Frontier Hard Chrome Long-Term Monitoring Plan

Work Assignment Number: 153-RARA-1027

EPA Contract: 68-W7-0026

February 2004

EPA Region V

RAC

Response Action Contract

Weston Solutions, Inc. · 190 Queen Anne Avenue North · Seattle, WA 98109-4926

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FRONTIER HARD CHROME
POST REMEDIAL ACTION
LONG-TERM MONTORING PLAN
VANCOUVER, WASHINGTON

Prepared for

U.S. Environmental Protection Agency
Region X
1200 Sixth Avenue
Seattle, Washington 98101

Contract No. 68-W7-0026
Work Assignment No. 153-RARA-1027
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Prepared by

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Frontier Hard Chrome Long Term Monitoring Plan

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Sean Sheldrake
EPA Project Manager

Approved By: _____ Date: _____
Chris Pace
EPA Quality Assurance

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DATA DISTRIBUTION LIST

Name	Title	Unvalidated Data		Validated Data	
		Hard Copy	Electronic Copy	Hard Copy	Electronic Copy
Sean Sheldrake	EPA Project Manager	X	X	X	X
Weston Project File	File			X	X
Larry Vanselow	Weston Project Manager			X	X

LIST OF ACRONYMS

Acronym	Definition
CLP	Contract Laboratory Program
CRDL	Contract Required Detection Limit
EDD	Electronic Data Deliverable
EPA	United States Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FHC	Frontier Hard Chrome
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDW	Investigation Derived Waste
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
MEL	Manchester Environmental Laboratory
MS/MSD	matrix spike/matrix spike duplicate
MW	Monitoring Well
NA	Not Applicable
PM	Project Manager
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
ROD	Record of Decision
RPD	relative percent difference
RSCC	Regional Sample Control Coordinator
SOPs	Standard Operating Procedures
TAL	Target Analyte List

SECTION 1

PROJECT MANAGEMENT

1.1 PROJECT ORGANIZATION

1.1.1 Introduction/Purpose

This Long Term Monitoring Plan is being prepared as directed by Task 9 "Project Performance" in the Scope of Work for Remedial Action (EPA 2003). The Long Term Monitoring Plan describes the procedures to be used during the performance of long-term groundwater monitoring at the Frontier Hard Chrome (FHC) Superfund site in Vancouver, Washington. Long term monitoring is required to track offsite plume concentrations as well as show the remedy is maintaining its operational functionality.

The FHC site was the subject of a remedial action conducted during the summer of 2003. The purpose of the remedial action (RA) was to treat the site's chromium-contaminated soil and groundwater to cleanup levels specified in the Record of Decision.

This plan contains the elements of a site-specific Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) for field and laboratory analysis activities. Included are descriptions of site background, project objectives, field sampling requirements, analytical procedures, and QA requirements that will be used to obtain valid, representative field and laboratory analytical measurements. The plan is intended to be combined with information presented in Weston's Quality Management Plan (QMP; Weston 2003a). Copies of the QMP are available in Weston's office located at 190 Queen Anne Avenue North, Suite 200, Seattle, Washington 98109.

1.1.2 Project Roles

The following are the Key Project Personnel (see organization chart, Figure 1):

1.1.2.1 U.S. Environmental Protection Agency (EPA) Region 10 Project Manager (PM)

The EPA PM for this project is Sean Sheldrake. Mr. Sheldrake is the overall project coordinator, decision maker, primary point of contact for general project problem resolution, and has approving authority for the project. He will review and approve the plan and subsequent revisions in terms of project scope, objectives, and schedules. He also will ensure that the plan is implemented properly.

1.1.2.2 EPA Region 10 Quality Assurance (QA) Manager

The EPA Region 10 QA Manager is Chris Pace. Mr. Pace (or his designee) reviews and approves the plan and subsequent revisions. He also may conduct assessments of field activities.

1.1.2.3 EPA Region 10 Regional Sample Control Coordinator (RSCC)

The EPA Region 10 Regional Sample Control Coordinator is Laura Castrilli. Ms. Castrilli coordinates sample analyses performed through the EPA Contract Laboratory Program (CLP) and/or the EPA Region 10 Manchester Environmental Laboratory (MEL) and provides sample identification numbers.

1.1.2.4 Weston Project Manager (PM)

The Weston PM is Larry Vanselow. Mr. Vanselow has the responsibility for the overall performance of the Weston team, and is the primary contact point with the EPA PM. He will review and approve the plan. He makes the ultimate decisions for the implementation of the project and ensures that implementation is performed in accordance with the specifications of the plan and Weston's QMP and SOPs. Mr. Vanselow will receive the CLP/Region 10 laboratory information from the RSCC and has overall responsibility for maintaining project budget and schedule.

1.1.2.5 Weston Field Leader

The Weston Field Leader provides overall coordination of field work, including notifying the sampling team and the EPA RSCC of upcoming sampling events. The current Weston Field Leader is David Dinkuhn. Mr. Dinkuhn will provide oversight of the field sampling team to ensure that the plan is implemented correctly and will record any deviations from it. He is the primary Weston point of contact for field sampling problems. He will be responsible for the execution of decisions and courses of action deemed appropriate by the Weston PM. The Weston Field Leader will also serve as Weston's site Health and Safety Officer.

1.1.2.6 Environmental Services Assistance Team (ESAT)

EPA's ESAT team will perform sample collection and field analyses. The team will ensure that the plan is implemented correctly and will record any deviations from it. The team will provide the Weston field leader with copies of all field sampling forms, field analysis results, laboratory chains of custodies, and shipping air bills. The primary ESAT point of contact is David Dobbs (ESAT Team Manager).

1.1.2.7 Weston QA Officer

The Weston QA Officer is Paul Swift. Mr. Swift will review and approve the plan, will conduct in-house audits of field operations, and will be responsible for auditing and reviewing the field activities, final deliverables, and if necessary, for approving corrective actions for nonconformities. Mr. Swift will oversee the implementation of the plan and evaluate the data generated. He also ensures that the implementation of the project is performed in accordance with the specifications of Weston's QMP and SOPs.

1.2 PROBLEM DEFINITION/BACKGROUND

1.2.1 Site Background

The FHC site is located in southeastern Vancouver, Washington **(**Figure 2). The facility address is 113 "Y" Street, Vancouver, Washington. The site is located in the Section 25, Township 2 north, Range 1 east, Willamette Meridian in Clark County, Washington. The location in latitude and longitude coordinates is 45 degrees, 37 minutes, 19 seconds north by 122 degrees, 38 minutes 45 seconds east (Degrees, Minutes, Seconds [DMS]). The site was previously occupied by several metals fabricating businesses and was used for storage and as a staging area for a neighboring business. Currently, no buildings exist on the site and the site is vacant.

The FHC site is located on a former floodplain of the Columbia River at an elevation of approximately 30 feet above mean sea level (MSL), about 0.5 mile north of the north bank of the river. A short distance north of the site (north of 5th Street), a bluff rises to an elevation of approximately 160 feet. The FHC site covers approximately 0.5 acre and is bordered to the east by Grand Avenue, to the south by Cassidy Manufacturing, and to the west by "Y" Street (Figure 3).

The FHC site derives its name from a company that operated a chrome plating operation at the site from 1970 until 1983. The FHC site was the location of chrome plate operations for approximately 25 years between 1958 and 1983. Activities began at the site in 1955, when the site was filled with hydraulic dredge material and construction rubble. The site was occupied by two businesses engaged in chrome plating. Pioneer Plating operated at the site from 1958 to 1970. During the operation of Pioneer Plating, chromium plating wastes were discharged to the sanitary sewer system. The business was taken over by FHC and operated until 1983.

FHC discharged untreated process wastewater containing hexavalent chromium and other heavy metals from its plating process directly to the City of Vancouver sewage collection system until 1976. FHC was asked by the city and the Washington State Department of Ecology (Ecology) to cease discharge to the sewer system until a treatment system was installed to remove chromium from their waste.

In June 1976, FHC modified its disposal system by redirecting untreated chromium-contaminated wastewater to an on-site "dry well" and routing cooling water to the unfilled area east of the FHC building. Discharge into the dry well continued for the next 7 years. In December 1982, the FHC site was proposed for inclusion on the National Priorities List under Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA or Superfund). FHC terminated its operations in January 1983.

EPA completed a ROD Amendment in August 2001 addressing both the groundwater and soil at the site. The preferred remedy called for the reduction of hexavalent chromium in soil and groundwater to trivalent chromium. The ROD also recommended institutional controls to be implemented as part of the preferred remedy.

Work began on the remedial design in October 2001. The remedial design was completed in February 2003. The remedial action, consisting of building demolition, treatment of source area soil and groundwater, and installation of an in-situ redox manipulation (ISRM) treatment wall (to treat hexavalent chromium), was completed in September 2003 (Weston 2003b).

1.2.2 Problem Definition

The goal of the remedial action was to treat source area soil and groundwater to reduce hexavalent chromium concentrations such that groundwater downgradient of the site would attenuate to chromium concentrations less than 50 micrograms per liter (ug/L). To demonstrate this, groundwater quality will be monitored in two areas. The first area consists of locations immediately within and down gradient of the ISRM wall. Wells located within and just down gradient of the wall will be monitored to ensure the continued operational functionality of the ISRM Treatment Wall. The second area targeted for monitoring consists of the historical chromium contaminated groundwater plume located down gradient of the ISRM wall. This down gradient plume did not get treated during the RA and will be monitored to track the long-term expected reduction in chromium concentration as a result of completing the remedial action.

Long-term groundwater monitoring is required by the site's ROD and the Institutional Control Plan (Weston 2003c). The results of the monitoring may be used to institute controls to protect human health (if necessary) during the time groundwater chromium concentrations exceed the cleanup target of 50 ug/L.

1.3 PROJECT DESCRIPTION AND SCHEDULE

1.3.1 Project Description

Long-term groundwater monitoring will consist of sampling two groups of wells over 5 years for a series of twelve sampling events. The first group of wells selected for monitoring the performance of the ISRM barrier wall consists of eighteen wells located within or near the wall. The second group of wells selected for monitoring the long-term attenuation of chromium consists of sixteen wells, primarily located down gradient of the FHC site (and the ISRM treatment wall). Groundwater samples will be collected from select wells within these groups during each sampling event. Groundwater samples will be analyzed for total analytes list (TAL) total metals and hexavalent chromium. Where turbidity exceeds 10 NTUs, dissolved metals will also be analyzed.

Sampling events will be conducted approximately quarterly for two years, semi-annually for the following 2 years, and annually for the next year. After the five year monitoring period, a review will be conducted to assess offsite threats and the need for continued institutional controls. The need for continuing groundwater monitoring will also be evaluated. Details on specific wells, locations to be sampled, and the analytical program are provided in Section 2.

1.3.2 Schedule

The tentative schedule for groundwater monitoring is provided below. Adjustments to the completion dates may be necessary to account for variable unforeseen conditions. Significant schedule changes that arise in the field will be discussed with the EPA PM at the earliest possible convenience. The proposed monitoring schedule is as follows:

Activity	Complete
Sampling Event 1	February 2004
Sampling Event 2	April 2004
Sampling Event 3	August 2004
Sampling Event 4	December 2004
Sampling Event 5	March 2005
Sampling Event 6	June 2005
Sampling Event 7	September 2005
Sampling Event 8	December 2005
Sampling Event 9	March 2006
Sampling Event 10	September 2006
Sampling Event 11	September 2007
Sampling Event 12	March 2008
Compilation Interpretive Report for 5 Year Review	May 2008

1.4 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

The project data quality objectives (DQOs) are to provide valid data of known and documented quality. The DQO process applied to this project followed that described in the EPA document, *Guidance for the Data Quality Objectives Process* (EPA 1994a).

1.4.1 DQO Data Categories

All samples analyzed under this plan will be analyzed using definitive analytical methods unless standard methods do not exist. All analytical methods employed for this project will be methods approved by the EPA. The data generated under this project will comply with the requirements for this data category as defined in *Data Quality Objective Process for Superfund* (EPA 1993).

1.4.2 Data Quality Indicators (DQIs)

DQI precision, accuracy, representativeness, comparability, and completeness goals for this project were developed following guidelines presented in the EPA document *Guidance for Quality Assurance Project Plans QA/G5* (EPA 1998).

The basis for assessing each of the elements of data quality is discussed in the following subsections. Table 1 presents the QA objectives for measurement of analytical data (such as the number of field duplicates to be collected) and QC guidelines for precision and accuracy. This Table will be updated annually to incorporate changes made to the Table 3 sampling schedule. Other DQI goals are included in the laboratories' Standard Operating Procedures (SOPs) (to be assigned) and Statements of Work (SOW).

1.4.2.1 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a population, including a sampling point, a process condition, or an environmental condition. Representativeness is the qualitative term that should be evaluated to determine that measurements are made and physical samples collected at locations and in a manner resulting in characterizing a matrix or media. Subsequently, representativeness is used to ensure that a sampled population represents the target population and an aliquot represents a sampling unit.

Further, all sampling procedures detailed in the plan will be followed to ensure that the data will be representative of the media sampled. The plan describes the sample location, sample collection and handling techniques to minimize potential contamination or compromise sample integrity, and proper chain of custody. Additionally, the sampling design will ensure that there are a sufficient number of samples and level of confidence that analysis of these samples will detect the chemicals of concern, if present.

1.4.2.2 Comparability

Comparability is the qualitative term that expresses the measure of confidence that two data sets or batches can contribute to a common analysis and evaluation. Comparability with respect to laboratory analyses pertains to method type comparison, holding times, stability issues, and aspects of overall analytical quantitation. The following items are evaluated when assessing data comparability:

- Determining if two data sets or batches contain the same set of parameters.
- Determining if the units used for each data set are convertible to a common metric.
- Determining if similar analytical procedures and quality assurance were used to collect data for both data sets.
- Determining if the analytical instruments used for both data sets have approximately similar detection levels.
- Determining if samples within data sets were selected and collected in a similar manner.

To ensure comparability of data collected during this investigation to other data that may have been or may be collected for the site, standard collection and measurement techniques will be used.

1.4.2.3 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not rejected through data validation. The requirement for completeness is 90% for aqueous samples.

The following formula is used to calculate completeness:

$$\%\ \text{completeness} = \frac{\text{number of valid results for samples analyzed}}{\text{number of possible results for all samples}} * 100$$

1.4.2.4 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. *Analytical* precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. The laboratory control sample (LCS) determines the precision of the analytical method. The comparison is not between a sample and a duplicate sample analyzed in the same batch. Rather, the comparison is between the sample and samples analyzed in previous batches.

Total precision is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Sample matrix duplicate spiked samples shall be analyzed to assess analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. See Table 1 for precision (RPD) guidelines for each analytical method.

The following formula is used to calculate precision:

$$\text{RPD} = (100) \times \frac{(S_1 - S_2)}{(S_1 + S_2)/2}$$

where:

S_1 = normal sample value
S_2 = duplicate sample value

1.4.2.5 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random uncertainty (variability due to imprecision) and systemic uncertainty. It reflects the total uncertainty associated with a measurement. A measurement is accurate when the value reported

does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS or MS sample to a control limit. Analysis of performance evaluation (PE) samples also may be used to provide additional information for assessing the accuracy of the analytical data being produced. See Table 1 for accuracy (percent recovery range) guidelines for each analytical method.

1.5 SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

No special training requirements or certifications are required for this project except for current 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) certification. Health and safety procedures for Weston personnel and Weston subcontractors are addressed in the Weston site-specific health and safety plan (HASP). Copies of this document are maintained in Weston's Seattle office and at the project site. All field personnel and required to read and comply with the plan. Non-Weston personnel (e.g., ESAT) are also required to develop and implement their own site-specific health and safety program that incorporates the provisions of the Weston HASP.

1.6 DOCUMENTATION AND RECORDS

Following the completion of each sampling event and the receipt of analytical data, a report summarizing the analytical results will be prepared and submitted to EPA. This report will list the wells sampled, provide a tabular listing of the analytical results, and provide a map showing the wells sampled with the associated chromium concentrations. Chromium concentration isopleths will be drawn on the maps. Each successive monitoring report will contain the current isopleth drawing as well as previous isopleth drawings to identify trends in groundwater chromium concentrations.

A yearly summary report (including sample results, QA information and figures) and an addendum to the Long Term Monitoring Plan will be prepared in February of the year following the periodic sampling. The addendum will list that year's wells to be sampled and suggested analytes, as well as any other desired changes to the Long Term Monitoring Plan.

Following the five year monitoring period, a compilation report will be prepared and submitted which will summarize the data collected and provide an interpretation of groundwater concentration trends. Conclusions regarding the achievement of cleanup goals will also be provided. Project files including work plans, reports, analytical data packages, correspondence, chain-of-custody documentation, original logbooks, corrective action forms, referenced materials, and photographs will be retained by Weston (or other responsible sampling organization/agency) and will provided to the EPA PM as requested to support the 5 year review.

SECTION 2

MEASUREMENT/DATA AQUISITION

2.1 SAMPLING PROCESS DESIGN

2.1.1 Property Access

Verbal permission to access the properties where the wells are located for sampling will be obtained by the Weston Field Leader prior to each sampling event. Contact information for the various property owners affected (by well) is provided in Table 2.

2.1.2 Monitoring Well Sampling

Monitoring wells selected to be sampled for the long-term monitoring program are shown on Figures 3 and 4. Note that Figures 3 and 4 show all existing wells at the FHC site and that not all of them have been selected for sampling. Photographs of the wells are provided in Appendix A to help locate them during sampling.

The wells selected for sampling are grouped into two categories: 1) operational/functional monitoring, and 2) long-term monitoring. A schedule of wells (by category) to be sampled for each event during the first monitoring year (2004) is provided in Table 3. Wells designated for sampling in the following years may change based on sample results from the first year of sampling. Changes to the sampling scheme will be implemented by preparing an annual addendum to this Long Term Monitoring Plan in February of the following year after 4 rounds of groundwater sampling have been completed and data has been received. The addendum will include updated versions of Tables 1, 3 and 5 and include the number of field samples and QA samples.

The wells selected are anticipated to provide a sufficient number of data points to meet the objectives of the plan. If, after the first round of sampling, the well coverage is deemed insufficient, up to four new monitoring wells will be installed and included in the monitoring program. At that time, this plan will be amended to reflect the well additions.

Prior to sampling, the Weston Field Leader will notify the ESAT team and the EPA RSCC of the upcoming sampling event. The RSCC will provide the laboratory assignment and project information such as sample number assignments to the sampling team with a copy to the Weston Field Leader. All sampling supplies (coolers, packing materials) and equipment (pumps, tubing) will be provided by the ESAT sampling team.

Well purging and sampling methods used will be in accordance with EPA sampling guidelines which are referenced in the Weston Low Flow Sampling Standard Operating Procedure (SOP, Appendix B). The Weston SOP for low-flow groundwater sampling will also be used to supplement the EPA guidelines. Weston will instruct/train the ESAT sampling team on use of Weston's Low Flow Sampling SOP. The ESAT sampling team will sample the wells for metals

using a peristaltic pump, new flexible silicon tubing within the pumping head, and new polyethylene tubing deployed to mid-screen depth. VOC sampling will be performed using positive displacement methods such as the Waterra Inertial Pump or similar. Monitoring well construction details, including screen depth intervals, are provided in Table 4. The wells will be purged prior to sampling so that representative samples are collected. The volume of water to be purged will be determined by the stabilization of monitored field parameters (conductivity, pH, dissolved oxygen, ORP, and temperature). These parameters must stabilize over at least three consecutive readings taken at 3 to 5 minute intervals prior to sample collection. Purging stabilization criteria are listed below:

Parameter	Stabilization Criteria
pH	± 0.1 unit
Specific conductance	± 3%
Oxidation-reduction	± 10 millivolts
Turbidity	± 10% (When turbidity is greater than 10 NTUs)
Dissolved Oxygen	± 0.3 milligram per liter

Upon collection, a portion of each groundwater sample will be analyzed for hexavalent chromium in the field (using Hach test kit #12710, see Appendix B for the SOP for this kit). All samples (excluding the total sulur analyses) will be submitted to EPA's Manchester Environmental Laboratory (MEL) or a Contract Laboratory Program (CLP) laboratory for analysis for total TAL metals. A 21-day turnaround time for analysis will be requested. In cases where turbidity is excessive (>10 NTU), samples (including the hexavalent chromium samples) will be passed through a 0.45-micron filter in the field and submitted for dissolved TAL metals analysis. Sample pH may change after acid addition due to buffering capacity. Samples will be checked for pH prior to shipping and acid will be added as necessary to obtain the desired pH.

The samples submitted for both total and dissolved metals analysis must have unique sample numbers (CLP and EPA) for each individual metals analysis. This will avoid the situation where two metals results are reported for the same sample number. Field parameters will be measured using a MicroPurge MP20 flow cell or equivalent.

At the completion of the sampling event, the ESAT field team will provide the Weston Field Leader with copies of the field documentation. Such documentation includes groundwater sampling/purge record sheets (provided in Appendix C), data sheet(s) signed by the analyst showing hexavalent chromium results, chain of custody sheets, the electronic Forms II Lite file, and sample shipment air bills.

Table 5 presents the anticipated number of samples, analytical methods, specific requirements for sample container size and type, sample preservation and holding times, and special handling requirements for samples expected to be collected during this task. Table 1 summarizes the number of field, and quality assurance/quality control (QA/QC) samples to be submitted according to the method requirements.

2.1.3 Groundwater Flow Direction

Groundwater elevation will be measured in the wells designated as Long Term Monitoring Wells (see Table 3) including wells W85-3A&B and W92-16A&B. The depth to water (from top of well casing) in each well will be measured accurately to +/- 0.01 foot. These elevation measurements will be completed within a 24 hour period. Table 4 provides well construction information. Measurement data will be recorded on the field sampling forms. Information on Columbia River stage height from the USGS gauging station 14144700 located on the I-5 bridge will also be downloaded from the USGS web site during this monitoring period. Stage height information is located at http://waterdata.usgs.gov/wa/nwis/.

Weston will use the depth to groundwater data in conjunction with the well elevation and horizontal coordinate data provided in Table 4 to develop the groundwater flow direction at the time of sampling.

Well elevation data shown in Table 4 and on the expanded well location map (Figure 5) was compiled from current (remedial action) survey data generated by Weston and historical survey data generated during past site work (by Weston and others). Since different elevation datums were used during the different survey events, elevation values for all wells have been standardized to one datum. The datum selected is that used during remedial action survey work (determined using the City of Vancouver's benchmark number 108 located near the FHC site). Elevations for wells installed before the remedial action were corrected using a derived correction factor. The correction factor was derived by comparing new versus old elevation values for eight historical wells that were re-surveyed during the remedial action. The average difference (+3.76 feet) was subtracted from the elevation values of all historical wells.

2.1.4 Sampling Equipment Decontamination

Sampling equipment decontamination should not be required if a peristaltic pump with dedicated tubing is used for sampling. However, if a non-dedicated pump such as a down hole centrifugal pump or inertial pump is used, decontamination prior to sampling and between samples will be required. Rinsate water samples will be collected from the sampling equipment.

The down hole pump will be decontaminated by being placed it into a tub containing non-phosphate detergent and deionized water and cycled in the solution for a minimum of 3 minutes. Next the pump will be placed in a tub containing deionized water and cycled for another 3 minutes. The pump will then be placed in a third tub for a third and final deionized water rinse. Used decontamination solutions will be placed with other waste water to await disposal.

2.1.5 Investigation-Derived Wastes

Investigation-derived waste (IDW) will consist of purge/decontamination water and used PPE. Purge/decontamination water will be stored on site in 55-gallon drums. Each storage container will be labeled on its side using weather-proof vinyl stickers, wax markers, or permanent paint markers. The labels will contain the following:

- The statement "Frontier Hard Chrome, Well Water Possibly Containing Chromium, Hold for Analysis."
- Date generated.
- The statement "Contact Larry Vanselow, Weston Solutions, for Information at (206) 521-7692.

A representative composite sample will be collected from the drums and analyzed for TAL metals. If the analytical results show that the water meets the City of Vancouver's criteria for discharge to the sanitary sewer, a permit for disposal will be requested from the city by Weston. If the water does not meet the disposal criteria, the water will be disposed of as appropriate by a disposal contractor. Subsequent disposal by sewer or by contractor will be accomplished by Weston.

If the IDW water from the first sampling event meets the disposal criteria, Weston will request permission to directly discharge water to the sanitary sewer upon generation. A composite sample from the water would be collected and analyzed and analytical results would be provided to the city of Vancouver when available.

Personnel protective equipment and other solid wastes will be grossly cleaned of all soil, bagged and taped, and disposed in a dumpster.

2.1.6 Field Documentation

In addition to individual sample station documentation, all daily field activities will be documented in indelible ink in a bound waterproof logbook or on daily field log forms. At a minimum, the field crew will record the following information in the daily logbook:

- Date and time of entry (24-hour clock).
- Project name and location.
- Project number.
- Time and duration of daily sampling activities.
- Weather conditions.
- Variations, if any, from required sampling protocols and reasons for deviations.
- Name of person making entries and other field personnel.
- On-site visitors, if any.
- General methods of sample collection.
- Cross-reference list for EPA and Weston sample numbers.

2.2 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

2.2.1 Sample Numbers

All samples collected will be assigned a unique sample number from the EPA Regional Sample Control Center, which will be reported to the laboratory for sample tracking purposes. In addition, all samples will be assigned a unique Weston identification code based on a consistent

sample designation scheme that is designed to suit the needs of the field staff, data management and data users. The Weston station code will be reported to the laboratory on the COC for correlation purposes.

All samples will consist of four components separated by a dash. These components are site ID, media code, station code, and sample type. The sample designation scheme is as follows:

Site ID		Media Code		Station Code		Sample Type
SSS	-	MM	-	SSSsss	-	t [ddd]

The four components are described in the following sections.

Site ID

The site ID component is a three-digit code that designates the specific EPA site sample. This is based on the Weston project phase code. The Site ID code assigned to this investigation is FHC for Frontier Hard Chrome.

Media Code

The media code is a two-character code that defines the media type of the sample. The media codes designated for this project are as follows:

GW — Groundwater
WT — Water, other (e.g., rinsate blank)

Station Code

The station code component is a six-character code that uniquely identifies each sampling station. The station code component has two parts: a two or three letter station designation XX indicating the area where the sample was collected followed by a three or four number sequential component (i.e., INJ1, 16A). The station codes designated for this project are as follows:

MW— Monitoring Well
IW — Injection Well

Sample Type

The sample type component has two parts: a sample type field “t” and a sample depth field “ddd”. The single character “t” indicates a sample type having one of the following two values:

0### — Field sample
1### — Duplicate sample
4### — Equipment Rinsate Blank

and a three-character field to indicate depth in tenths of feet to the top of the sample:

#000 — 0 foot (surface)

#050 — 5 feet
#125 — 12.5 feet

Sample depth determinations will be made to the nearest 0.5-foot.

Examples

Examples of complete sample numbers with descriptions are as follows:

FHC-GW-MWINJ1-0275:	A field groundwater sample collected from monitoring well INJ-1 at a depth of 27.5 feet bgs.
FHC-GW-W8502B-0300:	A field groundwater sample collected from monitoring well W85-2B at a depth of 30.0 feet bgs.
FHC-WT-W8502B-4300	A rinsate blank sample from non-dedicated equipment used to collect sample FHC-GW-W8502B-0300.

2.2.2 Sample Labeling

Sample containers will be labeled and covered with clear tape prior to sampling or labeled immediately after material is placed in the sample container. Labels will be produced using Forms II Lite software. Each label will follow Region 10 format and will include the following information:

- EPA Region Number.
- Project Number and Case Number.
- CLP sample number and Station Location.
- Analysis and Preservative.
- Sampling Date and Time.
- Samplers Name.
- Regional Sample Number.
- Lab Assigned.

2.2.3 Sample Containers, Preservation, and Holding Times

Samples will be preserved as described in specific analytical procedures presented in the EPA CLP statements of work for inorganic analyses, or the individual analytical methods. Sample preservation, holding time, and container requirements vary according to analyte, sample matrix, and hazard classification. It is anticipated that all samples collected will be low hazard. Table 5 includes the type and number of sample containers and preservation and holding time requirements specific to the groundwater analyses to be performed.

2.2.4 Sample Custody

The purpose of custody procedures is to provide a documented, legally defensible record that can be used to follow the possession and handling of a sample from collection through analysis. A sample is in custody if it meets at least one of the following conditions: it is in someone's

physical possession or view; it is secured to prevent tampering; or, it is secured in an area restricted to authorized personnel.

Sample control and chain-of-custody procedures in the field and during shipment will be performed in accordance with the procedures in the *Contract Laboratory Program (CLP) Guidance for Field Samplers* (EPA 2001). A chain-of-custody (COC) record will be completed for each container of samples (i.e., cooler) using Forms II Lite software. The COC will be completed during the course of the daily sampling activities or at the end of each day of sampling. Custody seals will be placed on each sample cooler in such a manner that the cooler cannot be opened without breaking the custody seals. The completed chain-of-custody forms will be delivered to the recipient laboratory with the respective samples.

The QA officer at each laboratory will ensure that the cooler custody seals are unbroken and that the chain-of-custody records are properly transferred to the laboratory upon receipt of the samples. Any questions or observations concerning sample integrity should also be noted.

2.2.5 Sample Packaging and Shipment Requirements

Packaging, marking, labeling, and shipping of samples will comply with all applicable regulations promulgated by the U.S. Department of Transportation (DOT) in the Code of Federal Regulations (49 CFR 171-177) or International Air Transport Association (IATA) regulations, as applicable.

In accordance with the above regulations and guidance, packaging and shipping of samples will be done in a manner that protects both sample integrity and the shipment handlers from the possible hazardous nature of samples. Individual sample containers will be placed in re-sealable plastic bags. These individual packages will then be placed in polyethylene liner bags in an appropriate shipping container. Double-bagged ice will be placed on top of the samples. Chain-of-custody forms and any other pertinent sample documentation information will be placed in a re-sealable plastic bag and taped to the inside cover of the cooler; custody seals will then be affixed to the cooler. All samples will be shipped overnight by express air service or, delivered by a courier or field sampling personnel. In the event that samples cannot be shipped or delivered until the following business day, the packaged samples will be held overnight under custody at a facility with restricted entry (authorized personnel only).

All samples will be shipped to the laboratory within 24-hours of sample collection. Samples will be shipped by commercial airlines for express delivery, if required.

2.2.6 Cooler Return

For laboratories other than the EPA MEL, the ESAT field sampling team will provide a completed air bill with a return shipping address so the laboratory can return the coolers to ESAT. The air bills will be marked for economy service (second day or ground).

2.2.7 Laboratory/RSCC Coordination

Sample shipments, data packages, data validation, and document control are all part of sample management. All scheduling for sample containers, analytical work, and data dispersal will be arranged in close consultation with the laboratory. The following steps will require close interface:

- Reviewing the number of samples to be submitted for analysis.
- Reviewing the analytical requirements, bottles needed, blank requirements, and volumes required for sample analysis.
- Coordinating special analytical requirements with the laboratory QA manager.
- Determining the approximate dates sampling will occur and informing the laboratory.
- Scheduling sample container shipments.
- Informing the laboratory of the need for analytical results in both hardcopy and diskette formats.

Laboratory assignment, scheduling, and oversight will be conducted through EPA's regional sample control coordinator (RSCC). The RSCC will be notified by telephone each time a sample shipment to the laboratory is made.

2.3 ANALYTICAL METHODS REQUIREMENTS

Analyses of samples collected during the field event will be performed by the EPA Region 10 MEL or a CLP laboratory designated by the EPA unless issues arise regarding capability or capacity. In this case, analyses may be conducted by a commercial laboratory under subcontract to Weston. The analyses to be applied to samples sent to the laboratories are listed in Table 5. These analyses were selected based on the specifications in this monitoring plan.

EPA and/or CLP laboratory analyses will take place under the standard three-week turnaround time period. Weston-subcontracted laboratory analyses will take place under the standard four-week turnaround time period. Table 1 summarizes laboratory instrumentation and methods to be used for the studies.

2.4 QUALITY CONTROL REQUIREMENTS

QC checks for sample collection will be accomplished by a combination of Chain-of-Custody protocols and laboratory quality assurance as prescribed in the sampling or analytical methods. No QC samples (i.e., double blind performance evaluation samples) are planned for this activity outside of normal laboratory QC criteria outlined in the analytical methods. These QC measures include ambient, rinsate, trip, and method blanks, matrix, surrogate, and internal standards spikes recovery, serial dilution analysis, interference check sample analysis, and calibration check sample recovery.

All of the laboratory analyses that will be performed for this project will produce definitive data. The laboratories' DQOs for completeness and the field team's ability to meet the DQO for representativeness are set at 90% for data generated from this study. Precision and accuracy requirements are outlined in Table 1.

2.5 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

The field equipment used during this project includes water quality meters to measure temperature, pH, dissolved oxygen, conductivity, turbidity, and ORP in groundwater samples, and a water level measuring tape. Testing, inspection, and maintenance of these instruments will be performed in accordance with the manufacturer's recommendations and/or the SOPs provided in Appendix B. Spare parts for the field equipment will be available from the manufacturer generally within 24 hours.

All field instruments and equipment used for analysis will be serviced and maintained only by qualified personnel. All instruments will be maintained by senior staff and/or electronics technicians. All repairs, adjustments, and calibrations will be documented in an appropriate logbook or data sheet that will be kept on file. The instrument maintenance logbooks will clearly document the date, the description of the problems, the corrective action taken, the result, and who performed the work.

All equipment used in the field is subject to standard preventive maintenance schedules established by equipment manufacturer protocols. When in use, equipment will be inspected at least twice daily, once before startup in the morning and again at the end of the work shift before overnight storage or return to the charging rack. Regular maintenance is to be conducted according to manufacturer's recommendations and in the field as needed, whichever is appropriate. Routine maintenance typically includes daily calibration, replacement of batteries as needed, and replacement of oxygen sensor membrane (dissolved oxygen meter) as needed. All performed preventive maintenance will be entered in the individual equipment's logbook and in the site field logbook.

In addition to preventive maintenance procedures, daily calibration checks will be performed at least once daily before use and recorded in the respective logbooks. Additional calibration checks will be performed as required. All logbooks will become part of either the permanent site file or the permanent equipment file.

2.6 INSTRUMENT CALIBRATION AND FREQUENCY

All instruments and equipment used during fixed laboratory sample analyses will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodology references and/or in accordance with the laboratory's Quality Assurance Manual and SOPs.

No calibration is required for the water level measuring tape. For the water quality meters, the calibration will be performed in accordance with the manufacturer's recommendations and the SOPs provided in Appendix B.

2.7 INSPECTION/ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

This information is covered by the SOPs and the QMP (Weston 2003a). Standards contained in these documents will be used to ensure the validity of data generated by Weston for this project. Sample jars are pre-cleaned by the manufacturer; certification documenting this is enclosed with each box of jars. Weston will include this documentation as part of the project file. Non-dedicated equipment is demonstrated to be uncontaminated by the use of rinsate blanks.

2.8 DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

No data will be used from other sources.

2.9 DATA MANAGEMENT

2.9.1 Data Receipt and Storage

Respective hardcopy and electronic results from the EPA and/or CLP laboratories will be reviewed by EPA and then delivered to Weston upon completion of each sample delivery group. Hardcopy and electronic data results from the subcontracted commercial laboratory will be delivered to Weston upon completion of each sample delivery group. A full documentation data deliverable (raw and final data) will be submitted by the subcontract commercial laboratory; data review and validation will be performed as described in Section 4.1. Data tracking, storage, and retrieval are tracked through the TDD "blue sheet," which records where the paper and electronic data are located. All paper data are stored in locked file cabinets; access to these files is restricted to key Weston personnel. Electronic data are archived by Weston work order number.

Electronic data deliverables will be submitted to EPA periodically, and at the end of the project.

2.9.2 Database Development and Results Reporting

Weston will use Microsoft Access software and the following procedures to compile and manage the chemical analysis data. The major data items captured to create a complete chemical analytical dataset are as follow:

- Station Identifier.
- Sample Identifier.
- Sample Description (Primary, Field, Duplicate, Replicate…).
- Sample Date.

- Full name of analytical parameter, observation or compound analyzed.
- CAS number when available or appropriate.
- Analytical result concentration value.
- Data validation qualifier.
- Units.
- Analytical method reference.
- Sample Media.
- Sample Media modifier.

The process of entering sample analytical data into a data management system is called analytical data loading. There are two primary strategies for loading analytical data; automated loading of Electronic Data Deliverables (EDDs), and direct hand entry from paper results. In general, EDDs are created by analytical laboratories and delivered with hard-copy (paper) results as a standard part of sample analysis.

Data management procedures will accommodate manual data validation, or for loading data on data sets that have been validated before they are delivered to Weston. In the case of Weston-validated data, no automated tools are needed to effect data validation changes, and an audit will lead to hard-copy laboratory results with validation changes noted and signed by qualified staff.

Before data entry, a hard-copy form of the data will be generated if not provided. Large volumes of source data are divided into manageable data entry groups. Each data entry group is supplied with a standard coversheet and assigned a sequential, unique data entry group ID. The data entry group ID serves as the basis for filing all data groups, and as the means of quickly tracking any data point to the data entry group from which it came.

The Environmental Data Management System (EDMS) will be used to capture and build a complete sample analysis dataset that matches source materials *exactly*. This dataset is complete when all inventoried sample analysis information has been received and entered, or if missing, has been properly accounted for. This complete dataset is called the *primary dataset*.

As it is the function of the primary dataset to represent source materials exactly, and is not appropriate for analysis, the primary dataset is maintained without modification. All post-processing is performed on copies of the primary dataset using a post-processing module. A copy of the primary dataset made for data analysis purposes is called an *analytical dataset*.

Several post-processing procedures are available. The major steps are to:

- Standardize reporting units.
- Reassign analytical groups as necessary.
- Detect and manage co-located data points.
- Perform data comparisons to reference values.

The analytical dataset is complete once all appropriate post-processing steps are completed. The completed analytical dataset is used for all data analysis and for exporting to external analysis software such as GIS.

Data analysis will be performed exclusively on the post-processed analytical dataset. Statistical software will be used to define data analysis queries by selecting a sample and analysis selection set, and determining the statistical and data listing parameters to be applied to the data. Predefined queries may be executed individually or in batches. Once queries have been executed, additional batch processing software is used to generate report-quality data listings and statistical summaries. These data listings and statistical summaries are used to create the analytical results presentations provided in the project's final reports.

SECTION 3

ASSESSMENT/OVERSIGHT

3.1 ASSESSMENTS AND RESPONSE ACTIONS

The Weston QA Officer or designee may conduct an audit of the field activities for this project. The auditor will have the authority to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data. The Weston PM will have the responsibility for initiating and implementing response actions associated with findings identified during the site audit. Once the response actions have been implemented, the Weston QA Officer or designee may perform a follow-up audit to verify and document that the response actions were implemented effectively. In-house audits performed by Weston may be conducted in accordance with the QMP (Weston 2003a). No audits are planned for the Frontier Hard Chrome Remediation Action project.

If major deviations from the QA requirements of the project are observed during the data validation process, Weston may contact the laboratory to correct the problem. If the laboratory will not be responsive to the request, Weston will inform the EPA PM of the situation. A brief narrative will be written explaining the analytical deviations and recommendations will be given based on the quality of the submitted data.

3.2 REPORTS TO MANAGEMENT

Debriefing of the EPA PM occurs by the Weston PM on an "as-needed" basis. Standard laboratory deliverables will be as specified in the laboratory statements of work for CLP and/or MEL data, as specified in the laboratory subcontract bid specification package for commercial laboratory analyses, and as specified in the Environmental Services Assistance Team (ESAT) contract for on-site analyses.

Once the periodic sampling is complete and the resulting data is obtained, the Weston PM will assist in preparation of a periodic project report. The report will include a summary of the activities performed during the period and the resulting data (along with any statements concerning data quality). The report will be approved by the EPA PM prior to forwarding to the individuals identified in the distribution list located in the Table of Contents section of this document.

A yearly summary report (including sample results, QA information and figures) and an addendum to the Long Term Monitoring Plan will be prepared in the month of February following the previous year's periodic sampling. The addendum will list the current year's wells to be sampled and suggested analytes (based on the previous year's results), as well as specify any other desired changes to the Long Term Monitoring Plan.

Weston's corrective action program is addressed in Section 3 of the QMP. Corrective actions will be conducted in accordance with these QMP specifications.

SECTION 4

DATA VALIDATION AND VERIFICATION

The data validation review of data deliverables will include an evaluation of: the information provided on the analytical data sheets and required support documentation for all sample analyses; the supporting sample collection documentation, including chain-of-custody; and field instrument calibration, results, and/or performance check documentation (if required by the method). This QA review will also examine adherence to the procedures as described in the cited SOPs and the specified analytical methods in the QAPP.

4.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

Analytical data generated through the CLP contract or by MEL for the remedial action will reviewed by EPA then validated by Weston (as required). Weston will review and validate data generated by the subcontract laboratory. The data validations will be performed on a two-week turn around time that starts upon receipt of the data deliverable from EPA or the subcontract laboratory.

4.2 VALIDATION AND VERIFICATION METHODS

All of the data validations will be performed in accordance with the QA/QC requirements specified in the QAPP, the technical specifications of the analytical methods and the

- EPA CLP National Functional Guidelines for Inorganic Data Review (EPA 1994b).

Validation deliverables will include a QA memo discussing QA conformance and deviations issues that may have affected the quality of the data. Data usability and the bases of application of qualifiers will also be discussed in the QA memo. Forms I (Analysis Data Sheet) with the applied validation qualifiers for estimated-qualified values also will be a part of the validation deliverables. The following qualifiers shall be used in the data validation:

U — The compound was analyzed for, but not detected.

UJ — The compound was analyzed for, but was not detected; the associated quantitation limit is an estimate because quality control criteria were not met.

J — The analyte was positively identified, but the associated numerical values is an estimate quantity because quality control criteria were not met or because concentrations reported are less than the quantitation limit or lowest calibration standard.

R — Quality control indicates that data are unusable (compound may or may not be present). Re-sampling and reanalysis are necessary for verification.

4.3 RECONCILIATION WITH USER REQUIREMENTS

The data quality indicators' targets for this project are discussed in Section 1.5 of this QAPP. The data validation will be used as a tool to determine whether these targets were met. Also, using the compiled data, the Weston QA Officer will determine variability and soundness of the data and the data gaps that will need to be filled to meet the data quality objectives of the project.

SECTION 5

REFERENCES

EPA (United States Environmental Protection Agency). 2003. Statement Of Work For Remedial Action. Chemical Stabilization of Chrome in Soils and Groundwater. Frontier Hard Chrome, Vancouver, WA. February 7th, 2003.

EPA. 2001. Contract Laboratory Program (CLP), Guidance for Field Samplers, Draft Final. OSWER 9240.0-35, EPA540-R-00-003. June.

EPA. 1998. Guidance for Quality Assurance Project Plans QA/G5, 600/R-98/018.

EPA. 1994a. Guidance for the Data Quality Objectives Process, EPA QA/G-4, EPA/600/R-96/055.

EPA. 1994b. Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review, 540/R-94/013.

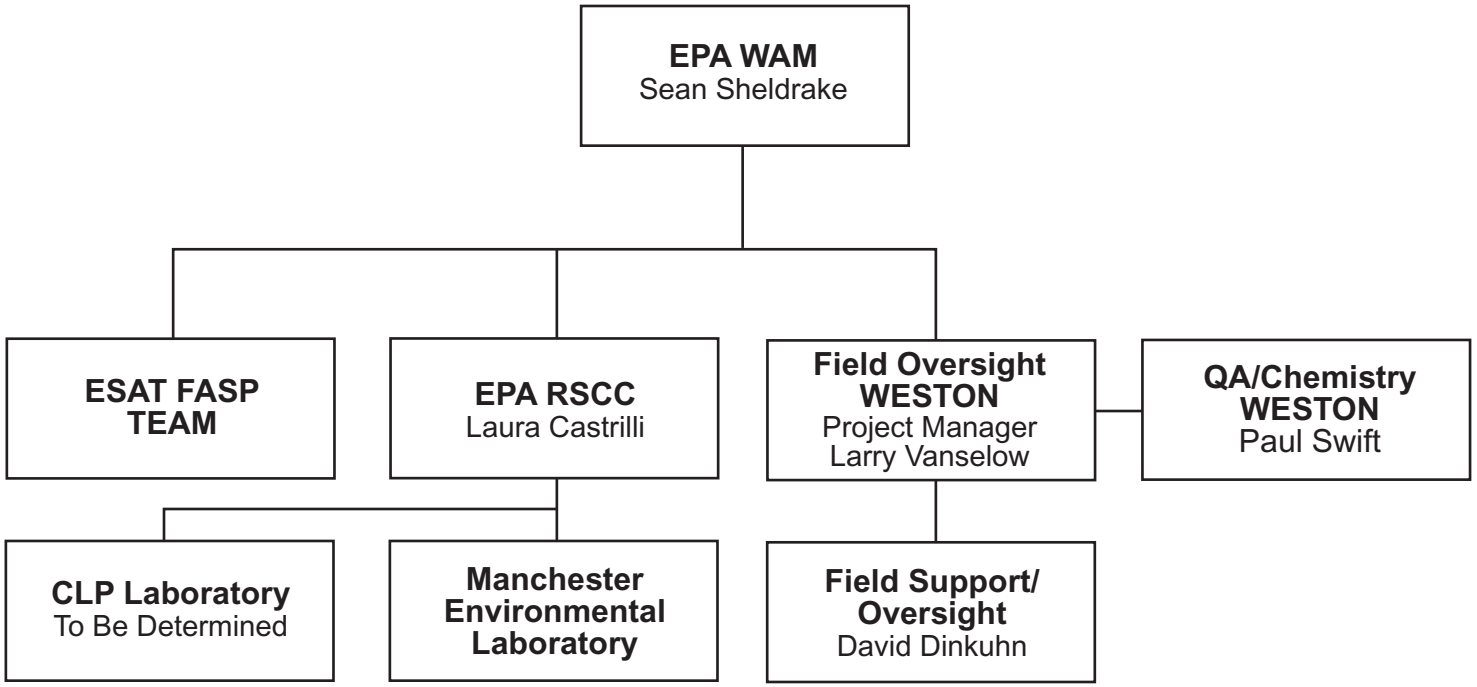
EPA. 1993. Data Quality Objectives Process for Superfund, Interim Final Guidance, EPA/540/R-93/071.

Weston (Weston Solutions, Inc.). 2003a. Corporate Quality Management Plan, West Chester, Pennsylvania, rev 1.

Weston. 2003b. Frontier Hard Chrome, Remedial Action Report. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington. December.

Weston. 2003c. Frontier Hard Chrome, Institutional Control Plan. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, Washington. December.

FIGURES



Frontier Hard Chrome
Vancouver, Washington
Project Organization

Figure
1

03-0383 Fig1.ai

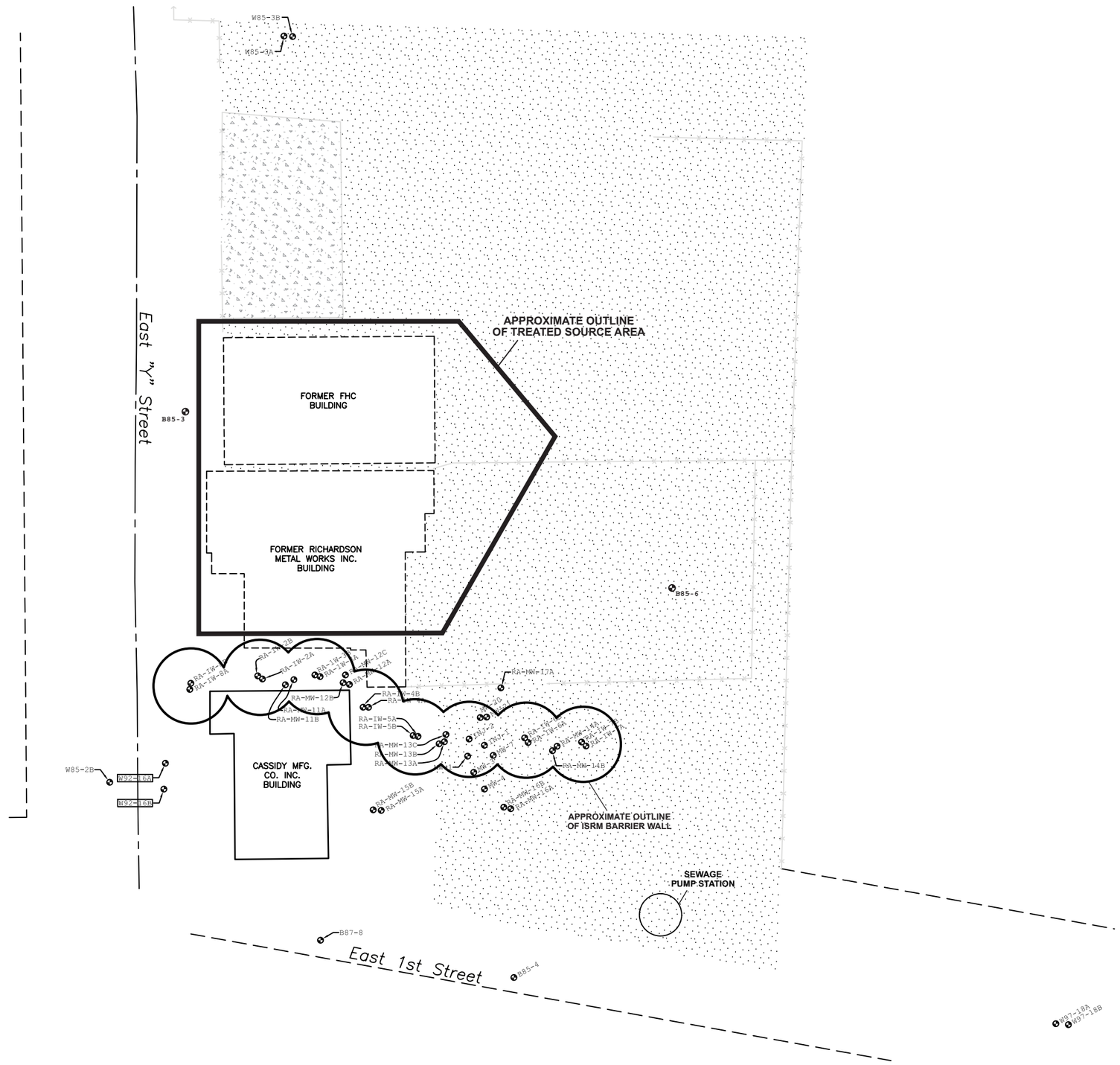
Source: USGS 7.5' Series Topo Map of Vancouver, WA (1990) and Portland, OR (1990).

Frontier Hard Chrome
Vancouver, Washington
Vicinity Map

Figure
2

WESTON SOLUTIONS

03-0383 Fig2.ai



LEGEND

- W85-2B — Monitoring Well Location and ID
- Gravel
- Concrete

N

0 30 60

Scale in Feet

Frontier Hard Chrome
Vancouver, Washington
Site Features and
Monitoring Well Locations

Figure
3

WESTON SOLUTIONS

03-0383 Fig3.ai

LEGEND

W85-5B — Monitoring Well Location and ID

– – – – Fence

0 150 300

N

Scale in Feet

Frontier Hard Chrome
Vancouver, Washington
Monitoring Well Locations

Figure
4

WESTON SOLUTIONS

03-0383 Fig4.ai

LEGEND

W85-5B — Monitoring Well Location and ID

– – – – Fence

Elevation Datum:
City of Vancouver benchmark number 108 at East Fifth and East Reserve Street on the North curb on Grand Boulevard in curb centerline South using 53.756 feet. The source of this was page 5 of the "Official Benchmarks City of Vancouver Washington 1929 N.G.V.D. Datum" book, revised on January 31, 1997.

WELL BY WELL NAME

Well No.	Northing	Easting	Case El.	Mon. El.
B85-3	NA	NA	24.90	25.60**
B85-4	112324.18	1091631.89	25.38	26.18
B85-6	NA	NA	24.64	25.20**
B87-8	112344.00	1091529.10	25.95	26.21
INJ-1	112447.61	1091616.21	25.94	26.11
INJ-2	112450.91	1091608.07	25.79	26.01
MW-1	112441.82	1091607.30	25.69	26.00
MW-10	112414.65	1091603.09	25.65	25.88
MW-20	112462.35	1091613.99	25.75	26.09
MW-21	112462.58	1091617.43	25.77	26.14
MW-3	112433.24	1091610.54	25.69	26.04
MW-4	112424.34	1091616.25	25.62	25.84
MW-7	112442.22	1091620.89	25.66	25.93
RA-IW-2A	112482.82	1091498.21	26.36	26.60
RA-IW-2B	112484.49	1091495.75	26.49	26.73
RA-IW-3A	112484.11	1091528.87	26.09	26.58
RA-IW-3B	112484.97	1091526.11	26.00	26.57
RA-IW-4A	112467.78	1091554.62	25.76	26.40
RA-IW-4B	112467.82	1091551.73	25.97	26.35
RA-IW-5A	112452.33	1091580.90	25.68	26.09
RA-IW-5B	112452.78	1091578.33	25.72	26.11
RA-IW-6A	112449.10	1091639.46	25.22	25.57
RA-IW-6B	112451.53	1091637.59	25.32	25.70
RA-IW-7A	112447.22	1091670.20	24.75	25.21
RA-IW-7B	112449.32	1091667.86	24.72	25.28
RA-IW-8A	112477.29	1091459.63	25.50	25.90
RA-IW-8B	112480.54	1091460.17	25.52	25.82
RA-MW-11A	112482.47	1091514.95	26.17	26.45
RA-MW-11B	112479.76	1091510.42	26.17	26.45
RA-MW-12A	112479.92	1091544.46	26.17	26.47
RA-MW-12B	112480.85	1091541.13	26.16	26.53
RA-MW-12C	112484.97	1091542.35	26.01	26.48
RA-MW-13A	112449.48	1091594.97	25.69	25.96
RA-MW-13B	112448.39	1091592.13	25.61	25.86
RA-MW-13C	112453.33	1091595.76	25.55	25.97
RA-MW-14A	112447.10	1091654.85	25.06	25.44
RA-MW-14B	112444.72	1091652.41	25.00	25.38
RA-MW-15A	112412.99	1091561.36	25.76	26.11
RA-MW-15B	112413.29	1091557.10	25.79	26.10
RA-MW-16A	112413.87	1091630.20	25.14	25.47
RA-MW-16B	112414.70	1091626.50	25.45	25.68
RA-MW-17A	112478.04	1091624.86	25.96	26.23
W85-2B	112427.94	1091417.06	25.77	26.09
W85-3A	112824.50	1091509.69	26.40	26.97
W85-3B	112824.23	1091514.26	26.77	27.14
W85-6A	NA	NA	25.38	25.80**
W85-6B	NA	NA	25.24	25.80**
W85-7A	NA	NA	22.83	23.10**
W85-7B	NA	NA	23.00	23.10**
W86-10B	NA	NA	26.80	26.60**
W86-13A	NA	NA	26.39	26.70**
W92-16A	112438.05	1091446.66	25.62	25.98
W92-16B	112424.30	1091445.85	25.51	25.87
W97-18A	112299.62	1091919.98	25.44	25.72
W97-18B	112299.13	1091926.64	25.36	25.73
W97-19A	NA	NA	22.45*	22.99*
W97-19B	NA	NA	21.72*	22.56*
W98-20A	NA	NA	23.57*	23.87*
W98-21A	NA	NA	25.28*	25.50*
W98-21B	NA	NA	25.50*	25.77*
W99-R5A	NA	NA	32.26	32.66
W99-R5B	NA	NA	32.33	32.67

* Well Elevation Corrected to Common Datum. See section 2.1.3 of Long-Term Monitoring Plan.

** Ground Surface Elevation.

0 150 300

Scale in Feet

Frontier Hard Chrome
Vancouver, Washington
Monitoring Well Locations

Figure
5

WESTON SOLUTIONS

03-0367 Fig5.ai

TABLES

Table 1—QA/QC Analytical Summary and Fixed Laboratory Analytical Methods
Frontier Hard Chrome, Vancouver, Washington – YR 2004

Laboratory	Task	Parameters/ Method	Method Description/ Detection Limits	Total Samples/ Containers Per Sampling Event[a]	QA/QC Sample Summary Analyses/Containers			Total Field and QA/QC Analyses/ Containers per Sampling Event[c]	Precision and Accuracy
					Field Duplicates	MS/MSD or MS/Duplicates[b]	Rinsate Blanks		
Field Analysis	Groundwater Monitoring	pH, ORP, temp, conductivity and dissolved oxygen/field instruments	Per SOP	33/33 (see Table 3)	NA	NA	NA	33/33	Per SOP/QAPP
		Dissolved hexavalent chromium/ Hach test kit #12710	Colorimetric / 0.05 mg/L	33/33 (see Table 3)	2/2	NA	NA	35/35	NA
EPA Regional Lab, or CLP Lab	Groundwater Monitoring	Total TAL metals[d] (less mercury)/ ILM05.2 or 6010B	ICP-AES and MD / CRQL	33/33 (see Table 3)	2/2	2/2	1/1	38/38	75% - 125% ± 20%
		Chlorinated Solvents / ILM04.2 or EPA 8260B	GC-MD / CRQL	9/9 (see Table 3)	1/1	1/6	1/3	12/19	75% - 125% ± 20% or CLP
		Sulfate / 300.0 (EPA Regional Lab)	IC-Cond / 0.5 mg/L	9/9 (see Table 3)	1/1	1/0	1/1	12/11	80% - 120% ± 20%
Commercial Lab		Total Sulfur / EPA 6010B	ICP-AES / 1 mg/L	9/9 (see Table 3)	1/1	1/0	1/1	12/11	75% - 125% ± 20%

Notes:

[a] Total number of field samples are estimated.

[b] For water sample matrix spike/matrix spike duplicates (MS/MSD), double volume is required for inorganic analyses. Sample numbers are based on 1 QC pair per 20 samples per matrix.

[c] Total analyses and containers includes both field and QA/QC aliquots to be submitted for fixed laboratory analysis.

[d] In cases where excess turbidity (>10 NTU) is present, dissolved samples will also be collected.

AES: Atomic emission spectroscopy
CLP: Contract Laboratory Program
CRQL: Contract-Required Quantitation Limit
GC-MD: Gas Chromatography- Mass Detection
IC-Cond: Ion Chromatography – Conductivity detection
ICP: Inductively Coupled Plasma
MS/MSD: Matrix Spike/Matrix Spike Duplicate
NA: Not Applicable
ORP: Oxidation-Reduction Potential
QA/QC: Quality Assurance/Quality Control
TAL: Target Analyte List

Analyte	CRQL (ug/L)	Analyte	CRQL (ug/L)	Analyte	CRQL (ug/L)
Aluminum	*200*	*Iron*	*100*	*Thallium*	10
Antimony	*60*	*Lead*	*3*	*Vanadium*	50
Arsenic	*10*	*Magnesium*	*5000*	*Zinc*	20
Barium	*200*	*Manganese*	*15*	*Cyanide*	10
Beryllium	*5*	*Mercury*	*0.2*		
Cadmium	*5*	*Nickel*	*40*		
Calcium	*5000*	*Potassium*	*5000*		
Chromium	*10*	*Selenium*	*5*		
Cobalt	*50*	*Silver*	*10*		
Copper	*25*	*Sodium*	*5000*		

Table 2 – Property Access Information
Frontier Hard Chrome, Vancouver, Washington

Well Number (s)[1]	Property Owner and Contact Information
RA-IW-4A, RA-IW-4B, RA-IW-5A, RA-IW-5B, RA-MW-15A, RA-MW-15B	Cassidy Manufacturing, Inc. Ken Sissons, Manager (360) 693-3404
RA-IW-2A, RA-IW-2B, RA-IW-3A, RA-IW-3B, RA-IW-6A, RA-IW-6B, RA-IW-7A, RA-IW-7B, RA-IW-8A, RA-IW-8B, RA-MW-11A, RA-MW-11B, RA-MW-12A, RA-MW-12B, RA-MW-12C, RA-MW-13A, RA-MW-13B, RA-MW-13C, RA-ME-14A, RA-MW-14B, RA-MW-16A, RA-MW-16B, RA-MW-17A, INJ-1, INJ-2, MW-1, MW-3, MW-4, MW-7, MW-20, MW-21	Kelly Group, Inc. Mark Charbennaou, Vice President (360) 737-6790
W85-3A, W85-3B	American Freight Systems Darwin Rutland, Vice President (360) 993-2378
W97-19A, W97-19B, W98-20A	Peter Kiewit Construction Tim Moe, Facilities Manager (360) 693-1478
W85-7A, W85-7B	Ferguson, a Wolseley Company Linda Cherney, Branch Manager (360) 694-5535
W85-6A, W85-6B, W98-21A, W98-21B	The Columbian Carol Starbuck, Facilities Manager David Haas, Facilities Technician (360) 699-6008
W99-R5A, W99-R5B	North Wind at Columbia Shores, Main Office

Notes:

[1]: Wells located in street right-of-ways are not listed.

Table 3 – YR 2004 Schedule (first year[1]) of Well/Analyses by Sampling Event
Frontier Hard Chrome, Vancouver, Washington

Well Number	Event 1 February 2004			Event 2 April 2004			Event 3 August 2004			Event 4 December 2004		
	Cr (VI) + Metals[2]	$S\&SO_4^=$	Water Level	Cr (VI) + Metals[2]	$S\&SO_4^=$	Water Level	Metals[2]	Chlorinated Solvents $S\&SO_4^=$	Water Level	Metals[2]	$S\&SO_4^=$	Water Level
Operational/Functional Monitoring Wells												
RA-IW-8A								X				
RA-MW-11A	X	X		X	X		X	X		X	X	
RA-MW-11B	X			X			X			X		
RA-MW-12A	X			X			X			X		
RA-MW-12B	X			X			X			X		
RA-MW-12C	X			X			X			X		
RA-MW-13A	X	X		X	X		X	X		X	X	
RA-MW-13B	X			X			X			X		
RA-MW-13C	X			X			X			X		
RA-MW-14A	X	X		X	X		X	X		X	X	
RA-MW-14B	X			X			X			X		
RA-MW-15A	X			X			X			X		
RA-MW-15B	X			X			X			X		
RA-MW-16A	X			X			X			X		
RA-MW-16B	X			X			X			X		
RA-MW-17A	X			X			X			X		
W92-16A	X		X	X		X	X		X	X		X
W92-16B	X		X	X		X	X		X	X		X
Long-Term Monitoring Wells												
B85-4	X	X	X	X	X	X	X	X	X	X	X	X
B87-8	X	X	X	X	X	X	X	X	X	X	X	X

Table 3 – YR 2004 Schedule (first year[1]) of Well/Analyses by Sampling Event
Frontier Hard Chrome, Vancouver, Washington

Well Number	Event 1 February 2004			Event 2 April 2004			Event 3 August 2004			Event 4 December 2004		
	Cr (VI) + Metals[2]	$S\&SO_4^=$	Water Level	Cr (VI) + Metals[2]	$S\&SO_4^=$	Water Level	Metals[2]	Chlorinated Solvents $S\&SO_4^=$	Water Level	Metals[2]	$S\&SO_4^=$	Water Level
Long-Term Monitoring Wells												
W85-3A			X			X			X			X
W85-3B			X			X			X			X
W85-6A	X	X	X	X	X	X	X	X	X	X	X	X
W85-6B	X		X	X		X	X		X	X		X
W85-7A	X	X	X	X	X	X	X	X	X	X	X	X
W85-7B	X		X	X		X	X		X	X		X
B85-3	X		X	X		X	X		X	X		X
W97-18A	X		X	X		X	X		X	X		X
W97-18B	X		X	X		X	X		X	X		X
W97-19A	X		X	X		X	X		X	X		X
W97-19B	X		X	X		X	X		X	X		X
W98-20A	X		X	X		X	X		X	X		X
W98-21A	X		X	X		X	X		X	X		X
W98-21B	X		X	X		X	X		X	X		X
W99-R5A	X	X	X	X	X	X	X	X	X	X	X	X
W99-R5B	X		X	X		X	X		X	X		X
Total Wells	**33**	**8**	**20**	**33**	**8**	**20**	**33**	**9**	**20**	**33**	**8**	**20**

Notes:

1: First years (2004) schedule shown. Subsequent years schedule covering 8 sampling events in 4 years will be provided in a yearly addendum.

2: Analyze for total target analytes list (TAL) metals; dissolved TAL metals analysis will also be required if sample turbidity is > 10 NTU. Conventional field parameters to be measured in all wells sampled.

Table 4—Well Construction Information
Frontier Hard Chrome, Vancouver, Washington

Well No.	Well Dia. (in)	Well Depth (feet)	Top of Screen Depth (ft)	Bottom of Screen Depth (ft)	Screen Length (ft)	Date Installed	Northing	Easting	Casing Elev. (feet)*	Top of Monument Elev. (feet)*
Injection Wells										
INJ-1	6	35.5	20.5	34.9	14.4	5/20/02	112447.61	1091616.21	25.94	26.11
INJ-2	6	27.7	22.8	27.2	4.4	8/29/02	112450.91	1091608.07	25.79	26.01
RA-IW-2A	6	28.2	23.4	27.4	4.0	4/23/03	112482.82	1091498.21	26.36	26.60
RA-IW-2B	6	33.7	28.3	32.7	4.4	4/22/03	112484.49	1091495.75	26.49	26.73
RA-IW-3A	6	28.1	23.3	27.3	4.0	4/23/03	112484.11	1091528.87	26.09	26.58
RA-IW-3B	6	33.7	28.3	32.7	4.4	4/22/03	112484.97	1091526.11	26.00	26.57
RA-IW-4A	6	27.5	22.6	27.0	4.4	6/25/03	112467.78	1091554.62	25.76	26.40
RA-IW-4B	6	33.7	28.3	32.7	4.4	6/24/03	112467.82	1091551.73	25.97	26.35
RA-IW-5A	6	28.1	23.2	27.6	4.4	6/26/03	112452.33	1091580.90	25.68	26.09
RA-IW-5B	6	33.3	27.9	32.3	4.4	6/25/03	112452.78	1091578.33	25.72	26.11
RA-IW-6A	6	25.9	21.0	25.4	4.4	6/27/03	112449.10	1091639.46	25.22	25.57
RA-IW-6B	6	31.6	25.2	29.6	4.4	6/27/03	112451.53	1091637.59	25.32	25.70
RA-IW-7A	6	24.9	19.9	24.3	4.4	6/28/03	112447.22	1091670.20	24.75	25.21
RA-IW-7B	6	30.1	24.7	29.1	4.4	6/28/03	112449.32	1091667.86	24.72	25.28
RA-IW-8A	6	28.1	23.1	27.5	4.4	6/30/03	112477.29	1091459.63	25.50	25.90
RA-IW-8B	6	33.7	28.3	32.7	4.4	6/29/03	112480.54	1091460.17	25.52	25.82
Monitoring Wells										
B85-3	2	29.5	24	29	5	10/7/85	112605.90	1091462.16	24.9	25.6^{+}
B85-4	2	26.5	21.5	26.5	5	10/10/85	112324.18	1091631.89	25.38	26.18
B85-6	2	29.5	24.5	29.5	5	10/15/85	112532.34	1091705.95	24.64	25.2^{+}
B87-8	4	29.5	24.5	29.5	5	1/13/87	112344.00	1091529.10	25.95	26.21
MW-1	2	34.5	19.2	34.0	14.8	5/21/02	112441.82	1091607.30	25.69	26.00

Table 4—Well Construction Information
Frontier Hard Chrome, Vancouver, Washington

Well No.	Well Dia. (in)	Well Depth (feet)	Top of Screen Depth (ft)	Bottom of Screen Depth (ft)	Screen Length (ft)	Date Installed	Northing	Easting	Casing Elev. (feet)*	Top of Monument Elev. (feet)*
MW-3	2	37.3	21.7	36.5	14.8	5/20/02	112433.24	1091610.54	25.69	26.04
MW-4	2	35.2	19.7	34.5	14.8	5/22/02	112424.34	1091616.25	25.62	25.84
MW-7	2	47.2	41.6	46.4	4.8	5/20/02	112442.22	1091620.89	25.66	25.93
MW-20	2	27.3	21.9	26.6	4.7	5/22/02	112462.35	1091613.99	25.75	26.09
MW-21	2	35.6	30.4	35.1	4.7	5/22/02	112462.58	1091617.43	25.77	26.14
RA-MW-11A	2	27.8	22.9	27.6	4.7	5/2/03	112482.47	1091514.95	26.17	26.45
RA-MW-11B	2	33.1	28.3	32.9	4.6	5/1/03	112479.76	1091510.42	26.17	26.45
RA-MW-12A	2	28.1	23.2	27.9	4.7	5/1/03	112479.92	1091544.46	26.17	26.47
RA-MW-12B	2	33.0	28.3	32.8	4.5	5/1/03	112480.85	1091541.13	26.16	26.53
RA-MW-12C	2	39.2	34.5	39.0	4.5	4/30/03	112484.97	1091542.35	26.01	26.48
RA-MW-13A	2	27.3	22.5	27.1	4.6	6/3/03	112449.48	1091594.97	25.69	25.96
RA-MW-13B	2	32.1	27.3	31.9	4.6	6/3/03	112448.39	1091592.13	25.61	25.86
RA-MW-13C	2	39.7	34.6	39.5	4.9	6/3/03	112453.33	1091595.78	25.55	25.97
RA-MW-14A	2	25.3	20.3	25.1	4.8	6/4/03	112447.10	1091654.85	25.06	25.44
RA-MW-14B	2	30.3	25.5	30.1	4.6	6/4/03	112444.72	1091652.41	25.00	25.38
RA-MW-15A	2	26.6	22.1	26.6	4.5	5/30/03	112412.99	1091561.36	25.76	26.11
RA-MW-15B	2	32.7	27.7	32.5	4.8	5/30/03	112413.29	1091557.10	25.79	26.10
RA-MW-16A	2	26.8	22.2	26.7	4.5	6/2/03	112413.87	1091630.20	25.14	25.47
RA-MW-16B	2	32.7	27.9	32.5	4.6	6/2/03	112414.70	1091626.50	25.45	25.68
RA-MW-17A	2	26.4	21.7	26.2	4.5	6/5/03	112478.04	1091624.86	25.96	26.23
W85-2B	4	50	45	49	5	9/10/85	112427.94	1091417.06	25.77	26.09
W85-3A	2	29.5	19.5	29.5	10	9/5/85	112824.50	1091509.69	26.40	26.97
W85-3B	4	49	44	49	5	9/4/85	112824.23	1091514.26	26.77	27.14
W85-6A[#]	2	27	17	27	10	10/12/85	111924.04	1091489.91	25.38	25.8[+]

Table 4—Well Construction Information
Frontier Hard Chrome, Vancouver, Washington

Well No.	Well Dia. (in)	Well Depth (feet)	Top of Screen Depth (ft)	Bottom of Screen Depth (ft)	Screen Length (ft)	Date Installed	Northing	Easting	Casing Elev. (feet)*	Top of Monument Elev. (feet)*
W85-6B#	4	49	44	49	5	10/11/85	111912.90	1091495.31	25.24	25.8+
W85-7A#	2	26.5	16.5	26.5	10	10/22/85	111916.01	1090984.92	22.83	23.1+
W85-7B#	2	49	44	49	5	10/21/85	111917.15	1090952.50	23.0	23.1+
W86-10B	4	50	43.8	48.8	5	12/12/86	112510.41	1093365.77	26.8	26.6+
W86-13A	4	28.5	23.5	28.5	5	12/16/86	112712.34	1090490.94	26.39	26.7+
W92-16A	4	34	24	34	10	6/23/92	112438.05	1091446.66	25.62	25.98
W92-16B	4	45	35	45	10	6/23/92	112424.30	1091445.85	25.51	25.87
W97-18A	2	27.5	22.5	27.5	5	2/27/97	112299.62	1091919.98	25.44	25.72
W97-18B	2	44.5	39.5	44.5	5	2/26/97	112299.13	1091926.64	25.36	25.73
W97-19A#	2	25	20	25	5	3/17/97	111767.46	1090360.19	22.45**	22.99**
W97-19B#	2	45	40	45	5	3/17/97	111758.69	1090357.80	21.72**	22.56**
W98-20A#	2	27	22	27	5	5/29/98	111631.28	1090944.00	23.57**	23.87**
W98-21A#	2	26	21	26	5	5/27/98	111623.54	1091536.07	25.28**	25.5**
W98-21B#	2	44	39	44	5	5/28/98	111616.84	1091543.41	25.5**	25.77**
W99-R5A	2	32.2	22	32	10	1999	110927.24	1089741.49	32.26	NA
W99-R5B	2	49	44	49	5	1999	110929.99	1089743.59	32.33	NA

Notes:

* Feet above mean sea level. Vertical datum - City of Vancouver benchmark number 108.

** Corrected to common datum. See Section 2.1.3 for explanation.

+ Ground surface elevation.

Northings and eastings obtained from conversion from GPS latitude and longitude taken February 2, 2004; GPS measurements and conversion done by EPA.

Table 5—Sample Analyses Summary
Frontier Hard Chrome, Vancouver, Washington – YR 2004

Task	Number of Locations, Matrix, and Number of Field Samples	Analytical Parameters and Method	Sample Preservation	Technical Holding Time	Sample Container(s)
Groundwater Monitoring	Thirty-three wells will be sampled per event (see Table 3)	Field sample parameters (temperature, pH, conductivity, ORP, turbidity, and dissolved oxygen)	NA	NA	Field measurement
		Total hexavalent chromium[a] / Hach test kits #12710	NA	48 hours	Field measurement
		Total TAL metals[a] (less mercury)	HNO_3 to pH < 2[b] Cool to 4 °C ± 2 °C	6 months	1-L poly bottle
		Chlorinated Solvents / EPA 8260B	HCl to pH < 2 Cool to 4 °C ± 2 °C	14 days	3 – 40 ml VOA vials with Teflon septum lid
		Sulfate / 300.0	Cool to 4 °C ± 2 °C	28 days	500 ml poly bottle
		Total Sulfur / EPA 6010B	HNO_3 to pH < 2 Cool to 4 °C ± 2 °C	6 months	100-ml poly bottle
	Rinsate blank non-dedicated groundwater submersible pump; 1 sample per sampling day	Same analyses as field samples above.			

Notes:

[a]: in cases where excess turbidity (>10 NTU) is present, dissolved samples will also be collected.

[b]: check pH prior to shipping and add additional acid as needed to obtain pH<2.

C: Celsius.

HCL: Hydrochloric acid.

HNO_3: Nitric acid.

NA: Not applicable

TAL: Total analyte list.