Frontier Hard Chrome
Remedial Action Data Evaluation Report

Work Assignment Number: 153-RARA-1027

EPA Contract: 68-W7-0026

February 2004

EPA Region V

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Response Action Contract

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DATA EVALUATION REPORT
FRONTIER HARD CHROME
VANCOUVER, WASHINGTON

Prepared for

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

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TABLE OF CONTENTS

TABLE OF CONTENTS *(Continued)*

Section Page

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES *(Continued)*

DATA EVALUATION REPORT

FRONTIER HARD CHROME SUPERFUND SITE

VANCOUVER, WASHINGTON

EPA CERCLIS ID NUMBER: WAD053614988

1. INTRODUCTION

1.1 SITE NAME, LOCATION, AND DESCRIPTION

The Frontier Hard Chrome (FHC) Superfund Site is located in the southwestern part of Washington State in the city of Vancouver, Washington. The address of the site is 113 Y Street, Vancouver, Washington.

FHC is in an industrial area of the city directly across the Columbia River from the city of Portland, Oregon (see Figure 1). The area topography is generally flat, extending south, east, and west. About one quarter mile to the north, a ridge rises steeply to where a large residential area begins. The site is approximately one-half mile north of the Columbia River and covers about one-half acre.

Before its development, the site was part of a gently undulating, swampy, alluvial floodplain terrace along the Columbia River. This surface was modified by grading and the placement of up to 20 feet of fill for local industrial developments. Fill materials consist of both hydraulic fill (silt and sand) and construction fill. During the 1940s, hydraulic fill was used to level a swampy area between Pearson Air Park and Grove Street. The hydraulic fill materials consisted of generally fine-grained sand, with silty sand near the surface and sand at depth. Construction fill was also placed at portions of the site beginning in the 1960s. The construction fill consists of concrete debris, asphaltic debris, red bricks, metal (iron chips), silt, sand, gravel, and minor quantities of clay. Approximately 12 to 20 feet of fill is present in the area of the FHC site.

1.2 PURPOSE

This report provides a summary of the pertinent environmental analytical data collected during treatment activities associated with the Source Area. The report also evaluates the data with regard to its performance criteria specified in the Sampling and Analysis Plan (Weston 2003). Eight different data sets are provided and evaluated:

- In-situ Redox Manipulation (ISRM) Wall Alignment Characterization Data
- Excavated Debris Characterization Data
- Treated Soil and Groundwater Confirmatory Sample Data
- Treated Fluff Soil Characterization Data
- Treated Soil Strength Data

- Perimeter Air Monitoring Data
- Perimeter Soil Sampling Data
- Groundwater Elevation Data

Laboratory data sheets for each type of data are provided in the Appendices where applicable.

SECTION 2

SITE SAMPLING RESULTS AND EVALUATION

2.1 IN-SITU REDOX MANIPULATION WALL ALIGNMENT CHARACTERIZATION

2.1.1 ISRM Wall Alignment Data Summary

The U. S. Environmental Protection Agency's (EPA's) Region X Environmental Services Assistance Team (ESAT) completed a series of 7 push-probe explorations along the proposed ISRM Treatment Wall alignment (PP-011 through PP-017). The purpose of these probes was to characterize the site geology in the local area and determine how the concentration of hexavalent chromium in groundwater varied with depth. Groundwater samples were collected at various depths (down to 40 feet) from these probes and analyzed for hexavalent chromium to determine the required depth of the ISRM Treatment Wall. Selected samples were sent to an offsite lab for total metals analysis. The location of the push-probe explorations is shown in Figure 2.

Table 1 lists the hexavalent and total chromium concentrations in the samples collected from these push-probes. Figure 3 shows a cross section of the geology along the proposed ISRM Treatment Wall. Figure 3 also shows the hexavalent chromium data associated with each of the samples.

ISRM Wall Alignment data is provided in Appendix A.

2.1.2 ISRM Wall Alignment Data Evaluation

Logging of the push-probe cores indicated that backfill was present to a depth of approximately 15 to 19 feet at which time clayey silt was encountered. This silt layer was relatively impermeable and extended from approximately 19 feet below ground surface (bgs) to 23 feet bgs. Below the silt layer was a more permeable silty sandy gravel extending down to approximately 27 feet bgs. Below 27 feet, highly permeable sandy gravel was present.

Hexavalent chromium concentrations in groundwater collected from the push-probe explorations exceeded the Record of Decision (ROD) Cleanup Level of 5,000 ug/L in two locations: PP-016 and PP-017. Groundwater samples collected east and west of PP-016 and PP-017 had significantly lower concentrations (less than 100 ug/L). Probe explorations PP-016 and PP-017 were located near the northeast corner of Cassidy Manufacturing and were located approximately 140 feet south of an area under the Frontier Hard Chrome Building that contained chromium in groundwater at concentrations of 119,000 ug/L.

Groundwater samples from push-probe explorations (PP-016 and PP-017) contained hexavalent chromium at concentrations exceeding 5,000 ug/L to a depth of 32 feet. Therefore, the design depth of the wall was set at approximately 34 feet.

Total chromium concentrations in selected groundwater samples were similar to the hexavalent chromium concentrations. This correlation indicates that the majority of chromium in

groundwater existed as hexavalent chromium and that eliminating hexavalent chromium would likely reduce the total groundwater chromium concentration.

2.2 EXCAVATED SOURCE AREA DEBRIS

2.2.1 Source Area Debris Data Summary

Debris was excavated from the Source Area prior to in-situ treatment using augers. The debris was placed in piles and sampled. Five debris piles were created and denoted as piles A through E. These piles were sampled and analyzed for total metals and TCLP metals for those samples where concentrations were elevated. The sample results were used to determine disposal options.

Sample data is summarized in Table 2. Analytical results are provided in Appendix B.

2.2.2 Source Area Debris Data Evaluation

Samples were collected at a ratio of approximately 1 sample per 100 tons of debris excavated. Barium, chromium and lead were the metals most commonly detected in the concrete debris samples. However, chromium and lead were the only constituents that had concentrations that may potentially result in the debris being a hazardous waste.

Out of a total of 13 debris samples, 2 samples exceeded 100 mg/kg chromium and 1 sample exceeded 100 mg/kg lead. Maximum total chromium and lead concentrations were 500 mg/kg and 180 mg/kg, respectively.

Chromium concentrations in the TCLP leachate were less than 1% of the total chromium concentration in the same sample. The lead TCLP concentration was approximately 1.5% of the total lead concentration. None of the debris samples exceeded the chromium and lead TCLP criteria of 5 mg/L for classification as a hazardous waste.

2.3 SOURCE AREA TREATMENT CONFIRMATORY SAMPLING

2.3.1 Source Area Confirmatory Sample Data Summary

Confirmatory samples were collected from the soil after it had been treated by mixing EcoBond reagent in-situ using augers. Groundwater samples were collected concurrently using push-probes. These samples were collected to confirm cleanup goals were met.

Soil was treated to a depth of 20 to 25 feet. Soil samples were collected at depths between approximately 7 feet and 17 feet. Groundwater samples were collected at approximately 20 feet or slightly deeper depending on the groundwater elevation. The groundwater elevation was generally 20 feet or less.

Soil and groundwater sampling data is summarized in Table 3. The location of soil columns where samples were collected is shown in Figure 4. Sample result field records are provided in Appendix C.

2.3.2 Source Area Confirmatory Sample Data Evaluation

Sample goals were to collect 1 soil confirmatory sample per 500 cubic yards of soil treated and 1 groundwater confirmatory sample per 1,600 square feet of surface area. Actual confirmatory sampling (i.e., sampling performed by ESAT/Weston) rates were approximately 1 soil sample per 465 cubic yards and 1 groundwater sample per 1,400 square feet. A total of 53 (45 samples plus eight duplicates) soil confirmatory samples and 20 (19 samples plus one duplicate) groundwater confirmatory samples were collected by ESAT/Weston in the treated area.

Twenty-two soil and 5 groundwater samples were also collected during process startup optimization testing.

Soil samples were analyzed in the field for hexavalent chromium. The samples were analyzed allowing at least 5 days between treatment and sampling to account for rebound effects. The soil treatment goal specified in the Record of Decision was 19 mg/kg. Hexavalent chromium was not detected in the field samples.

The soil detection level was 5 mg/kg due to interferences with the reagent. The reagent caused cloudiness in the extract, which required dilution prior to analysis, thereby raising the detection limit. However, given the nature of the reagent (a strong sulfur based reducing compound), it is likely that the concentrations of hexavalent chromium were well below 5 mg/kg.

One soil sample exceeded the criterion of 19 mg/kg hexavalent chromium. This sample (FHC-SO-PP027-0170) had a hexavalent chromium concentration of 26 mg/kg. Additional samples were collected around this location to determine the extent of the area exceeding cleanup goals. All surrounding samples met the cleanup goals indicating this exceedence was an isolated occurrence. Soil in the area where the exceedence occurred was re-treated and re-sampled. The second sample from this area (FHC-SO-PP034-0170) confirmed that the re-treatment reduced the hexavalent chromium concentration to less than 5 mg/kg.

Samples of groundwater collected using push-probes typically contained no detectable hexavalent chromium concentrations. The detection limit was approximately 800 ug/L due to interferences from the reagent.

Several groundwater samples were collected in the southern central portion of the site prior to treatment to determine treatment depth. Groundwater in this area did not exceed the criteria for hexavalent chromium (5,000 ug/L). This area was treated for soil contamination, however, no confirmatory groundwater samples were collected in this area as the pre-treatment samples were appropriate to confirm groundwater met cleanup criteria.

Groundwater was not present in some areas of the site and samples could not be collected. Groundwater was not present likely due to a lowered groundwater table as a result of the dry summer, or due to the lowered permeability of the treated area from the addition of cement.

Soil and groundwater sample locations are shown in Figures 5 and 6.

2.4 TREATED FLUFF SOIL

2.4.1 Treated Fluff Soil Data Summary

Excess soil was generated as a result of mixing reagent and portland cement with site soil. This excess soil had to be disposed offsite due to site space limitations. The excess soil was staged in stockpiles and sampled for total metals, then TCLP metals where necessary. Sampling was performed to determine appropriate disposal methods.

Eleven soil stockpiles were created. Both Weston and Williams Environmental Services (the remediation subcontractor) collected several samples from each stockpile. These samples were sent to offsite laboratories for analysis. The soil was disposed at an appropriate landfill based on the soil sample results.

Fluff soil sample results are provided in Table 4 and 5. Detailed sample results are provided in Appendix D.

2.4.2 Treated Fluff Soil Data Evaluation

Weston's goal was to collect 1 composite soil sample per every 500 cubic yards (750 tons) of fluff soil treated. In actuality, 19 composite samples were collected from 7,520 tons of fluff soil, equating to 1 sample per every 400 tons. The increased sample frequency was the result of the land filling requirements. The frequency of samples collected by Williams Environmental Services (WES) was at their discretion. Williams Environmental Services also collected 19 samples in a manner consistent with Weston's sampling.

In general, the concentration of chromium and lead measured by the Weston subcontracted laboratory were slightly higher than the results from the WES subcontracted laboratory; however, the conclusions drawn from the data were the same. All samples exceeded 100 mg/kg chromium, which was the threshold for follow-up TCLP testing. All Weston samples and the majority of WES samples exceeded 100 mg/kg lead, which was also the TCLP testing threshold.

Figures 7 through 10 show the frequency distribution for chromium and lead from the two laboratories. The chromium samples from the Weston subcontracted laboratory were more widely spaced over a larger concentration range than samples from the WES subcontracted laboratory. The frequency distribution for lead samples was similar between the two labs.

TCLP chromium and lead concentrations from all samples were less than the disposal threshold concentration of 5 mg/L. Therefore, the fluff soil was determined to be a nonhazardous waste and was disposed in a nonhazardous waste (Subtitle D) landfill. TCLP chromium concentrations were generally less than 0.1 mg/L. TCLP lead concentrations were generally less than 0.3 mg/L, with most samples containing no detectable lead concentrations.

2.5 TREATED SOURCE AREA SOIL STRENGTH

2.5.1 Treated Source Area Soil Strength Data Summary

Cylinders of treated soil were cast and sent offsite to a testing laboratory to determine

unconfined compressive strength (UCS). Thirty-four samples were collected and tested for UCS. A summary of the UCS data is provided in Table 6 and shown in Figure 11. Detailed test results are provided in Appendix E.

One strength test was run for approximately every 700 cubic yards of soil treated.

2.5.2 Treated Source Area Soil UCS Data Evaluation

Unconfined compressive strength varied from 30 pounds per square inch (psi) to 230 psi. The average UCS was 80 psi; well above the criteria of 30 psi. The majority of the samples exceeded 50 psi.

Figure 11 displays the frequency distribution of the UCS data. As shown on this figure, 100% of the samples met or exceeded the 30 psi criteria and approximately 60 % exceeded twice the criteria (60 psi).

2.6 PERIMETER AIR SAMPLING

2.6.1 Perimeter Air Sampling Data Summary

Dust monitoring and particulate air sampling was completed to ensure offsite receptors were not being exposed to contaminants above OSHA safety guidelines.

Particulate samples were collected using SKC portable air pumps and 0.8 micron preloaded filters. A total of fifty-seven particulate samples were collected. Generally, 3 samples were collected on a given day; one upwind sample and 2 downwind samples. Sampling typically occurred 2 days per week due to the low levels of metals detected on the filters.

Real time dust monitoring was also performed along the site perimeter. Daily time weighted average (TWA) and maximum short term exposure level (STEL) dust concentrations were measured during onsite intrusive work. One upwind and 2 downwind dust monitors were placed along the site perimeter fence.

A summary of the particulate sample analytical data is provided in Table 7. Detailed sample results are provided in Appendix F.

Figure 12 displays a summary of the dust concentrations in air measured downwind along the site perimeter (this figure does not include the upwind dust samples). A detailed data listing of dust concentrations is also provided in Appendix F.

2.6.2 Perimeter Air Sampling Data Evaluation

The laboratory reported the weight of a particular metal present on the filter. This weight was then divided by the total air flow rate to determine the metal concentration in air.

The laboratory reported no detectable weights of metals in all samples. Since no metals were detected, the detection limit was used to determine compliance with the OSHA Permissible

Exposure Level (PEL). All perimeter air samples were below the OSHA criteria when the detection limit was used in the calculation. In all likelihood, the actual quantity of metal on the filter was lower than the detection limit. Therefore, the concentration of the metal in air was most likely lower than the value calculated.

This determination is consistent with observed results. The soil treatment process was an extremely wet process covering the site with wet soil slurry the majority of the time. This wet operation resulted in no dust being generated, and as a result, no metal particulates were generated or collected on the filters.

Dust concentrations in downwind air were generally below 0.4 mg/ cubic meter. Ninety-three percent of all samples were below this concentration. Minimal differences were present in upwind and downwind concentrations, which indicates dust generation from site work was minimal.

The maximum time weighted average dust concentration measured on site was 1.9 mg/cubic meter. This concentration was measured downwind of the cement batch plant and was due to dust generated during filling of the cement bins and batch tanks.

The maximum STEL dust concentration measured was 12 mg/cubic meter. This was associated with samples near the cement batch plant. Overall, 90 percent of the maximum daily STEL concentrations were below 2.5 mg/cubic meter.

The highest dust concentrations were detected by monitors located next to the cement batch plant and were due to cement dust. Operators near the cement batch plant wore respirators during filling of the cement silos and at other times during dusting conditions.

2.7 PERIMETER SOIL SAMPLING

2.7.1 Perimeter Soil Sampling Data Summary

Soil samples were collected around the perimeter of the site (i.e., around the perimeter exclusion fence) and along the roadway into and out from the site. Samples were collected on both sides of the roadway.

Ten samples were collected around the site perimeter and 16 samples were collected along the road. Two duplicate samples were also collected. The samples were analyzed for both hexavalent chromium in the field and total chromium by an offsite laboratory. The purpose of this sampling was to ensure no chromium contaminated soil (that may present human health or environmental risk) had been tracked offsite during remediation activities.

A summary of the hexavalent chromium sample data is provided in Table 8. Total and hexavalent chromium results and sample locations are shown in Figure 13. Detailed sample results are provided in Appendix G.

2.7.2 Perimeter Soil Sampling Data Evaluation

The total chromium concentration around the perimeter of the site ranged from 46 mg/kg to 990 mg/kg. The average (upper 95th percentile confidence level about the mean [UCL_{95}]) concentration measured was 359 mg/kg.

The total chromium concentration of 990 mg/kg appears to result from sampling a small area where fluff soil had extended beyond the site exclusion zone. The next highest chromium concentration in the perimeter samples was 300 mg/kg.

Hexavalent chromium was not detected in any of the perimeter samples.

Total chromium concentrations along the roadway were much lower than those near the site. Roadway total chromium concentrations ranged from 7 to 210 mg/kg with a UCL_{95} of 59 mg/kg. All samples along the road way had total chromium concentrations of less than 90 mg/kg with the exception of one sample (210 mg/kg).

Hexavalent chromium was not detected in any of the roadway samples.

2.8 GROUNDWATER ELEVATION

2.8.1 Groundwater Data Summary

EPA-Region 10 measured the depth to groundwater in several monitoring wells from March 2003 through September 2003. The groundwater elevation was determined throughout the site from the measurement taken from a northern location (W85-3A) to a southwestern location (W99-R5A), a distance approximately 2,760 feet. The data or measurements from these monitoring wells allow for an approximate determination of a flow direction, horizontal hydraulic gradient and a groundwater velocity.

Groundwater elevation data from March through September 2003 is summarized in Table 9. Well specific measurements and gradient determinations can be found in Appendix H.

2.8.2 Groundwater Data Evaluation

A plot of the groundwater elevations and the surface elevation of the Columbia River over several months is shown in Figure 14. This figure shows that, although the groundwater table drops several feet over the course of the year, there is minimal difference between the groundwater elevations in the up and down gradient wells. The elevation of the Columbia River during most of this time period is lower then the water table elevation. Groundwater from the Frontier Hard Chrome site is flowing to the river in a southerly direction. The average horizontal gradient during this time period is 0.000028 ft/ft with a groundwater flow of 0.16 foot per day towards the river.

It should also be noted that groundwater flow reversal do occur during high stages or surface elevations of the Columbia River. Figure 14 illustrates this reversal on March 13, 2003.

SECTION 3

DATA USABILITY AND QUALITY ASSURANCE/QUALITY CONTROL

3.1 INTRODUCTION

Data collection, review/validation, and reconciliation with project Data Quality Objectives (DQO) from the Frontier Hard Chrome ISRM Wall Installation/Source Area Treatment project were completed. Quality Assurance/Quality Control specifications described in the Sampling and Analysis Plan (Weston 2003) were used to assess the compliance of collected data with project requirements.

All data were collected using definitive analytical methods and/or EPA-accepted methodology, and reviewed using guidelines specified in the Sampling and Analysis Plan to ensure that Method Quality Objectives (MQO) were achieved or that the impact of variances from MQOs were adequately assessed.

Reviewed data were then validated with respect to Precision, Accuracy (Bias), Representativeness, Comparability, and Completeness (PARCC) standards. All data are useable unless otherwise indicated by data validation qualifiers applied to individual data points. PARCC goals listed in the Sampling and Analysis Plan were achieved. Specific QA/QC detail for individual project tasks is described in the following sections.

3.2 DEBRIS ANALYSES

Debris associated with site preparation/excavation consisted mainly of broken concrete. Thirteen 5-point composite samples were submitted to the laboratory for analysis of total RCRA metals (less mercury), to include arsenic, barium, cadmium, chromium, lead, selenium, and silver, following EPA SW846 Methods 3050B (acid digestion) and 6010B (analysis by ICP-AES). A second aliquot of selected samples was analyzed for chromium and lead, based on results from the total metals analysis, following EPA SW846 Methods 1311 (TCLP extraction), 3010A (acid digestion), and 6010B (analysis by ICP-AES).

No QA/QC exceptions were noted in the data review and validation process. All QC samples (e.g., method blanks, matrix spike samples, matrix duplicate samples, and laboratory control samples) were analyzed at the proper frequency and recoveries met method quality objectives.

Project DQOs were achieved and the data may be used to make decisions regarding project objectives stated in the Sampling and Analysis Plan.

3.3 SOIL AND GROUNDWATER HEXAVALENT CHROMIUM FIELD ANALYSES

Confirmatory chemical analyses for hexavalent chromium were performed in the field using Hach test kits. The hexavalent chromium confirmatory sampling data were usable, and indicate that the soil and groundwater cleanup criteria of 19 mg/kg and 5,000 ug/L, respectively, were met.

For soil, the method developed consisted of weighing 6 grams of soil and extracting with 40 mL of the prepared Hach soil extraction solution. Following filtration, a 20:1 dilution was performed using deionized water and the Hach color reagent added. Formation of a violet color in the solution indicates the presence of hexavalent chromium. The absorbance of the solution is measured using the Hach spectrophotometer and compared with an internal, fixed calibration curve. The unit then displays the result as concentration (mg/L) of hexavalent chromium. Daily performance checks used solutions of known hexavalent chromium concentration. The solutions, containing 0.04 and 0.10 mg/L Cr(VI), were prepared from a stock standard solution provided by Hach. Based on the soil sample size and dilution factor, this method resulted in a detection limit of 5 mg/kg Cr(VI) in soil on a wet-weight basis.

Extraction was not performed for water samples – reagent was added directly to the sample and analyzed in a similar manner as a soil extract. Dilution was still necessary in most cases and resulted in a detection limit of 0.80 mg/L. These soil and groundwater detection limits were lower than those listed in the Work Plan analytical method requirements.

The sulfur-based remediation reagent interfered with the analyses due to the high alkalinity of the samples. The soil extraction solution is also alkaline, while the color formation reaction requires an acidic solution. The acidic buffer in the color reagent lacked sufficient capacity to properly adjust the pH of the test solutions. Both these effects necessitated dilution of the soil extracts. The water solutions were often alkaline, and the color reagent (which includes acidic buffer) lacked adequate buffering capacity. Similar to the soil sample extracts, a precipitate formed in many samples. Consequently, the water samples also required dilution. The nature of the remediation reagent was such that simple dilution of the samples caused precipitation prior to addition of the color reagent. In all soil and water samples, a reading from the spectrophotometer was measured without addition of the color reagent for use in blank correction. The blank correction value was subtracted from the reading measured following addition of the color reagent buffer. Many of the sample solutions were filtered through 0.8um filters to remove the fine precipitate in order to minimize erroneous readings.

Duplicate analysis was performed for both soil and water samples. Forty-five soil and eight field duplicate samples were analyzed. For groundwater, 20 confirmatory and two field duplicate samples were analyzed. All field duplicate analyses yielded acceptable precision.

Water and soil samples also were analyzed for pH and ORP (oxidation reduction potential). Water samples were analyzed directly using a probe electrode. For the soils, a twenty-gram sample was mixed with 20 mL of deionized water and the resulting slurry analyzed using a probe electrode. The pH meter was calibrated daily with 7.0 and 10.0 pH buffers, and the ORP meter was checked daily with a solution of known ORP. The pH and ORP data provide an indication of whether hexavalent chromium is thermodynamically stable. Under conditions of low to neutral pH (2 to 7 S.U.) and ORP values less than +0.5mV, chromium exists mainly in the trivalent form. Although hexavalent forms of chromium may exist at acid pH, the ORP value must be large (greater than +0.5 mV). Hexavalent chromium is most under alkaline conditions (pH greater than 7 S.U.) and high ORP (greater than +0.5 mV).

Project DQOs were achieved and the data may be used to make decisions regarding project objectives stated in the Sampling and Analysis Plan.

3.4 FLUFF ANALYSES

Nineteen "fluff" (treated) and two field-duplicate soil samples were submitted to the laboratory for analysis of total RCRA metals (less mercury), to include arsenic, barium, cadmium, chromium, lead, selenium, and silver, following EPA SW846 Methods 3050B (acid digestion) and 6010B (analysis by ICP-AES). A second aliquot of selected samples was analyzed for chromium and lead, based on results from the total metals analysis, following EPA SW846 Methods 1311 (TCLP extraction), 3010A (acid digestion), and 6010B (analysis by ICP-AES). Each fluff sample consisted of a 5-point composite sample.

No QA/QC exceptions were noted in the data review and validation process. All QC samples (e.g., method blanks, matrix spike samples, matrix duplicate samples, and laboratory control samples) were analyzed at the proper frequency and recoveries met method quality objectives. Analysis of field duplicate samples yielded acceptable precision.

Project DQOs were achieved and the data may be used to make decisions regarding project objectives stated in the Sampling and Analysis Plan.

3.5 AIR ANALYSES

Dust monitors were checked daily and calibrated at a minimum of once per week. Calibration was performed using dust free air (i.e., filtered air). Daily checks were performed by confirming that the monitors indicated the presence of low or no dust concentrations in a dust-free environment, such as the project office.

Air particulate samplers had their airflows checked twice per day at the beginning and ending of each shift. Filters were removed from the samplers on a daily basis for shipment to the laboratory for analysis.

Fifty-six air filter samples and one blank were submitted to the laboratory for analysis of total particulate metals, to include arsenic, beryllium, cadmium, chromium, copper, lead, nickel, and zinc, following NIOSH Method 7300 (acid digestion; analysis by ICP-AES).

Full data review was performed on the laboratory deliverable. No QA/QC exceptions were noted in the data review and validation process. All QC samples (e.g., method blanks, filter blanks, and laboratory control samples) were analyzed at the proper frequency and recoveries met method quality objectives.

Project DQOs were achieved and the data may be used to make decisions regarding project objectives stated in the Sampling and Analysis Plan.

3.6 SITE PERIMETER SOIL ANALYSES

Twenty-six site perimeter and two field-duplicate soil samples were submitted to the laboratory for analysis of total chromium following EPA SW846 Methods 3050B (acid digestion) and 6010B (analysis by ICP-AES).

No QA/QC exceptions were noted in the data review and validation process. All QC samples (e.g., method blanks, matrix spike samples, matrix duplicate samples, and laboratory control samples) were analyzed at the proper frequency and recoveries met method quality objectives, with the following exception: recoveries of both the matrix spike and matrix spike duplicate were greater than the upper control limit specified in the Sampling and Analysis Plan. Associated chromium results were qualified as estimated concentrations, possible high bias.

Analysis of the field duplicate samples yielded acceptable precision.

Project DQOs were achieved and the data may be used to make decisions regarding project objectives stated in the Sampling and Analysis Plan.

SECTION 4

DATA EVALUATION SUMMARY

Data collected during ISRM Wall Alignment by EPA ESAT indicated that the treatment wall should be installed to a depth of approximately 32 feet. Injection wells were installed to depths of approximately 34 feet. The reagent injected into the injection wells has a density greater than water; therefore, the depth of the ISRM treatment wall is a minimum of 34 feet deep and likely deeper due to sinking of the reagent once injected.

Debris removed from the Source Area prior to in-situ treatment generally contained low levels of heavy metals (generally less than 100 mg/kg). TCLP testing on selected debris samples showed that the debris was not hazardous and could be disposed in a nonhazardous waste landfill.

Hexavalent chromium was not detected (at a detection limit of 5 mg/kg) in soil following treatment. Hexavalent chromium concentrations measured in groundwater within the Source Area were below 800 ug/L (the method detection limit).

The average trivalent chromium concentration in soil onsite is approximately 1,200 mg/kg (based on the UCL_{95} of fluff soil which originated from the site surface).

Treatment of the Source Area soil and groundwater met the cleanup levels specified in the ROD amendment (shown below).

Summary of Cleanup Levels

Media	Chemicals of Concern	Cleanup Levels
Groundwater	Hexavalent Chromium	5,000 ug/L
Soil	Hexavalent Chromium	19 mg/kg
	Trivalent Chromium	80,000 mg/kg

Treated fluff soil contained elevated concentrations of chromium and lead. However, follow-up TCLP testing showed that this soil was not a hazardous waste and could be disposed in a nonhazardous waste landfill.

The average unconfined compressive strength of soil onsite after treatment is approximately 80 psi. The strength may vary from location to location but is within light building construction requirements.

Air sampling and analysis along the site perimeter during the time work was being performed did not indicate that dust was released offsite in excess of OSHA PEL standards.

Offsite dust migration was minimal to non-existent. Intermittent cement dust was visually noticed during periods of offload cement from delivery trucks into the onsite cement bins.

Soil sampling around the site perimeter and along the roadway did not identify any human health or environmental risks as a result of inadvertently tracking soil offsite.

The groundwater elevation in the vicinity of FHC is relatively flat. Groundwater flows in a southerly direction toward the Columbia River.

SECTION 5

REFERENCES

Weston Solutions, Inc. (Weston). 2003. Frontier Hard Chrome ISRM Wall Installation/Source Area Treatment Sampling and Analysis Plan. April 2003.

TABLES

Table 1 – ISRM Wall Alignment Hexavalent and Total Chromium Concentrations in Push-probe Groundwater

Probe Number	Depth (ft)	Hexavalent Chromium Concentration (mg/L)	Qualifier	Total Chromium (mg/L)	Qualifier
PP-011	25	0.02	U		
	30	0.02	U	0.0014	J
	35	0.02	U		
	31	0.02[a]	U	0.021	
PP-012	25	0.02	U		
	30	0.02	U		
	31	0.06[a]		0.158	
PP-013	22	0.02			
	25	0.04			
	30	0.02	U		
	31	0.19[a]		0.205	
PP-014	25	0.02	U		
	30	0.02	U		
	35	0.02	U		
	31	0.05[a]		0.089	
PP-015	23	0.05			
	27.5	0.02			
	31.5	0.02	U		
	31	0.22[a]		0.371	
PP-016	23	22			
	27.5	73			
	31.5	41		42	
	35.5	0.24			
	39.5	0.02	U		
	31	6[a]			
PP-017	22	0.02	U		
	27.5	20		17.5	
	31.5	0.06			
	35.5	0.36			
	38.5	0.02	U		
	31	0.37[a]			

Note a: This sample was taken after the well was installed in the location where the push-probe occurred. Sample was collected using a pump and placing the sample tube in the approximate middle of the well screen. Chromium concentrations taken from the well are, in several cases, greater than the push-probe locations likely due to reducing iron formed during push-probe work.

Table 2 – Source Area Debris Characterization Data

Debris Pile #	Concentration (mg/kg)							TCLP (mg/L)		Sample Number
	Arsenic	Barium	Cadmium	Chromium	Lead	Selenium	Silver	Chromium	Lead	
Pile A	-	100	-	96	74	-	-			FHC-DD-CC038-0000
	-	85	-	500	36	-	-	2.1		FHC-DD-CC039-0000
Pile B	-	64	-	23	-	-	-			FHC-DD-CC040-0000
	-	190	0.98	130	180	-	1.7	1.2	2.6	FHC-DD-CC041-0000
	-	110	-	13	6.2	-	-			FHC-DD-CC042-0000
Pile C	-	64	-	9.2	6.5	-	-			FHC-DD-CC043-0000
	-	53	-	6.3	-	-	-			FHC-DD-CC044-0000
	-	68	-	6.5	-	-	-			FHC-DD-CC045-0000
Pile D	-	55	-	8.2	-	-	-			FHC-DD-CC046-0000
	-	56	-	11	-	-	-			FHC-DD-CC047-0000
Pile E	-	69	-	13	-	-	-			FHC-DD-CC048-0000
	-	71	-	8.7	-	-	-			FHC-DD-CC049-0000
	-	79	-	24	-	-	-			FHC-DD-CC050-0000

- Indicates not detected at or above the analytical method detection limit
Blank cell indicates not analyzed

Table 3 – Source Area Treatment Soil and Groundwater Confirmatory Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	ORP (mV)	Cr (VI) Result (mg/kg or mg/L)
ESAT	FHC-SO-PP018-0070	Optimization	soil	7	N14	6/23/03	6/26/03	3		<5
ESAT	FHC-SO-PP018-0170	Optimization	soil	17	N14	6/23/03	6/26/03	3		<7
ESAT	FHC-SO-PP018-0220	Optimization	soil	22	N14	6/23/03	6/26/03	3		<8
ESAT	FHC-SO-PP019-0070	Optimization	soil	7	N15	6/23/03	6/27/03	4		<5
ESAT	FHC-SO-PP019-0170	Optimization	soil	17	N15	6/23/03	6/27/03	4		<5
ESAT	FHC-SO-PP019-0220	Optimization	soil	22	N15	6/23/03	6/27/03	4		<5
ESAT	FHC-SO-PP020-0070	Optimization	soil	7	A20	6/24/03	6/27/03	3		<8
ESAT	FHC-SO-PP020-0170	Optimization	soil	17	A20	6/24/03	6/27/03	3		<8
ESAT	FHC-SO-PP021-0070	Optimization	soil	7	E18	6/28/03	7/2/03	4	-375	<5
ESAT	FHC-SO-PP021-0170	Optimization	soil	17	E18	6/28/03	7/2/03	4	-410	<5
ESAT	FHC-SO-PP022-0070	Optimization	soil	7	G19	6/28/03	7/2/03	4	-452	<5
ESAT	FHC-SO-PP022-0170	Optimization	soil	17	G19	6/28/03	7/2/03	4	-418	<5
ESAT	FHC-SO-PP023-0070	Optimization	soil	7	H18	6/30/03	7/3/03	3	-448	<5
ESAT	FHC-SO-PP023-0170	Optimization	soil	17	H18	6/30/03	7/3/03	3	-419	<5
ESAT	FHC-SO-PP024-0070	Optimization	soil	7	J19	6/30/03	7/3/03	3	-471	<5
ESAT	FHC-SO-PP024-0170	Optimization	soil	17	J19	6/30/03	7/3/03	3	-463	<5
ESAT	FHC-SO-PP025-0070	Optimization	soil	7	L20	7/1/03	7/7/03	6	-459	<5
ESAT	FHC-SO-PP025-0170	Optimization	soil	17	L20	7/1/03	7/7/03	6	-466	<5
ESAT	FHC-SO-PP025-0220	Optimization	soil	22	L20	7/1/03	7/7/03	6	-442	<5
ESAT	FHC-SO-PP026-0070	Optimization	soil	7	M17	7/1/03	7/8/03	7	-408	<5
ESAT	FHC-SO-PP026-0170	Optimization	soil	17	M17	7/1/03	7/8/03	7	-449	<5
ESAT	FHC-SO-PP026-0240	Optimization	soil	24	M17	7/1/03	7/8/03	7	-421	<5
ESAT	FHC-SO-PP027-0070	Confirmation	soil	7	O19	7/1/03	7/8/03	7	-425	5

Table 3 – Source Area Treatment Soil and Groundwater Confirmatory Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	ORP (mV)	Cr (VI) Result (mg/kg or mg/L)
ESAT	FHC-SO-PP027-0170	Confirmation	soil	17	O19	7/2/03	7/8/03	6	-136	26
ESAT	FHC-SO-PP027-0170 (dup)	Confirmation	soil	17	O19	7/2/03	7/8/03	6		21
ESAT	FHC-SO-PP028-0170	Confirmation	soil	17	O17	7/2/03	7/10/03	8	-438	<5
ESAT	FHC-SO-PP029-0170	Confirmation	soil	17	O20	7/2/03	7/10/03	8	-464	<5
ESAT	FHC-SO-PP031-0070	Confirmation	soil	7	U16	7/8/03	7/14/03	6	-451	<5
ESAT	FHC-SO-PP031-0170	Confirmation	soil	17	U16	7/8/03	7/14/03	6	-410	<5
ESAT	FHC-SO-PP032-0070	Confirmation	soil	7	R21	7/7/03	7/15/03	8	-349	<5
ESAT	FHC-SO-PP032-0170	Confirmation	soil	17	R21	7/7/03	7/15/03	8	-344	<5
ESAT	FHC-SO-PP033-0070	Confirmation	soil	7	T8	7/14/03	7/21/03	7	-471	<5
ESAT	FHC-SO-PP033-0170	Confirmation	soil	17	T8	7/14/03	7/21/03	7	-429	<5
ESAT	FHC-SO-PP034-0170	Confirmation	soil	7	O19	7/16/03	7/21/03	5	-430	<5
ESAT	FHC-SO-PP034-1170 (dup)	Confirmation	soil	17	O19	7/16/03	7/21/03	5		<5
ESAT	FHC-SO-PP035-0070	Confirmation	soil	7	Q16	7/17/03	7/22/03	5	-439	<5
ESAT	FHC-SO-PP035-0170	Confirmation	soil	17	Q16	7/17/03	7/22/03	5	-462	<5
ESAT	FHC-SO-PP036-0070	Confirmation	soil	7	R12	7/17/03	7/28/03	11	-418	<5
ESAT	FHC-SO-PP036-0170	Confirmation	soil	17	R12	7/17/03	7/28/03	11	-407	<5
ESAT	FHC-SO-PP036-1170 (dup)	Confirmation	soil	17	R12	7/17/03	7/28/03	11		<5
ESAT	FHC-SO-PP037-0070	Confirmation	soil	7	R4	7/21/03	8/4/03	14	-467	<5
ESAT	FHC-SO-PP037-0170	Confirmation	soil	17	R4	7/21/03	8/4/03	14	-178	<5
ESAT	FHC-SO-PP039-0070	Confirmation	soil	7	C7	7/29/03	8/5/03	7	-380	<5
ESAT	FHC-SO-PP039-0170	Confirmation	soil	17	C7	7/29/03	8/5/03	7	-190	<5
ESAT	FHC-SO-PP045-0070	Confirmation	soil	7	KK11	7/31/03	8/18/03	18	-235	<5
ESAT	FHC-SO-PP045-0170	Confirmation	soil	17	KK11	7/31/03	8/18/03	18	-218	<5

Table 3 – Source Area Treatment Soil and Groundwater Confirmatory Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	ORP (mV)	Cr (VI) Result (mg/kg or mg/L)
ESAT	FHC-SO-PP046-0070	Confirmation	soil	7	LL4	8/11/03	8/18/03	7	-337	<5
ESAT	FHC-SO-PP046-0170	Confirmation	soil	17	LL4	8/11/03	8/18/03	7	-124	<5
ESAT	FHC-SO-PP047-0070	Confirmation	soil	7	RR6	8/7/03	8/18/03	11	-194	<5
ESAT	FHC-SO-PP047-0170	Confirmation	soil	17	RR6	8/7/03	8/18/03	11	-172	<5
ESAT	FHC-SO-PP048-0070	Confirmation	soil	7	O8	8/7/03	8/19/03	12		<5
ESAT	FHC-SO-PP048-0170	Confirmation	soil	17	O8	8/7/03	8/19/03	12	-208	<5
ESAT	FHC-SO-PP049-0070	Confirmation	soil	7	HH8	8/1/03	8/19/03	18	-384	<5
ESAT	FHC-SO-PP049-0170	Confirmation	soil	17	HH8	8/1/03	8/19/03	18	-297	<5
ESAT	FHC-SO-PP049-0170 (dup)	Confirmation	soil	17	HH8	8/1/03	8/19/03	18		<5
ESAT	FHC-SO-PP050-0070	Confirmation	soil	7	DD4	8/13/03	8/20/03	7	-138	<5
ESAT	FHC-SO-PP050-0070 (dup)	Confirmation	soil	7	DD4	8/13/03	8/20/03	7		<5
ESAT	FHC-SO-PP050-0170	Confirmation	soil	17	DD4	8/13/03	8/20/03	7	-364	<5
ESAT	FHC-SO-PP051-0070	Confirmation	soil	7	G9	7/18/03	8/20/03	33	-164	<5
ESAT	FHC-SO-PP051-0170	Confirmation	soil	17	G9	7/18/03	8/20/03	33	-145	<5
ESAT	FHC-SO-PP051-0170 (dup)	Confirmation	soil	17	G9	7/18/03	8/20/03	33		<5
ESAT	FHC-SO-PP052-0070	Confirmation	soil	7	I13	7/31/03	8/26/03	26	-367	<5
ESAT	FHC-SO-PP052-0070 (dup)	Confirmation	soil	7	I13	7/31/03	8/26/03	26		<5
ESAT	FHC-SO-PP052-0170	Confirmation	soil	17	I13	7/31/03	8/26/03	26	-319	<5
ESAT	FHC-SO-PP053-0070	Confirmation	soil	7	L13	8/18/03	8/26/03	6	-381	<5
ESAT	FHC-SO-PP053-0170	Confirmation	soil	17	L13	8/18/03	8/26/03	6	-366	<5
ESAT	FHC-SO-PP054-0070	Confirmation	soil	7	O12	8/16/03	8/26/03	10	-423	<5
ESAT	FHC-SO-PP054-0170	Confirmation	soil	17	O12	8/16/03	8/26/03	10	-355	<5
ESAT	FHC-SO-PP054-0170 (dup)	Confirmation	soil	17	O12	8/16/03	8/26/03	10		<5

Table 3 – Source Area Treatment Soil and Groundwater Confirmatory Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	ORP (mV)	Cr (VI) Result (mg/kg or mg/L)
ESAT	FHC-SO-PP055-0070	Confirmation	soil	7	F13	8/22/03	8/28/03	6	-287	<5
ESAT	FHC-SO-PP055-0170	Confirmation	soil	17	F13	8/22/03	8/28/03	6	-424	<5
ESAT	FHC-SO-PP056-0070	Confirmation	soil	7	C13	8/25/03	8/28/03	3	-470	<5
ESAT	FHC-SO-PP056-0170	Confirmation	soil	17	C13	8/25/03	8/28/03	3	-387	<5
Weston	FHC-SO-SS001-0015	Confirmation	soil	1.5	Surface Treatment Area	8/29/03	9/2/03	3		<5
Weston	FHC-SO-SS002-0015	Confirmation	soil	1.5	Surface Treatment Area	8/29/03	9/2/03	3		<5
ESAT	FHC-GW-PP021-0190	Optimization	water	19	E18	6/28/03	7/2/03	4	-468	<0.8
ESAT	FHC-GW-PP022-0190	Optimization	water	19	G19	6/28/03	7/2/03	4	-487	<0.8
ESAT	FHC-GW-PP023-0190	Optimization	water	19	H18	6/30/03	7/3/03	3	-529	<0.8
ESAT	FHC-GW-PP023-0190 (dup)	Optimization	water	19	H18	6/30/03	7/3/03	3		<0.4
ESAT	FHC-GW-PP024-0190	Optimization	water	19	J19	6/30/03	7/3/03	3	-519	<0.8
ESAT	FHC-GW-PP024-0190	Optimization	water	19	J19	6/30/03	7/3/03	3	-519	<0.8
ESAT	FHC-GW-PP025-0220	Optimization	water	22	L20	7/1/03	7/7/03	6	-497	<0.8
ESAT	FHC-GW-PP027-0230	Confirmation	water	23	O19	7/2/03	7/8/03	6	-499	<0.8
ESAT	FHC-GW-PP038-0300	Confirmation	water	30	C14	untreated	8/5/03	NA	-130	<0.8
ESAT	FHC-GW-PP046-0240	Confirmation	water	24	LL4	8/11/03	8/18/03	7	-527	<0.8
ESAT	FHC-GW-PP047-0200	Confirmation	water	20	RR6	8/7/03	8/18/03	11		<0.8
ESAT	FHC-GW-PP049-0250	Confirmation	water	25	HH8	8/1/03	8/19/03	18	-283	<0.8
ESAT	FHC-GW-PP049-0250 (dup)	Confirmation	water	25	HH8	8/1/03	8/19/03	18	-195	<0.8
ESAT	FHC-GW-PP050-0240	Confirmation	water	24	DD4	8/13/03	8/20/03	7	-281	<0.8

Table 3 – Source Area Treatment Soil and Groundwater Confirmatory Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	ORP (mV)	Cr (VI) Result (mg/kg or mg/L)
ESAT	FHC-GW-PP058-0240	Confirmation	water	24	S14	7/15/03	8/27/03	43	-480	<0.8
ESAT	FHC-GW-PP057-0240	Confirmation	water	24	R13	7/17/03	8/27/03	41	-457	<0.8
ESAT	FHC-GW-PP060-0240	Confirmation	water	24	U5	7/8/03	8/27/03	50	112	<0.8
ESAT	FHC-GW-PP059-0240	Confirmation	water	24	S14	7/15/03	8/28/03	44	46	<0.8
ESAT	FHC-GW-PP040-0250	Pre-Treatment[a]	water	25	M14	NA	8/11/03	NA	-377	<0.8
ESAT	FHC-GW-PP040-0300	Pre-Treatment[a]	water	30	M14	NA	8/11/03	NA	-67	<0.8
ESAT	FHC-GW-PP041-0250	Pre-Treatment[a]	water	25	J14	NA	8/11/03	NA	-314	<0.8
ESAT	FHC-GW-PP041-0300	Pre-Treatment[a]	water	30	J14	NA	8/11/03	NA	-124	<0.8
ESAT	FHC-GW-PP042-0250	Pre-Treatment[a]	water	25	F14	NA	8/12/03	NA	60	<0.8
ESAT	FHC-GW-PP042-0300	Pre-Treatment[a]	water	30	F14	NA	8/12/03	NA	-65	<0.8
ESAT	FHC-GW-PP043-0300	Pre-Treatment[a]	water	30	H12	NA	8/12/03	NA	46	<0.8
ESAT	FHC-GW-PP044-0250	Pre-Treatment[a]	water	25	H16	NA	8/12/03	NA	48	<0.8
ESAT	FHC-GW-PP044-0300	Pre-Treatment[a]	water	30	H16	NA	8/12/03	NA	-95	<0.8

Note a: These samples are also considered to be confirmation samples. Pre-Treatment groundwater samples were collected before source area treatment in these areas. Since these samples were below the treatment criteria concentration of 5,000 ug/L, no samples were collected after the area was treated with reagent

Table 4 – Fluff Soil Total Metals Data

Fluff Soil Pile #	Concentration (mg/kg)													
	Arsenic		Barium		Cadmium		Chromium		Lead		Selenium		Silver	
	Weston Lab	WES Lab	Weston Lab	WES Lab	Weston Lab	WES Lab	Weston Lab	WES Lab	Weston Lab	WES Lab	Weston Lab	WES Lab	Weston Lab	WES Lab
Pile 1	-	29.8	210	298	-	0.66	1200	412	210	310	-	-	-	-
Pile 2	-	6.72	180	123	-	0.22	860	209	150	102	-	-	-	-
Pile 3	-	5.31	180	162	-	0.3	800	687	170	131	-	-	-	-
Pile 4	-	8.62	220	135	-	0.13	1200	825	230	135	-	-	-	-
	-	9.4	190	142	-	0.22	1200	962	300	211	-	-	-	-
	-	4.1	250	103	-	-	2200	427	320	76	-	-	-	-
Pile 5	-	9.8	210	153	-	0.18	1800	506	260	223	-	-	-	-
	-	9.9	220	146	-	0.31	730	623	220	271	-	-	-	-
Pile 6	37	11.6	260	173	-	0.19	920	583	430	193	-	-	-	-
	-	36	220	239	-	0.54	1200	551	270	151	-	-	-	-
Pile 7	26	20.3	200	232	-	0.33	1100	572	240	234	-	-	-	-
	20	15.6	190	209	-	0.37	740	679	240	170	-	-	-	-
Pile 8	24	10.6	220	170	-	0.26	800	606	320	179	-	-	-	-
	-	18.6	190	170	-	0.26	690	606	180	179	-	-	-	-
Pile 9	16	9.2	170	176	-	0.27	620	628	240	160	-	-	-	-
	-	12.4	160	214	-	0.36	720	761	330	153	-	-	-	-
Pile 10	-	5.1	180	102	-	0.11	960	598	120	68	-	-	-	-
	-	5.2	150	102	-	0.19	750	518	110	66	-	-	-	-
Pile 11	-	8	180	118	-	0.23	620	431	170	117	-	-	-	-

Weston Subcontracted Lab: Onsite Environmental

WES Subcontracted Lab: Specialty Analytical

- indicates not detected at or above the analytical method detection limit

Table 5 – Fluff Soil Metals TCLP Data

Fluff Soil Pile #	TCLP Chromium (mg/L)		TCLP Lead (mg/L)	
	Weston Lab	WES Lab	Weston Lab	WES Lab
Pile 1	3.1	3.75	2.4	0.76
Pile 2	-	0.703	-	-
Pile 3	0.95	0.238	4.6	-
Pile 4	0.042	0.596	-	0.118
	-	0.079	-	-
	-	2.21	-	-
Pile 5	-	0.052	-	-
	0.057	0.06	-	-
Pile 6	0.048	0.014	-	-
	-	0.029	-	-
Pile 7	1.5	1.81	0.24	0.296
	0.26	1.98	-	0.26
Pile 8	-	0.017	-	-
	-	0.025	-	-
Pile 9	0.06	0.017	-	-
	0.1	0.019	-	-
Pile 10	0.023	0.082	-	-
	0.04	0.068	-	-
Pile 11	0.035	0.107	-	-

Weston Subcontracted Lab: Onsite Environmental
WES Subcontracted Lab: Specialty Analytical
- indicates not detected at or above the analytical method detection limit

Table 6—Compressive Strength Data

Treated Soil Column No.	Days of Curing	Unconfined Compressive Strength (psi)
F-18	17	150
C-20	17	130
A-19	17	120
A-20	17	85
C-17	17	100
L-18	29	32
N-18	28	30
R-21	35	51
T-13	28	60
O-19	28	50
P-11	28	60
Q-10	28	60
Q-17	28	50
D-10	28	30
CC-7	28	230
OO-5	28	55
SS-8	28	30
OO-8	28	140
EE-7	28	130
J-15	28	110
D-15	28	100
A-14	28	50
D-8	28	70
RR-11	28	50
MM-10	28	50
HH-7	28	70
X-7	28	40
B-10	1	80
K-15	1	110
O-7	1	90
K-16	1	130
F-15	1	40
BB-6	1	70
L-11	1	70

Table 7 - Perimeter Air Dust Concentrations

DATE	PUMP #	TWA mg/m^3	MAX mg/m^3	STEL mg/m^3
6/17/2003	**116***	0.019	0.9	0.04
	119	0.025	3.3	0.19
	120	0.019	1.58	0.06
6/19/2003	**116***	0.011	0.50	0.05
	119	0.011	0.92	0.06
	120	0.012	0.97	0.04
6/20/2003	**116***	0.009	0.82	0.053
	119	0.016	1.31	0.07
	120	0.006	0.88	0.04
6/21/2003	**116***	0.004	0.16	0.001
	119	0.005	0.29	0.02
	120	NA	NA	NA
6/23/2003	**116***	0.011	0.246	0.021
	119	0.008	0.578	0.026
	120	0.025	4.29	0.472
6/24/2003	**116**	0.03	4.674	0.361
	119	0.012	0.973	0.03
	120*	0.013	0.35	0.027
6/25/2003	**116**	0.083	7.808	0.783
	119	0.014	0.456	0.039
	120*	0.015	0.693	0.046
6/26/2003	**116**	0.061	14.27	0.831
	119	0.020	0.945	0.056
	120	0.017	2.581	0.057
6/27/2003	**116**	0.034	1.20	0.083
	119	0.021	0.897	0.037
	120*	0.018	0.245	0.032
6/28/2003	**116**	0.062	8.47	0.463
	119	0.036	4.416	0.325
	120*	0.022	3.473	0.07
6/30/2003	**116**	0.033	1.208	0.093
	119	0.037	2.34	0.112
	120*	0.024	4.754	0.102
7/1/2003	**116**	0.027	1.338	0.045
	119	0.035	5.802	0.329
	120*	0.019	1.027	0.038
7/2/2003	**116**	0.027	0.548	0.04
	119*	0.028	2.945	0.064
	120	0.029	0.435	0.056
7/3/2003	**116**	0.042	1.35	0.13
	119	0.06	7.1	0.27
	120*	0.024	0.8	0.045
7/7/2003	**116**	0.06	5.33	0.4
	119*	0.04	3.3	0.09
	120	0.03	0.46	0.07

DATE	PUMP #	TWA mg/m^3	MAX mg/m^3	STEL mg/m^3
7/8/2003	**116***	0.03	0.44	0.04
	119	0.03	0.68	0.05
	120	0.03	1.37	0.09
7/9/2003	**116***	0.04	7.22	0.11
	119	0.04	2.94	0.16
	120	0.104	8.8	0.43
7/10/2003	**116***	0.04	2.7	0.14
	119	0.05	3.0	0.15
	120	0.10	22.3	0.53
7/11/2003	**116**	No Data	No Data	No Data
	119*	No Data	No Data	No Data
	120	0.25	3.4	0.16
7/12/2003	**116**	0.011	0.61	0.08
	119*	0.010	0.73	0.05
	120	0.014	1.11	0.09
7/14/2003	**116**	No Data	No Data	No Data
	119*	No Data	No Data	No Data
	120	0.04	7.11	0.28
7/15/2003	**116***	0.009	3.19	0.07
	119	0.026	3.1	0.17
	120	0.36	82.80	4.98
7/16/2003	**116**	0.455	26.9	3.54
	119	0.314	13.9	1.19
	120*	0.007	0.49	0.03
7/17/2003	**116**	0.006	0.17	0.01
	119	0.347	19.07	1.51
	120*	0.009	0.52	0.02
7/17/03 to 7/18/03	**116**	a	a	a
	119*	a	a	a
	120	0.376	35.79	2.352
7/18/2003	**116**	0.003	1.28	0.1
	119*	0.003	1.25	0.02
	120	0.16	14.01	1.62
7/18/03 to 7/19/03	**116**	0.014	38.41	0.443
	119	0.372	224.1	6.261
	120*	0.000	4.391	0.174
7/19/2003	**116**	0.014	2.14	0.11
	119	0.21	59.15	2.37
	120	0.009	15.91	0.58
7/21/2003	**116**	0.08	22.76	0.56
	119*	0.03	20.12	0.61
	120	0.02	1.60	0.06
7/21/03 to 7/22/03	**116**	0.172	4.107	0.878
	119	0.003	0.39	0.022
	120*	0.004	—	—

* denotes upwind monitor. No upwind designation indicates calm conditions.

a: Battery Failure

**Could Not Retrieve Data

Table 7 - Perimeter Air Dust Concentrations

DATE	PUMP #	TWA mg/m^3	MAX mg/m^3	STEL mg/m^3
7/22/2003	116	0.02	1.37	0.07
	119*	0.02	1.27	0.10
	120	0.35	198.3	6.15
7/24/2003	116	0.008	0.920	0.027
	119	0.005	0.306	0.013
	120*	0.007	0.443	0.014
7/25/2003	116	—	—	—
	119	0.06	2.59	0.35
	120*	0.02	0.81	0.03
7/28/2003	116	No Data	No Data	No Data
	119	0.04	3.10	0.42
	120	0.02	1.25	0.05
7/29/2003	116*	0.03	0.85	0.08
	119	0.04	4.96	0.14
	120	0.2	5.33	1.27
7/29/03 Night Shift	116	0.591	2.429	0.085
	119	0.041	14.3	0.489
	120*	0.015	0.650	0.041
7/30/2003	116	0.03	3.23	0.09
	119	0.04	3.90	0.13
	120	0.02	2.30	0.05
7/30/2003 Nite Shift	116	0.009	0.130	0.200
	119	a	a	a
	120*	a	a	a
7/31/2003	116	0.08	3.45	0.38
	119*	0.03	1.27	0.07
	120	0.31	9.2	2.47
7/31/03 - 8/1/03 Night Shift	116	0.065	5.936	0.431
	119	0.014	0.524	0.036
	120*	0.027	0.261	0.038
8/1/2003	116	b	b	b
	119	0.06	7.77	0.30
	120*	0.01	3.24	0.07
8/1/03 - 8/2/03 Night Shift	116	0.16	5.553	0.253
	119	0.047	5.891	0.211
	120*	0.005	0.557	0.019
8/2/2003	116	0.08	3.40	0.80
	119	0.30	28.77	2.96
	120	0.37	22.04	1.12
8/2/2003 Night Shift	116	0.054	1.665	0.313
	119	1.881	38.45	12.33
	120	0.039	2.923	0.306
8/4/2003	116	0.01	2.7	0.05
	119	0.03	1.26	0.06
	120*	0.01	1.04	0.05
8/6/2003 Day	116	0.02	0.77	0.04
	119	0.11	51.07	1.33
	120	0.06	9.56	0.61
8/6/2003 Night	116	0.005	1.369	0.041
	119*	0.026	6.978	0.516
	120	0.233	8.646	1.801
8/7/2003 Day	116	c	c	c
	119*	0.06	4.96	0.9
	120	0.51	27.3	7.46
8/7/03 Night	116	0.004	1.099	0.069
	119*	0.010	19.63	0.236
	120	—	—	—
8/8/2003	116	0.121	17.22	0.78
	119	0.064	12.87	1.0
	120*	0.011	0.69	0.03
8/8/2003 Night	116*	0.000	0.289	0.006
	119	0.040	11.09	1.473
	120	0.335	28.15	3.141
8/9/2003	116	0.08	9.96	0.85
	119	0.02	21.92	0.7
	120*	0.002	0.38	0.009
8/11/2003	116	0.05	6.9	0.5
	119	0.400	23.0	7.1
	120*	0.007	0.8	0.04
8/11/2003 Night	116	—	—	—
	119	—	—	—
	120*	0.000	0.358	0.016
8/12/2003	116*	0.03	9.03	0.22
	119	0.29	22.81	2.02
	120	0.29	7.66	1.52
8/13/2003	116	0.362	7.738	1.751
	119	0.907	16.75	4.026
	120*	0.009	1.300	0.037
8/14/2003	116	0.556	16.29	2.771
	119*	0.006	0.763	0.029
	120	0.295	7.937	1.443
8/15/2003	116*	0.008	0.631	0.028
	119	0.074	20.14	1.050
	120	0.161	11.06	1.726
8/16/2003	116*	0.139	10.43	1.008
	119	0.338	12.41	2.634
	120	0.011	0.47	0.064
8/18/2003	116	0.370	18.55	1.349
	119	0.814	11.93	3.911
	120*	0.005	0.975	0.035

* denotes upwind monitor. No upwind designation indicates calm conditions.

a: Battery Failure

b: Could Not Retrieve Data

c: Fault Due To Overheating

Table 7 - Perimeter Air Dust Concentrations

DATE	PUMP #	TWA mg/m^3	MAX mg/m^3	STEL mg/m^3
8/19/2003	**116**	0.008	0.358	0.022
	119	0.050	5.664	0.256
	120*	0.016	1.491	0.041
8/21/2003	**116**	0.332	15.19	2.377
	119	0.031	3.167	0.197
	120*	0.020	2.307	0.074
8/22/2003	**116**	0.76	51	3.5
	119	0.02	1.1	0.1
	120*	0	0.9	0
8/23/2003	**116**	0.730	32.35	5.462
	119	0.076	13.55	0.615
	120*	0.011	0.594	0.030
8/25/2003	**116**	0.231	13.22	2.131
	119	0.038	5.789	0.290
	120*	0.019	1.279	0.070
8/26/2003	**116**	0.113	8.460	1.723
	119	0.022	2.348	0.106
	120*	0.014	0.508	0.034
8/27/2003	**116**	0.016	2.5	0.13
	119	0.023	1.71	0.061
	120*	0.007	0.715	0.031
8/28/2003	**116**	0.031	2.008	0.178
	119	0.059	9.214	0.365
	120*	0.019	0.765	0.065
8/29/2003	**116**	0.029	1.33	0.074
	119	0.124	9.764	0.982
	120*	0.022	0.334	0.03
8/30/2003	**116**	0.046	6.741	0.029
	119	0.074	9.586	0.639
	120*	0.019	0.566	0.032
9/2/2003	**116**	0.024	5.376	0.112
	119	0.032	2.114	0.135
	120*	0.018	0.553	0.031
9/3/2003	**116**	0.008	2.360	0.157
	119	0.028	4.332	0.111
	120*	0.009	0.684	0.021
9/4/2003	**116**	0.015	3.62	0.104
	119	0.03	5.550	0.260
	120*	0.000	0.435	0.010
9/5/2003	**116**	0.033	5.14	0.171
	119	0.05	0.054	0.321
	120*	0.012	0.37	0.022
9/6/2003	**116**	0.030	11.00	0.394
	119	0.042	3.349	0.163
	120*	0.010	0.235	0.031
9/8/2003	**116**	0.005	0.185	0.024
	119	0.008	0.474	0.028
	120	0.006	0.248	0.013

* denotes upwind monitor. No upwind designation indicates calm conditions.

Table 8—Perimeter/Roadway Field Analytical Sample Data

Sampler	Sample No.	Type	Matrix	Depth (ft)	Location (Column No.)	Date Column Treated	Date Analyzed	Column Treated Age (days)	Cr (VI) Result (mg/kg or mg/L)
Weston	FHC-SO-SS003-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS004-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS005-0000	Off Site	soil	surface	Roadway	NA	9/3/03	NA	<5
Weston	FHC-SO-SS006-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS007-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS008-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS009-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS010-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS011-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS012-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS012-1000 (dup)	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS013-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS014-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS015-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS015-1000 (dup)	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS016-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS017-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS018-0000	Off Site	soil	surface	Roadway	NA	9/4/03	NA	<5
Weston	FHC-SO-SS019-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS020-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS021-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS022-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS023-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS024-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS025-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS026-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS027-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5
Weston	FHC-SO-SS028-0000	Off Site	soil	surface	Perimeter	NA	9/3/03	NA	<5

Table 9 – Groundwater Elevation Measurements

Date	GW Elevation (feet)	
	Well W85-3A	Well W99-R5A
13-Mar-03	7.88	7.89
08-Apr-03	8.41	8.4
12-May-03	8.06	8.25
15-Jul-03	6.04	5.95
17-Sep-03	3.73	3.65