HARTCROWSER

Earth and Environmental Technologies

Petroleum-Contaminated Soil Removal
Lake Washington Ship Canal
Seattle, Washington

Prepared for
Seattle District
U.S. Army Corps of Engineers
and Jacobson Terminals, Inc.

Corps Contract No. DACW67-96-M-0671

March 1997
J-4617

CONTENTS

TABLES

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

Page

PETROLEUM-CONTAMINATED SOIL REMOVAL
LAKE WASHINGTON SHIP CANAL
SEATTLE, WASHINGTON

EXECUTIVE SUMMARY

The work documented in this petroleum-contaminated soil (PCS) removal report follows identification in 1993 of a potential petroleum release and follow-up site characterization by the United States Army Corps of Engineers (Corps) and Jacobson Terminals Incorporated (Jacobson). Construction of a new fence on the eastern border of the Corps property with the Pirelli-Jacobson property was initiated in 1993. During excavation for a concrete retaining wall footing, soil with an oily appearance and a strong petroleum odor was discovered. Excavation and construction ceased pending further investigation of the soil in this area. Field investigations were conducted by Woodward-Clyde on behalf of the Corps and by Hart Crowser Incorporated on behalf of Jacobson. These investigations identified the presence of petroleum hydrocarbons, polychlorinated biphenyls (PCBs), and trace concentrations of other constituents, and estimated the horizontal extent of contamination. Based on results of the combined studies and the potential to impact regional surface water and groundwater, the recommended remediation was to remove the contaminated soils.

Approximately 64 tons of PCS were excavated from the site and disposed of at the Rabanco Regional Landfill in Roosevelt, Washington. As part of the removal action, excavation side wall and bottom soil verification samples were collected and analyzed for total petroleum hydrocarbons (TPH) quantified as diesel/oil, and for PCBs. Results of analysis indicated soil from the excavation bottom and side walls contained diesel concentrations above the Washington State Department of Ecology's (Ecology) Model Toxics Control Act (MTCA) Method A Industrial soil cleanup level of 200 mg/kg. Results of analyses indicated PCB levels below Ecology's MTCA Method A Industrial soil cleanup level of 10 mg/kg. To determine potential groundwater contamination, three monitoring wells were installed, and groundwater samples were collected and analyzed for TPH and PCBs as part of this work.

The results of soil sampling and laboratory analysis indicate that PCS remains in the bottom and side walls of the excavation. Physical site constraints restrict further removal of PCS. Based on the analytical results of the current work and previous investigations, it is estimated that a total of approximately 100 cubic yards of PCS remains in-place on site. The recommended remedial approach for the remaining PCS is to leave it in-

place and continue to monitor groundwater to demonstrate that the in-place soil is not adversely affecting groundwater conditions.

PCBs were not detected in any of the groundwater samples collected. Chemical analytical results of groundwater from well HC-MW-3 (upgradient of the excavation area) reported a WTPH-D concentration of 0.33 mg/L, which is below the MTCA Method A cleanup level of 1.0 mg/L. TPH was not detected in groundwater samples from the other two monitoring wells.

1.0 INTRODUCTION

The Corps Seattle District and Jacobson retained Hart Crowser to perform contaminated soil removal and disposal, and groundwater monitoring well installation and sampling and analysis at the Lake Washington Ship Canal, Hiram Chittenden Locks. The purpose of the action was to address identified petroleum- and PCB-contaminated soil at the east boundary of the Corps property (west boundary of the Pirelli-Jacobson property; see Figure 1). The soil removal and excavation backfilling were performed between August 19 and 23, 1996; and the well installation/sampling and PCS disposal occurred between September 24 and 30, 1996. Portions of the field work were performed in the presence of Ms. Anna Campbell (Corps representative). The Corps assigned this project under Contract No. DACW67-96-M-0671. This work was accomplished in general accordance with the Management Plan, dated August 21, 1996, and the Management Plan Addendum, dated September 6, 1996.

2.0 PETROLEUM-CONTAMINATED SOIL REMOVAL AND SAMPLING

2.1 Extent of Soil Removal

Soil excavation decision points were defined by the following MTCA Method A Industrial soil cleanup levels:

- Diesel or other petroleum hydrocarbons - 200 mg/kg
- PCB mixtures - 10 mg/kg

In addition, it was anticipated in the Management Plan that physical features present at the site would likely limit the extent of soil excavation.

PCS excavation was guided by field soil screening tests and visual observations discussed below. The areal extent of PCS removal and the locations of soil verification samples are shown on Figure 1. The soil

verification samples analytical results indicate that TPH concentrations in the side walls and much of the bottom of the excavation were above the MTCA Method A Industrial soil cleanup level of 200 mg/kg, as shown in Table 3.

Groundwater was encountered during excavation at a depth of approximately 5 to 8 feet. This water level is considered the top of the localized groundwater table. Excavation below the water table was stopped at the request of the Corps project manager for the following reasons:

- Concern for building integrity;
- Concern with disposal of wet contaminated material removed below the water table;
- Concerns of contract-capacity for soil disposal and lack of dewatering capacity in the contract; and
- The limited benefits of additional excavation based on chemical analysis results of groundwater monitoring.

2.2 Field Observations

Approximately 90 cubic yards of soils were excavated to an approximate depth of 3 to 5 feet below adjacent ground surface. Soils were temporarily stockpiled on site in a plastic-lined and -covered area on the asphalt parking lot just north of the excavation. (See the **EXCAVATION AND INVESTIGATION-DERIVED WASTE** section discussion below.) During excavation, samples were collected from the ongoing excavation soil face or from shallow test pits dug adjacent to the excavation. These samples were screened in the field for PCBs and TPH using Ensys and Hanby field test kits, respectively. See Table 2 for a summary of field test kit results. Descriptions of soil sampling methods are provided in Appendix A. Final verification soil samples for laboratory analysis were collected when the excavation was completed.

Our field observations following excavation indicated visual signs of in-place soils affected by petroleum hydrocarbons in the excavation side walls. Only to the south, along the alley between the Corps and Jacobson buildings, was the lateral extent of the PCS determined. A test pit excavated approximately 5 feet south of the final southern PCS excavation limit did not encounter petroleum-stained soils.

Following verification soil sampling, the excavation was backfilled with imported soils. Soil was placed and compacted in successive layers

utilizing a plate vibratory compactor. Two soil compaction tests were completed, yielding 94 and 95 percent compaction based on ASTM D 1557 modified Proctor. See Appendix C for laboratory test results.

Daily field reports and field notes are presented in Appendix E.

2.3 Installation of Geotextile Fabric and Migration Barrier

After the excavation was completed and prior to starting backfilling operations, woven geotextile fabric was placed to cover the bottom of the excavation. This filter fabric provides a delineation of the extent of excavation, and also provided needed stability during backfilling. Existing grade soils were comprised of wet silty sand; this fabric allows water displacement during seasonal groundwater fluctuations, and also helps compaction efficiency.

Analytical results for verification samples of excavation side walls indicated TPH concentrations above the MTCA cleanup level for all side walls (Table 3). To prevent the clean imported backfill from coming into contact with the PCS left in-place, a migration barrier consisting of 18-mil-thick plastic sheeting was placed vertically along the west and east sides of the existing buildings.

2.4 Summary of Analytical Results

Seven soil verification samples were submitted to the Hart Crowser Chemistry Laboratory for analysis of TPH quantified as diesel/oil by method WTPH-D (Extended) and PCBs by EPA Method 8081. See Table 3 for results.

Only one (HC-EX-1L) of the seven soil verification samples had a TPH concentration below the MTCA Method A Industrial soil cleanup level of 200 mg/kg. The other samples contained TPH quantified as diesel at concentrations ranging from 280 to 22,000 mg/kg. All verification soil samples had PCB concentrations below the MTCA Method A Industrial soil cleanup level of 10 mg/kg. Data quality (including accuracy, precision, completeness, representativeness, and comparability) is evaluated in Appendix B relative to the objectives established in the Management Plan. Chemistry laboratory analytical reports are also presented in Appendix B.

3.0 MONITORING WELL INSTALLATION AND WATER SAMPLING

3.1 Monitoring Well Locations

To assess potential impacts of TPH and PCB contamination to the groundwater, three monitoring wells (HC-MW-1 through HC-MW-3) were installed in accessible areas around the PCS excavation, as shown on Figure 1. Well HC-MW-3 is located in the expected upgradient location from the PCS excavation. Wells HC-MW-1 and HC-MW-2 are located in expected downgradient locations.

Water was encountered at depths of approximately 5 to 8 feet. The initial soil boring for well HC-MW-2 (HC-SB-1) was not completed as a monitoring well because an approximate 5-foot-thick zone of wood debris was encountered in the planned well screen interval. An oil layer/sheen on the groundwater table and a creosote-like odor were noted in this boring during withdrawal of drill rods and water level measuring equipment. This oil sheen may have originated from the auger cuttings of the wood material. A well installed in this material would not represent an accurate groundwater condition; therefore, the soil boring was abandoned and HC-MW-2 was installed at a nearby location as shown on Figure 1.

3.2 Field Observations

Four soil borings (HC-MW-1 through HC-MW-3 and HC-SB-1) were drilled, three of which were completed as monitoring wells. HC-MW-1 and HC-MW-2 were completed at a depth of 14.5 feet. HC-MW-3 was completed at a depth of 13.0 feet. Eighteen-inch soil samples were collected at 5-foot-depth intervals from each boring. Each soil sample recovered was classified in general accordance with ASTM D 2488 as depicted on Figure A-1. Descriptions of soil sampling methods and logs of soil borings are provided in Appendix A.

Field observations during drilling indicate the site is underlain by 3 to 6 feet of fill consisting of crushed rock and silty, gravelly, fine to medium sand. Below this, the soils are generally described as hydraulic fill placed for construction of the ship canal locks and terminals. These soils consist of silty sand to sand with interbedded thin silt layers. In HC-MW-1 and HC-MW-3, a soft to medium stiff, clayey silt was encountered at approximate depths of 14 and 11 feet, respectively.

In soil borings HC-MW-3, HC-SB-1, and HC-MW-2, creosote-like odors were observed in the soil samples. Additionally, during drilling of HC-SB-1 and HC-MW-2, a sheen was observed on the groundwater table in the hollow-stem auger. Sheens were also initially observed during well development of monitoring wells HC-MW-2 and HC-MW-3. However, no sheen was observed during well sampling.

3.3 Summary of Analytical Results

Four groundwater samples, one from each well and one field duplicate from HC-MW-2, were submitted to the Hart Crowser Chemistry Laboratory for analysis of TPH quantified as diesel by method WTPH-D (Extended) and PCBs by EPA Method 8081.

Chemical analytical results for groundwater in HC-MW-3 indicated a detectable concentration of TPH quantified as diesel at 0.33 mg/L (see Table 4). This result is below the MTCA Method A cleanup level of 1.0 mg/L. No TPH quantified as diesel was detected in the other water samples analyzed. PCBs were not detected in any of the water samples. Data quality is evaluated in Appendix B relative to the objectives established in the Management Plan. The Hart Crowser Chemistry Laboratory Analytical Report is also presented in Appendix B.

4.0 EXCAVATION AND INVESTIGATION-DERIVED WASTES

4.1 Excavated PCS and Soil Boring Cutting Materials

The excavated stockpiled soils and drill cuttings were profiled to assure transport and disposal in compliance with all potentially applicable regulations, including the Toxic Substances Control Act (TSCA), land disposal restrictions (LDRs), and Washington State Dangerous Waste regulations. Three separate stockpiles—clean overburden, PCS, and a pre-existing stockpile (material excavated for construction of the foundation of the east boundary fence in 1993)—were profiled and characterized.

Six soil designation samples (HC-SP-1L through HC-SP-6L) were collected from the three stockpiles. One sample was collected from the clean overburden material and labeled HC-SP-1L. Three samples were collected from the PCS stockpile and labeled HC-SP-2L, HC-SP-3L, and HC-SP-4L. Two samples were collected from the pre-existing Corps stockpile (located at the south end of the site) and labeled HC-SP-5L and HC-SP-6L. All stockpile samples were collected as 5-point composites.

The six samples were submitted to the Hart Crowser Chemistry Laboratory for TPH quantified as diesel/oil by method WTPH-D (Extended) and PCBs by EPA Method 8081. In addition, the soil designation sample with the highest TPH concentration (HC-SP-3L) was submitted to MultiChem Analytical Services for analysis of semivolatile organics by EPA Method 8270 and total metals (As, Ba, Cd, Cr, Pb, Hg, Se, and Si) by EPA 6000 and 7000 Series. (Analysis for semivolatile organics and metals was required by the disposal company for verification of other potential hazardous constituents.) Analytical results are summarized in Table 1, and the chemistry laboratory analytical reports are presented in Appendix B.

Soil cuttings and excess split-spoon sample material from the soil borings were collected and placed in the PCS stockpile for off-site disposal.

Based on the analytical results, 64.3 tons of PCS were approved by the Corps and Jacobson for off-site disposal at Rabanco Regional Landfill's solid waste landfill in Roosevelt, Washington. Copies of disposal certificates for the PCS material are included in Appendix D. Soil sample analytical results for the two remaining stockpiles (clean overburden and the pre-existing Corps stockpile) were below MTCA Method A cleanup levels. These soils were left on site for reuse by the Corps.

4.2 Decontamination Wastewater

Following decontamination procedures for drilling and sampling equipment, all wash waters were immediately placed into sealed 55-gallon drums. Three 55-gallon drums were appropriately labeled and stored near HC-MW-3. Based on the analytical results for samples from these drums, the water does not exceed regulatory criteria and can be disposed of by sanitary sewer, storm drain, watering vegetation, or off-site treatment at a licensed facility.

4.3 Solid Waste

All solid waste material, including used personal protective equipment, waste paper, and plastic generated during investigation activities were disposed of off site in solid waste storage bins.

5.0 PROPOSED SITE REMEDIATION APPROACH

5.1 Extent of PCS

The following discussion regarding the site remediation approach is based on the analytical results of soil samples collected during the PCS removal (excavation side wall and bottom samples) and limited groundwater sampling and analysis. These results indicate the site still contains soil with TPH concentrations above the MTCA Method A Industrial soil cleanup level of 200 mg/kg.

Groundwater Impacts

Since soils in the PCS excavation area consist primarily of moderately permeable loose silts and sands, the potential exists for migration of TPH into the groundwater. Based on the limited analytical results, the groundwater in the area of concern has not been significantly impacted. Continued groundwater monitoring is recommended to evaluate any possible impacts the in-place PCS may have or contribute over time.

5.2 Recommended Approach to Site Remediation

The volume of PCS remaining beneath the site buildings and associated paved parking areas is estimated to be 100 cubic yards.

Given the limited impact to the groundwater surrounding the PCS excavation, we recommend continuing groundwater monitoring with no additional PCS excavation. With the significant source removal of PCS completed, and with the majority of the remaining PCS under existing buildings and isolated with plastic sheeting, there is less potential for TPH to leach to the groundwater. Water samples from the three monitoring wells should be collected and analyzed quarterly for one year to determine if seasonal variations of rainfall and groundwater fluctuations effect groundwater TPH concentrations. After one year, the frequency of the monitoring should be reevaluated.

Reporting activities should be performed in accordance with Ecology's guidance documents for petroleum-contaminated sites.

6.0 LIMITATIONS

Work for this project was performed, and this letter report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of the U.S. Army Corps of Engineers and Jacobson Terminals, Inc. for specific application to the referenced property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

Any questions regarding our work and this report, the presentation of the information, and the interpretation of the data are welcome and should be referred to the undersigned.

We trust that this report meets your needs.

Sincerely,

HART CROWSER, INC.

David A. Heffner

DAVID A. HEFFNER, P.E.
Associate Engineer

LAKEWASH.fr

Table 1 - Summary of Chemical Analytical Results-Stockpile Soil Samples

Analytes	MTCA Method A Industrial Cleanup Level	TSCA Regulatory Level	Stockpile Samples HC-SP-1L	HC-SP-2L	HC-SP-3L	HC-SP-13L Dup HC-SP-3L	HC-SP-4L	HC-SP-5L	HC-SP-6L
% moisture			6	7	8	9	8	2	2
TPH as Diesel in mg/kg	200		20	150	190	150	140	21	29
TPH as Oil in mg/kg	200		47 J	830	**1200**	**960**	**1100**	190	170
PCBs in mg/kg(2)									
Aroclor 1260	1	50	0.46	0.42	0.37	0.37	0.14 J	**1.5**	**4.5**
Semivolatiles in mg/kg									
2- Methylnapthalene					0.45 J				
Fluorene	140 (1)				0.69 J				
Phenanthrene	NA				1.6 J				
Anthracene	1050 (1)				0.32 J				
Fluoranthene	140 (1)				1 J				
Pyrene	105 (1)				1.6 J				
Benzo (a) Anthracene	0.012 (1)				**0.5** J				
Bis (2-ethylhexyl) phthalate	6.25 (1)				0.35 J				
Chrysene	0.012 (1)				**0.66** J				
Benzo (b) fluoranthene	0.012 (1)				**0.62** JT				
Benzo (k) fluoranthene	0.012 (1)				**0.62** JT				
Benzo (a) pyrene	0.012 (1)				**0.49** J				
Indeno (1,2,3-cd) pyrene	0.012 (1)				**0.3** J				
Benzo (g,h,i) perylene	NA				0.3 J				
Metals in mg/kg									
Arsenic	20				6.3				
Barium	245 (1)				71				
Cadmium	2				0.57 U				
Chromium	100				22				
Lead	250				42				
Mercury	1				0.11 U				
Selenium	17.5 (1)				1.4 U				
Silver	17.5 (1)				0.29 U				

Notes:
U = Not detected at reported detection limit
J = Estimated Value
JT= Value represents the sum of the benzo(b) and benzo(k) isomers
(1) MTCA Method C used when no MTCA Method A Level has been assigned.
Bolded values exceed regulatory criteria.
Blanks indicate sample not analyzed for indicated analyte.
(2) All other Aroclors (A1016, A1221, A1232, A1242, A1248, and A1254) were not detected at reported detection limits.

4617/TBL-1.xls

Table 2 - Summary of Soil Field Screening Results

Field Sample ID	Hanby TPH in mg/kg*	EnSys PCBs in mg/kg*[2]
MTCA Method A Industrial Cleanup Level	**200/200*[3]**	**1**
QT-1	>10,000	<10
QT-2	<10	<10
QT-3	>1,000	10 to 50
QT-4	5,000	<10
QT-5	>5,000	10 to 50
QT-6	>10,000	10 to 50
QT-7	100 to 200	10 to 50
QT-8	>100	ca. 50
QT-9	>1,000	10 to 50

* Wet-weight basis.

[2] High TPH values (>1,000) can interfere with PCB analysis.

[3] TPH as Diesel/Oil.

4617/TBL-2.xls

Table 3 - Summary of Chemical Analytical Results - Excavation Soil Verification Samples

Analytes	MTCA Method A Industrial Cleanup Level	Verification Samples							
		Bottom Samples			Sidewall Samples				
		HC-EX-1L	HC-EX-2L	HC-EX-3L	HC-EX-4L	HC-EX-5L	HC-EX-6L	HC-EX-7L	HC-EX-17L Dup HC-EX-7L
% moisture		14	11	15	9	9	9	10	12
TPH as Diesel in mg/kg	200	20 U	**330**	**280**	**2800 J**	**6300 J**	**9700 J**	**810**	54
TPH as Oil in mg/kg	200	48 J	**1600**	**1100**	**6700**	**12000 J**	**22000 J**	**2900**	**300**
PCBs in mg/kg(2)									
Aroclor 1260	1	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U

Notes:
U = Not detected at reported detection limit
J = Estimated Value
(1) MTCA Method C used when no MTCA Method A Level has been assigned.
Bolded values exceed regulatory criteria.
(2) All other Aroclors (A1016, A1221, A1232, A1242, A1248, and A1254) were not detected at reported detection limits.

4617/TBL-3.xls

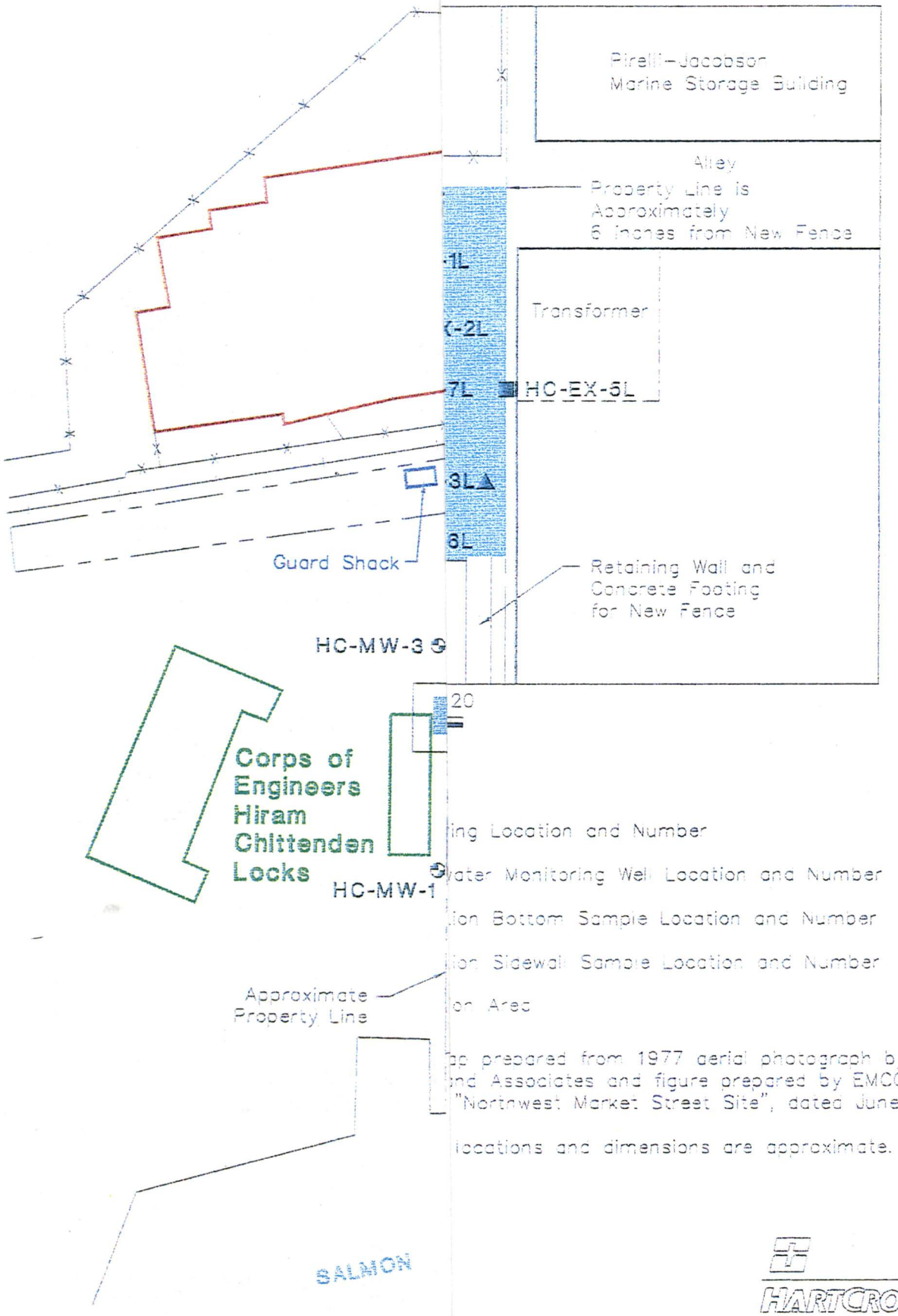
Table 4 - Summary of Chemical Analytical Results - Groundwater Samples

Analytes	MTCA Method A Cleanup Levels	Groundwater Sample			
		HC-MW-1L	HC-MW-2L	HC-MW-3L	HC-MW-12L Dup HC-MW-2L
TPH as Diesel in mg/L	1	0.25 U	0.25 U	0.33	0.25 U
TPH as Oil in mg/L	1	0.75 U	0.75 U	0.75 U	0.75 U
TSS in mg/L		130	44	72	
PCBs in mg/L	0.1	ND	ND	ND	ND

ND - not detected
U - not detected at indicated detection limit

4617/TBL-4.xls

Site and Exploration Pl



ap prepared from 1977 aerial photograph by
nd Associates and figure prepared by EMCON
"Northwest Market Street Site", dated June 1995.

locations and dimensions are approximate.

CVD 3/10/97 1=100 franklin.pcp
4617000.5

HARTCROWSER

J-4617 3/97

Figure 1

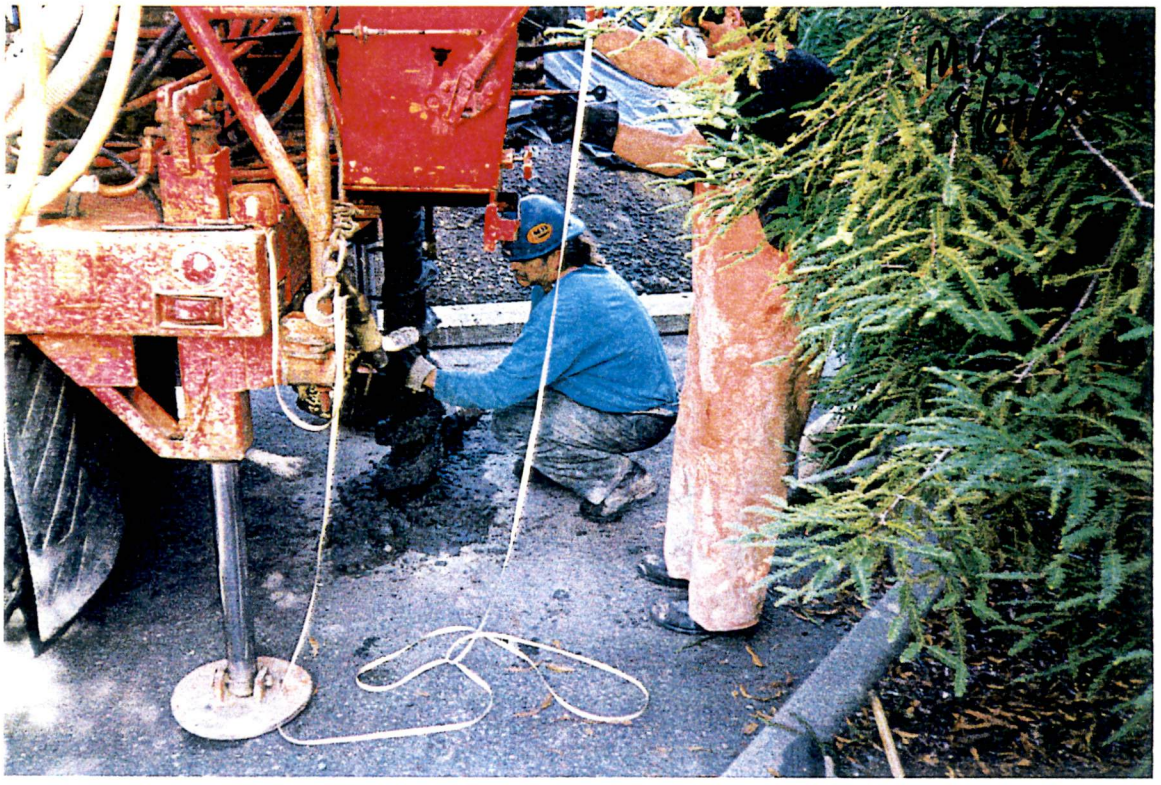
ATTACHMENT A
PHOTOGRAPHS

Photograph 1 - Site Before PCS Excavation. View North.

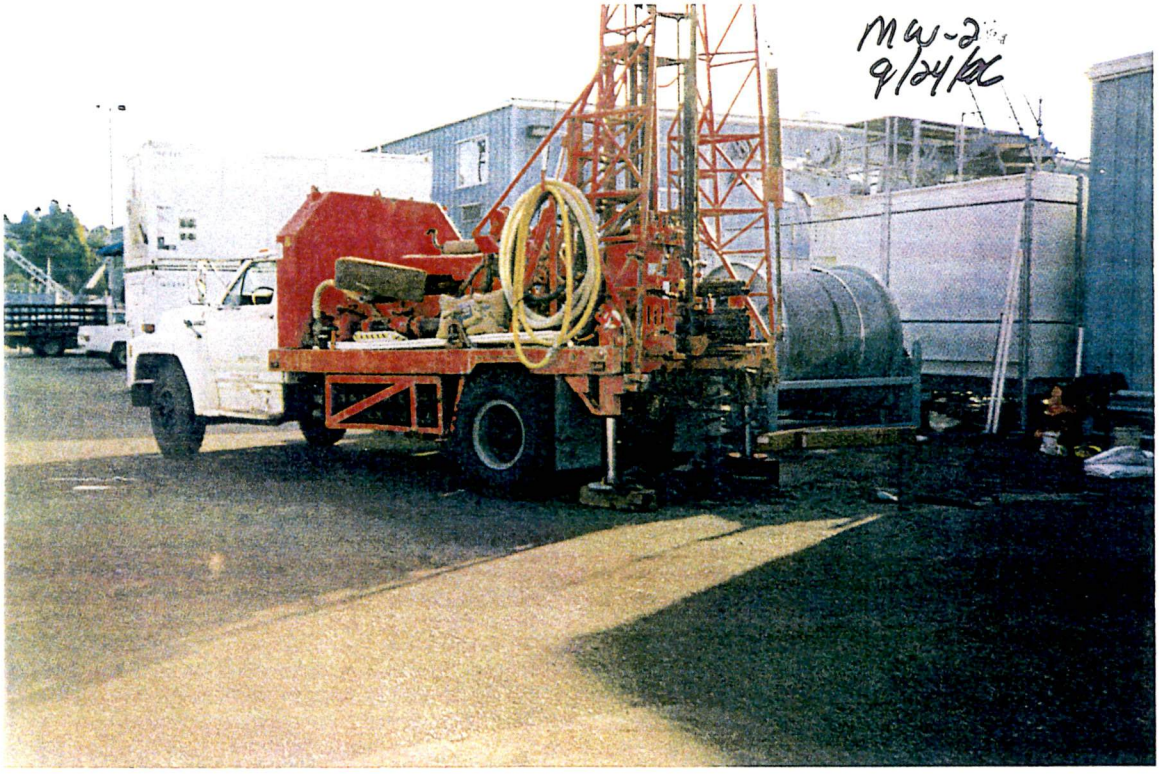
Photograph 2 - PCS Excavation. View South.

Photograph 3 - Site Following PCS Excavation with Migration Barrier Installed. View North.

Photograph 4 - PCS Stockpile in Background and Import Backfill Soil in Foreground. View North.



Photograph 5 - Drilling Monitoring Well HC-MW-3. View North.



Photograph 6 - Drilling Monitoring Well HC-MW-2. View Southwest.

APPENDIX A
FIELD AND LABORATORY METHODS

APPENDIX A
FIELD AND LABORATORY METHODS

FIELD METHODS

This appendix documents the methods used by Hart Crowser in completing the remedial actions, subsurface explorations, and sample collection at the Lake Washington Ship Canal, Hiram Chittenden Locks. The subject property is located in the Ballard section of Seattle, Washington. Work completed on property included the following:

- Excavation and stockpiling of contaminated soil;
- Verification soil sampling and analysis;
- Stockpile soil sampling and analysis;
- Backfill and compaction;
- Compaction testing;
- Hollow-stem auger drilling and soil sample collection;
- Monitoring well installation and development;
- Groundwater sampling; and
- Relative vertical survey of exploration locations.

Excavation and Stockpiling of Contaminated Soil

Excavation of contaminated soils was performed by S&J Trucking and Excavation of Fife, Washington. The identified contaminated material was excavated with a rubber-tired backhoe. There was limited access into the area between the Corps and Jacobson buildings because of horizontal excavation constraints due to buildings, sloping ground surface, and location of pavement. The area could only be accessed from the north end of the site. The physical limitations of a narrow alley in which several feet of overburden existed over the identified contaminated material layer, the close proximity to groundwater, and contract soil quantities, limited the excavation. To gain access into the area of PCS excavation, it was necessary to grade a ramp down into the excavation area from the north side. Once in the excavation area, excavation progressed from the south toward the entrance/exit ramp on the north.

The excavated material was placed on a double layer of 6-mil plastic located on the north side of the adjacent parking lot. The stockpile was covered with 6-mil plastic and secured with sandbags and concrete and wood blocks until final disposal.

Verification Soil Sampling and Analysis

Seven discrete verification soil samples (HC-EX-1L through HC-EX-7L) were collected from the bottom and side walls of the open excavation and analyzed for petroleum hydrocarbons and PCBs. Soil samples were collected from the east, west, south, and north side walls and three excavation bottom locations. Collection of the discrete samples was performed by hand with a shovel or stainless steel spoon by excavating below the exposed surface. The samples were placed into laboratory-cleaned jars and placed in a cooler filled with blue ice and held under chain of custody protocol until submitted for chemical analysis. The shovel and stainless steel spoon were decontaminated between sample collections with a Alconox wash, tap water rinse, and a de-ionized water rinse.

Stockpile Soil Sampling and Analysis

Six 5-point composite soil samples were collected from the three stockpiles created during the remedial action. The three piles created were excavated clean overburden, excavated PCS, and previously excavated material stockpiled at the southern end of the Corps Warehouse building. Each composite sample consisted of five subsamples collected and placed in a stainless steel mixing bowl and thoroughly mixed prior to collecting a sample. The samples were placed into laboratory-cleaned jars and placed in a cooler filled with blue ice and held under chain of custody protocol until submitted for chemical analysis.

Moisture-Density Relationship (MD)

Moisture-density tests were performed on the selected import backfill in general accordance with ASTM D 1557 (Modified Proctor Test). The test results plotted in terms of dry density versus water content determined a maximum dry density and optimum moisture content. A grain size of the material was also performed. The data have been incorporated into the CBR test results referred to in the following section and are presented on Figures C-2 and C-3.

Compaction Testing

After the excavation had been backfilled and compacted with selected imported backfill, two compaction tests were performed from the base of the backfilled excavation by a representative from Hart Crowser. The two nuclear density tests were performed with a Campbell Densometer operated by a nuclear testing equipment-certified representative. The compaction specified in the scope of work was 95 percent based on cohesionless soils

based on modified Proctor density method (ASTM D 1557). Test results were 94 and 95 percent compaction, and suitable in our opinion for support of the proposed asphalt pavement and fence foundations.

Soil Classification

The on-site field representative visually classified the soil samples recovered from the borings in general accordance with ASTM Method D 2488 (Figure A-1), prepared a log of soils encountered in the exploration, and recorded pertinent observations regarding drilling conditions, types of soils encountered, and depth to water during drilling (see Figures A-2 through A-5). Soil descriptions included the following properties: density of sands and gravels/consistency of silts and clays (as determined from the Penetration Resistance or qualitatively estimated from drill action), moisture, color, minor constituents, and major constituents. The presence of non-soil substances (e.g., debris, NAPLs) were also noted when applicable.

Well Installation and Development

Hart Crowser retained the services of McDonald Drilling, Inc., of Milton, Washington, to complete the subsurface drilling and installation of monitoring wells. Monitoring wells were installed in the borings after drilling, soil classification, and logging were completed. The wells were constructed using 2-inch-diameter PVC, flush-threaded joints, and either 5 feet or 10 feet of 20 slot screen. The wells were constructed by lowering the PVC assembly into the hollow-stem augers and backfilling the screened section with 10/20 silica sand as the augers were removed. The sand was extended at least one to two feet above the top of the screen. Bentonite grout was placed in the remaining borehole to a depth of 3 to 4 feet below ground surface. Concrete filled the hole to ground surface and was used to secure a steel flush-mounted monument over each well. The monuments and lids are secured with tamper-proof bolts. The wells have a concrete seal around each well to provide protection from runoff during storm events.

Hart Crowser developed the newly installed monitoring wells using a combination of stainless steel bailers and a 2-inch submersible purge pump. Development continued until the wells produced relatively clear water and negligible sediment thicknesses were measured at bottom. Wells HC-MW-1 and HC-MW-3 went dry during development. Each well was allowed to recharge to original water level and development continued until reaching the proposed 10 casing volumes or the measured parameters (pH, temperature, and conductivity) stabilized. No sediment was measured in the well or could be seen in the water removed. Between 9 and 15 gallons

of water were removed from each well. Field parameters (pH, temperature, conductivity) were monitored throughout most of the well development. Development was continued until the field parameters stabilized.

Equipment Decontamination

Before drilling, the drill rig, all auger sections, steel casing, and downhole equipment were steam cleaned. Between each boring, the drilling and downhole soil sampling equipment were steam cleaned using clean water. Steam cleaning was conducted adjacent to the boring location.

Before each sample for chemical analysis was collected, all downhole soil and groundwater sampling equipment was decontaminated by:

- Scrubbing with detergent solution (ALCONOX);
- Rinsing with tap water; and
- Thoroughly spraying with deionized water.

Investigation-Derived Waste Handling

Soil cuttings from the monitoring well drilling was added to the contaminated soil stockpile and disposed of off site. Decontamination and purge water were placed in 55-gallon drums labeled with the date, drum number, job name, source contract number, contact phone numbers, and a description of the contents and were left on the site.

There are six 55-gallons of wastewater left on the site. One of these drums was left on site from previous Corps work activities. This drum is located near HC-MW-1. There was one drum of steam cleaning rinse waters and one drum of decontamination water developed during the monitoring well installation. These two drums are located near HC-MW-3. Development and purge water from each well was placed into separate designated drums near each well.

Borehole Abandonment

HC-SB-1 was abandoned after encountering large amounts of voids and wood debris. The borehole was abandoned by filling with bentonite chips as the auger was withdrawn, in accordance with Chapter 173-160 WAC "Minimum Standards for Construction and Maintenance of Wells."

Groundwater Sampling

Groundwater samples were collected from each of the three wells on September 26, 1996. Water level measurements were made immediately prior to sampling. Approximately three casing volumes were removed from each well prior to sampling. Groundwater samples were collected using a low flow peristaltic pump, with silicon and poly tubing. The silicon and poly tubing were discarded between sampling locations. The decontamination procedure for re-usable equipment consisted of an Alconox solution wash, a tap water rinse, followed by a deionized water rinse. Groundwater was transferred directly from the bailers into laboratory-supplied bottles. The sample bottles were held in coolers with blue ice until delivered to the laboratories.

Field parameters measured at the time of sampling are presented below.

Table A-1 - Groundwater Field Parameter Data

Well Number	pH	Specific Conductivity in μs	Temperature in °C
HC-MW-1	7.8	96	7
HC-MW-2	7.8	93	8
HC-MW-3	7.8	114	7

Relative Vertical Site Survey

Hart Crowser determined the elevation of each completed monitoring well casing and adjacent ground surface, relative to an assumed elevation datum. Monitoring well HC-MW-2 was given an assumed elevation of 100.0 feet. All elevations for the monitoring wells are relative to this elevation, and are presented on the boring logs. Relative vertical elevations were used to evaluate water level data, so that the groundwater flow direction could be estimated. The groundwater flow direction at the site is to the southeast.

Sample Custody

A sample custody form and cooler receipt form were completed and transmitted with each release and receipt of samples collected in this investigation. Original custody documents are retained by Hart Crowser. Copies of the completed custody forms are presented in Appendix B with the laboratory testing data.

LABORATORY METHODS

Field Screening Test Kits

The excavation was guided by the use of field screening. The field screening consisted of: screening of organic vapors using a portable photoionization detector (PID) equipped with a 11.7 eV lamp and the use of Ensys and Hanby field PCB and TPH test kits.

The PID is capable of providing qualitative estimates of total organic vapor concentrations in the sample jar headspace and is not affected by the presence of methane. The soil sample jars headspace were covered with aluminum foil, capped, and allowed to equilibrate for a minimum of 10 minutes. PID measurements were made by removing the cap and penetrating the aluminum foil with the tip of the PID, taking care not to allow contact between the tip of the PID and soil particles. The maximum organic vapor reading observed during the first 10 seconds was recorded on the field boring log. Field PID measurements and visual observations were used to help select samples to be sent to the laboratory for chemical analysis.

Soil from the excavation was screened for TPH and PCBs in the field by using a Hanby and Ensys field test kit. The Hanby kit is capable of providing semi-quantitative estimates of the total petroleum hydrocarbon concentrations in the soil sample. Hanby measurements were made by weighing out five grams of soil and extracting with a solvent. The extract was poured into a test-tube, a catalyst was added, and the contents shaken. The color of the reacted sample indicated the type of compound present and the intensity was used to estimate its concentration.

The Ensys kit uses immunoassay techniques to estimate whether a sample has a PCB concentration higher or lower than that of a prepared standard (10 ppm for this project). Ten grams of soil were weighed out and extracted with methanol. A portion of the extract was then diluted with an aqueous buffer solution, prepared by immunoassay, and its color intensity measured using a photometer. The yellow color which develops is inversely proportional to the amount of PCBs present; i.e., if the extract sample is a lighter yellow than the standard, the soil sample concentration is reported as greater than 10 ppm.

Quality Control Samples

In addition to the soil samples, sample HC-EX-17L was submitted as a blind duplicate of HC-EX-7L for analysis of PCBs and total petroleum

hydrocarbons quantified as diesel. Two duplicate samples from the PCS stockpile and excavation locations (HC-SP-3L and HC-EX-7L) were also submitted to the NPD laboratory in Troutdale for confirmation analysis. Quality control sample results are presented in Attachment B-2 of Appendix B and discussed in the ***Comparability*** section in Appendix B.

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual–manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following:
Density/consistency, moisture, color, minor constituents, MAJOR CONSTITUENT, additional remarks.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance.
Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 – 4	Very soft	0 – 2	<0.125
Loose	4 – 10	Soft	2 – 4	0.125 – 0.25
Medium dense	10 – 30	Medium stiff	4 – 8	0.25 – 0.5
Dense	30 – 50	Stiff	8 – 15	0.5 – 1.0
Very dense	>50	Very stiff	15 – 30	1.0 – 2.0
		Hard	>30	>2.0

Moisture

Dry	Little perceptable moisture
Damp	Some perceptable moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptable moisture, probably above optimum

Minor Constituents

	Estimated Percentage
Not identified in description	0 – 5
Slightly (clayey, silty, etc.)	5 – 12
Clayey, silty, sandy, gravelly	12 – 30
Very (clayey, silty, etc.)	30 – 50

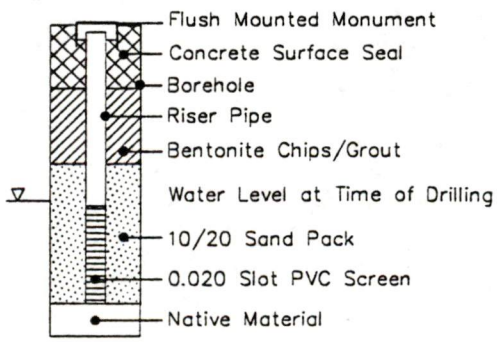
Legends

Sampling Test Symbols

BORING SAMPLES		TEST PIT SAMPLES	
⊠	Split Spoon	⊠	Grab (Jar)
▨	Shelby Tube	▨	Shelby Tube
▥	Cuttings	▨	Bag
▯	Core Run		
*	No. Sample Recovery		
P	Tube Pushed, Not Driven		

Test Symbols

GS	Grain Size Classification
CN	Consolidation
TUU	Triaxial Unconsolidated Undrained
TCU	Triaxial Consolidated Undrained
TCD	Triaxial Consolidated Drained
QU	Unconfined Compression
DS	Direct Shear
K	Permeabilty
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits
PID	Photoionization Reading
CA	Chemical Analysis



Groundwater Observations

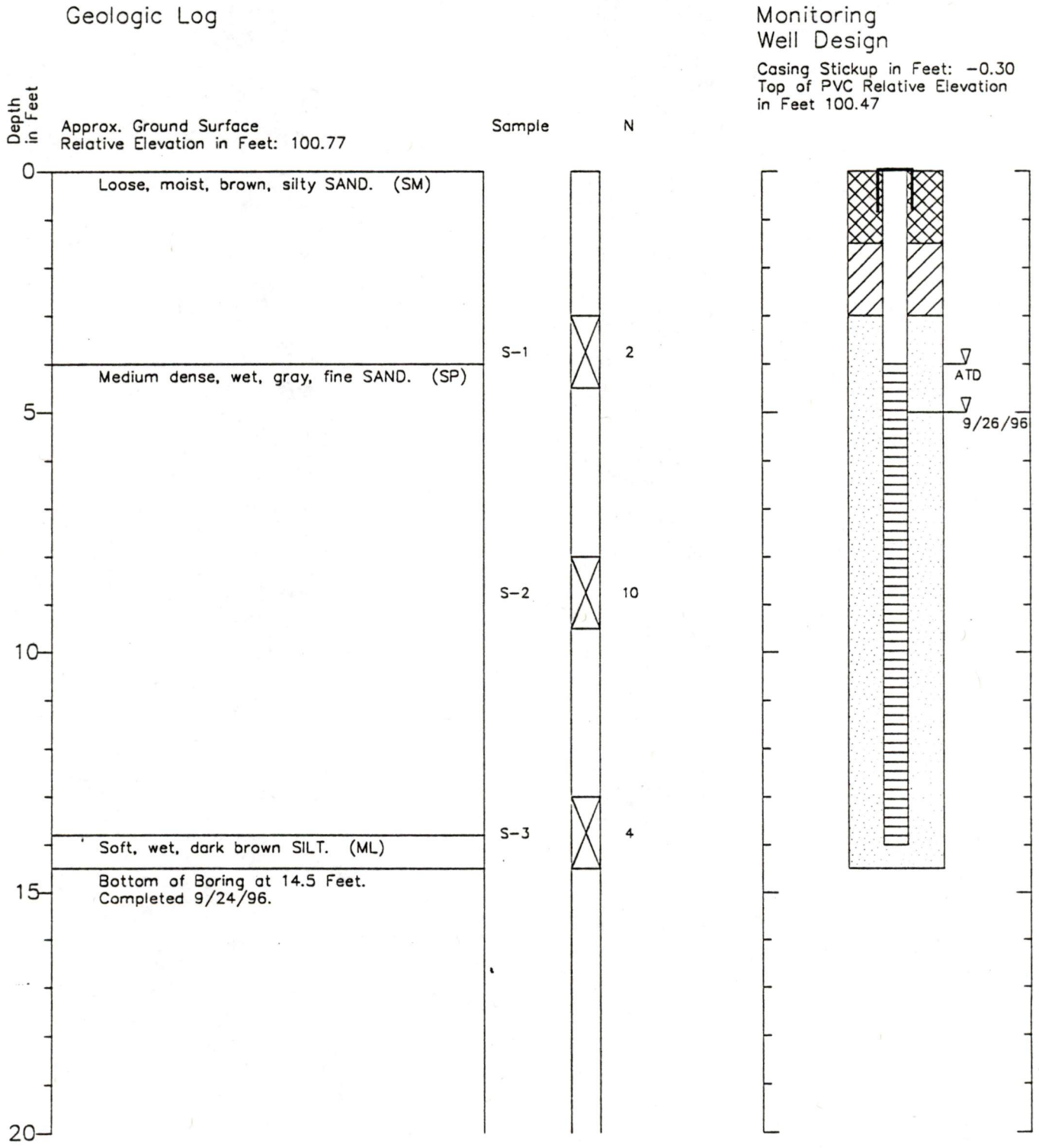
a-1 key 6 1=1 hc.pcp

HARTCROWSER

J-4617 3/97

Figure A-1

Boring Log and Construction Data for Monitoring Well HC-MW-1



1. Refer to Figure A−1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated is at time of drilling (ATD) or for date specified. Level may vary with time.
4. Ground surface elevation based on an assumed elevation of 100.00 feet on top of HC−MW−2 PVC casing.

HARTCROWSER

J-4617 9/96

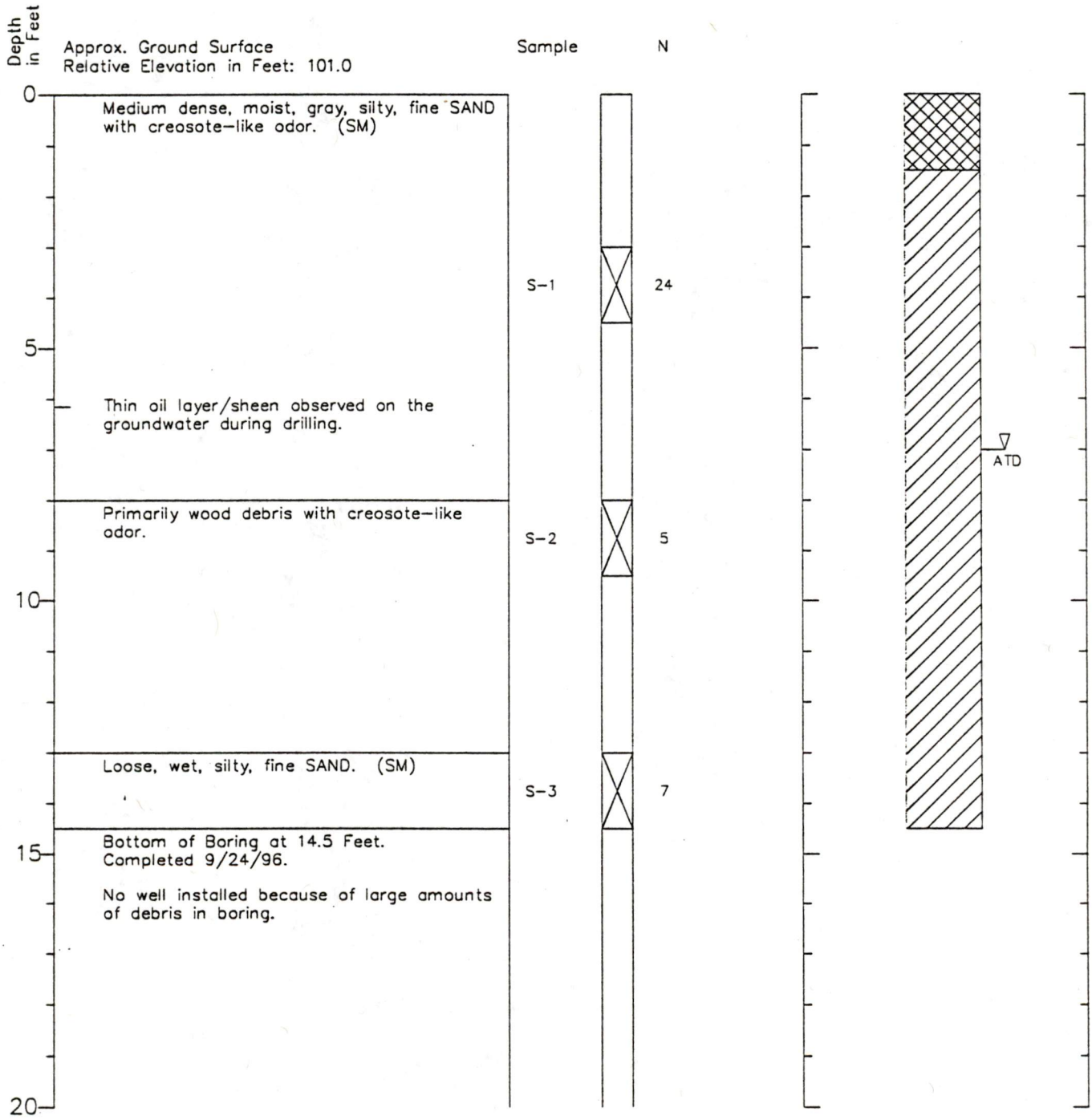
Figure A-2

acad log 1=1

Boring Log HC-SB-1

Geologic Log

Backfilled Boring



1. Refer to Figure A–1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated is at time of drilling (ATD) or for date specified. Level may vary with time.
4. Ground surface elevation based on an assumed elevation of 100.00 feet on top of HC–MW–2 PVC casing.

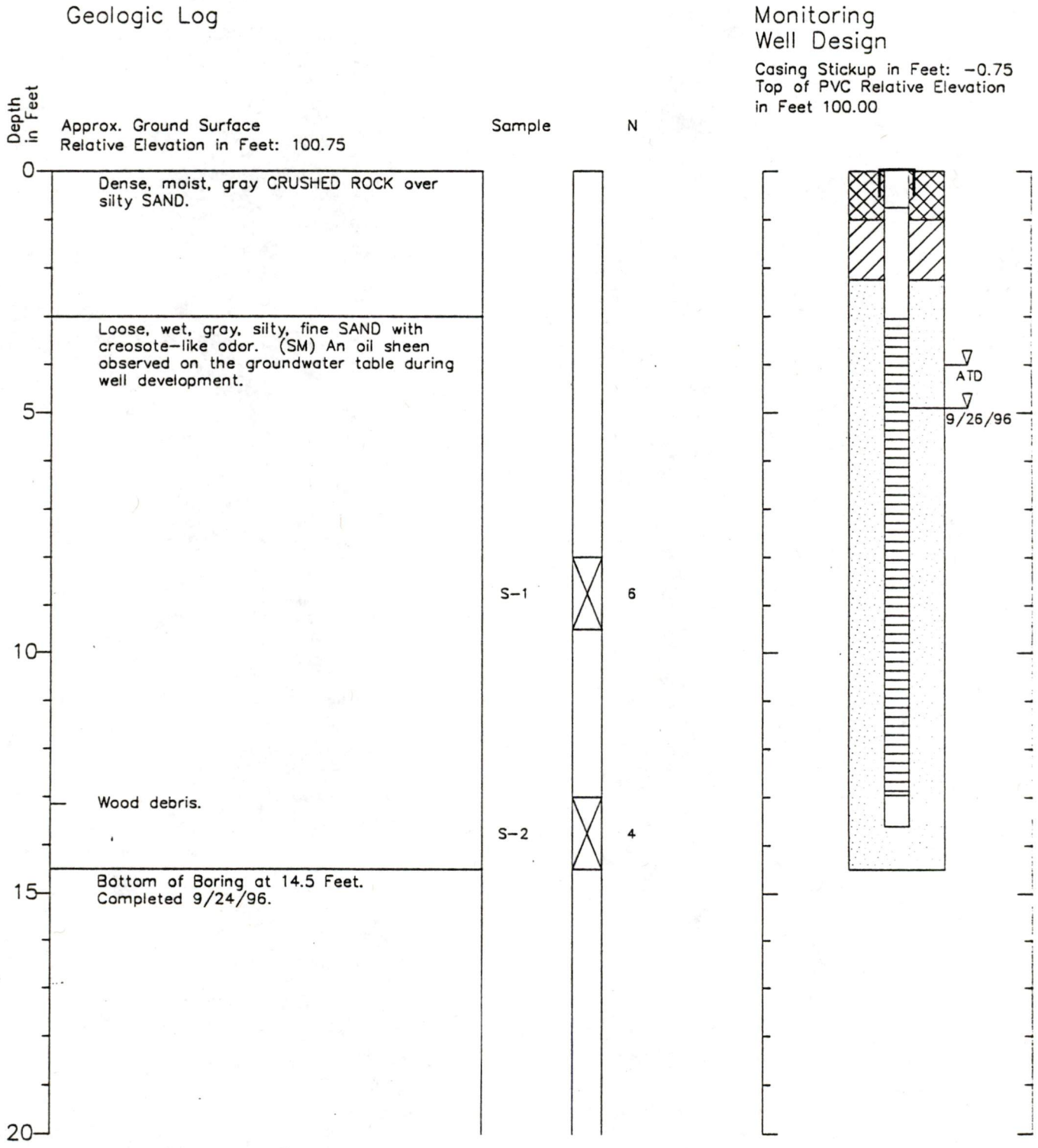
HARTCROWSER

J-4617 9/96

Figure A-3

acad log 1=1

Boring Log and Construction Data for Monitoring Well HC-MW-2



1. Refer to Figure A−1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated is at time of drilling (ATD) or for date specified. Level may vary with time.
4. Ground surface elevation based on an assumed elevation of 100.00 feet on top of HC−MW−2 PVC casing.

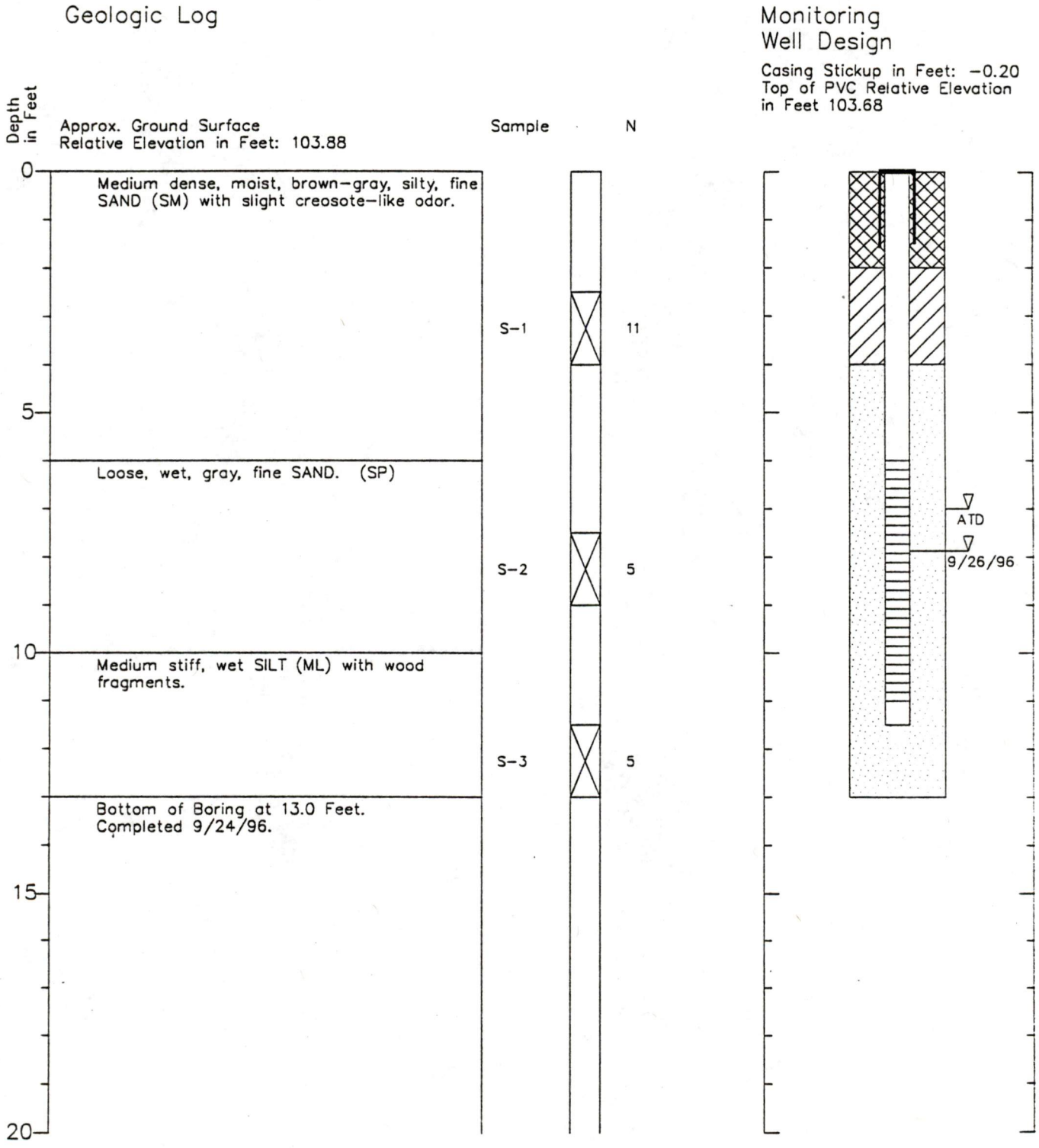
acad log 1=1

HARTCROWSER

J-4617 9/96

Figure A-4

Boring Log and Construction Data for Monitoring Well HC-MW-3



1. Refer to Figure A−1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated is at time of drilling (ATD) or for date specified. Level may vary with time.
4. Ground surface elevation based on an assumed elevation of 100.00 feet on top of HC−MW−2 PVC casing.

HARTCROWSER

J-4617 9/96

Figure A-5

acad log 1-1

Hart Crowser
J-4617

APPENDIX B
CHEMICAL DATA QUALITY REVIEW FOR SOIL AND GROUNDWATER SAMPLES

APPENDIX B
CHEMICAL DATA QUALITY REVIEW FOR SOIL AND GROUNDWATER SAMPLES

This section presents a summary of the data used in the Petroleum-Contaminated Soil Removal. Seventeen soil samples, including six stockpile samples, nine excavation samples, and two field duplicates were collected between August 20 and 23, 1996. Four groundwater samples were collected on September 26, 1996.

Two stockpile samples were submitted to MultiChem Analytical Services of Renton, Washington, for analyses of semivolatiles (EPA Method 8270) and priority pollutant metals (EPA Method 6000/7000). Although MultiChem is not a Corps-validated laboratory, the results for these two samples are suitable for the needs of the receiving facility. All samples were submitted to Hart Crowser Chemistry Laboratory for analysis of total petroleum hydrocarbons (WTPH-D and/or WTPH-G) and PCBs (EPA Method 8081).

This review discussion consists of the following sections:

- Data Quality Summary;
- Scope of Data Quality Review; and
- Results of Data Quality Review including comparison with detection limits goals, evaluation of overall precision, accuracy, representativeness, completeness, and comparability.

Summary of Data Quality Review

The data from this work generally met the data quality objectives outlined in the Management Plan and Addendum to the Management Plan. No data collected during this project were rejected based on data quality concerns.

Scope of Data Quality Review

The following criteria were evaluated in the standard data quality review process for the results:

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory and field duplicate relative percent difference (RPDs);

- Matrix spike/matrix spike duplicate (MS/MSD) recoveries; and
- Reporting Limits.

The QC criteria outlined in the Management Plan and Addendum to the Management Plan are based on laboratory established criteria that are periodically updated. The most recent update of these criteria are presented in each data package. The revised ranges are generally narrower than those listed in the Management Plan and the Addendum to the Management Plan. In addition, two analyses were added to this project that were not included in the Management Plan, including semivolatile organics and metals in soil. The QC criteria for these added analyses and the revised criteria for the other analyses are presented in Tables B-1 through B-4. These criteria were used to evaluate the data.

Results of Data Quality Review

The quality of the data collected during sampling are summarized below. The detailed data validation reports and quality assurance review (QAR) from the NPD laboratory are included as attachments to this appendix. Elements of the data quality review are presented below.

Reporting Limits

The reporting limits for soil and water results met the reporting limit goals established in the Management Plan and the Addendum to the Management Plan.

Accuracy

In general, the data accuracy for soil samples was acceptable in terms of the data quality objectives established in the Management Plan. Accuracy is defined as the degree of agreement of a measurement to an accepted reference or true value. Accuracy is measured as the percent recovery (%R) of an analyte in a reference standard or spiked sample. Accuracy (%R) criteria for project matrix spike recoveries and surrogate recoveries were compared with the control limits specified in Tables B-1 through B-4.

Soil Samples. Matrix spike/matrix spike duplicate (MS/MSD), laboratory control sample (LCS), and surrogate recoveries were within control limits, with the following exceptions. The semivolatile matrix spike 4-Nitrophenol was above control limits due to petroleum matrix interference. The spike was performed on a non-project sample, so no data were qualified based on the spike result. The matrix spike for arsenic was also out of the control limit. However, since the matrix spike was performed on a non-project-specific sample, no data were qualified.

The MS/MSD recovery for one batch of TPH-D results could not be calculated since the sample result was more than five times greater than the sample result. In addition, diesel and oil surrogate recoveries for sample HC-EX-6L and HC-EX-5L, and the diesel surrogate recoveries for sample HC-EX-4L could not be calculated due to co-elution interference. Diesel and oil results were qualified as estimated since no accuracy statement is available for these samples.

Water Samples. Laboratory control sample (LCS) and surrogate recoveries were within control limits. However, no MS/MSD was performed for TPH-D results, so potential matrix effects could not be evaluated.

Precision

Laboratory duplicate precision generally met the data quality objectives established in the Management Plan. Precision is the degree of agreement between a set of replicate measurements. Precision will be measured as the relative percent difference (RPD) between duplicate analyses for matrix spike duplicates, laboratory duplicates, and field duplicates. Precision RPD for MS/MSD and laboratory duplicates are presented in Tables B-1 and B-2. Quality control objectives for field duplicate precision have not been established by the EPA. These analyses measure both field and lab precision; therefore, the results may also have more variability than lab duplicates which measure only lab performance.

Soil Samples. The RPDs for MS/MSD and laboratory duplicates were within the ranges established in Table B-1, with the following exceptions. The MS/MSD RPD for several semivolatile organic spikes were out of control limits. The laboratory duplicate RPD for arsenic also exceeded control limits. The RPDs for mercury, selenium, silver, and total suspended solids could not be calculated since sample results were not detected. Since the duplicate for semivolatile organics and metals was performed on a non-project-specific sample, no data were qualified. The MS/MSD RPD could not be calculated for the sample results reported on September 17, 1996 since the sample results was four times greater than the spike result. An RPD was calculated from the concentrations of the spiked samples.

One field duplicate pair (HC-EX-7L/HC-EX17L) was collected and analyzed for TPH and PCBs. The RPD for PCBs could not be calculated since sample results were not detected. The RPD for TPH ranged from 165% to 173%, indicating highly variable sample matrix. This variance is expected due to difficulties associated with collecting identical field samples in a stiff silt matrix.

Water Samples. The laboratory duplicate RPDs could not be calculated for water samples since sample results were not detected. In addition, no MS/MSD was performed, so no laboratory precision information is available for water samples. One field duplicate pair was collected (HC-MW-2/HC-MW-12). Field duplicate RPD could not be calculated because samples results were not detected.

Completeness

Completeness is defined as the percentage of valid analytical results obtained compared with the total number of analytical results required by the project scope of work. Analytical completeness is defined as the percentage of non-rejected analytical results obtained compared with the total number of analyses requested. Since no sample results were rejected, the overall completeness goal for this project is 100%.

Representativeness

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter concentrations at a sampling point, or an environmental condition of a site. It is a function of sample site selection, sampling methods, and analytical techniques. Representativeness was maintained by performing all sampling, sample handling, and analyses in compliance with the procedures described in this Management Plan and the referenced analytical methods.

Comparability

Comparability is the confidence with which one data set can be compared to another. Comparability can be related to accuracy and precision, as these quantities are measures of data reliability. Data are comparable if sample collection techniques, measurement procedures, analytical methods, and reporting are equivalent for samples within a sample set.

To assure analytical comparability, a QA sample, a triplicate of the field duplicate samples, were collected and submitted to the NPD laboratory for analysis of TPH-D and PCB analysis. Sample results from the QA sample were compared to the project field duplicate samples in the QAR report provided in Attachment 2.

Soil Samples. Sample results for the QA sample and the project triplicate samples associated with the stockpile samples (HC-SP3L/HC-SP-13L) were within a factor of five. The PCB results were all not detected for the QA and project samples associated with the excavation samples (HC-EX-7L/HC-EX-17L). The TPH results from this set of QA samples

were not in agreement. Concentrations in the duplicate sample HC-EX-17L were more than ten times lower than its duplicate and QA pair. This discrepancy is likely due to the difficulty of obtaining representative samples in a highly variable matrix, as discussed in the precision section.

Table B-1 - Analytical Quality Control Criteria - Matrix Spike/ Matrix Spike Duplicate and Laboratory Control Sample Recoveries - Soil

Analytical Method	MS/MSD Percent Recovery Range	RPD	LCS Percent Recovery Range
TPH			
TPH-Diesel	52-155	20	80-110
TPH-Oil	52-155	20	
PCBs			
Aroclor 1242	69-160	20	56-142
Semivolatile Organics			
Phenol	37-122	20	27-116
2-Chlorophenol	28-132	20	25-112
1,4-Dichlorobenzene	32-109	20	25-108
n-Nitroso-di-N-Propylamine	32-109	20	20-110
1,2,4-Trichlorobenzene	26-123	20	26-110
4-chloro-3-methylphenol	37-123	20	29-114
Acenapthene	31-142	20	28-108
4-Nitrophenol	31-142	20	25-116
2,4-Dinitrophenol	35-112	20	28-107
Pentachlorophenol	20-93	20	25-107
Pyrene	53-129	20	25-131
Metals			
Arsenic	70-133	35	80-120
Barium	75-125	35	80-120
Cadmium	67-136	35	80-120
Chromium	76-107	35	80-120
Lead	65-142	35	80-120
Mercury	53-136	35	80-120
Selenium	24-111	35	80-120
Silver	75-125	35	80-120

4617/BTABLES.DOC

Table B-2 - Analytical Quality Control Criteria - Matrix Spike/ Matrix Spike Duplicate and Laboratory Control Sample Recoveries - Water

Analytical Method	MS/MSD Percent Recovery Range	RPD	LCS Percent Recovery Range
TPH			
TPH-Diesel	55-145	20	77-11
PCBs			
Aroclor 1242	50-150	20	56-144

4617/BTABLES.DOC

Table B-3 - Analytical Quailty Control Criteria - Surrogate Recoveries - Soil

Analytical Method	Percent Recovery Range
WPTH-D	
2-Fluorobiphenyl	67-155
o-Terphenyl	84-115
Hexacosane	84-118
PCBs	
TCMX	46-133
DCBP	53-134
Semivolatile Organics	
Nitrobenzene-d5	27-118
2-Fluorobiphenyl	30-115
Terphenyl-d14	39-128
Phenol-d5	30-124
2-Fluorophenol	28-118
2,4,6-Tribromophenol	26-123

4617/BTABLES.DOC

Table B-4 - Analytical Quailty Control Criteria - Surrogate Recoveries - Water

Analytical Method	Percent Recovery Range
WPTH-D	
2-Fluorobiphenyl	60-122
o-Terphenyl	80-127
Hexacosane	78-130
PCBs	
TCMX	54-119
DCBP	82-122

4617/BTABLES.DOC

Hart Crowser
J-4617

ATTACHMENT B-1
DATA VALIDATION REPORT AND LABORATORY ANALYTICAL REPORTS FOR SOIL AND GROUNDWATER SAMPLES

ATTACHMENT B-1
DATA VALIDATION REPORT AND LABORATORY ANALYTICAL REPORTS FOR SOIL AND GROUNDWATER SAMPLES

Seventeen soil samples, including six stockpile samples, nine excavation samples, and two field duplicates were collected between August 20 and 23, 1996. Four groundwater samples were collected on September 26, 1996. Two stockpile samples were submitted to MultiChem Analytical Services of Renton, Washington, for analyses of semivolatiles (EPA Method 8270) and priority pollutant metals (EPA Method 6000/7000). All samples were submitted to Hart Crowser Chemistry Laboratory for analysis of total petroleum hydrocarbons (WTPH-D and/or WTPH-G) and PCBs (EPA Method 8081).

The following criteria were evaluated in the standard data quality review process for the results:

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory and field duplicate relative percent difference (RPDs);
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries; and
- Reporting Limits.

The QC criteria used to evaluate the Hart Crowser Chemistry Laboratory data are periodically updated by the laboratory. The most recent update of these criteria are presented at the end of each data package. These QC criteria replace the criteria sited in the Management Plan (1996) and were used to evaluate the data. No QC criteria were established in the Work Plan for semivolatile organic and metals analyses. Laboratory control limits provided in the data package were used to evaluate the data. Data summarizing the quality control criteria are presented in Tables B-1 through B-4 of Appendix B.

Soil Samples

Semivolatile Organics. One stockpile sample was analyzed for the required compounds in accordance with the method. All required holding times were met. No laboratory duplicate results were reported. Method blank contamination was present for bis(2-ethylhexyl)phthalate. The sample result was greater than ten times the blank contamination so results were not qualified. Surrogate recoveries were within laboratory control limits. MS/MSD recoveries were within control limits with the exception of 4-nitrophenol recoveries which were above the laboratory control limits

due to petroleum interference. The RPDs of five analytes were also outside of control limits. However, since the MS/MSD was not performed on a project-specific sample, no data were qualified.

Total Metals. The soil samples were analyzed for the required compounds in accordance with the method. All required holding times were met. Laboratory duplicate RPDs were within control limits, with the exception of the RPD for arsenic. The duplicate was performed on a non-project specific sample, so no data was qualified. No method blank contamination was present. Blank spike recoveries were acceptable. Matrix spike recoveries were within laboratory control limits, with the exception of arsenic matrix spike recovery. Since the matrix spike was not performed on a project-specific sample and blank spike recoveries were acceptable, no data were qualified.

WTPH-D. The soil samples were analyzed for the required compounds in accordance with the method. Reporting limits met those outlined in the Management Plan. All required holding times were met. Laboratory duplicate RPDs were calculated if sample results were greater than five times the reporting limit. Laboratory duplicate RPDs were within control limits. No method blank contamination was present. MS/MSD percent recoveries for one batch of samples could not be calculated since the sample concentration was greater than five times the spike concentration. Concentrations from the MS/MSD results were used to calculate an RPD. Surrogate recoveries were within control limits, with the following exceptions. Some recoveries of surrogates in the laboratory control sample, one MS/MSD sample, could not be calculated based on coelution interference. In addition, diesel and oil surrogate recoveries for HC-EX-6L and HC-EX-5L and the diesel surrogate recoveries for sample HC-EX-4L could not be calculated due to co-elution interference. Results for diesel and oil results were qualified as estimated since no accuracy statement is available for these samples. HC-EX-17L was a blind field duplicate of HC-EX-7L. Field duplicate RPD ranged from 163% to 175%, indicating matrix variability.

PCBs. The soil samples were analyzed for the required compounds in accordance with the method. Reporting limits met those established in the Management Plan. All required holding times were met. Laboratory duplicates RPDs were within control limits. No method blank contamination was detected. MS/MSD and surrogate recoveries were within laboratory control limits. The RPD of the field duplicate pair HC-EX-7L/HC-EX-17L could not be calculated since sample results were not detected.

Groundwater Samples

WTPH-D. The groundwater samples were analyzed for the required compounds in accordance with the method. Reporting limits met those established in the Management Plan. All required holding times were met. Laboratory duplicate RPDs could not be calculated since sample results were not detected. HC-MW-12 was a field duplicate of HC-MW-2, but the RPDs could not be calculated since sample results were not detected. No method blank contamination was present. MS/MSD percent recoveries were not reported, but the LCS recoveries were acceptable, so no qualifiers were assigned. Surrogate recoveries were within control limits, with the following exceptions. Some recoveries of surrogates in the laboratory control sample could not be calculated based on coelution interference. No data was qualified based on surrogate problems with the LCS, since the recovery for the LCS was within control limits.

PCBs. The groundwater samples were analyzed for the required compounds in accordance with the method. Reporting limits met those established in the Management Plan. All required holding times were met. Laboratory duplicate RPDs could not be calculated since sample results were not detected. HC-MW-12 was a field duplicate of HC-MW-2, but the RPDs could not be calculated since sample results were not detected. No method blank contamination was detected. MS/MSD percent recoveries were not reported. Surrogate recoveries were within laboratory control limits.

TSS. The groundwater samples were analyzed within the required holding times. Reporting limits met those established in the Management Plan. Laboratory duplicate RPDs could not be calculated since one of the sample results was non-detect. No method blank contamination was detected. The blank spike recoveries were within control limits. The data are acceptable as reported.

Hart Crowser
J-4617

ATTACHMENT B-2
CHEMICAL QUALITY ASSURANCE REPORT
DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION LABORATORY

DEPARTMENT OF THE ARMY
NORTH PACIFIC DIVISION LABORATORY
CORPS OF ENGINEERS
1491 N.W. GRAHAM AVENUE
TROUTDALE, OREGON 97060-9503

CENPP-PE-L (1110-1-8100c) 2 Dec 96

MEMORANDUM FOR: Commander, Seattle District, ATTN: CENPS-EN-GT-ET (Yang/Ginn)

SUBJECT: W.O. 96-0358, Results of Chemical Analysis

Project: LAKE WASHINGTON SHIP CANAL
Intended Use: Site Evaluation
Submitted by: Hart Crowser, Inc.
Date Sampled: 20 Aug through 26 Sep 96 Date Received: 20 Aug through 28 Sep 96
Reference: a) DD Form 448, MIPR No. E86-96-3136 dated 21 Aug 96, amended 27 Sep 96
b) Primary reports dated September 10, September 17, and October 11, 1996 from Hart Crowser, Inc.

1. Enclosed are the original Chemical Quality Assurance Report, original and one copy of QA reports 9492 and 9461 from Applied Research and Development Laboratory, Inc. with EDF diskettes, CENPP-PE-L sample cooler receipt forms, one HTRW discrepancy notification form and two conversation records.

2. Please note that the Chemical Quality Assurance Report and QA data have not been forwarded to Hart Crowser, Inc., Seattle, Washington.

3. If you have any questions or comments concerning the Chemical Quality Assurance Report, please contact the author, Dr. Janice Stuart, at (503) 669-0246 or Pamela Hertzberg at (503) 666-8143.

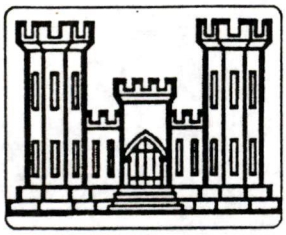
4. This completes all work requested for this project.

Timothy J. Seeman

Enclosures

TIMOTHY J. SEEMAN
Director

Copy Furnished: CEMRO-HX-C



U.S. Army Corps of Engineers
North Pacific Division Laboratory
Troutdale, Oregon

Chemical Quality Assurance Report

Lake Washington Ship Canal

NPDL Work Order Number: 96-0358

Prepared for: **Seattle District**

Approved by: Pamela D. Hertzberg

PAMELA D. HERTZBERG, Chief
Project Management and Data Evaluation Branch

CHEMICAL QUALITY ASSURANCE REPORT

LAKE WASHINGTON SHIP CANAL

1. **SUMMARY:**

   1.1 The diesel and oil data for two samples and the diesel datum for one sample should be considered estimates. Low levels of polychlorinated biphenyls (PCB) may not have been detected because of elevated reporting limits.

   1.2 The primary and quality assurance (QA) data comparisons are presented in Tables I through III. The diesel and oil data for one triplicate do not agree. Refer to section 8 for more detail.

2. **BACKGROUND:** The project samples were collected August 20 through September 26, 1996 and received by the analytical laboratories August 20 through September 28, 1996.

3. **OBJECTIVES:**

   3.1 Four water samples (including one blind duplicate) and 15 soil samples (including two blind duplicates) were collected to determine the extent of the chemical contamination on the site.

   3.2 One QA water and two soil samples were submitted to evaluate the primary laboratory's data.

4. **PROJECT ORGANIZATION:**

   4.1 The project samples were collected by Hart Crowser, Inc., Seattle, Washington.

   4.2 The primary samples were analyzed by Hart Crowser Laboratory (HCL), Seattle, Washington.

   4.3 The QA samples were analyzed by Applied Research and Development Laboratory, Inc. (ARDL), Mt. Vernon, Illinois.

5. ANALYTICAL REFERENCES:

Number	Title	Date
SW-846, Third Edition	Test Methods for Evaluating Solid Waste - Final Update II	1/95
WSDOE Guidance for Remediation of Releases from UST, Appendix L	Total Petroleum Hydrocarbons Analytical Methods for Soil and Water	4/92
EPA 600/4-79-020	Methods for the Chemical Analysis of Water and Wastes	3/83

6. EVALUATION OF THE PRIMARY LABORATORY'S DATA:

6.1 Primary Laboratory Methods: The following is a listing of preparation and analytical methods used by the laboratory as reported in their data deliverable.

Primary Laboratory	Parameter	Preparation Method	Analytical Method
HCL	PCB	--	EPA 8081
	DRO	--	WTPH-D
	Oil	--	WTPH-D-ext

-- = not reported

6.2 Chain of Custody Records and Sample Cooler Receipt Forms: All chain of custody (COC) records and sample shipping conditions, as documented on the sample cooler receipt (SCR) form, were evaluated according to EPA and U.S. Army Corps of Engineers (USACE) ER 1110-1-263 regulations and the following notations made.

The coolers were hand delivered and a SCR form was not completed for the September 10 and September 17, 1996 reports. An evaluation of the sample conditions could not be made for these samples. The SCR form completed for the October 11, 1996 samples indicated that the samples were delivered in boxes without ice. The samples were stored at the laboratory at a temperature of 4 ^{o}C and were acidified at the time of extraction.

6.3 Sample Holding Times, Reporting Limits, Laboratory Method Blanks, Accuracy and Precision: Sample holding times and detection/reporting limits were evaluated per EPA or Washington Department of Ecology (WDOE) criteria. The laboratory method blanks

were evaluated for the absence of targeted analytes. The extraction efficiency, accuracy and precision of the data, as represented by surrogate, matrix spike (MS), matrix spike duplicate (MSD), laboratory control (LC) and laboratory control duplicate (LCD) recoveries and relative percent difference (RPD) results, were compared to EPA, WDOE or laboratory established (LE) quality control (QC) acceptance limits for out of control results.

6.3.1 Polychlorinated Biphenyls: The soil PCB reporting limits of 200-500 ppb were higher than the project specific data quality objectives (DQO) of 15-25 ppb and lower levels of targeted analytes may not have been detected in the soil PCB samples. No other deficiencies were noted with the QC results.

6.3.2 Diesel Range Organics and Heavy Oil: The recoveries for the diesel surrogates o-terphenyl, 2-fluorobiphenyl (FBP) and the oil surrogate, hexacosane, were not reported due to co-elution with the targeted analytes for samples HC-EX-6L and HC-EX-5L and the diesel surrogate recoveries were not reported for sample HC-EX-4L and the LC samples from all three reports. No oil LC results were reported in any report. The diesel and oil soil MS/MSD recoveries from the September 17, 1996 report were not reported because the original sample concentrations were greater than 4 times the spike amount. The soil MS/MSD results were used to calculate precision and the RPD results were less than 20%. The sample duplicate RPD result from the September 10, 1996 report for sample HC-SP1 was not calculated because the results were below the reporting limit however, a sample duplicate RPD result for sample HC-SP3 was less than 20% and the precision for the analytical batch is acceptable. Based on the above observations, the diesel and oil data for samples HC-EX-6L and HC-EX-5L and the diesel datum for sample HC-EX-4L should be considered estimates and all oil data should be viewed with caution because of the lack of an accuracy statement. Water MS/MSD recoveries were not reported in the October 11, 1996 report and potential matrix effects could not be evaluated for the water samples.

7. EVALUATION OF THE QA LABORATORY'S DATA:

7.1 QA Laboratory Methods: The following is a listing of preparation and analytical methods used by the laboratory as reported in their data deliverable.

QA Laboratory	Parameter	Preparation Method	Analytical Method
ARDL	PCB (w/s)	EPA 3510/3550	EPA 8081/8080
	DRO	Method	WTPH-D
	Oil	Method	WTPH-D-ext
	TSS	Filtration	EPA 160.2

7.2 COC Records and SCR Forms: All COC records and sample shipping conditions, as documented on the SCR form, were evaluated according to EPA and USACE ER1110-1-263 regulations and the following notations made.

There was a sample container labeling discrepancy with the COC record. The COC record was corrected but not included in the data package. Refer to conversation records dated August 27 and 28, 1996. The cooler associated with report 9461 was received at North Pacific Division Laboratory (NPDL) with a temperature of 9.2 °C which is above the EPA recommended temperature range of 4 ± 2 °C.

7.3 Sample Holding Times, Reporting Limits, Laboratory Method Blanks, Accuracy and Precision: Sample holding times and detection/reporting limits were evaluated per EPA or WDOE criteria. The laboratory method blanks were evaluated for the absence of targeted analytes. The extraction efficiency, accuracy, and precision of the data, as represented by surrogate, MS, MSD, LC and LCD recoveries and RPD results, were compared to EPA, WDOE or LE QC acceptance limits for out of control results.

7.3.1 Polychlorinated Biphenyls: The LE QC limits for surrogate recoveries are considered too broad by NPDL staff and the DQO limits were used for data evaluation purposes. One of two surrogate recoveries was below the LE QC limits but both recoveries were below the DQO QC limits for sample HC-MW-2 (report 9492). The LC/LCD RPD result from report 9492 was out of control at 35%. Low levels of targeted analytes may not have been detected if present in sample HC-MW-2 because of low surrogate recoveries and precision failure. One of two surrogate recoveries was above the LE QC limit but within the DQO QC limit for sample HC-EX-7L. Samples HC-EX-7L and HC-SD-3L were diluted by a factor of five reportedly because of a dark colored extract. The Aroclor 1260 datum for sample HC-SD-3L should be considered acceptable and low levels of the remaining PCB analytes in sample HC-SD-3L and all targeted analytes in sample HC-EX-7L may not have been detected because of the elevated reporting limits.

7.3.2 Diesel Range Organics and Heavy Oil: The laboratory only used one surrogate compound, o-terphenyl, to represent the extraction efficiency of the two types of fuel; per the method surrogate compounds representative of the hydrocarbon type are recommended. The laboratory only reported the LC/LCD recoveries for heavy oil and not diesel for both water and soil analyses. It is unclear whether the spike was not recovered or not added. Neither water nor soil MS/MSD recoveries were not reported and potential matrix effects could not be determined. The diesel data for samples HC-MW-2, HC-EX-7L and HC-SC-3L should be considered estimates because of the lack of appropriate supporting accuracy QC results.

8. **COMPARISON OF THE PRIMARY AND QA LABORATORIES' DATA:** The primary and QA data comparisons are presented in Tables I through III. The analytical results presented in each table were reviewed for agreement with each other or their respective reporting limits and evaluated for comparability. The intra- and inter-laboratory data for a sample must be within a factor of three (for water matrices) and five (for soil/sediment matrices) of each other to be considered in agreement. The primary and QA laboratories' reporting limits must be within a factor of 10 to be considered comparable. Estimated data (results which have been quantified below the reporting limit and qualified with a "J" flag) should not be considered significant for the purpose of data agreement. All data comparisons agree with each other and are comparable with the following exceptions.

The diesel and oil data for primary sample HC-EX-17L presented in Table II did not agree with the blind duplicate (sample HC-EX-7L) or the QA data. The data for sample HC-EX-7L and the QA sample agree indicating that the data for sample HC-EX-17L were the abhorrent ones. The discrepancy could not be analytically resolved and the discrepancy could be due to non-identical samples submitted from the field.

CENPP-PE-L (96-0358)
Comparison of Primary and QA Data

TABLE I

Matrix: Water		Field Identification:	Primary Samples		QA Sample
Parameter	Units	Analytes Detected	HC-MW-2	HC-MW-12	HC-MW-2
PCB	µg/L		< [4.0-10.0]	< [4.0-10.0]	< [1.0-2.0]
DRO	mg/L	as Diesel	< 0.25	< 0.25	< 0.25
		as Oil	< 0.75	<0.75	<0.75
Inorganics	mg/L	TSS	NR	NR	31.2

Comments: All data agree.

TABLE II

Matrix: Soil		Field Identification:	Primary Samples		QA Sample
Parameter	Units	Analytes Detected	HC-EX-7L	HC-EX-17L	HC-EX-7L
PCB	µg/Kg		< [200-500]	< [200-500]	< [196.0-398.0]
DRO	mg/Kg	as Diesel	810	54	700.0
		as Oil	2900	300	1500.0

Comments: The diesel and oil data for sample HC-EX-17L do not agree with the blind duplicate or QA data. Refer to section 8 for more detail.

TABLE III

Matrix: Soil		Field Identification:	Primary Samples		QA Sample
Parameter	Units	Analytes Detected	HC-SP-3	HC-SP-13	HC-SP-3
PCB	µg/Kg	Aroclor 1260	370	370	380.0
DRO	mg/Kg	as Diesel	190	150	700.0
		as Oil	1200	960	1300.0

Comments: All data agree.

µg/L or µg/Kg = parts per billion (ppb)
< {reporting limit} = analyte not detected
C = confirmed by second GC column
mg/L or mg/Kg = parts per million (ppm)
NR = not requested chain of custody record

9. PROBLEMS ENCOUNTERED\CORRECTIVE ACTIONS TAKEN:

9.1 The project specific DQOs were not submitted to NPDL prior to sampling therefore the QA laboratory could not be informed of the required sensitivity, precision and accuracy requirements. It is recommended that the DQOs be submitted when the project is set up or at the very least concurrently with the samples.

9.2 It was unclear from the data package if Hart Crowser performed the requested analyses or if the samples were sub-contracted. The primary data packages did not include QC results (included recoveries only), spike amounts or soil fuel chromatograms. Without the missing information, calculations could not be verified, adherence to method protocol could not be determine and a complete evaluation of the data could not be made.

9.3 TSS analysis was not requested on the COC record for the primary samples HC-MW-2 and HC-MW-12 yet was requested for the QA split. This seems contrary to the QA purpose of verifying primary results and may have been an unnecessary expenditure.

9.4 The primary laboratory reported that the samples were analyzed for PCBs by EPA 8081 however, for samples HC-SP4 and HC-SP13, EPA 8080 was indicated as the method used.

CONVERSATION RECORD

TIME

DATE 8/28/96

TYPE ☐ VISIT ☐ CONFERENCE ☒ TELEPHONE ☒ INCOMING ☐ OUTGOING

ROUTING

NAME/SYMBOL	INT

Location of Visit/Conference:

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU	ORGANIZATION (Office, dept., bureau, etc.)	TELEPHONE NO.
Donna Cochran	ARDL	~~202~~ (618) ~~244~~ 3235

SUBJECT COC vs. Sample Shipment Discrepancy!

SUMMARY

Donna said they received two soil samples for WTPH-D and PCB 8080. However, COC had one sample for WTPH-D and one sample for PCB 8080. Talked to Hart Crowser ~~personnel~~ post employee who said both samples were to be analyzed for WTPH-D and PCB 8080.

Donna was notified of correction. 8/28/96. COC was changed to reflect action.

ACTION REQUIRED

NAME OF PERSON DOCUMENTING CONVERSATION	SIGNATURE	DATE

ACTION TAKEN

SIGNATURE	TITLE	DATE
[signature]	PM	8/28/96

Sample Custody Record

DATE 8/21/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser,
1910 Fairview Avenue E
Seattle, Washington 98102-369

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER DAVE HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FEDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: NWTPH-D EXT	TESTING: PCB 8080	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	8/20/96	15:30	HC-SD-3L	SOIL	X	X	1	
	8/21/96	09:10	HC-EX-7L	SOIL	X	X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	8.26 1996	SIGNATURE	8/27/96
PRINTED NAME JM FEDER	TIME 13:00	PRINTED NAME Mark Francisco	TIME 0945
COMPANY HC-SEA		COMPANY USACE	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE Mark Francisco	8/27/96	SIGNATURE	
PRINTED NAME Mark Francisco	TIME 1500	PRINTED NAME	TIME
COMPANY USACE		COMPANY	

TOTAL NUMBER OF CONTAINERS (2)

METHOD OF SHIPMENT OVERNIGHT.

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS NORMAL.

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

CENPD-ET-EL rev. 7/96

HTRW COOLER RECEIPT FORM

C:\wg31\htw\HTW-CRF

Project: Lake Washington Ship Canal W.O.# 96-0358

Cooler received on 9/27/96 and opened on 9/27/96 by Pamela O. Hume

(signature) Pamela

1. Were custody seals on outside of cooler and intact? ..... YES NO
   a. If YES, how many and where: (2) both sides of box
   b. Were signature and date correct? ..... YES NO
2. Were custody papers taped to the lid inside the cooler? ..... YES NO
3. Were custody papers properly filled out (ink, signed, dated, etc.)? ..... YES NO
4. Did you sign custody papers in the appropriate place? ..... YES NO
5. Did you attach shipper's packing slip to this form? ..... YES NO
6. What kind of packing material was used? Styrofoam/popcorn
7. Was sufficient ice used (if appropriate)? ..... YES NO

Temperature 5.8

Approved by [signature] Date 9/27/96

8. Were all bottles sealed in separate plastic bags? ..... YES NO
9. Did all bottles arrive in good condition (unbroken)? ..... YES NO
10. Were all bottle labels complete (ID. No., dated, Anal. method, etc,) ..... YES NO 1
11. Did all bottle labels agree with custody papers? ..... YES NO
12. Were correct bottles used for the tests indicated? ..... YES NO
13. If present, were VOA vials/containers checked for absence of air bubbles/ head space and noted if found? Size of bubble _____ ..... N/A YES NO
14. Was sufficient volume of sample sent in each bottle? ..... YES NO
15. Were correct preservatives used? ..... N/A YES NO

Approved by: [signature] Date 9/27/96

If not approved:

a. Name of person contacted Dina Ginn Date 9/27/96

b. Corrective action taken; if necessary: _____

Additional Comments: (see attached)

1) Received 1 Liter jar for PCB (stated on label). However, COC requested EPA 8081.

CONVERSATION RECORD

12:00 | 9/27/96

TYPE ☐ VISIT ☐ CONFERENCE ☒ TELEPHONE ☐ INCOMING ☒ OUTGOING

ROUTING	
NAME/SYMBOL	INT

Location of Visit/Conference:

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU	ORGANIZATION (Office, dept., bureau, etc.)	TELEPHONE NO.
Dina Ginn	CENPS	

SUBJECT Lake WA Ship Canal
96-0358

SUMMARY

Spoke with Dina to verify that the sample received today is to be analyzed for PCB only, since chain of custody says "8081/14 with flag asks for "8080 Pest/PCB" + label says "PCB".

Dina said it shall be analyzed for PCB only.

ACTION REQUIRED

NAME OF PERSON DOCUMENTING CONVERSATION	SIGNATURE	DATE

ACTION TAKEN Changed C-of-C from to indicate "PCB only"

SIGNATURE	TITLE	DATE
P Hartberg		9/27/96

CENPD-ET-EL rev. 7/96

HTRW COOLER RECEIPT FORM

C:\wg31\htw\HTW-CRF

Project: LAKE WASHINGTON SHIP CANAL W.O.# 96-0358

Cooler received on 8/27/96 and opened on 8/27/96 by Mark Francisco

(signature) Mark Francisco

1. Were custody seals on outside of cooler and intact? ..... (YES) NO
   a. If YES, how many and where: 1 ON FRONT, 1 ON BACK
   b. Were signature and date correct? ..... (YES) NO
2. Were custody papers taped to the lid inside the cooler? ..... (YES) NO
3. Were custody papers properly filled out (ink, signed, dated, etc.)? ..... (YES) NO
4. Did you sign custody papers in the appropriate place? ..... (YES) NO
5. Did you attach shipper's packing slip to this form? ..... (YES) NO
6. What kind of packing material was used? Bubble wrap
7. Was sufficient ice used (if appropriate)? ..... YES (NO)

   Approved by [signature] Date 8/27/96 Temperature 9.2°C

8. Were all bottles sealed in separate plastic bags? ..... (YES) NO
9. Did all bottles arrive in good condition (unbroken)? ..... (YES) NO
10. Were all bottle labels complete (ID. No., dated, Anal. method, etc,) ..... (YES) NO
11. Did all bottle labels agree with custody papers? ..... (YES) NO
12. Were correct bottles used for the tests indicated? ..... (YES) NO
13. If present, were VOA vials/containers checked for absence of air bubbles/ head space and noted if found? Size of bubble _____ ..... (YES) NO
14. Was sufficient volume of sample sent in each bottle? ..... (YES) NO
15. Were correct preservatives used? ..... (YES) NO

    Approved by: [signature] Date 8/27/96

    If not approved:

    a. Name of person contacted Dina Ginn Date 8/27/96

    b. Corrective action taken; if necessary: _____ (see attached)

Additional Comments: _____

U.S. ARMY CORPS OF ENGINEERS - NORTH PACIFIC DIVISION LABORATORY
1491 NW Graham Road, Troutdale, Oregon 97060-9508

From: Pamela O. Amde	Office: CENPP-PE-L	Telephone: (503) 666-8143
To: Dina Ginn	Office: CENPS	Telephone: 206/764-4478
Date: 8/27/96	Pages Sent: Header + 0	Signature: PDA

HTRW Discrepancy Notification Form

Project Name: Lake Washington Ship Canal W.O.# 96-0358

Problems Encountered:

1. Custody Seals: a. ☐ None present
   b. ☐ Broken
   c. ☐ Signature or date did not match Chain of Custody
   d. ☐ Other _____

FAXED DATE: 8/27/96

2. Chain of Custody Form: a. ☐ Not signed
   b. ☐ Not dated Complete date not used
   c. ☐ Other _____

3. Temperature: a. ☒ EPA requires coolers to arrive at the lab with an internal temperature of 4 ° Celsius ± 2 °, cooler arrived at 9.2 ° Celsius.

4. Packing of Samples: a. ☐ Samples were not in individual plastic bags
   b. ☐ Broken containers
   c. ☐ Labels incomplete or did not agree with Chain of Custody
   d. ☐ Improper container size used
   e. ☐ Air bubbles in VOA vials, size of bubble _____.
   f. ☐ Head space in containers
   g. ☐ Improper preservative used
   h. ☐ Other _____

Comments & Corrective action taken: _____

Hart Crowser
J-4617

CHEMISTRY LABORATORY ANALYTICAL REPORT
MULTICHEM ANALYTICAL SERVICES

MultiChem Analytical Services 560 Naches Avenue S.W., Suite 101, Renton, WA 98055
(Formerly Analytical Technologies, Inc.-Washington) (800) 609-0580 ◆ (206) 228-8335 ◆ Fax (206) 363-1742

MAS I.D. # 608114

September 19, 1996

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle WA 98102-3699

Attention : Dave Heffner

Project Number : 4617

Project Name : Lake WA Ship Canal

Dear Mr. Heffner:

On August 27, 1996, MultiChem Analytical Services received two samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Sally J. Hanley
Senior Project Manager

SJH/hal/ff

Enclosure

MultiChem Analytical Services

MAS I.D. # 608114

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

MAS #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
608114-1	HC-SP-4L	08/20/96	SOIL
608114-2	HC-SP-3L	08/20/96	SOIL

----- TOTALS -----

MATRIX	# SAMPLES
SOIL	2

MAS STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

MultiChem Analytical Services

MAS I.D. # 608114

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

ANALYSIS	TECHNIQUE	REFERENCE	LAB
SEMIVOLATILE COMPOUNDS	GCMS	EPA 8270	R
ARSENIC	AA/GF	EPA 7060	R
BARIUM	ICAP	EPA 6010	R
CADMIUM	ICAP	EPA 6010	R
CHROMIUM	ICAP	EPA 6010	R
LEAD	ICAP	EPA 6010	R
MERCURY	AA/COLD VAPOR	EPA 7471	R
SELENIUM	AA/GF	EPA 7740	R
SILVER	ICAP	EPA 6010	R
MOISTURE	GRAVIMETRIC	CLP SOW ILM03.0	R

R = MAS - Renton
ANC = MAS - Anchorage
SUB = Subcontract

MultiChem Analytical Services

MAS I.D. # 608114

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

CASE NARRATIVE: SEMIVOLATILE ORGANICS ANALYSIS

The following anomalies were associated with the samples for this accession:

Bis(2-ethylhexyl)phthalate was detected below the MAS reporting limit in the water and soil method blanks associated with this accession. Since the amount of bis(2-ethylhexyl)phthalate detected in the sample extracts was less than the reporting limits, no corrective action was performed .

Consistent with the directives of SW-846 and other EPA methods, all GC/MS analyses were performed so that the maximum concentration of sample was analyzed. Sample 608114-2 (HC-SP-3L) required dilution to reduce matrix interferences. As stated in Section 7.5.4 of method 8270, these dilutions must be performed. The reporting limits for this sample are therefore proportionate to the dilution required.

The percent recovery for 4-nitrophenol was above MAS control limits for the matrix spike/matrix spike duplicate (MS/MSD) as a result of petroleum hydrocarbon interferences. Due to the nature of the interferences secondary ion quantitation was not possible. These interferences also resulted in multiple relative percent differences (RPDs) to exceed MAS established control limits.

Benzo(b) and benzo(k)fluoranthene cannot be differentiated based on their mass spectra and their retention times are almost identical; therefore, the result given for benzo(b) and benzo(k)fluoranthene in sample 608114-2 (HC-SP-3L) should be considered the sum of the two isomers.

All other associated quality control (QC) results were within established limits.

MultiChem Analytical Services

MAS I.D. # 608114

SEMIVOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 4617	DATE RECEIVED	: N/A
PROJECT NAME	: LAKE WA SHIP CANAL	DATE EXTRACTED	: 08/28/96
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 09/09/96
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8270	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<0.17
PHENOL	<0.17
ANILINE	<0.83
BIS(2-CHLOROETHYL)ETHER	<0.17
2-CHLOROPHENOL	<0.17
1,3-DICHLOROBENZENE	<0.17
1,4-DICHLOROBENZENE	<0.17
BENZYL ALCOHOL	<0.17
1,2-DICHLOROBENZENE	<0.17
2-METHYLPHENOL	<0.17
2,2'-OXYBIS(1-CHLOROPROPANE)	<0.17
3/4-METHYLPHENOL	<0.17
N-NITROSO-DI-N-PROPYLAMINE	<0.17
HEXACHLOROETHANE	<0.17
NITROBENZENE	<0.17
ISOPHORONE	<0.17
2-NITROPHENOL	<0.17
2,4-DIMETHYLPHENOL	<0.17
BENZOIC ACID	<0.83
BIS(2-CHLOROETHOXY)METHANE	<0.17
2,4-DICHLOROPHENOL	<0.17
1,2,4-TRICHLOROBENZENE	<0.17
NAPHTHALENE	<0.17
4-CHLOROANILINE	<0.17
HEXACHLOROBUTADIENE	<0.17
4-CHLORO-3-METHYLPHENOL	<0.17
2-METHYLNAPHTHALENE	<0.17
HEXACHLOROCYCLOPENTADIENE	<0.83
2,4,6-TRICHLOROPHENOL	<0.17
2,4,5-TRICHLOROPHENOL	<0.83
2-CHLORONAPHTHALENE	<0.17
2-NITROANILINE	<0.83
DIMETHYLPHTHALATE	<0.17
ACENAPHTHYLENE	<0.17
3-NITROANILINE	<0.83
ACENAPHTHENE	<0.17
2,4-DINITROPHENOL	<0.83
4-NITROPHENOL	<0.83

MultiChem Analytical Services

MAS I.D. # 608114

SEMIVOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 4617	DATE RECEIVED	: N/A
PROJECT NAME	: LAKE WA SHIP CANAL	DATE EXTRACTED	: 08/28/96
CLIENT I.D.	: METHOD BLANK	DATE ANALYZED	: 09/09/96
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8270	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
DIBENZOFURAN	<0.17
2,4-DINITROTOLUENE	<0.17
2,6-DINITROTOLUENE	<0.17
DIETHYLPHTHALATE	<0.17
4-CHLOROPHENYL-PHENYLETHER	<0.17
FLUORENE	<0.17
4-NITROANILINE	<0.83
4,6-DINITRO-2-METHYLPHENOL	<0.83
N-NITROSODIPHENYLAMINE	<0.17
4-BROMOPHENYL-PHENYLETHER	<0.17
HEXACHLOROBENZENE	<0.17
PENTACHLOROPHENOL	<0.83
PHENANTHRENE	<0.17
ANTHRACENE	<0.17
DI-N-BUTYLPHTHALATE	<0.17
FLUORANTHENE	<0.17
BENZIDINE	<1.7
PYRENE	<0.17
BUTYLBENZYLPHTHALATE	<0.17
3,3'-DICHLOROBENZIDINE	<0.33
BENZO(A)ANTHRACENE	<0.17
BIS(2-ETHYLHEXYL)PHTHALATE	0.019 J
CHRYSENE	<0.17
DI-N-OCTYLPHTHALATE	<0.17
BENZO(B)FLUORANTHENE	<0.17
BENZO(K)FLUORANTHENE	<0.17
BENZO(A)PYRENE	<0.17
INDENO(1,2,3-CD)PYRENE	<0.17
DIBENZO(A,H)ANTHRACENE	<0.17
BENZO(G,H,I)PERYLENE	<0.17

SURROGATE PERCENT RECOVERY		LIMITS
NITROBENZENE-D5	63	27 - 118
2-FLUOROBIPHENYL	67	30 - 115
TERPHENYL-D14	71	39 - 128
PHENOL-D5	67	30 - 124
2-FLUOROPHENOL	64	28 - 118
2,4,6-TRIBROMOPHENOL	52	26 - 123

J = Estimated value.

MultiChem Analytical Services

MAS I.D. # 608114-2

SEMIVOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 08/20/96
PROJECT #	: 4617	DATE RECEIVED	: 08/27/96
PROJECT NAME	: LAKE WA SHIP CANAL	DATE EXTRACTED	: 08/28/96
CLIENT I.D.	: HC-SP-3L	DATE ANALYZED	: 09/09/96
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8270	DILUTION FACTOR	: 10

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
N-NITROSODIMETHYLAMINE	<1.9
PHENOL	<1.9
ANILINE	<9.3
BIS(2-CHLOROETHYL)ETHER	<1.9
2-CHLOROPHENOL	<1.9
1,3-DICHLOROBENZENE	<1.9
1,4-DICHLOROBENZENE	<1.9
BENZYL ALCOHOL	<1.9
1,2-DICHLOROBENZENE	<1.9
2-METHYLPHENOL	<1.9
2,2'-OXYBIS(1-CHLOROPROPANE)	<1.9
3/4-METHYLPHENOL	<1.9
N-NITROSO-DI-N-PROPYLAMINE	<1.9
HEXACHLOROETHANE	<1.9
NITROBENZENE	<1.9
ISOPHORONE	<1.9
2-NITROPHENOL	<1.9
2,4-DIMETHYLPHENOL	<1.9
BENZOIC ACID	<9.3
BIS(2-CHLOROETHOXY)METHANE	<1.9
2,4-DICHLOROPHENOL	<1.9
1,2,4-TRICHLOROBENZENE	<1.9
NAPHTHALENE	<1.9
4-CHLOROANILINE	<1.9
HEXACHLOROBUTADIENE	<1.9
4-CHLORO-3-METHYLPHENOL	<1.9
2-METHYLNAPHTHALENE	0.45 J
HEXACHLOROCYCLOPENTADIENE	<9.3
2,4,6-TRICHLOROPHENOL	<1.9
2,4,5-TRICHLOROPHENOL	<9.3
2-CHLORONAPHTHALENE	<1.9
2-NITROANILINE	<9.3
DIMETHYLPHTHALATE	<1.9
ACENAPHTHYLENE	<1.9
3-NITROANILINE	<9.3
ACENAPHTHENE	<1.9
2,4-DINITROPHENOL	<9.3
4-NITROPHENOL	<9.3

J = Estimated value.

MultiChem Analytical Services

MAS I.D. # 608114-2

SEMIVOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 08/20/96
PROJECT #	: 4617	DATE RECEIVED	: 08/27/96
PROJECT NAME	: LAKE WA SHIP CANAL	DATE EXTRACTED	: 08/28/96
CLIENT I.D.	: HC-SP-3L	DATE ANALYZED	: 09/09/96
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8270	DILUTION FACTOR	: 10

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS	
DIBENZOFURAN	<1.9	
2,4-DINITROTOLUENE	<1.9	
2,6-DINITROTOLUENE	<1.9	
DIETHYLPHTHALATE	<1.9	
4-CHLOROPHENYL-PHENYLETHER	<1.9	
FLUORENE	0.69	J
4-NITROANILINE	<9.3	
4,6-DINITRO-2-METHYLPHENOL	<9.3	
N-NITROSODIPHENYLAMINE	<1.9	
4-BROMOPHENYL-PHENYLETHER	<1.9	
HEXACHLOROBENZENE	<1.9	
PENTACHLOROPHENOL	<9.3	
PHENANTHRENE	1.6	J
ANTHRACENE	0.32	J
DI-N-BUTYLPHTHALATE	<1.9	
FLUORANTHENE	1.0	J
BENZIDINE	<19	
PYRENE	1.6	J
BUTYLBENZYLPHTHALATE	<1.9	
3,3'-DICHLOROBENZIDINE	<3.7	
BENZO(A)ANTHRACENE	0.50	J
BIS(2-ETHYLHEXYL)PHTHALATE	0.35	JB
CHRYSENE	0.66	J
DI-N-OCTYLPHTHALATE	<1.9	
BENZO(B)FLUORANTHENE	0.62	JT
BENZO(K)FLUORANTHENE	0.62	JT
BENZO(A)PYRENE	0.49	J
INDENO(1,2,3-CD)PYRENE	0.30	J
DIBENZO(A,H)ANTHRACENE	<1.9	
BENZO(G,H,I)PERYLENE	0.30	J

10.1.96

SURROGATE PERCENT RECOVERY		LIMITS
NITROBENZENE-D5	86	27 - 118
2-FLUOROBIPHENYL	105	30 - 115
TERPHENYL-D14	125	39 - 128
PHENOL-D5	105	30 - 124
2-FLUOROPHENOL	100	28 - 118
2,4,6-TRIBROMOPHENOL	86	26 - 123

J = Estimated value.
B = Analyte is found in the associated blank as well as the sample.
T = Sum of benzo(b) and benzo(k)fluoranthene isomers.

MultiChem Analytical Services

MAS I.D. # 608114

SEMIVOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL
SAMPLE MATRIX : SOIL
EPA METHOD : 8270

SAMPLE I.D. # : BLANK
DATE EXTRACTED : 08/28/96
DATE ANALYZED : 09/09/96
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
PHENOL	<0.167	2.50	1.50	60	N/A	N/A	N/A
2-CHLOROPHENOL	<0.167	2.50	1.74	70	N/A	N/A	N/A
1,4-DICHLOROBENZENE	<0.167	1.67	1.07	64	N/A	N/A	N/A
N-NITROSO-DI-N-PROPYLAMINE	<0.167	1.67	1.11	66	N/A	N/A	N/A
1,2,4-TRICHLOROBENZENE	<0.167	1.67	1.04	62	N/A	N/A	N/A
4-CHLORO-3-METHYLPHENOL	<0.167	2.50	1.74	70	N/A	N/A	N/A
ACENAPHTHENE	<0.167	1.67	1.15	69	N/A	N/A	N/A
4-NITROPHENOL	<0.833	2.50	2.20	88	N/A	N/A	N/A
2,4-DINITROTOLUENE	<0.167	1.67	1.15	69	N/A	N/A	N/A
PENTACHLOROPHENOL	<0.833	2.50	1.21	48	N/A	N/A	N/A
PYRENE	<0.167	1.67	1.16	69	N/A	N/A	N/A

CONTROL LIMITS	% REC.	RPD
PHENOL	27 - 116	20
2-CHLOROPHENOL	25 - 112	20
1,4-DICHLOROBENZENE	25 - 108	22
N-NITROSO-DI-N-PROPYLAMINE	20 - 110	20
1,2,4-TRICHLOROBENZENE	26 - 110	20
4-CHLORO-3-METHYLPHENOL	29 - 114	20
ACENAPHTHENE	28 - 108	21
4-NITROPHENOL	25 - 116	20
2,4-DINITROTOLUENE	28 - 107	20
PENTACHLOROPHENOL	25 - 107	28
PYRENE	25 - 131	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
NITROBENZENE-D5	72	N/A	27 - 118
2-FLUOROBIPHENYL	71	N/A	30 - 115
TERPHENYL-D14	76	N/A	39 - 128
PHENOL-D5	72	N/A	30 - 124
2-FLUOROPHENOL	71	N/A	28 - 118
2,4,6-TRIBROMOPHENOL	71	N/A	26 - 123

MultiChem Analytical Services

MAS I.D. # 608114

SEMIVOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL
SAMPLE MATRIX : SOIL
EPA METHOD : 8270

SAMPLE I.D. # : 820712-1
DATE EXTRACTED : 08/28/96
DATE ANALYZED : 09/09/96
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
PHENOL	<0.333	2.50	1.54	62	1.86	74	19
2-CHLOROPHENOL	<0.333	2.50	1.66	66	2.05	82	21F
1,4-DICHLOROBENZENE	<0.333	1.67	0.989	59	1.21	72	20
N-NITROSO-DI-N-PROPYLAMINE	<0.333	1.67	1.08	65	1.27	76	16
1,2,4-TRICHLOROBENZENE	<0.333	1.67	1.02	61	1.18	71	15
4-CHLORO-3-METHYLPHENOL	<0.333	2.50	1.59	64	1.90	76	18
ACENAPHTHENE	<0.333	1.67	0.843	50	1.00	60	17
4-NITROPHENOL	<1.67	2.50	4.07	163F	5.48	219F	30F
2,4-DINITROTOLUENE	<0.333	1.67	0.731	44	0.957	57	27F
PENTACHLOROPHENOL	<1.67	2.50	1.00	40	1.34	54	29F
PYRENE	<0.333	1.67	1.06	63	1.39	83	27F

CONTROL LIMITS	% REC.	RPD
PHENOL	37 - 112	20
2-CHLOROPHENOL	28 - 132	20
1,4-DICHLOROBENZENE	32 - 109	22
N-NITROSO-DI-N-PROPYLAMINE	32 - 109	20
1,2,4-TRICHLOROBENZENE	26 - 123	20
4-CHLORO-3-METHYLPHENOL	33 - 140	20
ACENAPHTHENE	37 - 123	21
4-NITROPHENOL	31 - 142	20
2,4-DINITROTOLUENE	35 - 112	20
PENTACHLOROPHENOL	20 - 93	28
PYRENE	53 - 129	20

SURROGATE RECOVERIES	SPIKE	DUP. SPIKE	LIMITS
NITROBENZENE-D5	65	75	27 - 118
2-FLUOROBIPHENYL	54	66	30 - 115
TERPHENYL-D14	67	88	39 - 128
PHENOL-D5	69	85	30 - 124
2-FLUOROPHENOL	66	80	28 - 118
2,4,6-TRIBROMOPHENOL	73	94	26 - 123

F = Out of limits due to matrix interference.

MultiChem Analytical Services

MAS I.D. # 608114

CASE NARRATIVE

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

CASE NARRATIVE: METALS AND INORGANICS ANALYSIS

The following anomalies were associated with the sample for this accession:

The reporting limit for cadmium was elevated due to matrix interference from high levels of iron. A two fold dilution was performed to eliminate the effects of matrix interference and the reporting limits were raised accordingly.

The oven temperature was outside the required range of 103-105 degrees celcius upon completion of the percent solids determination. The temperature was two degrees celcius below the lower range. This deviation was not deemed to significantly impact the results. Therefore, the sample was processed "as is" and actions have been taken to correct the problem.

The matrix spike (MS) percent recovery of arsenic in the associated QC was outside the MAS established control limits of 33-134%. The relative percent difference (RPD) was also outside the established control limits indicating a non-homogenous matrix. Therefore, the total arsenic MS recovery was flagged with a "F" for matrix interference.

The RPD of the arsenic duplicate exceeded the established control limits of 35%. The arsenic results were flagged with an "*" and no further corrective action was taken.

The reporting limits for selenium were elevated due to matrix interference. A five fold dilution was performed to a yield post-digestion spike recovery that was within the MAS established control limit. The reporting limit was raised accordingly.

All other corresponding quality assurance/quality control (QA/QC) parameters were within established MAS control limits.

MultiChem Analytical Services

MAS I.D. # 608114

METALS ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	08/30/96	09/06/96
BARIUM	09/04/96	09/05/96
CADMIUM	09/04/96	09/05/96
CHROMIUM	09/04/96	09/05/96
LEAD	09/04/96	09/05/96
MERCURY	09/03/96	09/04/96
SELENIUM	08/30/96	09/09/96
SILVER	09/04/96	09/05/96

MultiChem Analytical Services

MAS I.D. # 608114

METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/Kg
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

MAS I.D. #	CLIENT I.D.	ARSENIC	BARIUM	CADMIUM
608114-2	HC-SP-3L	6.3 D3	71	<0.57 D1
METHOD BLANK	-	<0.25	<0.50	<0.25

D1 = Value from a two fold diluted analysis.
D3 = Value from a five fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 608114

METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/Kg
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

MAS I.D. #	CLIENT I.D.	CHROMIUM	LEAD	MERCURY
608114-2	HC-SP-3L	22	42	<0.11
METHOD BLANK	-	<0.50	<1.5	<0.10

MultiChem Analytical Services

MAS I.D. # 608114

METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/Kg
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

MAS I.D. #	CLIENT I.D.	SELENIUM		SILVER
608114-2	HC-SP-3L	<1.4	D3	<0.29
METHOD BLANK	-	<0.25		<0.25

D3 = Value from a five fold diluted analysis.

MultiChem Analytical Services

MAS I.D. # 608114

METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/Kg

ELEMENT	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
ARSENIC	BLANK	<0.250	N/A	N/A	1.34	1.25	107
ARSENIC	820712-4	13.0	5.68	H	3.12	1.53	F
BARIUM	BLANK	<0.500	N/A	N/A	47.4	50.0	95
BARIUM	609007-6	48.2	46.4	4	95.9	53.5	89
CADMIUM	BLANK	<0.250	N/A	N/A	45.9	50.0	92
CADMIUM	609007-6	<0.521	<0.537	NC	48.2	53.5	90
CHROMIUM	BLANK	<0.500	N/A	N/A	46.8	50.0	94
CHROMIUM	609007-6	20.3	19.3	5	68.3	53.5	90
LEAD	BLANK	<1.50	N/A	N/A	47.1	50.0	94
LEAD	609007-6	2.04	2.61	25	52.7	53.5	95
MERCURY	BLANK	<0.100	N/A	N/A	0.525	0.500	105
MERCURY	608106-7	<1.10	<1.08	NC	5.59	5.48	102
SELENIUM	BLANK	<0.250	N/A	N/A	1.20	1.25	96
SELENIUM	820712-4	<1.52	<1.52	NC	0.600	1.53	39
SILVER	BLANK	<0.250	N/A	N/A	48.1	50.0	96
SILVER	609007-6	<0.260	<0.269	NC	49.9	53.5	93

NC = Not Calculable.
F = Out of limits due to matrix interference.
H = Out of limits.

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

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

MultiChem Analytical Services

MAS I.D. # 608114

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

PARAMETER	DATE ANALYZED
MOISTURE	08/29/96

MultiChem Analytical Services

MAS I.D. # 608114

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : %

MAS I.D. #	CLIENT I.D.	MOISTURE
608114-2	HC-SP-3L	10

MultiChem Analytical Services

MAS I.D. # 608114

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : SOIL
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : %

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
MOISTURE	608072-40	11	13	17	N/A	N/A	N/A

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

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Sample Result} - \text{Duplicate Result})|}{\text{Average Result}} \times 100$$

Sample Custody Record

DATE 8/27/96 PAGE 1 OF 1

F1008114

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER DAVE HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FELDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: TOTAL METALS	TESTING: SEMI-VOA 8270	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
1	8/20/96	15:45	HC-SP-4C	SOIL	X	X	1	
2	8/20/96	15:30	HC-SP-3C	SOIL	X	X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE: J. FELDER	8.27.1996	SIGNATURE: A. Schuenberg	8/27/96
PRINTED NAME: J. FELDER	TIME: 0815	PRINTED NAME: A. Schuenberg	TIME: 0815
COMPANY: HC-SEA		COMPANY: MAS	

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

TOTAL NUMBER OF CONTAINERS: 2

METHOD OF SHIPMENT: COURIER

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS: NORMAL

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

Sample Custody Record

DATE 8/27/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER DAVE HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FELDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: TOTAL METALS*	TESTING: SEMI-VOA 8270	TESTING:
	8/26/96	15:45	HC-SP-4C	SOIL	X	X	1
	8/25/96	15:30	HK-SP-3C	SOIL	X	X	1

Post-it™ brand fax transmittal memo 7671 # of pages ▸ 1

To Sally Hanley	From Brian Christensen
Co. Multichem	Co. Hart Crowser
Dept.	Phone # 206-324-9530
Fax # 206-363-1742	Fax # 206-328-5581

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	8.27.1996	SIGNATURE	
PRINTED NAME J. FELDER	TIME	PRINTED NAME	TIME
COMPANY HC SEA	0815	COMPANY	
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINTED NAME	TIME	PRINTED NAME	TIME
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS 2

METHOD OF SHIPMENT COURIER

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS NORMAL

* RCRA metals (8)

DISTRIBUTION:
1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

Printed On Recycled Paper

TOTAL P.01

TAT from 8/28/96

MultiChem Analytical Services 560 Naches Avenue S.W., Suite 101, Renton, WA 98055
(Formerly Analytical Technologies, Inc.-Washington) (800) 609-0580 ◆ (206) 228-8335 ◆ Fax (206) 363-1742

MAS I.D. # 609102

October 22, 1996

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle WA 98102-3699

Attention : Brian Christianson

Project Number : 4617

Project Name : Lake WA Ship Canal

Dear Mr. Christianson:

On September 26, 1996, MultiChem Analytical Services received three samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Sincerely,

Sally J. Hanley
Senior Project Manager

SJH/hal/mrj

Enclosure

MultiChem Analytical Services

MAS I.D. # 609102

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

MAS #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
609102-1	HC-MW-1	09/26/96	WATER
609102-2	HC-MW-2	09/26/96	WATER
609102-3	HC-MW-3	09/26/96	WATER

----- TOTALS -----

MATRIX	# SAMPLES
WATER	3

MAS STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from the date of the report. If an extended storage period is required, please contact our sample control department before the scheduled disposal date.

MultiChem Analytical Services

MAS I.D. # 609102

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

ANALYSIS	TECHNIQUE	REFERENCE	LAB
TOTAL SUSPENDED SOLIDS	GRAVIMETRIC	EPA 160.2	R

R = MAS - Renton
ANC = MAS - Anchorage
SUB = Subcontract

MultiChem Analytical Services

MAS I.D. # 609102

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL

PARAMETER	DATE PREPARED	DATE ANALYZED
TOTAL SUSPENDED SOLIDS	09/30/96	10/01/96

/

MultiChem Analytical Services

MAS I.D. # 609102

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/L

MAS I.D. #	CLIENT I.D.	TOTAL SUSPENDED SOLIDS
609102-1	HC-MW-1	130
609102-2	HC-MW-2	44
609102-3	HC-MW-3	72
METHOD BLANK	-	<10

MAS I.D. # 609102

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC. MATRIX : WATER
PROJECT # : 4617
PROJECT NAME : LAKE WA SHIP CANAL UNITS : mg/L

PARAMETER	MAS I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC.
TOTAL SUSPENDED SOLIDS	LCS	<10.0	N/A	N/A	41.0	43.6	94
TOTAL SUSPENDED SOLIDS	609096-1	10.0	<10.0	NC	N/A	N/A	N/A

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

$$\text{RPD (Relative \% Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 100$$

Sample Custody Record

DATE 9/26/96 PAGE 1 OF 1

NMFS LAB

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER 609102

PROJECT MANAGER BRIAN CHRISTIANSON

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FEDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: TSS	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
1	9/26/96	14:00	HC-MW-1	WATER	X	1	
2	9/26/96	11:30	HC-MW-2	WATER	X	1	
3	9/26/96	13:15	HC-MW-3	WATER	X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE: [signature]	9-26-96	SIGNATURE: [signature]	9/26/96
PRINTED NAME: JIM FEDER	TIME	PRINTED NAME: Brian Sender	TIME
COMPANY: HC SEA	15:00	COMPANY: MAF	1745
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINTED NAME	TIME	PRINTED NAME	TIME
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS: 3

METHOD OF SHIPMENT: COURIER

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS: NORMAL TAT.

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

Hart Crowser
J-4617

CHEMISTRY LABORATORY ANALYTICAL REPORT
HART CROWSER CHEMISTRY LABORATORY

HARTCROWSER

Earth and Environmental Technologies

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

CHEMISTRY LABORATORY ANALYTICAL REPORT

September 17, 1996

David Heffner, Associate Engineer, Hart Crowser

RE: Corps, Lake Washington Ship Canal, Sequence A

Attached are the compiled results from analyses conducted on samples collected and received on August 21 and 23, 1996. We performed extraction and analysis as indicated:

	Matrix	Quantity	Date Extracted	Date Analyzed
• TPH-D	Soil	10	8/27/96	8/28/96
• PCB (8081)	Soil	10	8/23/96	8/23/96

This report contains the following:

- Analytical results for soil samples presented on a dry weight basis.
- Data qualifiers.
- Results for method blank.
- Recoveries for laboratory control sample.
- Recoveries for matrix spiked samples.
- Differences for matrix spike duplicate analyses.
- Analytical reporting limits.
- QA/QC Control limits.
- Copies of Chain of Custody forms.

Analytical Comment

The TPH-D diesel concentration in sample HC-SP-6L is less than five times the reporting limit. Relative percent difference is not calculated.

The TPH-D diesel concentration in sample HC-EX-4L is greater than five times the spike concentration. Recoveries are not calculated for the Matrix Spike (MS) and Matrix Spike Duplicate (MSD). Concentrations from the spiked samples are used to calculate Relative Percent Difference (RPD).

The following samples were analyzed, and results are presented in this report:

HC-EX-1L
HC-EX-2L
HC-EX-3L
HC-EX-4L
HC-EX-5L
HC-EX-6L
HC-EX-7L
HC-EX-17L
HC-SP-5L
HC-SP-6L

HART CROWSER, INC.

James Herndon

JAMES HERNDON
Laboratory Manager
Washington State Department of Ecology
Laboratory Accreditation Number C134
Corps of Engineers Validation 5/13/96

Analytical Results

Compound	HC-EX-1L	HC-EX-2L	HC-EX-3L	HC-EX-6L
Matrix	Soil	Soil	Soil	Soil
% Moisture	14%	11%	15%	9%
	Results in mg/kg (ppm)			
TPH-D				
TPH-D, C12 > C24, (Diesel)	20 U	**330**	**280**	**9,700**
TPH-D, C24 > C37, (Oil)	**48 J**	**1,600**	**1,100**	**22,000**
2-Fluorobiphenyl (surr #1)	92%	102%	104%	C
o-Terphenyl (surr #2)	95%	102%	106%	C
Hexacosane - nC26 (surr #3)	96%	99%	106%	C
	Results in µg/kg (ppb)			
PCB 8081				
A1016	200 U	200 U	200 U	200 U
A1221	500 U	500 U	500 U	500 U
A1232	500 U	500 U	500 U	500 U
A1242	200 U	200 U	200 U	200 U
A1248	200 U	200 U	200 U	200 U
A1254	200 U	200 U	200 U	200 U
A1260	200 U	200 U	200 U	200 U
Tetrachloro-m-xylene (surr)	83%	70%	73%	73%
Decachlorobiphenyl (surr)	90%	86%	89%	80%

Analytical Results, continued

Compound	HC-EX-7L	HC-EX-17L	HC-EX-5L	HC-EX-4L
Matrix	Soil	Soil	Soil	Soil
% Moisture	10%	12%	9%	9%
	Results in mg/kg (ppm)			
TPH-D				
TPH-D, C12 > C24, (Diesel)	**810**	**54**	**6,300**	**2,800**
TPH-D, C24 > C37, (Oil)	**2,900**	**300**	**12,000**	**6,700**
2-Fluorobiphenyl (surr #1)	108%	93%	C	C
o-Terphenyl (surr #2)	98%	98%	C	C
Hexacosane - nC26 (surr #3)	98%	100%	C	86%
	Results in µg/kg (ppb)			
PCB 8081				
A1016	200 U	200 U	200 U	200 U
A1221	500 U	500 U	500 U	500 U
A1232	500 U	500 U	500 U	500 U
A1242	200 U	200 U	200 U	200 U
A1248	200 U	200 U	200 U	200 U
A1254	200 U	200 U	200 U	200 U
A1260	200 U	200 U	200 U	1,300
Tetrachloro-m-xylene (surr)	68%	73%	69%	67%
Decachlorobiphenyl (surr)	81%	83%	80%	83%

Analytical Results, continued

Compound	HC-SP-5L	HC-SP-6L	Dupl HC-SP-6L
Matrix	Soil	Soil	Soil
% Moisture	2%	2%	2%
	Results in mg/kg (ppm)		
TPH-D			
TPH-D, C12 > C24, (Diesel)	**21**	**29**	**30**
TPH-D, C24 > C37, (Oil)	**190**	**170**	**190**
2-Fluorobiphenyl (surr #1)	101%	101%	102%
o-Terphenyl (surr #2)	104%	104%	106%
Hexacosane - nC26 (surr #3)	108%	109%	110%
	Results in μg/kg (ppb)		
PCB 8081			
A1016	200 U	200 U	200 U
A1221	500 U	500 U	500 U
A1232	500 U	500 U	500 U
A1242	200 U	200 U	200 U
A1248	200 U	200 U	200 U
A1254	200 U	200 U	200 U
A1260	**1,500**	**4,500**	**4,700**
Tetrachloro-m-xylene (surr)	78%	85%	90%
Decachlorobiphenyl (surr)	83%	80%	85%

Data Qualifiers

U	Not detected at the indicated reporting limit.
-	Below reporting limit.
J	Estimated value.
B	Also detected in associated method blank.
C	Co-elution interference.
M	Unable to report due to matrix interference.
n/t	Test not performed.
n/a	Not applicable.
Surr	Surrogate compound.
Dupl	Laboratory analytical duplicate.

Method Blank

Compound	
Matrix	Soil
Results in mg/kg (ppm)	
TPH-D	08/27/96
TPH-D, C12 > C24, (Diesel)	20 U
TPH-D, C24 > C37, (Oil)	50 U
2-Fluorobiphenyl (surr #1)	96%
o-Terphenyl (surr #2)	101%
Hexacosane - nC26 (surr #3)	100%

Results in μg/kg (ppb)	
PCB 8081	08/23/96
A1016	200 U
A1221	500 U
A1232	500 U
A1242	200 U
A1248	200 U
A1254	200 U
A1260	200 U
Tetrachloro-m-xylene (surr)	91%
Decachlorobiphenyl (surr)	94%

Laboratory Control Sample

Compound	
Matrix	Soil
	% Recovery
TPH-D	08/27/96
TPH-D, C12 > C24, (Diesel)	101%
2-Fluorobiphenyl (surr #1)	C
o-Terphenyl (surr #2)	C
Hexacosane - nC26 (surr #3)	111%
	% Recovery
PCB 8081	08/23/96
A1242	83%
Tetrachloro-m-xylene (surr)	86%
Decachlorobiphenyl (surr)	93%

Matrix Spikes

Compound	MS HC-EX-4L	MSD HC-EX-4L
Matrix	Soil	Soil
% Moisture	9%	9%
	Results in mg/kg (ppm)	
TPH-D		
TPH-D, C12 > C24, (Diesel)	**3,600**	**3,900**
TPH-D, C24 > C37, (Oil)	**7,300**	**7,700**
2-Fluorobiphenyl (surr #1)	C	C
o-Terphenyl (surr #2)	C	C
Hexacosane - nC26 (surr #3)	C	84%
	% Recovery	
PCB 8081		
A1242	90%	89%
Tetrachloro-m-xylene (surr)	68%	69%
Decachlorobiphenyl (surr)	81%	77%

Relative Percent Difference for Duplicates

Compound	HC-EX-4L	HC-SP-6L
Matrix	Soil	Soil
TPH-D		
TPH-D, C12 > C24, (Diesel)	8%	
TPH-D, C24 > C37, (Oil)	5%	
PCB		
A1260		4%

Analytical Reporting Limits

Limits in mg/kg (ppm)

TPH-D	Soil
Diesel (C12 > C24)	20
Oil (C24 > C37)	50

Limits in μg/kg (ppb)

PCBs 8081/608	Soil
A1016	200
A1221	500
A1232	500
A1242	200
A1248	200
A1254	200
A1260	200

QA/QC Control Limits

Method: TPH-D
Evaluation: 8/96

Parameter Matrix	LCL Soil	UCL Soil
LCS	80%	110%
MS/MSD	52%	155%
MS/MSD (RPD)	0%	20%
Duplicate (RPD)	0%	33%
Surrogates		
2-Fluorobiphenyl	67%	115%
o-Terphenyl	84%	115%
Hexacosane	84%	118%

N/A - not available due to insufficient database.
LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

QA/QC Control Limits, continued

Method: PCBs (8081/608)
Evaluation: 8/96

Parameter Matrix	LCL Soil	UCL Soil
LCS	56%	142%
MS/MSD	69%	160%
MS/MSD (RPD)	0%	N/A
Duplicate (RPD)	0%	N/A
Surrogates		
Tetrachloro-m-xylene	46%	133%
Decachlorobiphenyl	53%	134%

N/A - not available due to insufficient database.
LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

(1)

Sample Custody Record

DATE 8/21/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER D. HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FEDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: WT PH. D EST	TESTING: PCB 8080	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	8/21/96	0850	HC-EX-1L	SOIL	X	X	1	
		0855	HC-EX-2L		X	X	1	
		0900	HC-EX-3L		X	X	1	
		0905	HC-EX-6L		X	X	1	
		0910	HC-EX-7L		X	X	1	
		0915	HC-EX-17L		X	X	1	
		0920	HC-EX-5L		X	X	1	
		0945	HC-EX-4L		X	X	1	
	↓	0945	HC-EX-4L MS/MSD	↓	X	X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	8-21-1996	SIGNATURE	8/21/96
PRINTED NAME FEDER	TIME	PRINTED NAME Brian Van Ysseldyk	TIME
COMPANY HC-SEA	0950	COMPANY HCI	950

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

TOTAL NUMBER OF CONTAINERS (9)

METHOD OF SHIPMENT HAND

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS NORMAL TAT.

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

(A)

Sample Custody Record

DATE 8/23/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER D. HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: J. FELDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: WTPH-D ext	TESTING: PCBs 8082	NO. OF CONTAINERS	OBSERVATIONS / COMMENTS / COMPOSITING INSTRUCTIONS
	8/23/96	0820	HC-SP-5L	SOIL	X	X	1	PREVIOUS SP
	8/23/96	0825	HC-SP-6L	SOIL	X	X	1	" "

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	8/23 1996	Brian Van Ysselo SIGNATURE	8/23/96
J. FELDER PRINTED NAME	TIME	Brian Van Ysselo PRINTED NAME	TIME
HC-SEA COMPANY	0846	HCI COMPANY	846
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINTED NAME		PRINTED NAME	
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS (2)

METHOD OF SHIPMENT HAND

SPECIAL SHIPMENT / HANDLING OR STORAGE REQUIREMENTS SEE HEFFNER TO VERIFY NORMAL TAT

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

HARTCROWSER

Earth and Environmental Technologies

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

CHEMISTRY LABORATORY ANALYTICAL REPORT

September 10, 1996

David Heffner, P.E., Associate Engineer, Hart Crowser

RE: Lake Washington Ship Canal, J-4617

Attached are the compiled results from analyses conducted on samples collected on August 20, 1996, and received on August 20, 1996. We performed extraction and analysis as indicated:

	Matrix	Quantity	Date Extracted	Date Analyzed
• TPH-D	Soil	5	8/21/96	8/21/96
• PCB (8081)	Soil	5	8/21/96	8/21/96

This report contains the following:

- Analytical results for soil samples presented on a dry weight basis.
- Data qualifiers.
- Results for method blank.
- Recoveries for laboratory control sample.
- Recoveries for matrix spiked samples.
- Differences for matrix spike duplicate analyses.
- Differences for analytical duplicate analyses.
- Recoveries for proficiency sample.
- Analytical reporting limits.
- QA/QC Control limits.
- Copies of Chain of Custody forms.

Analytical Comment

The A1260 concentration in sample HC-SP3 is less than five times the reporting limit. Relative percent difference is not calculated.

The following samples were analyzed, and results are presented in this report:

HC-SP1
HC-SP2
HC-SP3
HC-SP4
HC-SP13

HART CROWSER, INC.

James Herndon

JAMES HERNDON
Laboratory Manager
Washington State Department of Ecology
Laboratory Accreditation Number C134
Corps of Engineers Validation 5/13/96

Analytical Results

Compound	HC-SP1	HC-SP2	HC-SP3	Duplicate HC-SP3
Matrix	Soil	Soil	Soil	Soil
% Moisture	6%	7%	8%	8%
	Results in mg/kg (ppm)			
TPH-D				
TPH-D, C12 > C24, (Diesel)	**20**	**150**	**190**	**190**
TPH-D, C24 > C37, (Oil)	**47 J**	**830**	**1,200**	**1,100**
2-Fluorobiphenyl (surr #1)	94%	93%	101%	100%
o-Terphenyl (surr #2)	96%	92%	100%	102%
Hexacosane - nC26 (surr #3)	96%	92%	99%	100%
	Results in µg/kg (ppb)			
PCB 8081				
A1016	200 U	200 U	200 U	200 U
A1221	500 U	500 U	500 U	500 U
A1232	500 U	500 U	500 U	500 U
A1242	200 U	200 U	200 U	200 U
A1248	200 U	200 U	200 U	200 U
A1254	200 U	200 U	200 U	200 U
A1260	**460**	**420**	**370**	**540**
Tetrachloro-m-xylene (surr)	88%	70%	70%	73%
Decachlorobiphenyl (surr)	96%	89%	90%	93%

Analytical Results, continued

Compound	HC-SP4	HC-SP13
Matrix	Soil	Soil
% Moisture	8%	9%
	Results in mg/kg (ppm)	
TPH-D		
TPH-D, C12 > C24, (Diesel)	**140**	**150**
TPH-D, C24 > C37, (Oil)	**1,100**	**960**
2-Fluorobiphenyl (surr #1)	94%	98%
o-Terphenyl (surr #2)	95%	98%
Hexacosane - nC26 (surr #3)	94%	96%
	Results in µg/kg (ppb)	
PCB 8080		
A1016	200 U	200 U
A1221	500 U	500 U
A1232	500 U	500 U
A1242	200 U	200 U
A1248	200 U	200 U
A1254	200 U	200 U
A1260	**140 J**	**370**
Tetrachloro-m-xylene (surr)	72%	72%
Decachlorobiphenyl (surr)	90%	89%

Data Qualifiers

U	Not detected at the indicated reporting limit.
-	Below reporting limit.
J	Estimated value.
B	Also detected in associated method blank.
C	Co-elution interference.
M	Unable to report due to matrix interference.
n/t	Test not performed.
n/a	Not applicable.
Surr	Surrogate compound.
Dupl	Laboratory analytical duplicate.

Method Blank

Compound	08/21/96
Matrix	Soil
Results in mg/kg (ppm)	
TPH-D	
TPH-D, C12 > C24, (Diesel)	20 U
TPH-D, C24 > C37, (Oil)	50 U
2-Fluorobiphenyl (surr #1)	91%
o-Terphenyl (surr #2)	95%
Hexacosane - nC26 (surr #3)	95%
Results in µg/kg (ppb)	
PCB 8081	
A1016	200 U
A1221	500 U
A1232	500 U
A1242	200 U
A1248	200 U
A1254	200 U
A1260	200 U
Tetrachloro-m-xylene (surr)	81%
Decachlorobiphenyl (surr)	92%

Laboratory Control Sample

Compound	08/21/96
Matrix	Soil
	% Recovery
TPH-D	
TPH-D, C12 > C24, (Diesel)	100%
2-Fluorobiphenyl (surr #1)	69%
o-Terphenyl (surr #2)	C
Hexacosane - nC26 (surr #3)	99%
	% Recovery
PCB 8081	
A1242	85%
Tetrachloro-m-xylene (surr)	86%
Decachlorobiphenyl (surr)	97%

Matrix Spikes

Compound	MS HC-SP1	MSD HC-SP1
Matrix	Soil	Soil
% Moisture	6%	6%
	% Recovery	
TPH-D		
TPH-D, C12 > C24, (Diesel)	90%	86%
2-Fluorobiphenyl (surr #1)	87%	90%
o-Terphenyl (surr #2)	100%	95%
Hexacosane - nC26 (surr #3)	94%	92%
	% Recovery	
PCB 8081		
A1242	102%	106%
Tetrachloro-m-xylene (surr)	83%	87%
Decachlorobiphenyl (surr)	93%	92%

Relative Percent Difference for Duplicates

Compound	RPD HC-SP1	RPD HC-SP3
Matrix	Soil	Soil
TPH-D		
TPH-D, C12 > C24, (Diesel)	4%	0%
TPH-D, C24 > C37, (Oil)		9%
PCB 8081		
A1242	4%	

Proficiency Sample Results

Compound	ERA QC
Matrix	Soil
	#40007
	% Recovery
TPH-D	
TPH-D, C12 > C24, (Diesel)	86%
2-Fluorobiphenyl (surr #1)	C
o-Terphenyl (surr #2)	C
Hexacosane - nC26 (surr #3)	95%
	% Recovery
PCB 8081	#9303
A1248	77%
Tetrachloro-m-xylene (surr)	80%
Decachlorobiphenyl (surr)	94%

Analytical Reporting Limits

Limits in mg/kg (ppm)

TPH-D	Soil
Diesel (C12 > C24)	20
Oil (C24 > C37)	50

Limits in µg/kg (ppb)

PCBs 8081/608	Soil
A1016	200
A1221	500
A1232	500
A1242	200
A1248	200
A1254	200
A1260	200

QA/QC Control Limits

Method: TPH-D
Evaluation: 8/96

Parameter Matrix	LCL Soil	UCL Soil
LCS	80%	110%
MS/MSD	52%	155%
MS/MSD (RPD)	0%	20%
Duplicate (RPD)	0%	33%
Surrogates		
2-Fluorobiphenyl	67%	115%
o-Terphenyl	84%	115%
Hexacosane	84%	118%

LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

Method: PCBs (8081/608)
Evaluation: 8/96

Parameter Matrix	LCL Soil	UCL Soil
LCS	56%	142%
MS/MSD	69%	160%
MS/MSD (RPD)	0%	N/A
Duplicate (RPD)	0%	N/A
Surrogates		
Tetrachloro-m-xylene	46%	133%
Decachlorobiphenyl	53%	134%

N/A - not available due to insufficient database.
LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

Sample Custody Record

DATE 8/20/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER D. HEFFNER

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FETDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: WTPH-D EXT	TESTING: PCB's 8082	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	8/20/96	15:55	HC-SP-1	SOIL	X	X	1	
	↓	15:15	HC-SP-2	SOIL	X	X	1	
		15:30	HC-SP-3	SOIL	X	X	1	
		15:45	HC-SP-4	SOIL	X	X	1	
		15:30	HC-SP-13	SOIL	X	X	1	
	↓	15:55	HC-SP-1 (MS/MSD)	SOIL	X	X	1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	8-20-1996	SIGNATURE Brian Van Ysseldyk	8/20/96
PRINTED NAME FETDER	TIME	PRINTED NAME Brian Van Ysseldyk	TIME
COMPANY HC-SEA	1615	COMPANY HCI	1615
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINTED NAME	TIME	PRINTED NAME	TIME
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS 6

METHOD OF SHIPMENT HAND

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS 24hr TAT

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

HARTCROWSER

Earth and Environmental Technologies

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

CHEMISTRY LABORATORY ANALYTICAL REPORT

October 11, 1996

Brian Christianson, Senior Project Geologist, Hart Crowser

RE: Lake Washington Ship Canal, J-4617, Sequence B

Attached are the compiled results from analyses conducted on samples collected and received on September 26, 1996. We performed extraction and analysis as indicated:

	Matrix	Quantity	Date Extracted	Date Analyzed
• TPH-D	Water	4	10/2/96	10/2/96
• PCB (8081)	Water	4	10/1/96	10/3/96

This report contains the following:

- Analytical results for water samples.
- Data qualifiers.
- Results for method blank.
- Recoveries for laboratory control sample.
- Analytical reporting limits.
- QA/QC Control limits.
- Copy of Chain of Custody forms.
- Copy of Sample Receipt form.

Analytical Comment

The PCB and TPH-D concentrations in sample HC-MW-1 are less than five times the reporting limit. Relative percent difference is not calculated.

The following samples were analyzed, and results are presented in this report:

HC-MW-1
HC-MW-2
HC-MW-3
HC-MW-12

HART CROWSER, INC.

James Herndon

JAMES HERNDON
Laboratory Manager
Washington State Department of Ecology
Laboratory Accreditation Number C134
Corps of Engineers Validation 5/13/96

Analytical Results

Compound	HC-MW-1	Dupl HC-MW-1	HC-MW-2	HC-MW-3
Matrix	Water	Water	Water	Water
	Results in µg/L (ppb)			
PCB (8081)				
A1016	4.0 U	4.0 U	4.0 U	4.0 U
A1221	10 U	10 U	10 U	10 U
A1232	10 U	10 U	10 U	10 U
A1242	4.0 U	4.0 U	4.0 U	4.0 U
A1248	4.0 U	4.0 U	4.0 U	4.0 U
A1254	4.0 U	4.0 U	4.0 U	4.0 U
A1260	4.0 U	4.0 U	4.0 U	4.0 U
Tetrachloro-m-xylene (surr)	88%	96%	96%	84%
Decachlorobiphenyl (surr)	92%	103%	107%	101%
	Results in mg/L (ppm)			
TPH-D				
TPH-D, C12 > C24, (Diesel)	0.25 U	0.25 U	0.25 U	**0.33**
TPH-D, C24 > C37, (Oil)	0.75 U	0.75 U	0.75 U	0.75 U
2-Fluorobiphenyl (surr #1)	80%	87%	82%	82%
o-Terphenyl (surr #2)	95%	95%	92%	98%
Hexacosane - nC26 (surr #3)	93%	94%	93%	102%

Analytical Results, continued

Compound	HC-MW-12
Matrix	Water
Results in µg/L (ppb)	
PCB (8081)	
A1016	4.0 U
A1221	10 U
A1232	10 U
A1242	4.0 U
A1248	4.0 U
A1254	4.0 U
A1260	4.0 U
Tetrachloro-m-xylene (surr)	104%
Decachlorobiphenyl (surr)	116%
Results in mg/L (ppm)	
TPH-D	
TPH-D, C12 > C24, (Diesel)	0.25 U
TPH-D, C24 > C37, (Oil)	0.25 U
2-Fluorobiphenyl (surr #1)	91%
o-Terphenyl (surr #2)	97%
Hexacosane - nC26 (surr #3)	98%

Data Qualifiers

U	Not detected at the indicated reporting limit.
-	Below reporting limit.
J	Estimated value.
B	Also detected in associated method blank.
C	Co-elution interference.
M	Unable to report due to matrix interference.
n/t	Test not performed.
n/a	Not applicable.
Surr	Surrogate compound.
Dupl	Laboratory analytical duplicate.

Method Blank

Compound	
Matrix	Water
Results in µg/L (ppb)	
PCB (8081)	10/01/96
A1016	4.0 U
A1221	10 U
A1232	10 U
A1242	4.0 U
A1248	4.0 U
A1254	4.0 U
A1260	4.0 U
Tetrachloro-m-xylene (surr)	96%
Decachlorobiphenyl (surr)	99%

Results in mg/L (ppm)	
TPH-D	10/02/96
TPH-D, C12 > C24, (Diesel)	0.25 U
TPH-D, C24 > C37, (Oil)	0.75 U
2-Fluorobiphenyl (surr #1)	92%
o-Terphenyl (surr #2)	98%
Hexacosane - nC26 (surr #3)	100%

Laboratory Control Sample

Compound	
Matrix	Water
	% Recovery
PCB (8081)	10/01/96
A1242	83%
Tetrachloro-m-xylene (surr)	101%
Decachlorobiphenyl (surr)	107%
	% Recovery
TPH-D	10/02/96
TPH-D, C12 > C24, (Diesel)	93%
2-Fluorobiphenyl (surr #1)	C
o-Terphenyl (surr #2)	C
Hexacosane - nC26 (surr #3)	103%

Analytical Reporting Limits

Limits in mg/L (ppm)

TPH-D	Water
Diesel (C12 > C24)	0.25
Oil (C24 > C37)	0.75

Limits in μg/L (ppb)

PCBs 8081/608	Water
A1016	4.0
A1221	10.0
A1232	10.0
A1242	4.0
A1248	4.0
A1254	4.0
A1260	4.0

QA/QC Control Limits

Method: TPH-D
Evaluation: 8/96

Parameter Matrix	LCL Water	UCL Water
LCS	77%	111%
MS/MSD	N/A	N/A
MS/MSD (RPD)	0%	N/A
Duplicate (RPD)	0%	N/A
Surrogates		
2-Fluorobiphenyl	60%	122%
o-Terphenyl	80%	127%
Hexacosane	78%	130%

N/A - not available due to insufficient database.
LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

QA/QC Control Limits, continued

Method: PCBs (8081/608)
Evaluation: 8/96

Parameter Matrix	LCL Water	UCL Water
LCS	56%	144%
MS/MSD	N/A	N/A
MS/MSD (RPD)	0%	N/A
Duplicate (RPD)	0%	N/A
Surrogates		
Tetrachloro-m-xylene	54%	119%
Decachlorobiphenyl	82%	122%

N/A - not available due to insufficient database.
LCL - lower control limit (mean minus 3s)
UCL - upper control limit (mean plus 3s)
s - standard deviation

(B)

Sample Custody Record

DATE 9/26/96 PAGE 1 OF 1

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699

JOB NUMBER 4617 LAB NUMBER

PROJECT MANAGER CHRISTIANSON

PROJECT NAME LAKE WA SHIP CANAL

SAMPLED BY: JAMES L. FELDER

LAB NO.	SAMPLE	TIME	STATION	MATRIX	TESTING: EPA 8081 *	TESTING: WTPH-D EXT	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/COMPOSITING INSTRUCTIONS
	9/26/96	14:00	HC-MW-1	WATER	X	X	2	
	↓	11:30	HC-MW-2	↓	X	X	3	(BETWEEN 2 boxes).
		13:15	HC-MW-3		X	X	2	
	↓	11:30	HC-MW-12	↓	X	X	2	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/26/96	Brian Van Ysendyk SIGNATURE	9/26/96
PRINTED NAME Jim FELDER	TIME	Brian Van Ysendyk PRINTED NAME	TIME
COMPANY HC-SEA	16:00	COMPANY HCI	10:00
RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	TIME	SIGNATURE	TIME
PRINTED NAME		PRINTED NAME	
COMPANY		COMPANY	

TOTAL NUMBER OF CONTAINERS

METHOD OF SHIPMENT: HND.

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS: * PCBs only as per BEC 9/26/96

NORMAL TAT.

DISTRIBUTION:

1. PROVIDE WHITE AND YELLOW COPIES TO LABORATORY
2. RETURN PINK COPY TO PROJECT MANAGER
3. LABORATORY TO FILL IN SAMPLE NUMBER AND SIGN FOR RECEIPT
4. LABORATORY TO RETURN WHITE COPY TO HART CROWSER

HART CROWSER SAMPLE RECEIPT CHECK SHEET

JOB NUMBER: 4617 - SEQUENCE B

CLIENT: CDF SITE: Lake WA Ship Canal

DATE RECEIVED: 9/26/96 TIME 16.00

RECEIVED BY: EN FIELD MGR: Folder PROJ. MGR: Christianson

CARRIER:

IN PERSON BY Folder BY CAB/EXPRESS _____ SHIPPED VIA _____

# of Coolers _____ Boxes 2 Bags _____ Jars _____

		Initials	COMMENT
Airbill/shipping document included?	(Y) N	EN	document #: STFocm
Custody seals on outside?	(Y) N		
Number of seals: 2			
Seal date: 9/26/96			
Seal name: Fed-Ex			
Custody seals intact on receipt?	(Y) N		
CoC included with samples?	(Y) N		
CoC filled out in ink?	(Y) N		
CoC job#, name accurate?	(Y) N		
CoC signed?	(Y) N		
Ice used?	Y (N)		
Type? BLUE WATER OTHER			
Sample temperature recorded?	Y (N)		C° Straight from field to lab
Packing material used?	Y (N)		
Type? FOAM PEANUT BUBBLE OTHER			
All containers in good condition?	(Y) N		
All container labels in good condition?	(Y) N		
Correct container/volume for analysis	(Y) N		
All samples listed on CoC?	(Y) N		
pH < 2 for TPH water samples?	(Y) N		at extraction
Chemical preservatives added?	Y (N)		not indicated
Bubbles in VOA water samples?	~~Y~~ ~~N~~		N/A
Sign CoC if accurate and complete?	(Y) N		
PM notified if problems with shipment?	Y N		Who?

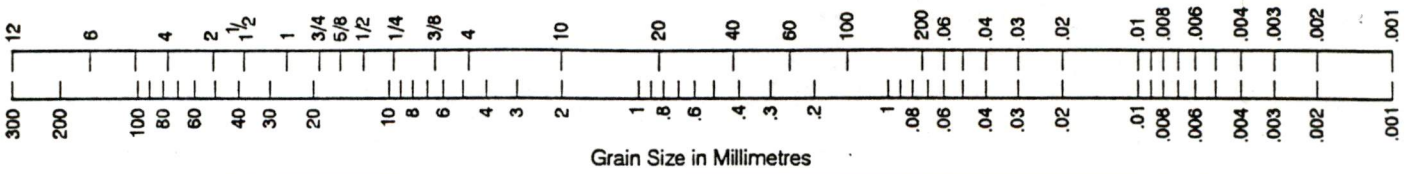
SAMPLE RECEIVED FROM FIELD IN BOXES. PLACED IMMEDIATELY IN COOLER (4°C) ACIDIFIED ON EXTRACT.

APPENDIX C
HART CROWSER
PHYSICAL TESTING

Unified Soil Classification (USC) System

Soil Grain Size

Size of Opening In Inches	Number of Mesh per Inch (US Standard)	Grain Size in Millimetres



Grain Size in Millimetres

COBBLES	GRAVEL	SAND	SILT and CLAY
Coarse-Grained Soils			Fine-Grained Soils

Coarse-Grained Soils

G W	G P	G M	G C	S W	S P	S M	S C
Clean GRAVEL <5% fines	*	GRAVEL with >12% fines		Clean SAND <5% fines	*	SAND with >12% fines	
GRAVEL >50% coarse fraction larger than No. 4				SAND >50% coarse fraction smaller than No. 4			
Coarse-Grained Soils >50% larger than No. 200 sieve							

G W and S W $\left(\frac{D_{60}}{D_{10}}\right)$ >4 for G W >6 for S W & $1 \leq \left(\frac{(D_{30})^2}{D_{10} \times D_{60}}\right) \leq 3$

G P and S P Clean GRAVEL or SAND not meeting requirements for G W and S W

G M and S M Atterberg limits below A line with PI <4

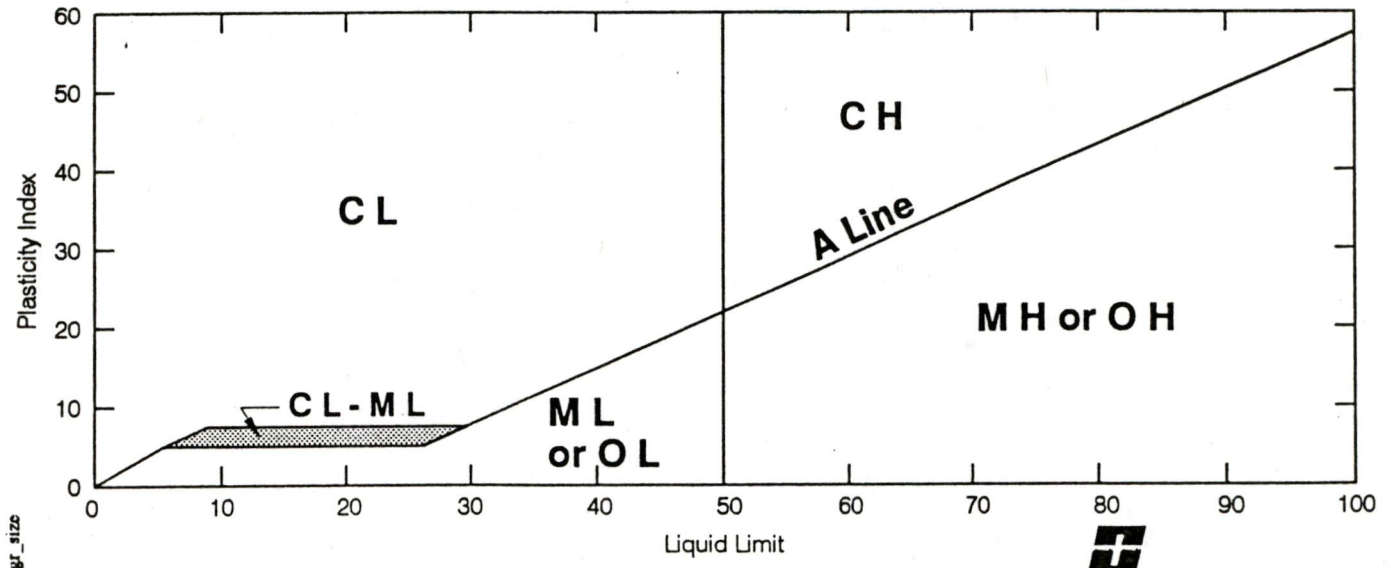
G C and S C Atterberg limits above A Line with PI >7

* Coarse-grained soils with percentage of fines between 5 and 12 are considered borderline cases required use of dual symbols.

D_{10}, D_{30}, and D_{60} are the particles diameter of which 10, 30, and 60 percent, respectively, of the soil weight are finer.

Fine-Grained Soils

M L	C L	O L	M H	C H	O H	Pt
SILT	CLAY	Organic	SILT	CLAY	Organic	Highly Organic Soils
Soils with Liquid Limit <50%			Soils with Liquid Limit >50%			
Fine-Grained Soils >50% smaller than No. 200 sieve						



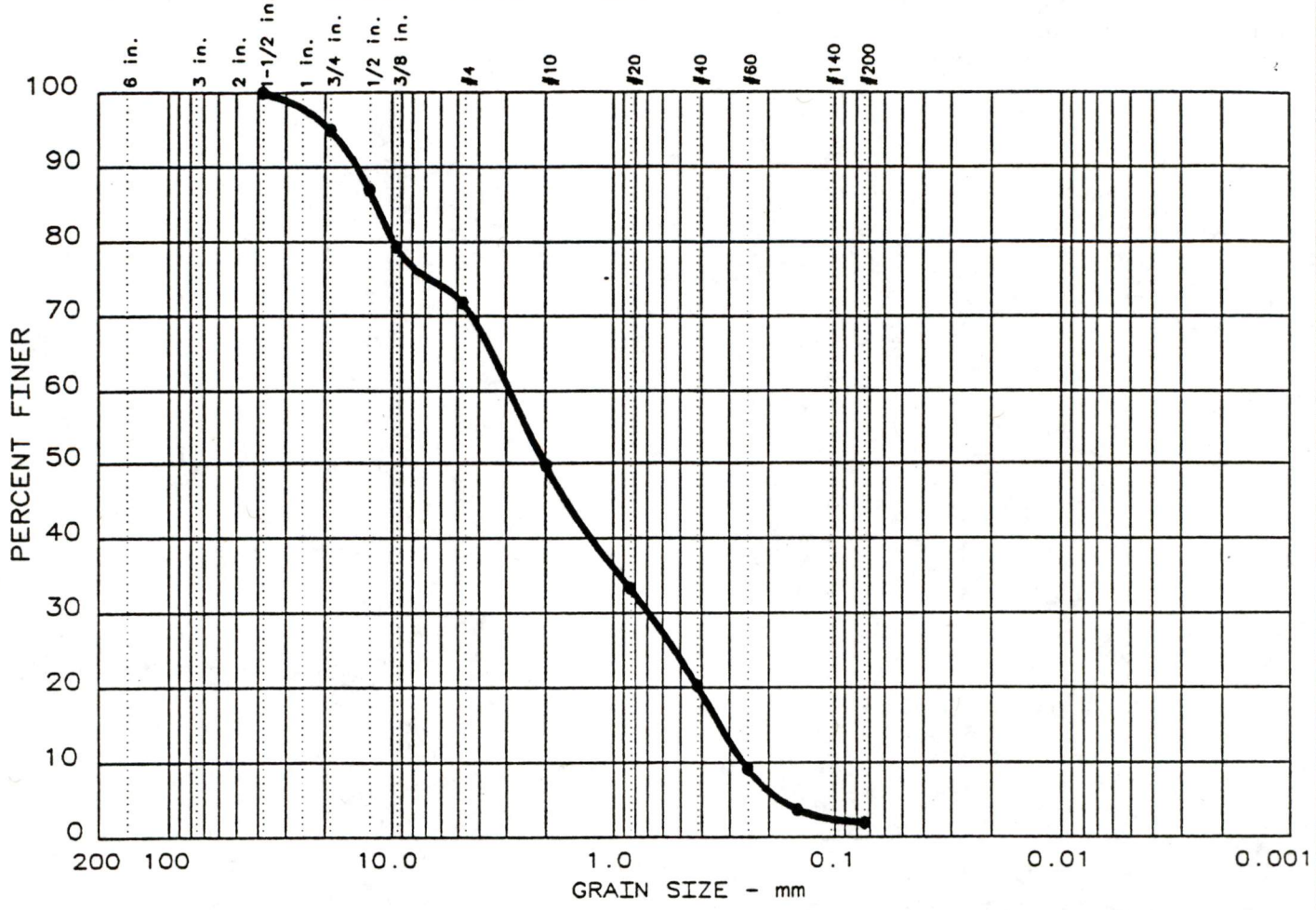
CorelForms\gr_size

HARTCROWSER

J-4617 11/96

Figure C-1

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	28.2	69.9	1.9	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			11.75	2.88	2.02	0.691	0.3308	0.2597	0.64	11.1

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● Gravelly SAND	SP	5%

Remarks:

Project: COE/Jacobson Lake Wa. Ship Canal

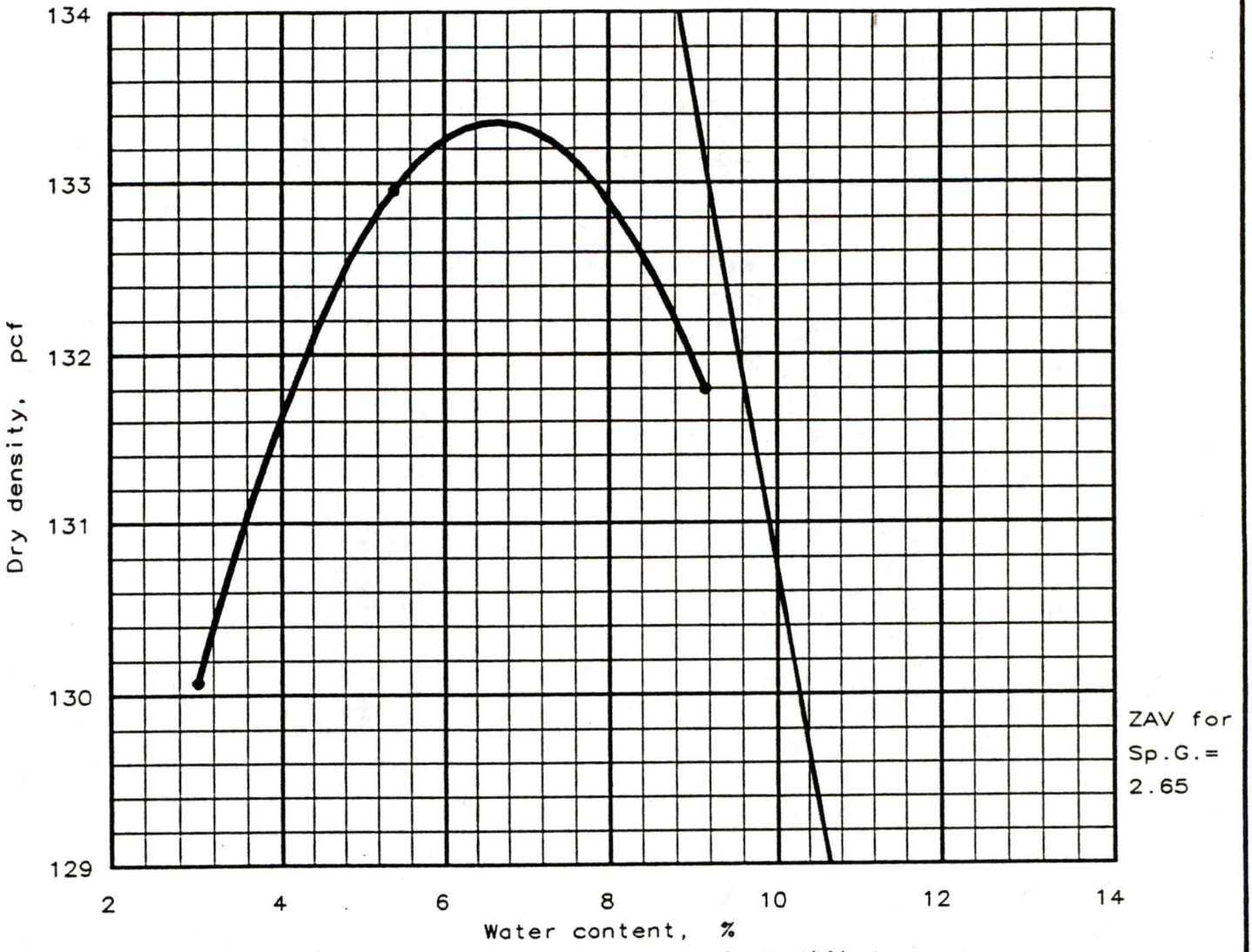
● Location: Pit Run

HARTCROWSER

J-4617 8/21/96

Figure C-2

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 1557-91 Procedure C, Modified

Oversize correction applied to final results

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
			5 %	2.65			5.1 %	1.9 %

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 134.7 pcf Optimum moisture = 6.6 %	133.4 pcf 6.7 %	

Project No.: J-4617

Project: COE/Jacobson Lake Wa. Ship Canal

Location: Pit Run

Date: 8-21-1996

Remarks:

HARTCROWSER

MOISTURE-DENSITY RELATIONSHIP TEST

Figure C-3

APPENDIX D
PCS DISPOSAL CERTIFICATES

RABANCO RECYCLING CO.

A DIVISION OF RABANCO COMPANIES
2733 3rd Avenue South
Seattle, Washington 98134
(206) 623-4080

TICKET NUMBER 587063

DATE: 09/30/96
TIME: 11:53:46

12881 - S&J CONST Job:96-1476
S J CONST
TRUCK #: 3 DUMP TRUCK
PLACE: A SEATTLE
PRODUCT: PCS-Seattle (1/6)

GROSS LBS:		43540.00
TARE LBS:		21900.00
NET LBS:		21640.00
NET TONS:		10.820
RATE PER TON:	$	0.00
AMOUNT:	$	0.00
REFUSE TAX 3.60%:		0.00
TOTAL AMOUNT:	$	0.00

TONS 10.82

Recycled

X A C Custe
CUSTOMER SIGNATURE
I HAVE READ AND AGREE TO THE CONDITIONS ON THE REVERSE SIDE.

RABANCO RECYCLING

A DIVISION OF RABANCO COMPANIES
2733 3rd Avenue South
Seattle, Washington 98134
(206) 623-4080

TICKET NUMBER 587216

DATE: 09/30/96
TIME: 14:27:30

12081 - S&J CONST Job:96-1476
SJ
TRUCK #: 3 DUMP TRUCK
PLACE: A SEATTLE
PRODUCT: PCS-Seattle (T/S)

GROSS LBS:		59920.00
TARE LBS:		21800.00
NET LBS:		38120.00
NET TONS:		19.060
RATE PER TON:	$	0.00
AMOUNT:	$	0.00
REFUSE TAX 3.60%:		0.00
TOTAL AMOUNT:	$	0.00

TONS 19.06

Recycled

X AL Custer
CUSTOMER SIGNATURE
I HAVE READ AND AGREE TO THE CONDITIONS ON THE REVERSE SIDE.

RABANCO RECYCLING CO.

A DIVISION OF RABANCO COMPANIES
2733 3rd Avenue South
Seattle, Washington 98134
(206) 623-4080

TICKET NUMBER 587282

DATE: 09/30/96
TIME: 16:20:32

12081 - S&J CONST Job:96-1476
S&J
TRUCK #: 1 DUMP TRUCK
PLACE: A SEATTLE
PRODUCT: MSW-Seattle (T/S)

GROSS LBS:		34120.00
TARE LBS:		21760.00
NET LBS:		12360.00
NET TONS:		6.180
RATE PER TON:	$	0.00
AMOUNT:	$	0.00
REFUSE TAX 3.60%:		0.00
TOTAL AMOUNT:	$	0.00

TONS 6.18

X A J Cust

CUSTOMER SIGNATURE
I HAVE READ AND AGREE TO THE CONDITIONS ON THE REVERSE SIDE.

Recycled

RABANCO RECYCLING CO.

A DIVISION OF RABANCO COMPANIES
2733 3rd Avenue South
Seattle, Washington 98134
(206) 623-4080

TICKET NUMBER 587215

DATE: 09/30/96
TIME: 14:19:46

12881 - S&J CONST Job:96-1476
FORAN
TRUCK #: 10 DUMP TRUCK
PLACE: A SEATTLE
PRODUCT: PCS-Seattle (T/S)

GROSS LBS:		55100.00
TARE LBS:		20940.00
NET LBS:		34160.00
NET TONS:		17.080
RATE PER TON:	$	0.00
AMOUNT:	$	0.00
REFUSE TAX 3.60%:		0.00
TOTAL AMOUNT:	$	0.00

TONS: 17.08

Recycled

X _____
CUSTOMER SIGNATURE
I HAVE READ AND AGREE TO THE CONDITIONS ON THE REVERSE SIDE.

RABANCO RECYCLING CO.

A DIVISION OF RABANCO COMPANIES
2733 3rd Avenue South
Seattle, Washington 98134
(206) 623-4080

TICKET NUMBER 587074

DATE: 09/30/96
TIME: 11:58:59

12881 - S&J CONST Job:96 1476
FORAN
TRUCK #: 10 PUMP TRUCK
PLACE: A SEATTLE
PRODUCT: PCS-Seattle (T/S)

GROSS LBS:		43300.00
TARE LBS:		20980.00
NET LBS:		22320.00
NET TONS:		11.160
RATE PER TON:	$	0.00
AMOUNT:	$	0.00
REFUSE TAX 3.60%:		0.00
TOTAL AMOUNT:	$	0.00

TONS 11.16

Recycled

X _____
CUSTOMER SIGNATURE
I HAVE READ AND AGREE TO THE CONDITIONS ON THE REVERSE SIDE.

APPENDIX E
HART CROWSER FIELD NOTES

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. (1)
Page 1 of 2
DATE 19 AUG 1996
S (M) T W Th F S

JOB LAKE WA SHIP CANAL — ARRIVAL TIME: 0720
LOCATION BALLARD, WA — DEPARTURE TIME: 17:00
CLIENT COE / JACOBSON — WEATHER: 9C — NO RAIN SUNNY IN PM.
PURPOSE OF OBSERVATIONS REMEDIATION
H-C REPRESENTATIVE JF — H C PROJECT MANAGER DAH
CONTRACTOR S & J — PERMIT NO.
CONTRACTOR REP. KEN LAUDERMILCH — JOB PHONE (2)

This report presents opinions formed as a result of our observation of the contractor's activities relating to geotechnical engineering. We rely on the contractor to comply with the plans and specifications throughout the duration of the project irrespective of the presence of the Hart Crowser representative. The presence of our field representative will be for the purpose of providing observation and field testing. Our work does not include supervision or direction of the actual work of the contractor, his employees or agents. Neither the presence of our representative nor the observation and testing by our firm shall excuse the contractor in any way for defects discovered in his work. Our firm will not be responsible for job or site safety on this project. The conclusions and recommendations of this field report are subject to review by the Hart Crowser Project Manager.

COMMENTS: HC REP ON-SITE TO CONDUCT REMEDIAL ACTIVITIES. ANNA CAMPBELL WAS THE COE ON SITE REP. AFTER HEALTH & SAFETY MTG, STOCKPILE AREA TO THE NORTH ADJACENT TO FENCE AND RAILROAD LINES, WAS PREPARED.

EXCAVATION WAS PERFORMED W/ BACKHOE 580 K EXT. HOE. TO PROVIDE ACCESS INTO THE EXCAVATION AREA - CONTRACTOR FILLED IN DITCH WITH SURROUNDING SOILS. ONCE THIS AREA WAS FLAT + STABLE, BACKHOE WAS ABLE TO GET BETWEEN BLDGS. AND BEGIN EXCAVATION OF MATERIAL.

THE CLEAN OVERBURDEN LOCATED ADJACENT TO COE BLDG. WAS REMOVED FIRST. THIS WAS ~2 FT OF MATERIAL, VOLUME ~10 cy, AND IS PRESENTLY STOCKPILED ON WEST END OF HAYDOWN AREA.

SECONDLY, EXCAVATION OF CONTAMINATED MATERIAL EXISTS IN A LAYER LOCATED @ -4-7' BGS. EXCAVATION OF AREA BETWEEN BLDGS. WAS PERFORMED TO A DEPTH OF -5 FT BGS.

BY: JTA — HART CROWSER REPRESENTATIVE
REVIEWED BY: David A. Heffner — HART CROWSER PROJECT MANAGER
I have read and understand the content of this Field Report. — CONTRACTOR REPRESENTATIVE

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
206.324.9530

Job No. 4617
Field Report No. (1)
Page 2 of 2

Job LAKE WA SHIP CANAL Date 19 Aug 1996

IT WAS REVEALED THAT CONTAMINATED LAYER EXTENDS BENEATH BOTH BLDGS AND FARTHER TO THE SOUTH PAST THE END OF RETAINING WALL. EXPLORATORY TEST PIT SHOWS LAYER EXTENDS AT LEAST 7' PAST END OF RETAINING WALL. CONTAMINATED LAYER DOES END SOMEWHERE BETWEEN THIS PIT AND SOUTHERN ENTRANCE (CONFIRMED W/ TEST PIT).

APPROXIMATELY ~60 cy OF NON-TSCA PCS WAS REMOVED AND STOCKPILED. ALSO ~10 cy OF CLEAN SOIL WAS STOCKPILED.

DUE TO THE DEPTH OF CONTAM. LAYER AND ONE-WAY ACCESS - IT WILL BE NECESSARY TO REMOVE SIDEWALK AND POTENTIALLY SOME ASPHALT TO PROVIDE A MORE GRADUAL SLOPE INTO EXCAVATION. WITH SOUTH END HAVING ~4 FT OF CLEAN FILL OVER CONTAM. LAYER IT WAS DECIDED TO HALT EXCAVATION WITH THE CONCERN OF NOT BEING ABLE TO EXTRACT CLEAN SOIL SEPARATELY. SCREENING TESTS REVEALED ALL PCB's SCREENS WERE LESS THAN 50 PPM. 8 SCREENS (QT-...) WERE RUN FOR TPH/PCB's. SOIL PILES WERE SECURED.

EXCAVATION ENCOUNTERED SEVERAL CREOSOTED/OILY TIMBERS RANGING IN SIZE. PLACED SEPARATELY ON PLASTIC. IT IS EVIDENT GW IS AT ~7 FT AND BELOW 8-10 FT IS DREDGING SANDS & VARIOUS DEBRIS.
NO FINAL VERIFICATION SAMPLES WERE COLLECTED.

BY: JLF
HART CROWSER REPRESENTATIVE

REVIEWED BY: D.A. Huffman
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

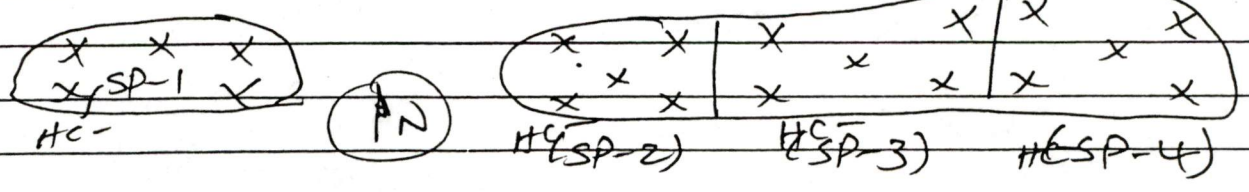
Job No. 4617
Field Report No. (2)
Page 1 of 1
DATE 20 Aug 96
S M (T) W Th F S

JOB LAKE WA SHIP CANAL ARRIVAL TIME: 0830
LOCATION BALLARD, WA DEPARTURE TIME: 16:00
CLIENT COE/JACOBSON WEATHER: 9C-
PURPOSE OF OBSERVATIONS REMEDIAL ACTIONS
H-C REPRESENTATIVE JF H C PROJECT MANAGER DAH
CONTRACTOR S & J PERMIT NO.
CONTRACTOR REP. KEN LAUDERMILCH JOB PHONE (2)

COMMENTS:

HC REP ON-SITE AT THE REQUEST OF COE FOR DETAILED MEASUREMENTS AND REPRESENTATIVE SOIL VOLUME CALCULATIONS. COE REP + HC REP MEASURED EXCAVATION WITH RESPECT TO THE PROPERTY LINE. CALCULATIONS WERE FAXED TO THE COE 19 Aug 96. MIGRATION BARRIER WAS MEASURED TO NEED 2 PIECES: ONE @ 25'x 6' ~~SF~~ (150 SF AND ONE 27'x 3' (81 SF) FOR A TOTAL OF 231 SF

IN AFTERNOON STOCKPILES WERE SAMPLED FOR DESIGNATION PRIOR TO DISPOSAL. SAMPLES WERE COLLECTED W/ SS SPOON USING 5-PT COMPOSITE. 3 SAMPLES WERE FROM PCS AND ONE (1) FROM CLEAN PILE.



1 MS/MSD, QC, QA SAMPLE COLLECTED. TPH/PCB PERFORMED @ HC. TRANSFERRED UNDER STANDARD C.O.C. PROTOCOL.

BY: JF
HART CROWSER REPRESENTATIVE

REVIEWED BY: David A. Heffner
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 3
Page 1 of 2
DATE 21 AUG 96
S M T (W) Th F S

JOB LAKE WA SHIP CANAL — ARRIVAL TIME: 0650
LOCATION BALLARD, WA — DEPARTURE TIME: 14:30
CLIENT COE / JACOBSON — WEATHER: CLEAR - 70-80°
PURPOSE OF OBSERVATIONS REMEDIAL ACTION
H-C REPRESENTATIVE JLF — H C PROJECT MANAGER DAH
CONTRACTOR S & J — PERMIT NO.
CONTRACTOR REP. KEN LAUDERMILCH — JOB PHONE (2)

COMMENTS: HC REP ON-SITE FOR CONTINUED REMEDIAL ACTIVITIES. CONTRACTOR WAS INSTRUCTED TO REMOVE REMAINING PREVIOUSLY EXCAVATED MATERIAL FROM THE HOLE. JACOBSON ASKED FOR ADDITIONAL SOIL TO BE REMOVED ON THEIR PROPERTY - APPROXIMATELY ~33 CY WAS REMOVED. DUE TO THE METHOD NECESSARY TO EXTRACT SOIL FROM THE EXCAVATION - SOIL VOLUMES FROM STOCKPILE CALCULATIONS ARE LARGER THAN IN-PLACE (SWELLED) CALCS. SEE ATTACHED CALC SHEET. BACKFILL WAS PLACED ON ASPHALT LOT WITH NO PLASTIC UNDERNEATH, APPROVED BY COE REP - DUE TO DIFFICULTY IN - PICKING UP LATER. EXCAVATION WAS LINED WITH GEOTEXTILE (WOVEN) FABRIC - SIDES WERE ALSO COVERED W/ EXCESS. 12 MIL PLASTIC SHEETING WAS USED FOR MIGRATION BARRIER AND WAS PLACED TO COVER FROM FOOTINGS TO THE BOTTOM OF EXCAVATION. APPROXIMATELY ~230 SF WAS USED. ONCE MATERIALS WERE IN-PLACE - BACKFILL WAS PLACED FROM THE NORTH AND MOVING TO THE SOUTH. MATERIAL WAS PLACED IN ~8 INCH LAYERS. ONCE ENOUGH MATERIAL WAS PLACED TO PROVIDE ACCESS INTO EXCAVATION. MATERIAL WAS STATE SPEC #17 PATRUN FROM CADMAN ROCK OUT OF E. MARGINAL PIT. A TOTAL OF 105.54 TONS WAS

BY: JLF — REVIEWED BY: David Hoffman — I have read and understand the content of this Field Report.

HART CROWSER REPRESENTATIVE — HART CROWSER PROJECT MANAGER — CONTRACTOR REPRESENTATIVE

HART CROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. (3) CONT. 2
Page 2 of 2
DATE 21 AUG 96
S M T (W) Th F S

JOB _____ ARRIVAL TIME: _____
LOCATION (SAME) DEPARTURE TIME: _____
CLIENT _____ WEATHER: _____
PURPOSE OF OBSERVATIONS _____
H-C REPRESENTATIVE _____ H C PROJECT MANAGER _____
CONTRACTOR _____ PERMIT NO. _____
CONTRACTOR REP. _____ JOB PHONE _____

COMMENTS:

CONTINUED; DELIVERED TO THE SITE. ABOUT ~66 TONS WAS PLACED INTO EXCAVATION AND ABOUT ~40 TONS STOCKPILED ON SITE. HC AND COE REP AGREED TO PLACED AND COMPACT FILL UP TO THE LEVEL OF THE RETAINING WALL FOOTING; THIS WOULD FACILITATE THE COMPLETION OF RETAINING WALL. VERIFICATION SAMPLES WERE COLLECTED FROM EXCAVATION WITH ID'S HC-EX-1L → 7L. 1 QA/QC AND 1 MS/MSD SAMPLE COLLECTED. SAMPLES SUBMITTED TO HC-SEA LAB FOR WTPH-D EXT AND PCB ANALYSIS—NORMAL T.A.T. MODIFIED PROCTER VALUES (ASTM D1557) AS PERFORMED BY HC-GEOTECH LAB WERE

MAX γ_{DRY} = 134.7 PCF (CORRECTED)
MOISTURE OPT = 6.6 % (")

MAX γ_{DRY} = 133.4 PCF (UNCORRECTED)
OPT. MOISTURE = 6.7 % "

2 - DENSITY TESTS WERE PERFORMED WITH γ_{DRY} = 126.0 AND 127.9 PCF.

SITE AND STOCKPILES WERE SECURED — HC REP.

BY: _____ REVIEWED BY: _____ I have read and understand the content of this Field Report.

HART CROWSER REPRESENTATIVE | HART CROWSER PROJECT MANAGER (D. Heffner) | CONTRACTOR REPRESENTATIVE

HARTCROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 39
Page 1 of 1
DATE 8.21.96
S M T (W) Th F S

JOB Jacobsen Terminal
LOCATION Ballard Wa.
CLIENT Jacobsen
PURPOSE OF OBSERVATIONS Nuke Density
H-C REPRESENTATIVE BES
CONTRACTOR S+T
CONTRACTOR REP.

ARRIVAL TIME: 1300
DEPARTURE TIME: 1345
WEATHER: Clear ; 75°
H C PROJECT MANAGER Feider
PERMIT NO.
JOB PHONE

COMMENTS: H.C. rep. on site to perform two nuclear density tests with the Campbell Densometer. Two tests were performed @ location(s) determined by H.C. rep. J. Feider on site. Since no max. density values were available results were provided to the P.M. for disposition.

BY: _____
HART CROWSER REPRESENTATIVE

REVIEWED BY: David Heffner
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
_____
CONTRACTOR REPRESENTATIVE

HART CROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. (4)
Page 1 of 1
DATE 23 AUG 96
S M T W Th (F) S

JOB LAKE WA SHIP CANAL — ARRIVAL TIME: 0800
LOCATION BALLARD, WA — DEPARTURE TIME: 0845
CLIENT COE - JACOBSON — WEATHER: CLEAR - 80's
PURPOSE OF OBSERVATIONS REMEDIAL ACTION
H-C REPRESENTATIVE JLF — H C PROJECT MANAGER DAH
CONTRACTOR S&J — PERMIT NO. —
CONTRACTOR REP. NONE — JOB PHONE

COMMENTS:

HC REP ON-SITE TO COMPLETE SOIL SAMPLING ACTIVITIES. AS PER COE REQUEST, HC REP COLLECTED 2 STOCKPILE SAMPLES FROM THE PREVIOUSLY EXISTING CLEAN SOIL PILE. THIS STOCKPILE IS LOCATED JUST SOUTH OF THE COE BLDG, IN THE PARKING LOT. 2 SAMPLES WITH ID'S HC-SP-5L AND HC-SP-6L WERE COLLECTED USING A 5-PT COMPOSITE TECHNIQUE. SAMPLES WERE SUBMITTED TO THE HC-SEA CHEMICAL LABORATORY UNDER PROPER C.O.C PROCEDURES FOR WTPH-DEXT & PCB'S, NORMAL TAT.

BY: JLF
HART CROWSER REPRESENTATIVE

REVIEWED BY: David Hoffman
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 5
Page 1 of 2
DATE 9/24/96
S M T W Th F S

JOB _____ ARRIVAL TIME: 0845
LOCATION BALLARD, WA DEPARTURE TIME: _____
CLIENT COE / JACOBSON WEATHER: FULL CLOUDY
PURPOSE OF OBSERVATIONS INSTALLATION OF MONITOR WELLS
H-C REPRESENTATIVE C. WOLFE H C PROJECT MANAGER BRIAN CHRISTIANSON
CONTRACTOR MCDONALD DRILLING PERMIT NO. _____
CONTRACTOR REP. CHARLES JOB PHONE _____

COMMENTS:

0845 ARRIVED ON SITE. DID WALK THROUGH TO FIND LOCATION OF MONITOR WELL LOCATIONS. ALL THREE LOCATIONS FOUND - WAITING FOR DRILLERS

0905 DRILLERS ON SITE - DID WALKTHROUGH. STARTED LOOKING FOR AN ON-SITE WATER SUPPLY TO FILL UP DRILL RIG WATER TANK

0935 ANNE CAMPBELL ON SITE

1000 DRILLER BACK WITH WATER. HAD TO GO TO LOCKS TO GET IT. START STEAM CLEANING AUGER

1025 BEGIN DRILLING ON MW-3

1050 EASY DRILLING UNTIL 11.0'. DRILLER FELT HE WAS IN SILTY LAYER. DROVE A SPLIT SPOON TO CONFIRM. H_2O AT ~7.8'. DECISION MADE TO STOP DRILLING HERE AND INSTALL WELL USING A 5' SCREEN. ALL THREE WELLS INSTALLED TODAY WILL HAVE AREPACK SCREENS TO INSURE PROPER SAND PACKS.

1130-1150 LUNCH ANNE C. LEFT SITE

BY: _____ REVIEWED BY: _____ I have read and understand the content of this Field Report.

HART CROWSER REPRESENTATIVE HART CROWSER PROJECT MANAGER CONTRACTOR REPRESENTATIVE

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 5
Page 2 of 2

Job COE / JACOBSON Date 9/24/96

1150 CONTINUE WELL INSTALLATION

1215 INSTALLATION COMPLETE. BEGIN STEAM CLEANING AUGER AND FINISH INSTALLING MONUMENT

1230 MOVE DRILL RIG TO MW-1 LOCATION. HAD TO MOVE DEBRIS TO GET ACCESS TO BORING. VERY NARROW PATH TO NEGOTIATE WITH RIG.

1250 START DRILLING ON MW-1

1300 ANNE C. BACK ON SITE

1315 HIT SILT LAYER AT ~ 14'. WILL INSTALL 10' SCREEN @ 4-14'. STOPPED DRILLING - NO ODOR OBSERVED

1320 START INSTALLING MONITOR WELL. WHEN TRYING TO CONNECT TWO FIVE FOOT SCREENS TOGETHER IT WAS NOTICED THAT THERE WERE ONLY MALE CONNECTIONS AT BOTH ENDS. DRILLER HAD TO CUT OFF FEMALE ENDS OF OTHER PVC RISER PIPE IN ORDER TO COMPLETE CONNECTION

1345 ANNE C LEFT SITE FOR THE DAY

1415 INSTALLATION OF MW-1 COMPLETE

1420 BRIAN CHRISTIANSON ON SITE TO TAKE OVER FOR CARL WOLFE

BY: REVIEWED BY: I have read and understand the content of this Field Report.

HART CROWSER REPRESENTATIVE HART CROWSER PROJECT MANAGER CONTRACTOR REPRESENTATIVE

HARTCROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 6
Page 1 of 2
DATE 9/24/96
S M T W Th F S

JOB Lake Washington Ship Canal
LOCATION Ballard, WA
CLIENT USACE / Jacobsen Terminal
PURPOSE OF OBSERVATIONS Installation of monitoring well
H-C REPRESENTATIVE B. Christianson
CONTRACTOR McDonald Drilling
CONTRACTOR REP.

ARRIVAL TIME: 1420
DEPARTURE TIME:
WEATHER: Clear to partly cloudy ca
H C PROJECT MANAGER
PERMIT NO. —
JOB PHONE —

COMMENTS: Arrived on-site to observe monitoring well installation in relief of Carl Wolfe for training class.

Monitoring wells MW-1 & MW-3 were installed on my arrival. Final cleanup and monitoring well monument installation was nearing completion (MW-1). (1415 to 1445 HRS)

No USACE representative on-site for remainder of day, no other off-site visitors this afternoon.

HC-MW-2 was begun at (1500 HR) on Jacobsen Terminal Property. This well was abandoned & renamed HC-SB-1 because it was not completed as a monitoring well because of wood debris encountered between 8 to 13 feet below the ground surface. Because of the presence of creosote-like oil in wood cuttings the boring was abandoned. Message left with Dina Goin (USACE) on condition & reason for moving hole. Common factors with Scott Jacobsen (Jacobsen Terminal) and Dave Heffner, the hole was moved ± 10' East of original location. At 1620 HR alternative location drilled for HC-MW-2. Minimal wood encountered. 1655 HR-Installation of MW-2. Creosote-like odor also present in drill cuttings. 1725 completed installation with 10 foot pre pack screens. 1820 Completed clean-up, steam cleaning drilling equipment, & drumming waters. Installed temper proof bolts & locking thermos caps

BY: David E. Christianson
HART CROWSER REPRESENTATIVE

REVIEWED BY:
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 6
Page 2 of 2

Job Lake Wash. Ship Canal Date 9/24/96

on all the monitoring wells.
Drill cuttings for HC-MW-2 & HC-SB-1 placed in PCS stockpile for disposal with PCS soils excavation, planned later this week.
Photos taken of MW-2 & SB-1 drilling activities.
Discussed drilling costs and materials with Mc Donald Drilling prior to leaving site.

BY: Brad E. Christian
HART CROWSER REPRESENTATIVE

REVIEWED BY:
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 7
Page 1 of 1
DATE 9-25-96
S M T (W) Th F S

JOB LAKE WA SHIP CANAL ARRIVAL TIME: —
LOCATION BALLARD LOCKS DEPARTURE TIME: —
CLIENT USACE / JACOBSON TERM. WEATHER: CLEAR - 65°
PURPOSE OF OBSERVATIONS WELL DEVELOPMENT
H-C REPRESENTATIVE JLF H C PROJECT MANAGER BEC
CONTRACTOR — PERMIT NO. —
CONTRACTOR REP. — JOB PHONE —

COMMENTS:

HC REP ON SITE TO DEVELOP NEWLY INSTALLED MONITORING WELLS. DEVELOPING CONSISTED OF WITHDRAWING THE FIRST SEVERAL CASING VOLUMES WITH SS-BAILER AND THE REMAINDER WITH 2" PURGE PUMP. SEDIMENT THICKNESS AND WATER QUALITY PARAMETERS WERE COLLECTED. ALL DEVELOPMENT WATER WAS PLACED IN DRUMS (LABELED) AND LEFT ON-SITE. THE FOLLOWING ARE NOTED POINTS:

- MW-1: INSTALLED 2-TAMPER PROOF BOLTS. WELL WENT DRY AFTER 1.5 CASING VOL. RECHARGE VERY SLOW. TOTAL DEVELOP. VOLUME ONLY 9.0 GALLONS. (2-DRUMS) NO SHEEN NO ODOR.
- MW-2: (1 DRUM) SLIGHT MINOR SHEEN SEEN ON 1ST VOLUME ONLY. CLEANED UP WELL. PLENTY OF WATER-FLOW. NO ODOR.
- MW-3: (3 DRUMS) CREOSOTE LIKE ODOR NOTED THROUGHOUT DEVELOPMENT. NO SHEEN.
- DRUM INVENTORY WAS PERFORMED.

BY: JLF REVIEWED BY: I have read and understand the content of this Field Report.

HART CROWSER REPRESENTATIVE | HART CROWSER PROJECT MANAGER | CONTRACTOR REPRESENTATIVE

HARTCROWSER

FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 7
Page 1 of 1
DATE 9-25-96
S M T (W) Th F S

JOB LAKE WA SHIP CANAL ARRIVAL TIME: —
LOCATION BALLARD LOCKS DEPARTURE TIME:
CLIENT USACE / JACOBSON TERM. WEATHER: CLEAR - 65°
PURPOSE OF OBSERVATIONS WELL DEVELOPMENT
H-C REPRESENTATIVE JLF H C PROJECT MANAGER BEC
CONTRACTOR — PERMIT NO.
CONTRACTOR REP. — JOB PHONE

COMMENTS:

HC REP ON SITE TO DEVELOP NEWLY INSTALLED MONITORING WELLS. DEVELOPING CONSISTED OF WITHDRAWING THE FIRST SEVERAL CASING VOLUMES WITH SS-BAILER AND THE REMAINDER WITH 2" PURGE PUMP. SEDIMENT THICKNESS AND WATER QUALITY PARAMETERS WERE COLLECTED. ALL DEVELOPMENT WATER WAS PLACED IN DRUMS (LABELED) AND LEFT ON-SITE. THE FOLLOWING ARE NOTED POINTS:

- MW-1: INSTALLED 2-TAMPER PROOF BOLTS. WELL WENT DRY AFTER 1.5 CASING VOL. RECHARGE VERY SLOW. TOTAL DEVELOP. VOLUME ONLY 9.0 GALLONS. (2-DRUMS) NO SHEEN NO ODOR.
- MW-2: (1 DRUM) SLIGHT MINOR SHEEN SEEN ON 1ST VOLUME ONLY. CLEANED UP WELL. PLENTY OF WATER-FLOW. NO ODOR.
- MW-3: (3 DRUMS) CREOSOTE LIKE ODOR NOTED THROUGHOUT DEVELOPMENT. NO SHEEN.
- DRUM INVENTORY WAS PERFORMED.

BY: JLF
REVIEWED BY:
I have read and understand the content of this Field Report.

J. Feila
HART CROWSER REPRESENTATIVE

HART CROWSER PROJECT MANAGER

CONTRACTOR REPRESENTATIVE

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. 8
Page 1 of 1
DATE 9-26-96
S M T W (Th) F S

JOB LAKE WA SHIP CANAL — ARRIVAL TIME: 0900
LOCATION BALLARD, WA — DEPARTURE TIME: 16:30
CLIENT COE / JACOBSON — WEATHER: CLEAR
PURPOSE OF OBSERVATIONS GW SAMPLING
H-C REPRESENTATIVE JLF — H C PROJECT MANAGER BEC
CONTRACTOR — — PERMIT NO. —
CONTRACTOR REP. — — JOB PHONE —

This report presents opinions formed as a result of our observation of the contractor's activities relating to geotechnical engineering. We rely on the contractor to comply with the plans and specifications throughout the duration of the project irrespective of the presence of the Hart Crowser representative. The presence of our field representative will be for the purpose of providing observation and field testing. Our work does not include supervision or direction of the actual work of the contractor, his employees or agents. Neither the presence of our representative nor the observation and testing by our firm shall excuse the contractor in any way for defects discovered in his work. Our firm will not be responsible for job or site safety on this project. The conclusions and recommendations of this field report are subject to review by the Hart Crowser Project Manager.

COMMENTS:

HC REP ON-SITE TO COLLECT SAMPLES FROM NEWLY INSTALLED MONITORING WELLS. TWO MONITORING WELLS FROM THE COE PROPERTY AND ONE WELL FROM THE JACOBSON PROPERTY WERE SAMPLED. ALL WELLS WERE SAMPLED FOR WTPH-D EXT, PCB'S, AND TSS. THE TSS ANALYSIS WAS PERFORMED BY THE MULTICHEM LABORATORY LOCATED IN RENTON, WA. A DUPLICATE AND QA SAMPLE WAS COLLECTED FROM MW-2. QA SAMPLE WAS SUBMITTED TO COE NPL IN TROUTDALE, OR.. WELLS HC-MW-1 AND HC-MW-3 WENT DRY DURING PURGING THE WELL, THUS ALL DUPLICATE/QA/QC's SAMPLES WERE COLLECTED FROM MW-2. PCB AND WTPH-D EXT. SAMPLES WERE SUBMITTED TO THE HC LAB.
DURING SAMPLING, FIELD PARAMETERS, pH, T°C, EC, AND VISUAL OBSERVATIONS WERE COLLECTED.

BY: JLF
HART CROWSER REPRESENTATIVE

REVIEWED BY:
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. (9)
Page 1 of 1
DATE 9-30-96
S (M) T W Th F S

JOB LAKE WA SHIP CANAL ARRIVAL TIME: 0815
LOCATION BALLARD, WA DEPARTURE TIME: 10:00
CLIENT COE / JACOBSON WEATHER: CLEAR
PURPOSE OF OBSERVATIONS RELATIVE SURVEY
H-C REPRESENTATIVE JLF/MAH H C PROJECT MANAGER BEC
CONTRACTOR — PERMIT NO. —
CONTRACTOR REP. — JOB PHONE —

COMMENTS:

HC REP ON-SITE TO PERFORM RELATIVE SURVEY OF NEWLY INSTALLED WELLS, MW-2, LOCATED ON JACOBSON TERM. PROPERTY, WAS GIVEN AN INITIAL ARBITRARY ELEVATION OF 100.00 FT. THE 2 OTHER WELLS, LOCATED ON COE PROPERTY WERE SURVEYED RELATIVE TO MW-2.

THE ELEVATIONS ESTABLISHED FOR THIS SURVEY ARE:

MW-1 : 100.47 FT (TOC)
MW-2 : 100.00 FT (TOC)
MW-3 : 103.68 FT (TOC)

ELEVATIONS MEASURED FROM TOP OF CASING (TOC)

BY: JLF
HART CROWSER REPRESENTATIVE

REVIEWED BY:
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

HARTCROWSER
FIELD REPORT

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
FAX 206.328.5581
206.324.9530

Job No. 4617
Field Report No. (10)
Page 1 of 1
DATE 9-30-96
S (M) T W Th F S

JOB LAKE WA SHIP CANAL ARRIVAL TIME: 13:30
LOCATION BALLARD, WA DEPARTURE TIME: —
CLIENT COE / JACOBSON WEATHER: CLEAR
PURPOSE OF OBSERVATIONS SOIL REMOVAL & DISPOSAL
H-C REPRESENTATIVE JLF H C PROJECT MANAGER BEC
CONTRACTOR S & J TRUCKING PERMIT NO. —
CONTRACTOR REP. FRAN JOB PHONE —

COMMENTS:

HC REP ON-SITE TO INSTRUCT CONTRACTOR ON SOIL DISPOSAL ACTIONS. AFTER VERBAL INSTRUCTIONS — HC REP LEFT SITE. PREVIOUSLY EXCAVATED AND STOCKPILED MATERIAL WAS LOADED AND TRANSPORTED TO REGIONAL DISPOSAL (RABANCO) FOR DISPOSAL. STOCKPILE WAS REMOVED FROM THE SITE BY S & J TRUCKING. WHICH LOADED AND TRANSPORTED THE MATERIAL. 5 LOADS, FOR A TOTAL OF 64.30 TONS WERE DISPOSED OF AT RABANCO. S & J DE-MOBED FROM THE SITE, AND HC REP VERIFIED SOIL WAS REMOVED.

BY: JLF
HART CROWSER REPRESENTATIVE

REVIEWED BY:
HART CROWSER PROJECT MANAGER

I have read and understand the content of this Field Report.
CONTRACTOR REPRESENTATIVE

Return To:

HARTCROWSER
1910 Fairview Ave. E.
Seattle, WA 98102-3699
FAX 206-328-5581
206-324-9530

HARTCROWSER
1201 Jadwin Ave., Ste. 204, Richland, WA 99352
509-946-4344

ALL-WEATHER

FIELD

Notebook No. 351

Job Number: 4617

Project: LAKE WASHINGTON SHIP CANAL

Client: COE / JACOBSON

Location: BALLARD, WA

Book No: 1 of 3

Inclusive Dates: AUG 1996

Subject: TPH / PCB REMED.

Field Representative: JMF / BEC

"Rite in the Rain"
ALL-WEATHER WRITING PAPER ®

Name

US Army Corps of Engineers
Seattle District

Anna Campbell
Environmental Geologist

P.O. Box 3755
Seattle, WA 98124-2255
(206) 764-6075
email:anna.campbell@nps.usace.army.mil

4735 East Marginal Way South
Seattle, WA 98134-2385
FAX (206) 764-6795

Addre

Phone

Projec

JACOBSON INTERNATIONAL, INC.
Scott A. Jacobson

300 Admiral Way Suite 209
Edmonds, WA 98020

Phone (206) 744-9765
Fax (206) 744-2791

Home (206) 542-2806

P.O. Box 3755
4735 E. Marginal Way S.
Seattle, WA 98124-2255

Bus: (206) 764-4478
Fax: (206) 764-6795

US Army Corps of Engineers
Seattle District

DINA R. GINN
Environmental Engineer

E-Mail:
dina.ginn@nps.usace.army.mil

Lake Washington Ship Canal
Hiram M. Chittenden Locks
3015 N.W. 54th Street
Seattle, WA 98107-4299

Bus: (206) 783-7001
Fax: (206) 764-6672
Page: (206) 991-5733

US Army Corps of Engineers
Seattle District

JOHN T. POST, JR.
Chief of Maintenance
Lake Washington Ship Canal Project

789-2622
Ext: 240

8-14-96

0900 – Mtg. ≅ COE (Dina)
HC (DHH & JLF) to discuss
procedures and Management
Plan questions.

Man. Work Plan
– copy of Figure included.

~~14:00~~ – Showed S & J THE SITE
DROPPED OFF BACKHOE

8-19-96

0730 → On-Site; ANNA CAMBELL IS THE REP FROM USACOE.

0750 → KENNY LAUDERMILCH (S & J) OPERATOR.
PLASTIC - STORE

REMOVED EAST TREE + FILLED IN TRENCH TO PROVIDE ACCESS TO REAR.

CONTRACTOR CONCERNED ABOUT PUTTING BACKHOE BETWEEN BLDGS.

0810 → EXPOSED N. SIDE 12" water LINE. CALLED JOHN POST @ 789-2622 @ 240

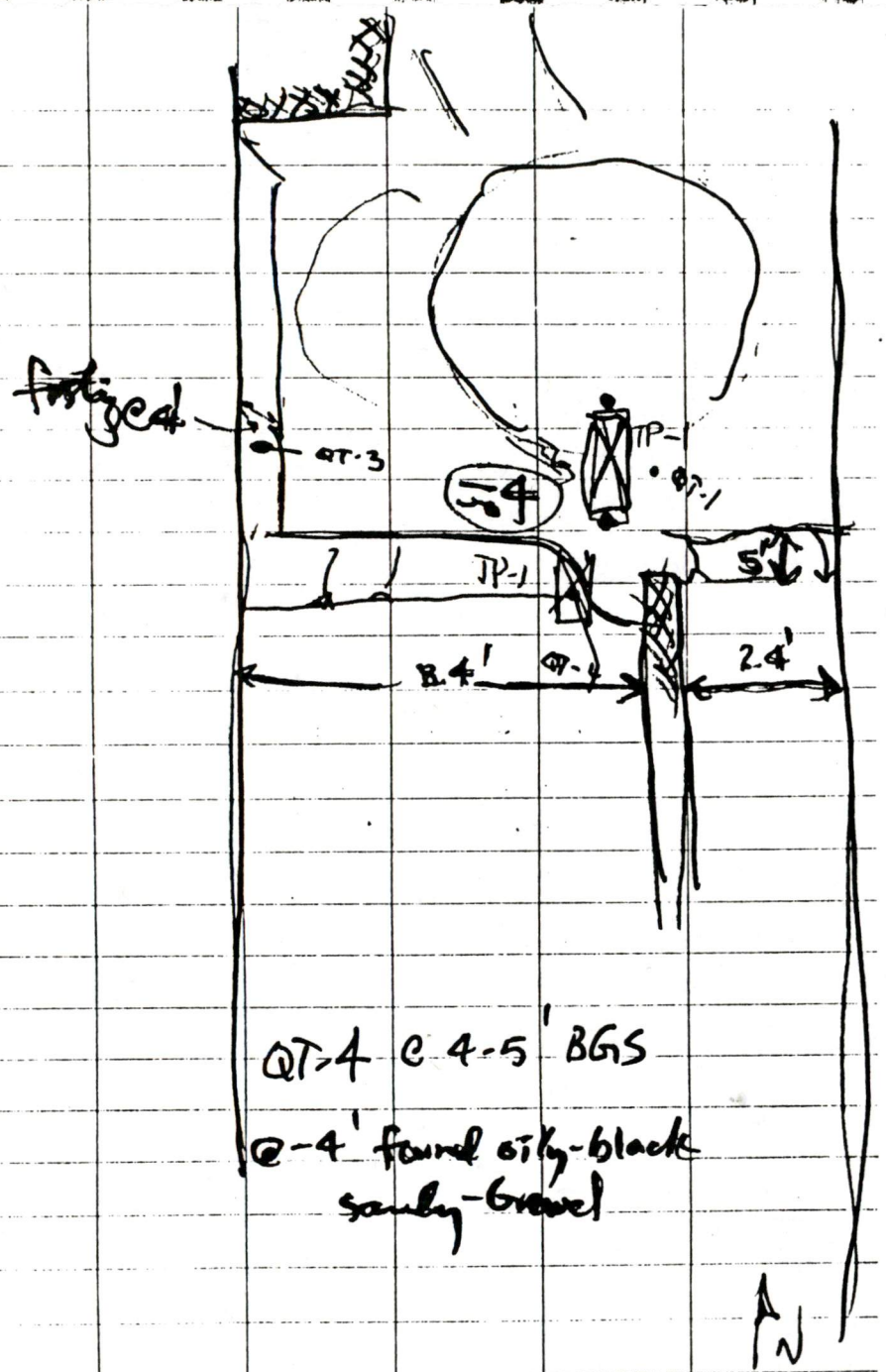
HE CONFIRMED H20 SHUT OFF - HAVING REP COME AND CAP IT.

S & J WILL EXPOSE.

CALL RICHARD / BOBBY
- HARD HAT
- NITRILES XL (30)
- TYVEK (XXL) (5)
- COOLER & ICE
- H2O

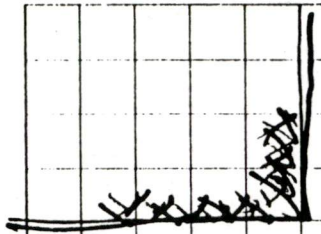
0830 FILLED IN DITCH & CLEAN SOIL TO PROVIDE ACCESS. WILL REMOVE PCS/PCB SOIL IN STAGES.

8-19-96



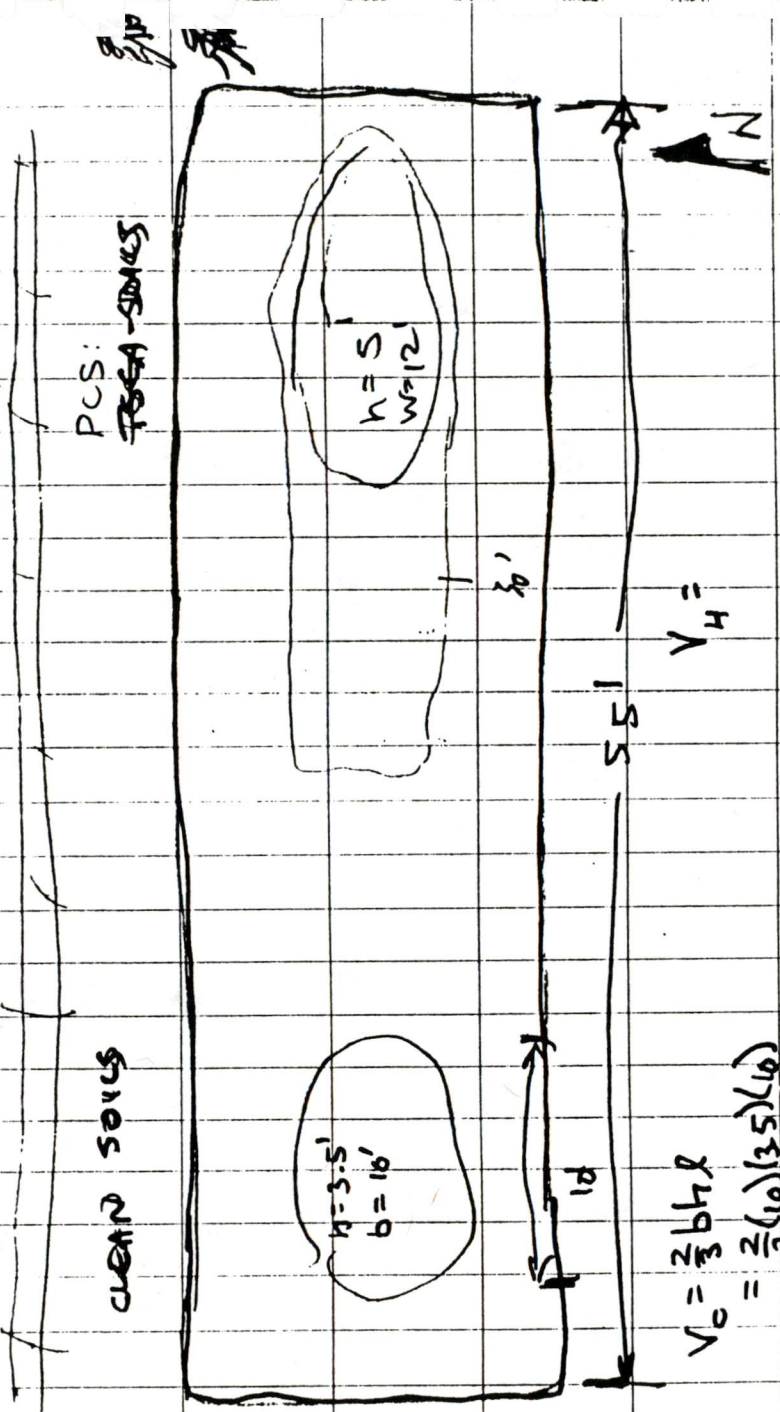
QT-4 @ 4-5' BGS

@ -4' found oily-black sandy-Gravel



TP-1: GRAY-BLACK SANDY SILT LAYER EXTENDS -4-7" (QT-4)

AT DEPTH FINDING CREOSOTED TIMBERS & BLACK OILY SUBSTANCE.



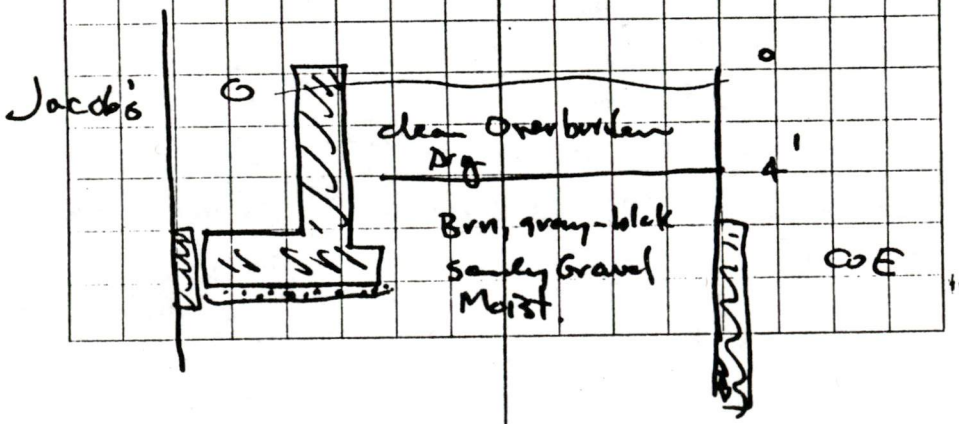
10:16 FINISH REMOVING TEMP TSCA PILE FROM AREA.

① A SPLUNDH WANTS TO TOP TREES IN EAST END - STOCKPILE AREA. GET OFF PHONE/POWER LINES.

→ HITTING OILY AREA (-6-7)

10:30 — DAH! CALLED HC - Creosoted timbers + pull out onto plastic

11:20 — cnH DAH:
How far South do we follow:



8-19-96

11:46 ➡ S&J REMOVAL OF PCS/TPH FROM SOUTH OF RET. WALL AND NORTH AREA.

FOR NOW STAYING ABOVE WATER TABLE. GOING BELOW WILL ONLY CREATE A MESS. NEARBY STORM-DRAIN.

STOPPED EXC. TO THE SOUTH APPEARS GW @ -5 VERY SLOW INFILTRATION. NOW PUDDLING -1.5 Below top of slab-footing.

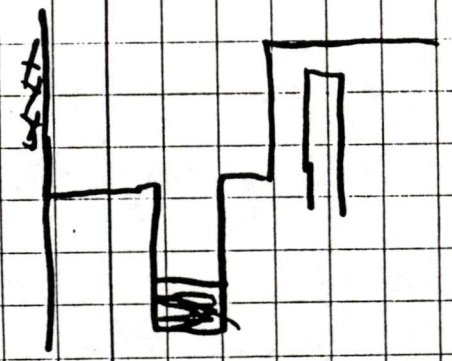
13:00 REMOVING PCS - MEASURE PILES.

WILL WANT TO RENEGOTIATE IF YARDAGE > 60 cy.

COE-SIDE

IN-PLACE:

$$V_I = \frac{16L \times 6H \times 8W}{27} = 28.4 \text{ cy}$$



14:00

$V_H = 30L \times 5H \times 12W$
$= 67\ cy$

$V_H = \frac{2}{3}bhl$ | $V = \frac{1}{2}bhL$

$V = 900\ cf$

$V_H = 1{,}200\ cf$ | $V_h = 33\ cy$

$V_H = 45\ cy$

40

18:00 $45L \times 5H \times 12W$

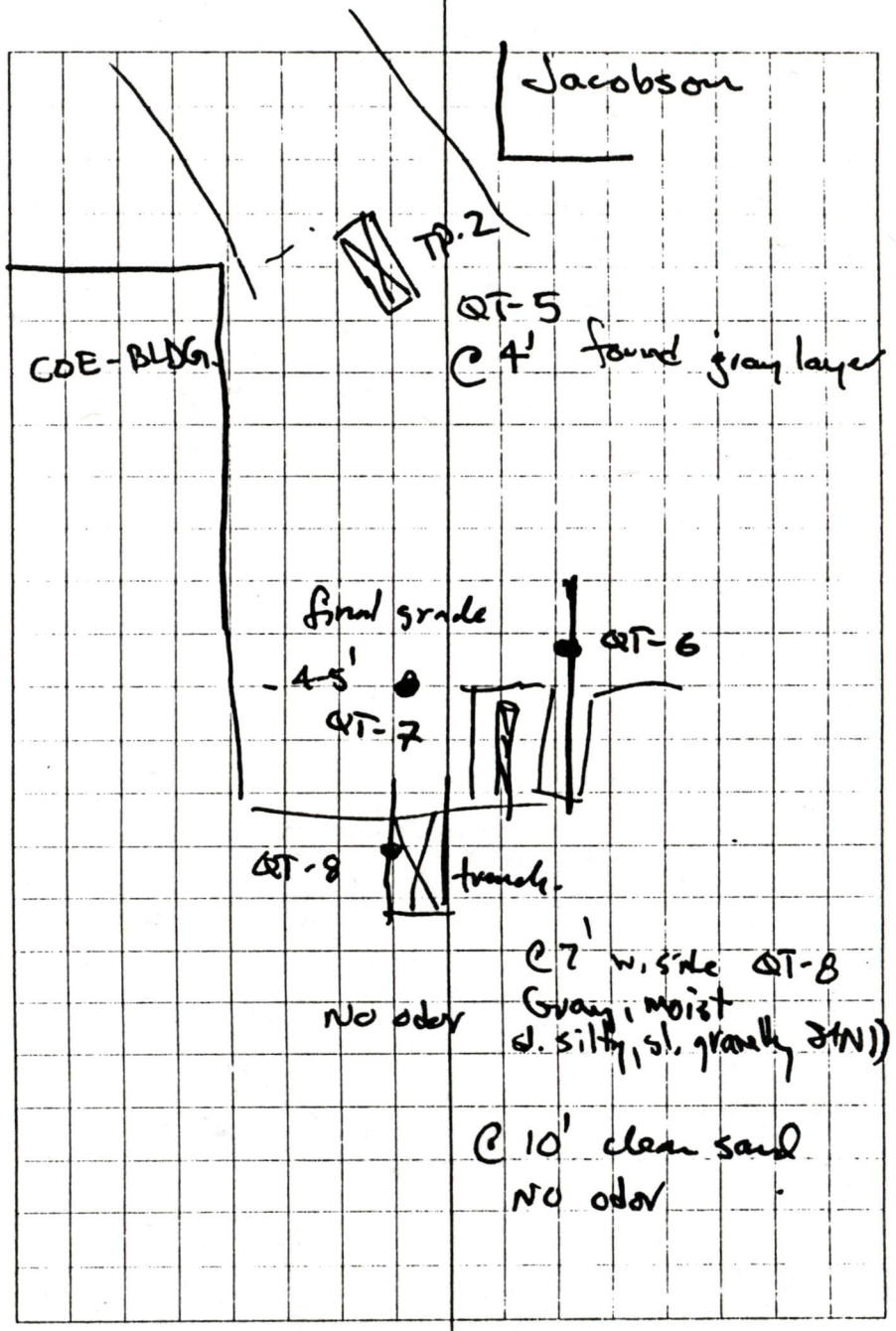
$V_H = \frac{2}{3}bhl$

1600

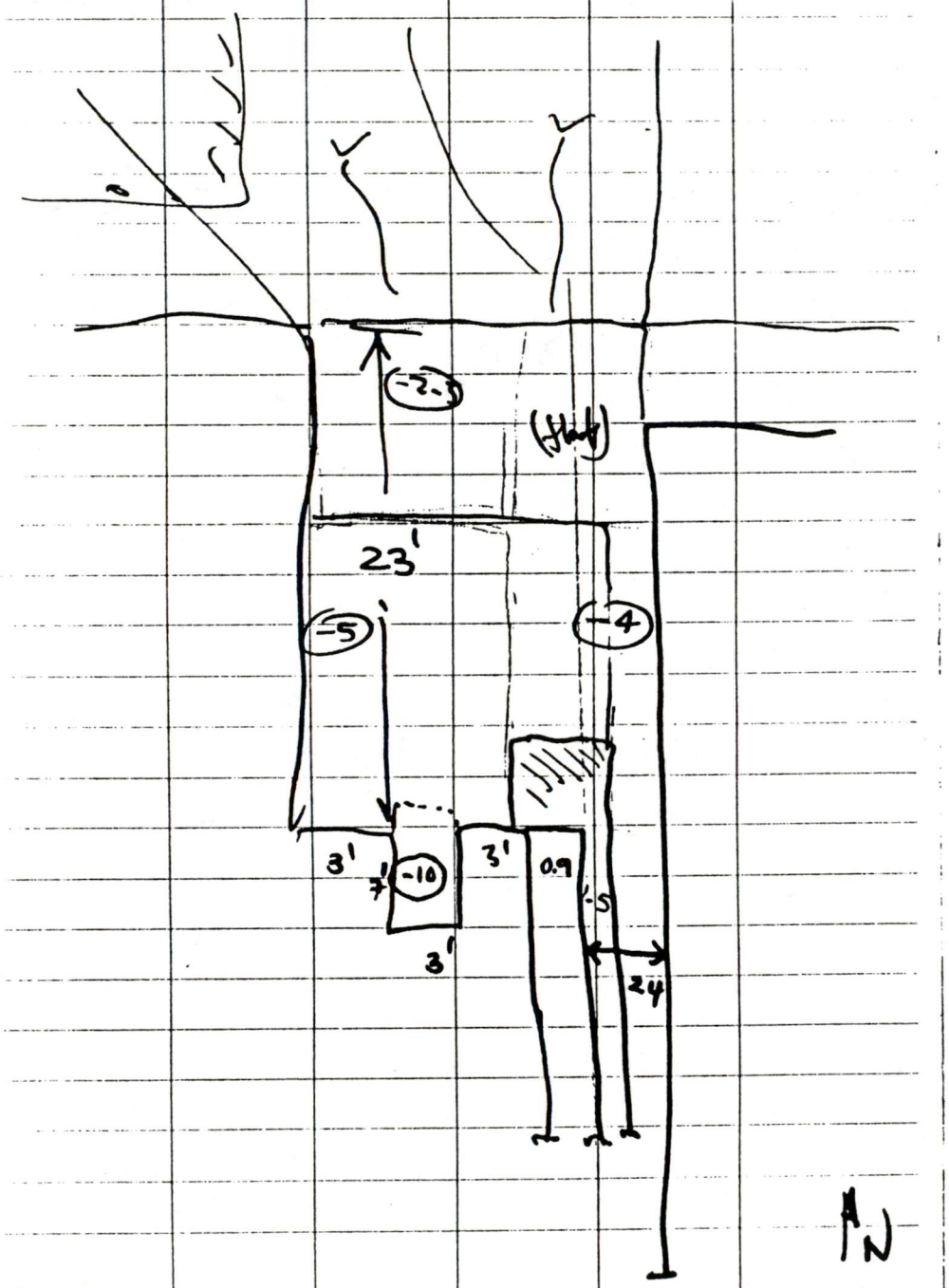
$V_H = 1800\ cf$

60

$V_H = 67\ cy$



8-19-96



20 Aug. 96

0730 ▸ Conference Call c DINA, ANM

0845 ▸ Meet Anna Campbell on site to measure migration barrier.

- measure hole
- measure migration barrier LP

20 Aug 96

Keep - Copy jars - teflon lined
of paper.

(4)(2.3)(1.5)

Jacobson Soil

V_J = ① (0.5)(11.5)(2.3) +
② (6.0)(2.0)(2.3) +
③ (8.0)(3.5)(2.3) +
④ (4.0)(2.3)(1.5)

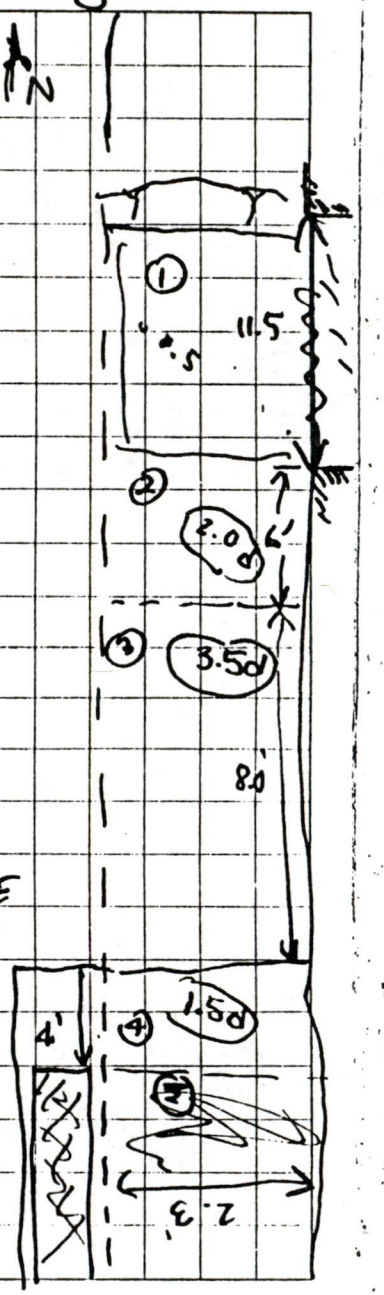
Σ = 13.23 + 27.6 + 64.4
+ 13.8

Σ = 119.03 cf
= 4.4 cy IN-PLACE

8% ↓

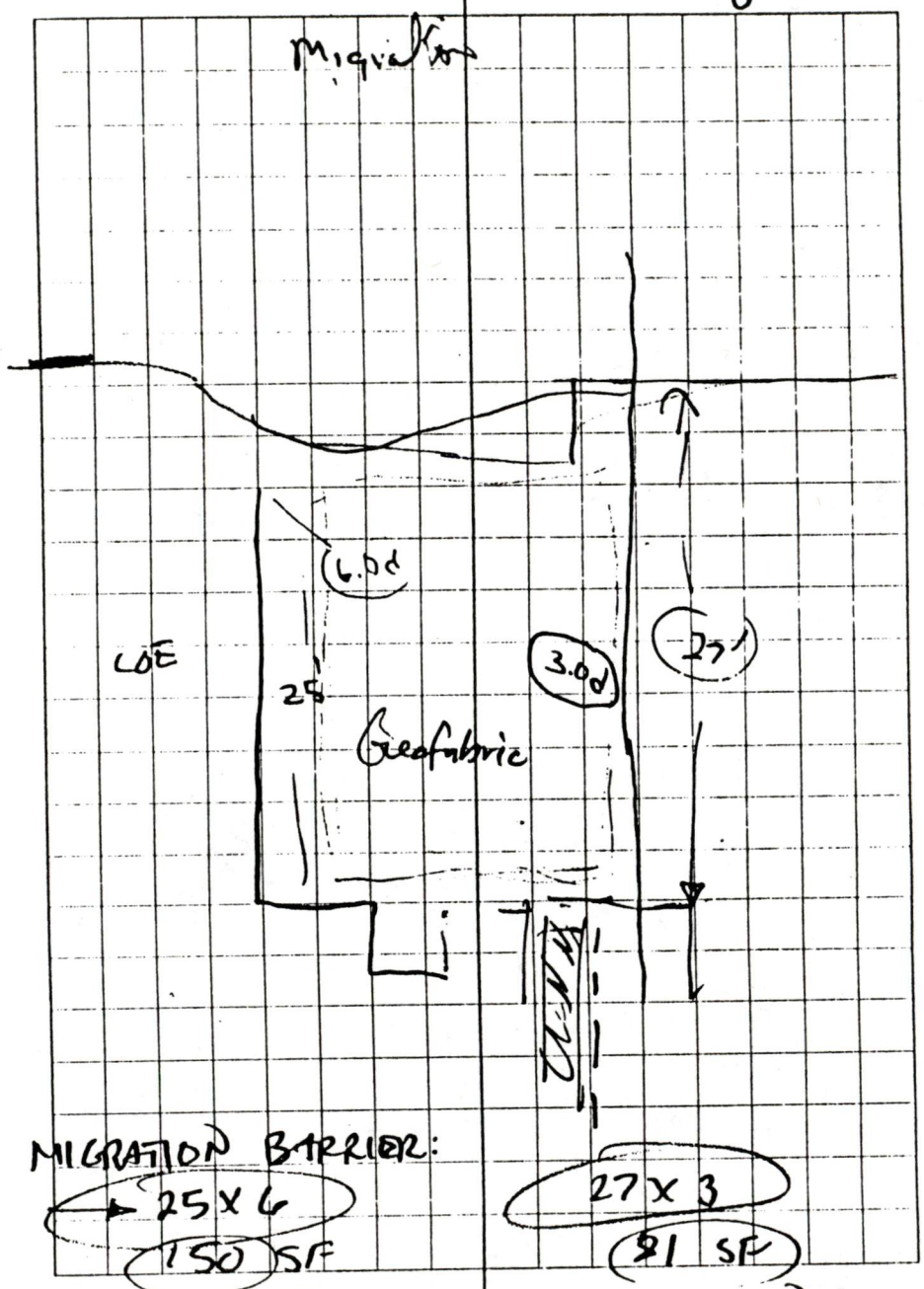
swelled: 20% ↑ x = cy
1.2

5.28 cy



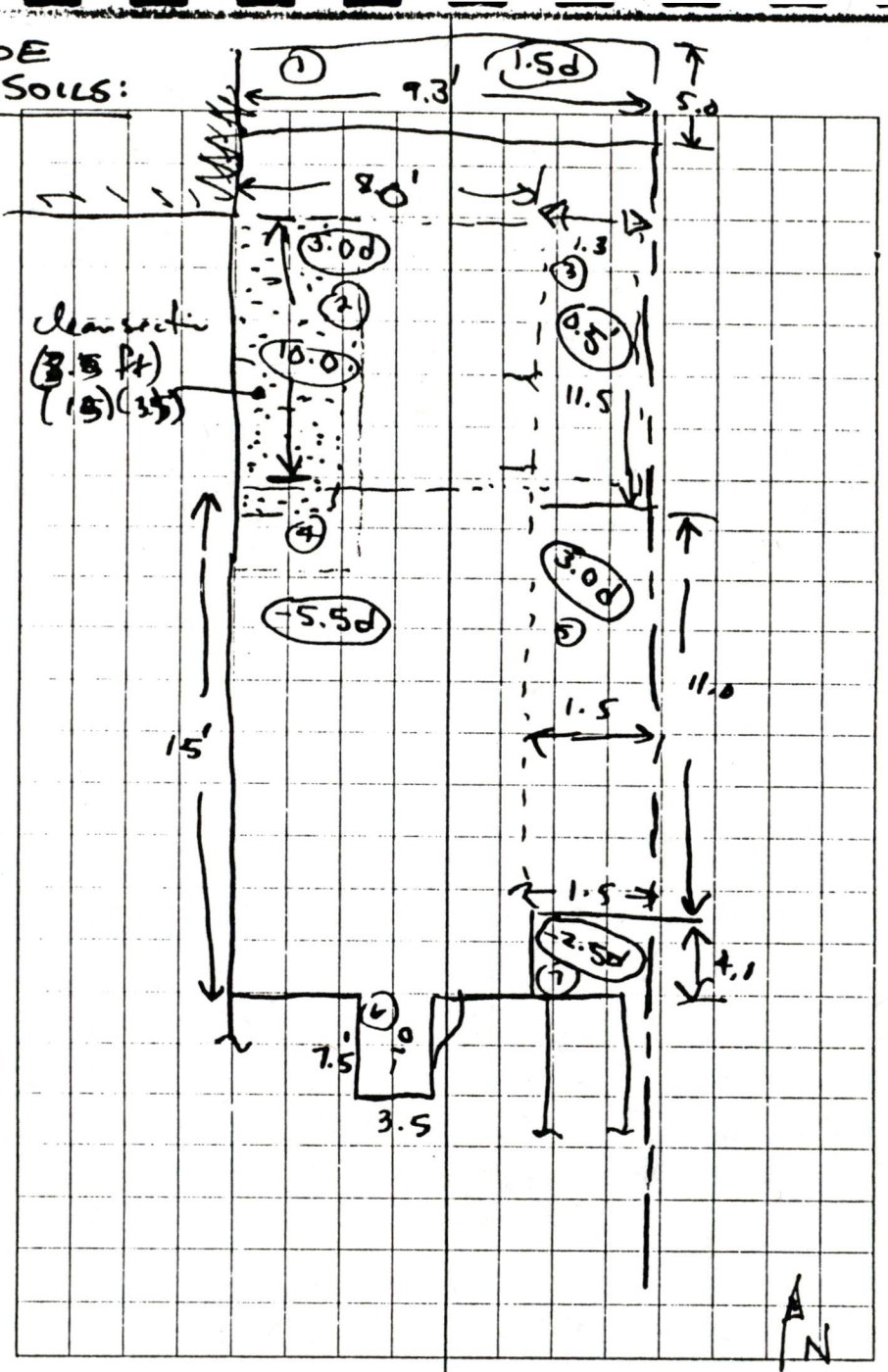
20 Aug. 96

check ± Kym Anderson:
do we run



20 Aug 96

COE SOILS:



$V_c = \Sigma(V_1 \ldots V_7)$

$V_c = (d)(\ell)(w)$

		CF
$(1.5)(5.0)(9.3)$	①	69.75
$+(3.0)(10.0)(8.0)$	②	240.00
$+(0.5)(11.5)(1.3)$	③	7.48
$+(5.5)(15.0)(8.0)$	④	660.00
$+(3.0)(11.0)(1.5)$	⑤	49.50
$+(10.0)(7.5)(3.5)$	⑥	262.50
$+(2.5)(4.0)(1.5)$	⑦	15.00
− clean mat $+\left(\frac{15}{12}\right)(3.5)(3.5)$		~~12.00~~ 13.00

$\Sigma =$ 1304.23 cf − ~~12.00~~ 13.00 = ~~1292.23~~ 1291.23 cf

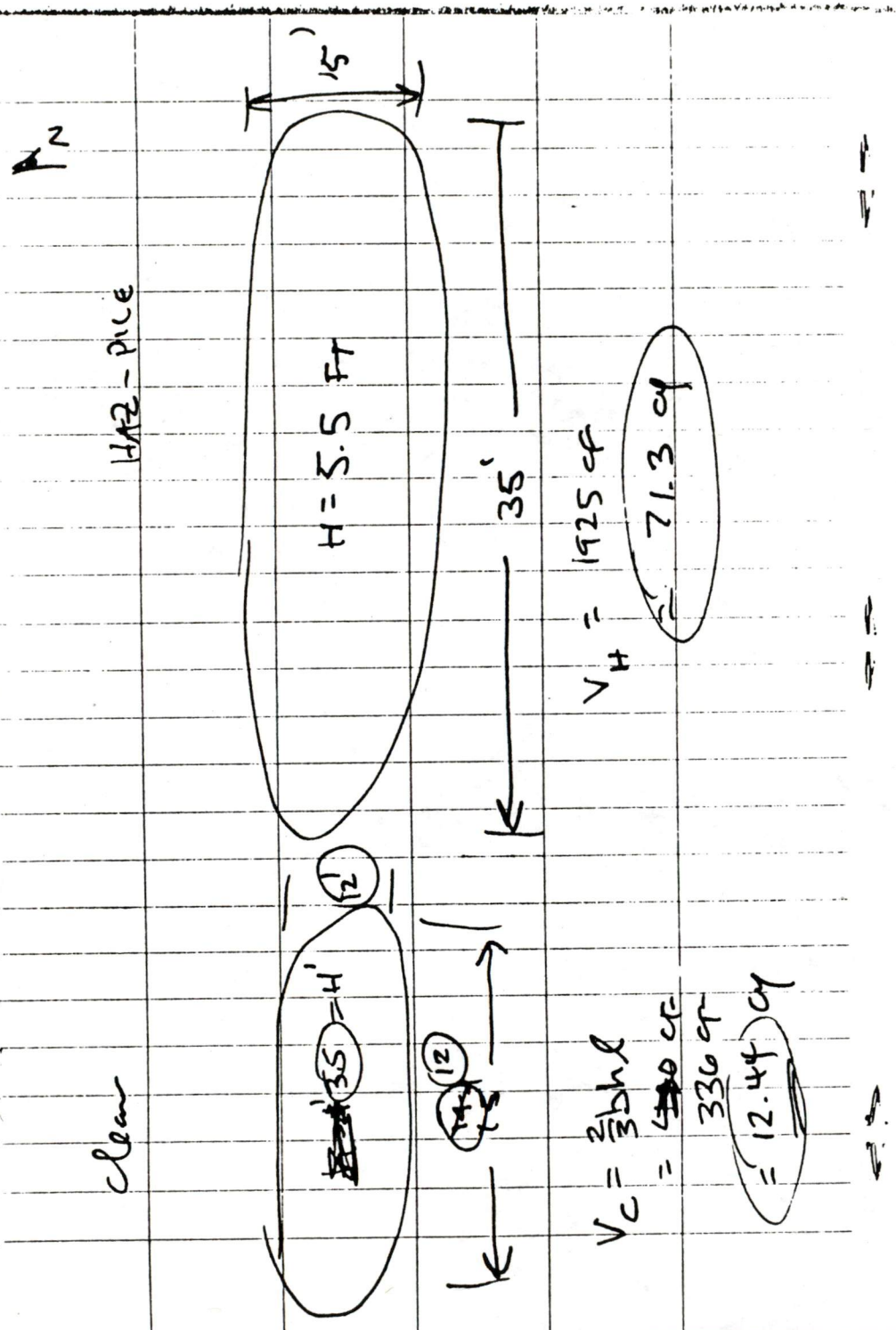
$V_c =$ ~~48.3~~ 47.8 cy (92%) ~~45.6 cy~~ IN-PLACE

INCLUDES CLEAN PILE.

swelled @ ~~1.5~~ 1.2 (20%)

$= \frac{54.8}{57.96}$ cy

total ~~58.7~~ 50.0 (~~42~~ 41.2 (91.7) / 8 (8.3) → 8.8 → 91.2



11:42 am
Phone John - SSS:
Cadman - backfill - find out about trucks. 100 TONS. Bring-in.

Triple line bldg. & 6-mil should be adequate - if you don't - you'll wait a few days.

ok.

Trash Pump $100/dy.
Pump out test pit. Fill 55-gal drum up.

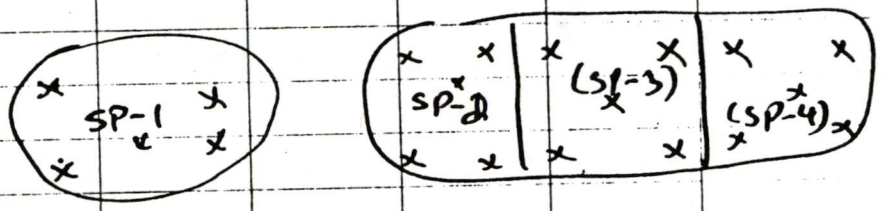
Just remove what's remaining in hole and place in the stockpile.

Cadman @ 12:30 first truck

Kenny @ 0700

Stockpile Sampling

N



15:55 PCB/TPH - 1-8 oz
SP-1 ms/msD 1-8 oz (HOLD)

1-8 oz
15:15

✓ SP-2: 2-8 oz
SP-3: 1-8 oz PCB/TPH
1-8 oz 8270 - Hold ~~HC-SP-5~~
15:30 1-8 oz QA labeled HC-SP-13
1-8 oz QC labeled HC-SP-13

SP-4 2-8 oz PCB/TPH/8270
15:45 ~~1-8 oz ms/msD~~

Need to relabel HC-SP-13 for QA lab to read HC-SP-3L

3.2.2.4

7 + 4 = 11 Samples
10% (~1)

QA - sample ~~splits~~:
QC - HC lab blind duplic
11 -
HC-SP-01 L
EX
GW

10
11
12

SP-1 ms/msD miss
1 jar

8-21-96

0700 - On-Site:

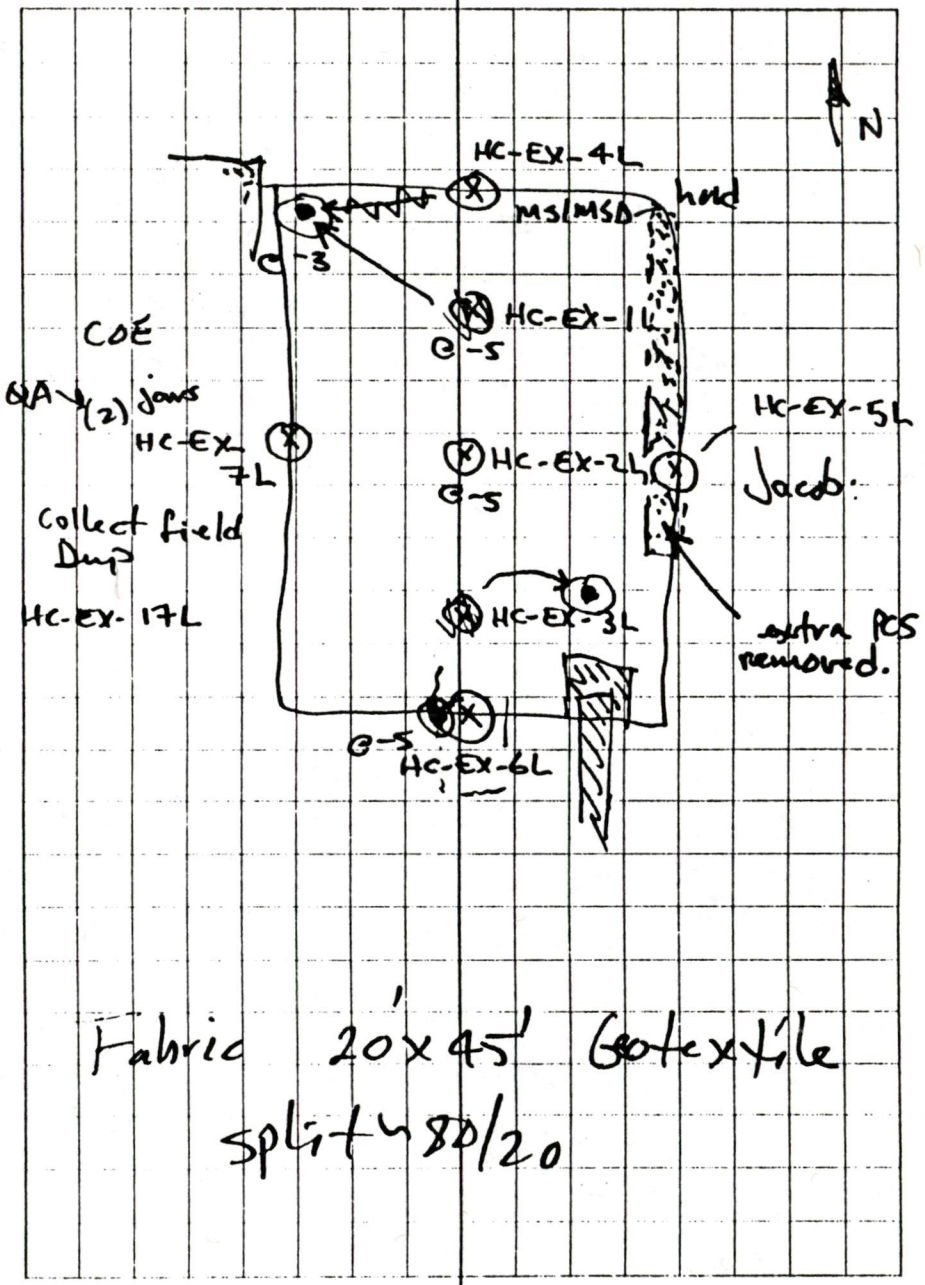
- Sampling Excavation

	HC-EX-1L	0850	
	-2L	0855	
	-3L	0900	
	-6L	0905	
	-7L	0910	(2) 1 for QA lab
HC-EX-7L	-17L	0915	Dup
	HC-EX-5L	0920	
	HC-EX-4L	0945	
	-4L ms/MSD	0945	

QA lab:

HC-EX-7L

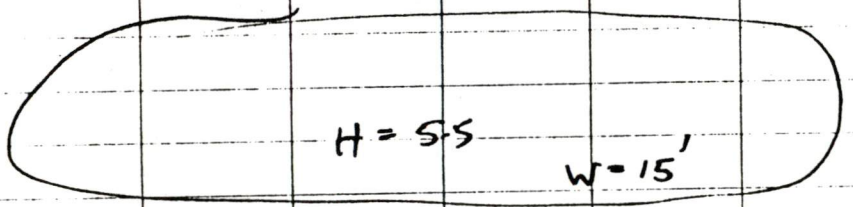
8-21-96



0745 – Contr. in Exc. cleaning out residual material from TP.

Removed additional material from Jacobson side.

FINAL STOCKPILE:



$V_H = \frac{2}{3}bhl$

$= \frac{2}{3}(15)(5.5)(45)$

$= 2,365$ cf

$= 87.6$ cy

71.3 cy (Aug 11/30/96

16.3

4248 BES

8[14] – Sandy – Fish Camp
1-907-384-FISH

9[03]: Michelle 546-2526

9[06]: ANNE: ↓ 11.4'
W = 6.6'

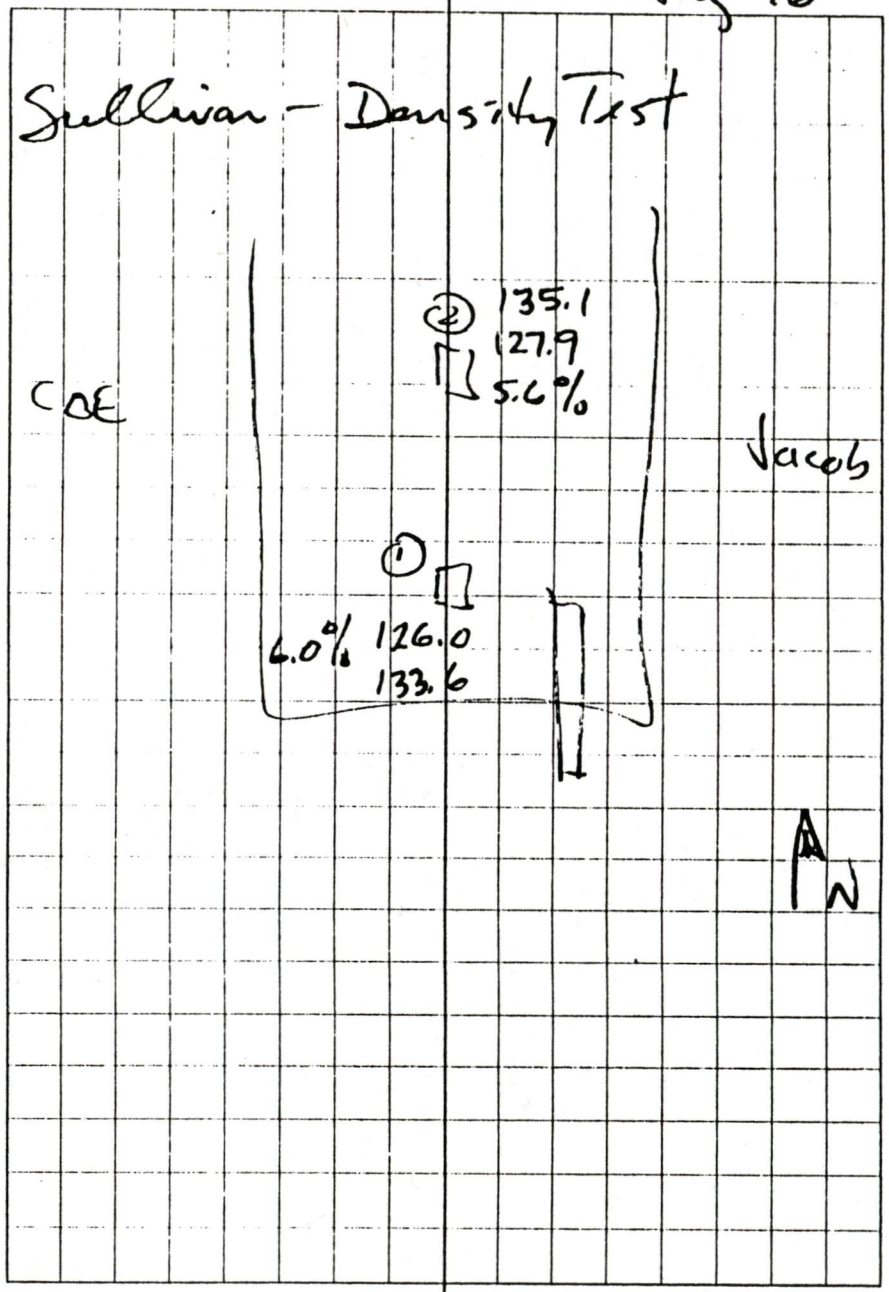
9[25]: ANNE: BES AVAILABLE

105.54 TONS OF BACKFILL

timbers – Creosoted
~ 6' FT Long
4-5 4"x4"
1 3"x6" ~~6x8~~
1 2x12
6 – fragments

21 Aug 96

Sullivan - Density Test



3EIC:

MODIFIED PROCTOR

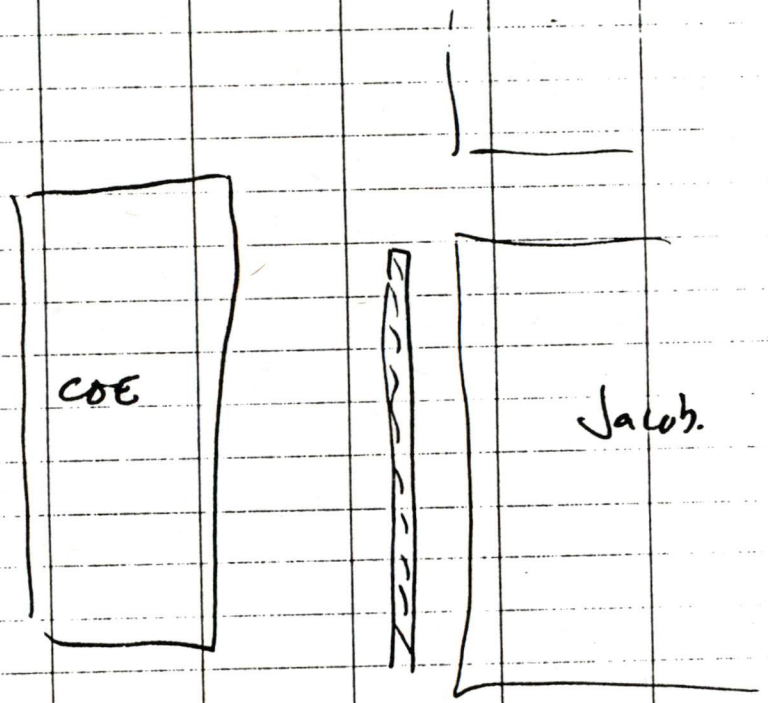
MAX DRY δ CORRECTED 134.7 pcf
Opt. Moisture 6.6%

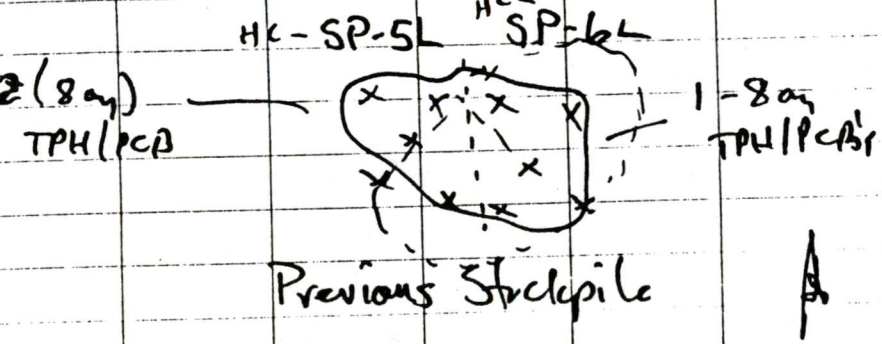
UNCORRECTED 133.4 pcf
6.7 %

$\frac{126.0}{134.7} = 94.5\%$

$\frac{127.9}{134.7} = 95.9\%$

8-23-96



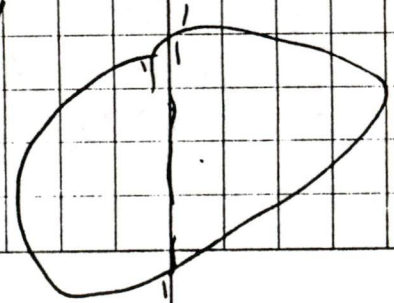


HC-SP-5L 0820

HC-SP-6L 0845

V ≈ 20 cy

Usual



QT-1 8/19/96 E. SIDEWALL
-5.0 FT BGS
TPH > 10,000 PPM
< 10 ppm PCB

QT-2 8/19/96 S. SIDEWALL
-6.0 BGS < 10 ppm PCB

Hardy balance calibration 100.0g/100g

EnSys balance " 99.7/100.0g

QT-3 : W. sidewall under COE Bldg.
<50 PCBs >1600 ppm TPH

QT-4 S. sidewall -1 So. of Wall
-4' depth
< 10 ppm PCB
5,000 ppm Waste 0:1

I.D.	mg/kg TPH	PCB	
QT-1	>10,000	<10	
QT-2	<10	<10	
QT-3	>1,000		
QT-4		<10	
QT-5	>5,000	<50	
QT-6	>10,000	<50	
QT-7	100-200	<50	>10
QT-8	>100 TPH	>10	<50
QT-9		>10	<50

917-3503

HARTCROWSER
1910 Fairview Ave. E.
Seattle, WA 98102-3699
FAX 206-328-5581
206-324-9530

Return To:

HARTCROWSER
1201 Jadwin Ave., Ste. 204, Richland, WA 99352

ALL-WEATHER

FIELD

Notebook No. 351

Job Number: 4617

Project: LAKE WASHINGTON SHIP CANAL

Client: COE / JACOBSON

Location: BALLARD, WA

Book No: 2 of 3

Inclusive Dates: 9/24/96 -

Subject: MONITOR WELL INSTALLATION

Field Representative: CWW / BEC

9-24-96

0845 - ARRIVED ON SITE. DID WALK THROUGH TO FIND LOCATION OF MONITOR WELL LOCATIONS ALL THREE LOCATIONS FOUND - WAITING FOR DRILLERS
WEATHER: PTLY CLDY, 60°

0905 DRILLERS ON SITE - DID WALKTHROUGH. TRYING TO FIND AN ON SITE WATER SUPPLY

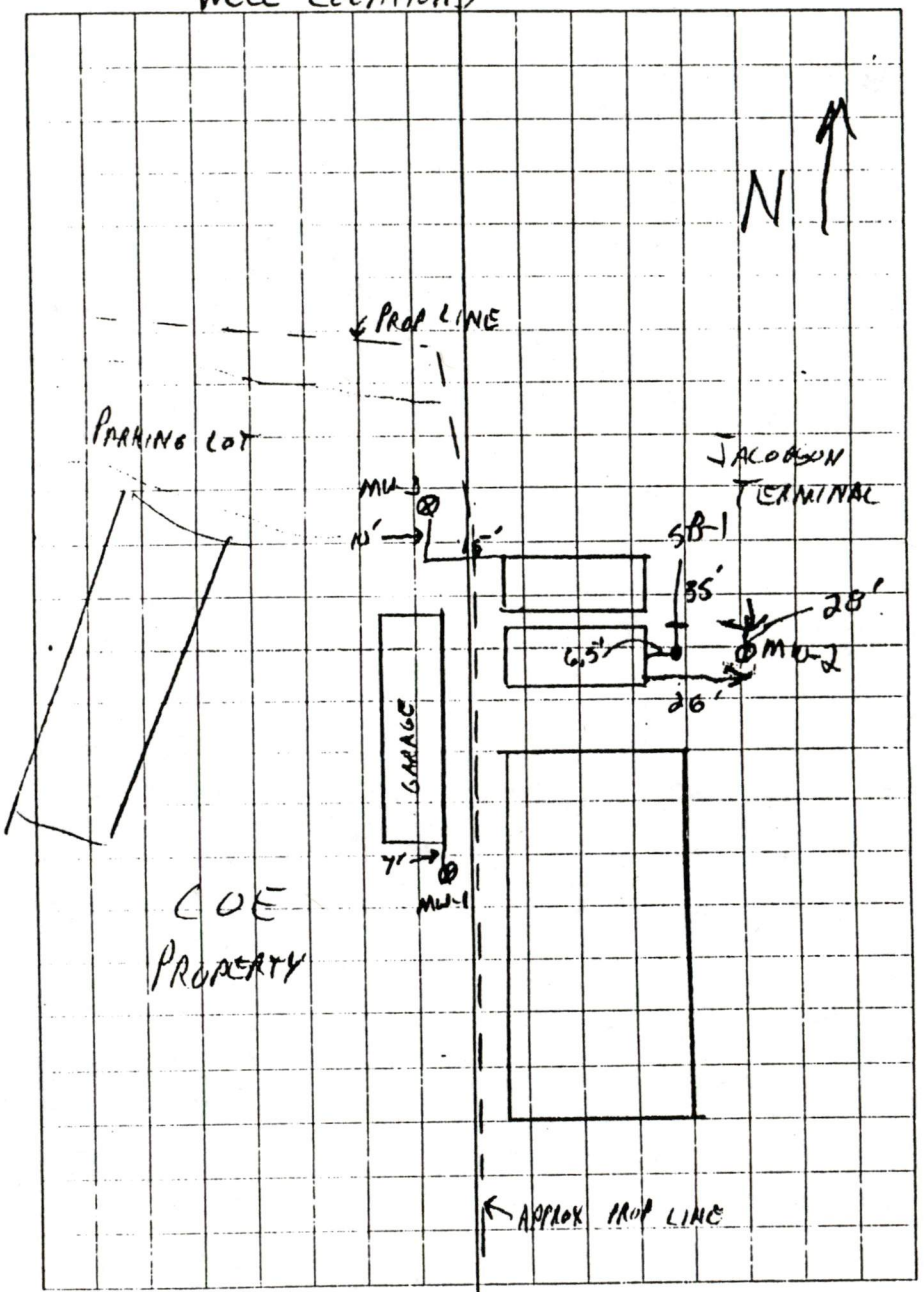
0935 ANNE CAMBELL ON SITE

1000 DRILLER BACK WITH WATER. HAD TO GO TO LOCKS TO GET IT. HAVE TO STEAM CLEAN AUGER BEFORE DRILLING

1025 BEGIN DRILLING ON MW-3

1050 EASY DRILLING UNTIL 11.0' DRILLER FELT HE WAS IN SILTY LAYER. DRUG SAMPLE TO CONFIRM. DECISION MADE TO STOP DRILLING HERE AND INSTALL WELL

WELL LOCATIONS



1055 START INSTALLING MONITOR WELL. WELL WITH PREPACK SCREEN BEING INSTALLED AT ALL THREE LOCATIONS TODAY.
WATER LEVEL MEAS. AT 7.83'
5' SCREEN INTERVAL FROM 6'-11'

1130-1150 LUNCH. ANNE C. LEFT SITE

1150 CONTINUE INSTALLATION

1215 INSTALLATION COMPLETE. BEGIN STEAM CLEANING AUGER AND FINISH INSTALLING MONUMENT

1230 MOVE DRILL RIG TO MW-1 LOCATION. HAD TO MOVE DEBRIS TO GET ACCESS TO BORING. VERY NARROW PATH TO NEGOTIATE W/ RIG.

1250 START DRILLING ON MW-1

1300 ANNE C. BACK ON SITE

1315 HIT SILT LAYER AT 14.0'. WILL INSTALL 10' SCREEN @ 4-14'
STOPPED DRILLING. NO GW OBSERVED

1320 START INSTALLING MONITOR WELL
WHEN TRYING TO CONNECT TWO FIVE FOOT SCREENS TOGETHER IT WAS NOTICED THAT THERE WERE ONLY MALE ENDS. DRILLER HAD TO CUT OFF FEMALE ENDS OF OTHER PVC RISER PIPE IN ORDER TO COMPLETE CONNECTION. SHOULD HAVE NO EFFECT ON INTEGRITY OF WELL

1345 ANNE C LEFT SITE FOR THE DAY

1415 INSTALLATION OF WELL COMPLETE

1420 BRIAN CHRISTIANSON ON SITE TO TAKE OVER FOR CARL WOLFE

1415 to 1445 well monument installed MW-1

1445 to 1500 mobe/setup MW-2

1500 Drilling MW-2 → Changed to HC-501
wood encountered @ 8 to 13 feet appears to have creosote associated with it.

1600 Drill pulled out of MW-2E moved 18' E of location of original MW-2.

1600 Called & left message Dmobrin on condition of hole.

1620 Drill alternate MW-2 & 18' E. of original location

1655 Installing MW-2 10' prepacked screens.

1725 completed installation

1725 to 1820 cleanup & steam clean flights, barrelled de-con water & drill steam clean waters. Separate Installed tamper proof bolts on MW monuments.

604-0210

(1) DRILL RIG ON MW-3

Return To:

HARTCROWSER
1910 Fairview Ave. E.
Seattle, WA 98102-3699
FAX 206-328-5581
206-324-9530

HARTCROWSER
1201 Jadwin Ave., Ste. 204, Richland, WA 99352

ALL-WEATHER

FIELD

Notebook No. 351

Job Number: 467

Project: LAKE WA SHIP CANAL

Client: COE JACOBSEN TERMINAL

Location: _____

Book No: 3 of 3

Inclusive Dates: 9-30-96

Subject: RELATIVE SURVEY

Field Representative: JLF/MAH

LAKE WASHINGTON SHIP CANAL
- RELATIVE SURVEY
MW-1, 2, 3.

J-4617

9-30-96

M. HEITNER
J. FELDER

STA	+	HI	-	ELEV
MW-2	5^{71}	105^{71}		100^{00}
TP, & PT REF. WALL			4^{02}	103^{69}
TP,	3^{51}	107^{20}		
MW,			6^{73}	100^{47}
TP,			3^{51}	103^{69}
TP,	5^{515}	109^{265}		
MW 3			5^{585}	103^{68}
TP,			5^{515}	103^{69}

ELEV TOC	MW-2	100^{00}
	MW-1	100^{47}
	MW-3	103^{68}

APPENDIX F
UNITED STATES ARMY CORPS OF ENGINEERS
DRAFT REPORT REVIEW COMMENTS

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-2255

REPLY TO ATTENTION OF
EN-GT-EM

9 December 1996

Hart Crowser
ATTN: Brian Christianson
1910 Fairview Avenue E.
Seattle, Washington 98102-3699

Dear Mr. Christainson:

Please find enclosed review comments for the draft final report, Petroleum-Contaminated Soil Removal for the Lake Washington Ship Canal-Chittenden Locks. Please review the comments and call to discuss any concerns regarding comment content. Please address the comments, revise the final report and submit a final copy within 10 working days of the receipt of this letter.

If you have any questions or concerns please address them to me at the above address or contact me by phone at 206-764-4478. Thank you for your time and attention.

Sincerely,

Dina R. Ginn
Project Manger

Encl
Comments:
Ginn, Wakeman, Campbell

CENPS-EN-GT-EM 27 November 1996

SUBJECT: Comments Petroleum-Contaminated Soil Removal, Lake Washington Ship Canal, Seattle, Washington. Prepared by Hart Crowser

Reviewer: Dina Ginn, Project Manager, (206) 764-4478

1. General: Change voice, remove references to "We removed..." in entire report. Conduct a more rigorous editorial review there are significant typo and language errors.

2. Executive Summary: Include a brief background on the identification of the problem. At a minimum state when potential release was identified, that characterization occurred (COE and Jacobsen) and that the remedial alternative selected was removal of contaminated soil. (Source removal)

3.1.0 Introduction: Paragraph 1. Provide more detail in description of location. It is the east-west boundary fence between Hiram Chittenden Locks and Pirelli-Jacobsen Marine.

4. 2.1 Soil Removal, Paragraph 2: Soil removal below the water line was not conducted for several reasons including: presence of additional contamination under buildings, difficulty in site access, lack of significant dewatering capacity in contract, disposal of "wet" contaminated material, concern with contract capacity for soil disposal and final evaluation of benefits of continued removal. These concerns were discussed with HC prior to the decision. The phrase "Stopped at the request of Corps Project Manager" does not provide adequate background for the decision not to continue excavating into the water table.

5. 2.2 Field Observation, Paragraph 2: Paragraph is unclear. See above.

6. 2.3 Install ... Fabric: Reword physical barrier to "delineate extent of excavation"

7. 4.1 PCS Excavation. Add to paragraph a sentence indicating the existing Corps stockpile was excavated material from the foundation of the east boundary fence.

8. Table 1: Utilizing only Aroclor 1260 to indicate PCB content implies that was the only Aroclor analyzed. Since all were analyzed a note must be included are all Aroclors listed with non-detect results.

9. Table 1: TSCA Regulatory level is for PCB not TPH as oil.

10. Table 3. Delete note 3.

11. Figure 1: It can not be determined by the text or figure which samples are sidewall samples.

12. Appendix A: Field Methods: Add backfill and compaction to the work list.

13. Appendix A, Excavation: Paragraph 1 is very confusing. It appears to be providing a summary of excavation procedures and the constraints to excavation but is hard to read. Clarify. Potential additional constraints to vertical excavation include contract soil quantities and presence of groundwater. Potential additional constraints to horizontal excavation are access, locations of buildings, location of pavement and reach of equipment.

14 Appendix A, Investigation Derived Wastes. Previously the report indicates that the soil cuttings for bores were added to stockpiles and water from decon/development/purge was drummed. This indicates something else. Correct.

15. Appendix A, Relative Vertical Site Survey. Provide what the elevations of the other wells were in this section.

16. Appendix A, Field Screening Test Kits Paragraph 4. This paragraph appears to be from the Bonneville LUST investigation. DELETE

17. Appendix A, Quality Control Samples, Paragraph 1. There is no discussion on why results of the blind duplicate, HC-EX-17L, for HC-EX-7L were not even close the original sample.

18. Appendix A, Quality Control Samples, Paragraph 2. The QAR will be provided by December 6th for discussion in the report.

19. Figure A-2 thru A-5. Clarify footnotes 3 and 4.

20. General: Field Notes 19 August 1996 Page 2 of 2. State that a test pit was dug on the south end of the "alley" and confirmed that the contamination layer terminates between the south end of the excavation and this location. This is not discussed in the report at all.

COMMENTS- PETROLEUM CONTAMINATED SOIL REMOVAL, LWSC

Anna Campbell
CENPS-EN-GT-GE
(206) 764-6075

1. Pg. 1, pp1: The sentence discussing PCB concentrations is poorly written. Please rephrase without use of "exceedences". For example- Results of analyses indicated PCB levels below....".

2. Pg.1, pp3: Same as comment 1.

3. Pg. 2, Section 2.1, 2nd sent.: insert "of" between extent and PCS.

4. Pg. 2, section 2.2, 1st sent.: change sentence to: Approximately 90 cubic yards of soil were excavated to...".

5. Pg.2, final sent.: delete "determined to be".

6. Pg. 3, pp1, 1st sent.: delete "our".

7. Pg.3, remainder of pp1: I don't understand this sentence- please clarify.

8. Pg. 3, sect 2.3, 1st sent.: insert "the" between after and excavation.

9. Pg. 3, sect 2.3, pp2, 1st sent.: Please rephrase without using "exceedences" (i.e. ...indicated TPH concentrations above cleanup levels...).

10. Pg. 3, sect 2.3, pp2, 2nd &3rd sent.: Please combine these two sentences to read: To prevent the clean imported backfill from coming into contact with the PCS left in place, a migration barrier consisting of 18-mil-thick plastic sheeting was placed vertically along the west and east sides of the existing buildings.

11. Pg. 3, sect 2.4, pp1, last sent.: delete "analysis".

12. Pg. 3, sect 2.4, pp2, 2nd sent.: delete "a" between at and concentrations.

13. Pg. 4, sect 3.1, pp2, 2nd sent: replace "converted to" with "completed as" and change approximate to approximately.

14. Pg. 4, sect 3.1, pp2, 3rd sent.: replace "was observed" to "were noticed". Also, how was the sheen on the groundwater table observed?

15. Pg. 4, sect 3.1, pp2, 4th sent.: should read "This oil sheen may have ....."

16. Pg. 4, sect 3.2, pp1, 1st 4 sentences: should read "Four soil borings (...) were drilled and three were completed as monitoring wells. HC-MW-1 and -2 were completed as monitoring wells at depths of 14.5 feet. HC-MW-3 was completed as a monitoring well at a depth of 13.0 feet. Eighteen-inch soil samples were collected from each boring at 5-foot intervals.

17. Pg. 4, sect 3.2 pp2, 1st sent.: Field observations during drilling indicate the site is underlain by.....

18. Pg. 5, Sect 3.3, pp1, 1st sent.: replace "plus" with "and".

19. Pg. 6, sect 4.1, last sentence: should read "These soils were left on-site for reuse by the Corps."

20. Pg. 6, sect 4.2& 4.3, last sentence of each: off-site should be hyphenated.

21. Pg. A-1 last pp: is 12-mil correct? Also, were sandbags actually used?

22. Pg. A-3 top of page: says both tests passed the compaction criteria of 95%, while section 2.2 says the results were 94% and 95%. Does the 94% result pass the 95% criteria because of error calculations? Please explain.

23. Pg. A-3, Well installation and development: this sections says that all three wells have 10 foot screens, but the log shows MW-3 has a 5 foot screen. Also, there is a sentence near the bottom of the page that states that the total volume of development water removed from MW-1 was 9 gallons instead of the calculated 14. What is the relevance of this? If this is significant, the preceding sentence should state that the other 2 wells had 10 volumes removed, not that each well had 10 volumes removed. Does the following sentence (Development was stopped...) pertain to MW-1 only? Please clarify.

24. Pg. A-4, Equipment decontamination, 1st pp: delete "generally" from last sentence.

25. Pg. A-4, Equipment decontamination, 2nd pp: replace "is" with "was".

26. Pg. A-4, Investigation derived waste handling: This doesn't make much sense. "Soil cuttings from drilling and decontamination water" should be rephrased. What about development water? There is one drum with soil cuttings from all 4 holes? How many drums of water? Where are the drums now? Please clarify.

27. Pg. A-4, Borehole abandonment: delete entire first sentence. HC-SP-1 should be changed to HC-SB-1.

28. Pg. A-4, Groundwater sampling, 1st sent.: should read "Groundwater samples were collected... 2nd sent: replace "just" with "immediately". 4th sent: please rewrite.

29. Pg. A-5, 1st sentence: replace "included" with "consisted of".

30. Pg. A-5, Relative vertical site survey, 2nd to last sentence: replace "are" with "were". last sentence: should read "The groundwater flow direction at the site is to the southeast."

31. Pg. A-5, sample custody: "complete" should be "completed".

32. Pg. A-5, Field screening test kits: replace "included" with "consisted of".

33. Pg. A-6, Field screening test kits, last pp: Is this left over from a previous report? It doesn't make sense in the context of this one.

34. Figures A-2-5, Elevations: please use "relative elevation" instead of "elevation", or direct attention to footnote 4.

CENPS-EN-GT-ET 27-Nov-96
Subject: Petroleum Contaminated Soil Removal, Lake Washington Ship Canal
Project No. (Contract): DACW-67-96-0671
Project No. (NPD Tracking No.): NPS-96-00358
To: Dina Ginn
From John S. Wakeman

1. This data report is not suitable in tone or content to document a site closure. No pertinent project history including previous investigations at the site. (I have provided a copy of a closure documentation package header for possible transmittal to the contractor.)

2. The narrative voice is wrong. The narrative should not be "we," it should be a document that describes the reasons for the Government and Jacobson to select the remedy, using third person throughout.

3. Inappropriate description of key decisions and decision rules. Some of the most important field decisions are particularly obscure:

(1) The phrase on pages 1 and 3 physical site "restraints" --possibly meaning constraints-- is not sufficient information to indicate why excavation was halted.

(2) On page 3, it sounds as though it had been a decision of the onsite Corps oversight person (Anna Campbell), whereas this decision should have been recognized from the first in the Management Plan, and the direction must have from the Contracting Officer.

4. Rationale. The removal approach is not clear from this document and does not permit the reader to understand the rationale from the planning, through action, and ending up in the proposed remediation. It needs to be clearly stated [redacted]ly what was intended, why it was necessary to stop excavation while leaving soils above MTCA levels, and then why the proposed remediation approach (do nothing but monitor) is protective. (It is my understanding that the possibility of paving the soils on the Corps side has been discussed as well.)

I recommend that the directed discussion of possible remediation measures include administrative and physical barriers to direct contact, potential for paving the site, and the probable isolating results of site paving and geotextile from release of TPH. In addition, it needs to be stated that the removal of the TPH and PCB containing soil has reduced the site risk to acceptable levels apart from ground water impacts.

5. Objective Statements and DQO Process are Insufficient. EM 200-1-2 requires the use of the Data Quality Objectives process for Corps of Engineers HTRW work. ER 1110-1-263 and EM 200-1-6 emphasize that the process is not optional, and must be done.

(a) The DQO process documents the key project decisions, describes how the data are to be collected and analyzed to fulfill the data need to suppot the decisions, and reviews the data in light of the quantitative DQOs. The steps are:

- Problem Statement:
- Identify Decision(s):
- Identify Inputs to Decision(s) (location of samples, frequency of sampling, methods of analysis)
- Define the study boundaries:
- Decision Rule(s):
- Specify Limits on Decision Errors

(b) It is not clear in this report what the key decisions and decision rules are, how (or if) they were accomplished, and it is incompletely documented whether contract requirements (management plan statements) were met in the data report. The following paragraphs illustrate the unfortunate effect this has on the appearance of the data.

(c) In the Chemical Data Quality Review (CDQR) section of the document, DQOs are inadequately described (and were in the management plans too), and several times have been changed from the management plans. The attached preliminary Chemical Data Quality Assessment Report (CDQAR, which is a requirement of the above ER and EMs) emphasizes the problems encountered in trying to systematically review the work in this light. [This CDQAR may not be completed until the Chemical Quality Assessment Report is received from NPD Lab, on or about 4 Dec.]

(d) I strongly recommend that the contractor take the information in the table of the preliminary CDQAR and rewrite the Chemical Data Quality Review (CDQR) section to state and compare the action to the quantitative DQOs. Also, in the CDQR section, management plans should not incorporated by reference unless they are attached to the documentation package. In light of the incompleteness of the management plans to state acceptance criteria, it would be better to restate them in the CDQR.

(e) Neither the CDQR section nor the main text indicates that the use of Multichem is entirely to determine the "underlying hazardous constituents" for the sake of documenting these for the TSD facility. Multichem is not a Corps of Engineers validated lab (which is a requirement of EM 200-1 and ER 1110-1-263), and it should be stated that the information is not to document information for the Government decision. To use a nonvalidated lab is a considerable detriment to the work, and this rationale may minimize the detriment. I suggest that the Multichem data review (metals, B/N/A) be separated in a separate section, if done at all. There are no DQOs for the Multichem work. Also, the lack of lab duplicates for metals and useable MS/MSD information may cast some concern on these data. I would like to see a statement that the Multichem data were suitable for the needs of the receiving facility, and no more discussion. This applies also to the results tables in the front of the text, which discloses (to what purpose I

cannot imagine) that a number of PAHs are above MTCA C values. These cleanup related values are not applicable standards because the soils being measured are destined for the landfill.

(f) Throughout the CDQR, the phrase "acceptable" is used. This is an incorrect term. Acceptance is a Government function. The contractor may only recommend acceptance. Alternately, he may state that the quantitative PARCC DQOs were fulfilled or use professional judgment in applying qualifiers.

(g) Insufficient rationale for applying qualifiers. First, there is no acceptance range I could find for precision at all, and one is needed. Second, when PARCC parameters are not fulfilled, there needs to be a statement of the rationale for the qualification or lack of qualification of the data. The paragraph on the bottom of B-2, for example, needs to describe the impact to the data of not calculating field duplicate RPDs, no MS/MSDs, and lack of some surrogate recoveries. The statement "No data were qualified based on surrogate recovery in the QC samples. The data are acceptable...." needs rationalization. Likewise, for the PCBs, it is stated that "reporting limits were acceptable" (they weren't, when compared with the soil DQOs from the management plan see the table at the end of the preliminary CDQAR); that lab dupe RPDs couldn't be calculated, that MS/MSD recoveries were not reported. Yet, the paragraph puzzlingly concludes that these data are "acceptable."

(h) Lack of rationale could cause the decision to be questioned. These data have already been used in an unqualified manner to determine the appropriateness of disposal! There are only three states that the data can attain with respect to analytical bias: low (reported value is probably below the real one), high (reported value may overstate the real value), and unknown. A low bias may not affect the useabilty of the data if the data are all very far below the decision point, as is the case with the PCB data. However, this part of the report should identify and address all variations from complete fulfillment of PARCC parameters in light of bias and effect on project decision.

CENPS-EN-GT-ET 26-Nov-96

Chemical Data Quality Assessment Report
PRELIMINARY

Date of Report: 12 Nov 96
Project: Petroleum Contaminated Soil Removal, Lake Washington Ship Canal
Project No. (Contract): DACW-67-96-0671
Project No. (NPD Tracking No.): NPS-96-0358
Project Location: Ballard, Washington
Project Authority: Operating Project
Phase of Project or Round of Sampling: N/A
Project Chemist: John Wakeman

1. Additional References
   a. Management Plan partial, dated 12 Aug 96
   b. Management Plan Supplement, dated 6 Sep 96
   c. Chemical Quality Assurance Report by North Pacific Division Laboratory, (#) dated (TO BE PROVIDED LATER)
2. Data Report Review

   a. Significant Issues Identified.

The report is poorly edited, and may not serve the purpose of documenting the activities and in particular in supporting the determination of a partial closure with administrative controls being to pave the surface soils. Most importantly, the DQO process was followed in an incomplete and slipshod manner.

   b. Statement of Data Usability In Comparison to Project Data Quality Objectives.

Numerous of the PARCC parameters were not being specified in the Management Plan and Supplement, but instead being stated and evaluated after the fact. The Management Plan and Supplement should not have been accepted. There is no way without a time machine to fix the absence of quantitative DQOs for this project. An attempt has been made to evaluate the data for usability with the post-facto DQOs. It is concluded that the data may be adequate for the closure decision, but a lesson learned is that a project chemist should critically review the management plans before the contractor goes into the field.

   c. Corrective Actions Identified.

This preliminary CDQAR will be provided to the contractor along with editorial comments and a request to provide missing data and to appropriately modify the Management Plan via the final report so that all required DQOs are included.

3. Nature of action. These data were collected (a) to support a decision of the adequacy of a soil removal operation for soils that were demonstrated to have significant oil and grease contamination and at least one "hit" of PCB that exceeded the TSCA levels of 50 mg/kg, and (b) to measure possible impacts to ground water from the presence of these soils. Sampling also supported the decision to dispose and to document the appropriate disposal. Sampling included --

- Field kit sampling to guide "triage" of soils for purposes of excavation and stockpiling. (These data are not considered in this CDQAR.)
- Stockpile profiling for purposes of disposal of soil. limited to TPH and PCB testing.
- Confirmation of cleanup to Model Toxics Control Act cleanup levels. (It was not possible, due to site geometry, to excavate all soils above the TPH-D -for diesel- clean up goals.)
- Groundwater sampling/analysis to determine existing impacts

An additional category of testing was included in the data report that was not identified in the management plans. This includes B/N/A extractable testing (Method 8270B) and metals including TCLP. The purpose of this testing (which was not accomplished in a Corps Validated Laboratory) was to disclose for the TSD facility the "underlying hazardous constituents." This testing, which was at the request of the contractor to accomplish his disposal, is not included in this report since it was not used for a Government decision. (The data will be cited in the data report as a part of the waste closeout documentation.)

4. Project Data Quality Objectives Overview

As described in EM 200-1-2 and required by Corps regulations (ER 1110-1-263) data quality objectives (DQOs) are an integrated set of specifications which define the data quality requirements based on the intended use of the data. Project-specific DQOs are established for both the field and laboratory operations. The determination of data quality includes the evaluation of the PARCC parameters (i.e., precision, accuracy, representativeness, comparability (including sensitivity), and completeness. The PARCC parameters are quantitative or qualitative limits which, when exceeded, generate data that is questionable for the intended use. It is important that data quality be demonstrated for the analytes of concern at the levels of concern. To ensure that quality data are produced, systematic checks are made to show that test results remain reproducible and that the analytical method is actually measuring the quantity of target analytes in each sample.

To generate data that will meet the project-specific requirements, it is necessary to define the types of decisions that will be made and identify the intended use of the data. The DQO process assists in determining the appropriate reporting limits, extraction/digestion methods, clean-up methods, analytical methods, target analytes, and method quality control samples, quality control acceptance ranges, and corrective actions. Project-specific DQOs should not be confused with laboratory-specific objectives. Each laboratory would normally define their own set of laboratory-specific objectives for general day-to-day use for its implementation of any given performance-based method, including the SW-846 methods. The following process is followed in generating these DQOs:

a. Problem Statement:
b. Identify Decision(s):
c Identify Inputs to Decision(s) (location of samples, frequency of sampling, methods of analysis)
d. Define the study boundaries:
e. Decision Rule(s):
f. Specify Limits on Decision Errors

5 Chemical Data Quality Usability Assessment. The formulation of DQOs in the management plans is flawed and incomplete. A table attempting to state DQOs is appended to this CDQAR after searching through both plans and the data report. In the table, values proposed for evaluation for the first time in the data report have been included in straight brackets [xx]. Following paragraphs comment on the reconstructed DQOs and their attainment. *(Data usability is not concluded until we have the CQAR from NPD Laboratory.)*

a. Precision. Precision refers to the distribution of a set of reported values about the mean. For the collection of environmental samples, precision is commonly determined from field duplicate samples or quality assurance split samples. For the chemical analysis of environmental samples, precision is commonly determined from laboratory duplicate samples (i.e., matrix spike/matrix spike duplicates, and/or matrix duplicate samples). The laboratory control sample would typically be used only to indicate the analytical instrument precision. Precision is usually expressed as the relative percent difference or relative standard deviation.

It is evident from the table that precision DQOs were NOT generally specified in the Management Plan and Supplement. (These are highlighted by gray toning.) Actual RPDs on Matrix Spikes and Duplicates are fairly consistently low. Use of a default +/- 20 % would generally be adequate. For water, there are no detected values for which RPDs may be calculated.

b. Accuracy. Accuracy refers to the bias of a measurement and can be difficult to evaluate for an entire data collection activity. Sources of error may

include the sampling process, field cross-contamination, sample preservation, sample handling, sample matrix, sample preparation, and sample analysis techniques. Accuracy values can be presented as average error; however, accuracy is more commonly expressed as percent bias or percent recovery. Percent bias or percent recovery is a standardized average error, that is, the average error divided by the actual or spiked concentration and converted to a percentage. Accuracy is commonly determined in the field through the collection of blanks and/or spiked samples. Accuracy is commonly determined in the laboratory from spiked samples (i.e., matrix spikes, laboratory control samples, surrogate spikes, etc.) or performance evaluation samples.

It appears that the accuracy DQOs were attained.

c. Representativeness: Representativeness refers to the degree to which sample data accurately and precisely describe the characteristics of a population of samples, parameter variations at a sampling point, or environmental condition. Representativeness is a *qualitative* parameter which is primarily concerned with the proper design of the sampling program or subsampling of a given sample. The representativeness criteria is best satisfied in the laboratory by making certain that all subsamples taken from a given sample are representative of the entire sample. This includes sample premixing and the discarding of obvious foreign objects. Representativeness can also be assessed by the use of duplicate field and laboratory samples. Samples that are not properly preserved or are analyzed beyond acceptable holding times are not considered to provide representative data.

Sample handling and holding times were met. Most duplicate field analyses were within range; however, some could not be calculated due to no detected values.

d. Completeness: Completeness is defined as the percentage of a set of measurements made which are judged to be valid, i.e., which meet project-specific DQOs. The highest degree of completeness that can be achieved is normally desired. Completeness is normally defined to include both field and laboratory activities. In other words, samples that are not acceptable based on field DQOs are not generally acceptable and should not be scored as complete. The completeness objective for *critical samples* may be higher than for non-critical samples. The method of calculating completeness was specified in the SOW and SAP.

$$\text{Completeness (\%)} = \frac{\text{number of } \textbf{complete} \text{ sample parameters}}{\textbf{total} \text{ number of sample parameters submitted}} * 100\%$$

For this project, the basis for calculation of completeness (and thus the basis for corrective action) was defined as all project samples of a given parameter, without regard to batching. No statement of completeness is made in the text.

e. Comparability: Comparability is a parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable for similar samples and sample conditions. This goal is achieved through the use of standard techniques to collect and analyze representative samples and reporting analytical results with appropriate units. Sensitivity is considered a part of comparability. Sensitivity refers to the amount of material necessary to produce a detector response that can be reliably detected or quantified. Specific detection limits are matrix dependent. Comparability is influenced by the other PARCC parameters because only when precision and accuracy are known can data sets be compared with confidence.

Sensitivity DQOs were met for TPH-D in all media, and for PCBs in water. Sensitivity DQOs for PCBs in soil were not met (stated: 15-25 ug/kg; attained: 200-500 mg/kg). This could give a low bias to values less than 500 ug/kg (0.5 mg/kg). The higher attained sensitivities may still be satisfactory for a project decision at 1 mg/kg.

6. CQAR Data Comparisons and Data Discrepancies TO BE PROVIDED LATER.

7. Recommendations. It is recommended that the contractor rewrite the data report to include a thorough discussion of the DQOs, their attainment, and the effects to data use at the project decision points.

Summary of Analytical DQOs		Bracketed Values are from the Data Report. All other values are from the Management Plan							
Parameter	Lab Control Sample CL	Precision RPD CL	Matrix Spike/MS Duplicate RPD	Lab Duplicate RPD	Accuracy (% Recovery)	Comparability		Completeness	Notes
SOIL						Sensitivity	Units		
TPH-D	[80-110]	[20]	[20]	[33]	[52-155]	[20]	mg/kg	90%	
Surr. 2 Fluorobiphenyl					60-123 [67-115]				
Surr. o-Terphenyl					76-119 [84-115]				
Surr. hexacosane					84-115 [84-118]				
TPH-O	[80-110]	Not Stated	Not Stated		Not Stated	[50]	mg/kg	90%	
PCB, by Aroclor or Surrogate									
1016	56-142	Not Stated		Not Stated	[69-160]	15	ug/kg	90%	Actual sensitivity is 200 u
1221	56-142	Not Stated		Not Stated	[69-160]	25	ug/kg	90%	Actual sensitivity is 500 u
1232	56-142	Not Stated		Not Stated	[69-160]	15	ug/kg	90%	Actual sensitivity is 500 u
1248	56-142	Not Stated		Not Stated	[69-160]	15	ug/kg	90%	Actual sensitivity is 200 u
1254	56-142	Not Stated		Not Stated	[69-160]	15	ug/kg	90%	Actual sensitivity is 200 u
1260	56-142	Not Stated		Not Stated	[69-160]	15	ug/kg	90%	Actual sensitivity is 200 u
Surr. tetrachloro-m-xylene	[56-142]				[46-133]				
Surr. decachlorobiphenyl	[56-142]				[53-134]				
WATER						Sensitivity	Units		
TPH-D		20	Not Stated		55-145	0.25	ug/kg	90%	
Surr. 2 Fluorobiphenyl					58-122				
Surr. o-Terphenyl					68-126				
Surr. hexacosane					61-132				
TPH-O		Not Stated	Not Stated			Not Stated	Not Stated	90%	
PCB, by Aroclor or Surr.									
1016	77-111	Not Stated	50	Not Stated	50-150	4	ug/L	90%	
1221	77-111	Not Stated	50	Not Stated	50-150	10	ug/L	90%	
1232	77-111	Not Stated	50	Not Stated	50-150	10	ug/L	90%	
1248	77-111	Not Stated	50	Not Stated	50-150	4	ug/L	90%	
1254	77-111	Not Stated	50	Not Stated	50-150	4	ug/L	90%	
1260	77-111	Not Stated	50	Not Stated	50-150	4	ug/L	90%	
Surr. tetrachloro-m-xylene					54-119				
Surr. decachlorobiphenyl					82-122				