA
USEPA 8270-SIM	Anthracene	0.000900	0.0100	mg/kg dry wt	-	25	66-158	50	70-152	40	120-12-7	24,000
USEPA 8270-SIM	Benzo (a) anthracene	0.000700	0.0100	mg/kg dry wt	-	25	41-156	50	60-125	40	56-55-3	0.137
USEPA 8270-SIM	Benzo (a) pyrene	0.000900	0.0100	mg/kg dry wt	-	25	52-148	50	64-134	26	50-32-8	0.1
USEPA 8270-SIM	Benzo (b) fluoranthene	0.000700	0.0100	mg/kg dry wt	-	25	53-151	50	62-147	40	205-99-2	0.137
USEPA 8270-SIM	Benzo (k) fluoranthene	0.000900	0.0100	mg/kg dry wt	-	25	46-161	50	60-144	40	207-08-9	0.137
USEPA 8270-SIM	Benzo (b & k) fluoranthene	0.000900	0.0200	mg/kg dry wt	-	-	46-161	50	60-144	40	NA	NA
USEPA 8270-SIM	Benzo (ghi) perylene	0.000700	0.0100	mg/kg dry wt	-	25	26-154	50	57-137	40	191-24-2	NA
USEPA 8270-SIM	Chrysene	0.000500	0.0100	mg/kg dry wt	-	25	55-155	44	70-139	24	218-01-9	0.137
USEPA 8270-SIM	Dibenz (a,h) anthracene	0.000500	0.0100	mg/kg dry wt	-	25	27-157	50	56-140	40	53-70-3	0.137
USEPA 8270-SIM	Fluoranthene	0.000700	0.0100	mg/kg dry wt	-	25	46-172	50	70-141	40	206-44-0	3,200
USEPA 8270-SIM	Fluorene	0.000400	0.0100	mg/kg dry wt	-	25	66-143	52	76-132	43	86-73-7	3,200
USEPA 8270-SIM	Indeno (1,2,3-cd) pyrene	0.000500	0.0100	mg/kg dry wt	-	25	24-159	43	55-138	39	193-39-5	0.137

Table A-1
Analytical Method Details

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	Matrix Spike %R	Matrix Spike RPD	Blank Spike %R	Blank Spike RPD	CAS #	MTCA CULs
Polycyclic Aromatic Hydrocarbons by GC/MS-SIM in Soil (continue)												
USEPA 8270-SIM	1-Methylnaphthalene	0.000900	0.0100	mg/kg dry wt	-	25	39-140	50	46-128	40	90-12-0	5
USEPA 8270-SIM	2-Methylnaphthalene	0.000400	0.0100	mg/kg dry wt	-	25	32-139	50	41-125	40	91-57-6	5
USEPA 8270-SIM	Naphthalene	0.000800	0.0100	mg/kg dry wt	-	25	38-134	50	43-125	40	91-20-3	5
USEPA 8270-SIM	Phenanthrene	0.000600	0.0100	mg/kg dry wt	-	25	63-139	50	73-125	40	85-01-8	NA
USEPA 8270-SIM	Pyrene	0.000800	0.0100	mg/kg dry wt	-	25	51-172	50	68-140	40	129-00-0	2,400
USEPA 8270-SIM	p-Terphenyl-d14			Surrogate	50-147	-	-	-	-	-	1718-51-0	
Polycyclic Aromatic Compounds by GC/MS with High Volume Injection in Water												
USEPA 8270C-HVI	Acenaphthene	0.00462	0.100	ug/L	-	-	40-150	40	53-124	40	83-32-9	960
USEPA 8270C-HVI	Acenaphthylene	0.00843	0.100	ug/L	-	-	40-150	40	54-134	40	208-96-8	NA
USEPA 8270C-HVI	Anthracene	0.00342	0.100	ug/L	-	-	40-150	40	57-133	40	120-12-7	2,400
USEPA 8270C-HVI	Benzo (a) anthracene	0.00367	0.0100	ug/L	-	-	40-150	40	57-131	40	56-55-3	0.012
USEPA 8270C-HVI	Benzo (a) pyrene	0.00194	0.0100	ug/L	-	-	40-150	40	50-140	40	50-32-8	0.012
USEPA 8270C-HVI	Benzo (b) fluoranthene	0.00285	0.0100	ug/L	-	-	40-150	40	43-149	40	205-99-2	0.012
USEPA 8270C-HVI	Benzo (k) fluoranthene	0.00327	0.0100	ug/L	-	-	40-150	40	41-150	40	207-08-9	0.012
USEPA 8270C-HVI	Benzo (ghi) perylene	0.00274	0.100	ug/L	-	-	40-150	40	40-140	40	191-24-2	NA
USEPA 8270C-HVI	Chrysene	0.00262	0.0100	ug/L	-	-	40-150	40	49-136	40	218-01-9	0.012
USEPA 8270C-HVI	Dibenz (a,h) anthracene	0.00254	0.0100	ug/L	-	-	40-150	40	40-130	40	53-70-3	0.012
USEPA 8270C-HVI	Fluoranthene	0.00232	0.100	ug/L	-	-	40-150	40	57-147	40	206-44-0	640
USEPA 8270C-HVI	Fluorene	0.00659	0.100	ug/L	-	-	40-150	40	40-148	40	86-73-7	640
USEPA 8270C-HVI	Indeno (1,2,3-cd) pyrene	0.00222	0.0100	ug/L	-	-	40-150	40	41-137	40	193-39-5	0.012
USEPA 8270C-HVI	1-Methylnaphthalene	0.0155	0.100	ug/L	-	-	40-150	40	43-132	40	90-12-0	160
USEPA 8270C-HVI	2-Methylnaphthalene	0.0237	0.100	ug/L	-	-	40-150	40	40-147	40	91-57-6	160
USEPA 8270C-HVI	Naphthalene	0.00894	0.100	ug/L	-	-	40-150	40	53-121	40	91-20-3	160
USEPA 8270C-HVI	Phenanthrene	0.00445	0.100	ug/L	-	-	40-150	40	44-146	40	85-01-8	NA
USEPA 8270C-HVI	Pyrene	0.00364	0.100	ug/L	-	-	40-150	40	57-147	40	129-00-0	480
USEPA 8270C-HVI	Benzo (a) pyrene-d12			Surrogate	20-145	-	-	-	-	-	63466-71-7	
USEPA 8270C-HVI	1-Methylnaphthalene-d10			Surrogate	18-145	-	-	-	-	-	38072-94-5	
USEPA 8270C-HVI	2,4,6-TBP			Surrogate	21-148	-	-	-	-	-	118-79-6	
Conventional Chemistry Parameters by APHA/USEPA Methods in Soil												
USEPA 7196A	Hexavalent Chromium	0.074	0.40	mg/kg dry wt	-	30	75-125	30	80-120	25	18540-29-9	240
Conventional Chemistry Parameters by APHA/USEPA Methods in Water												
USEPA 7196A	Hexavalent Chromium	0.00130	0.00500	mg/L	-	25	85-115	25	90-110	20	18540-29-9	0.048

NOTES:

MTCA CULs = Most stringent Washington Department of Ecology Model Toxics Control Act (MTCA) Method A or Method B cleanup levels (CULs) was used for reference only.
When available, MTCA Method A CULs for soil were taken from Table 720-2, and Method A CULs for groundwater were taken from Table 720-1 (WAC 173-340-900).

For chemicals that were not detected in soil, Method B CULs were taken from Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation (CLARC) Version 3.1, November 2001. If a chemical was detected in at least one soil sample, the toxicity values given in CLARC were compared to recent toxicity values given in the USEPA (2004) Region 9 Preliminary Remediation Goals (PRGs). If toxicity values had not changed, the Method B CULs in CLARC were used. If toxicity values were different from those reported in CLARC, MTCA CUL calculation software was used to estimate updated Method B CULs for soil with the updated toxicity values. A similar process was used to determine Method B groundwater CULs.

Table A-2
Sampling Guide

Analysis	SpecificMethod	Container	Preservation	Hold (days)	Amount Needed
Volatile Petroleum Products by NWTPH-Gx in Soil					
NWTPH-Gx	NWTPH-Gx	40 ml Voa Vial w/MeOH	Store cool at 4°C	14	12 grams
Volatile Petroleum Products by NWTPH-Gx in Water					
NWTPH-Gx	NWTPH-Gx	Voa Vial	Add HCl to pH<2; Store 4°C	14	2 VOA vials
Volatile Petroleum Hydrocarbons by WDOE TPH Policy Method in Soil					
MTCA-VPH Ranges	WA MTCA-VPH	40 ml Voa Vial w/MeOH	Store cool at 4°C	14	12 grams
Volatile Petroleum Hydrocarbons by WDOE TPH Policy Method in Water					
MTCA-VPH Ranges	WA MTCA-VPH	Voa Vial	Add HCl to pH<2; Store 4°C	14	2 VOA vials
Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up) in Soil					
NWTPH-Dx	NWTPH-Dx	Glass jar w/PTFE seal	Store cool at 4°C	14	250 grams
Semivolatile Petroleum Products by NWTPH-Dx (w/o Acid/Silica Gel Clean-up) in Water					
NWTPH-Dx	NWTPH-Dx	1L Amber-HCl	Add HCl to pH<2; Store 4°C	14	2000 mls
Extractable Petroleum Hydrocarbons by WDOE TPH Policy Method in Soil					
MTCA NW EPH Subanalysis	WA MTCA-EPH	Glass jar w/PTFE seal	Store cool at 4°C	14	250 grams
Extractable Petroleum Hydrocarbons by WDOE TPH Policy Method in Water					
MTCA NW EPH Subanalysis	WA MTCA-EPH	1L Amber-Unpres.	Add HCl or H2SO4 to pH<2; Store 4°C	14	2000 mls
Total Metals by EPA 6000/7000 Series Methods in Soil					
Ag Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
As Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Be Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Cd Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Cr Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Cu Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Ni Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Pb Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Sb Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Se Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Tl Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Zn Total ICPMS 6020	EPA 6020	Glass or Plastic	Store cool at 4°C	180	100 grams
Hg Total 7470/7471	EPA 7471A	Glass or Plastic	Store cool at 4°C	28	100 grams

Table A-2
Sampling Guide

Analysis	SpecificMethod	Container	Preservation	Hold (days)	Amount Needed
Total Metals by EPA 6000/7000 Series Methods in Water					
Ag Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
As Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Be Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Cd Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Cr Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Cu Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Ni Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Pb Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Sb Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Se Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Tl Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Zn Total ICPMS 6020	EPA 6020	Glass or Plastic	Add HNO3 to pH<2	180	500 mls
Hg Total 7470/7471	EPA 7470A	Glass or Plastic	Add HNO3 to pH<2	28	500 mls
Volatile Organic Compounds (Special List) per EPA Method 8260B (Low Soil Method) in Soil					
MTCA 5035/8260	EPA 8260B	2 Voa Vials w/ stir bar	Store cool at 4°C	14	5 grams each
Volatile Organic Compounds by EPA Method 8260B in Water					
8260B LL VOA Full List/MS-15	EPA 8260B	Voa Vial - HCl	Add HCl to pH<2; Store 4°C	14	2 VOA vials
Polynuclear Aromatic Hydrocarbons by GC/MS-SIM in Soil					
MTCA PAHs	EPA 8270-SIM	Glass jar w/PTFE seal	Store cool at 4°C	14	250 grams
Polynuclear Aromatic Compounds by GC/MS with High Volume Injection in Water					
MTCA HV PAHs	EPA 8270C-HVI	1L Amber-Unpres.	Store cool at 4°C	7	2000 mls
Conventional Chemistry Parameters by APHA/EPA Methods in Soil					
Cr6, Soil-7196	EPA 7196A	Glass or Plastic	Store cool at 4°C	28	100 grams
Conventional Chemistry Parameters by APHA/EPA Methods in Water					
Cr6 - Aqueous	EPA 7196A	Glass or Plastic	Store cool at 4°C	1	250 mls

Table A-3
Documentation Requirements for Independent QA/AC Review of Inorganic Substances Data
Precision Engineering, Inc

Analysis of the requested inorganic analytes should be reported as follows:

- Dates samples were collected, received by the laboratory, and analyzed.
- On each laboratory sample data sheet: method of detection (e.g., AA, ICP).
- On each laboratory sample data sheet: a tabulation of method detection limits (MDLs) or method reporting limits (MRLs), or a master sheet of MDLs or MRLs with detection limit multiplication factors (due to dilutions or dry weights) specified.
- Constituent concentrations reported in µg/L or mg/L for water and µg/kg or mg/kg for soil (dry-weight basis) for each sample analyzed.
- Volumes analyzed and dilution factors, if any.
- Ancillary information, including percent moisture in soil samples.
- Method blank data associated with each sample.
- Results for matrix spike analyses, concentrations added, and percent recovery from samples.
- Results of laboratory duplicate or laboratory control sample analyses for each constituent, as applicable to the method.
- A statement in the cover letter describing how standard calibration curves were generated and applied to the samples for quantitation (and access to laboratory records of standard calibration curves and all other pertinent data for possible inspection), if this varies from the Method specified in SW-846 (USEPA, 1986a).
- A statement in the cover letter describing any significant problems in any aspect of sample analysis, deviation from prescribed QA/QC criteria, or other relevant information. A statement in the cover letter describing any changes or deviations from the required Methods, the reason for the change(s), and a description of the deviations that were used for sample analysis.
- A copy of the chain-of-custody form for each sample reported.

Table A-4
Documentation Requirements for Independent QA/AC Review of Organic Substances Data
Precision Engineering, Inc.

Analytical laboratory reports for organic substances, including volatile organic compounds, semivolatile organic compounds, and chemically similar compounds, should be reported as follows:

- Dates samples were collected, received by the laboratory, and analyzed.
- On each laboratory sample data sheet: method of detection (e.g., GC, HPLC).
- On each laboratory sample data sheet: a tabulation of Method detection limits (MDLs) or method reporting limits (MRLs), or a master sheet of MDLs or MRLs with detection limit multiplication factors (due to dilutions or dry weights) specified.
- Constituent concentrations reported in milligrams per liter (mg/L) or micrograms per liter (µg/L) for water, and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for soil (dry-weight basis) for each sample analyzed.
- Volumes analyzed and dilution factors, if any.
- Ancillary information, including percent moisture in soil samples.
- With each sample, complete data for associated method blanks.
- Surrogate recoveries for analyses reported as percent recoveries.
- Results for matrix spike and matrix spike duplicate analyses, concentrations added, percent recovery, and relative percent difference.
- A statement in the cover letter describing how standard calibration curves were generated and applied to the samples for quantitation (and access to laboratory records of standard calibration curves and all other pertinent data for possible inspection), if this varies from the Method specified in SW-846 (USEPA, 1986a).
- A statement in the cover letter describing any significant problems in any aspect of sample analysis, deviation from prescribed QA/QC criteria, or other relevant information. A statement in the cover letter describing any changes or deviations from the required Methods, the reason for the change(s), and a description of the deviations that were used for sample analysis.
- A copy of the chain-of-custody form for each sample analyzed.

APPENDIX A-1

BORING LOG

Maul Foster & Associates Inc.	Log of Exploratory Boring

CLIENT _____
PROJECT NAME _____
PROJECT # _____
Engineer/Geologist _____
Drilling Contractor _____
Drilling Method _____
Hole Diameter _____

Sheet _____ Of _____
Boring Number _____
Date Started _____
Date Finished _____
Total Depth _____
Ground Elevation _____
Datum _____

Water Level Data

Depth				
Time				
Date				
Boring Depth				

Completion Details	Sample Number	Sampling Method	Blow Count	Sample Interval	Other (Specify)	Depth in Feet	Soil Group Symbol	Field Location of Boring:
								LITHOLOGIC DESCRIPTION

Notes:

APPENDIX A-2

FIELD SAMPLING DATA SHEETS

Maul Foster & Alongi, Inc.

7223 NE Hazel Dell Avenue, Suite B, Vancouver, WA 98665 (360) 694-2691 Fax. (360) 906-1958

Soil Field Sampling Data Sheet

Client Name		**Sample Location**					
Project Number		**Sampler**					
Project Name		**Sampling Date**					
Sampling Event		**Sample Name**					
Sub Area		**Sample Depth**					
FSDS QA:		**Easting**		**Northing**		**TOC**	

Sample Information

Sampling Method	Sample Type	Sample Category	PID/FID	Sampling Time	Container Code	#
	Soil				2 oz. soil	
					4 oz. soil	
					8 oz. soil	
					Other	
					Total Containers	0

Sample Description:

General Sampling Comments

Sampling Method Code:

(1) Backhoe, (2) Hand Auger, (3) Drill Bit Cutting Head, (4) Geoprobe, (5) Split Spoon, (6) Shelbey Tube, (7) Grab, (8) Other (Specify)

Signature _____

Maul Foster & Alongi, Inc.

7223 NE Hazel Dell Avenue, Suite B, Vancouver, WA 98665 (360) 694-2691 Fax. (360) 906-1958

Water Field Sampling Data Sheet

Client Name		**Sample Location**	
Project #		**Sampler**	
Project Name		**Sampling Date**	
Sampling Event		**Sample Name**	
Sub Area		**Sample Depth**	
FSDS QA:		**Easting**	**Northing**	**TOC**

Hydrology/Level Measurements

Date	Time	DT-Bottom	DT-Product	DT-Water	(Product Thickness) DTP-DTW	(Water Column) DTB-DTW	(Gallons/ft x Water Column) Pore Volume

(0.75" = 0.023 gal/ft) (1" = 0.041 gal/ft) (1.5" = 0.092 gal/ft) (2" = 0.163 gal/ft) (3" = 0.367 gal/ft) (4" = 0.653 gal/ft) (6" = 1.469 gal/ft) (8" = 2.611 gal/ft)

Water Quality Data

Purge Method	Time	Purge Vol (gal)	Flowrate l/min	pH	Temp (C)	E Cond (uS/cm)	DO (mg/L)	EH	Turbidity
Final Field Parameters									

Methods: (1) Submersible Pump (2) Peristaltic Pump (3) Disposable Bailer (4) Vacuum Pump (5) Dedicated Bailer (6) Inertia Pump (7) Other (specify)

Water Quality Observations:

Clear and colorless.

Sample Information

Sampling Method	Sample Type	Sampling Time	Container Code/Preservative	#	Filtered
			VOA-Glass		
			Amber Glass		
			White Poly		
			Yellow Poly		
			Green Poly		
			Red Total Poly		
			Red Dissolved Poly		
			Total Bottles	0	

General Sampling Comments

Signature

APPENDIX A-3

NORTH CREEK ANALYTICAL CORPORATE QUALITY ASSURANCE MANUAL

North Creek Analytical, Inc.

Corporate Quality Assurance Manual

(Revision 14.1; January 2004)

Seattle
11720 North Creek Parkway North, Suite 400
Bothell, WA 98011-8223
425-420-9200

Spokane
East 11115 Montgomery, Suite B,
Spokane, WA 99206-4776
509-924-9200

11922 East 1st Avenue
Spokane, WA 99216
509-928-5715

Portland
9405 SW Nimbus Avenue,
Beaverton, OR 97008-7132
503-906-9200

Bend
20332 Empire Ave, Suite F-1
Bend, OR 97701-5911
541-383-9310

Anchorage
2000 West International Airport Road
Suite A10
Anchorage, AK 99502-1119
907-563-9200

SIGNATURE PAGE

The signatures below document that signatories agree to concur with the contents of this manual and are committed to provide the resources necessary to ensure proper quality operation of the laboratory facility. This approval page applies to all revisions made on or before January 2, 2004.

Scot Cocanour, Chief Executive Officer

Kent Patton
Vice-President, National Sales Director
Technical Director (Portland)

Dennis Wells
Vice-President, Laboratory Director
Quality Assurance Manager (Spokane)

Philip Nerenberg
Vice-President, Laboratory Director
(Portland, Bend)

Brad Meadows
Laboratory Director (Seattle)

Suzanne LeMay
Quality Assurance Manager (Portland, Bend)

Emanuel Hignutt
Laboratory/ Quality Assurance Manager (Anchorage)

David Wunderlich
Quality Assurance Manager (Seattle)

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Figures

Appendices

Corporate Quality Assurance Manual, Revision 14.1
Internal Distribution List

Controlled copies of the *CQAM* are distributed on the date issued to the "laboratory's approved signatories"; individuals listed below in Part A. The signature requirement of each ensures that each controlled copy will be updated with current revisions. Controlled copies of the *CQAM* are also distributed to responsible positions in each department of the laboratory in order to provide access to all personnel. Applicable positions and corresponding departments are listed below in Part B. The QA Manager at each facility will be responsible for distributing copies of the *CQAM* to the applicable positions and keeping an on-going distribution list for controlled copies of the *CQAM* within their respective facility.

Part A - Individual Distribution:

Scot Cocanour	President, Chief Executive Officer
Kent Patton	Vice-President, *National Sales Director* Technical Director (Portland)
Dennis Wells	Vice-President, Laboratory Director Quality Assurance Manager (Spokane)
Philip Nerenberg	Vice-President Laboratory Director (Portland, Bend)
Brad Meadows	Laboratory Director (Seattle)
Emanuel Hignutt	*Laboratory/Quality Assurance Manager (Anchorage)*
Suzanne LeMay	*Quality Assurance Manager (Portland, Bend)*
Dave Wunderlich	*Quality Assurance Manager (Seattle)*

Part B - Position / Departmental Distribution:

Operations Manager
Project Manager(s) / Client Services / Sales
Office Manager / Administration
Sample Control Officer / Sample Receiving & Support
Inorganic Manager / Metals
Microbiology Supervisor / Microbiology
Organics Manager / Organics
Extractions Supervisor / Organic Extractions

(NELAC 5.5.1b, 5.5.2 f)

1.0 INTRODUCTION AND POLICY STATEMENTS

1.1 Introduction and Compliance References

North Creek Analytical, Inc. (NCA) is a network of professional analytical services laboratories with locations in Washington (Seattle and Spokane), Oregon (Portland and Bend) and Alaska (Anchorage). NCA is an established and acknowledged leader in full service analytical capabilities, as well as, specialty analyses.

NCA provides chemical, microbiological and physical testing services for government, industrial, and private entities, including the Department of Defense, State regulatory agencies, Ports, Utilities, Transportation, Oil companies and their consultants. Each entity has specific quality standards for data generation and laboratory operations. *The NCA Quality Assurance Manual (QAM) outlines the standard policies, responsibilities and procedures that are the foundation of laboratory operations; allowing NCA a basis on which to build and meet the specifications of the individual projects and programs.*

In addition, this document has been prepared to assure compliance with the *2001 National Environmental Laboratory Accreditation Conference (NELAC) standards and ISO/IEC Guide 17025 (1999).* Where applicable, notation of the NELAC standard reference is made in italics at the end of the corresponding section of this document.

1.2 Quality Assurance Policy Statement

The NCA QAM is a corporate set of policies and procedures designed to ensure that the data produced by all facilities consistently conforms to the applicable quality standards set by state and federal regulations. The quality system functions at the management level through company objectives and management policies. It functions at the analytical level through standard operating procedures and quality control practices. The two levels are spanned by the functions of the Quality Assurance department. The result is data of known and documented quality that is accurate, reproducible and legally defensible.

(NELAC 5.5.2a)

1.2.1 Scope

NCA requires the application of sound QA/QC principles to all aspects of data generation. This QA Manual documents an integrated system of policies for all phases of laboratory operation including procurement of supplies, sample handling, sample analysis, data acquisition, report preparation and report review.

Every staff member at NCA plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is therefore required that all laboratory personnel read, review, understand and agree to comply with the procedures and requirements established by this document.

(NELAC 5.5.1d)

1.2.2 Purpose

The NCA QA System, documented as the QA Manual, is designed to control and monitor the quality of the data generated in the laboratory.

1.2.3 Goals

The NCA QA System has been established to support the following corporate goals:

(1) Ensure that all services provided meet or exceed industry standards for quality assurance.

(2) Operate in a manner that supports our corporate philosophy:
"To provide to our clients a broad range of environmental testing services at a fair price delivered with data quality, turnaround time, and client service that consistently meet or exceed expectations."

The NCA QA System operates within this framework of corporate goals to achieve the following specific quality objectives:

(a) Provide effective guidance for verifying compliance with quality and reliability standards.

(b) Provide a mechanism to continually monitor the use and effectiveness of the QA System.

(c) Provide a mechanism for recommending improvements in all areas of NCA operations where quality may be affected.

(d) Provide a system of analytical quality control that will allow the end user to confidently assess the quality of the analytical data.

(e) Ensure comparability of data through standardization of policies, procedures and methodology throughout the NCA network of laboratories.

(f) Ensure that the methodologies selected for a project will yield results that are representative of the parameters to be measured and that the sample handling techniques selected for an analysis will yield results representative of that matrix.

(g) Ensure that the analytical practices employed for a project will yield a sufficient quantity of results which are useable for the intended purposes of the analytical data.

(NELAC 5.5.1c, 5.5.2 a)

1.3 Policy on Review of QA Manual and Quality System

1.3.1 QA Manual Review

The Technical Directors *and Quality Assurance Managers* review the QA Manual on an annual basis. All changes to existing QA policy are discussed at this time. All revisions, additions or deletions to policy are authorized by NCA management via publication of a revision to the QA Manual, which is signed by Management.

(NELAC 5.5.1e)

1.3.2 QA System Review

QA personnel at each location continually assess the efficacy of the NCA Quality System and notify laboratory management, as needed, of corrective actions warranting recommendation for procedure or policy changes. Laboratory management conduct reviews of their Quality Systems and testing activities annually to ensure suitability and effectiveness and to introduce any necessary changes or improvements in the Systems and laboratory operations. Management's conclusions and goals are summarized in report to QA personnel.

(NELAC 5.5.3.2)

1.4 Policy on Ethics and Data Integrity

NCA, as a member of the American Council of Independent Laboratories (ACIL), participates in the ACIL Seal of Excellence Laboratory Program. Participation in this program requires that the laboratory subscribe to a specific Code of Ethics promulgated by the ACIL program. In addition to this industry standard, NCA has further defined its own Ethics Policy (Figure 1) along with a corresponding *Ethics and Data Integrity Agreement* (Figure 2) which clarifies the roles and responsibilities of all staff members with respect to ethical conduct and data integrity.

1.5 Policy on Confidentiality of Information

It is the responsibility of all NCA employees to safeguard sensitive client and company information, including (but not limited to) analytical, financial, marketing, and operating information. Analysis information and results will be released only to the client, or to other parties after receipt of written authorization from the client. The nature of our business and the economic well being of NCA is dependent upon protecting and maintaining client confidentiality, as well as proprietary information.

(NELAC 5.4.2i, 5.5.2 r)

1.6 Policy for Exceptionally Permitting Departures from Documented Policies, Procedures or Contractual Specifications

Departures, exceptions or deviations from documented policies, procedures or contractual specifications are not permitted without approval by the Laboratory Director, Laboratory Manager, Technical Director, or QA Manager, and where applicable, require written permission of the client for whom the data is intended. In order to expedite sample analysis, permission may be confirmed in an email. A copy of the correspondence is retained in the client or work order file.

(NELAC 5.5.2 p)

2.0 ORGANIZATION, RESPONSIBILITIES & AUTHORITIES

2.1 Organization

2.1.1 Organization Objectives

Each individual laboratory and the NCA corporate structure as a whole are organized in such a manner as to:

(a) ensure that, in accordance with NCA's *Ethical Conduct and Data Integrity Agreement and* ACIL's *Code of Ethics,* all personnel are free from any commercial, financial or any other undue pressures which might adversely affect their work.

(NELAC 5.4.2b)

(b) maintain independence of judgement and avoid conflict of interest. For example, the QA staff must have functions independent from the laboratory operations for which they have QA oversight.

(NELAC 5.4.2c,g)

(c) ensure that all work is conducted by persons who are adequately trained and supervised.

(NELAC 5.4.2d,e)

2.1.2 Organizational Charts

The NCA corporate structure is depicted as Figure 3.0. Organizational charts for each NCA facility, included as Figures 3.1 through 3.5, depict each laboratory facility within the NCA corporate structure and document the relationship between management, technical operations and support services of each. Respective responsibilities of key positions to the laboratory's quality system are outlined in Section 2.2. The QA lines of authority are depicted as Figure 4.0.

(NELAC 5.5.2b,c)

2.2 Responsibilities of Key Personnel

The following are brief descriptions of the administrative and QA responsibilities for personnel. Detailed job descriptions, including minimum educational and technical qualifications for each position, are kept by the Human Resources Manager and/or Laboratory *Director*. Due to limited availability of personnel in smaller NCA facilities, one person may assume the responsibilities for more than one position. In such instances, the minimum requirements for all assumed roles must be achieved.

(NELAC 5.4.2d)

2.2.1 Chief Executive Officer

The *Chief Executive Officer (CEO)* has overall responsibility for the business, financial, managerial and technical operation of all NCA laboratory facilities and must provide each member of the management team with sufficient authority and resources to comply with the NCA QA Program. Duties of this position include:

(a) selecting, promoting and directing senior management staff,
(b) delegating authority for major operational functions,
(c) overseeing control of financial responsibilities,
(d) serving as the final authority regarding operational decisions, interpretation of analytical methods and resolution of disagreements regarding QA policies.

(NELAC 5.4.2a, f)

2.2.2 Laboratory Director/Laboratory Manager

The Laboratory Director reports directly to the *CEO*; the Laboratory Manager reports to the Laboratory Director or *Chief Executive Officer*. This senior operational management position within each laboratory is responsible directly, or by delegation, for the following:

(a) management of all analytical and operational activities of the laboratory including: personnel, documentation, sample custody and data quality,
(b) administrative and technical oversight of all data generation and reporting functions and client services,
(c) material and labor management including allocating and hiring technical staff, project scheduling, prioritizing work, production labor, overtime, oversight of laboratory supply purchases and promotion or discipline of operational staff,
(d) ensuring the availability of adequate staff, functional equipment, sufficient technical training and efficient operating systems in order to produce analytical results in compliance with the NCA QA Manual,
(e) coordinating with the QA/Technical Director to ensure timely implementation of QA corrective actions and to resolve any complaints or critical quality issues which might result in interruption of analytical production,

(f) maintaining a proactive program for detecting and preventing improper, unethical or illegal actions associated with the laboratory's operation.

(NELAC 5.6.2a-h)

2.2.3 Technical Director

The Technical Director, *when so named*, reports to the local Laboratory *Director* and has the overall responsibility for implementing, reviewing the effectiveness of and assuring conformance to the NCA QA Program. The Technical Director also has indirect reporting authority to the NCA *Chief Executive Officer* on issues affecting laboratory data quality. The function of the Technical Director and Laboratory Director may be combined if required. Duties include:

(a) communicating quality issues to the *Chief Executive Officer* and Laboratory Director,
(b) technical oversight of laboratory operations; including reviewing bids, proposals, and potential new work and ensuring adequate facilities, resources and capabilities to fulfill the obligation,
(c) initiating and ensuring the completion of QA corrective actions arising from internal/ external audits, client complaints and/or data quality issues,
(d) conducting internal audits and data review,
(e) revision of SOPs, NCA QA Manual and other QA documents,
(f) development, documentation and achievement of training and certification processes,
(g) maintain laboratory certifications and communications with regulatory authorities,
(h) development of new analytical capabilities and answering technical inquiries from clients, project managers and marketing personnel,
(i) responsibility for making decisions regarding quality with primary consideration for limiting liability in order to safeguard long-term profitability. The Technical Director must make decisions regarding quality, independent from immediate profit and scheduling considerations. The Technical Director shall have sufficient authority to interrupt or stop laboratory production in order to rectify any nonconformance or deficiency that will impact upon the overall quality of analytical data. Such authority must be exercised with the knowledge of the Laboratory *Director*. If the Technical Director and Laboratory *Director* are not in agreement with regard to an interruption of production, the *Chief Executive Officer* shall decide the appropriate course of action.

(NELAC 5.5.2 i, 5.4.2 f,g)

2.2.4 Quality Assurance Manager

The QA Manager reports to the Technical Director or Laboratory Director. The Quality Assurance Manager is responsible for supporting the Technical Director in implementing, reviewing and assuring conformance to the NCA QA Manual and measuring its overall effectiveness. Responsibilities include:

(a) ensuring the implementation of quality control procedures and monitoring the collection and summarization of QC data to support reported laboratory data quality objectives for MDL and control limits,
(b) conducting internal audits and data review,
(c) oversight of PT sample analysis, data submission and laboratory certifications,
(d) collection and evaluation of non-conformance reports,
(e) revision of SOPs, NCA QA Manual and other QA documents,
(f) control QA documentation such as SOPs and QA Reports.

(NELAC 5.4.2 g)

2.2.5 Project Manager

Project Managers are responsible for direct interaction with clients to ensure that clients' needs are met and for negotiating appropriate priorities for analytical work. Duties include:

(a) project planning and set-up,
(b) review of contracts and sample log-ins,
(c) project tracking,
(d) ensure that the requirements of NCA policies and any applicable contractual specifications have been met for the project,
(e) final review of all reports, including QC, for completeness and representativeness,
(f) generate and sign the final report.

2.2.6 Department Manager/Analytical Supervisor

The Department Manager/Supervisor oversees the activities of a particular department to ensure that adequate personnel, equipment, time and other company resources are available and properly allocated to successfully accomplish the analytical requirements of projects within the department. Responsibilities of the position include:

(a) ensuring adequate peer and/or supervisory review of all results, including QC data, before submission to Project Managers,
(b) assure that the proper level of analytical QC is being carried out by the analyst and that all QC and other data impacting the analysis are properly documented,
(c) direct QA activities, such as the updating of SOPs and completion of MDL studies .

2.2.7 Environmental Health and Safety Officer

The Environmental Health and Safety (EHS) Officer is responsible for facilitating continuous improvement to laboratory health and safety by development and implementation of a Health and Safety Plan. The EHS Officer also ensures NCA's compliance with hazardous waste disposal regulations by development and implementation of a Hazardous Waste Management Program.

2.2.8 Sample Management Personnel

Sample Management personnel are responsible for receiving and logging-in samples delivered to NCA including:

(a) record the condition of the samples, ensure that samples are preserved properly, delivered in appropriate containers and are present in sufficient quantity for analysis,
(b) maintain a chain of custody, assign laboratory numbers, enter sample work order information into the laboratory information system,
(c) ensure samples are stored properly,
(d) immediately notify the project manager and/or client of any anomalies with sample receipt and/or log-in.

2.2.9 Analyst/Technician

As the primary staff member position, an Analyst/Technician is responsible for all steps in their assigned analytical procedures. Analysts/Technicians are the front line for quality in the laboratory and bear primary responsibility for producing defensible data. Analyst/Technician duties include:

(a) overseeing sample preservation and preparation, performing analysis, and recording all pertinent analytical data,
(b) performing *procedures* consistent with the guidelines specified in the NCA QA Program, all pertinent SOPs and the published analytical reference procedures,
(c) conducting routine maintenance of equipment and document acceptable performance of instrumentation with respect to the requirements of their analytical procedures,
(d) performing, evaluating and documenting the specific QC measures stated in the QA Program and SOPs,
(e) Conducting and documenting primary review of their analytical data prior to release of the data to peers, supervisors, or managers for secondary review.
(f) Reporting out-of-control data or events to the Department Manager, Supervisor and/or QA Manager.

2.3 Deputies

In the case of the absence of one of the following key personnel, the corresponding position noted would be considered the deputy:

(a) President/ CEO	-	Laboratory Director
(b) Laboratory Director	-	Technical Director
(c) Environmental H & S Officer	-	*Laboratory Director*
(d) Technical Director	-	QA Manager
(e) QA Manager	-	Technical Director

(NELAC 5.4.2h)

2.4 General Responsibilities

All laboratory personnel involved in the generation and reporting of data have a responsibility to read and understand the NCA QA Manual. The responsibilities of all laboratory personnel include:

(a) Ensuring that all work generated by them, or for which they are responsible, is in compliance with the NCA QA Manual.
(b) Performing all work according to approved written SOPs based on the most current promulgated method; or, in the absence of an approved SOP, other applicable protocols or methods.
(c) Ensuring that all records related to their work are complete and accurate.
(c) Documenting and providing immediate notification of any quality problems to the QA Manager or other appropriate management personnel.

Laboratory personnel have the authority to accept or reject data based upon compliance with defined QA criteria and/or professional judgement. Department managers must approve the acceptance or rejection of data that falls outside of established QC guidelines. This authority is in accordance with the guidelines established in the NCA QA Manual.

Any effort to influence laboratory personnel, either internally or externally, through undue pressure, commercial representations, financial obligations, or any other such action is strictly prohibited. Any staff member who believes or interprets that such action has been taken must immediately report this activity to the Laboratory Director, Laboratory Manager, Technical Director, and/or QA Manager.

3.0 ACCREDITATIONS, CERTIFICATIONS AND AFFILIATIONS

Each laboratory facility of NCA, Inc. holds accreditations/certifications from various government agencies and private organizations. The accreditations and certifications applicable to the individual NCA location, along with the full scope of parameters, are presented in the respective appendix of this document. Each facility maintains their respective accreditations/certifications independently by (1) compliance with the relevant standards of operation, (2) submission of acceptable performance evaluation test results and (3) undergoing periodic external audits by the accrediting authority. Project Managers work in conjunction with the QA staff to ensure that appropriate certifications are held so that all reported analytical data complies with the clients' regulatory requirements.

(NELAC 5.4.2 j, 5.5.2h)

4.0 PROFESSIONAL STAFF

4.1 Qualifications

NCA ensures that key personnel meet the experience and educational requirements specified by the applicable programs under which work is conducted at each facility by stipulating qualifications for all positions and through continuous training of technical staff. The senior operational staff, Laboratory *Director, Laboratory Manager* and Technical Director, within each laboratory is responsible for ensuring that the laboratory has sufficient qualified personnel to meet the demands of the workload.

(NELAC 5.5.2t, 5.6.2)

4.2 Training

4.2.1 Orientation

When reporting for work for the first time, all new employees at NCA receive a copy of the documents listed below:

(a) NCA Employee Policy Manual: contains information on the company's history and goals, administrative scheduling, benefits, and general administrative policies.

(b) Health and Safety Manual (which includes the *Chemical Hygiene Plan*): contains preventative procedures to avoid emergencies, as well as procedures for coping with emergencies such as spills, injuries, and fire. The *Chemical Hygiene Plan* contains pertinent information about the chemicals to which employees may be exposed and how to properly handle those chemicals.

(c) NCA QA Manual (to read and return): A controlled copy of the QA Program is available to all staff members within their respective departments. Administrative or support staff may be directed to read only specific sections pertaining to their duties. The QAM contains information on the laboratory's quality assurance goals and objectives as well as how those goals are implemented in the laboratory.

(d) Ethics and Data Integrity Agreement: These guides are each new employee's reference Materials. Each new employee must read and understand the contents of these guides and sign a document agreeing to adhere to the requirements prescribed in the manuals, prior to any further training. These records are kept on file with each facility's Personnel or Human Resources Manager.

(NELAC 5.6.2c)

4.2.2 Departmental Operation Training

(a) In each operational area, laboratory method manuals are maintained that include copies of the procedures for which an analyst may be held responsible. These manuals include relevant quality control documentation, standard operating procedures, and procedures for trouble--shooting or corrective action. The analyst/technician must read and understand the contents of the method manuals. The analyst/technician must also be able to answer questions, demonstrating an understanding of the applicable methods.

(b) A Department Manager, Analytical Supervisor or other experienced analyst/technician is responsible for familiarizing new analysts/technicians with the instrumentation or techniques involved in their procedures. This includes covering items such as:

- Review of instrument manuals
- Preventive maintenance procedures
- Troubleshooting techniques
- Calibration requirements
- Documentation practices
- Data archiving procedures
- Maintenance logbooks
- Instrument history
- Hands-on operation of the instrument

4.2.3 Demonstration of Proficiency

The final level of training in every operational department requires a Demonstration of Capability (DOC) and shall be completed prior to analysis of samples. This demonstration may include analysis of proficiency testing (PT) samples, performance of a method validation study, method detection limit study or redundant analysis of client samples. Upon satisfactory completion of this phase, the analyst/technician performs analysis on client samples without oversight by another trained analyst/technician. If the analyst/technician does not meet these requirements he/she continues to work with the experienced analyst/technician until performance requirements are passed successfully.

(NELAC 5.10.2.1)

4.2.4 Training Records

(a) Records of training are maintained through a cooperative effort of each technical employee, their immediate supervisor and the QA Manager, but are the responsibility of the QA Manager.

(b) Training files will be maintained for each technical staff member in the facility (sample control personnel, analysts/technicians, project managers, operational managers, etc.)

(c) Various forms may be used within the laboratory departments to document on-going training and proficiency. At a minimum, all training forms should include:

- Personnel name
- Training title/type or method name
- Date(s) of training
- Supervisor acknowledgment
- Expiration, retraining or re-certification period for the training (if applicable)

(d) Training files should contain:

- Documentation of the employee's agreement and ability to perform the most recent version of any analytical test methods for which they are responsible
- Continued acceptable proficiency test results
- Documentation of training courses or workshops on specific instrumentation, analytical techniques, etc.

(NELAC 5.6.2c, 5.6.3)

5.0 MATERIALS, EQUIPMENT AND FACILITIES

5.1 Facility Descriptions and Floor Plans

5.1.1 Facility Design

(a) All of the facilities were designed by chemists and constructed to meet the specific needs of a modern environmental chemistry laboratory. The buildings feature separate areas for sample receiving, preparation, organic Gas Chromatograph (GC) analyses, organic Gas Chromatograph/ Mass Spectroscopy (GC/MS) analyses, inorganic analyses, microbiological analysis, and administrative functions. Ample space has been provided in all locations for refrigerated storage of samples before analysis and archival storage of samples after analysis.

(b) The laboratories are designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for our employees. OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation, access and safety equipment are met or exceeded. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

(c) Monitoring systems are in place to ensure that each facility adequately supports proper laboratory operation. These systems include but are not limited to:

(1) monitoring of turnaround time,
(2) review of sample weekly/monthly sample volume,
(3) health/safety reports,
(4) quality assurance reports, and
(5) FTE calculations.

Figures 5.1 through 5.5 contain floor plans for the five US facilities detailing location of fume hoods, bench space and instrumentation.

5.1.2 Facility Security

All NCA locations are operated as secure facilities *and all personnel receive general security training as provided in NCA's Security Policy for Hazardous Materials*. Sample receiving and reception entrances are staffed to screen visitors and visitor logbooks are maintained. Laboratory, office and storage areas are restricted. Visitors must be accompanied by an NCA employee at all times while in the facility.

(NELAC 5.7)

5.2 Capital Equipment and Maintenance

5.2.1 Equipment

NCA is continually upgrading and expanding its instrumentation capabilities. All instrumentation utilized is in accordance with the relevant methods and SOPs. Records for all analytical equipment are maintained at each NCA facility and include: equipment type, manufacturer and model number. Facility specific NCA instrumentation is listed in the documented appendix. Instrumentation is purchased with regard to the applicable method performance criteria.

5.2.2 Maintenance

Equipment is kept in proper working order through scheduled maintenance.

(a) Routine Maintenance
Routine maintenance schedules and required spare parts lists are in each specific analytical area. An example of routine maintenance for gas chromatographs might include changing injection liners, replacing septa, recharging gas line filters, and following manufacturer's procedures for cleaning detectors. It is the responsibility of the instrument operator to ensure that preventative maintenance concerns are routinely addressed.

(b) Non-Routine Maintenance
The expertise of department managers is sufficient for most non-routine maintenance and repair of the instrumentation within their department. The department manager, in conjunction with the technical director, is responsible for authorizing outside services for non-routine maintenance or repair of instrumentation. Technical support and services that meet regulatory requirements, such as A2LA Calibration Accreditation Policy – ISO/IEC Guide 17025, and/or manufacturer approvals are utilized for non-routine maintenance.

(NELAC 5.8b&e, 5.5.2m)

5.2.3 Logbooks

All instruments have logbooks in which *operating conditions*, adjustments, routine and non-routine maintenance, and any repairs are recorded. Each entry in the instrument logbook includes the date, the analyst, an adequate description of the problem, an adequate explanation of the solution and a verification that the instrument is functioning properly.

(NELAC 5.8e)

5.2.4 Identification

(a) Each piece of equipment that generates data must be labeled with a unique identification. Raw data can then be traced to the instrument from which it was generated. The unique identification of an instrument should also be noted in the instrument logbook.

(b) Any instrument or piece of equipment that has been shown to be defective, in that data generated by it consistently does not meet quality standards, shall be taken out of service and clearly identified as such.

(NELAC 5.8c)

(c) Calibration of instrumentation is maintained such that the instrument remains in an operative state or performed prior to commencement of analysis. Calibration status is therefore not designated on an instrument. Raw data supporting instrument calibration is retained in the respective department.

(NELAC 5.8d)

5.3 Purchasing of Materials

Materials for use in the analytical process must meet applicable guidelines. This includes all gases used in gas chromatography, stock standards, all solvents, acids, and bases used in extraction or digestion, dilution, and standard preparation, and any other routinely restocked items. Upon receipt of any of items for which it is applicable, the lot number from the manufacturer is recorded and the purity of the lot established through a method blank and/or a calibration check. Specific detail of documentation requirements for reference standards is covered in the applicable section of this document. Routinely restocked items are purchased from qualified suppliers.

(NELAC 5.5.2l, 5.15)

6.0 SUBCONTRACTING

6.1 Requirements for Subcontracted Facility

(a) When subcontracting analytical services NCA will assure, to the extent necessary, that the subcontract laboratory maintains a QA Program consistent with the requirements of this document, the requirements specified in ISO/IEC 17025 *and/or the client's Quality Assurance Project Plan (QAPP)*.

(b) Work will only be subcontracted to laboratories holding current approval status with the accrediting body under which the work is being conducted.

(NELAC 5.14b)

(c) When possible, subcontract work from a NCA laboratory will be performed in other NCA facilities or by laboratories affiliated with the Sequoia Laboratory Network.

6.2 Evaluation and Responsibilities

(a) The QA Manager is responsible for evaluating the subcontractor's QA Program and accreditations and retaining current documentation of the evaluation. Subcontractor evaluation may or may not include an on-site audit. At a minimum, the subcontractor's accreditations and a copy of their QA manual will be reviewed *and kept on file*.

(b) The Project Manager is as responsible to the client for subcontracted data as they are for data generated by their own facility. The project manager should monitor the status of the analyses and communicate with the subcontract laboratory to facilitate the successful execution of the work and ensure the timeliness and completeness of the analytical report.

(c) A Project Manager may ship samples to a subcontract laboratory at any point after approval of the sample receipt documentation. The sample control department within each facility bears responsibility for ensuring compliance with applicable shipping regulations and QA requirements when shipping samples from an NCA facility to a subcontract laboratory.

(d) Raw data for subcontracted work will only be retained at the subcontract facility, except in cases were a data package is requested for the project. Copies of the raw data will then also be retained at the originating NCA laboratory.

(e) If work subcontracted between NCA facilities requires a data package, the subcontracted facility may be requested to provide the data as a complete package to be appended to that of the originating NCA laboratory.

6.3 Notification

(a) NCA will notify the client in writing (e-mails acceptable) of the intent to subcontract any part of their requested analytical testing and when appropriate, gain the approval of the client, preferably in writing. Client notification will be documented and maintained with the appropriate work order.

(NELAC 5.14a)

(b) The Project manager is responsible for notification and documentation.

(c) Data reported from analyses performed by a subcontractor laboratory will be clearly identified as such on the analytical report provided to the client.

(NELAC 5.14b)

7.0 SAMPLING PROCEDURES

The generation of quality data begins with the collection of the sample, and therefore the integrity of the sample collection process is of concern to the laboratory. Written sample collection procedures are available for clients who are performing sampling for drinking water testing. Sample collection guidelines, appropriate containers, preservatives and volumes required for analyzing routine parameters are included in the appendices of this document. In order to help ensure sample integrity, the following points, while outside of normal analytical laboratory operations, are included in the QA Manual:

(a) Samples must be collected in appropriate containers. In general, pre-cleaned *and certified* glass containers are used for organic parameters, and pre-cleaned *and certified* polyethylene containers are used for inorganic/metals parameters.
(b) Sample containers must be properly cleaned *to eliminate one potential source of contamination that could occur during the collection process.*
(c) Samples must be preserved and/or collected appropriately to minimize the loss of compounds of interest due to adsorption, volatilization, chemical degradation, or biological degradation.
(d) Appropriate volumes of sample must be collected to ensure that the required reporting limits can be met and that the required quality control frequency can be analyzed.
(e) Samples must be properly shipped to the laboratory in the appropriate time frame to ensure that temperature and holding time requirements can be achieved.

7.1 Holding Times

The U.S. EPA has established holding time requirements for various analyses. These holding time requirements are listed in the documented appendix of this document. As indicated, holding time requirements differ depending upon the applicable regulatory program. NCA follows the holding times given in SW-846 unless otherwise stipulated by methodology or regulatory authority *or project-specific QAPP.*

8.0 WORK PLAN REVIEW AND SAMPLE MANAGEMENT

8.1 Objectives

Prior to the commencement of work, *NCA will request that the client provide significant project details so that facilities and resources may be properly evaluated* before commencing such work. NCA's sample management system receives, tracks, preserves, stores, and disposes of samples under controlled conditions. Controls for sample receipt and custody are established by applicable protocols as documented in SW-846, and/or other governing regulations such as NELAC. Facility-specific SOPs document work plan review, sample handling procedures, and performance guidelines.

8.2 Work Plan Review

Prior to receiving samples associated with a contract or bid, the NCA project manager reviews the project-specific requirements found in these documents or the project's QA Plan or Sampling and Analysis Plan. The project manager assesses the laboratory's ability to meet these requirements. If conflicts exist, they are resolved to the client's satisfaction before the receipt of any samples. *If samples are submitted without project-specific requirements, NCA will default to standard NCA method analyte lists, reporting limits and control limits.*

Sample Receipt

A sample acceptance policy is outlined in the facility-specific SOP. Upon receipt, the Sample Control Department Manager (or designee) must document the acceptance of samples from the courier and the date/time of acceptance. The following criteria must be evaluated and documented according to the facility-specific SOP:

- Proper and complete COC documentation
- Presence or absence of custody seals
- *Appropriate cooler temperature on temp blank*
- Adherence to specified hold times
- Condition of sample containers
- Proper sample labeling
- Use of appropriate sample containers
- Appropriate sample preservation (if applicable)
- Adequate sample volume

(NELAC 5.11.2 & 5.11.3a-b)

If deviations from policy are observed, clients will be notified immediately to determine the appropriate course of action and data from the affected samples will be flagged. Samples will remain under the control of the Sample Custodian until transferred to the appropriate storage area. Following transfer to the laboratory, all samples must remain in custody.

(NELAC 5.11.3c)

8.4 Chain-of-Custody Documentation

The chain-of-custody (COC) documents the history and trace-ability of the sampling/analytical programs. All samples received by NCA must be accompanied by a COC and should contain the following information:

- Date/Time of Sampling
- Sample Identification
- Number of Containers
- Preservation Type
- Special Instructions
- Date of Transfer
- *Collector's name*
- Sample Matrix
- *Location*
- Type of Containers
- Requested Analysis
- Signature of Sampler
- Time of Transfer
- Project Identification

If a COC is not received with the sample delivery, the appropriate project manager must contact the client immediately and establish an adequate resolution for custodial integrity.

8.5 Sample Log-in

Samples are logged in to the Laboratory Information Management (LIM) system. Each sample container is assigned a unique identification number. The following information is typically recorded in the laboratory's work order log within the LIM system

- *Client/Project Name*
- *Unique laboratory ID code*
- *Requested analyses linked to lab ID code*
- *Date and time of laboratory receipt*
- *linked field ID code*
- *Initials of person responsible for the entries*

(NELAC 5.11.1a & 5.11.3d)

8.6 Sample Storage

Samples, sample fractions, and/or sample extracts will be stored in a controlled environment of the type dictated by the analytical protocol. For refrigerated areas, the Sample Control Manager (or designee) will monitor and record storage temperatures as specified in the appropriate facility SOP. NCA laboratories are controlled access facilities, and as such, all sample storage areas within each facility are deemed secure and under custodial integrity.

8.7 Sample Custody

A sample is considered to be under custody if it:

- Is in the physical possession of the analyst
- Is in view of the analyst
- Is stored and secured within a controlled access area

9.0 ANALYTICAL QUALITY CONTROL

9.1 Objectives

Analytical Quality Control (QC) refers to the routine application of statistically based procedures to evaluate and control the reliability of results from analytical measurements.

9.1.1 The types of QC samples employed and their frequency of use is derived from the following sources:

(a) Quality control practices outlined in the reference documents associated with the analytical methods themselves. For instance, EPA SW-846 method 7000 establishes general quality control requirements for metals analyses while Method 8000 establishes the same for organic analyses.

(b) Other quality control measures set out in the laboratory evaluation guidance documents under which laboratory accreditation is maintained (i.e. ISO/IEC Guide 17025).

(c) Program specific requirements.

9.1.2 At a minimum the following essential QC parameters are monitored:

(a) Process or instrument contamination through analysis of blanks.
(b) Matrix bias through analysis of Matrix Spike samples.
(c) Precision through the analysis of Duplicate samples or duplicate spikes.
(d) Accuracy through the analysis of Surrogate spikes and Laboratory Control Samples.
(e) Method Detection Capability through performance of MDL and/or IDL studies.
(f) Comparability of data to outside sources through analysis of Blind Performance Evaluation samples and second source calibration checks.
(g) Instrument and Method performance through analysis of calibration standards.

9.1.3 Control limits and Data Quality Objectives for the essential QC parameters listed above are derived by reference to:

- Acceptance criteria published in the individual analytical methods employed.
- Acceptance criteria mandated through contractual agreement *or program requirements.*

- Acceptance criteria derived "in-house" through the use of a statistically valid measurement technique such as control charting.

9.1.4 Outliers are identified and appropriate corrective action is taken according to the guidelines given in the applicable SOPs for each analytical area or *designated in a specific program.*

9.2 Analytical Batch and QC Samples

9.2.1 Analytical Batch

Samples to be analyzed are grouped together in a batch. The number and frequency of QC samples to be analyzed are assigned on a per batch basis. NCA conforms to the definition of an analytical batch provided in Chapter 1 of SW-846:

> *A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.*

The frequency and type of QC samples within a batch will conform to the specific requirements of *a program*, the mandated test method or applicable regulation as specified in the applicable SOP. All analytical batches will contain a minimum of the following QC samples:

- one method blank
- one set of duplicates
  (sample duplicates, spiked duplicates or Laboratory Control sample duplicates)
- some form of reference sample
  (blank spike, matrix spike or certified reference material)

This minimum will often be exceeded by the set of quality control samples dictated by each specific methodology or specific program requirements. Standard operating procedures must clearly document the set of quality control samples that will be incorporated into analytical methods and take precedence in establishing analytical frequency.

9.2.2 QC Samples

Quality Control samples are employed at NCA as a means of assessing method performance on an on-going basis. The following types of QC samples are analyzed to meet the objectives outlined in Section 9.1 above.

9.2.2.1 Surrogate Spikes

In most organic analyses, surrogate compounds are spiked into all field and QC samples. Surrogates are a check on efficiency of the extraction. The percent recovery of surrogates is documented and compared to established control limits. The use of surrogates provides a technique for monitoring the degree to which the associated target analytes can be recovered from each specific sample's matrix.

9.2.2.2 Matrix Spikes, Blank Spikes and Reference Samples

Accuracy measurements are performed to verify the agreement of an analytical result with the certified value. Depending upon the specific requirements of the method, either an environmental sample of the appropriate matrix or a laboratory blank matrix may be spiked with a known quantity of the analyte(s) and analyzed in the same manner as the rest of the analytical batch. Additionally, reference samples are available from many commercial vendors. Reference samples consist of real-world samples or commercially prepared lots of spiked matrices which have been statistically characterized through inter-laboratory comparisons to obtain reference or "true" values for a selected list of target analytes in the sample. The percent recovery (%R) of an analyte in a spiked or reference sample is evaluated against the control limits set for that analyte. Percent recovery is calculated as follows:

$$\%\ Recovery = \frac{(Conc.\ of\ Spike) - (Conc.\ of\ Sample)}{Spike\ Conc.\ Added} * 100$$

9.2.2.3 Sample And Spike Duplicates

(a) Results of duplicate sample analyses, duplicate spike analyses and/or duplicate reference sample analyses can be used to determine precision within each batch. The relative percent difference (RPD) between the two duplicates is evaluated against the control limits established for the analyte. The RPD is calculated as follows:

$$Relative\ \%\ Difference = \frac{|D1 - D2|}{(D1 + D2)/2} * 100$$

$D1 = Result\ of\ first\ duplicate$

$D2 = Result\ of\ second\ duplicate$

(b) Unless otherwise specified by the analytical method, associated reference guidance or a client-specific project plan, the RPD between spiked samples will be calculated using the absolute values of their measured concentrations, and not the *values of their percent recoveries*.

(c) Unless otherwise specified, control limits for RPD are based upon representative mid-level responses. For most methods performed within the laboratory, RPD values will increase dramatically as the absolute values of the replicates approach the reporting limit for the analyte. Necessity for corrective action will not, therefore, be indicated when low-concentration replicates (i.e. one or both replicates less than 5 times the MRL) yield an RPD value above the control limit.

9.2.2.4 Blanks

(a) Method Blanks

The method blank is used to measure the analytical response attributable to all factors other than the analyte in the sample. Method blanks are analyzed identically to the samples; however, they are prepared from laboratory matrices that do not contain analytes. The specific frequency of use for method blanks during the analytical sequence is generally defined in the specific standard operating procedure for each analysis.

Method blank acceptance criteria shall be in accordance with that documented in the analytical SOP or as documented in project data quality objectives. Analytes detected in the method blank at levels above the MRL shall be investigated and corrective action taken. In situations where method blank contamination is reported, the samples within the batch containing similar contamination shall be flagged accordingly.

(b) Calibration Blanks
Calibration blanks are prepared and analyzed along with calibration standards. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.

(c) Instrument Blanks
Blank reagents or reagent water may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

9.2.2.5 Method Detection Limit (MDL)
The Method Detection Limit (MDL) is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte. For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of seven analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL.

Estimate the MDL as follows:
Obtain the concentration value that corresponds to:
a) an instrument signal/noise ratio within the range of 2.5 to 5.0, or
b) the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

9.2.2.6 Method Reporting Limits
Method Reporting Limits (MRLs) are defined as the lowest value to which the laboratory will report an unqualified quantitative result for an analyte. In accordance with SW-846 guidance, the lowest concentration standard employed for initial calibration or analyzed in conjunction with samples defines the reporting limit for each analyte. They are generally assigned as multiples of the MDL. If required by contract or protocol, results obtained below the method reporting limit but above the corresponding MDL may be reported if flagged as estimated values.

9.2.3 Traceability of Measurements

Procedures for ensuring the traceability of measurements must be documented in appropriate SOPs. These SOPs must adequately address the procedures and guidelines for selecting, purchasing, handling, storing, monitoring, and using standards, reagents, reference materials, equipment, and services. SOPs, as appended to this document, must be available to all laboratory personnel for review and reference.

(NELAC 5.5.2.g)

9.3 Instrument and Equipment Calibration

9.3.1 Instrument Calibration

Instrument calibration procedures vary significantly between the various types of analytical methods performed within the NCA facilities. As a general policy, calibration of instrumentation is performed in accordance with the protocols and frequencies cited in the applicable guidance documents associated with the analytical methods employed by the laboratory (i.e. SW-846 method 7000 for metals, method 8000 for Organics). Actual procedures are clearly defined by the standard operating procedure (SOP) associated with each method. Acceptance criteria for establishing acceptable calibration performance are also given in the reference procedures and analytical SOPs maintained within each facility.

9.3.2 Standards

Standard reference materials used for instrument calibration may be obtained from a variety of sources, providing the material is certified and, whenever possible, N.I.S.T traceable. Standards are purchased from commercial suppliers, dated upon receipt, and replaced as needed according to the methodology or manufacturer recommendations. Standards are logged in to the Laboratory Information Management System (LIMS) and assigned a unique identification number. The following information is typically recorded in the laboratory's electronic standards log within the LIMS:

- Standard ID
- Description of Standard
- Department
- Solvent type/Lot #
- Final Volume
- Expiration Date
- Preparation Date
- Prepared By
- Source Type (daughter solution or primary stock)
- Solution Type (Spike, Surrogate or Other)
- Descriptive Comments (Lot #'s, prep instructions, etc.)
- Parent Standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount Used (if applicable)
- Component Analytes
- Final concentration of each analyte

Labels can be generated from the LIMS or prepared by hand. At a minimum, all standards must be labeled with the Standard ID, Description of the Standard, Date Prepared, Expiration Date, and the initials of the chemist preparing the standard. Standard ID numbers are documented on all associated analytical raw data so that the analytical procedure can be unambiguously traced to the certified reference materials used in generation of the data.

9.3.3 General Equipment

Balances - Calibration and service is performed at least once per year by an outside company. Balance calibration is verified by laboratory personnel using certified reference weights each day of use. Each laboratory's reference weights are evaluated and re-calibrated by a *certified metrology laboratory* at least once every five years.

Critical thermometers - Thermometers associated with analytical procedures, sample storage or reagent storage are checked against a N.I.S.T. traceable reference thermometer on at least an annual basis. Each laboratory's NIST reference thermometer is evaluated and re-calibrated by a *certified metrology laboratory* at least once every three years for those laboratories involved in drinking water testing and five years for all others.

Temperature Control Logs - Temperature control logs are used for ovens, refrigerators, incubators, and other temperature controlled equipment. Temperature logs provide a written record of operating consistency for monitored equipment and help to immediately identify or even prevent equipment malfunctions which might compromise sample integrity or data quality.

Deionized Water Monitoring - The conductivity of the laboratory deionized water is monitored daily by checking a conductivity gauge attached to the deionizing system. Analytical conductivity readings are also taken at points of use throughout the laboratory on a weekly basis.

Mechanical Pipet Calibration - Mechanical pipets are checked to ensure that they are capable of delivering their indicated volumes within specific accuracy and precision requirements. The specific requirements and procedures for performing and documenting pipet calibration are maintained within each facility.

9.4 Control Charting and Acceptance Criteria

9.4.1 Control Charting

Control charts are statistical mechanisms used to graphically monitor data quality objectives in the laboratory. Quality Control sample results are grouped and plotted as individual points. Warning and control limits are calculated for each data quality parameter at +/- 2 and +/- 3 times the standard deviation from the mean of the group of data points used to construct the control chart. These warning and control limits trigger levels of corrective action as defined in specific laboratory SOPs.

The database program utilized within the NCA facilities permits rapid evaluation of control charts for individual or grouped sets of analyses and matrices. As a general policy, control charts should be evaluated by the analysts associated with their methods as a normal part of analytical data review procedures. Control charts are evaluated to detect trends in the performance of the method with respect to the charted QC Samples and to assess the applicability of the control limits currently in place for the methodology.

9.4.2 Acceptance Criteria

Acceptance criteria (Control Limits) for QC Samples are established to evaluate laboratory precision and bias based on the analysis of control samples. Typically, control limits for bias are based on the historical mean recovery plus or minus three standard deviation units, and control limits for precision range from zero (no difference between duplicate control samples) to the historical mean relative percent difference plus three standard deviation units.

QC Sample acceptance criteria are often established according to individual method requirements. When a method does not define limits, analysts, supervisors, department managers, and other technical staff in cooperation determine limits with the QA Manager. Control limits may be based on both evaluation of historical performance and statistical data. In the absence of sufficient data to establish meaningful control limits, the QA Manager, senior operational managers and Department Managers work together to set default limits based upon related methodology or industry standards.

Analysts and Department Managers evaluate control limits at least annually. The need for changes may be indicated by statistical evaluation of QC samples, review of control charts or by other factors associated with the procedure. Changes to the control limits assigned to an analysis must be reviewed and approved by the QA Manager.

In an effort to maintain continuity and consistency between each laboratory's Data Quality Objectives (compiled list of all control limits, reporting limits and related method information), control limits shall be consistent with those specified in the appropriate analytical protocol. Control limits based upon statistical interpretation (control charting) of historical data should fall within those specified in the appropriate analytical protocol, and any exceptions to this treatment shall be reviewed/approved by the QA Manager and/or Technical Director prior to use.

9.5 Methods and Method Development

9.5.1 Selection of Methods

The analytical methods employed within the laboratory must be based upon sound laboratory practices and established scientific principles. In general, NCA follows procedures established by EPA SW 846 Methods, EPA Series 500 and 600 Methods, ASTM Standards, Code of Federal Regulations Title 40, and Standard Methods (applicable promulgated edition). *NCA must follow specific project or regulatory program required methodologies.* When specified, such requirements will be followed.

9.5.2 Method Development and Initial Demonstration of Capability

Development of a method encompasses the completion of a standard operating procedure along with any requisite initial demonstrations of capability (IDC). The standard operating procedure must clearly define how NCA plans to implement the referenced method. Any significant deviations from the referenced method must be clearly described. In almost all cases, an IDC will include a method detection limit (MDL) study, but may also include one or more of the following items:

- Instrument Detection Limit (IDL) study
- Linear Range (LR) study
- Precision and Accuracy (P&A) study
- Desorption Efficiency (DE) study
- Retention Time Window (RTW) determination
- Standard Reference Material (SRM) analysis (if available)
- Single-blind Performance Evaluation (PE) sample analysis (if available)

When not otherwise specified in the analytical method reference or associated guidance documents, the QA Manager, senior operations managers and Department Managers work together to determine which of these items will be required as part of the IDC.

The various studies comprising the Initial Demonstration of Capability are performed in accordance with the applicable reference documents associated with the analytical methods. Unless otherwise specified, MDLs are determined in accordance with the procedure outlined in 40 CFR part 136 Appendix B (rev 1.01). Where methods provide specific performance criteria, acceptable performance on IDC studies must be documented for all analytes reported for the analytical technique.

9.5.3 On-Going Demonstration of Capability

Due to incremental changes in analytical equipment, personnel practices and related analytical variables, demonstrations of capability must be performed on routine analytical procedures at least once annually. A new demonstration of capability must also be performed when the analytical process undergoes a major change. Unless otherwise specified in the analytical method reference or associated guidance documents, the QA Manager, senior operations managers and Department Managers work together to determine whether or not a revision to an on-going analytical process constitutes a major change.

10.0 DATA GENERATION, VALIDATION AND REPORTING

Specific procedures for reducing, verifying and reporting data are outlined within the corresponding SOPs maintained by the QA Managers in their respective facilities. General policies common to the facilities are outlined below:

10.1 Data Generation

All observations, measurements and calculations for standards, calibrations, preparations, digestions, cleanup procedures, sample measurement, quality control sample measurement and general analytical conditions are documented via hand-written notations in hard-bound logbooks, designated record-keeping forms, or are printed from electronic data systems and compiled in a comprehensive manner to provide quick reference to reviewers.

All hand-written notations in logbooks, record forms or hard-copy printouts of analytical records must be marked with the initials of the person responsible for the notation along with the date the notation was performed. Any corrections to the analytical data must be performed by marking through the errant information with a single line followed by the initial of the person performing the correction and the date when the correction was performed. In some cases, it may be necessary to provide further explanation on the analytical records regarding the reasons for a correction.

Once the analyst is satisfied that the analytical data have been generated using sound laboratory practices and meets all applicable quality control requirements, the data are transferred to an electronic data base via hand-entry into the database's programmed user interface or through Datatool, *Element's* automatic upload for electronic data files.

10.2 Validation and Review

NCA's general policy for data validation requires that all data generated within each NCA laboratory be subjected to at least three levels of review before being released to the client. The levels of review are outlined as follows:

First level: Bench-level review of analytical data against QA/QC policies, SOPs and pre-determined performance criteria by the analyst responsible for conducting the analysis. This level of review is typically performed within the laboratory's database program which provides the reviewer with preparation information, standards concentrations, detection/reporting limits, QC acceptance limits, initial results, percent solids and final calculated results.

Second level: Peer and/or supervisory review of the documentation from the analysis to confirm the observations and calculations of the original analyst, compliance with applicable policies and procedures and to confirm the absence of transcription errors. This level of review is typically conducted using the hard-copy records from the analysis along with the laboratory database review screen. Acknowledgment of second level review is indicated within the database program when the reviewer updates the status of the analytical results so that the project management group may proceed with analytical reporting.

Second level reviewers may be peer analysts who have completed the necessary training to review the specific type of analytical data or they may be supervisors, department managers or other management team staff with the appropriate experience and method knowledge to conduct the review. *Second level review may not be performed by the original analyst.*

Third level: Project level review of the results focuses on the completeness of the analytical data, comparability between associated tests, and confirmation of compliance with project specifications or other client expectations, consistency with historical data, and appropriateness. This type of review is typically conducted by producing an electronic draft of the analytical report from the laboratory database program. During preparation of the draft, the Laboratory Information Management System (LIMS) program automatically checks for and lists any sample results involving out-of-control QC samples, modified analyte lists, or any special data flags which may have been assigned by the primary or secondary reviewers. The Project Manager is responsible for conducting third-level review. When a Case Narrative is required, the Project Manager is also responsible for compiling any comments from Non-Conformance reports or analyst notations in the LIMS to explain exceptional incidents associated with the analytical process.

Third level review may not be performed by the original analyst but it may be performed by the second level reviewer when this person is also a Project Manager or otherwise responsible for generation of the analytical report to the client.

7.3 *Reporting*

Final reports are generated by Project Managers after all three levels of review have been successfully completed. Generation of the final report is accomplished when the Project Manager generates and saves the electronic version of the draft report to a centralized electronic archive and then prints the file on laboratory letterhead. In order to ensure consistency between the different formats of analytical data, electronic data files (Electronic Data Deliverables or "EDDs") may be produced directly from the Laboratory Information Management System (LIMS) at the same time the hard-copy final report is generated.

Copies of the signed final report are maintained along with the project folder for each work order. Project folders and supporting analytical raw data are archived for a minimum of seven years unless otherwise specified by client contract or other expressed agreements.

NCA offers four levels of report formats to meet the needs the client. Level I, III, IV and electronic deliverables are provided upon request. The default format for analytical results is Level II.

Level I: Standard Analytical Summary Report – analytical results summary.

Level II: Standard Analytical Report – analytical results summary and batch QC summary.

Level III: Standard Analytical Report – analytical results summary, batch QC summary, continuing calibration summary, and sample raw data.

Level IV: Standard Analytical Report – analytical results summary, QC summary with site-specific QC, QC raw data, continuing calibration summaries, continuing calibration raw data, initial calibration summaries, initial calibration raw data, sample raw data, case narrative, chain of custody and any other pertinent data requested by the client or their authorized representative.

NCA provides a variety of reporting formats, from electronic deliverables to our standard paper report. In general NCA reports include:

Summary Page: Client Sample ID, Laboratory Sample ID, Sample Matrix, Date/Time Sampled, *Date/Time Received* and Header with Client and Project information.

Sample Page: Client Sample ID, Laboratory Sample ID, Analytical Results, *Dilution Factor*, Method Reporting Limit, Data Qualification Codes, Batch Identification, Preparation Date, Analysis Date, Specific Method, Units, Matrix, Analyte Identification and Header with Client and Project information.

QC Page: Laboratory Sample ID, QC Results, *Spike Level*, QC Acceptance Limits, Method Reporting Limit, Data Qualification Codes, Batch Identification, Preparation Date, *Preparation* Method, Units, Analyte Identification and Header with Client and Project information.

Notes and Definitions Page: Data Qualifiers, Abbreviations, and Header with Client and Project information.

11.0 CORRECTIVE ACTION

11.1 Policy

It is NCA's policy to ensure continuous acceptable quality levels for all lab services provided. In order to meet this goal, a system has been established to assure that conditions adverse to quality are promptly identified and corrected. Acceptance criteria pertinent to measurements and/or traceability of measurements are documented in the applicable SOPs. Required corrective actions for situations outside of these acceptance criteria are also detailed in the SOP. Monitoring and adherence to these acceptance criteria and/or corrective actions is completed by both bench and management level personnel.

(NELAC 5.5.3.5)

11.2 Bench Level Corrective Action

Isolated events which may have a negative impact on quality are documented at the bench level through use of a Non-Conformance Report. At a minimum, the form used must serve to document the date/time, personnel involved and conditions of the problem, along with the date/time, explanation of resolution and supervisory or QA approval.

Unless otherwise addressed in the SOPs associated with an analytical procedure, individual events that may affect quality are documented on a non-conformance report and brought to the immediate attention of the Department Manager and Project Manager. The Department Manager is responsible for notifying and consulting with Project Managers, the QA Manager or senior operational managers as necessary to resolve the issues associated with the non-conformance. Project Managers are responsible for notifying and consulting with the client regarding non-conformances.

Examples of non-conformance events which may not otherwise be addressed in analytical SOPs might include one time variations in method parameters due to an unusual matrix, evidence of unusual laboratory contamination, loss or damage to the sample or its extract, or unusually high concentrations of interferences which render the intended method inappropriate for the sample. When such an event is recognized, its impact upon quality is assessed and corrective action is decided upon. The Department Manager, Supervisor and/or QA Manager approve the corrective action. The Project Manager files a copy of the non-conformance report with the project folder *to permit the reconstruction of the data set at a later date, if necessary.* A second copy of the non-conformance report is maintained by the QA Manager to monitor trends in the laboratory.

11.3 Management Level Corrective Action

The Quality Assurance Manager may initiate investigation and corrective action by issuing a formal Corrective Action Report (CAR) or similar suitable report in any of the following situations:

- When an audit (see Section 12, *Laboratory Evaluation and Audits*) reveals circumstances that may adversely affect quality as determined by the QA Manager.
- When review of non-conformance reports reveals a significant trend which may adversely affect quality.
- When a technical complaint is received from clients, auditors, regulatory representatives or NCA staff indicating problems associated with quality.

The progress of corrective actions is documented through the CAR form. At a minimum, the CAR form must serve to document the following corrective action sequence:

(a) Identify the problem and define its impact on data quality.
(b) Assign responsibility for investigation and proposed completion date.
(c) Investigate and determine the cause of the problem by promptly auditing those areas of activity and responsibility.
(d) Determine a course of corrective action.
(e) Assign responsibility for implementing the corrective action and proposed completion date.
(f) Verify that the corrective action was successful.
(g) Evaluate the effectiveness of the corrective action in preventing further events that may impact adversely on data quality.
(h) The QA Manager will maintain records of the complaint and subsequent actions.

12.0 LABORATORY EVALUATION AND AUDITS

Laboratory audit procedures provide assurance that the quality control process is being performed effectively. Audits specifically provide management with an on-going assessment of the quality of results produced by the laboratory, including how well the policies and procedures of the Quality Assurance System are being executed. They are also instrumental in identifying areas where improvement in the QA System will increase the reliability of data. *There are three types of audits: System Audits, Technical Audits and Performance Audits.*

12.1 Quality System Reviews - System and Technical Audits

NCA system audits consist of evaluations of the measurement system to ensure proper care and use, while technical audits assure that the laboratory is adhering to policies and procedures set forth in this QAM, the SOPs and the published methods. A component of NCA's technical audit is the Data Quality Audit. In a data quality audit, the technical completeness and accuracy of a data set are evaluated. These evaluations are completed on 10% of the analytical reports generated by a laboratory. Data quality audits are also conducted at the request of a client or a NCA project manager.

System and technical audits are planned, organized and performed by the QA Manager or other qualified personnel within each facility, according to a predetermined schedule and when requested by management. System and technical audits may be combined, as long as all elements/areas of the laboratory are reviewed over the course of one year. The results of all QA inspections and resulting corrective actions are filed together and are under the control of the QA Managers. A report is prepared based on the audit and is distributed to management in a timely manner. The report is also discussed with laboratory personnel so that a concerted effort can be made to correct all deficiencies and to provide positive feedback. Where audits findings cast doubt on the correctness or validity of reported test results, the laboratory shall take immediate corrective action and shall immediately notify, in writing, any client whose worked was involved.

(NELAC 5.5.3.1)

12.2 Performance Audits

Performance Testing (PT) is a quantitative assessment of the accuracy of an analysis. Hence, it is a means to evaluate the performance of laboratory technicians and the instrumentation or analytical systems on which they work. NCA participates in both internal and external laboratory check sample programs as a means for examining overall laboratory performance, as well as, to qualify for various federal, state and independent certification programs. All laboratories are required to perform at least two proficiency testing studies per year *for each program (e.g., drinking water),* utilizing NIST approved PT samples, to comply with NELAC requirements.

(NELAC 2.2.3, 2.4.1)

13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

It is the responsibility of the Quality Assurance Managers, as part of their participation in the QA Committee, to maintain consistent and effective lines of communication with corporate management. To facilitate this communication, the following system of reporting has been established:

(a) QA Managers will prepare a Quality Assurance Summary report covering the activities at their facility on at least a quarterly basis. These reports are submitted to the Technical Director and intended for use in the Director's annual assessment and report (1.3.2). *The reports will summarize the facility-specific QA activities such as accreditation proceedings, staff training, internal audits, external audits, performance evaluation results, Corrective Action investigations, trend analysis and client feedback that occurred or were received during the time period.*

(b) QA Managers will provide formal notification to the Laboratory Director, senior operational managers and Project Managers at all NCA facilities whenever an accreditation status changes for their facility.

14.0 DOCUMENTS AND DOCUMENT CONTROL

This section outlines the key types of documents, their preparation, control and storage.

14.1 Analytical Reports, Data and Associated Documents

Records generated as the result of analytical procedures may include the following: Analytical Reports, Chains of Custody, Logbooks, Lab Notebooks, Bench Sheets, Nonconformance Reports, Chromatograms and Spectra. All such records whether in electronic or hard-copy format are stored chronologically by batch or project and kept for a minimal period of seven years.

14.2 Document Control

NCA requires that document control procedures ensure:

(a) Pertinent issues of appropriate documents are available in all locations.
(b) Invalid or obsolete documents are promptly replaced with updated versions and reasonable notification is provided as to the newly available updates.
(c) All reasonable precautions will be exercised to protect records from damage or tampering.
(d) All NCA locations archive data in compliance with applicable *corporate policies and facility-specific SOPs*.

14.3 Controlled Documents

The following documents are subject to document control procedures within the laboratory:

- Quality Assurance Manual
- Standard Operating Procedures
- *Employee Policy Manual*

While these documents are controlled internally, copies of these documents may be circulated for review outside of the laboratory. These external copies will not be subject to document control procedures.

(a) Quality Assurance Manual (QAM)
For tracking purposes, all editions of the QAM will be issued with revision numbers and effective dates on each page of the document. Signed original copies will be kept in the QA Departments of each NCA facility. The QA Department in each facility will be responsible for distribution and tracking of all copies of the document to ensure that all staff members have access to the most recent revision and that all obsolete revisions are properly retired from use. *NCA employees also have access to a secured, electronic version of this document on the intranet.*

(b) Standard Operating Procedures
For tracking purposes, all SOPs are issued with unique document numbers, revision numbers and revision/effective dates. The QA Department for each NCA facility will maintain a file of original documents, produce sufficient copies to ensure that all staff members have access to the most recent revisions and retire all obsolete revisions. Obsolete revisions of all SOPs will be archived by the QA Department at each NCA facility. *A facility may also provide its employees with access to secured, electronic versions of the SOPs.*

(c) Employee Policy Manual
For tracking purposes, the Employee Policy Manual is issued with a unique document number and effective date. The corporate HR Department will be responsible for distribution and tracking of all copies of the document to ensure that all staff members have access to the most recent revision and that all obsolete revisions are properly retired from use. NCA employees also have access to a secured, electronic version of this document on the intranet.

15.0 CONTROL OF COMPUTER DATA AND SOFTWARE

NCA uses computers and software programs for:

- Control and data acquisition for laboratory instrumentation
- Automation and presentation of routine calculations
- Storage and retrieval of analytical data
- Compilation of analytical and business reports

Computer systems are located throughout each laboratory with information gathering, review, security, and backup activities coordinated primarily through a local area network (LAN). An Information Systems (IS) Manager and/or a designated Systems Administrator (SA) shall bear responsibility for management of all computer systems within each NCA laboratory facility.

15.1 Personnel and Responsibilities
The Information Systems Manager and/or System Administrator within each location is responsible for managing the security of all computer systems used within the respective laboratory facility. This includes:

- Controlling access to computer systems and software
- Maintaining software documentation and licensing
- Coordinating routine backup procedures

15.2 Access Control

All computers and software are maintained in the laboratory building. Portable or laptop computing devices are assigned only to employees who have been cleared for unrestricted access to the facility (possess key and alarm code). Each laboratory building is a secured facility. Access to the facility is denied unless escorted by NCA personnel.

Access to computers and software is restricted to authorized personnel. Password protection is employed for initialization of the Laboratory Information Management System (LIMS) and for access to various shared resources on the LAN. Within the LIMS database program, access to view and edit data is limited through control of individual user permissions.

Remote access to the LAN (i.e. dial-up network connection, Internet, remote-administration) is controlled through use of individual dial-up accounts with specific passwords and permissions. Commercially available virus scanning and protection software is to be maintained resident on the laboratory network server and/or individual computers for automated detection and elimination of any potentially damaging files.

Original versions of computer software, documentation, license agreements, and backup copies are maintained in the office of the Information Systems Manager and/or System Administrator or some other limited access location (i.e. Lab Manager's office or QA Manager's office) within each facility. All installation and/or reinstallation of computer software will be carried out under the supervision of the Information Systems Manager and/or System Administrator.

The Information Systems Manager and/or System Administrator within each facility are responsible for maintaining records indicating the locations of all hardware and licensed software. Records will include documentation of maintenance, repair and any software or hardware problems encountered.

15.3 Data Backup

Procedures for backing up computer data are coordinated by the Information Systems Manager and/or System Administrator, the QA Managers and the Department Managers within each facility but are routinely performed by the operators or users within the specific analytical departments where a data system is used. Standard Operating Procedures are maintained by each NCA location to describe the equipment, processes, personnel, frequency and recovery tactics associated with computerized analytical data.

16.0 GLOSSARY OF TERMS

The following terms are excerpted from EPA document SW-846, 3rd Ed. with Updates I and II:

ACCURACY: The closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component.

BATCH: A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

BIAS: The deviation due to matrix effects of the measured value ($X_s - X_u$) from a known spiked amount. 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 contaminant spiked into a sample (matrix spike).

BLANK: see Equipment Rinsate, Method Blank, Trip Blank.

CONTROL SAMPLE: A QC sample introduced into a process to monitor the performance of the system.

ATA QUALITY OBJECTIVES (DQOs): A statement of the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. This is qualitatively distinct from quality measurements such as precision, bias, and detection limit.

DATA VALIDATION: The process of evaluating the available data against the project DQOs to make sure that the objectives are met. Data validation may be very rigorous, or cursory, depending on project DQOs. The available data reviewed will include analytical results, field QC data and lab QC data, and may also include field records.

DUPLICATE: see Matrix Duplicate, Field Duplicate, Matrix Spike Duplicate.

EQUIPMENT BLANK: see Equipment Rinsate.

EQUIPMENT RINSATE: A sample of analyte-free media that has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.

ESTIMATED QUANTITATION LIMIT (EQL): The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes the EQL analyte concentration is selected as the lowest non-zero standard in the libration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 are provided for guidance and may not always be achievable.

FIELD DUPLICATES: Independent samples that are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.

LABORATORY CONTROL SAMPLE: A known matrix spiked with compound(s) representative of the target analytes. This is used to document laboratory performance.

MATRIX: The component or substrate (e.g., surface water, drinking water) which contains the analyte of interest.

MATRIX DUPLICATE: An intra-laboratory split sample which is used to document the precision of a method in a given sample matrix.

MATRIX SPIKE: An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

MATRIX SPIKE DUPLICATES: Intra-laboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process. For a method blank to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either:

(1) The method detection limit, or
(2) Five percent of the regulatory limit for that analyte, or
(3) Five percent of the measured concentration in the sample.

METHOD DETECTION LIMIT (MDL):The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte. For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of three analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL, where the t-statistic is obtained from standard references.

ORGANIC-FREE REAGENT WATER: For *volatiles*, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water. Organic-free reagent water may also be prepared by boiling water for 15 minutes and, subsequently, while maintaining the temperature at 90°C, bubbling a contaminant-free inert gas through the water for 1 hour.

For *semivolatiles* and *non-volatiles*, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

PRECISION: The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses. These samples should contain concentrations of analyte above the MDL, and may involve the use of matrix spikes. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV) and the relative percent difference (RPD).

PROJECT: Single or multiple data collection activities that are related through the same planning sequence.

QUALITY ASSURANCE PROJECT PLAN (QAPP): An orderly assemblage of detailed procedures designed produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.

RCRA: The Resource Conservation and Recovery Act.

REAGENT BLANK: See Method Blank.

REAGENT GRADE: Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents that conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.

REAGENT WATER: Water that has been generated by any method that would achieve the performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.

REFERENCE MATERIAL: A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.

SPLIT SAMPLES: Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- or interlaboratory precision.

STANDARD ADDITION: The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.

STANDARD CURVE: A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument. Standards should be prepared at the frequency specified in the appropriate section. The calibration standards should be prepared using the same type of acid or solvent and at the same concentration as will result in the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.

SURROGATE: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

TRIP BLANK: A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

Figure 1. NCA Ethics Policy Statement

ETHICS POLICY

As an organization of dedicated professionals, NCA is committed to ensuring the integrity of our data, incorporating the highest appropriate standard of quality in all of our analytical programs, serving the needs of our clients, and setting the standards of performance for the environmental testing lab industry. We pledge to manage our business according to the following principles:

- ✓ NCA only offers environmental analyses for which it can demonstrate proficiency through high-quality, traceable and legally defensible performance standards that produce results that meet applicable accuracy and precision requirements.
- ✓ We deliver our analytical services in an ethical, confident, honest, and forthright manner.
- ✓ By educating our staff about the ethical and quality standards required to work in this industry, NCA demonstrates its commitment to complete honesty in the production and reporting of data.
- ✓ We operate our facilities in a manner that protects the environment and the health and the safety of staff members and the public.
- ✓ NCA is committed to obeying all pertinent federal, state, and local laws and regulations.
- ✓ This firm operates with an "Open Door" policy that enables every staff member to have free and direct access to the management team. This policy is designed to foster two-way communication and encourage staff members to fulfill their responsibility to NCA's quality commitment.

We also pledge to strive:

- ✓ To continually improve data product and client service quality,
- ✓ To treat all staff members equitably, to acknowledge their scientific contributions, and to provide them with opportunities for professional growth and development,
- ✓ To cooperate and participate with government agencies and other industry organizations to develop responsible and progressive practices, laws, regulations, technologies, and standards, and,
- ✓ To recognize and respond to needs and concerns of our community.

Figure 2. NCA Ethical Conduct and Data Integrity Agreement

North Creek Analytical, Inc.
2003 Ethical Conduct and Data Integrity Agreement

The *Ethical Conduct and Data Integrity Agreement* must be acknowledged by signature at the time of hire or within two weeks of receipt, if already employed. Furthermore, each staff member will be required to renew this agreement in the first quarter of each calendar year while employed by NCA. Acknowledgement of the agreement is a condition of continued employment at NCA and failure to comply with this requirement will result in immediate discharge from employment. This agreement is not an employment contract and does not modify the at-will employment agreement between the company and its staff.

I agree to abide by the following protocols while performing my duties at NCA:

Personal Pledge

I understand that I am charged with meeting NCA's high standard of ethical conduct in performance of my duties, and furthermore pledge to only report data, test results and conclusions that are accurate to the best of my knowledge and were obtained using sound laboratory practices as determined by industry standards.

Guardian Pledge

1. I will not condone any accidental or intentional reporting of inauthentic data by other NCA staff and will immediately report such occurrences to my supervisor, the QA Manager, the Ethics & Compliance Officer, the Laboratory Director or to corporate leadership.

2. If any member of the NCA staff requests that I engage in an activity that I feel is compromising data integrity, I have the right to refuse compliance with the request and to appeal the action through NCA's Ethics & Compliance Officer, laboratory management or corporate management, including the CEO.

3. I understand that, if my duties include supervisory responsibilities, I will not instruct, direct or request any subordinate to perform any practice that would violate NCA's *Ethics Policy* or this *Ethical Conduct and Data Integrity Agreement*. Additionally, I will not discourage, intimidate or inhibit a staff member who may choose to appeal my supervisory instruction under this agreement and will not retaliate against those who do so.

Protocols of Ethical Conduct

1. All work assigned to me will be performed in compliance with the NCA Quality Assurance Manual and NCA Standard Operating Procedures. I understand that it is my responsibility to be aware of and compliant with current policies and method requirements for assigned procedures.

2. I will only report results or data that match the actual results observed or measured.

3. I will not intentionally falsify any data in any manner. Furthermore, I will not modify data values unless the modifications can be technically justified through a measurable analytical process or method acceptable to NCA. All such modifications will be clearly documented and approved through appropriate procedures and will include my initials and date.

4. I will not report dates and times of analyses that are not the actual dates and time the analyses were conducted.

5. I will not intentionally represent another analyst's work as my own or represent my work as someone else's.

6. I will not intentionally make false statements to, or seek to otherwise deceive, clients, client representatives, regulatory agency representatives, auditors or other NCA staff members. I will not, through intentional acts of omission, commission, erasure or destruction, improperly report measurements, standards results, data, test results or analytical conclusions.

Name **Signature** **Date**

Figure 3.0 NCA Network Organizational Chart

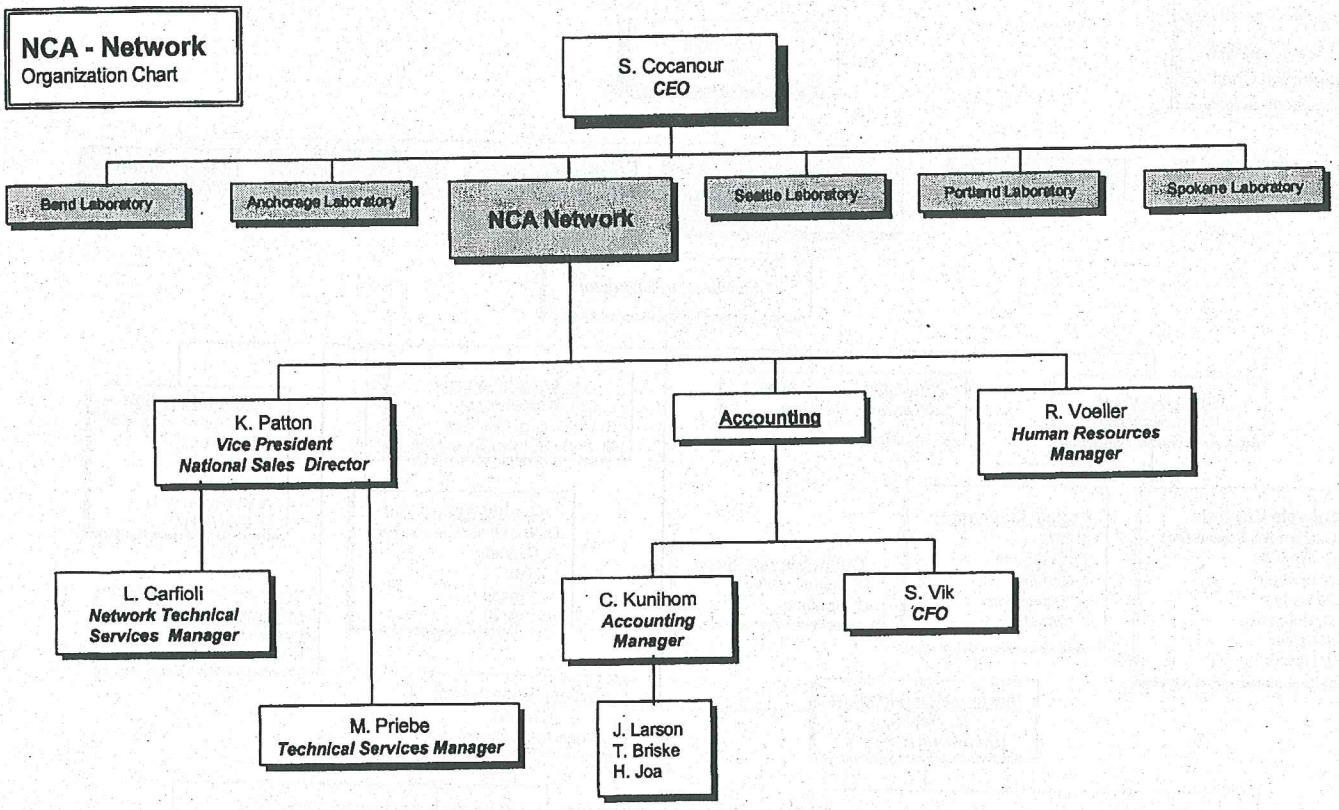


Figure 3.1 Seattle Organizational Chart

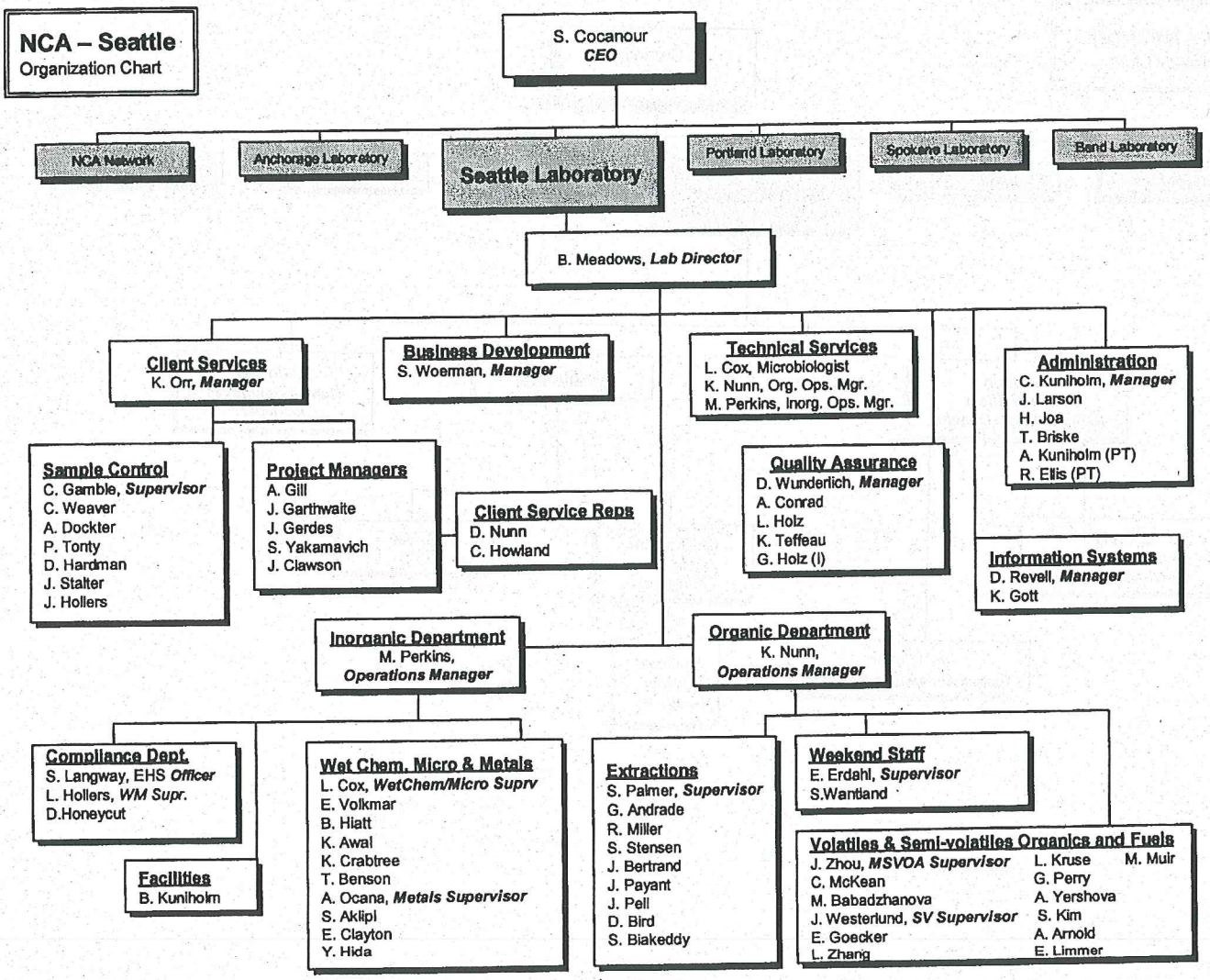


Figure 3.2 Portland Organizational Chart

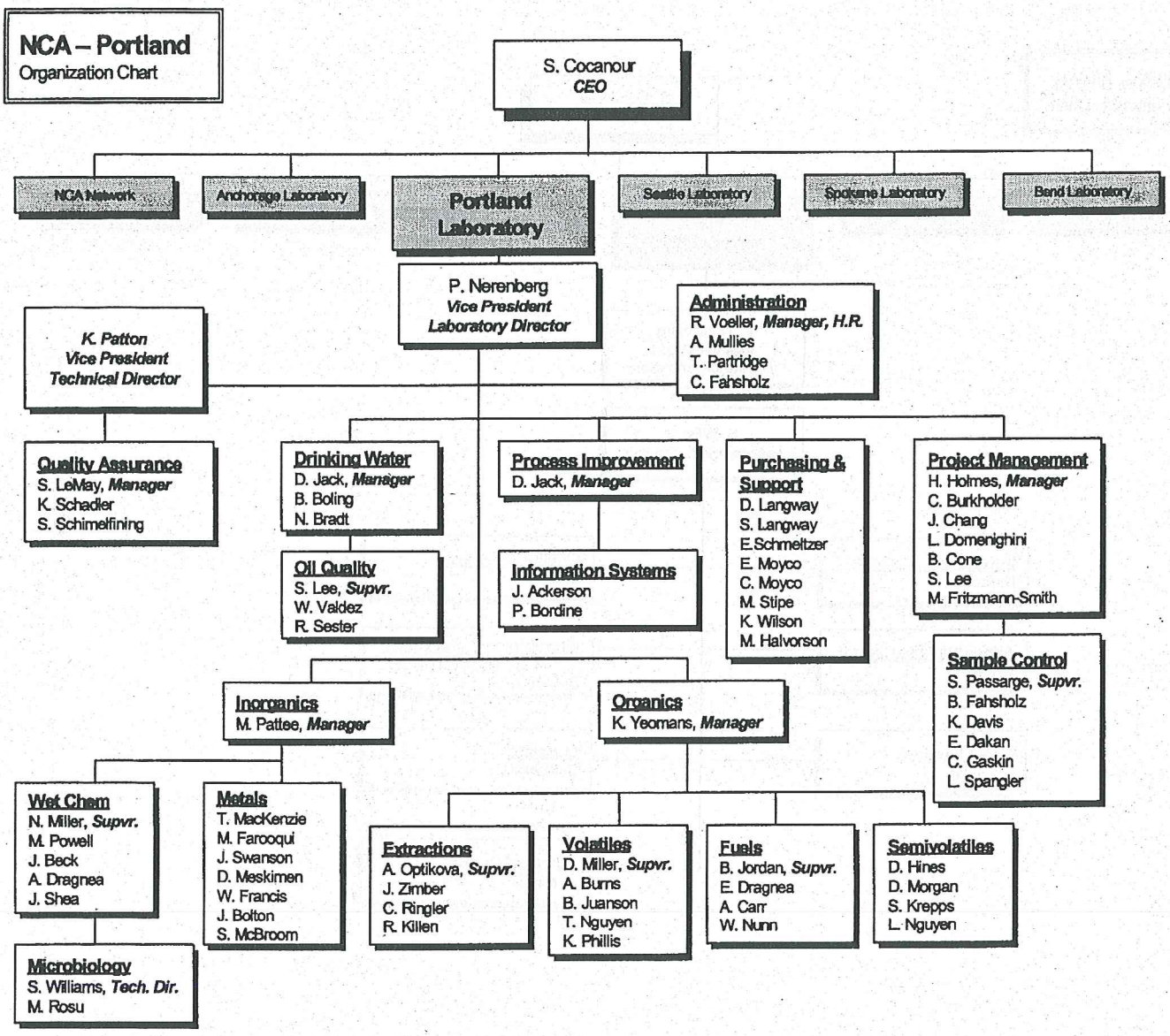


Figure 3.3 Bend Organizational Chart

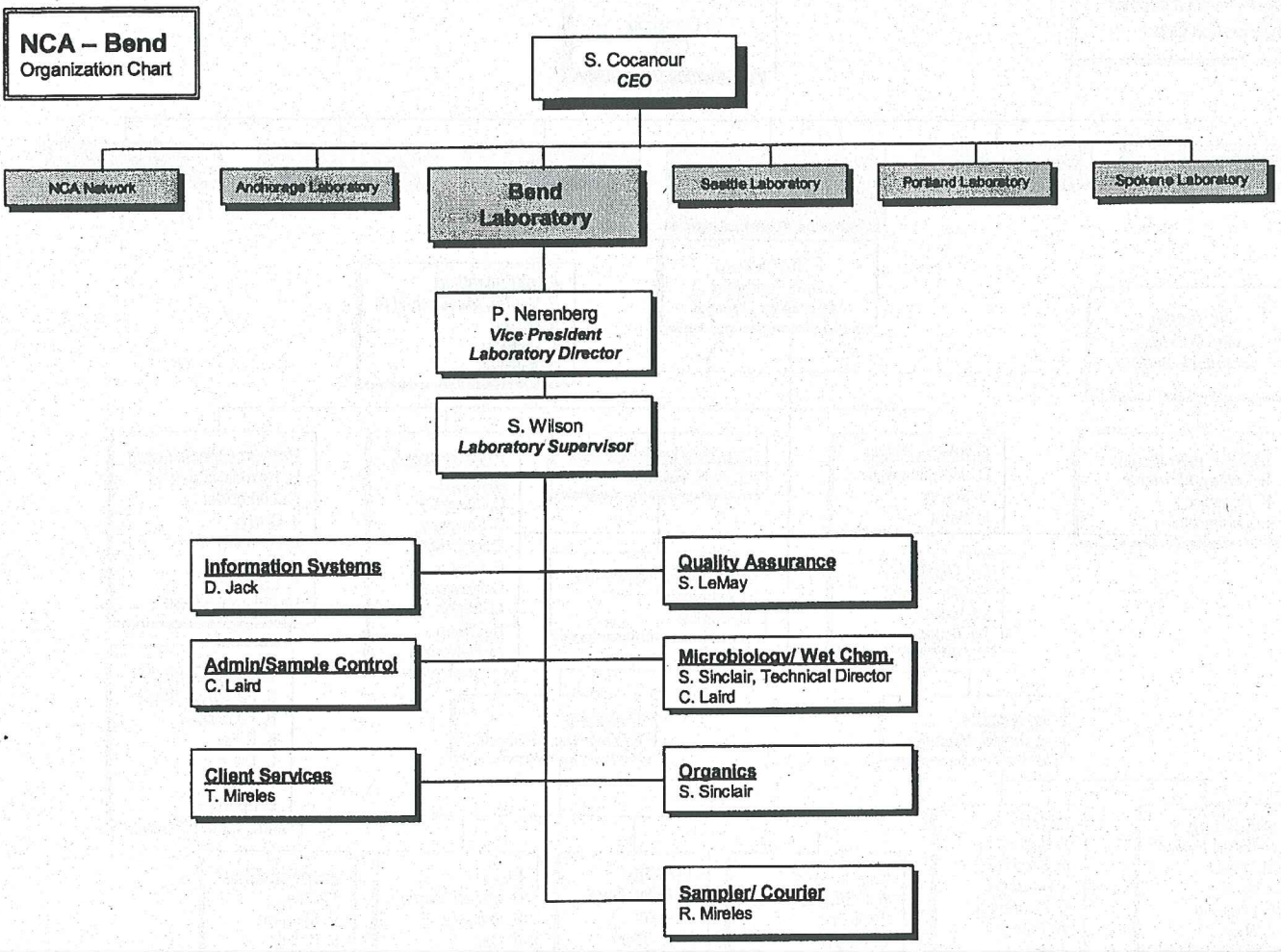


Figure 3.4 Spokane Organizational Chart

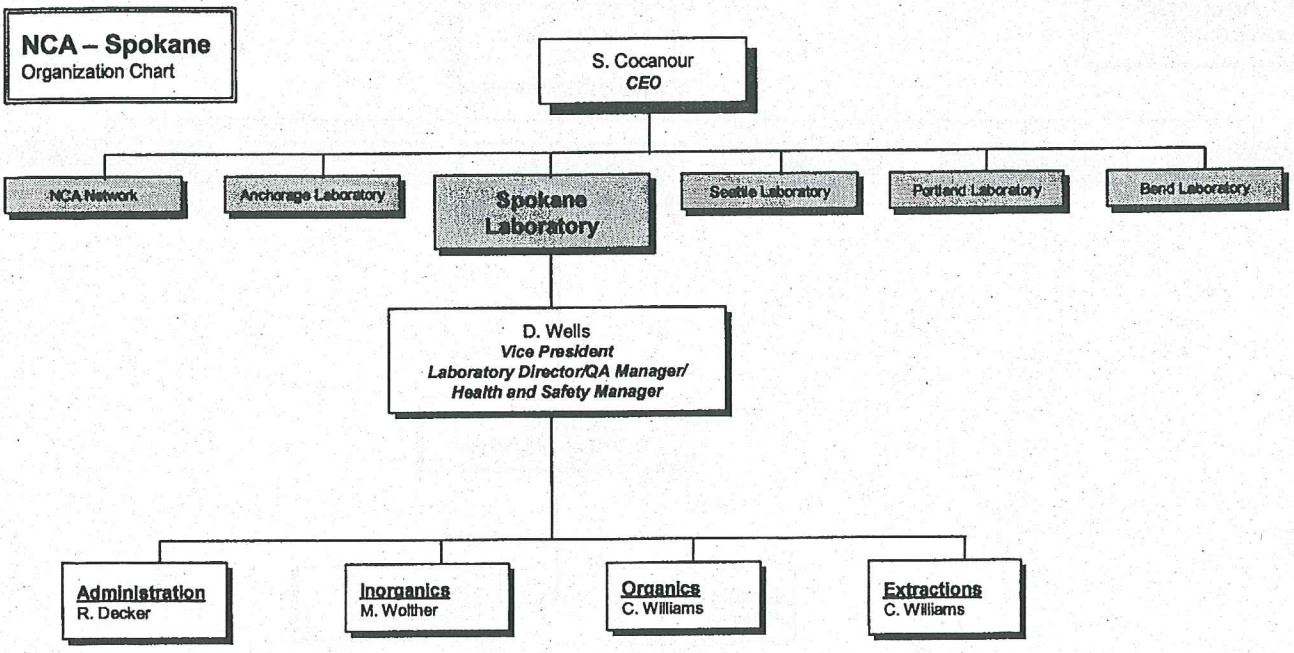


Figure 3.5 Anchorage Organizational Chart

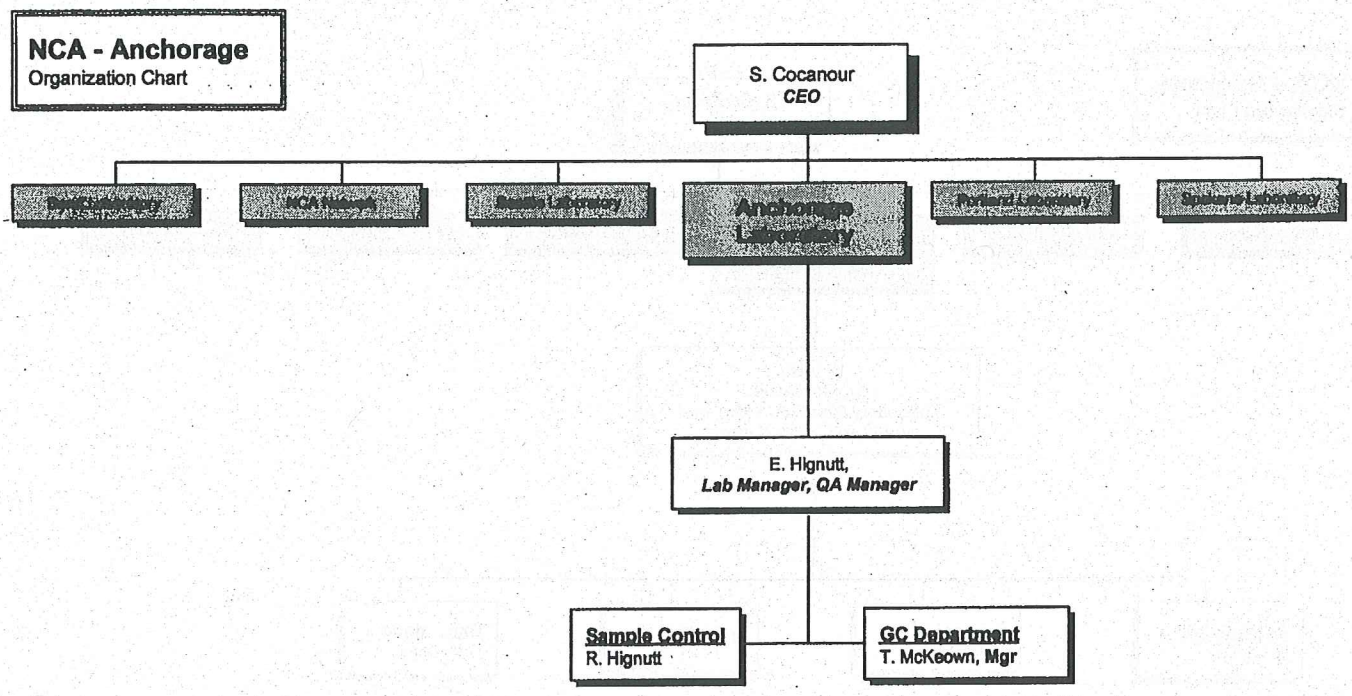


Figure 4.0 QA Lines of Authority

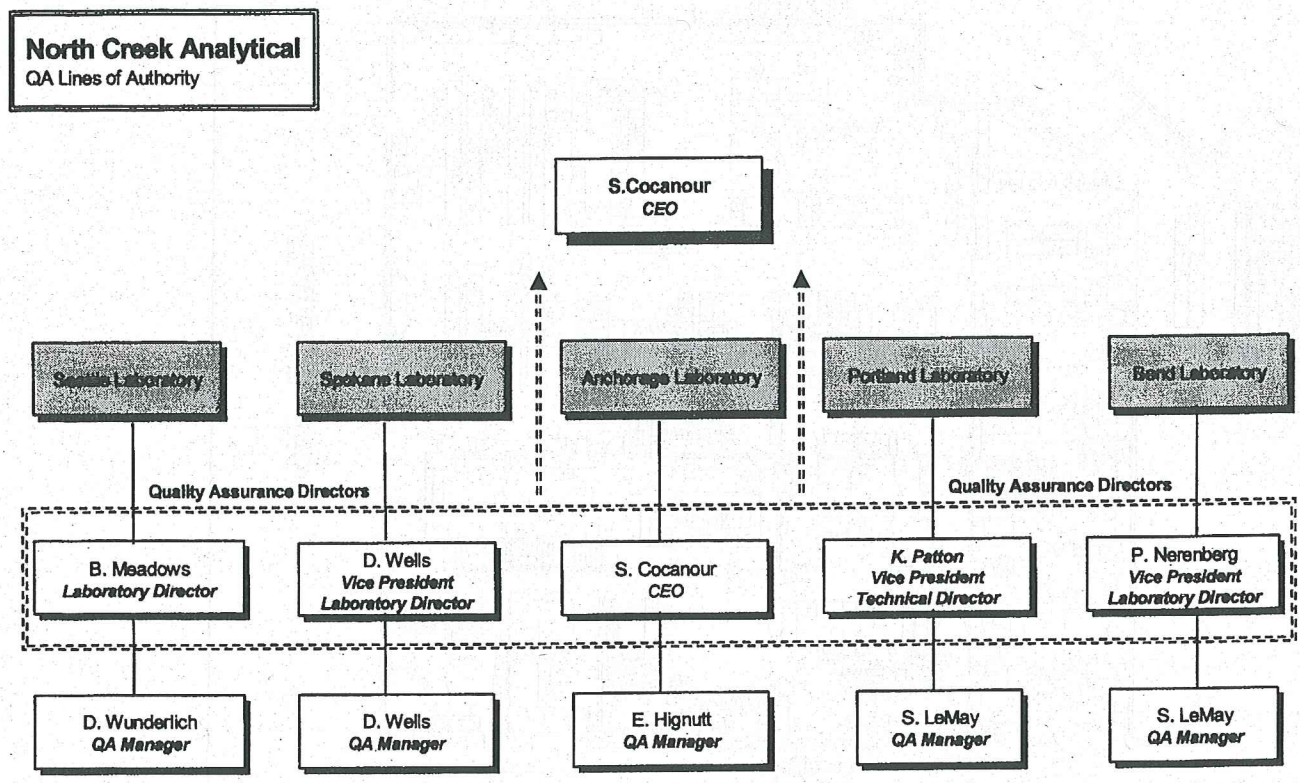


Figure 5.1 Seattle Facility Floor Plan

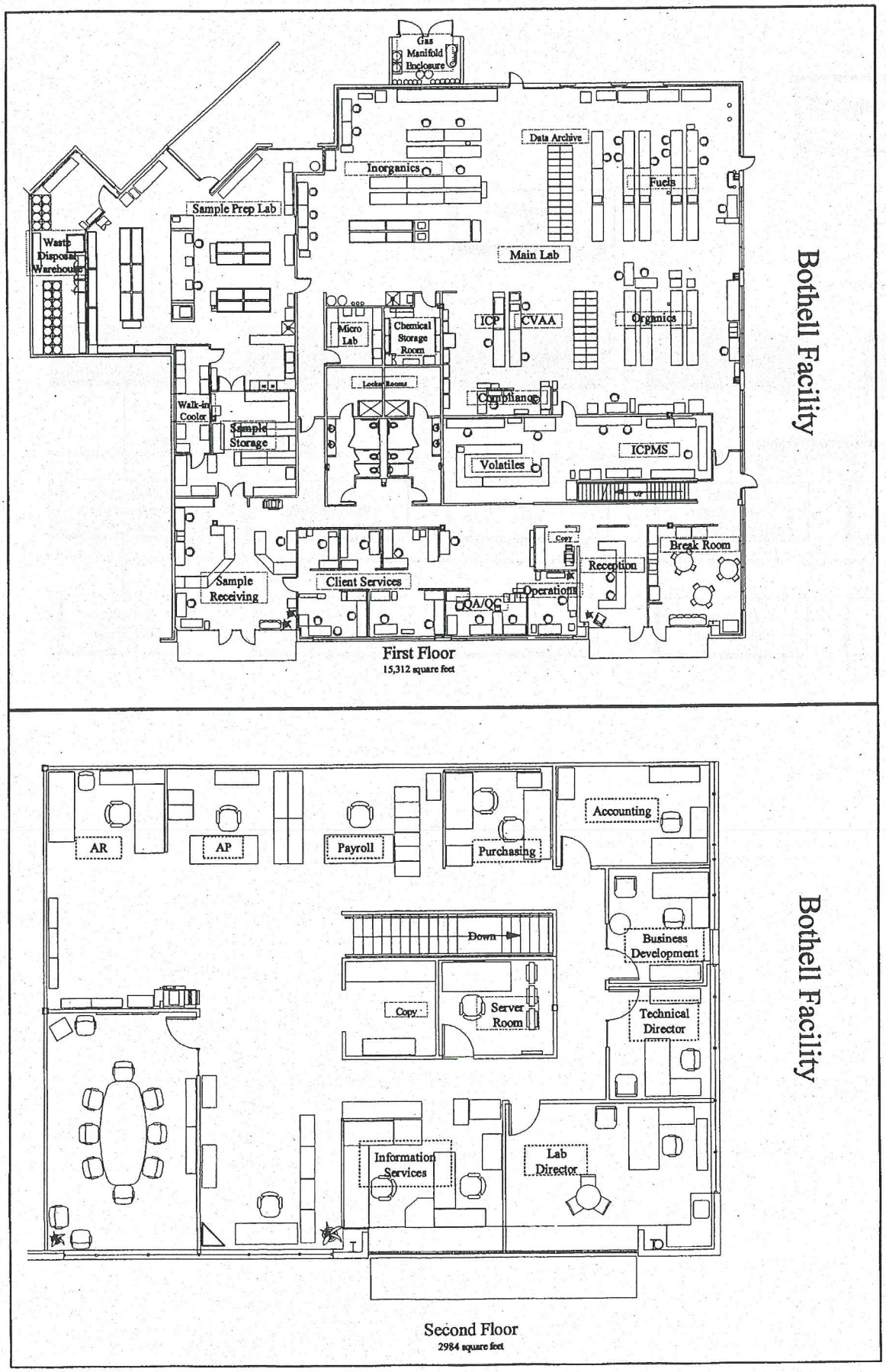


Figure 5.2 Portland Facility Floor Plan

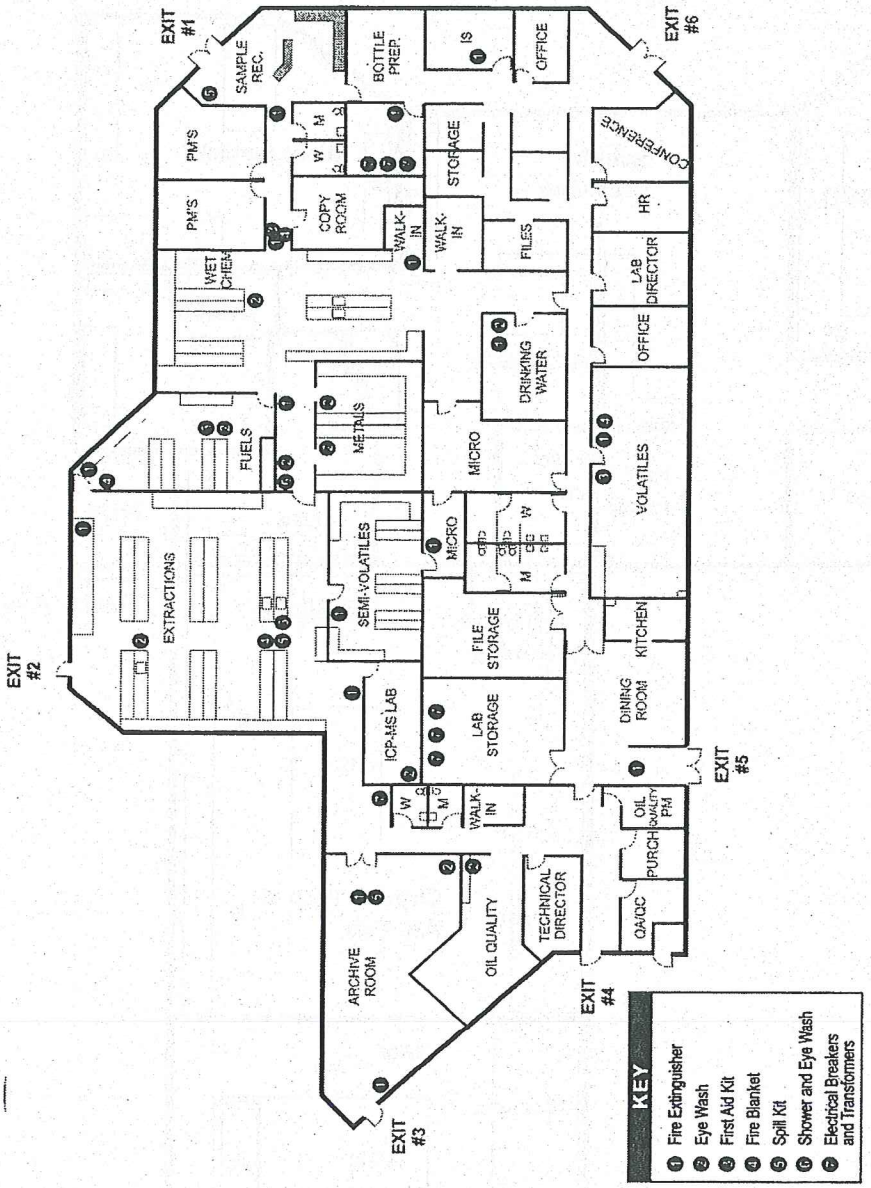


Figure 5.3 Bend Facility Floor Plan

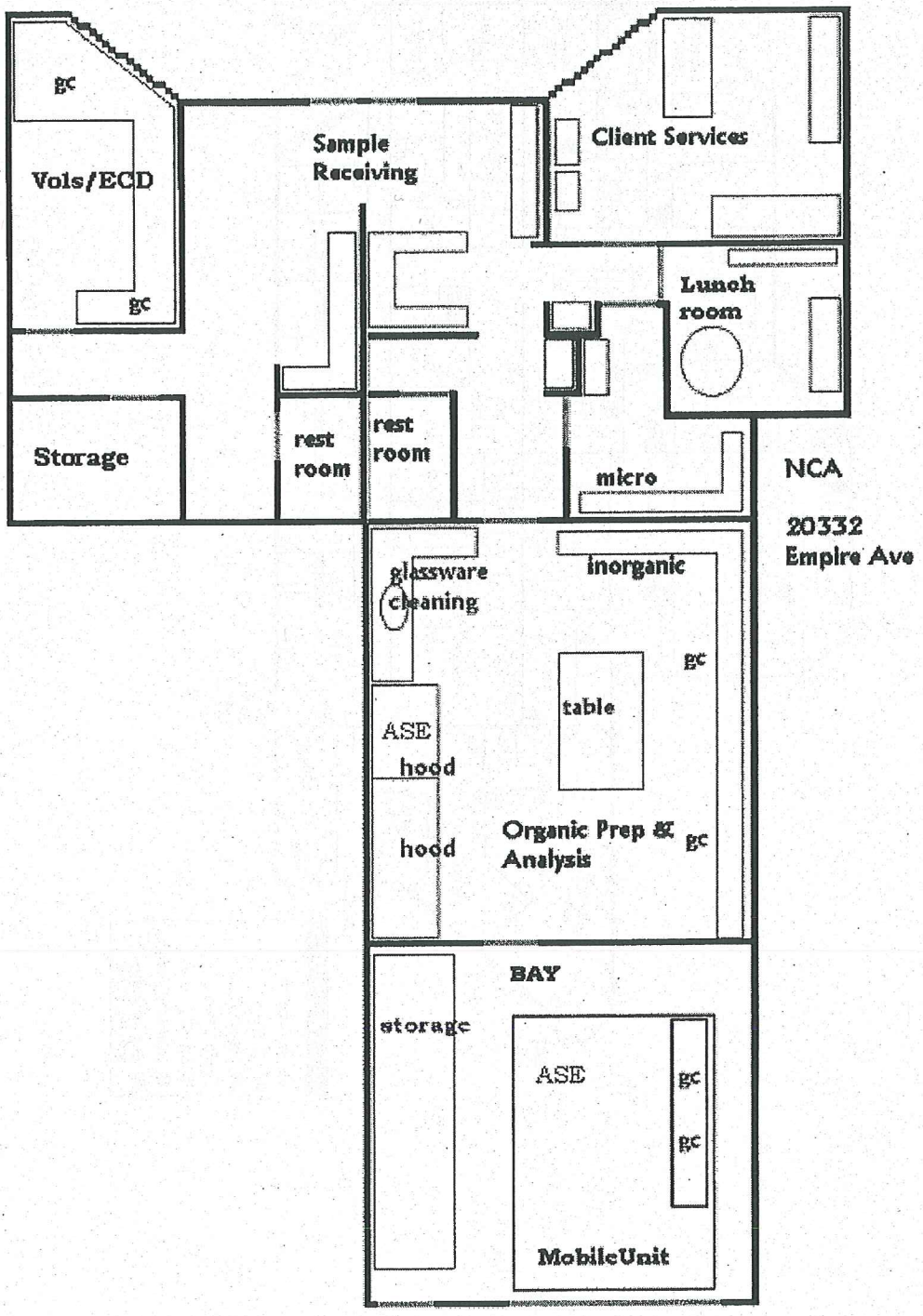


Figure 5.4a Spokane - Montgomery Street Facility Floor Plans

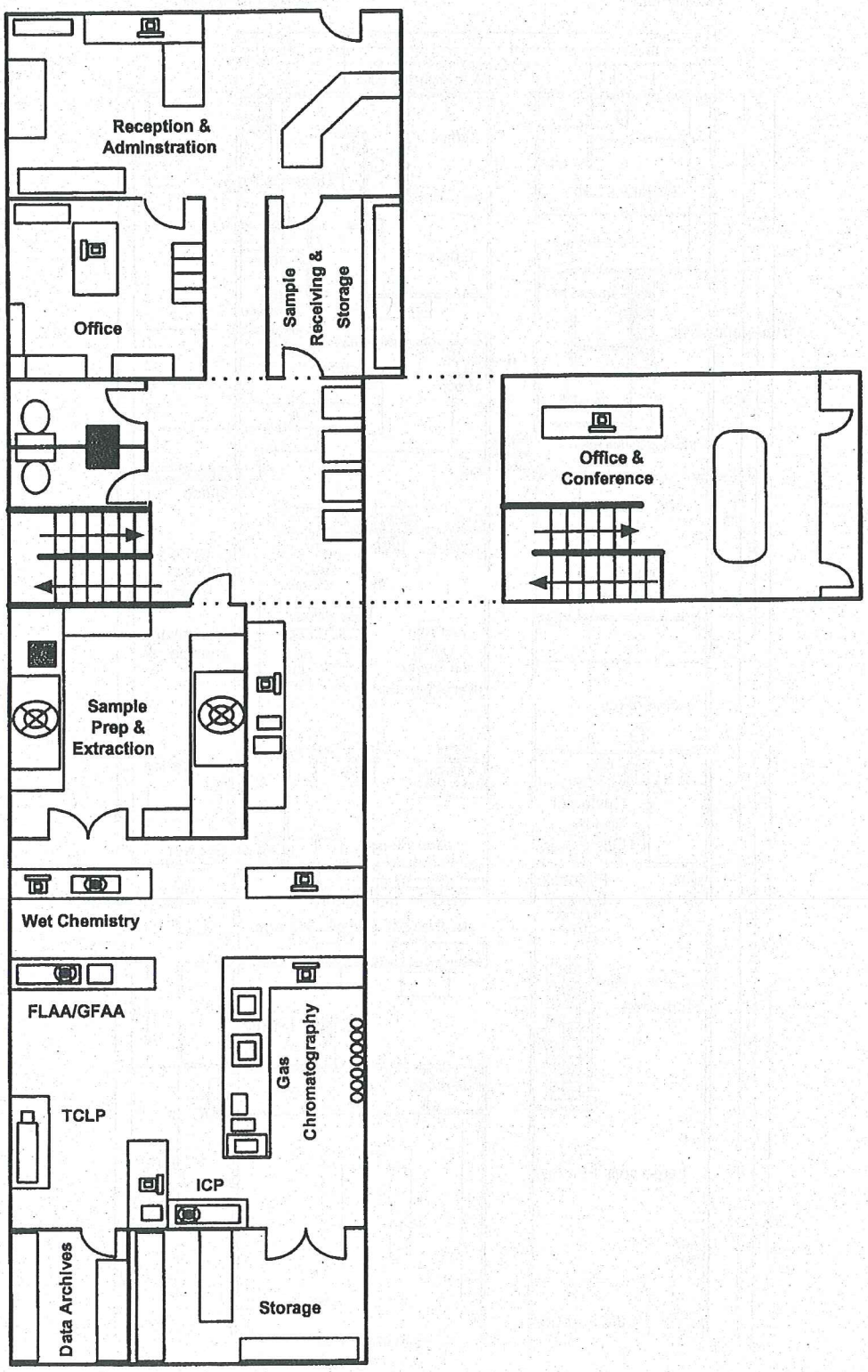


Figure 5.4b Spokane – First Avenue Facility Floor Plans

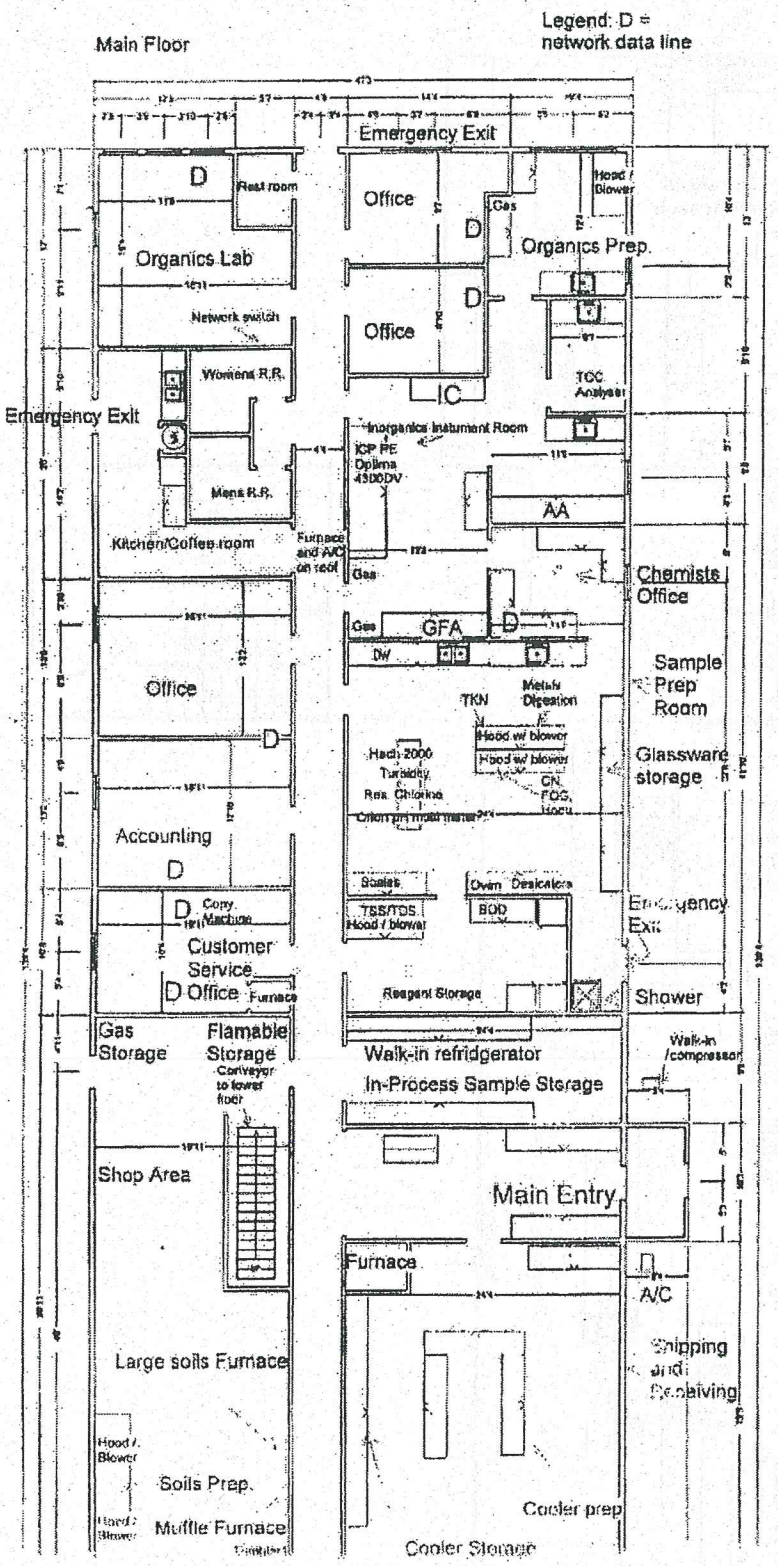


Figure 5.5 Anchorage Facility Floor Plans

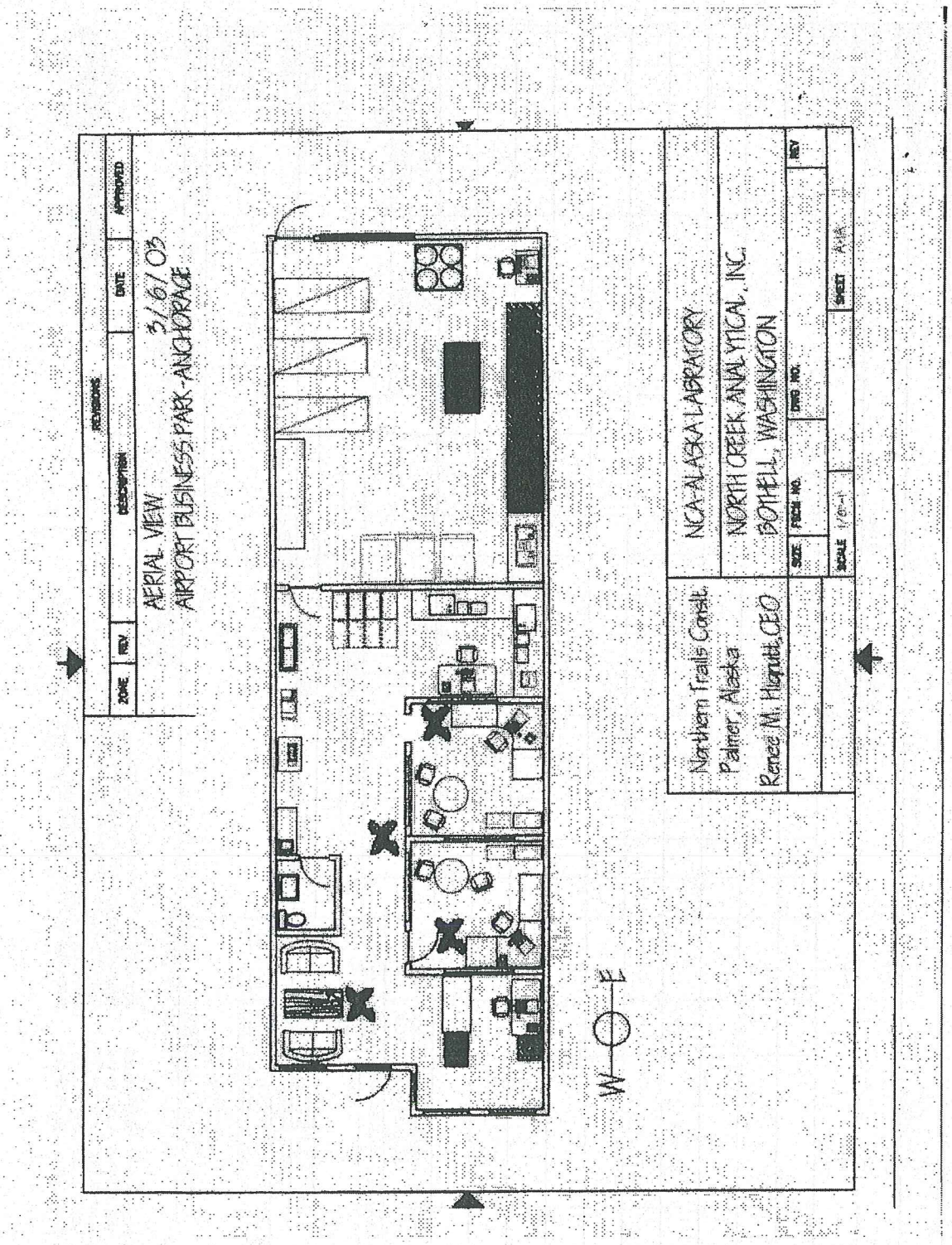
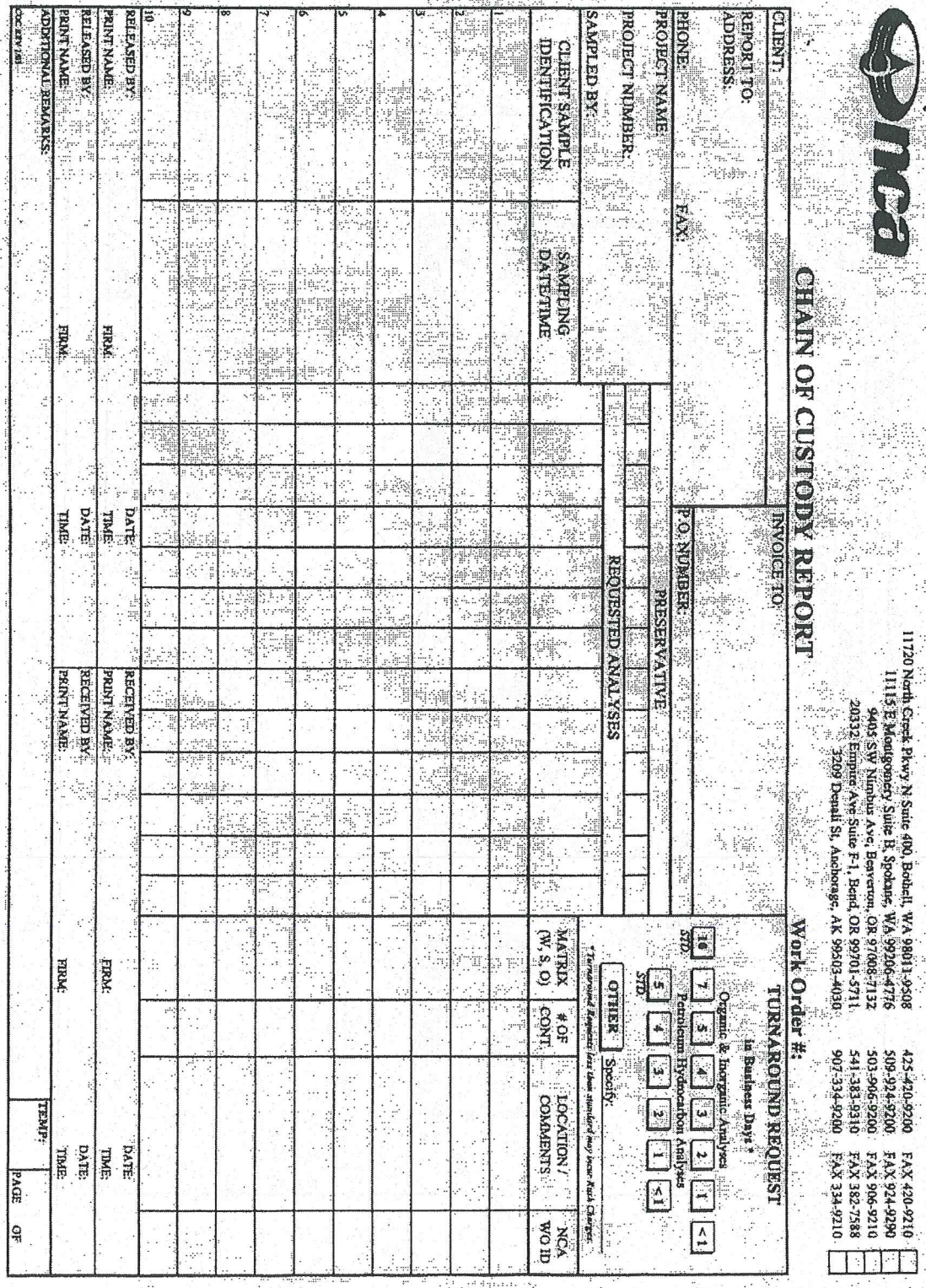


Figure 6.0 Example Chain of Custody



nca

11720 North Creek Pkwy N Suite 400, Bothell, WA 98011-8508 425-420-9200 FAX 420-9210
11115 E Montgomery Suite B, Spokane, WA 99206-4776 509-924-9200 FAX 924-9290
9405 SW Nimbus Ave, Beaverton, OR 97008-7132 503-906-9200 FAX 906-9210
20332 Empire Ave Suite F-1, Bend, OR 97701-5711 541-383-9310 FAX 382-7588
3209 Denali St, Anchorage, AK 99503-4038 907-334-9200 FAX 334-9210

CHAIN OF CUSTODY REPORT

Work Order #:

CLIENT: INVOICE TO:

REPORT TO:
ADDRESS:

PHONE: FAX:

PROJECT NAME: P.O. NUMBER:

PROJECT NUMBER: PRESERVATIVE

SAMPLED BY: REQUESTED ANALYSES

TURNAROUND REQUEST
in Business Days *
Organic & Inorganic Analyses
10 | 7 | 5 | 4 | 3 | 2 | 1 | <1
STD.
Petroleum Hydrocarbon Analyses
5 | 4 | 3 | 2 | 1 | <1
STD.
OTHER Specify:
* Turnaround Requests less than standard may incur Rush Charges.

	CLIENT SAMPLE IDENTIFICATION	SAMPLING DATE/TIME										MATRIX (W, S, O)	# OF CONT.	LOCATION / COMMENTS	NCA WO ID
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															

RELEASED BY: DATE: RECEIVED BY: DATE:
PRINT NAME: TIME: PRINT NAME: TIME:
FIRM: FIRM:

RELEASED BY: DATE: RECEIVED BY: DATE:
PRINT NAME: TIME: PRINT NAME: TIME:
FIRM: FIRM:

ADDITIONAL REMARKS: TEMP:

COC.rev.1.03 PAGE OF

Appendix 1.0

Seattle Specific

1.1 Seattle Equipment Listing

1.2 Seattle Accreditations and Method Capabilities

1.3 Seattle Standard Operating Procedures (SOP) Reference Table

1.1 Seattle Equipment List

	Inst. ID	Manufacturer	Model#	Description
Extractions	GPC	Analytical Bio-Chemical Laboratories (ABCL)		
		ABCL	1101-9077	Chart Recorder
		ABCL	UVD-1	UV Detector
		ABCL	601/602	Sample Input Module
	ASE	Dionex	ASE 200	PFE
	N-EVAP 1	Organomation	8125	N-EVAP
	N-EVAP 2	Organomation	8125	N-EVAP
	Sonicator 1	Tekmar	TM375	Sonicator
	Sonicator 2	Tekmar	TM375	Sonicator
	Sonicator 3	Tekmar	TM375	Sonicator
	Sonicator 4	Sonics & Materials	VC375	Sonicator
Fuels	GC#2	Hewlett Packard	5890 Series II	GC/PID/FID
		OI Analytical	4460 A	Purge & Trap
		OI Analytical	MPM-16/ MHC-16	Autosampler
	GC#4	Hewlett Packard	5890 Series II	GC/PID/FID
		Tekmar/Dohrmann	3100	Purge & Trap
		Tekmar/Dohrmann	14-AA70-100	Autosampler
	GC#6	Hewlett Packard	5890 Series II	GC/PID/FID
		Tekmar/Dohrmann	3100	Purge & Trap
		Tekmar/Dohrmann	14-AA70-100	Autosampler
	GC#8	Hewlett Packard	5890 Series II	GC/PID/FID
		OI Analytical	4460 A	Purge & Trap
		OI Analytical	MPM-16/ MHC-16	Autosampler
	GC#10	Hewlett Packard	5890 Series II	GC/PID/FID
		Tekmar/Dohrmann	3100	Purge & Trap
		Tekmar/Dohrmann	14-AA70-100	Autosampler
	GC#12	Hewlett Packard	5890 Series II	GC/PID/FID
		OI Analytical	4460A	Purge & Trap
		OI Analytical	MPM-16 /MHC-16	Autosampler
	GC#14	Hewlett Packard	5890 Series II	GC/PID/FID
		Tekmar	LSC 2000	Concentrator
		Tekmar	ALS 2032 ALS 2016	Autosampler
	GC#1	Hewlett Packard	5890 Series II	GC with dual FID Detectors
	GC#3	Hewlett Packard	5890E	GC with dual FID Detectors
	GC#5	Hewlett Packard	5890 Series II Plus	GC with dual FID Detectors
	GC#9	Hewlett Packard	6890	GC with dual FID Detectors

1.1 Seattle Equipment List (continued)

	Inst. ID	Manufacturer	Model#	Description
Inorganics	1020	OI Analytical	1020	TOC
	DX100	Dionex	DX100	IC
	DX2000	Dohrman	DX2000	Halide Analyzer
	UV-VIS#1	Spectronic	20 Genesys	UV-VIS
	UV-VIS#2	Perkin Elmer	Lambda 3B	UV-VIS
	Lachat	Lachat	8000	Flow Analyzer
		Lachat	ASX-500	Autosampler
	ICP	TJA	ICAP 61E	ICP
	CVAF	PSA	Millennium 10.0	CVAF
	ICP/MS-1	Hewlett Packard	4500	ICP/MS
	ICP/MS-2	Hewlett Packard	7500	ICP/MS
Organics: Chlorinated Pesticides PCBs and Chlorinated Herbicides	ECD 1	Hewlett Packard	5890 Series II	GC with dual ECD Detectors
	ECD 3	Hewlett Packard	5890 Series II	GC with dual ECD Detectors
	ECD 4	Hewlett Packard	6890	GC with dual ECD Detectors
Volatiles	MS-1	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5970	MS Detector
		Tekmar	LCS2000	Concentrator
		Varian	Archon 5100	Autosampler
	MS-4	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5971	MS Detector
		Tekmar	LSC2000	Concentrator
		Varian	Archon 5100	Autosampler
	MS-5	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5972	MS Detector
		Tekmar	LCS2000	Autosampler
		Varian	Archon 4522	Autosampler
	MS-8	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5970	MS Detector
		Tekmar	LSC2000	Concentrator
		Hewlett Packard	G1904-60500	Autosampler
		Tekmar	ALS2016	Autosampler
	MS-10	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5970	MS Detector
		Hewlett Packard	G1900-60500	Concentrator
		Hewlett Packard	G1904-60500	Autosampler
		Hewlett Packard	G1907-60500	Sample Heater

1.1 Seattle Equipment List (continued)

	Inst. ID	Manufacturer	Model#	Description
Semi-Volatiles MS	MS-2	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5971 A	MS Detector
	MS-3	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5971	MS Detector
	MS-6	Hewlett Packard	6890 Series	GC
		Hewlett Packard	5973	MS Detector
	MS-7	Hewlett Packard	5890 Series II	GC
		Hewlett Packard	5972	MS Detector
	MS-9	Hewlett Packard	6890 Series	GC
		Hewlett Packard	5973	MS Detector

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
1658 Herbicides	WW	WW,HW							
524.2 Volatiles	DW	DW						DW	DW
615 Herb	WW	WW							
8015B TPH-DRO/GRO	HW		HW	HW	W/S	W/S			
8021B (BTEX)	HW	WW,HW	HW	HW	W/S	W/S	W (BETX)		
8021B (MN)			HW	HW					
8081A Pesticides	HW	WW,HW	HW	HW	W/S	W/S			
8082 PCB Aroclors	HW	WW,HW	HW	HW	W/S	W/S	W/S		
8082 Mod PCB Only	HW	WW,HW							
8082 PCB Congeners		WW,HW							
8151A/8151A Herb	HW	WW,HW	HW	HW	W/S	W/S			
8260B VOA Full List	HW	WW,HW	HW	HW	W/S	W/S	W/S		
8270C SVOA Full List	HW	WW, HW	HW	HW	W/S	W/S			
Acidity-305.1	DW, WW	DW,WW	WW	WW					
Acidity-SM2310B	WW	DW,WW	WW	WW					
Ag ICP 200.7	DW, WW	DW, WW	WW	WW					
Ag ICP 6010B	HW	HW	HW	HW	W/S				
Ag ICPMS 200.8	DW, WW	DW, WW	WW						
Ag ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
AK 101 AA		WW,HW					W/S		
AK101 (GRO)		WW,HW					W/S		
AK102 (DRO)		WW,HW					W/S		
AK102AA		WW,HW					W/S		
AK103 (RRO)		WW,HW					S		
AK103AA		WW,HW					W/S		
Al ICP 200.7	DW, WW	DW,WW	WW	WW					
Al ICP 6010B	HW	HW			W/S				
Al ICPMS 200.8	DW, WW	DW, WW	WW						
Al ICPMS 6020	HW	HW			W/S	W/S			
Alkalinity 310.1	WW	DW,WW	WW	WW					
Alkalinity-SM2320B	DW, WW	DW,WW	WW	WW					
Ammonia SM4500-N	DW, WW	DW,WW	WW	WW					
Ammonia-350.3	DW, WW	DW,WW,HW	WW	WW					
As ICP 200.7	WW	DW,WW	WW	WW					
As ICP 6010B	HW	HW	HW	HW	W/S		W/S		
As ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
As ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		
Au ICPMS 200.8	DW, WW	DW, WW							
Au ICP 6010B									
B ICP 200.7	DW, WW	DW,WW	WW	WW					
B ICP 6010B	HW	HW							
B ICPMS 200.8	DW, WW	DW, WW							
B ICPMS 6020	HW	HW							
Ba ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Ba ICP 6010B	HW	HW	HW	HW	W/S		W/S		

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
Be ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Be ICP 6010B	HW	HW	HW	HW	W/S				
Be ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Be ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
BOD SM5210									
BOD405.1/5210B	WW	DW,WW	WW	WW					
CBOD405.1/5210B	WW	DW,WW							
Bromide-300.0	DW, WW	DW,WW,HW	WW						DW
Bromide-SM4110B	WW	DW,WW							
Bromide-9056	HW	HW							
Ca ICP 200.7	DW,WW	DW,WW	WW	WW					
Ca ICP 6010B	HW	HW			W/S				
Ca ICPMS 200.8	WW	DW, WW							
Ca ICPMS 6020	HW	HW			W/S	W/S			
Cd ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Cd ICP 6010B	HW	HW	HW	HW	W/S		W/S		
Cd ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Cd ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		
Chloride-300.0	DW, WW	DW,WW, HW	WW		W	W			
Chloride-SM4110B	DW, WW	DW, WW							
Chloride-9056	HW	HW							
Chloride-SM4500-Cl	WW (as SM4110B)								
Cl Residual SM4500CL G	DW, WW	DW,WW	WW	WW					
Cl Residual-330.5	WW	DW,WW	WW	WW					
Co ICP 200.7	DW,WW	DW,WW	WW	WW					
Co ICP 6010B	HW	HW	HW	HW	W/S				
Co ICPMS 200.8	DW,WW	DW, WW	WW						
Co ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
COD SM5220D		DW,WW							
COD-410.4	WW	DW,WW	WW	WW					
Color-110.2	WW	DW,WW							
Color-SM2120B	DW	DW,WW							
Conductivity-120.1	WW	DW,WW	WW	WW					
Conductivity-9050A	HW	HW							
Conductivity-SM2510B	DW,WW	DW,WW							
Corrosivity (coupon)	HW (as 1110)	HW (as 1110)							
Corrosivity-9040B			HW	HW					
CNAMEN335.14500CNG		DW,WW	WW	WW					
Cr ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Cr ICP 6010B	HW	HW	HW	HW	W/S		W/S		
Cr ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Cr ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
Cr6, Solid 3060A/7196A			HW	HW	S				
Cr6, Soil-7195	HW	HW							
Cr6, EPA 7195	HW	HW							
Cr6, Aqueous 7196A	HW	DW,WW		HW	W				
Cr6, Aqueous SM3500Cr	DW,WW	DW,WW							
Cu ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Cu ICP 6010B	HW	HW	HW	HW	W/S				
Cu ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Cu ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
Cyanide - SM4500CN E	DW, WW	DW,WW	WW	WW				DW	DW
Cyanide WAD 4500CN-I	DW,WW	DW,WW						DW	
Cyanide, Amen-SM4500-I	DW,WW	DW,WW						DW	
Cyanide, Amen-9010B		HW							
Cyanide, Amen-335.1	WW	DW,WW	WW	WW					
Cyanide, Total-335.2	WW	DW,WW	WW	WW					
Cyanide, Total-9010A				HW					
Cyanide, Total-9010B		HW			W/S	W/S			
Cyanide, Total-9012	HW								
Cyanide, Amen-9012	HW								
Cyanide, Total-9014			HW						
Dioxane		WW,HW							
DO-360.1/4500-O G	WW	DW,WW	WW	WW					
)-360.2/4500-O BC	WW	DW,WW	WW						
E. Coli MPN-SM9221	DW, WW								
EDB/DBCP-8011	HW	WW,HW							
EOX-9023		HW							
EPA 1631 Modified									
EPA 608 NPDES	WW	WW	WW	WW					
EPA 615 Modified									
EPA 624 NPDES	WW	WW	WW	WW					
EPA 625 NPDES	WW	WW	WW	WW					
FC MF-SM9222	DW, WW	DW,WW	WW	WW					
FC MPN-SM9221	DW, WW	DW,WW, HW (9221E)	WW	WW					
Fe ICP 200.7	DW, WW	DW,WW	WW	WW					
Fe ICP 6010B	HW	HW			W/S				
Fe ICPMS 200.8	WW	DW, WW							
Fe ICPMS 6020	HW	HW			W/S	W/S			
Fe(+3)6010BSM3500FeD		DW,WW							
Ferrous Iron		DW,WW							
Flashpoint			HW	HW					
Fluoride-300.0	DW,WW	DW, WW,HW	WW, HW	HW	W	W			
Fluoride-SM4110B	DW,WW	DW,WW						DW	
Fluoride-9056	HW	HW	HW						
Fluoride-340.2	WW	DW,WW	WW,HW	WW,HW					
Fluoride-SM4500-F C	DW	DW,WW	WW	WW				DW	DW
GCMS-SIM PAH	HW					W/S	W/S		
GCMS VOA 5035/8260						S			

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
Hg Total 7470/7471	HW	HW	HW	HW	W/S	W/S			
Hg Total CVAA 245.1	DW, WW	DW,WW	WW	WW				DW	DW
Ignitability-1010	WW, HW	DW, WW,HW	HW	HW					
K ICP 200.7	DW,WW	DW,WW	WW	WW					
K ICP 6010B	HW	HW			W/S				
K ICPMS 200.8	WW	DW, WW							
K ICPMS 6020	HW	HW			W/S	W/S			
Li ICPMS 200.8	DW, WW	DW, WW							
Li ICPMS 6020	HW	HW							
MBAS-425.1	DW, WW	DW,WW	WW	WW					
MBAS-SM5540C	WW	DW,WW	WW	WW					
Mg ICP 200.7	DW,WW	DW,WW	WW	WW					
Mg ICP 6010B	HW	HW			W/S				
Mg ICPMS 200.8	WW	DW, WW							
Mg ICPMS 6020	HW	HW			W/S	W/S			
Mn ICP 200.7	DW, WW	DW,WW	WW	WW					
Mn ICP 6010B	HW	HW			W/S				
Mn ICPMS 200.8	DW, WW	DW, WW	WW						
Mn ICPMS 6020	HW	HW			W/S	W/S			
Mo ICP 200.7	WW	DW,WW	WW	WW					
Mo ICP 6010B	HW	HW	HW	HW					
Mo ICPMS 200.8	DW, WW	DW, WW	WW						
Mo ICPMS 6020	HW	HW	HW						
MT - EPH		WW,HW							
MT - VPH		WW,HW							
MTCA-EPH	HW	WW,HW							
MTCA-VPH	HW	WW,HW							
MTTPH-Dext		WW,HW							
MTTPH-G		WW,HW (as Gx)							
Na Total ICP 200.7	DW, WW	DW,WW	WW	WW				DW	
Na Total ICP 6010B	HW	HW			W/S				
Na Total ICPMS 200.8	WW	DW, WW							
Na Total ICPMS 6020	HW	HW			W/S	W/S			
Ni Total ICP 200.7	DW, WW	DW,WW	WW	WW				DW	DW
Ni Total ICP 6010B	HW	HW	HW	HW	W/S		W/S		
Ni Total ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Ni Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		
Nitrate-300.0	DW, WW	DW,WW,HW	WW		W	W		DW	DW
Nitrate-SM4110B	DW, WW	DW, WW						DW	
Nitrate-9056	HW	HW							
Nitrite-300.0	DW, WW	DW,WW,HW	WW		W	W		DW	DW
Nitrite-SM4110B	DW, WW	DW, WW						DW	
Nitrite-9056	HW	HW							
NO2-NO3 353.2	DW, WW	DW,WW,HW	WW	WW					
NWTPH-Dx	HW (and 8015)	WW,HW(+ "W" + 8015)							

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	**6/30/04**	**8/31/04**	**1/31/04**	**1/31/04**	**11/15/03**	**7/3/04**	**12/26/03**	**6/30/04**	**3/31/04**
NWTPH-Gx	HW (and 8015)	WW,HW(+ "W" + 8015)							
NWTPH-HCID		WW,HW(+ "W" + 8015)							
O&G FOG			WW	WW					
O&G-1664 HEM Only	WW	DW,WW	WW	WW					
O&G-1664 HEM/SGT	WW		WW	WW					
O&G-1664 SGT Only	WW		WW	WW					
O&G-9071A		HW(as 9070A)							
O&G-9071A w/SGT	HW								
Orthophospate-300.0	DW, WW	DW,WW(HW-9056)	WW		W	W			
Orthophosphate-SM4110	DW, WW	DW, WW							
Orthophosphate 365.2	WW	DW,WW	WW	WW					
Orthophosphate-9056	HW	HW							
P Soluble 365.2	WW								
P Total Color 365.2	DW,WW	DW,WW	WW	WW					
P Total ICP 200.7									
P Total ICP 6010B									
Paint Filter-9095	HW	HW							
Pb Total ICP 200.7	WW	DW,WW	WW	WW					
Pb Total ICP 6010B	HW	HW	HW	HW	W/S		W/S		
Pb Total ICPMS 200.8	DW, WW	DW, WW	WW					DW	DW
Pb Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		
pH-150.1	DW, WW	DW,WW	WW	WW					
H-SM4500H+B			WW	WW					
pH-9040B	HW	HW	HW	HW					
pH-9045	HW								
pH-9045B		HW(as 9045C)							
Phenols-420.1	DW,WW	DW,WW	WW	WW					
Phenols-9065	HW	HW				W/S			
Phos-Ortho SM4500-P		DW,WW	WW	WW					
Phos-Total SM4500-P	WW	DW,WW							
Plate Count-SM9215	DW,WW	DW,WW	WW	WW					
Reactive Sulfide		HW	HW	HW					
Salinity-SM2520	WW	DW,WW							
Sb Total ICP 200.7	WW	DW,WW	WW	WW					
Sb Total ICP 6010B	HW	HW	HW	HW	W/S				
Sb Total ICPMS 200.8	DW,WW	DW, WW						DW	DW
Sb Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
Se Total ICP 200.7	WW	DW,WW	WW	WW					
Se Total ICP 6010B	HW	HW	HW	HW	W/S				
Se Total ICPMS 200.8	DW,WW	DW, WW	WW					DW	DW
Se Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
Si ICP 200.7		DW(200.8also)WW	WW	WW					
Si ICP 6010B		HW(6020 also)							
SiO2 Colorimetric	DW,WW (as SM4500-Si D	DW,WW							

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
Sn TCLP ICPMS 6020									
Sn Total ICP 200.7	DW, WW	DW, WW	WW	WW					
Sn Total ICP 6010B	HW	HW							
Sn Total ICP 200.8	DW, WW	DW, WW							
Sn Total ICP 6020	HW	HW							
Solids, Sttbl-160.5		DW,WW	WW	WW					
Solids, Sttbl-SM2540F			WW	WW					
Solids, TDS-160.1	WW	DW,WW	WW	WW					
Solids, TDS-SM2540C	DW,WW	DW,WW	WW	WW					
Solids, Total-160.3	DW,WW	DW,WW	WW	WW					
Solids, Total-SM2540B	WW	DW,WW	WW	WW					
Solids, TSS-160.2	WW	DW, WW	WW	WW					
Solids, TSS-SM2540D	DW,WW	DW,WW	WW	WW					
Solids, TVS-160.4	WW	DW,WW	WW	WW					
Solids, TVS-SM2540E	WW	DW,WW							
Sp. Gravity D287									
Sp. Gravity-SM2710F									
SPLP Extraction									
Sr ICPMS 200.8									
Sr ICPMS 6020									
STLC Extraction			HW	HW					
Sulfate-300.0	DW,WW	DW,WW,HW	WW		W	W			
Sulfate-9056	HW	HW							
Sulfate-SM4110B	DW,WW	DW,WW							
Sulfide-376.1	DW,WW	DW,WW	WW	WW					
Sulfide-376.2	DW,WW	DW,WW	WW	WW					
Sulfide-9030B	HW	HW							
Sulfide-9034	HW								
Sulfite-377.1	DW,WW	DW,WW							
TC MF-SM9222	DW,WW	WW, DW (9222B)	WW	WW					
TC MPN-SM9221	DW,WW	WW, DW & HW	WW	WW					
TC P/A-SM9223	DW (colilert&colisure)	DW,WW (colilert&colisure)							
TCLP Extraction		HW							
TCLP/ZHE Extraction		HW	HW	HW					
Th Total ICPMS 6020		DW,WW							
Ti Total ICP 200.7	DW,WW	DW,WW	WW	WW					
Ti Total ICP 6010B	HW	HW							
Ti Total ICPMS 200.8	DW,WW	DW, WW							
Ti Total ICPMS 6020	HW	HW							
TKN-351.3	DW,WW	DW,WW	WW	WW					
TKN-SM4500	DW,WW	DW,WW							
Tl Total ICP 200.7	WW	DW,WW	WW	WW					
Tl Total ICP 6010B	HW	HW		HW	W/S				
Tl Total ICPMS 200.8	DW,WW	DW, WW	WW					DW	DW
Tl Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S			

1.2 Bothell Accreditations and Method Capabilities

Test Code	WDOE/WDOH	A2LA	NELAP CA	NELAP UT	Navy	COE	AK	ID	CO
Expiration date:	6/30/04	8/31/04	1/31/04	1/31/04	11/15/03	7/3/04	12/26/03	6/30/04	3/31/04
TOC (4) EPA 9060	HW	HW							
TOC,415.1 5310B	DW,WW	DW,WW	WW	WW					DW
TOX - SM 5320B	DW,WW	DW,WW	WW						
TOX-9020	HW								
TOX-9020B		HW							
Turbidity180.1/2130B	DW,WW	DW,WW	WW	WW					
TX-9076	HW	HW							
U 200.8	DW,WW	DW, WW							
U ICPMS 6020	HW	HW							
V Total ICP 200.7	DW,WW	DW,WW	WW	WW					
V Total ICP 6010B	HW	HW	HW	HW	W/S		W/S		
V Total ICPMS 200.8	DW,WW	DW, WW	WW						
V Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S	W/S		
Zn Total ICP 200.7	DW,WW	DW,WW	WW	WW					
Zn Total ICP 6010B	HW	HW	HW	HW	W/S				
Zn Total ICPMS 200.8	DW,WW	DW, WW	WW						
Zn Total ICPMS 6020	HW	HW	HW	HW	W/S	W/S			
Zr Total ICP 6010B									

W = water
S = solid
WW/PW = drinking water
WW/NonPotable = wastewater
HW = Hazardous Waste (not aqueous)

1.3 Seattle SOP Summary and Link to NELAC Standard

SOP No.	Title	NELAC Link
B-SOP-EXT-001	Preparation of Soils and Solids for Semi-Volatile Analysis by EPA 3550B (Sonication)	Appendix D1
B-SOP-EXT-002	Waste Extraction Test (WET) California Environmental Health Standards 66261.126	Appendix D1
B-SOP-EXT-003	Preparation of Liquids for Semi-Volatile Analysis by EPA 3520C Liquid/Liquid Extraction	Appendix D1
B-SOP-EXT-004	Standard Operating Procedure: Toxicity Characteristic Leaching Procedure (TCLP), EPA 1311	Appendix D1
B-SOP-EXT-005	N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) in Soil, Sludge and Sediment Samples by EPA 9071B Mod	Appendix D1
B-SOP-EXT-006	Preparation of Solids for Semi-Volatile Analysis by EPA 3540C Liquid/Solid Extraction	Appendix D1
B-SOP-EXT-007	Preparation of Liquids for Semi-Volatile Analysis by EPA 3510C Liquid/Liquid Extraction	Appendix D1
B-SOP-EXT-009	Gel Permeation Chromatography Extract Clean-up Procedure, EPA Method 3640 (GPC)	Appendix D1
B-SOP-EXT-010	Oil and Grease by EPA 1664, N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM)	Appendix D1
B-SOP-EXT-011	Chlorinated Herbicides: Preparation of Waters, Soils and Wastes By EPA 8151A	Appendix D1
B-SOP-EXT-012	Aliphatic/Aromatic Fractionation Procedure by Column Chromatography	
B-SOP-EXT-013	Standard Operating Procedure for WTPH and NWHCID for Soils and Solids	
B-SOP-EXT-014	Preparation of Wipes for PCB Analysis by EPA 8082	
B-SOP-EXT-015	EPA 3580A: Waste Dilutions	
B-SOP-EXT-016	EPA Method 3665A: PCB Acid Clean Up Procedure	
B-SOP-EXT-017	Silica Gel/Acid Cleanup	
B-SOP-EXT-018	Preparation of Solids for Semi-Volatile Analysis by Pressurized Fluid Extraction (EPA 3545)	
B-SOP-EXT-019	Florisil Cartridge Cleanup of Extracts for Pesticide Analysis	
B-SOP-EXT-020	Homogenization and Subsampling of Laboratory Samples	
B-SOP-FLS-004	Measurement of Gaoline Range Hydrocarbons (GRO) by Gas Chromatography FID/PID (GC FID/PID) in Series: AK 101	
B-SOP-FLS-005	Measurement of Aliphatic and Aromatic Hydrocarbons in Residual Range Organics (RRO) by Gas Chromatography/FID (GC/FID): AK 102	
B-SOP-FLS-006	Measurement of Volatile Organics Compounds in Gasoline by Gas Chromatography PID (GC/PID): EPA 8021B	Section 5.9, Appendix D1
B-SOP-FLS-007	Determination of Gasoline Range Hydrocarbons (GRO) by Gas Chromatography (GC) with FID/PID Detection	Section 5.9, Appendix D1
B-SOP-FLS-008	Method for the Determination of Volatile Petroleum Hydrocarbons (VPH): Washington VPH	

B-SOP-FLS-009	Semi-Volatile Hydrocarbons By GC/FID	Section 5.9, Appendix D1
B-SOP-FLS-010	Semi-Volatile Hydrocarbon Analysis by Washington EPH	
B-SOP-FLS-011	Semi-Volatile Hydrocarbon Analysis by Montana EPH	
B-SOP-FLS-012	Method for the Determination of Volatile Petroleum Hydrocarbons (VPH): Montana VPH	
B-SOP-FLS-013	Operation of the ToxiRAE PID for the Prescreening of Soil Samples for Gas/BTEX Analysis	
B-SOP-ISG-001	Information Systems Hardware Audits	Section 5.10.6
B-SOP-ISG-002	Software Validation and Control	Section 5.10.6
B-SOP-ISG-003	Storage and Security of Computer Programs and Electronic Data	Section 5.10.6
B-SOP-ISG-004	Software Installation and Configuration	Section 5.10.6
B-SOP-MIC-001	Standard Operating Procedures for Preparation of Culture Media	Section 5.9.4.1, Appendix D3
B-SOP-MIC-002	Standard Operating Procedures for Heterotrophic Plate Count (Pour Plate Method): SM 9215	Appendix D3
B-SOP-MIC-003	Standard Operation Procedures for Colilert P/A (Presence/Absence Coliform Test): SM 9223	Appendix D3
B-SOP-MIC-004	Standard Operating Procedures for Membrane Filter-Technique (MF) for Total Coliforms in Water: SM 9222B	Appendix D3
B-SOP-MIC-005	Standard Operating Procedures for Membrane Filter-Technique (MF) for Fecal Coliforms in Water: SM 9222D	Appendix D3
B-SOP-MIC-006	Standard Operating Procedures for Multiple-Tube Fermentation Technique for Total Coliforms (MPN): SM 9221B	Appendix D3
B-SOP-MIC-007	Standard Operating Procedures for Multiple-Tube Fermentation Technique for Fecal Coliforms (MPN): SM 9221E, Standard Fecal Col	Appendix D3
B-SOP-MIC-008	Standard Operating Procedures for Soil and Compost Extraction for MPN Analysis	
B-SOP-MIC-009	Standard Operating Procedures for Salmonella in Composts	
B-SOP-MIC-010	Microbiology - Specific QA/QC	Section 5.7.1(c) Appendix D3
B-SOP-MTL-001	Mercury in Water by EPA 245.1 and 7470A, and Solid Matrices by EPA 7471A Manual Cold Vapor Technique (CVAA)	Section 5.9, Appendix D1
B-SOP-MTL-002	Determination of Total and Dissolved Trace Elements in Liquids, Solids and Wastes EPA 200.7 and 6010B (Inductively Coupled Plasma)	Section 5.9, Appendix D1
B-SOP-MTL-003	Determination of Total and Dissolved Trace Elements in Liquids, Solids, and Wastes, Inductively Coupled Plasma Mass Spectroscopy	Section 5.9, Appendix D1
B-SOP-MTL-004	Acid Digestion for Total Recoverable or Dissolved Metals for Analysis by FLAA, ICP, or ICPMS: EPA 3005A	Appendix D1
B-SOP-MTL-006	Strong Acid Digestion of Solid Samples for Recoverable Metals for Analysis by ICP or ICPMS - EPA 3050B	Appendix D1
B-SOP-MTL-007	Acid Digestion of Aqueous Samples for Total Metals for Analysis by ICP or ICPMS EPA 3020A	Appendix D1
B-SOP-MTL-008	Acid Digestion of Aqueous Samples for Total Metals for Analysis by ICP and ICPMS EPA 3010A	Appendix D1

B-SOP-MTL-009	Dissolved, Suspended, Total and Total Recoverable Metals: Preparation of Aqueous Samples for EPA 200.7	Appendix D1
B-SOP-MTL-010	Acid Digestion of Biological Tissues for Total Recoverable Metals Determination EPA 200.3	Appendix D1
B-SOP-MTL-011	Preparation of Aqueous Samples for Dissolved and Total Recoverable Metals (EPA 200.8)	Appendix D1
B-SOP-MTL-012	Determination of Hexavalent Chromium in Water and Wastewater by ICP (EPA 6010B)	Appendix D1
B-SOP-ORG-001	Measurement of Volatile Organic Compounds by Gas Chromatographic/Mass Spectrometry (EPA 8260B)	Section 5.9, Appendix D1
B-SOP-ORG-002	Measurement of Semi-Volatile Organic Compounds by Gas Chromatrography/Mass Spectrometry (Method 8270C)	Section 5.9, Appendix D1
B-SOP-ORG-003	Measurement of Chlorinated Pesticides by Gas Chromatography Electron Capture Detection (GC/ECD)	Section 5.9, Appendix D1
B-SOP-ORG-004	Analysis of Chlorinated Herbicides by 8151A Utilizing Gas Chromatography with Electron Capture Detection (ECD)	Section 5.9, Appendix D1
B-SOP-ORG-005	Measurement of Polychlorinated Biphenyls (PCBs) by Gas Chromatography Electron Capture Detection (GC/ECD)	Section 5.9, Appendix D1
B-SOP-ORG-007	Measurement of Volatile Organic Compounds By Gas Chromatography/ Mass Spectrometry (GC/MS): Method 624	Section 5.9, Appendix D1
B-SOP-ORG-008	Semi-Volatile Organic Compounds by Gas Chromatography/ Electron Capture Detection (GC/ECD): Method 608 - Organochlorine Pestic	Section 5.9, Appendix D1
B-SOP-ORG-009	Semi-Volatile Organic Compounds by Gas Chromatography/ Mass Selection Detection (GC/MS): Method 625 - Base/Neutrals and Acids	Section 5.9, Appendix D1
B-SOP-ORG-012	Measurement of 1,4-Dioxane in Aqueous Samples by GC/MS-SIM	Section 5.9, Appendix D1
B-SOP-ORG-013	Measurement of Semi-Volatile Organic Compounds By Gas Chromatography/Mass Spectrometry using Selected Ion Monitoring (Method 8270)	Section 5.9, Appendix D1
B-SOP-ORG-014	Measurement of EBD and DBCP in Aqueous Matrices Utilizing Micro-extraction and Gas Chromatography with an Electron Capture Detector (GC/ECD)	Section 5.9, Appendix D1
B-SOP-ORG-015	Determination of PCBs in Aqueous Samples Using a Micro-extraction Technique Followed by Gas Chromatography Utilizing an Electron Capture Detector (EPA 8082 Mod)	Section 5.9, Appendix D1
B-SOP-PMG-001	Project Management Roles and Responsibilities	Section 5.5.2(I) 5.16
B-SOP-PMG-002	Contingency Analysis	Section 5.14
B-SOP-PMG-003	Correcting Defective Reports and Issuing Amended Reports	Section 5.13 (d,e)
B-SOP-QAG-001	Control of the Laboratory's Quality System Documents	Section 5.5
B-SOP-QAG-003	Internal and External Audits	Section 5.5.3
B-SOP-QAG-004	Establishment and Verification of Method Detection Limits (MDL)	Section 5.5.4 Appendix D 1.4
B-SOP-QAG-005	Formatting and Writing of Standard Operating Procedures	Section 5.10.1
B-SOP-QAG-006	Archiving and Control of Analytical Data and Laboratory Documents	Section 5.12

)P-QAG-007	QC Protocol for Analytical Batch Processing	Appendix D1
B-SOP-QAG-009	Measurement Traceability and the Selection and Purchasing of Services and Materials	Section 5.9, 5.10.5, 5.15
B-SOP-QAG-010	Standard Operating Procedures for Non-Conformances: Data Qualifiers, Non-Conformance Reports, Case Narratives, and Corrective	Section 5.5.3
B-SOP-QAG-011	Standard Operating Procedure for Data Deliverable Packages	
B-SOP-QAG-012	Manual Integration	Section 5.4.2 (b,c)
B-SOP-QAG-013	Mint Miner	
B-SOP-QAG-014	Protocol for Resolving Anomalous Situations	Section 5.5.2(o) 5.11.(c)
B-SOP-QAG-015	Quarterly QA Reports and Management Review of the Quality System	Section 5.5.3.2
B-SOP-QAG-016	Client Confidentiality and Information Security	Section 5.4.2(i) 5.13(f)
B-SOP-QAG-017	Qualifying Subcontractors	Section 5.14
B-SOP-QAG-018	Training of Technical Staff	Section 5.6, 5.10.2
B-SOP-QAG-019	Application of Control Limits and Use of Control Charts	Section 5.5.4b
B-SOP-QAG-020	Ethical Conduct and Conflict of Interest Training	Section 5.4.2 (b,c) 5.6.2(c)
B-SOP-QAG-021	Preventive Actions Including Instrument Maintenance and Demonstrations of Analytical Control	Section 5.8
)P-QAG-022	Measurement Uncertainty	Section 5.13(12)
B-SOP-QAG-023	Data Review and Reporting of Analytical Results	Section 5.10.4
B-SOP-QAG-024	Documentation Entry and Error Correction	Section 5.12.1
B-SOP-QAG-025	Stop Work and Subsequent Return to Production	
B-SOP-SPL-001	Calibration and Monitoring of Laboratory Balances	Section 5.9.4.1
B-SOP-SPL-002	Glassware Washing Procedures for Organic, Inorganic and Microbiological Sample Preparation	Appendix D 1.8
B-SOP-SPL-003	Standard Operating Procedure for Total Solids CLP SOW ILM03.0 Exhibit D Part F	
B-SOP-SPL-004	Monitoring of Refrigerated Storage	Section 5.9.4.1, 5.11
B-SOP-SPL-005	Sample Control and Storage	Section 5.11, 5.12
B-SOP-SPL-006	Standard Operating Procedures for Sample Disposal	Section 5.11.5
B-SOP-SPL-007	Sample Container Preparation	
B-SOP-SPL-008	Standard Operating Procedure for Sample Log-in Using Element	Section 5.11, 5.12
B-SOP-SPL-009	Monitoring Volatile and Fuels Refrigerators for Background Contamination	Section 5.11

B-SOP-SPL-010	Building Security	Section 5.12
B-SOP-SPL-011	Use of Radalert	
B-SOP-SPL-012	Legal and Internal Chain-of-Custody Protocols	
B-SOP-WET-001	Monitoring of the Laboratory Deionized Water System	Appendix D 1.6
B-SOP-WET-002	Measurement of Organic Carbon Fraction: ASTM-D2974	
B-SOP-WET-003	Determination of Alkalinity by Titration	Section 5.9, Appendix D1
B-SOP-WET-004	Analysis of Anions by Ion Chromatography	Section 5.9, Appendix D1
B-SOP-WET-006	Determination of Hexavalent Chromium in Water by EPA 7196A, Soil by EPA 3060A/7196A	Section 5.9, Appendix D1
B-SOP-WET-007	Acidity as CaCO3 in Water by Titration: EPA Method 305.1 and SM 2310B	Section 5.9, Appendix D1
B-SOP-WET-009	Determination of Ammonia-Nitrogen in Water: EPA 350.3 and SM 4500-NH3 E	Section 5.9, Appendix D1
B-SOP-WET-010	Determination of Total and Amenable Cyanide in Water: EPA 335.1, EPA 335.2, and SM 4500-CN-E & G	Section 5.9, Appendix D1
B-SOP-WET-011	Determination of Fluoride in Water: EPA 340.2 and SM 4500-F-C	Section 5.9, Appendix D1
B-SOP-WET-012	Hardness in Water by Calculation: SM 2340B	Section 5.9, Appendix D1
B-SOP-WET-013	Determination of pH in Water: EPA 150.1 and SM 4500-H+	Section 5.9, Appendix D1
B-SOP-WET-014	Total Kjeldahl Nitrogen (TKN) in Water: EPA 351.3 and SM 4500-Norg B	Section 5.9, Appendix D1
B-SOP-WET-015	Biological Oxygen Demand: EPA 405.1 and SM 5210B	Section 5.9, Appendix D1
B-SOP-WET-016	Measurement of Total Solids (TS) and Total Volatile Solids (TVS) in Water and Wastes: EPA 160.3/160.4 and SM 2540B/E	Section 5.9, Appendix D1
B-SOP-WET-017	Measurement of Residue, Non-filterable (TSS) and Volatile Suspended Solids (VSS) in Water and Wastewater: EPA 160.2 /160.4 and SM 2540D/E	Section 5.9, Appendix D1
B-SOP-WET-018	Filterable Residue in Water and Wastewater: EPA 160.1 and SM 2540C	Section 5.9, Appendix D1
B-SOP-WET-019	Dissolved Oxygen in Water: EPA 360.1 and SM 4500-O G	Section 5.9, Appendix D1
B-SOP-WET-020	Chemical Oxygen Demand (COD) in Water: EPA 410.4	Section 5.9, Appendix D1
B-SOP-WET-021	Determination of Color By Visual Comparison Method: EPA 110.2 and SM 2120B	Section 5.9, Appendix D1
B-SOP-WET-022	Specific Conductivity: EPA 120.1, 9050 and SM 2510B	Section 5.9, Appendix D1

)P-WET-023	Determination of Total Organic Carbon in Water, Wastewater, and Solids: EPA 415.1, EPA 9060 modified, and SM 5310B	Section 5.9, Appendix D1
B-SOP-WET-024	Turbidity in Water and Wastewater: EPA 180.1 and SM 2130B	Section 5.9, Appendix D1
B-SOP-WET-025	Determination of Settlable Solids: EPA 160.5 and SM 2540F	Section 5.9, Appendix D1
B-SOP-WET-026	Nitrate-Nitrite: EPA 353.2 and SM 4500-NO3 E	Section 5.9, Appendix D1
B-SOP-WET-027	Determination of Ortho-Phosphate and Phosphorous: EPA 365.2 and SM 4500-P F	Section 5.9, Appendix D1
B-SOP-WET-028	Chlorine, Total Residual (Spectrophotometric, DPD): EPA 330.5	Section 5.9, Appendix D1
B-SOP-WET-029	Determination of Anionic Surfactants as MBAS: EPA 425.1 and SM 5540C	Section 5.9, Appendix D1
B-SOP-WET-030	Determination of Total Organic Halides (TOX) in Wastewater: EPA 9020B and SM 5320B	Section 5.9, Appendix D1
B-SOP-WET-031	Total Volatile Solids: EPA 160.4	Section 5.9, Appendix D1
B-SOP-WET-032	Determination of Phenolic Material in Water and Wastewater: EPA 420.1	Section 5.9, Appendix D1
B-SOP-WET-033	Sulfide by Titration: EPA 376.1	Section 5.9, Appendix D1
)P-WET-034	Carbon Dioxide by Titration: SM 4500-CO2 C	Section 5.9, Appendix D1
B-SOP-WET-035	Sulfide: EPA 376.2	Section 5.9, Appendix D1
B-SOP-WET-036	Sulfite: EPA 377.1	Section 5.9, Appendix D1
B-SOP-WET-037	Determination of Salinity in Water and Wastewater: SM 2520B	Section 5.9, Appendix D1
B-SOP-WET-038	Determination of Hexavalent Chromium in Water and Wastewater: EPA 7196A and SM 3500-Cr D	Section 5.9, Appendix D1
B-SOP-WET-039	Determination of Ferrous and Ferric Iron: SM 3500-FeD Modified	Section 5.9, Appendix D1
B-SOP-WET-040	Determination of Total Sulfides by Distillation and Titration: EPA 9030B/376.1	Section 5.9, Appendix D1
B-SOP-WET-041	Determining the Volumetric Accuracy of Centrifuge Tubes	Section 5.9, Appendix D1
B-SOP-WET-042	Ignitability of Liquids, Closed-Cup Method	Section 5.9, Appendix D1
B-SOP-WET-043	Ignitability of Solids, Closed-Cup Method	
B-SOP-WET-044	Auto-Pipette Calibration	Section 5.9.4.1e
B-SOP-WET-045	Colorimetric Determination of Dissolved Silica: EPA 370.1	Section 5.9, Appendix D1
B-SOP-WET-046	Determination of Tannin and Lignin: SM 5550B	
.OP-WET-047	Paint Filter Liquids Test: EPA 9095A	

B-SOP-WET-048	Determination of Reactive Sulfide: WS-846, Chapter 7	Section 5.9, Appendix D1
B-SOP-WET-049	Determining Corrosivity Towards Steel: EPA 1110	Section 5.9, Appendix D1
B-SOP-WET-050	Measurement of Sodium Persulfate in Aqueous Samples	Section 5.9, Appendix D1
B-SOP-WET-051	Measurement of Dissolved Oxygen in Aqueous Samples by Winkler Titration: EPA 360.2	Section 5.9, Appendix D1
B-SOP-WET-052	Measurement of EDTA Hardness in Aqueous Samples by EPA Method 130.2	Section 5.9, Appendix D1
B-SOP-WET-053	Determination of Chlorophyll A in Water: SM 10200H	Section 5.9, Appendix D1

Appendix 2.0

Portland Specific

2.1 Portland Equipment Listing

2.2 Portland Accreditations

2.3 Portland Standard Operating Procedures (SOP) Reference Table

2.1 Portland Equipment List

Gas Chromatography/Mass Spectrometry

One (1) Hewlett-Packard 5972 Mass Spectrometer (MS) on a 5890 Series II GC with an MS-DOS Enviroquant™ Data System, Tekmar *3000* Purge and Trap, Tekmar 2032 Autosampler, NIST 75K Mass Spectral Library. The primary analyses are volatile organics by GC/MS methods 524.2, 624, and 8260B

Three (3) 5973 Mass Spectrometers (MS), each on a 6890 Plus Gas Chromatograph equipped with Hewlett-Packard Enviroquant™ Data Systems, Tekmar 3000 Purge and Trap Concentrators, all with Varian Archon Autosamplers and NIST 75K Mass Spectral Library. The primary analyses are volatile organics by GC/MS methods 524.2, 624, and 8260B.

Two (2) Hewlett-Packard 5970 Mass Spectrometers (MS) on a 5890 Series II GCs with HP 7673 Automated Sample Injection Towers. The primary analysis is semivolatile organics. Data acquisition is via Hewlett-Packard Enviroquant™ data system. The Primary application for this instrument is semivolatile organic compounds.

Three (3) Hewlett-Packard 5973 Mass Spectrometers (MS) on *6890* Series II GCs with HP 7673 Automated Sample Injection Towers in tandem with an Apex Prosep 800 Plus.. The primary analysis is semivolatile organics. Data acquisition is via Hewlett-Packard Enviroquant™ data system. The Primary applications for these instruments are semivolatile organic compounds and drinking water analysis.

One (1) Hewlett-Packard 5972 Mass Spectrometer (MS) on a 5890 Series II GC with an HP 7673 Automated Sample Injection Tower. The primary analysis is semivolatile organics. Data acquisition is via Hewlett-Packard Enviroquant™ data system. The Primary application for this instrument is semivolatile organic compounds.

One (1) Hewlett-Packard 5971 Mass Spectrometer (MS) on a 5890 Series II GC.

Gas Chromatography

Hewlett Packard 5890 Series II Gas Chromatograph (GC) equipped with the Hewlett-Packard Enviroquant™ Data System, OI 4460 MPM-16 port purge and trap Autosampler, OI 4560 purge and trap concentrator, OI 4430 MPM-16 Photoionization Detector (PID) equipped with Photoionization Detector in series with an OI 4420 Electrolytic Conductivity Detector (ELCD). The primary analyses are EPA 601/602 and 8021B volatiles.

Hewlett Packard 5890 Series II GC equipped with a Flame Ionization Detector and Flame Photometric Detector and HP 7673 Autosampler. The detector signal is acquired via the Hewlett-Packard Enviroquant™ Data System. The primary analysis is extractable Organophosphorous pesticides and glycols.

Four (4) Hewlett-Packard 5890 and two (2) Hewlett-Packard 6890 Gas Chromatographs (GC) equipped with Electron Capture Detectors, 7673 or 7683 Automatic Sample Injection Towers and split/splitless capillary injectors. The detector signal is acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is pesticides and PCBs.

Four (4) Hewlett-Packard 5890 gas chromatographs (GC) equipped with dual Flame Ionization Detectors (FID), dual Automatic Sample Injection Towers and split/splitless capillary injectors. The FID detector signals are acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is extractable diesel and oil range hydrocarbons.

Four (4) Hewlett-Packard 5890 Series II GCs equipped with the Hewlett-Packard Enviroquant™ data system and OI 4430 Photoionization Detectors (PID) in series with Flame Ionization Detectors (FID). All GCs are equipped with Tekmar LSC *2000* Purge and Trap Concentrators; two GCs are equipped with Tekmar 2016 16-port purge and trap Automatic Samplers and two GCs are equipped with Dynatech PTA-30 Autosamplers. The primary analysis is volatile, gasoline range hydrocarbons with BTEX distinction.

2.1 Portland Equipment List (continued)

A Hewlett-Packard 5890 Series II GC equipped with a Flame Ionization Detector, a Tekmar Headspace Analyzer and a split/splitless capillary injector. The detector signal is acquired via the Hewlett-Packard ChemStation™ data system. The primary analysis is miscellaneous solvents and alcohols and screening for 8021B and 8260B volatile analyses.

A Hewlett-Packard 5890 Series II GC equipped with a Flame Ionization Detector primary analysis is dissolved gasses in transformer oil.

A Varian Saturn 2200 Iontrap connected to a CP-3800 GC with a CP-8410 injector.

Liquid Chromatographs:

Hewlett Packard 1090 HPLC equipped with diode array UV and Fluorescence Detectors, Autosampler and Liquid Chromatograph (LC) ChemStation™ data system. The primary application is HPLC analysis of PAHs and explosives.

Two (2) Hewlett Packard 1050 HPLC equipped with diode array UV and Fluorescence Detectors, Autosampler and Liquid Chromatograph (LC) ChemStation™ data system. The primary application is Drinking water analysis of carbamates and glyphosates in Drinking water.

Organic Prep:

A 24 sample capacity continuous liquid-liquid extraction apparatus

Branson Sonifier 450 sonicators and one Cole-Parmer Ultrasonic Homogenizer 4710 series.

Two (2) ABC Laboratories Autoprep 1000 Gel Permeation Chromatographs (GPCs) equipped with UV detectors. The primary application is GPC cleanup of organic extracts.

Horizon Technology SPE-DEX 4790 Extractor.

Mettler HR73 Halogen Moisture Analyzer.

Dionex ASE 200 Accelerated Solvent Extractor.

Metals Analysis:

Hewlett Packard 7500 Series ICP-MS equipped with an ISIS Auto-diluter and a Cetac Autosampler.

Hewlett Packard 4500 Series ICP-MS MS equipped with an ISIS Auto-diluter and a Cetac Autosampler.

Leeman PS 1000 DRE ICP/Echelle spectrophotometer with autosampler.

Two (2) PSA Merlin Millennium Mercury Analyzers equipped with cold vapor atomic absorption (CVAA) and atomic fluorescence detection and a PSA 20.200 Random Access Autosampler.

Infrared Analyzers

:in-Elmer 1600 Fourier Transform Infrared (FTIR) Analyzer. The primary application is for Hydrocarbon analysis.

2.1 Portland Equipment List (continued)

Additional Equipment:

Dohrman Phoenix 8000, UV Persulfate TOCAnalyzer with autosampler.

Dionex Series 4500 Ion Chromatograph equipped with Pulsed Electrical Detector (PED) and a Hewlett-Packard ChemStation™ data system. Connected via an Alpha-Omega HP35900C Analog-to-Digital converter

Dionex Series 4500 Ion Chromatograph equipped with a conductivity detector.

Dionex DX-120 Ion Chromatograph equipped with a high performance conductivity cell with heater and Dionex PeakNet data system.

Foxboro Miran 1 FF Infrared Spectrophotometer for oil and grease analysis.

Zellweger Analytics Lachet, Quikchem FIA. Used for trace level nutrients, with Cetac Autosampler and Omnion software.

Perstorp/Astoria Pacific Flow Solution III Auto-analyzer equipped with 550 and 305D detectors.

Perkin-Elmer Lambda 3B UV/VIS dual beam spectrometer used for a variety of classical wet chemistry determinations.

Spectronic Genesys 2 Spectrometer.

CEM MARS X microwave digestor.

Other laboratory equipment includes centrifuges, ovens, furnaces, analytical balances, TCLP Extraction Apparatus, hot blocks, extraction/distillation equipment, refrigerated vaults and other general chemistry equipment.

2.2 Portland Accreditations and Method Capabilities

Accrediting Agency	*Accred. #*	*Granted*	*Expiration*	*Comments*
ORELAP	OR100021	1/10/03	1/9/04	SDWA, RCRA, CWA
WDOE	C097	6/24/03	6/23/04	CWA, RCRA, SDWA (ORELAP Reciprocity)
ADEC	UST-012	11/22/02	12/26/03	RCRA, AK methods (Recertification window:9/26 – 11/26/03)
ADEC	OR40-03	5/5/03	4/21/04	524.2, 200.8
California	02117CA	9/4/02	9/30/03	SDWA (NELAP Secondary)
NFESC		9/20/01	3/31/03	Renewal Pending
N Dakota DOH	R-179	3/1/03	8/31/03	SDWA, RCRA, CWA (ORELAP Reciprocity)
USACE		1/16/03	1/16/05	RCRA

2.3 Portland SOP Summary

SOP No.	Title	Date of Current Rev.
	Quality Assurance (0000.0)	
NCAP-0001.2	Format Protocols for Standard Operation Procedures	2/1/01
NCAP-0003.3	Nonconformance and Corrective Action Reports	3/11/03
NCAP-0005.2	Rules for Resolving Technical Complaints, Reanalysis and Issuance of Corrected Report	11/6/01
NCAP-0010.2	Conducting Data Accuracy Audits	7/22/98
NCAP-0012.3	Conducting Technical Systems Audits	2/13/01
NCAP-0016.1	Annual Management Review of Quality	11/21/00
NCAP-0017.0	Subcontract Policy and Procedure	11/21/00
NCAP-0020.0	Client Confidentiality	11/21/00
NCAP-0030.0	Project Management Roles and Responsibilities	12/15/00
NCAP-0040.0	Control of Laboratory Documents	11/21/00
NCAP-0041.0	Control and Storage of Laboratory Records	8/22/01
NCAP-0050.0	Traceability of Measurements	7/30/01
NCAP-0060.0	Measurement Uncertainty	8/8/01
NCAP-0070.0	Method Validation	11/6/01
NCAP-0080.0	Preventive Actions Including Instrument Maintenance and Analytical Control	8/27/01
NCAP-0100.2	Storage and Security of Computer Programs and Electronic Data	11/21/00
NCAP-0200.2	Documentation and Validation of Computer Software	6/26/01
NCAP-0210.0	Archiving and Retention of Computerized Electronic Analytical Data	
NCAP-0500.0	Establishment and Verification of Method Detection Limits (MDL)	04/01/00
NCAP-0600.0	Manual Integration	12/01/00
NCAP-0700.0	Employee Training	01/24/01
NCAP-0710.0	Ethics and Conflict of Interest Training	5/29/01
	General Laboratory (1000.0)	
NCAP-1001.2	Ordering, Receiving and Handling of Solvents, Acids, Reagents and Standards in the Laboratory	6/27/01
NCAP-1002.0	Storing Peroxidable Chemicals	
NCAP-1050.2	Glassware Cleaning	11/15/00

NCAP-1100.0	Bulking TKN/COD Waste		8/19/99
NCAP-1120.0	Bulking Autosampler vials		3/2/01
NCAP-1130.0	Bulking Pyridine		
NCAP-1140.0	Bulking DCM Waste		11/9/00
NCAP-1150.0	Bulking Sulfuric Acid		
NCAP-1160.0	Bulking High VOCs		
NCAP-1165.0	Bulking Aqueous Waste		pending
NCAP-1170.0	Bulking Liquid PCB Waste		
NCAP-1180.0	Barrel Labeling		
NCAP-1185.0	Autoclave		
NCAP-1190.0	Bulking High Metals		
NCAP-1195.0	Soil Disposal		
NCAP-1200.0	Resolving Anomalous Situations		10/23/00
NCAP-1300.1	Analysis of solids, dry weight or total solids		4/10/01
NCAP-1350.1	Subsampling and Homogenization		4/23/03
	Sample Receiving (2000.0)		
NCAP-2005.2	Sample Receiving w/sub-sampling addendum		11/6/01
NCAP-2006.0	ISCO Sampler		9/14/00
NCAP-2007.0	Sample Storage and Disposal		pending
NCA)-2008.0	Disposal Log		pending
	Microbiology (3000.0)		
NCAP-3001.3	Laboratory Supplies, Equipment and Maintenance		6/28/01
NCAP-3101.4	Sterilization Procedures		11/13/01
NCAP-3102.2	Water Quality Assurance		10/6/00
NCAP-3103.1	Microbiological Glassware Procedures		8/15/00
NCAP-3210.3	MTF (One Vessel) Coliform Analysis	SM9221B	11/13/01
NCAP-3211.0	Coliform, MTF, Single Vessel	SM9221D	11/13/01
NCAP-3220.4	Total Coliform - Membrane Filtration	SM 9222B/EPA 9132	11/13/01
NCAP-3230.1	Chromogenic Substrate P/A; TC&EC (Colilert)	SM9223B	8/15/00

NCAP-3231.0	Monthly Colilert Quality Checks		8/15/96
NCAP-3235.1	Chromogenic Substrate, Quanti-Tray 2000	SM 9223A	11/14/01
NCAP-3240.2	Heterotrophic Plate Count - Pour Plate Method	SM 9215B	11/14/01
NCAP-3310.1	Total and Fecal Coliform- Most Probable Number	SM9221B	8/15/00
NCAP-3320.1	Fecal Coliform- Membrane Filtration	SM9222D	11/14/01
NCAP-3321.1	E. coli – Membrane Filtration	SM9213D	11/14/01
NCAP-3322.0	Fecal Coliforms, Multiple Tube Fermentation	SM9221	6/28/02
NCAP-3330.2	Fecal Streptococcus- Most Probable Number	SM9230B	11/14/01
NCAP-3340.0	Hydrocarbon Degrading Bacteria Count - Membrane Filter Method		6/9/97
NCAP-3345.1	Hydrocarbon Degrading Bacteria Count – Most Probable Number		10/29/02
NCAP-3350.0	Heterotrophic Bacteria Count - Membrane Filter Method		6/10/97
NCAP-3360.0	Salmonella in Compost		7/30/98
NCAP-3365.0	Fecal Coliform in Compost and Semi-solid samples		9/16/98
NCAP-3401.0	Sample Collection, Handling and Preservation		8/15/96
NCAP-3501.0	Microbiology Data and Reporting Requirements		8/15/96

Wet Chemistry (4000.0)

NCAP-4006.3	Ion Chromatography	EPA 300.0A/9056	3/14/03
NCAP-4008.1	Fluoride Ion Selective Electrode	EPA 340.2, SM 4500-F C	6/19/02
NCAP-4009.2	Chemical Oxygen Demand	EPA 410.4, SM 5220D	11/2/01
NCAP-4010.0	Free Carbon Dioxide	SM 4500-CO_2 C	10/1/02
NCAP-4012.1	Chlorine, Total Residual	EPA 330.5, SM 4500-ClO2 D	6/21/02
NCAP-4013.0	Alkalinity, titrimetric (pH 4.5)	EPA 310.1, SM 2320	7/18/01
NCAP-4014.0	Alkalinity	EPA 310.2	9/12/01
NCAP-4016.1	Conductivity	EPA 9050/120.1, SM 2510B	1/27/97
NCAP-4017.2	Total Cyanide	EPA 9012A/335.1, SM4500-CN E, G, I	2/11/98
NCAP-4018.4	Total Cyanide- Micro Distillation	EPA 9012A/335.1/, SM 4500-CN B, C	2/5/03
NCAP-4019.3	Phenolics, Total Recoverable	EPA 420.1/9065, SM 5530	11/2/01
NCAP-4020.0	Total Cyanide, Semi-Auto	EPA 335.4, SM 4500-CN E	5/1/01
NCAP-4021.M	Lachat Instruments Method Manual	Zellweger Analytics	5/1/01

NCAP-4022.0	Nitrate/Nitrite	EPA 353.2	11/15/01
NCAP-4023.0	Orthophosphorus (Lachat)	EPA 365.1	11/12/01
NCAP-4024.0	Ammonia	EPA 350.1, SM4500-NH3 H	11/13/01
NCAP-4026.0	Total Kjeldahl Nitrogen	EPA 351.2	11/20/01
NCAP-4027.1	Total Kjeldahl Nitrogen	EPA 351.4	8/5/98
NCAP-4028.0	Total Sulfide Distillation	EPA 9030B, SM 4500-S2 F	6/10/97
NCAP-4029.1	Sulfide Idiometric (Method Except)	EPA 9030B/376.1, SM4500-S2 F	11/15/01
NCAP-4030.0	Sulfide, colorimetric	EPA 376.2	7/17/03
NCAP-4055.2	Total Organic Carbon	EPA 415.1/9060, SM 5310C	11/2/01
NCAP-4058.0	TOC – Soil, Sludge and Sediment	EPA 9060 Modified	10/6/99
NCAP-4059.2	Biochemical Oxygen Demand	EPA 405.1, SM 5210B	6/28/01
NCAP-4060.2	pH	EPA 9040/150.1, SM 4500-H B	12/98
NCAP-4062.1	Total Solids	EPA 160.3, SM 2540 B	7/28/98
NCAP-4063.1	Total Dissolved Solids	EPA 160.1, SM 2540 C	10/19/99
NCAP-4064.2	Total Suspended Solids	EPA 160.2, SM 2540 D	9/1/99
NCAP-4065.2	Fixed & Volatile Solids	EPA 160.4	9/1/99
NCAP-4066.1	Settleable Solids	EPA 160.5	7/28/98
NCAP-4068.1	Color	EPA 110.2	7/29/98
NCAP-4070.0	Turbidity	EPA 180.1/ SM 2130B	11/22/00
NCAP-4080.0	Total Phosphorus (Auto-analyzer)	EPA 365.1, SM 4500-P F	5/2/01
NCAP-4090.0	Ortho-Phosphate (auto-analyzer)	EPA 365.1, SM 4500-P F	5/2/01
NCAP-4091.M	Flow Solution III Operation Manual	Perstorp	5/2/01
NCAP-4100.2	T &O-Phosphate (colorimetric)	EPA 365.2, SM 4500-P E	6/19/02
NCAP-4101.0	Boardman Well Sample Prep	OAL procedure	9/13/00
NCAP-4102.0	Boardman Ecological Pgms- Soil	OAL procedure	9/13/00
NCAP-4103.0	Boardman Ecological Pgms- Veg	OAL procedure	9/13/00
NCAP-4105.0	Prep of Veg Samples- Fluoride	OAL procedure	9/12/00
NCAP-4110.0	Drew-166 (Tolyltriazole)	OAL procedure	9/18/00
NCAP-4170.2	Formaldehyde	M.A.S.A. 115	11/15/00
NCAP-4180.2	Tannin &Lignin	SM 5550	11/15/00

NCAP-4190.1	Dissolved Silica	EPA 370.1/ SM 4500-Si F	11/16/00
NCAP-4191.0	Dissolved Silica, high level	EPA 370.1/SM 4500-Si F	pending
NCAP-4200.0	Paint Filter	EPA 9095	4/17/02
NCAP-4210.0	Potassium Permanganate		pending
	Metals (5000.0)		
NCAP-5000.2	Digestion of Water Samples for Dissolved or Total Metals for Analysis by ICPMS, ICP or Flame AA	EPA 3005	5/10/02
NCAP-5001.3	Digestion of Soils or Sediments for Total Metals	EPA 3050B	11/5/02
NCAP-5002.0	Digestion of Oils, Heavy Sludges, and Powders for Total Metals Analysis by GFAA, ICP or Flame AA		7/27/99
NCAP-5003.0	ACOE Metals Digestion		
NCAP-5011.2	Inductively Coupled Plasma - Atomic Emission Spectroscopy	EPA 6010A, 6010B	11/4/02
NCAP-5012.1	Inductively Coupled Plasma – Atomic Emission Spectroscopy	EPA 200.7	9/30/98
NCAP-5100.0	Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma- Mass Spectrometry	EPA 200.8	7/1/96
NCAP-5200.2	Determination of Trace Elements by Inductively Coupled Plasma-Mass Spectrometry	EPA 6020	4/15/02
NCAP-5210.0	6020 by Hydride Generation		11/15/01
NCAP-5300.2	Analysis of Mercury	EPA7470A/7471A; 245.1/245.5, 3112B	5/10/02
NCAP-5301.4	Preparation of Water Samples for Mercury	EPA 7470A/245.1	5/10/02
NCAP-5302.1	Preparation of Solid Samples for Mercury	EPA 7471A	5/10/02
NCAP-5303.0	Preparation of Wipe and Filter Samples for Mercury	EPA 7470A	7/29/96
NCAP-5304.0	Prep of Water for Mercury	EPA 1631	8/24/00
NCAP-5305.0	Mercury Analysis by CVAF	EPA 1631	pending
NCAP-5310.1	Preparation of Water Samples for Mercury – California Method	EPA 7470A/245.1	11/8/00
NCAP-5400.1	Toxicity Characteristic Leaching Procedure	EPA 1311	6/24/99
NCAP-5401.0	SWLP (solid water leaching procedure)	EPA 1311M	7/21/00
NCAP-5450.2	Hardness	SM 2340B	11/9/00
NCAP-5500.0	Hexavalent Chromium (Coprecipitation)	EPA 7195/218.5	9/17/98
NCAP-5550.1	Digestion for Hexavalent Chromium Analysis	EPA 7195	6/9/00
	Volatiles (6000.0)		
NCAP-6000.2	NW-TPH-Gx		11/5/01
NCAP-6001.0	BTEX	EPA 8021B	4/30/02

NCAP-6100.5	Purgeable Organic Compounds in Water	EPA 8260B/624	5/10/02
NCAP-6150.0	Alcohols for Volatile Analysis		11/21/00
NCAP-6200.0	Closed System Soil Method	EPA 5035	7/15/98
NCAP-6300.4	Purgeable Halogenated Volatile Organic Compounds	EPA 8021B	11/2/01
NCAP-6400.1	Zero Headspace Extraction Procedure (ZHE)	EPA 1311	5/99
NCAP-6500.0	Alaska Method for the Determination of Gasoline Range Organics	AK101.0	11/1/99
NCAP-6600.1	Holding Blanks for Volatile Analysis		1/12/94
NCAP-6650.0	Headspace Screening for Volatile Analysis		4/15/93
NCAP-6700.3	Purgeable Organic Compounds in Water	EPA Method 524.2	1/15/02
	Semi-Volatiles (7000.0)		
NCAP-7003.11	Organochlorinated Pesticide Analysis	EPA 8081	5/30/02
NCAP- 7005.2	Pesticides	EPA 608	11/2/01
NCAP-7006.5	PCB Analysis	EPA 8082	4/12/02
NCAP-7008.6	Organophosphorus Pesticide Analysis	EPA 8141A	5/21/02
NCAP-7010.0	PCBs by GC/ECD	EPA 3500B/8082	10/00
NCAP-7011.0	Analysis of PCBs in Oil	EPA 3580A/3620B/3660B/3665A/8082	10/00
NCAP-7020.0	Soil Prep	EPA 8151A	1/2/02
NCAP-7021.1	Chlorinated Herbicides in Solids	EPA 8151A	5/10/02
NCAP-7022.0	Chlorinated Acids-Herbicides	EPA 8151A	1/23/02
NCAP-7023.0	Chlorinated Acids-Herbicides Prep	EPA 8151A	4/1/02
NCAP-7040.2	Phenols by Capillary Column GC/FID	EPA 8041	6/20/03
NCAP-7080.3	Glycol Analysis	EPA 8015M	6/13/00
NCAP-7100.1	High Level Extraction	EPA 8082	8/98
NCAP-7200.4	Sonication Extraction	EPA 3550B	4/15/02
NCAP-7301.10	Polynuclear Aromatic Hydrocarbon Analysis	EPA 8310	11/2/01
NCAP-7350.0	PCB/Chlorinated Pesticide Wipe Sample Prep	EPA 3580 Modified	12/4/01
NCAP-7355.0	Fish Tissue Prep	Oregon Coastal EMAP	pending
NCAP-7400.4	Separatory Funnel Extractions	EPA 3510C	5/30/02
NCAP-7450.3	BN/A Separatory Funnel Extraction	EPA 3510C	5/30/02
NCAP-7475.0	ASE	EPA 3545	pending

NCAP-7500.3	Waste Dilution	EPA 3580A	10/24/02
NCAP-7550.1	Soxhlet Extraction	EPA 3540C	5/21/02
NCAP-7600.4	Gel Permeation Chromatography Extract Cleanup Procedure	EPA 3640A	11/8/00
NCAP-7601.2	Sulfur Cleanup Procedure	EPA 3660B	4/15/02
NCAP-7602.1	Florisil Cleanup Procedure	EPA 3620B	5/30/02
NCAP-7700.3	Preparation of PAH & PCB Screens		5/3/02
NCAP-7800.2	Continuous Liquid/Liquid Extraction	EPA 3520C	10/98
NCAP-7801.3	GC/MS Analysis of Semivolatile Organics	EPA 8270C	11/2/01
NCAP-7802.1	Sample prep for analysis of organic compounds in fish tissue samples		7/27/98
NCAP-7803.0	Gravimetric determination of lipid content		7/27/98
NCAP-7901.3	Polynuclear Aromatic Hydrocarbons by GC/MS in SIM Mode	EPA 8270 Mod.	11/2/01
SOP-012	Chlorinated Phenols	EPA 8150M	
	Equipment (8000)		
NCAP-8000.2	Laboratory Thermometer Calibration		10/4/02
NCAP-8200.1	Calibration and Maintenance of Air-Displacement Pipets		12/98
NCAP-8300.2	Logbook Maintenance		In review
NCAP-8400.0	Geiger Counter		10/4/02
	Fuels (9000.0)		
NCAP-9001.2	Method Exceptions, Gravimetric Oil and Grease	EPA 413.1	11/5/98
NCAP-9005.1	NWTPH-HCID, ORTPH-HCID, WATPH-HCID		9/24/01
NCAP-9102.1	Semivolatile Petroleum Hydrocarbons for Soil and Water	AK102, AK103 & AK102/103	11/14/00
NCAP-9200.0	Semivolatile Hydrocarbons in Water	AK102M	2/28/03
NCAP-9400.2	HEM by Extraction and Gravimetry	EPA 1664/9070	11/1/01
NCAP-9401.0	HEM by Extraction and Gravimetry, soil	1664 M	11/8/02
NCAP-9801.2	Semivolatile Petroleum Hydrocarbons for Soil and Water	NWTPH-Dx, ORTPH-D/D-ext, WTPH-D/D-ext	11/1/01
NCAP-9900.2	RSK 175 by GC-FID		inactive
SOP-014	GC/FID Analysis of Diesel in Soil, Water, Sludge & Oil	8015 Modified - Extractable	inactive
	Mobile Lab (10000)		
NCAP-10001.0	Digestion of Soils and Sediments	EPA 3050	3/1/01
NCAP-10002.0	Digestion of Water Samples	EPA 3005	3/1/01

NCAP-10003.0	Preparation of Water Samples for Hg	EPA 1631	3/12/01
NCAP-10004.0	Preparation of Solid Samples for Hg	EPA 1631	3/12/01
NCAP-10005.0	Trace Metals by GFAA	EPA 200.9	5/4/01
NCAP-10006.0	Mercury Analysis	EPA 1631	5/7/01
NCAP-10007.0	TCLP Prep	EPA 1311	5/7/01
	Oil Quality (11000)		
NCAP-11000.0	ASTM Color		9/11/00
NCAP-11001.0	Dielectric Breakdown	ASTM D877	9/11/00
NCAP-11002.0	Heat of Combustion	ASTM D240-87	9/11/00
NCAP-11003.0	Interfacial Tension	ASTM D971	9/11/00
NCAP-11004.0	Acid Number	ASTM D0974	9/13/00
NCAP-11005.0	Power Facto,	ASTM D924	9/11/00
NCAP-11006.0	Rust Prevention		5/7/01
NCAP-11007.0	Specific Gravity		5/7/01
NCAP-11008.0	Viscosity	ASTM D445, D2161	9/11/00
NCAP-11009.0	Visual Inspection	ASTM D1524	9/11/00
NCAP-11010.0	Water and Sediment	ASTM D2709	9/12/00
NCAP-11011.0	Dissolved Gas		11/12/01
NCAP-11012.0	Ferrography, Direct Reading		pending
NCAP-11013.0	Ferrography, Analytical		pending
NCAP-11014.0	API Gravity of Crude Pertoleum and Petroleum Products	ASTM 287	pending
NCAP-11020.0	Sulfur in Petroleum Products	ASTM D129	4/15/02
NCAP-11021.0	Chlorine in New and Used Petroleum Products	ASTM D808	4/15/02
NCAP-11022.0	Analysis of Graphites used as Lubricants	ASTM 1553	4/17/02
	Drinking Water (12000)		
NCAP-12001.0	Sample Acceptance of Drinking Water		12/11/01
NCAP-12010.2	Volatile SOCs	EPA 504.1	4/1/02
NCAP-12020.2	Chlorinated Pesticides	EPA 508.1	4/1/02
NCAP-12030.3	Chlorinated Acids – Herbicides	EPA 515.3	5/6/03
NCAP-12040.1	Pesticides and Synthetic Organic Chemicals	EPA 525.2	1/17/02

NCAP-12050.3	Carbamates	EPA 531.2	5/6/03
NCAP-12060.2	Glyphosate	EPA 547	4/1/02
NCAP-12070.2	Endothall	EPA 548.1	4/1/02
NCAP-12080.1	Diquat and Paraquat	EPA 549.2	4/1/02
NCAP-12090.2	Haloacetic Acids and Dalapon	EPA 552.2	6/6/02
NCAP-12100.0	Threshold Odor Test	SM 2150B	7/25/03

Appendix 3.0

Spokane Specific

3.1 Spokane Accreditations

3.2 Spokane Standard Operating Procedures (SOP) Reference Table

3.1 Spokane Accreditations and Method Capabilities

Method	WDOE (NCA-S, Montgomery Street)	WDOE (NCA-S, First Ave)
Expiration date:	**11/30/03**	**1/6/04**
552.2 Haloacetic Acids		DW
8021 (BTEX)	WW, A	
8081 Pesticides	HW	
8082 PCB Aroclors	HW	
8260B VOA Full List	HW	
Acidity-SM2310B		WW
Ag ICP 200.7		WW
Ag ICP 6010		HW
Ag GFAA 272.2		DW, WW
Al ICP 200.7		DW, WW
Alkalinity 310.1		DW, WW
Ammonia-350.2		WW
As ICP 200.7		WW
As ICP 6010		HW
As GFAA 206.2		DW, WW
B ICP 200.7		DW
Ba ICP 200.7		DW, WW
Ba ICP 6010		HW
Be ICP 200.7		DW, WW
Be ICP 6010		HW
BOD405.1		WW
CBOD405.1		WW
Ca ICP 200.7		WW
Cd ICP 200.7		DW, WW
Cd ICP 6010		HW
Cd GFAA 213.2		DW, WW
Chloride-300.0		DW, WW
Cl Residual SM4500CL G		WW
Co ICP 200.7		WW
COD-410.4		WW
Color-SM2120C		DW, WW
Conductivity-120.1		DW,WW
Cr ICP 200.7		DW, WW
Cr ICP 6010		HW

3.1 Spokane Accreditations and Method Capabilities

Method	WDOE (NCA-S, Montgomery Street)	WDOE (NCA-S, First Ave)
Expiration date:	**11/30/03**	**1/6/04**
Cu ICP 200.7		DW, WW
Cu GFAA 220.2		HW
Cyanide - SM4500CN E		DW, WW
Cyanide WAD 4500CN-I		WW
Cyanide, Amen-SM4500-CN G		WW
Cyanide, Total-335.2		WW
EDB/DBCP-8011	HW	
Fe ICP 200.7		DW, WW
Fluoride-340.2		DW, WW
GCMS-SIM PAH	HW	
Hardness-130.2		DW, WW
Hg Total CVAA 245.1		DW,WW
Ignitability-1010	HW	
K ICP 200.7		WW
MBAS-SM5540C		WW
Mg ICP 200.7		WW
Mn ICP 200.7		DW, WW
Mo ICP 200.7		WW
Na Total ICP 200.7		DW, WW
Ni Total ICP 200.7		DW, WW
Ni Total GFAA 249.2		WW
Nitrate-300.0		DW, WW
Nitrite-300.0		DW, WW
NO2-NO3 300.0		DW, WW
NWTPH-Dx	HW	
NWTPH-Gx	HW	
O&G-1664 HEM		WW
Orthophosphate 365.3		DW, WW
P Total Color 365.3		WW
Pb Total ICP 200.7		WW
Pb Total ICP 6010		HW
Pb Total GFAA 239.2		DW, WW
pH-150.1	WW	DW, WW
pH-9045	HW	

3.1 Spokane Accreditations and Method Capabilities

Method	WDOE (NCA-S, Montgomery Street)	WDOE (NCA-S, First Ave)
Expiration date:	**11/30/03**	**1/6/04**
Sb Total ICP 200.7		WW
Sb Total ICP 6010		HW
Sb Total GFAA 204.2		DW,WW
Se Total ICP 200.7		WW
Se Total ICP 6010		HW
Se Total GFAA 270.2		DW,WW
Sn Total ICP 200.7		WW
Solids, TDS-160.1		DW, WW
Solids, Total-160.3		WW
Solids, TSS-160.2	WW	WW
Solids, TVS-160.4		WW
Sulfate-300.0		DW,WW
Sulfide-376.2		WW
Ti Total ICP 200.7		WW
TKN-351.3		WW
Tl Total ICP 200.7		WW
Tl Total ICP 6010		HW
Tl Total GFAA 279.2		DW,WW
TOC,415.1 5310B		WW
Turbidity180.1		DW,WW
V Total ICP 200.7		WW
Zn Total ICP 200.7		DW,WW
Zn Total ICP 6010		HW

DW = drinking water
WW = wastewater
HW = Hazardous Waste (not aqueous)
A = Air

3.2 Spokane SOP Summary

SOP No.	New SOP No.	Title	Date of Current Rev.
NCAB-0001.0	S-SOP-QAG-001-R0	Documentation Protocol	1/17/01
NCAS-0002.5		Data Archival	12/4/95
NCAS-0003.5		Corrective Action Procedure	12/4/95
NCAB-0003.1		CAP Organic Analyses (GC, LC, GC/MS)	1/12/93
	S-SOP-QAG-005-R0	Formatting and Writing SOPs	1/17/01
NCAB-0003.2		CAP Inorganic Analyses (Metals/Wet Chem)	1/28/93
NCAB-0004.0	S-SOP-SPL-003-R0	Dry Weight Conversion	1/17/01
NCAB-0005.0		Rules for Resolving Technical Complaints	6/26/92
NCAB-0007.0		Handling Confidentiality of Data	10/19/92
NCAS-0008.5		Technical Data Review for Reports	2/17/95
NCAS-0009.5		Project Manager: Client Procedures	12/4/95
NCAB-0010.0		Subcontracting Analytical Services	1/5/92
NCAS-0011.5		Relogging Samples	12/4/95
NCAS-0013.5		Copying and Mailing of Reports	12/5/95
NCAS-1001.5		Sample Handling	1/9/98
NCAS-2001.5	S-SOP-SPL-001-R0	Glassware Cleaning	1/9/01
NCAB-2002.0		Establishing Method Detection Limits	1/10/90
NCAB-2003.0	S-SOP-SPL-002-R0	Calibration of Balances	1/17/01
NCAB-2004.0		Significant Figures and Rounding Off	6/23/92
NCAB-2006.5		QC policy for TPH by WA-DOE	3/26/93
NCAS-2100.5		TPH QC Policy for OR-DEQ (Portland)	12/5/95
NCAS-2007.5		General Training	12/5/95
NCAB-2008.0		Corrective Actions Reports	2/19/93
NCAB-2010.0		QC Policy for Inorganic Analyses	2/2/93
NCAB-2020.0		QC Policy for Metals Analyses	9/9/92
NCAB-2030.0		QC Policy for Organic Analyses	1/29/93
NCAS-2040.5		Handling and Prep of Standards for Organics	12/5/95

NCAB-2060.0		Proper Use of Respirators	5/21/93
NCAB-2070.0		Document Changes	9/28/93
NCAB-2080.0	S-SOP-SPL-004-R0	Sample Container Preparation	1/17/01
NCAB-2090.0		Storage and Security of Data	2/3/95
NCAS-4003.5	S-SOP-SPL-003-R0	Total Solids	1/17/01
NCAS-4009.5		Chemical Oxygen Demand	1/12/98
NCAB-4034.0		pH-Electrode (Water)	10/19/92
NCAS-4041.5		Total Suspended/Non-filterable Solids	12/18/97
NCAB-5001.5	S-SOP-MTL-001-R0	ICP Instrument Training	1/24/98
NCAS-5003.0		Format and Frequency SOP-Metals Analysis	8/14/95
NCAS-5004.5	S-SOP-MTL-002-R0	AAS: Mercury Cold Vapor Analysis	8/14/95
NCAS-5006.5		AAS: N2O/Acetylene Flame-Reducing	1/30/98
NCAS-5007.5		AAS: N2O/Acetylene Flame-Oxidizing	1/30/96
NCAS-5008.5		AAS: Air/Acetylene Flame	1/30/6
NCAS-5009.5		Organic Lead in Water	1/30/96
NCAS-5010.5		Organic Lead in Soil	1/30/96
NCAS-5011.5	S-SOP-MTL-009-R0	ICP-AES Method 6010A, 200.7	2/28/97
NCAS-5012.5	S-SOP-MTL-014-R0	Flame Instrument Training	1/30/96
NCAS-5013.5	S-SOP-MTL-013-R0	Naming Metal QC	8/20/96
NCAS-5014.0	S-SOP-MTL-015-R0	Routine Maintenance: Metals and Wet Chem	8/20/96
NCAS-5015.0		AAS: Arsenic and Selenium	8/14/95
NCAS-5016.0	S-SOP-MTL -010-R0	TCLP Method 1311	3/24/99
NCAS-5017.0	S-SOP-MTL-011-R0	SPLP Method 1312	3/29/99
NCAS-7002.0	S-SOP-FLS-002-R0	Method Exceptions: 8020-BTEX Only	1/9/01
NCAB-7003.0		Method Exceptions: 8080	1/9/01
NCAB-7006.0		Method Exceptions 601, 602	10/27/92
NCAB-2030.0		Purge and Trap EPA 5030	
NCAS-2040.5	S-SOP-FLS-002-R0	Method Exceptions EPA 600 PCBs in Transformer Fluid and Oil	
NCAB-2060.0	S-SOP-FLS-002-R0	Method Exceptions EPA 608 GC Organic Pesticides and PCBs	

NCAB-7020.5		Routine Maintenance-Semivolatile GC	1/13/98
NCAB-7020.2		Routine Maintenance-Volatile GC	1/29/93
NCAS-7021.0	S-SOP-ORG-001-R0	Method Exceptions 8082: PCBs in Soil	12/18/97
NCAS-7022.0	S-SOP-ORG-002-R0	Method Exceptions 8082: PCBs in Water	12/18/97
	S-SOP-ORG-004-R0	8011 EDB by GC/ECD	2/5/03
NCAS-8002.5	S-SOP-EXT-001-R0	Sonication Extraction	1/9/01
NCAS-8004.5	S-SOP-EXT-006-R0	Separatory Funnel Liquid/Liquid Extraction	1/10/01
NCAS-8012.5	S-SOP-EXT-009-R0	Extractions –3620: Florisil Cleanup	1/13/98
NCAS-8013.5	S-SOP-FLS-008-R0	Extractions –3630: Silica Gel Cleanup	1/19/98
NCAS-9001.2	S-SOP-FLS-001-R0	Method Exceptions-WTPH-D in Soil	1/9/01
NCAS-9002.0	S-SOP-FLS-003-R0	Method Exceptions-WTPH-G in Soil	1/9/01
NCAS-9003.0	S-SOP-FLS-003-R0	Method Exceptions-WTPH-G in Water	1/9/01
NCAS-9004.2	S-SOP-FLS-001-R0	Method Exceptions-WTPH-D in Water	4/15/96
NCAS-9009.2	S-SOP-FLS-001-R0	Method Exceptions WTPH-HCID in Soil	4/15/96
NCAS-9010.0	S-SOP-EXT-004-R0	Method Exceptions- 413.2 (IR) for Soil	1/9/01
NCAS-9011.0	S-SOP-EXT-004-R0	Method Exceptions- 413.2 (IR) for Water	1/9/01
NCAS-9012.0	S-SOP-EXT-004-R0	Method Exceptions-WTPH-418.1 for Soil	1/9/01
NCAS-9013.0	S-SOP-EXT-004-R0	Method Exceptions-WTPH-418.1 for Water	1/9/01
	S-SOP-EXT-005-R0	Preparation of Wipe Samples for PCB Analysis	1/9/01
	S-SOP-FLS-002-R0	PCB Acid Cleanup By 3665A	1/9/01
	S-SOP-FLS-007-R0	Acid-Silica Gel Cleanup (DSL)	1/12/01
	S-SOP-ORG-003-R0	PAH SIM by 8270C	1/12/01
	S-SOP-MTL-003-R0	Total/Dissolved Trace Elements in Liquid, Solids and Wastes by EPA 6020 (ICP)	
	S-SOP-MTL-004-R0	Acid Digestion for Total/Dissolved Metals for Analysis using FLAA/ICP by EPA 3005A	
	S-SOP-MTL-006-R0	Acid Digestion for Total/Dissolved Metals for Analysis using FLAA/ICP by EPA 3050B	
	S-SOP-MTL-007-R0	Acid Digestion for Total Metals using FLAA/ICP by EPA 3020A	
	S-SOP-MTL-008-R0	Acid Digestion of Aqueous Samples for Total Metals using FLAA/ICP by EPA 3010A	
	S-SOP-MTL-012-R0	EPA 1311 TCLP Metals, Wheelabrator Ash Procedure	

Appendix 4.0

Bend Specific

4.1 Bend Equipment Listing

4.2 Bend Accreditations

4.3 Bend Standard Operating Procedures (SOP) Reference Table

4.1 Bend Equipment Listing

Gas Chromatography

Hewlett Packard 5890 GC equipped with a Flame Ionization Detector and TCD. The detector signal is acquired via the Hewlett-Packard Enviroquant™ Data System. The primary analysis is RSK175, dissolved gases.

Hewlett-Packard 5890 Series II Gas Chromatograph (GC) equipped with Electron Capture Detectors, 7673 Automatic Sample Injection Towers and split/splitless capillary injectors. The detector signal is acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is pesticides and herbicides.

Two (2) Hewlett-Packard 5890 Series II gas chromatographs (GC) equipped with dual Flame Ionization Detectors (FID), dual Automatic Sample Injection Towers and split/splitless capillary injectors. The FID detector signals are acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is extractable diesel and oil range hydrocarbons.

Hewlett-Packard 5890 gas chromatograph (GC) equipped with Photoionization Detectors (PID) in series with Flame Ionization Detectors (FID), and secondary detection system equipped with Photoionization Detectors (PID) for confirmation. GC is equipped with Tekmar LSC 2000 Purge and Trap Concentrators with Tekmar 2016 16-port purge and trap Automatic Samplers. The detector signal is acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is volatile, gasoline range hydrocarbons with BTEX distinction.

Hewlett-Packard 5890 gas chromatograph (GC) equipped with Photoionization Detectors (PID) in series with Flame Ionization Detectors (FID). GC is equipped with Tekmar LSC 2000 Purge and Trap Concentrators with Tekmar 2032 32-port purge and trap Automatic Samplers. The detector signal is acquired via the Hewlett-Packard Enviroquant™ data system. The primary analysis is volatile, gasoline range hydrocarbons with BTEX distinction.

Organic Prep:

Branson Sonifier 450 sonicator and Cole-Parmer Ultrasonic Homogenizer 4710 series.

Turbo Vap concentrator

Two (2) Dionex ASE 200 Accelerated Solvent Extractor.

Additional Equipment:

Dionex Series 4000 Ion Chromatograph equipped with a conductivity detector.

Other laboratory equipment includes centrifuges, ovens, furnaces, analytical balances, hot blocks, probes, refrigerated vaults and other general chemistry equipment.

Mobile Laboratory Equipment:

ENG F350 Econline Van equipped with 2 onan generators.

ENG Mighty Trailer equipped with 11KW generator.

nes 5th Wheel.

30KW Diesel generator.

4.2 Bend Accreditations

Accrediting Agency	*Accred. #*	*Granted*	*Expiration*	*Comments*
ORELAP	OR100020	4/11/03	4/10/04	SDWA, RCRA
WDOE	C287	7/14/03	7/14/04	CWA
WDOE	C289	11/2/02	11/2/03	Mobile lab, CWA
ADEC	UST-058	9/16/02	9/16/03 *	Mobile, RCRA, AK methods
ADEC	UST-066	6/12/03	6/12/04	RCRA, AK methods

* site specific, State of Alaska will grant new expiration at next location with passing PTs.

4.3 Bend SOP Summary

SOP No.	Title	Date of Current Rev.
	Quality Assurance (0000.0)	
	Bend Appendix	1/2002
	North Creek Analytical Safety Manual	3/2000
NCAC-0001.0	Format Protocols for Standard Operation Procedures	1/7/02
NCAC-0003.0	Nonconformances	1/7/02
NCAC-0005.0	Rules for Resolving Technical Complaints, Reanalysis and Issuance of Corrected Report	1/7/02
NCAC-0010.0	Conducting Data Accuracy Audits	1/7/02
NCAC-0012.0	Conducting Technical Systems Audits	1/7/02
NCAC-0016.0	Annual Management Review of Quality	1/7/02
NCAC-0017.0	Subcontract Policy and Procedure	1/7/02
NCAC-0020.0	Client Confidentiality	1/7/02
NCAC-0030.0	Project Management Roles and Responsibilities	1/7/02
NCAC-0040.0	Control of Laboratory Documents	1/7/02
NCAC-0041.0	Control and Storage of Laboratory Records	1/7/02
NCAC-0500.0	Establishment and Verification of Method Detection Limits (MDL)	1/7/02
NCAC-0700.0	Employee Training	1/1/02
NCAC-0710.0	Ethics and Conflict of Interest Training	1/7/02
	General Laboratory (1000.0)	
NCAC-1001.0	Ordering, Receiving and Handling of Solvents, Acids, Reagents, Standards and Media	1/7/02
NCAC-1200.1	Resolving Anomalous Situations	11/2001
NCAC-1301.0	Maintanence/Adjusting Procedures for Microbiology or Wet chemistry Equipment	21/3/01
	Sample Receiving (2000.0)	
NCAC-2005.1	Sample Receiving w/sub-sampling addendum	11/2001

Microbiology (3000.0)

NCAC-3001.2	Quality Assurance for Microbiological Analysis	11/13/01
NCAC-3101.2	Sterilization Procedures	12/3/01
NCAC-3102.2	Water Quality Assurance	12/3/01
NCAC-3103.2	Microbiological Glassware Procedures	12/3/01
NCAC-3104.0	Media and Buffer Preparation	12/4/01
NCAC-3105.0	Reference Cultures and Subculturing	1/03/02
NCAC-3106.0	Microbiological Environmental Monitoring	12/27/01
NCAC-3220.2	Total Coliform – Membrane Filtration, for Drinking Water SDWA by SM 9222B and EC+MUG for *E.coli* Confirmation by SM9221F **(NELAC accredited)**	12/501
NCAC-3230.2	Chromogenic Substrate Coliform Test (TC P/A) SM9223B **(NELAC accredited)**	11/29/01
NCAC-3310.1	Total and Fecal Coliform- Most Probable Number, SM 9221B	4/99
NCAC-3310.2	Fecal Coliform-Most Probable Number	4/99
NCAC-3320.1	Fecal Coliform- Membrane Filtration, SDWA by 9222D, CWA by SM9222D and EPA-600/4/016 **(NELAC accredited)**	12/10/01
NCAC-3321.2	Total Coliform Enumeration Membrane Filtration SDWA by SM19th Edition 9222B, CWA by SM 18th edition 9222B, RCRA by EPA SW-846 **(NELAC accredited)**	12/5/01
NCAC-3501.2	Microbiology Data and Reporting Requirements	1/4/02
	Wet Chemistry (4000.0)	
NCAC 4006.2	Nirtate By Ion Selective Electrode, SM-4500-NO_3-D **(NECLAC accredited)**	9/15/01
NCAC 4012.0	Chlorine, Total Residual, EPA 330.5M	4/9/99
NCAC 4016.1	Specific Conductivity, EPA 9050/120.1	11/11/01
NCAC 4059.0	Biological Oxygen Demand (BOD-5), EPA 405.1	4/7/99
NCAC 4059.3	Specific Oxygen Uptake Rate (SOUR), SM 2710B W/SOUR Addendum	10/19/99
NCAC 4060.1	pH, EPA 150.1/9040/9041/9045	11/11/01
NCAC 4066.1	Total Solids, EPA 160.3, SM 2540B	3/24/00
NCAC 4066.2	Total Disolved Solids, EPA 160.1, SM 2540C	3/24/00
NCAC 4066.3	Total Suspended Solids, EPA 160.2, SM 2540D	3/24/00
NCAC 4066.4	Fixed and Volatile Solids, EPA 160.4, SM 2540E	3/24/00
NCAC 4066.5	Settable Solids, EPA 160.5	4/9/99
NCAC 4066.6	Particulate Fallout, DEQ Analytical Procedure	5/12/99

NCAP 4068.1	Color EPA 110.2	7/29/98
NCAP 4070.0	Turbidity EPA 180.1	11/22/00
	Volatiles (6000.0)	
NCAP-6000.2	NW-TPH-Gx	11/5/01
NCAP-6001.0	BTEX EPA 8021B	4/30/02
NCAP-6500.0	Alaska Method for the Determination of Gasoline Range Organic AK101.0	11/1/99
NCAP-6650.0	Headspace Screening for Volatile Analysis	4/15/93
	Semi-Volatiles (7000.0)	
NCAP-7003.11	Organochlorinated Pesticide Analysis EPA 8081	5/30/02
NCAP- 7005.2	Pesticides EPA 608	11/2/01
NCAP-7006.5	PCB Analysis EPA 8082	4/12/02
NCAP-7010.0	PCBs by GC/ECD EPA 3500B/8082	10/00
NCAP-7011.0	Analysis of PCBs in Oil EPA 3580A/3620B/3660B/3665A/8082	10/00
NCAP-7020.0	Soil Prep EPA 8151A	1/2/02
NCAP-7100.1	High Level Extraction EPA 8082	8/98
NCAP-7200.4	Sonication Extraction EPA 3550B	4/15/02
NCAP-7355.0	Fish Tissue Prep Oregon Coastal EMAP	pending
NCAP-7400.4	Separatory Funnel Extractions EPA 3510C	5/30/02
NCAP-7475.0	ASE EPA 3545	pending
	Equipment (8000.0)	
NCAC-8000.0	Laboratory Thermometer Calibration	1/7/02
NCAC-8200.0	Calibration Checks on Positive Displacement Pipetters	12/3/01
	Fuels (9000.0)	
NCAP-9005.1	NWTPH-HCID, ORTPH-HCID, WATPH-HCID	9/24/01
NCAP-9102.1	Semivolatile Petroleum Hydrocarbons for Soil and Water AK102, AK103 & AK102/103	11/14/00
NCAP-9200.0	Semivolatile Hydrocarbons in Water AK102M	2/28/03
NCAP-9400.2	HEM by Extraction and Gravimetry EPA 1664/9070	11/1/01
NCAC-9801.2	Semivolatile Petroleum Hydrocarbons for Soil and Water NWTPH-Dx, ORTPH-D/D-ext, WTPH-D/D-ext	11/1/01
NCAC-9900.2	RSK 175 by GC-FID	12/4/01

Mobile Lab (10000)

NCAP-10001.0	Digestion of Soils and Sediments	EPA 3050	3/1/01
NCAP-10002.0	Digestion of Water Samples	EPA 3005	3/1/01
NCAP-10003.0	Preparation of Water Samples for Hg	EPA 1631	3/12/01
NCAP-10004.0	Preparation of Solid Samples for Hg	EPA 1631	3/12/01
NCAP-10005.0	Trace Metals by GFAA	EPA 200.9	5/4/01
NCAP-10006.0	Mercury Analysis	EPA 1631	5/7/01
NCAP-10007.0	TCLP Prep	EPA 1311	5/7/01

Appendix 5.0

Anchorage Specific

5.1 Anchorage Equipment Listing

5.2 Anchorage Accreditations

5.1 Anchorage Equipment List

Gas Chromatography/Mass Spectrometry

One (1) Hewlett-Packard 5971 Mass Spectrometer (MS) on a 5890 Series II GC with an MS-DOS Enviroquant™ Data System, OI 4560 Purge and Trap Concentrator, OI MPM-16 port purge and trap Autosampler, NIST 75K Mass Spectral Library. The primary analyses are volatile organics by GC/MS method 8260B.

Gas Chromatography

Two (2) Hewlett-Packard 5890 gas chromatographs (GC) equipped with dual Flame Ionization Detectors (FID), dual HP 7673 Automatic Sample Injection Towers and split/splitless capillary injectors. The FID detector signals are acquired via the Hewlett-Packard Enviroquant™ Data System. The primary analysis is extractable diesel and oil range hydrocarbons.

Two (2) Hewlett-Packard 5890 Series II GCs equipped with the Hewlett-Packard Enviroquant™ Data System and OI 4430 Photoionization Detectors (PID) in series with OI 4410 Flame Ionization Detectors (FID). GC is equipped with Tekmar LSC *2000* Purge and Trap Concentrator and Tekmar ALS2016 16-port purge and trap Automatic Samplers. The primary analysis is volatile, gasoline range hydrocarbons with BTEX distinction.

Organic Prep:

Dionex Model ASE 200 Accelerated Solvent Extractor.

Additional Equipment:

Other laboratory equipment includes centrifuges, ovens, furnaces, analytical balances, extraction equipment, refrigerators and other general chemistry equipment.

5.2 Anchorage Accreditations and Method Capabilities

Accrediting Agency	*Accred. #*	*Granted*	*Expiration*	*Comments*
ADEC	UST-067	7/8/03	6/16/04	GRO by AK101 in water and solids DRO by AK102 in water and solids RRO by AK102 in solids BTEX by AK101 in water and solids BTEX by EPA 8021B in waters PCBs by EPA 8082 in waters and solids (Recertification window: 3/16 – 05/16/04)

Appendix 6.0

Sample Container and Preservative Guide

SAMPLE CONTAINER AND PRESERVATIVE GUIDE
Waste Water / Surface Water/Groundwater

	METHOD	CONTAINER	VOLUME	PRESERVATIVE	HOLDING TIME
Volatile Organic Chemistry					
VPH - Gasoline[1]	8015B/Gx/VPH/GRO	glass w/septum	2 x 40 ml vials	Cool 4°C, HCL pH<2	14 days
Gasoline/BTEXMN/MTBE	8015B/Gx/GRO/ 8021B	glass w/septum	2 x 40 ml vials	Cool 4°C, HCL pH<2	14 days
Halocarbons	601 / 8021B	glass w/septum	2 x 40 ml vials	Cool 4°C [4], HCL pH<2	14 days[2]
Aromatics	602 / 8021B	glass w/septum	2 x 40 ml vials	Cool 4°C [4], HCL pH<2	14 days[2]
Purgeables	624 [9] / 8260 B [9]	glass w/septum	2 x 40 ml vials	Cool 4°C [4], HCL pH<2	14 days[2]
Alcohols or Glycols	8015B mod.	glass w/septum	2 x 40 ml vials	Cool 4°C, HCL pH<2	14 days
C1-C6 gases (methane, ethane, ethane, etc.)	RSK 175	glass w/septum	2 x 40 ml vials	Cool 4°C, HCL pH<2	14 days
Semivolatile Organic Chemistry					
EPH – Diesel and Heavy Oil[3]	8015B/Dx/EPH/DRO	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Semivolatiles (BNAs)	625 / 8270C	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Organochlorine Pesticides &/or PCBs	608 / 8081A /or 8082	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Phosphorous Pesticides	614 / 8141	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Herbicides	615 / 8151A	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Polynuclear Aromatics	8310/8270C	glass-amber	1 L	Cool 4°C	7 days[6]/40[6]
Total Recoverable Petroleum Hydrocarbons/HEM/O&G	1664/418.1/413.2	glass-amber	1 L	Cool 4°C, HCL pH<2	28 days
Organic Chemistry					
Total Organic Carbon	415.1 / 9060	glass-amber w/septum	250 ml	Cool 4°C, HCl or H_2SO_4 to pH<2	28 days
Total Organic Halides (TOX)	9020B	glass-amber	500 ml	Cool 4°C, H_2SO_4 pH<2	28 days
Metal Analyses[8]					
Mercury	245.1 / 7471A	poly	500 ml	HNO_3 to pH<2	28 days
Low level Mercury	1631	Teflon	500 ml	HNO_3 to pH<2	
Chromium VI	7196A/7195	poly	500 ml	Cool 4°C	24 hrs.
Ferrous Iron	SM 3500 Fe D	poly	500 ml	Cool 4°C	24 hrs./6 months
Other Metals (not speciated)	200 / 6000B / 7000A	poly	500 ml	HNO_3 to pH<2	6 months

[1] Volatile Petroleum Hydrocarbons
[2] Holding time for 600 series methods not preserved with HCl is 7 days (3 days if acrolein is included.)
[3] Extractable Petroleum Hydrocarbons
[4] If chlorinated, add sodium thiosulfate before acidification.
[5] If chlorinated, add ascorbic acid or sodium thiosulfate before acidification.
[6] Holding Times shown are days until extraction/days after extraction to analysis.
HCL preserved NWTPH-Dx, -EPH, MT-EPH and AK102 have a 14/40 hold.
chlorinated, add sodium sulfite before acidification to pH<2 with HCl.
Dissolved metals should be field-filtered through 0.45micron filter, prior to preservation.
[9] An additional unpreserved VOA must be used for 2-CVE, Acrolein, and/or Acrylonitrile (the holding time for 8260B is 7 days)

SAMPLE CONTAINER AND PRESERVATIVE GUIDE

	METHOD	CONTAINER	VOLUME	PRESERVATIVE	HOLDING TIME
Inorganic & Wet Chemistry					
Alkalinity	SM 2320B/310.1	poly or glass	500 ml	Cool 4°C	14 days
BOD	405.1	poly	1 L	Cool 4°C	48 hours
COD	410.4	poly or glass	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
Chloride	300.0	poly or glass	500 ml	None	28 days
Chlorine Residual	SM 4500G/330.5	poly or glass	500 ml	None, do not expose to sunlight	Immediate
Chlorophyll-a	SM 10200H	Amber glass	1 L	Filter, Freeze filter	24 hours
Cyanide	SM 4500/9010/335	poly or glass	1 L	Cool 4°C, NaOH to pH>12	14 days
Flashpoint	1010	poly or glass	100 ml	Cool 4°C	NA
Fluoride	300.0/340.2	poly	500 ml	None	28 days
Hardness	SM 2340B/130.2	poly or glass	100 ml	HNO_3 to pH<2	6 months
MBAS (Surfactants)	SM 5540C/425.1	poly or glass	500 ml	Cool 4°C	48 hours
Nitrogen, Ammonia	350.2/350.3	poly or glass	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
Nitrogen, Nitrate + Nitrite	353.2	poly or glass	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
Nitrogen, Nitrate or Nitrite	300.0	poly or glass	500 ml	Cool 4°C	48 hours
Nitrogen, Total Kjeldahl	351.2/351.3/351.4	poly or glass	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
Nitrogen , Total	SM4500N	poly or glass	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
O&G/HEM/TRPH	1664/413/418.1	glass-amber	1 L	Cool 4°C, HCl to pH<2	28 days
Ortho Phosphate	300.0	poly or glass	500 ml	Cool 4°C, Field-Filtered	48 hours
Phenols	9065/420.1	glass-amber	500 ml	Cool 4°C, H_2SO_4 to pH<2	28 days
Phosphorous	365.3/6010B	poly or glass	500 ml	Cool 4°C, H_2SO_4/ HNO_3 to pH<2	28 days
pH	150.1/9045C	poly or glass	500 ml	None	Immediate
Solids (TDS, TSS, TS, TVS)	160.1/160.2/160.3/ 160.4	poly or glass	500 ml	Cool 4°C	7 days
Settleable Solids (SS)	160.5	poly or glass	250 ml	Cool 4°C	48 hours
Specific Conductance	SM 2510B/120.1/9050	poly or glass	500 ml	Cool 4°C	28 days
Specific Gravity	SM 2710F	poly or glass	500 ml	None	NA
Sulfate	300.0	poly or glass	500 ml	Cool 4°C	28 days
Sulfide	9030/376.1/376.2	poly or glass	500 ml	Cool 4°C, Zn Acetate+NaOH pH>9	7 days
Tannins and Lignins	SM 5550 B	poly or glass	500 ml	Cool 4°C	48 hours
TOC	9060/415.1	glass w/septum	250 ml	Cool 4°C, HCl or H_2SO_4 to pH<2	28 days
Turbidity	180.1	poly or glass	100 ml	Cool 4°C	48 hours

SAMPLE CONTAINER AND PRESERVATIVE GUIDE

Microbiological Chemistry

Total Coliform /E.coli (P/A)	SM 9223	poly or glass	120 ml	Cool 4°C	30 hours
Total & Fecal Coliforms	SM 9221/9222/9223	Sterilized poly or glass	120 ml	Cool 4°C + Sodium Thiosulfate[1]	8 hours
Heterotrophic Plate Count	SM 9215B	Sterilized poly or glass	120 ml	Cool 4°C + Sodium Thiosulfate[1]	8 hours
Fecal Streptococcus	SM 9230B	Sterilized poly or glass	120 ml	Cool 4°C + Sodium Thiosulfate[1]	8 hours

[1]If chlorinated, add 0.6g Ascorbic Acid

APPENDIX A-4

MFA RESUMES

James J. Maul, R.G.

President/Principal Hydrogeologist

EDUCATION

Western Washington University:
BS, Geology

LICENSES/REGISTRATION

Registered Geologist:
Oregon, No. G868
Washington, No. 1829

PROFESSIONAL ASSOCIATIONS

Association of Ground Water Scientists and Engineers

National Water Well Association

Mr. Maul directs projects for industrial and municipal clients involving property transfer, redevelopment, site investigation, site characterization, groundwater and corrective action studies, and corrective action design for the high-tech wood treating, chemical manufacturing, aluminum, chemical storage, solid waste, and forest products industries.

Mr. Maul has over 20 years of experience providing consulting services. He has managed projects in various stages of remedial action, from design of groundwater and soil cleanup programs to their implementation, and projects under the Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation and Liability Act, as well as state cleanup programs. Mr. Maul's technical and regulatory expertise is acquired from both direct involvement in and management of projects. He has a proven track record in the development of successful and cost-effective solutions to environmental concerns. He has extensive experience in negotiating on behalf of clients with regulatory agencies at the federal and state levels.

RELEVENT PROJECT EXPERIENCE

- Barge-Construction Facility and Former Ship-Dismantling and Scrap-Metal Facility, Portland, OR: Mr. Maul directed a remedial investigation/feasibility study at a 48-acre industrial site in the South Waterfront District, which was undergoing redevelopment. Parts of the site are still used for manufacturing. Issues included contaminated groundwater, soil, surface water, and sediments. Contaminants included polychlorinated biphenyls, dioxins, hydrocarbons, heavy metals, and solvents. Mr. Maul developed a detailed cost estimate for site remediation to support insurance litigation and cost recovery against third parties. He evaluated the requirements of Oregon's cleanup program with those of the federal National Contingency Plan. He provided expert witness services and testified at trial. Mr. Maul assisted the client with dovetailing remediation with redevelopment.

- Port of Ridgefield, Ridgefield, WA: Mr. Maul directed an emergency removal action in conjunction with a remedial investigation/feasibility study at a former wood-treating site. He assisted the client with negotiations with the U.S. Environmental Protection Agency to move the site from the Superfund program to the Washington Department of Ecology and clean up under the Model Toxics Control Act. Mr. Maul evaluated actions the property owner could take to lower the hazard ranking score, using National Contingency Plan criteria. This avoided placement on the National Priorities List and allowed the client to qualify for state grant money to fund the cleanup, which is currently estimated at $40 million. Mr. Maul provided oversight during structures removal. He directed the development of detailed cost estimates for remediation to support insurance litigation and recover against third parties. Mr. Maul is currently directing the characterization of a pentachlorophenol and creosote free-product plume in groundwater that covers over 4 acres, extends to over 55 feet below ground surface,

and threatens to migrate onto a federal wildlife refuge. He is also directing the design for steam injection to remove product contamination.

- High-Tech Manufacturing Facility, Beaverton, OR: Mr. Maul directed the preparation of Resource Conservation and Recovery Act Facility Assessment summaries and a preliminary scoping document for Tektronix, Inc. The project involved significant interaction with the client and its attorneys. Both documents provided comprehensive documentation of known site conditions, including site operations, releases, and investigations that took place over a 40-year period. Over 20 facility assessment summaries were completed. The client used many of the facility assessment summaries in completing property transfers for part of the property. The preliminary scoping document enabled the facility to begin a remedial investigation/feasibility study under the Oregon Department of Environmental Quality cleanup rules and guidelines, under oversight of the Department of Environmental Quality site response program, transitioning from the Department of Environmental Quality's Resource Conservation and Recovery Act program. It detailed potential contaminant sources, established a phased schedule for completing the remedial investigation/feasibility study, and provided support and justification for the remedial investigation scope of work and schedule.

- Former Wood-Treating Site, Sandpoint, ID: Mr. Maul directed a removal action and remedial investigation/feasibility study at an L.D. McFarland Company, Ltd. site that used pentachlorophenol and creosote. He evaluated earlier site investigation data developed by the U.S. Environmental Protection Agency. He developed a conceptual plan and directed the development of a cost estimate for the remedial investigation/feasibility study and final remedy scenarios. Mr. Maul provided oversight during structures removal and soil remediation in the summer of 1998, and completed the soil removal in April 1998. He submitted the first remedial work plan under Idaho's Voluntary Remediation rules. The work plan contained a description of removal actions, soil and groundwater characterization data, and a human health and ecological risk assessment. Mr. Maul directed implementation of the groundwater remedial investigation phase of the project.

- Former Aluminum-Reduction Facility, Vancouver, WA: Mr. Maul participated in an investigation of a 50-acre lagoon at the former Vanalco facility in southwest Washington that was contaminated with cyanide and synthetic organic compounds. He installed test borings and groundwater monitoring wells and collected groundwater samples to evaluate water quality. He evaluated site hydrogeology, the extent of groundwater contamination, lagoon leakage rates, and impacts to surface water.

- Pressure-Wood-Treating Facility, Hillsboro, OR: Mr. Maul directed a project for evaluating contamination at Permapost that required a Resource Conservation and Recovery Act Part B Permit. Contamination problems involving pentachlorophenol, dioxins, heavy metals, and liquid-phase petroleum originated from areas where wood-treating chemicals had been applied, and from Resource Conservation and Recovery Act-regulated lagoons used to dispose of wastewater. Mr. Maul installed exploratory borings and monitoring wells, characterized site geology and hydrogeology and the extent of groundwater contamination, and prepared the Resource Conservation and Recovery Act Part B Permit application and subsequent renewals. He implemented a corrective action program for groundwater cleanup, using pump and test and a postclosure groundwater-monitoring plan. He evaluated fate and transport of pentachlorophenol in groundwater and the potential for groundwater to impact human health and the environment. He developed a plan to evaluate system effectiveness and prepared reports documenting system effectiveness.

- Finished-Wood-Products-Treating Company, White City, OR: Mr. Maul directed a Resource Conservation and Recovery Act facility investigation and corrective measures study. Pentachlorophenol, dioxin, and mineral spirits contamination originated from four dip wood-treating tanks, an oil/water separator, and two underground storage tanks. He negotiated a facility investigation work plan and interim corrective measures with state regulatory agencies; installed 40 test borings and 30 monitoring wells; and characterized site geology and hydrogeology, impacts to surface water from spills and source areas, and the extent of groundwater contamination. Interim measures included excavating and removing hazardous wastes, designing and installing an emergency stormwater treatment system, installing groundwater recovery wells, and capping contaminated areas. Upon completion of the facility investigation, a final Corrective Measures Study was completed and corrective measures implemented. Mr. Maul completed a fate and transport evaluation of off-site pentachlorophenol migration.

- METRO, Portland, OR: Mr. Maul provided hydrogeologic services for a feasibility study to site a regional landfill for METRO. He supervised geologic activities, including geologic mapping, drilling and monitoring well installation, coring, landslide investigation, and production well installation for large-scale aquifer testing to evaluate the nature of fracturing in sedimentary rocks underlying the site.

- Waterfront Brownfield Industrial Site, Portland, OR: Mr. Maul directed property transfer assessment for a 40-acre brownfield site on Portland's north waterfront. The facility included a former oil-fired power plant, manufacturing buildings, surface impoundments, an oil pipeline and terminal, and various waterfront activities. The site is adjacent to a former wood-treating facility that is a federal Superfund site. Services included a fast-track assessment of potential environmental liabilities, including contamination of the stormwater system, soil, groundwater, Willamette River sediments, abandoned wastes, and structures; and evaluation of pentachlorophenol migration onto the subject property. Mr. Maul prepared cost estimates for site investigation and remediation, and assisted the client with the negotiation of a Prospective Purchaser Agreement with the Oregon Department of Environmental Quality.

- Merlin Landfill, Grants Pass, OR: Mr. Maul directed a remedial investigation/feasibility study at a municipal landfill in southern Oregon involving extensive negotiations with the Oregon Department of Environmental Quality, the Bureau of Land Management, and the U.S. Environmental Protection Agency regarding continued operation of an unlined disposal cell. He installed nested, multiple-completion monitoring wells to characterize a fractured granite aquifer and evaluated potential impacts to off-site groundwater users. He found contaminants (halogenated and nonhalogenated volatile organic compounds), including trichloroethene and vinyl chloride, below 120 feet. Mr. Maul designed parameters for groundwater cleanup, leachate control, and groundwater and leachate treatment. A groundwater remediation system has been installed to recover and test volatile organic compounds. Mr. Maul developed the strategy that kept the site from being placed on the National Priorities List.

- Closed Municipal Landfill, Scappoose, OR: Mr. Maul managed a preliminary assessment and site inspection at a closed municipal landfill to evaluate potential impacts to off-site groundwater users from a 250-acre gravel-mining operation. He reviewed available historical information and aerial photographs as well as current operations, and documented local ground and surface water use and surrounding property use and ownership. He installed exploratory borings, sampled soil and groundwater, evaluated impacts to surface water quality, and sampled river sediment.

- Pressure-Wood-Treating Facility, west-central OR: Mr. Maul directed the Resource Conservation and Recovery Act facility investigation at a site contaminated by creosote and related compounds (e.g., polycyclic aromatic hydrocarbons and heavy oils), pentachlorophenol and related compounds (e.g., dioxins and light oil), and heavy metals. He installed test borings and monitoring wells and conducted coring and aquifer testing to evaluate site hydrogeology and the extent of contaminant migration. Mr. Maul established an unlined drip pad, chemical storage areas, treated-wood storage areas, and a former impoundment as sources of contamination. A critical component of this investigation was defining the extent of light and heavy nonaqueous-phase contaminants in a shallow alluvial aquifer and deeper bedrock aquifer. Mr. Maul developed a strategy to keep the site from being placed on the National Priorities List. Mr. Maul is currently negotiating cleanup of the site with both the Resource Conservation and Recovery Act and Superfund programs of Region 10 U.S. Environmental Protection Agency.

- Former Pentachlorophenol Wood-Treating and Transformer-Repair Facility, Corvallis, OR: Before purchase, Mr. Maul assisted a client with the review of historical data. He directed the development of a cost estimate to complete a remedial investigation/feasibility study with Oregon Department of Environmental Quality oversight and for implementation of remedies at the site. The client entered into a purchase agreement with the property owner, contingent upon obtaining a Prospective Purchaser Agreement with the Department of Environmental Quality. Mr. Maul directed negotiation of the Prospective Purchaser Agreement and implemented the remedial investigation/feasibility study, which was completed in five months, at which time the Prospective Purchaser Agreement was awarded and the Record of Decision entered. Mr. Maul directed a fate and transport evaluation of pentachlorophenol in groundwater and an evaluation of the potential threats to human health and the environment. The site is currently undergoing development.

- Chrome-Plating Facilities, Portland, OR, and Seattle, WA: Mr. Maul directed the completion of an insurance settlement report for Precision Equipment in Oregon and Washington. He developed the overall strategy with the client's attorney. His report provided a summary of detailed information on site history, including past operations, environmental investigations, and remedial actions, as compiled from historical records from the facility, its attorneys, and regulatory agencies. It also included a description of required future soil, groundwater, and sediment investigations and remedial action that will likely be required at each site, based on the current site conditions. A detailed cost estimate was completed for the future work. The insurance settlement report provided the client with justification for asking for a settlement with its insurance carrier. Mr. Maul met with the insurance carrier and its consultant to present an overview of cleanup strategies.

PUBLICATIONS AND PRESENTATIONS

"How the Port of Ridgefield coped with a $50 million cleanup." National Brownfield Conference, Portland, Oregon, October 2003.

"Innovative approaches to addressing environmental contamination." Superfund Reform Conference. Environmental Law Education Center, Portland, Oregon, May 2003.

Comparison of costs using innovative technologies." The Third International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, California, May 2002.

"Comprehensive environmental compliance program." Technical Association of Pulp and Paper Industries, Inc. (TAPPI) International Environmental Conference, Orlando, Florida, May 1996.

"A streamlined approach to the risk assessment process at a solid waste facility." Technical Association of Pulp and Paper Industries, Inc. (TAPPI) International Environmental Conference, Orlando, Florida, May 1996.

"Requirements for remedial investigation and feasibility studies under the national contingency plan." Continuing Law Education Seminar, Portland, Oregon. September 1995.

Alistaire Clary, P.E.

Senior Engineer

EDUCATION

Washington State University:
BS, Civil Engineering

LICENSES/REGISTRATION

Professional Civil Engineer:
Washington, No. 38310
Oregon, No. 71315

PROFESSIONAL ASSOCIATIONS

American Society of Civil Engineers

Ms. Clary is a civil engineer with experience in environmental assessments, including remedial investigations and feasibility studies. She also assists commercial and industrial clients with site development and permitting, including site plans, land use applications, National Pollutant Discharge Elimination System stormwater permits, mining and reclamation plans, and Washington State Environmental Policy Act checklists. She prepares design plans and specifications and completes construction management tasks such as inspection and design clarification when needed. She also has experience with stormwater and wastewater treatment system design. Her fieldwork experience includes soil and groundwater drilling and sampling programs and surveying. Ms. Clary is a civil engineer licensed in Washington and Oregon.

RELEVENT PROJECT EXPERIENCE

Environmental Site Assessment

- Precision Equipment, Portland, OR: Ms. Clary currently manages a remedial investigation at this facility, which is adjacent to the Columbia Slough. The remedial investigation includes an evaluation of environmental impacts caused by chrome-plating activities at the site. Ms. Clary coordinated and completed soil sampling inside the facility, including sampling at the bottom of a confined-space vault, using a Geoprobe™ drilling rig. Additional sampling has been completed outside the facility to evaluate historical fill on the site. Ms. Clary has also coordinated the decommissioning of a dry well, which was permitted through both the City of Portland Bureau of Environmental Services and the Oregon Department of Environmental Quality.
- Confidential Client, Washougal, WA: Ms. Clary completed sediment sampling in the Columbia River to assist in the design of a stormwater facility outfall from a wood-products facility.
- Numerous Clients: Ms. Clary's site characterization experience includes conducting fieldwork such as environmental audits, observation of reconnaissance drilling, water sampling, soil sampling and classification, and field screening for environmental site investigations at commercial and industrial facilities.
- Tektronix, Inc., Beaverton, OR: Ms. Clary coordinated and performed Resource Conservation and Recovery Act Facility Assessment summaries and a Preliminary Scoping Document for this electronics manufacturing facility. Both documents provided comprehensive documentation of known site conditions, including site operations, releases, and investigations that took place over a 40-year period. Over 20 RCRA Facility Assessment summaries were completed. The client used many of the Facility Assessment summaries in completing property transfers for part of the property. The Preliminary Scoping Document enabled the facility to begin a remedial investigation/feasibility study under Oregon Department of Environmental Quality cleanup rules and guidelines, under oversight of the DEQ site response program rather

than under the RCRA program. It detailed potential contaminant sources, established a phased schedule for completing the remedial investigation/feasibility study, and provided support and justification for the remedial investigation scope of work and schedule. Ms. Clary also completed a phase 1 environmental site assessment for Tektronix property located along Beaverton Creek.

- Delphia Oil, Astoria, OR: Ms. Clary is currently completing a remedial investigation at this bulk oil storage facility and gas station. Ms. Clary has advised the client with respect to a strategy for complying with a multiple-party unilateral order for the investigation of areawide petroleum hydrocarbon contamination at the Port of Astoria. Ms. Clary meets regularly with consultants and attorneys for other potentially responsible parties. She develops strategies for addressing the Oregon Department of Environmental Quality requirements while meeting the client's interests. Ms. Clary also confers regularly with Delphia's attorney to discuss and develop strategies to limit Delphia's involvement and liability at the site. Ms. Clary has coordinated the completion of soil and groundwater sampling at the facilities and is currently working with the other consultants to complete the remedial investigation report. She is also developing a strategy for closure of the site.

- Crown Plating, Vancouver, WA: Ms. Clary completed a soil assessment at this facility. The investigation included detailed mapping of cracks in a concrete floor and rating the cracks based on the risk that plating solution could migrate through the floor. Sampling of soil beneath the floor was completed at the locations with the highest rankings. Ms. Clary coordinated with the Washington State Department of Ecology to use sampling data to extrapolate concentrations below tanks and secondary containment areas at the site, thereby eliminating the need for moving these permanent features.

Feasibility Studies

- ZRZ Realty, Portland, OR: Ms. Clary prepared a feasibility study for remediation of soil and sediment at this site along the Willamette River. The industrial facility contains contaminated soil and sediment related to past shipbuilding activities. The feasibility study was conducted at the site pursuant to a voluntary agreement between the client and the Oregon Department of Environmental Quality.

- Triangle Park, LLC, Portland, OR: Ms. Clary provided assistance on the preparation of a feasibility study for soil remediation at a former industrial facility located in the Portland Harbor.

Remediation

- Arwana Farms, Clark County, WA: Ms. Clary developed a cleanup plan for a manure spill from a dairy farm into a small stream that runs through a rural town in Clark County and discharges to the Columbia River. Cleanup was coordinated with the Washington State Department of Ecology and the Washington State Department of Fish and Wildlife. Ms. Clary provided oversight during cleanup activities and acted as a liaison between the dairy farm, regulatory agencies, and neighborhood groups.

- Taylor Lumber & Treating, Inc., Sheridan, OR: Ms. Clary designed a stormwater conveyance and treatment system for a wood-treating facility. The corrective measures were implemented under Oregon Department of Environmental Quality and U.S. Environmental Protection Agency oversight. Stormwater at the site contained hazardous substances from contact with contaminated surface soils. A treatment system was designed that included an oil/water

separator, a pump station, detention and sedimentation tanks, mixing tanks and chemical treatment, particulate filters, granular activated carbon filters, and a filter press. Ms. Clary also provided oversight during the construction of the system.

Permitting

- Confidential Client, Portland, OR: Ms. Clary completed comprehensive spill prevention control and countermeasures plan compliance services for a bulk fuel terminal on the Willamette River. She designed containment systems for a railcar loading station, pump areas, piping, and other features to provide adequate spill control. She completed a hydraulic review of the existing stormwater conveyance and treatment system and developed a design to reconfigure the oil/water separator outfall to the Willamette River to improve operation during rainfall events. Ms. Clary also assisted with an evaluation of alternatives for capping large gasoline and diesel tank farms.

Alan R. Hughes, R.G.

Project Geologist

EDUCATION

University of Washington:
BS, Geology

LICENSES/REGISTRATION

Registered Geologist:
Oregon, No. G1928

Registered Geologist:
Washington, No. 2498

CERTIFICATIONS

Hazardous Material Incident Response, 40-hour

Hazardous Waste Management and Supervision

Lockout/Tagout and Confined Space Recognition

First Aid/CPR Training

Mr. Hughes has seven years of environmental consulting experience. He has conducted investigations at wood-treating facilities, chlorinated-solvent sites, aggregate mining sites, solid-waste sites, refineries, petroleum-contaminated sites, dry-cleaning facilities, and other hazardous-waste sites. Mr. Hughes has drilled and installed exploratory borings, extraction and injection wells, monitoring wells, and piezometers, using multiple drilling techniques. Mr. Hughes's current duties include coordinating and overseeing exploratory drilling and well installation; soil, groundwater, and sediment sampling; conducting beneficial land and water use evaluations; generating boring logs and cross sections; preparing site-specific health and safety plans; preparing cost estimates; assisting in data management interpretation and report preparation.

RELEVENT PROJECT EXPERIENCE

Environmental Site Investigations

- Multiple Sites in WA, OR, and ID: Mr. Hughes prepared site-specific health and safety plans for sites with different types of chemicals of concern in soil, groundwater, and sediment. He prepared work plans, field sampling plans, annual reports, technical memoranda, and other site-specific documents.
- Multiple Sites in WA, OR, and ID: Mr. Hughes prepared boring logs, geological cross sections, and equipotential and isopach maps.
- Multiple Sites in WA, OR, and ID: Mr. Hughes installed transducers and data loggers and conducted aquifer tests (step-discharge, constant-discharge, slug tests [data interpretation using Bower and Rice Method in Aquifer Test]) to assess aquifer properties.
- Multiple Sites in WA, OR, and ID: Mr. Hughes coordinated exploratory drilling and monitoring well installation programs, including communications with subcontractors. Drilling techniques included direct push, hollow-stem auger, air rotary, dual-rotation air rotary, cable tool, rotosonic (and versions modified for limited access).
- Multiple Sites in WA, OR, and ID: Mr. Hughes conducted slug tests to assess the hydraulic conductivity of aquifers, using data loggers, transducers, and slugs (data interpretation using Bower and Rice Method in Aquifer Test).

- Multiple Sites in WA, OR, and ID: Mr. Hughes oversaw exploratory drilling to assess the vertical and lateral extent of chemicals of interest in soil and groundwater, and to evaluate groundwater occurrence and gradient.
- Multiple Sites in WA, OR, and ID: Mr. Hughes observed test pitting and soil sampling and conducted sediment sampling near outfalls; observed excavating, including excavations located over geophysical anomalies; and managed investigation-derived waste.
- Multiple Sites in WA, OR, and ID: Mr. Hughes conducted groundwater monitoring and well development activities, scheduled and coordinated field and sampling activities, and conducted beneficial land and water use surveys.
- Former Wood-Treating Facility, Ridgefield, WA: Mr. Hughes observed exploratory borings for reconnaissance soil and groundwater samples. He assisted in the installation of groundwater extraction and injection wells for steam injection remediation, and installed monitoring wells to monitor the remediation progress. He observed the abandonment of previous borings and monitoring wells using heat-resistant grout. Mr. Hughes conducted sediment sampling and hydraulic conductivity tests, using data loggers and slugs. The drilling was performed using cable tool, hollow-stem auger, air rotary, and sonic drilling techniques. Chemicals of interest included pentachlorophenol, polycyclic aromatic hydrocarbons, and arsenic-chromium-copper. Mr. Hughes has conducted sampling of the steam-enhanced remediation treatment system and has trained client personnel in sampling techniques.
- Former Wood-Treating Facility, Sandpoint, ID: Mr. Hughes conducted multiple phases of investigation at this facility. The investigations included advancing exploratory borings to assess horizontal and vertical contamination in subsurface soils and shallow and deep groundwater, installing monitoring wells, conducting hydraulic conductivity tests on monitoring wells to assess the aquifer, and performing a beneficial land and water use survey. Chemicals of interest included pentachlorophenol and creosote constituents (e.g., polycyclic aromatic hydrocarbons).
- Commercial Property, Milwaukie, OR: Mr. Hughes observed exploratory borings for reconnaissance soil and groundwater samples at this site. He assisted in the installation of monitoring wells. The drilling was performed using cable tool, hollow-stem auger, and Geoprobe™ drilling techniques. Mr. Hughes also oversaw test-pitting activities related to geophysical investigations.
- High-Tech Manufacturing Facility, Beaverton, OR: Mr. Hughes oversaw reconnaissance soil and groundwater drilling, abandoned recovery wells, and installed replacement recovery wells. He participated in annual groundwater sampling activities. Mr. Hughes also performed a beneficial water and land use study.
- Truck Manufacturing Facility, Portland, OR: Mr. Hughes conducted soil and groundwater investigations at two sites adjacent to the Portland Harbor site. The investigation involved focused reconnaissance drilling and sampling. Mr. Hughes oversaw a focused reconnaissance soil removal action, including geophysical investigations and the removal of buried waste. After the investigations and removals were completed, Mr. Hughes assisted in completing reports of the findings and procedures. Mr. Hughes also performed beneficial water and land use studies on the two properties.
- Waterfront Brownfield Site, Portland, OR: Mr. Hughes completed characterization of the nature and extent of chemicals of concern in upland soil and provided information for future site

redevelopment with Geoprobe™ drilling techniques. Chemicals of interest included metals, polychlorinated biphenyls, volatile organic compounds, and petroleum hydrocarbons. Mr. Hughes also completed a beneficial use study for the site.

- Industrial Waterfront Property, Portland, OR: Mr. Hughes conducted groundwater sampling and drilling oversight and completed a beneficial water and land use study. He also completed sediment sampling along the Willamette River, which borders the site to the east.
- Former Manufactured Gas Plant and Petroleum Terminal, Astoria, OR: Mr. Hughes conducted reconnaissance soil and groundwater sampling and the installation of monitoring wells, using sonic drilling techniques. Mr. Hughes also conducted a riverbank survey along the Columbia River, looking for possible seep areas. He has participated in semiannual groundwater sampling activities and nonaqueous-phase liquid monitoring and removal activities related to monitoring wells.

Remediation

- Multiple Sites in WA, OR, and ID: Mr. Hughes prepared cost estimates and performed cost analysis for various aspects of remedial measure options, including slurry walls, extraction wells, and bioremediation technologies.

APPENDIX B

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

PRECISION ENGINEERING, INC.
1231 S. DIRECTOR STREET
SEATTLE, WASHINGTON

Revised

November 23, 2005

Prepared by

Maul Foster & Alongi, Inc.
7223 NE Hazel Dell Avenue, Suite B
Vancouver, Washington 98665

Project No. 8006.08.04

Precision Engineering, Inc.
1231 S. Director Street
Seattle, Washington

The material and data in this Health and Safety Plan were prepared under the supervision and direction of the undersigned.

Maul Foster & Alongi, Inc.

Alan Hughes
Project Manager

Ulysses Cooley
Health and Safety Coordinator

CONTENTS

CONTENTS (Continued)

1 NEAREST HOSPITAL/EMERGENCY MEDICAL CENTER

1.1 Nearest Hospital

Providence Medical Center
500 17th Avenue
Seattle, Washington

Phone: (206) 320-2000

Distance: 7.1 Miles

Travel Time: 15 Minute

1.2 Emergency Route to Hospital

(See First Page of Document)

1.2.1 Driving Directions

1. Start at 1231 S. Director Street, travel north – go less than 0.1 mile
2. Turn **Left** on **14th Avenue** – go 0.4 mile
3. Continue on **16th Avenue** – go 0.5 mile
4. Turn **Left** on **E. Marginal Way** – go 0.7 mile
5. Turn **Right** on **Corson Avenue** – go 0.5 mile
6. Turn **Right** on **S. Bailey Street** – go 0.1 mile
7. Turn **Left** onto **I-5 North**, toward Vancouver BC – go 3.1 miles
8. Take exit **#164A/I-90 East**, toward Dearborn St./James St. – go 0.6 mile
9. Turn **Right** on **S. Dearborn Street** – go 0.3 mile
10. Turn **Left** on **Rainier Avenue** – go 0.3 mile
11. Bear **Right** on **14th Avenue** – go 0.5 mile

12. Turn **Right** on **E. Jefferson Street** – go 0.2 mile

13. Arrive at **Providence Medical Center**

1.3 Emergency Phone Numbers

Ambulance, Police, Fire	**Dial 911**
Alan Hughes Project Manger	Phone: (360) 694-2691 Cell: (360) 772-6801
Jim Maul Project Director	Phone: (360) 694-2691 Cell: (360) 903-8633
Ulysses Cooley Health & Safety Coordinator	Phone: (360) 694-2691 Cell: (360) 772-4505

Route to Hospital

2 EMERGENCY PROCEDURES

Site personnel must be able to respond effectively to any emergencies that might develop. The following information will be readily available at the site in a location known to all workers:

- Route to nearest clinic—see Section 1.2
- Emergency telephone numbers—see Section 1.3

2.1 Immediate Response

Should an emergency occur (serious injury, unconsciousness, fire, explosion), all work will immediately cease. Field personnel will offer whatever assistance is required. Those not needed for immediate assistance will decontaminate according to normal procedures (if possible) and leave the immediate area, pending re-start of work.

The emergency section of this HSP will be reviewed during the on-site health and safety briefing so that if an emergency occurs, personnel will know what their duties should be. In the unlikely event of a fire or explosion, or uncontrolled release of a contaminant into the environment, prompt action to limit the extent of damage will be required. The SSO will evaluate emergency situations and inform all personnel by use of a signal device or visual or shouted instructions, as appropriate.

2.2 Environmental Release

If a significant release of contaminants to the environment occurs, the following agencies will be notified immediately:

Washington State Department of Ecology
24-Hour Emergency Spill Response **800-258-5990**

2.3 Fire or Explosion

It is unlikely that a fire or explosion will occur. MFA personnel will attempt to control only very small fires. If the fire cannot be controlled with the 10-pound ABC fire extinguisher located in the exclusion zone, then immediate intervention by the local fire department is imperative. The following steps will be followed in the event of a fire or explosion:

- Evacuate all personnel from the area to a previously agreed upon, upwind location.

- Account for all personnel.
- SSO will designate a person to immediately notify the fire department by calling 911. The designated person will provide the fire department with the following information:
  - Name
  - Location of fire or explosion
  - Number and type of injuries, if any
  - Telephone from which the call is being placed
  - Any other information requested by the 911 operator
- Remain in the upwind location until dismissed from the site by the SSO or the fire department official in charge.

2.4 Medical Emergency

For any potentially life-threatening injury or state of unconsciousness, call 911 and stay with the victim. Administer first aid and/or cardiopulmonary resuscitation (CPR) as necessary. For non-life-threatening incidents that require medical treatment, call prior to transport to a medical facility. For medical emergencies, call 911 or:

Providence Medical Center (206) 320-2000

If a worker leaves the site to seek medical attention, another person will accompany the patient. In cases where it is not clear that a physician's opinion is needed, it is MFA's policy that medical attention will be received. The MFA Project Manager and Health and Safety Coordinator (HSC) will be notified of the medical evaluation as soon as possible. For minor cuts and bruises, an on-site first aid kit will be available in the support zone.

2.5 Emergency Decontamination

In the event that a worker that is contaminated is seriously injured, conventional decontamination procedures can be bypassed. However, measures to minimize the spread of contamination, such as placing the individual on clean plastic sheeting inside the vehicle, should be taken.

Less severely injured individuals will have their protective clothing carefully removed or cut off before being transported to the hospital.

2.6 Follow up and Evaluation

The SSO will notify the MFA Project Manager as soon as possible after the emergency situation has been stabilized. The Project Manager will notify the appropriate client

contacts and the MFA HSC. The SSO will file a detailed accident report with MFA within 24 hours.

3 PROJECT INFORMATION

Date: November 15, 2005

Project: 8006.08.04

Site: Precision Engineering, former machinery-repair and chrome-plating facility

Location: 1321 S. Director Street, Seattle, Washington

Project Manager: Alan Hughes

Prepared By: Alan Hughes

4 KEY PROJECT PERSONNEL

4.1 Site Work Team

Name	Responsibility
Jim Maul	Project Director
Alan Hughes	Project Manager
Alistaire Clary	Project Engineer
Merideth Gibson	Field Geologist

4.2 Entry Briefing Date

First day of field work and weekly thereafter.

4.3 Special Conditions (e.g., work schedule or limitations)

Any work performed at night must be performed with lights mounted on stands and using the "buddy system".

MFA personnel are not allowed to perform site activities alone after dark.

4.4 Required Training

MFA employees as well as contractor employees assigned to perform field activities covered by this procedure must be currently approved for hazardous waste site work, including:

- Current medical clearance to conduct hazardous waste field work and to wear a respirator;
- Successful completion of a respirator fit test within the last 12 months for the make and model of the respirator assigned to that individual for use at that site;

- Completion of training as required by Title 29 Code of Federal Regulations (CFR) 1910.120(e), including:
  - 40 hours of hazardous waste worker basic instruction within the last 12 months, or,
  - 8 hours of hazardous waste worker refresher training within the last 12 months, subsequent to completion of 40 hours of basic hazardous waste worker training.

4.5 Special Training

Copies of all required training, current medical surveillance certificates, and respirator fit test record must be sent to MFA prior to entering the site.

EMERGENCY PHONE NUMBERS

Ambulance, police, fire Dial 911

Alan Hughes, Project Manager 360-694-2691 / 360-772-6801 (cell)

Jim Maul, Project Director 360-694-2691 / 360-903-8633 (cell)

Ulysses Cooley, Health & Safety Coordinator 360-694-2691 / 360-772-4505 (cell)

5 PROJECT DESCRIPTION

Maul Foster and Alongi, Inc. (MFA) has prepared this Health and Safety Plan (HSP) for the Precision Engineering Seattle facility, located at 1231 S. Director Street, Seattle, Washington (the Site). This HSP has been prepared to instruct MFA personnel involved with groundwater sampling and other characterization activities at the Site.

All personnel are advised that this field project may result in exposure to chemical and physical hazards. The requirements in this HSP are designed to minimize the risk of chemical exposure or physical injuries by a combination of personal protective equipment (PPE), engineering controls, and safe work practices.

Previous work on the site included drilling activities to collect subsurface soil and reconnaissance groundwater samples and to install monitoring wells. MFA will perform additional site characterization activities (see Section 5.1).

The purpose of this HSP is to provide information to minimize the potential for adverse exposures or injuries while performing these observation/documentation activities. A combination of personal protective equipment, engineering controls, and safe work practices will be used to minimize the risk of physical injuries and chemical exposures. The procedures and requirements contained in this plan are intended for MFA personnel performing field activities. All personnel are advised that this field project may result in exposure to chemical and physical hazards.

All MFA field personnel are responsible for understanding and adhering to this HSP, and should also be alert to any unsafe conditions or practices that may affect their safety. All subcontractors have the primary responsibility for site safety of their own personnel. Any safety deficiencies should be immediately communicated to the SSO and to the health and safety coordinator (HSC). If personnel safety is threatened, the SSO, project manager, or MFA health and safety coordinator will be contacted immediately.

All personnel who will be working on site activities are required to read and understand this HSP. All personnel entering the work area must sign the Personal Acknowledgement Sheet (Appendix A). This acknowledges that they have read and understood the safety plan and agree to abide by it.

5.1 SCOPE OF WORK

MFA scope of work for this project includes or may include the following activities:

- Measure groundwater levels and measure water quality parameters from groundwater monitoring wells
- Collect groundwater monitoring samples from groundwater monitoring wells
- Collect samples from the drainage ditch located on the property south of the Precision site
- Oversee drilling to install monitoring wells and to collect subsurface soil and reconnaissance groundwater samples
- Manage wastes produced during sampling and/or drilling activities

5.2 SAMPLING PARAMETERS

Soil and groundwater samples may be sampled for the following analytes: hexavalent chromium, Priority Pollutant metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc), volatile organic compounds (VOCs), gasoline-range organics (GROs), diesel-range organics (DROs) and oil-range organics (OROs), volatile petroleum hydrocarbons (VPH), extractable petroleum hydrocarbons (EPH), polycyclic aromatic hyrocarbons (PAHs).

NOTE: This Health and Safety Plan (HSP) must be reevaluated and updated annually or when site conditions or scope of work changes.

6 FACILITY DESCRIPTION AND BACKGROUND

6.1 Type of Facility

Former machinery-repair and chrome-plating facility.

6.2 Building/Structures

Operations occurred inside the building. There are in-ground vaults located within the building that were formerly used to contain chromic acid and other chemical tanks.

6.3 Access

The site and building are easily accessible.

6.4 Topography

Topography is generally flat, except near the drainage ditch. Extra care must be taken when working in this area due to sloped work areas.

6.5 General Geologic/Hydrologic Setting

Fluvial deposits (e.g., sands, gravels, and silts).

6.6 Site Status

Inactive.

6.7 Site History

From 1968 to 2005, the site was used as an equipment repair, manufacturing, and chrome-plating facility. Releases of chromium have occurred to site environmental media.

6.8 Special Conditions/Comments

None.

7 WASTE TYPE(S)/CHARACTERISTICS

7.1 Hazardous Substances

Are there hazardous substances known to have been stored/spilled on site?

__X__ YES _____ NO

7.2 Chemicals of Interest in Soil, Groundwater, and Sediment

Site investigations completed in June 2005 identified diesel, hexavalent chromium, motor oil, total chromium, trivalent chromium, trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) in soil and/or groundwater at concentrations that exceed their respective Ecology Model Toxics Control Act (MTCA) Method A, Method B, or Method C cleanup levels (CULs) for soil or groundwater.

7.3 Special Considerations/Comments

Prior to any site work, a copy of this health and safety plan must be read and the Acknowledgement page signed. Before any underground exploration begins, make sure the following calls are made: Public Property: One Call Utility Check (800) 424-5555. Onsite: contact a private utility locating company.

8 HAZARD EVALUATION

The following subsections describe the potential physical and chemical hazards associated with implementing this project. The control measures that field personnel must use to eliminate or minimize these hazards, such as air monitoring, personal protective clothing, and decontamination procedures, are detailed in subsequent sections of this plan.

8.1 Physical Hazards

Potential physical hazards in site operations include:

Hollow Stem Auger and Geoprobe™ Drilling. Subsurface drilling using hollow stem auger and Geoprobe drilling methods poses physical hazards, as well as noise hazards. The use of turning augers can result in potential safety hazards (see Appendix B). Use of the drill mast and winches poses overhead hazards using both methods. To reduce the risk associated with drilling, all personnel working around the drill rig must be wearing a hard hat, steel-toed boots, eye protection, and hearing protection at all times. The SSO will be responsible for controlling the entry of the personnel to the active working area of the site.

Live Steam/High Pressure Water. The use of live steam or high-pressure water for decontaminating sampling equipment may pose an additional hazard. Care must be taken to avoid directing streams of live steam or high-pressure water toward any part of a worker's body, particularly at the face or exposed skin.

Utilities. Overhead and underground utilities pose a potential hazard. Precision or MFA will arrange to have underground utilities located in work areas by a public and/or private utility locating company before drilling or excavation activities begin.

Trips/Falls. As with all work sites, caution will be exercised to prevent slips.

Vehicle Traffic. Project activities will be conducted in areas of frequent vehicle traffic. The work area will be clearly delineated and lit, if necessary, and access by unauthorized personnel or vehicles will be limited by existing fencing, traffic cones, and barricades.

Noise. The effects of noise on humans include psychological effects (interference with communication by speech, job performance, and safety) and physiological effects such as temporary and permanent hearing loss. Of these the most debilitating is permanent

hearing loss. The factors that affect the degree and extent of hearing loss are intensity or loudness of the noise, type of noise, period of exposure each day, total work duration, and distance from the noise source. Due to working in close proximity to equipment, all MFA personnel will be required to wear hearing protection at all times when equipment is operating.

Lifting Hazards. Field operations often require that physical labor tasks be performed. All personnel should utilize proper bending and lifting procedures. Whenever an object is to be lifted, the person should bend at the knees and lift the object using the legs. Additionally, any bulky or heavy objects (over 30 pounds) should not be lifted without assistance.

8.2 Heat and Cold Stress

Use of impermeable clothing reduces the cooling ability of the body due to evaporation reduction. This may lead to heat stress. In order to minimize the effects of heat stress, appropriate work-rest cycles will be maintained and water or electrolyte-rich liquids (Gatorade or equivalent) will be available.

During periods of cold weather, field personnel will wear warm clothing and (if necessary) rain gear to keep dry.

8.3 Fires and Explosions

In the case of an emergency, fire safety is the responsibility of all persons on site. The following general precautions address site-wide operations.

A fire extinguisher will be kept in the MFA field vehicle. The extinguisher will be Type ABC approved by the National Fire Prevention Association (NFPA). Combination-type ABC fire extinguishers will be readily accessible to all personnel in the working area. All extinguishers will be inspected monthly and serviced yearly.

All heavy equipment will be equipped with fire extinguishers.

See air monitoring section for potential explosive atmospheres precautions.

8.4 Uneven Walking Surfaces

Care should be used when walking in or out of large areas of excavations and in unpaved areas. A combination of steep grades, loose material, and vegetation can make walking or standing on these surfaces difficult.

8.5 Noise

The effects of noise on humans include psychological effects (interference with communication by speech, job performance, and safety) and physiological effects such as temporary and permanent hearing loss. Of these the most debilitating is permanent hearing loss. Due to the potential to work near loud equipment, all MFA personnel will be required to have hearing protection with them at all times.

8.6 MFA Vehicular Use

When operating vehicles on the site, employees will adhere to the requirements in the MFA SOP for vehicle safety operations (Appendix C). Any traffic incidents should be reported as indicted in the MFA incident report SOP (Appendix D).

8.7 Chemical Hazard Evaluation

Potentially hazardous chemicals known or suspected to be onsite:

Chemical of Concern	OSHA PEL	OSHA STEL	OSHA IDLH	Odor Threshold	LEL (%)	IP(eV)	Other Hazard
Chromium	1 mg/m^3	NA	250 mg/m^3	NA	NA	NA	R
Chromium (VI)	0.001 mg/m^3	NA	15 mg/m^3	NA	NA	NA	R, C
Diesel (Naphthalene)	10 ppm	15 ppm	250 ppm	14.68-12.0 ppm	0.9	8.12	E,F,P
Trichloroethylene (TCE)	100 ppm	300 ppm	500 ppm; C	50 ppm	NA	9.45	P

Notes:
-- - none established
C - carcinogen
GW - groundwater
IDLH - immediately dangerous to life and health
IP (eV) - ionization potential
N/A - not applicable
F - flammable
COR - Corrosive
NA - not available
P - poison
PCB - polychlorinated biphenyl
PEL - permissible exposure level
SC - suspected carcinogen
STEL - short-term exposure level
R - Reactive
E - Explosivity

8.8 Air Monitoring and Action Levels

Special conditions and comments: During invasive activities which may cause dust (drilling, test pitting, surface soil sampling, etc.) fugitive dust emissions must be eliminated. Engineering controls (i.e., soil wetting) will be initiated prior to any invasive

activities. **Fugitive dust emissions must be controlled to protect the public. Continuing excavation activities in level C PPE without use of engineering controls is prohibited on this site.**

Section 10.1 discusses air monitoring, toxicity action levels, explosion hazard levels, and instrumentation calibration in detail.

Readings also must be taken at this same frequency just downwind of drilling or excavation activities for document that fugitive dust emissions are less than the action levels shown below. If meter readings demonstrate concentrations in the breathing zone or downgradient of the excavation equal or exceed the action levels described below, the following actions must be taken:

- Upgrade to Level C PPE, as described below
- Use engineering controls (i.e., soil wetting) to control fugitive dust emissions

Fugitive dust emissions must be controlled to protect the public. Continuing excavation activities in level C PPE without use of engineering controls is prohibited on this site.

8.9 Chemical Exposure Pathways

Exposure to these contaminants can occur via inhalation of vapors or contaminated dust, incidental ingestion of soil, and skin contact. Symptoms of acute exposure could include eye, nose, or throat irritation, central nervous system effects (dizziness, nausea, headache, lack of coordination, etc.), or irritated or red skin.

Inhalation. Exposure via inhalation will be avoided by working upwind of contaminant sources, by preventing dust from forming, and by respiratory protection if indicated to be necessary by air monitoring results. Dust-control measures such as soil wetting will be implemented whenever visible dust is generated by work activities.

Ingestion. Exposure via incidental ingestion of soil will be avoided by practicing good work habits and washing hands and face thoroughly before eating and at the end of the work shift.

Dermal Exposure. Exposure via skin contact will be avoided by wearing appropriate protective clothing (e.g., by wearing Nitrile gloves while contacting soil and groundwater).

9 SAFETY EQUIPMENT AND PROCEDURES

9.1 Required Personal Protective Equipment

Hard hat, steel-toed boots and safety glasses with side shields are required at all times. Use splash shields if performing activities where the potential exists for liquids to contact face or eyes. Wear Nitrile gloves when handling soil or groundwater. Wear Tyvek suit, coveralls, or rain gear as needed. Wear hearing protection when heavy equipment (drill-rig for example) is operating.

9.1 Personal Protective Equipment

Field personnel will wear personal protective equipment (PPE) as specified:

Level D Activities - Workers performing general site activities where skin contact with contaminated materials is not likely will wear a hard hat, steel-toed boots, safety glasses, Nitrile gloves, and hearing protection, as needed.

Level C Activities - Half or full-face piece respirators equipped with organic vapor/high efficiency particulate cartridges (OV/HEPA) will be worn in addition to equipment specified for Level D activities when performing activities in which inhalation of soil dust, silica dust or VOCs are of concern. Work coveralls, Tyvek coveralls (if contaminated soil is encountered), coated-Tyvek coveralls (if liquid product is encountered), or rain gear will be worn, as needed. Hearing protection will be worn when a drill rig, backhoe, generator, or other noisy equipment is operating.

Modified Level D Activities - In addition to equipment specified for Level D activities (when performing activities in which inhalation of soil dust, silica dust or VOCs are NOT of concern) Tyvek coveralls (if contaminated soil is encountered), coated-Tyvek coveralls (if liquid product or potentially contaminated groundwater is encountered). Hearing protection will be worn when a drill rig, backhoe, generator, or other noisy equipment is operating.

Based on the physical and chemical hazards identified in this section, the following personal protective equipment will be required for the following site activities (specify both an initial level of protection and a more protective level of protection in the event conditions should change):

Activity	Level of Protection	
	Initial	Contingency
Bank work, soil sampling	D, MD*	MD, C
Drilling	D, MD**	MD, C
Groundwater sampling	D	MD, C
Surface water sampling	D	MD, C
Sediment sampling	D, MD*	MD, C
Sample handling	D	MD

* When working in areas where non aqueous phase liquid (NAPL) is expected to be encountered, the initial level of protection will be MD. The MFA SSO will inform drilling personnel when they will be working in NAPL areas.

**When drilling in areas where NAPL has been encountered, the initial level of protection for drilling will be MD. The MFA SSO will inform drilling personnel when they are in NAPL areas.

9.2 Air Monitoring Equipment

Organic vapor analyzer (photoionization detector or flame ionization detector), Draeger tubes (if necessary, see Section 10.1, toxicity action levels) and combustible gas meter (if necessary, based on presence of organic vapors).

9.3 Communications

A mobile phone will be available to field personnel. Field personnel cannot carry mobile phones or pagers into a potentially flammable environment, as they are not intrinsically safe. In potentially flammable environments a mobile phone will be kept in the MFA field vehicle.

9.4 Decontamination Procedures

Discard Tyvek suit and gloves (if used). Clean dirt off boots. Wash hands and face prior to breaks and before leaving site. Bring soap and wash water if a wash room is not available at the site. Used personal protective equipment (PPE) will be double-bagged for proper disposal.

9.4.1 Mini-Decontamination Procedure

- Wash and rinse outer gloves, if worn, and boots in buckets in the contamination reduction zone.
- Inspect Tyvek suit, if worn, for stains, rips or tears.
- If suit is contaminated or damaged, full decontamination will be performed as described in Section 8.4.2.
- Remove outer gloves. Inspect and discard in a labeled container for disposable clothing if ripped or damaged.
- Remove respirator, if worn, and clean off using pre-moistened alcohol wipes. Deposit used cartridges in a plastic bag.
- Replace cartridges and outer gloves before returning to work.

9.4.2 Full Decontamination Procedures

- Wash and rinse outer gloves, if worn, and boots in buckets in the contamination reduction zone.
- Remove outer gloves and Tyvek suit, if worn, and deposit in a labeled container for disposable clothing.
- Remove respirator, if worn, and place used cartridges in a plastic bag.
- If end of day, wash and rinse respirator in a special "respirators only" decon bucket.
- Remove inner gloves and deposit in a labeled container for disposable clothing.
- Remove work boots without touching exposed surfaces, and put on street shoes. Place work boots in a plastic bag for later reuse.

- Immediately wash hands and face using soap and clean water.
- Shower as soon after the work shift as possible.

9.5 Emergency Equipment

A fire extinguisher will be kept in the MFA field vehicle. The extinguisher will be Type ABC approved by the National Fire Prevention Association (NFPA). The extinguisher will be inspected monthly and serviced yearly. A first-aid kit will be available in the MFA field vehicle.

10 AIR MONITORING

Personnel exposure monitoring should be performed as specified in this section to protect field personnel from hazardous concentrations of organic vapors. Monitoring must be performed by individuals familiar with the calibration, use, and care of the required instruments.

During site activities, air monitoring shall be conducted at least every ½ hour in the worker's breathing zone, which is a 1 foot diameter sphere surrounding the worker's head. Respirators must be worn when meter readings in the breathing zone (sustained for 2 minutes) equal or exceed the action levels described below for upgrade to Level C PPE.

10.1 Toxicity action levels

The toxicity action levels given below are set to comply with Occupational Safety and Health Administration (OSHA) Permissible Exposure Levels and American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and National Institute for Occupational Safety and Health (NIOSH) recommendations for the chemicals which may be encountered on the site. Gasoline averages approximately 1% benzene. These action levels are also adjusted for the relative response of common PID or FID instruments to motor fuel vapors.

The alarm on this instrument should be set to sound at the action level. If the instrument must be unattended, the detector inlet should be located as close to the worker's breathing zone as possible.

Workers must be evacuated from the area when organic vapor concentrations exceeding respiratory protective equipment protection factors are encountered.

Air Monitoring Procedures and Toxicity Action Levels

OVM	Detection of **1 ppm** (above ambient) or greater in breathing zone **sustained for 2 minutes**	Drager test for benzene. If **1 ppm benzene** detected with Drager tube, upgrade to level C. Drager test for vinyl chloride. If **1 ppm vinyl chloride** detected with Drager tube, stop work immediately. Call MFA HSC.	Try ventilating area, always work upwind.
Drager tube test (benzene)	Over **1 ppm benzene sustained** in breathing zone	Remain in Level C, continue to monitor breathing zone with Drager tube. If **1 ppm or greater benzene**, leave exclusion zone. Return only if levels decrease to below 1 ppm.	Try ventilating area, always work upwind
Drager tube test (vinyl chloride)	Over **1 ppm benzene sustained** in breathing zone	Stop work immediately. Call the MFA HSC. Let the work area ventilate for at least 15 minutes. Monitor again with Drager tube.	If vinyl chloride detection above 1 ppm persists, stop work and leave the area. Call MFA HSC.
OVM	Detection of 10 ppm (above ambient) in breathing zone **and determined not to be benzene or vinyl chloride**	Upgrade to Level C and continue to monitor breathing zone with Drager tube. **If 20 ppm, leave exclusion zone**. Return only if levels decrease to below 50 ppm.	Try ventilating area, always work upwind
Combustible Gas meter [C]	At or above 10% of LEL	Cease activities, turn off all potential sources of ignition	Determine source of flammable vapors

[a] Some photoionization instruments do not work and shall not be used for work in high (>90%) humidity or rainy weather. Under these atmospheric conditions, only photoionization instruments certified for use in high humidity will be used.

[b] For workers wearing half-face respirators.

[C] See Section 9.2 for complete explosion hazard action levels.

Respirator/Respirator Cartridge Information

Respirator Manufacturer	**North**
Respirator Cartridge Selected for Use	HEPA/organic vapor/
Respirator Cartridge Change Schedule	Every 4 hours

Note: Project personnel are not permitted to deviate from the specified levels of protection without the prior approval of the SSO or MFA HSC.

10.2 Explosion Hazard Action Levels

The chemical contaminants present on this site are ionizable (i.e., they can be detected with a PID). The action levels discussed above are far below concentrations that would cause an explosion hazard. A Combustible Gas Indicator (CGI) is not necessary since work will cease at concentrations far below those that would create a potentially explosive atmosphere, based on the presence of organic vapors.

However, in the event that site characterization activities require working in a potentially explosive atmosphere (based on the presence of organic vapors) the explosivity action levels below will be used. These action levels are set to minimize risk due to flammable or explosive atmospheres. Measurements should be taken at all locations where organic vapors may cause an explosive condition. American Petroleum Institute (API) procedures shall be followed for measurements in tanks or piping.

Instrument	Action Level (Evacuate)
Combustible Gas Indicator	10%

The CGI alarm must be set to sound at the action level. For this work it is highly recommended that hexane or methane to a pentane standard be used for calibration. When measurements with a CGI indicate the presence of combustible gas levels equal to or exceeding the explosivity action level in the work area, the following action must be taken:

1. Extinguish all possible ignition sources in the work area and shut down all powered equipment.
2. Move personnel at least 100 feet away from work area.
3. Contact the MFA HSC. An incident report must be submitted within 24 hours.
4. At the instruction of the MFA HSC and after waiting 15 minutes for organic vapors to dissipate, the SSO may use the CGI to, cautiously and with prudence, approach the worksite to determine the extent and concentration of organic emissions. The SSO shall not enter (or allow any personnel to enter) any area where CGI readings exceed the explosivity action level, nor shall the SSO make any approach if there is a possibility of fire or explosion.
5. Personnel may re-enter the work area only by clearance from the SSO after the cause of the emission has been determined and the source abated.
6. Prepare incident report and submit to the MFA HSC.

10.3 Instrument Calibrations

All instruments shall be calibrated both immediately prior to commencing the day's field work and after work ceases for the day. Calibration and monitoring records shall be kept in the project file and provided to the HSC. Records shall include:

- Worker's name
- Date
- Time
- Location
- Temperature and humidity
- Calibration gas identity and concentration

Exposure data (time, location, and concentration)

11 HEALTH AND SAFETY EQUIPMENT CHECKLIST

THE FOLLOWING SAFETY EQUIPMENT IS REQUIRED ON YOUR JOB SITE!

Equipment	Requirements
Hard Hat	Required on ALL job sites.
Steel Toed Boots	Required on ALL job sites
Safety Glasses w/side shields	Required on ALL job sites
Hearing Protection	Use when appropriate
Photoionization Detector or Flame Ionization Detector	PID calibrated to 100 ppm isobutylene
Combustible Gas Indicator	If required, based on detections of organic vapors. where the historic landfill is located. Hexane or methane to a pentane standard is to be used for calibration.
Respirator	Half or Full face respirator with OVM cartridges. Change cartridges daily or as advised by the MFA HSC or SSO.
Protective Clothing	Tyvek suit when appropriate
Chemical Protective Gloves	Nitride, Scorpio, or Solvex gloves
Decontamination Equipment	Bring soap and water to wash hands and face if no facilities are available.
Caution Tape, Traffic Cones, or Barriers	Use when working near traffic.
Emergency Eye Wash Fountain	Located in the MFA field vehicle.
First Aid Kit	Located in MFA field vehicle.
Fire Extinguisher	Located in the MFA field vehicle
Drinking Water	Located in the MFA field vehicle

12 SITE CONTROL MEASURES

It is important for the MFA onsite SSO to keep all unauthorized personnel a safe distance from the work area. The SSO will establish work zones to restrict access to the work site to personnel who have proper safety training, and to increase worker awareness of potential contamination. The site will be divided into three work zones: the exclusion zone, the contaminant reduction zone, and the support zone

12.1 Exclusion Zone

An exclusion zone will be set up around the work area. This zone will extend in about a 25-foot radius from around the borehole. Only persons authorized by the MFA SSO will enter this zone. Equipment and personnel leaving these areas will be decontaminated before leaving the site.

12.2 Contamination Reduction Zone

The contamination reduction zone is the area just outside the exclusion zone that will serve as an area to decontaminate equipment and personnel. Care will be taken to prevent the spread of contamination from this area. Disposable equipment will be stored in plastic bags in the contamination reduction zone pending proper disposal.

12.3 Support Zone

The support zone will be used to stage clean equipment, change into protective clothing, take rest breaks, eat meals, etc.

13 GENERAL SAFE WORK PRACTICES

Field operations for this project shall be conducted in accordance with the minimum safety practices described below required for MFA employees.

13.1 Safety Practices for Field Personnel

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increase the probability of hand-to-mouth transfer and ingestion of materials is prohibited in any area where the possibility of contamination exists.

2. Hands must be thoroughly washed when leaving a contaminated or suspected contaminated area before eating, drinking, or any other activities.

3. Contaminated protective equipment shall not be removed from the work area until it has been properly decontaminated or containerized on site.

4. Avoid activities which may cause dust. Removal of materials from protective clothing or equipment by blowing, shaking, or any means which may disperse materials into the air is prohibited.

5. Field personnel must use the "buddy system" when wearing any respiratory protective devices. Only when no respiratory equipment is required can field personnel work alone. Communications between members must be maintained at all times. Emergency communications shall be prearranged in case unexpected situations arise. Visual contact must be maintained between pairs on site, and team members should stay close enough to assist each other in the event of an emergency.

6. Personnel should be cautioned to inform each other of subjective symptoms of chemical exposure such as headache, dizziness, nausea, and irritation of the respiratory tract.

7. No excessive facial hair which interferes with a satisfactory fit of the face piece-to-face seal will be allowed on personnel required to wear respiratory protective equipment.

8. The selection, use, and maintenance of respiratory protective equipment shall meet the requirements of established MFA procedures, recognized consensus standards (AIHA, ANSI, NIOSH), and shall comply with the requirements set forth in 29 CFR 1910.134.

9. At sites with known or suspected contamination, appropriate work areas for field personnel support, contaminant reduction, and exclusion win be designated and maintained.

10. MFA field personnel are to be thoroughly briefed on the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communications methods, both initially and in daily briefings.

11. All MFA field vehicles shall contain a first aid kit and multipurpose portable fire extinguisher.

12. All field personnel will, whenever possible, remain upwind of drilling rigs, open excavations, boreholes, etc.

13. Subsurface work shall not be performed at any location until the area has been cleared by a utility locator firm to be free of underground utilities or other obstructions.

14. Field personnel are specifically prohibited from entering into excavations, trenches, or other confined spaces deeper than 4 feet. Unattended boreholes must be properly covered or otherwise protected.

14 ACKNOWLEDGEMENT

All MFA personnel are to read, understand, and agree to comply with the specific practices and guidelines as described in this Health and Safety Plan (including attachments for specific activities and the General Work Practices described below) regarding field safety and health hazards.

This Health and Safety Plan has been developed for the exclusive use of MFA personnel only. MFA makes this plan available for review by contracted or subcontracted personnel for informational purposes only. This plan does not cover the activities performed by employees of any other employer on the work site. All contract or subcontracted personnel are responsible for generating and using their own plan which must have requirements is as least as stringent as those listed in this health and safety plan.

I have read and understand this HSP and all attachments, and agree to comply with the requirements described within:

Name	Title	Date

APPENDIX A

REQUIRED FORMS

Maul Foster & Alongi, Inc.
AIR MONITORING RECORD

Project Title_____ Project No._____

Site Specific Name/Location_____ Date_____ Day_____

Weather: Temp_____ Wind Direction/Speed _____ / _____ Humidity_____

	Instrument	S/N	Calibration date	Calibration gas/method	Calibration by
Organic vapors					
Particulates					
O_2					
Radiation					
Combustible gas					
Radiation					

Time	Location / Description	Organic vapor ppm	Particulates mg/m3	0_2 %	H_2S ppm	CG % LEL

Notes:_____

Data collected by_____

Print Name Signature

APPENDIX B

DRILLING INTO SOIL AND ROCKS

DRILLING INTO SOIL AND ROCKS

PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide an overview for working safely around drilling operations with truck-mounted and other engine-powered drill rigs. The procedure addresses off-road movement of drill rigs, overhead and buried utilities, use of augers, rotary and core drilling, and other drilling operations and activities.

APPLICATION

The guidelines shall be applied to Maul Foster & Alongi (MFA) projects in which truck-mounted, or other engine-powered, drill rigs are used.

The guidelines are applicable to MFA employees only. For drill rigs operated by contractors, the primary responsibility for drilling safety is with the drilling contractor.

RESPONSIBILITY AND AUTHORITY

Drill rig safety and maintenance is the responsibility of the drill rig operator. MFA employees are responsible for their own safety including recognizing and avoiding drill rig hazards. MFA employees that observe a drill rig condition believed to be unsafe shall advise the drill rig operator and/or the client of the unsafe condition.

SAFETY GUIDELINES

Movement of Drill Rigs

Before moving a rig, the operator must do the following:

1. To the extent practical, walk the planned route of travel and inspect it for depressions, gullies, ruts, and other obstacles.

2. Check the brakes of the truck/carrier, especially if the terrain along the route of travel is rough or sloped.

3. Discharge all passengers before moving on rough or steep terrain.

4. Engage the front axle (on 4x4, 6x6, etc. vehicles) before traversing rough or steep terrain.

Driving drill rigs along the sides of hills or embankments should be avoided; however, if side-hill travel becomes necessary, the operator must conservatively evaluate the ability of the rig to remain upright while on the hill or embankment. The possibility must be considered that the presence of drilling tools on the rig may reduce the ability of the rig to remain upright (raises the center of mass of the rig).

Logs, ditches, road curbs, and other long and horizontal obstacles should be normally approached and driven over squarely, not at an angle.

When close lateral or overhead clearance is encountered, the driver of the rig should be guided by another person on the ground.

Loads on the drill rig and truck must be properly stored while the truck is moving, and the mast must be in the fully lowered position.

After the rig has been positioned to begin drilling, all brakes and/or locks must be set before drilling begins. If the rig is positioned on a steep grade and leveling of the ground is impossible or impractical, the wheel of the transport vehicle should be blocked and other means of preventing the rig from moving or topping over employed.

All drilling work shall stop and the drilling derrick must be lowered during lightning storms.

BURIED AND OVERHEAD UTILITIES

The location of overhead and buried utility lines must be determined before drilling begins, and the locations should be noted on boring plans and/or assignment sheets.

When overhead power lines are close by, the drill rig mast should not be raised unless the distance between the rig and the nearest power line is at least 20 feet or other distance as required by local ordinances, whichever is greater. The drill rig operator or assistant should walk completely around the rig to make sure that proper distance exists.

When the drill rig is positioned near an overhead line, the rig operator should be aware that hoist lines and power lines can be moved towards each other by wind. When

necessary and approved by the Project Manager (PM), the utility and/or power lines may be shielded, shut down, or moved by the appropriate personnel.

CLEARING THE WORK AREA

Before a drill rig is positioned to drill, the area on which the rig is to be positioned should be cleared of removable obstacles and the rig should be leveled if sloped. The cleared/leveled area should be large enough to accommodate the rig and supplies.

SAFE USE OF AUGERS

Never place hands or fingers under the bottom of an auger flight or drill rods when hoisting the augers or rods over the top of another auger or rod in the ground or other hard surfaces, such as the drill rig platform.

Never allow feet to get under the auger or drill rod while they are being hoisted.

When the drill is rotating, stay clear of the drill string and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.

Move auger cuttings away from the auger with a long-handled shovel or spade; never use hands or feet.

Never clean an auger attached to the drill rig unless the transmission is in neutral or the engine is off, and the auger has stopped rotating.

FIRE SAFETY

- Fire extinguishers shall be kept on or near drill rigs for fighting small fires.
- If methane is suspected in the area, a combustible gas instrument (CGI) shall be used to monitor the air near the borehole with all work to stop at 20 percent of the Lower Explosive Limit (LEL).

Explosion Hazard Action Levels

The explosivity action levels below are set to prevent the creation of flammable or explosive atmospheres. Borehole measurements should be taken while personnel are drilling or using hand tools at all locations where methane may be present.

EXPLOSIVITY ACTION LEVELS
(% OF THE LEL)

Instrument	Action Level (Evacuate)
Combustible Gas Indicator	10%

The Combustible Gas Indicator (CGI) alarm must be set to sound at the action level. For this work it is highly recommended that hexane or methane to a pentane standard be used for calibration.

When measurements with a CGI indicate the presence of combustible gas levels equal to or exceeding the explosivity action level in the work area, the following action must be taken:

1. Extinguish all possible ignition sources in the work area and shut down all powered equipment.
2. Move personnel at least 100 feet away from work area.
3. Contact the drilling contractor's Health and Safety Officer (HSO).
4. At the instruction of the HSO and after waiting 15 minutes for organic vapors to dissipate, the drilling contractor's Site Safety Officer (SSO) or PM may use the CGI to, cautiously and with prudence, approach the worksite to determine the extent and concentration of organic emissions. The SSO or PM shall not enter any area where CGI readings exceed the explosivity action level, nor shall the SSO or PM make any approach if there is possibility of fire or explosion.
5. Personnel may reenter the work area only by clearance of the drilling contractor's HSO after the borehole has been inerted of potentially explosive vapors.

SAFE USE OF HAND TOOLS

OSHA regulations regarding hand tools should be observed in addition to the guidelines provided below:

- Each tool should be used only to perform tasks for which it was originally designed.

- Damaged tools should be repaired before use or discarded.
- Safety goggles or glasses should be worn when using a hammer or chisel. Nearby co-workers and by-standers should be required to wear safety goggles or glasses also, or move away.
- Tools should be kept cleaned and stored in an orderly manner when not in use.

SAFE USE OF WIRE LINE HOISTS, WIRE ROPE, AND HOISTING HARDWARE

Safety rules described in Title 29 Code of Federal Regulations (CFR) 1926.552 and guidelines contained in the Wire Rope User's Manual published by the American Iron and Steel Institute shall be used whenever wire line hoists, wire rope, or hoisting hardware are used.

PROTECTIVE GEAR

Minimum Protective Gear

Items listed below should be worn by all members of the drilling team while engaged in drilling activities.

- Hard Hat;
- Safety Shoes (shoes or boots with steel toes and shanks);
- Hearing protection;
- Safety glasses; and
- Gloves.

Other Gear

Items listed below should be worn when conditions warrant their use. Some of the conditions are listed after each item.

1. **Safety Harnesses and Lifelines:** Safety harnesses and lifelines shall be worn by all persons working on top of an elevated derrick beam or mast. The lifeline should be secured at a position that will allow a person to fall no more than six feet. OSHA Full Protection (1926 Subpart m) requirements apply.

2. **Life Vests:** Use for work over water.

TRAFFIC SAFETY

Drilling in streets, parking lots or other areas of vehicular traffic requires definition of the work zones with cones, warning tape, etc.

APPENDIX C

VEHICLE SAFETY OPERATION

MOTOR VEHICLE SAFETY

PURPOSE

The goal of this Operating Procedure (OP) is to reduce the potential for employee injury, property damage, and liability associated with the operation of motor vehicles on Maul Foster & Alongi, Inc. (MFA) business. Motor vehicle accidents cause over 40,000 deaths annually in the United States and are the number one cause of work related death.

The risk to MFA employees is increased when in rented vehicles, away from home, focused on business issues, and under time pressures. Standard procedures will help reduce the common problem of complacency regarding motor vehicle safety.

APPLICATION

This OP applies to MFA owned vehicles, vehicles leased or rented for MFA business, and personal vehicles when used on MFA business.

HAZARDOUS MATERIALS

The U.S. Department of Transportation (DOT) regulations (HM-181) provides listings of Hazardous Materials and the quantities required for labeling and for placarding. MFA will not carry quantities of hazardous materials which require placards in any vehicle operating on MFA business. In general, MFA discourages the transportation of any hazardous material by MFA vehicle. However, if transportation of small quantities of hazardous materials is necessary in vehicles operated for MFA business, proper packaging, labeling, and emergency information (e.g. MSDS) will be provided. Further information may be found in HS-513, Guidelines for the Transportation of Hazardous Materials.

LICENSE

All operators of vehicles on MFA business must have a valid driver's license. A Commercial Drivers License (CDL) may be required for certain employees.

MFA may require employees to provide copies of their motor vehicle license. MFA may use insurance company computer database access to check to see if an employee's license has been suspended.

SEAT BELTS

The use of seat belts and shoulder straps by both driver and passengers is mandatory. Accident statistics clearly demonstrate the reduced risk of injury or death when wearing seat belts.

ALCOHOL/ILLEGAL SUBSTANCES

MFA employees shall not operate vehicles when under the influence of alcohol or other intoxicants. MFA employees shall prevent other employees that may be under the influence from driving. Reduction in sensory and motor skills begins well below the typical legal limit of 0.10 percent blood alcohol.

Over 45% of all traffic fatalities in the U.S. are alcohol related, with blood alcohol levels at 0.10 percent or greater.

MFA may require drug testing after any motor vehicle accident while on MFA business. Further details on testing may be seen in the Human Resources Operating Procedure PERS-107.

TRAINING

MFA employees are encouraged to take the course "Defensive Driving" sponsored by the National Safety Council. This course is available through the MFA Training Institute and is widely available throughout the U.S., Europe, and Australia.

RENTAL VEHICLES

An employee must be familiarized with a rental vehicle before it is driven. To avoid accidents because an accessory (e.g. windshield wiper) cannot be located during operation, it is recommended that the driver locate the horn, windshield wiper switch, lights, defroster, gauges, hood and gas fill door releases, and seat and mirror adjustments before the vehicle is started. Once the vehicle is started, fluid levels, wiper blades, and lights should be checked. Safety belt devices are becoming complicated and must be used correctly by the driver. The spare tire should be located, along with instructions and tools to change a flat tire. As the vehicle is driven off the lot, the driver should get acquainted with the acceleration and braking of the vehicle. The driver must be familiar with country, state and local traffic laws (e.g. speed limits, right turn on red, kilometers vs. miles, etc.).

The use of taxis is preferred in many international cities due to both complex driving conditions and significantly higher accident rates.

COMPANY VEHICLES

Only authorized employees may use MFA owned vehicles. Up-to-date records of all maintenance and repair work that has been performed on each vehicle must be kept and readily accessible. Inspection, registration, and other required documents will be kept in the vehicle or in possession of the operator. The driver must inspect the vehicle before operation for fluid leaks and levels, tire pressure, and assess the condition of lights, windshield wipers, and horn.

GENERAL SAFETY GUIDELINES

General safety guidelines are listed below:

- Allot enough time for travel to avoid the need to hurry.
- Be well rested and alert.
- Always wear seat belts.
- Do not be aggressive; confrontations could result in violence.
- Be aware of the surroundings. Notify someone of your destination and anticipated time of arrival.
- Pack a survival kit in the vehicle for cold weather and emergencies.
- Keep doors locked.
- Do not pick up hitchhikers.
- Pull off the road in the event of a flat tire or other vehicular failure. Stay with the vehicle until help arrives.
- Drive defensively.
- Drivers with manual-dialing phones should pull their vehicles to the side of the road when phoning. Telephones should be mounted as close as possible to the driver's line of sight.

ACCIDENT REPORTING

In case of a vehicle accident, the driver must STOP. If the driver is able, emergency reflectors or flares should be set out to protect the drivers, passengers, and vehicle. The driver should get help for injured people or render first aid if they are qualified.

Specifics of the accident should be discussed only with the police and a supervisor. The driver should not assume any blame or responsibility, express opinions, or become involved in arguments. Any serious accident shall be reported as soon as possible by telephone to the driver's supervisor and local reporting requirements should be followed.

An employee who is involved in an accident when on MFA business must report it by completing Form HS-102 Incident Report and submit it to the Operating Unit Health and Safety Officer. Additional information (e.g. accident report, citations, etc.) may be requested by the Operating Unit Manager or Corporate Health and Safety Officer.

MOTOR VEHICLE VIOLATIONS

MFA requires employees to abide by all state and local driving regulations. Should the MFA driver receive a violation notice, the employee is fully responsible for any fines.

APPENDIX D

MFA INCIDENT REPORT

ACCIDENT/LOSS REPORT

******THIS REPORT MUST BE COMPLETED IN FULL AND SUBMITTED WITHIN 24 HOURS TO THE REGIONAL HEALTH AND SAFETY MANAGER***

Date of Accident:_____ Company:_____

Time Occurred:_____ Project Number:_____

Where Occurred:_____ Name and Location of Project:_____

_____ _____

PART I — PROPERTY DAMAGE/LOSS

Equipment Involved:_____

Names of Persons Involved:_____

Describe Incident/Damage:_____

_____

Estimated Cost of Damage:_____

***Police Report must be filed on all automobile accidents and on all equipment thefts. Copy of Police Report must also be submitted.**

DRAW A DIAGRAM OF INCIDENT ON THE BACK OF THIS REPORT

PART II — PERSONAL INJURY *(Fill out only if personal injury occurred)*

Name of employee injured:_____ Age:_____ Social Security No._____

Address:_____ Occupation:_____

What was employee doing when injured:_____

Exact location where injury occurred (station number or prominent landmark):_____

_____

Was place of accident or exposure on job site?:_____

Describe injury:_____

_____

How did injury occur?:_____

_____

Did employee see a doctor or go to the hospital?_____ If yes, give name, address, ad phone number of doctor or hospital:_____

Did employee lose time?_____ If yes, how long?_____ Date returned to work:_____

_____

Number of days employee usually worked a week: _____ Number of hours worked:_____

Date of this report:_____