Remedial Investigation Work Plan – Phase I

Port of Port Angeles Terminals 5, 6, and 7

Appendix A
Study Area Data Reports

PLATT-POPA EGUC.5

DRAFT REPORT

FOCUSED SITE INVESTIGATION

of the

Former Merrill & Ring Property
Port Angeles, Washington

prepared for

Daishowa
America
Port Angeles
MILL

by

CH2M HILL

MARCH 1989

PREFACE

This report has been prepared by CH2M HILL under a contract with Daishowa America Company, Ltd.

CONCLUSIONS AND EXECUTIVE SUMMARY

A focused environmental site investigation was conducted at the former Merrill & Ring wood treating facility located in Port Angeles, Washington. The site investigation was undertaken in the late summer and autumn of 1988 and was focused on a 2-acre area of the former Merrill & Ring Lumber Company. The main objective of the study was to evaluate the magnitude and extent of the wood preservatives pentachlorophenol (PCP) and tetrachlorophenol (TCP) potentially released to soil, groundwater, and marine sediments by Merrill and Ring. The practice of applying PCP and TCP to wood was discontinued in the focused site investigation area over 15 years ago. The study was performed by CH2M HILL under contract to Daishowa America Company, Ltd., which recently purchased the site.

Project conclusions and results are summarized below.

CONCLUSIONS

PCP and TCP were detected in soil, groundwater, and marine sediments as follows:

- PCP and/or TCP were detected in soil samples collected from 6 of 12 locations at depths of 5 to 30 feet below the ground surface. Excluding results that are quantitatively suspect, concentrations ranged from 1.7 mg/kg (ppm, on an as received basis) to 24 mg/kg. With the exception of the highest value (24 mg/kg), the remaining values are within three to five times the method detection limit (1.0 mg/kg, on an as received basis.

- PCP and/or TCP were detected in groundwater samples collected from 9 of 19 monitoring wells (nine existing Hart Crowser wells included). However, only three wells (MW-6A, MW-6C, and MW-16A--see Figure S-1 for well locations) indicated the presence of these compounds consistently over time. Concentrations of PCP and TCP in these three wells ranged from 0.04 to 14.3 mg/l (ppm). Groundwater from each of these wells was sampled three times. The two followup sampling events show consistently lower values, with a high value of 2.1 mg/l at MW-6A. These subsequent values are believed to be more representative of the actual conditions because of difficulties in developing or redeveloping the wells.

- PCP was detected in marine sediments at two of five locations. Concentrations were 4.7 and

6.4 mg/kg on a dry weight basis. However, both of these values were qualified by the analytical laboratory as being quantitatively suspect. These values are relatively low, being within three to five times the method detection limit.

Based on analytical results and characterization of subsurface conditions at the former Merrill & Ring property, there is no technical precedent, nor are there human health or environmental criteria, that would indicate that remedial action is required. Although there is some limited PCP and TCP contamination in soil and groundwater, the analytical results are anomalous and many of the detected values are qualified by the laboratory as quantitatively or qualitatively suspect. Further action is not justified for the following reasons:

- The reported PCP and TCP concentrations in soil do not exceed any published criteria for soil quality. Using the EPA convention that laboratory results for soil may not be meaningful when concentrations are less than 5 to 10 times the practical quantitation limit, the concentrations detected during the focused site investigation are not significant with the exception of one value at boring 16C. As an additional comparison, the concentrations of PCP detected in soil samples collected at the site are comparable to those reported for residential street sweeping debris (Metro, December 1982).

- Groundwater at the site is not used for any beneficial purpose and, because of its brackish quality, it is not suitable as a future source of drinking water. Therefore, regulatory standards for drinking water are not applicable to groundwater at the site. Furthermore, PCP and TCP concentrations in groundwater samples collected from monitoring wells nearest the shoreline are below the federal and state criteria for marine surface waters.

- The planned expansion of the Daishowa facility includes the construction of a new paper mill. The mill will be constructed directly over the focused site investigation area. All identified zones of contamination will therefore be effectively "capped." This will prevent infiltration of precipitation and surface runoff through the unsaturated soils that may act as a potential source of groundwater contamination. Figure S-2

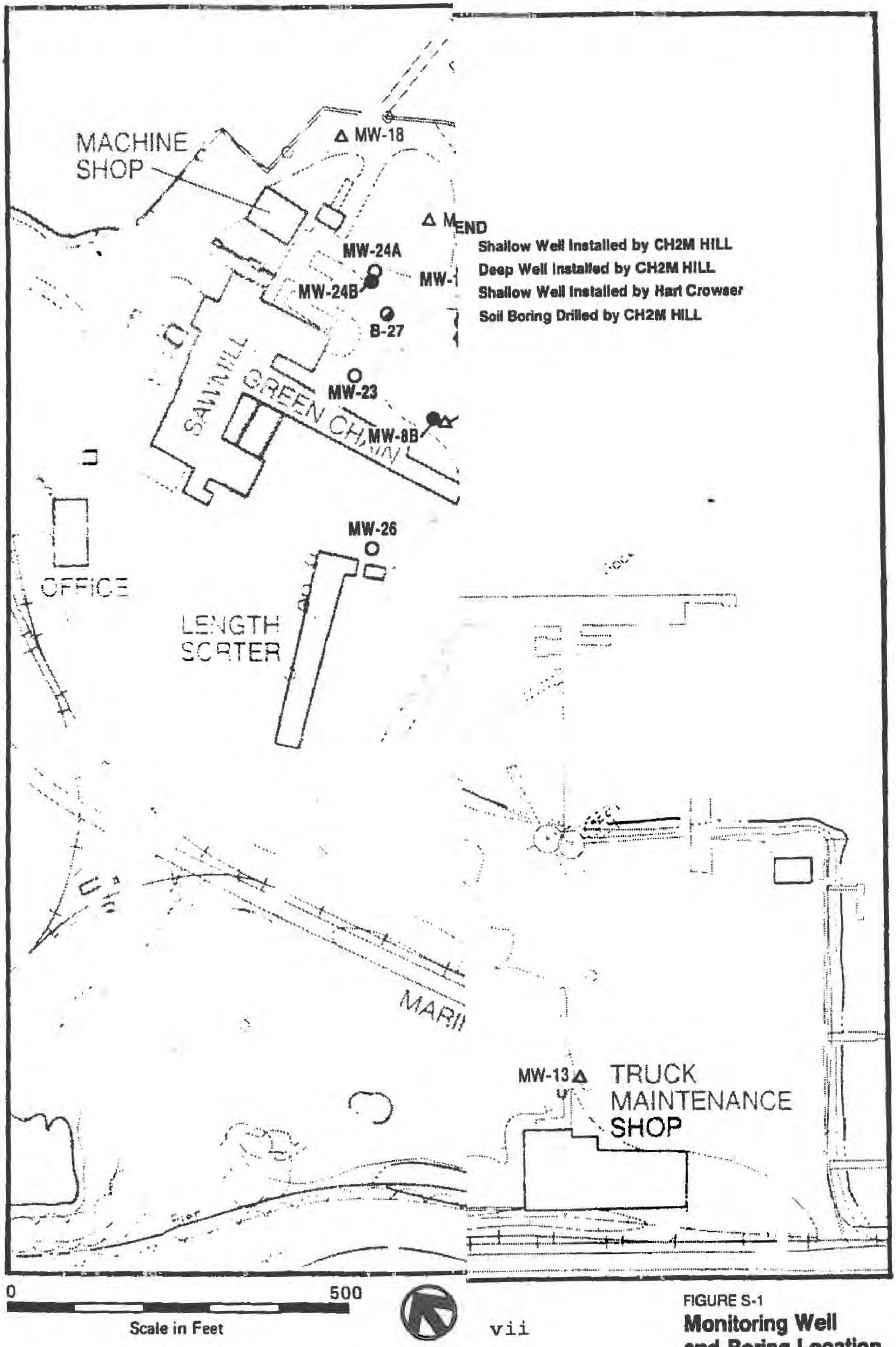
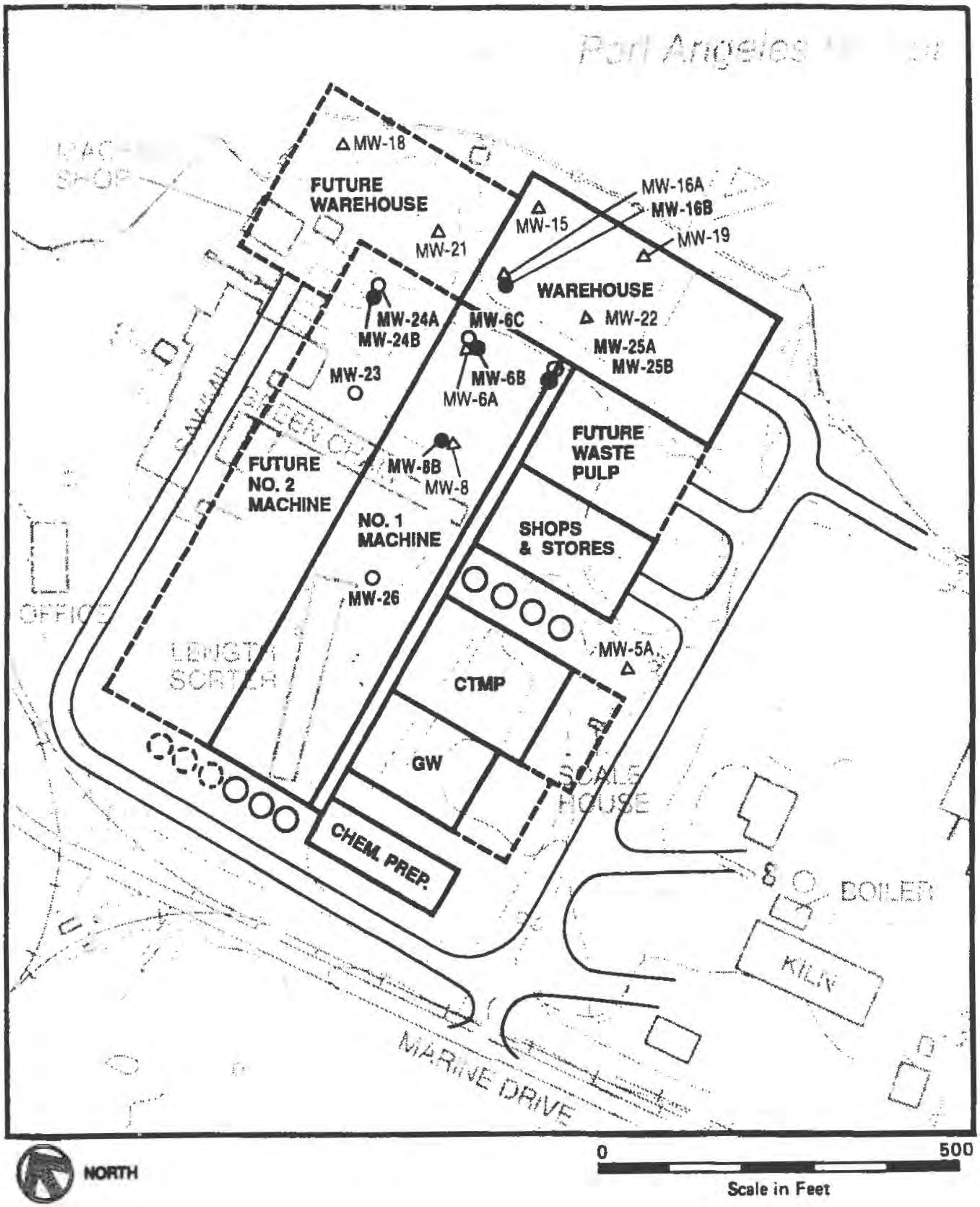


FIGURE S-1
Monitoring Well and Boring Location



LEGEND

○ Shallow Well Installed by CH2M HILL

● Deep Well Installed by CH2M HILL

△ Shallow Well Installed by Hart Crowser

FIGURE S-2
Proposed Mill Expansion
Daishowa America Co., Ltd.

shows the layout of the proposed mill relative to the existing monitoring wells in the focused site investigation area.

- Data collected concerning the PCP and TCP in groundwater suggest that these chemicals may be degraded by chemical and microbiological means before reaching Port Angeles Harbor. The anaerobic conditions and periodic flooding of the Merrill & Ring site may further enhance microbial breakdown of PCP (Mikesell and Boyd, 1988, and reference cited therein). This fact appears to be supported by the low levels and absence of PCP and TCP in groundwater and soil samples collected from monitoring wells nearest the Port Angeles Harbor and from marine sediment samples collected downgradient and offshore of the study area.

- Based on groundwater analytical data, the presence of PCP and TCP in groundwater appears to be limited to shallow depths (i.e., 5 to 15 feet below the ground surface) in small areas near monitoring wells MW-6A, MW-6C, and MW-16A (see Figure S-1 for well locations). This is corroborated by the lack of PCP and TCP in soil and groundwater adjacent to and downgradient of these locations. PCP was not detected in any groundwater samples collected from deep monitoring wells (screened approximately 40 to 50 feet below ground surface). TCP was detected only one time in a deep monitoring well (MW-6B), at a concentration very near the method detection limit. This detection is anomalous as neither PCP or TCP were detected in a subsequent groundwater sample collected from MW-6B, or in the soils obtained in boring this well, except for one qualified TCP result.

BACKGROUND INFORMATION AND STUDY FINDINGS

In June 1988, Daishowa purchased and leased approximately 50 acres of land, formerly the site of the Merrill & Ring Lumber Company. During a property transfer assessment performed by Hart Crowser, it was determined that wood preservatives, including PCP and TCP, had contaminated soils and possibly groundwater in the northeast corner of the property (Hart Crowser, 1988). This portion of the former Merrill & Ring site was the location of an old planer mill and dip tank. The source of PCP is attributed to drippage and spillage associated with the application of PCP to wood. This area of the former Merrill & Ring site has not been used for wood preserving activities for approximately 15 years.

In response to the property transfer assessment, Daishowa retained CH2M HILL to determine the nature and extent of PCP contamination in the vicinity of the old planer mill and, if necessary, identify remedial actions that could effectively be implemented to protect human health and the environment.

Daishowa also requested that CH2M HILL conduct a review of the property transfer assessment report prepared by Hart Crowser and verify available site information and records. A limited number of soil and groundwater samples were also collected and analyzed to corroborate or refute the general findings of the property transfer assessment.

In response to Daishowa's requests, CH2M HILL conducted a focused site investigation, which included assessment of local hydrogeological conditions and chemical analyses of soil, groundwater, and marine sediment samples. Using nine groundwater monitoring wells installed by Hart Crowser, and installing ten new groundwater monitoring wells, CH2M HILL characterized site groundwater hydrogeology and analyzed soils and groundwater for the presence or absence of PCP and TCP. Figure S-1 presents the focused site investigation area and the location of all groundwater monitoring wells. The verification study sample locations are presented in the technical memorandum appended to this report.

SITE INVESTIGATION AND ANALYTICAL METHODS

Evaluation of site groundwater hydrology was undertaken by classifying subsurface materials, measuring groundwater elevations, performing noninvasive slug tests, and measuring tidal influence or groundwater elevation and movement.

Soil and marine sediment samples were characterized for physical characteristics including grain size, permeability, and--for marine sediments only--total organic carbon content.

Soil, sediment, and groundwater samples were analyzed in accordance with appropriate test methods described in the Code of Federal Regulations (40 CFR, Part 261, Appendix III--Chemical Analysis Test Methods). The procedures selected are described in Test Methods for Evaluating Solid Waste (SW 846, September 1986) and include:

- EPA recommended analytical Test Method 8040 for PCP and TCP
- EPA recommended analytical Test Method 8270 for semivolatile organic compounds
- 40 CFR 264 Appendix IX parameters

- EPA recommended analytical Test Method 7471 for mercury in soils

Method 8040 analyses were performed on 60 soil, 6 sediment, and 44 groundwater samples. Method 8270 analyses were conducted on 17 soil, 1 sediment, and 4 groundwater samples. Method 8270 analyses were used as a performance check on the Method 8040 analyses and as a means to test sampled media for the presence of other contaminants including phenolic breakdown products.

Mercury analyses were performed to determine if the wood preservative used, Permatox 180, included a fungicide that could have contaminated soils with mercury. Finally, Appendix IX analyses of four groundwater and one soil sample were performed as a standard of concern by Daishowa to ensure that it conducted a thorough examination of the most probable contaminated areas for other hazardous substances that may be of concern to the Washington State Department of Ecology (Ecology). Appendix IX parameters were chosen as the most extensive and practical set of analyses for potentially regulated contaminants. The soil sample was analyzed for the same set of parameters although the regulations in 40 CFR 264 are aimed at groundwater only. The Appendix IX analyses also serve as verification of previous dioxin test results performed by Hart Crowser.

Verification of the groundwater samples of the Hart Crowser property transfer assessment wells was undertaken during the sampling of groundwater in the focused site investigation. Verification of six soils and two additional marine sediments also was undertaken. A summary of the verification data acquisition efforts is provided in a technical memorandum included as an addendum to this report.

Laboratory results and the significance of the project findings are presented in detail in Sections 4 and 5 of this report. Raw data are presented in Appendixes D, E, and F.

SUBSURFACE SOILS

With the exception of monitoring well MW-16C (TCP at 6.2 mg/kg) all subsurface soil samples analyzed by Method 8040 indicate that PCP and TCP were present in very low concentrations (PCP at 2.22 to 2.81 mg/kg; TCP at 1.35 to 4.55 mg/kg). These reported values fall near the laboratory's method detection limit and the concentrations do not exceed published soils criteria for PCP. In general, the results of these soils analyses are similar to the average concentration of PCP detected in urban residential street sweeping dust (Metro, December 1982).

The Method 8270 analyses of subsurface soils compare favorably to the Method 8040 results, with no PCP or TCP (tentatively identified since 8270 does not target TCP specifically) at any concentration in any samples except those collected from MW-25B (PCP at 1.7 and 0.28 mg/kg; TCP at 0.19 and 0.71 mg/kg) and SB-16CD (PCP at 24 mg/kg; TCP at 27 mg/kg).

None of the PCP and the tentatively identified TCP values exceed EPA's health-based soil criterion of 500 mg/kg for PCP.

Other results from the Method 8270 analysis for semivolatile organic compounds indicated the presence of some polynuclear aromatic hydrocarbon (PAH) compounds, phenol, and 4-methylphenol in surface soils (2.5 feet or less). None of these compounds was detected in soils below the surface. These compounds also were reported at very low concentrations, all of which fall below apparent biological effects thresholds (AETs) proposed to evaluate marine sediments in the draft Puget Sound Marine Sediment Criteria Evaluation (Ecology, 1988). These samples are surface soils, so the comparison to marine sediment standards is for illustration only. There are no other health-based or regulating criteria with which to compare these results. The AETs, however, are considered stringent criteria.

Mercury analyses of soils (29 samples) indicated that no soil tested exceeded the range of mercury found naturally in soils.

Appendix IX analyses of soil did not identify any significant contamination. The Appendix IX results confirmed Hart Crowser's conclusion that dioxin contamination is unlikely at the Merrill & Ring site. No dioxins were detected in any of the Appendix IX analyses conducted during the focused site investigation.

GROUNDWATER

With the exception of monitoring wells MW-6A (PCP ranged from 0.51 mg/l to 3.07 mg/l) and MW-6C (PCP ranged from 0.16 mg/l to 14.3 mg/l), the groundwater sampled by Method 8040 analyses showed PCP values below or very near the practical quantitation limit (0.05 mg/l or ten times the laboratory's method detection limit of 0.005 mg/l). It is important to note that the highest value for both MW-6B and MW-6C were detected during the first round of sampling and analysis and dropped to a much lower level with subsequent sampling events. This is believed to be a result of the gradual reduction in turbidity of the groundwater collected from monitoring wells after well development or redevelopment. The close support laboratory reported the turbidity of the groundwater samples was due in large part to colloidal suspensions that could not be centrifuged out of the samples. Studies have shown that PCP can be adsorped on colloids (Choi and Aomine, 1974). If colloidal PCP were being measured as part of the groundwater level, the gradual settling of the suspension should be accompanied by a lowering of the diluted levels in the groundwater. This groundwater is brackish and is not a source of drinking water, so there are no applicable regulatory standards.

TCP detections and concentrations varied in groundwater samples collected from the same wells at different times. TCP was detected in groundwater samples collected from MW-19 and MW-25A in one of the two rounds of sampling and analyses. Both values are qualified as suspect by the laboratory. TCP was detected in samples collected from MW-16A in all three sampling events. These values, however, are all qualified by the laboratory. Concentrations were 0.105 mg/l for Round 1, 0.006 mg/l for Round 2, and 0.092 mg/l for Round 3. PCP was detected in groundwater samples collected from MW-16A during Round 1 (0.052 mg/l) and Round 3 (0.064 mg/l) only. PCP was not detected in the Round 2 sample.

The groundwater sample collected from deep well MW-6B during Round 1 contained TCP at 0.010 mg/l (only two times the method detection limit). MW-6B was analyzed a second time by Method 8040, twice by Method 8270, and for Appendix IX constituents; neither PCP nor TCP was detected in any of these tests. This discrepancy is believed to be the result of prolonged groundwater turbidity after well development. PCP was not detected in this well during either round of sampling. It is believed that the detected TCP may have been detected in the colloidal material. PCP or TCP was not identified in the deep monitoring zone near MW-6B.

Analysis of groundwater samples collected from shallow wells MW-6A and MW-6C verify the presence of PCP and TCP at the site. Detectable concentrations of both compounds were reported in samples collected from both wells during all three sampling events, although, again, samples collected during the first sampling event had substantially higher levels than those collected during latter sampling events. Furthermore, the 40 CFR Appendix IX analysis of MW-6C, which was conducted during the last sampling event, did not detect the presence of PCP or TCP. MW-6A showed irregular fluctuations in concentrations of PCP and TCP. It is believed that these fluctuations are a result of particulates in groundwater samples, and are not a true measure of soluble PCP and TCP in groundwater.

There are no drinking water criteria for TCP, and the groundwater sampled does not represent a drinking water source. For comparison, however, the second and third groundwater samples collected from MW-6C did not contain TCP at concentrations greater than the proposed maximum contaminant level goals (MCLGs) for PCP in drinking water (0.22 mg/l).

The State of Washington Water Quality Standards (WAC 173-201-047) has set the marine surface water toxic substance criteria for PCP at 0.0079 mg/l for chronic exposure and 0.013 mg/l for acute exposure. For the three wells closest to the harbor (approximately 60 to 80 feet from the shoreline), one well did not have PCP values that exceed either criterion, one well reported PCP value during the first sampling round that exceeded the chronic limit but was below both limits for the second round, and the third well exceeded both the chronic and acute limits during the first round but was below both for the second round of sampling. It is important to emphasize that these limits are for marine surface waters and do not apply to these groundwater monitoring well samples. The values that exceeded the marine criteria were both reported during the first round of sampling following well development. Tetrachlorophenol is not listed in the state regulations. It was detected in only one of the three wells nearest the harbor, at a level below the published marine chronic lowest observed effect value of 0.440 mg/l. Again, this comparison of groundwater to surface water criteria or published effects data is for illustrative purposes only to demonstrate that values of contaminants detected in groundwater at this site are at or below regulated levels in marine water. It is reasonable to assume that marine surface waters 60 to 80 feet away would not exceed current water quality standards.

PCP was detected in two of the four groundwater samples analyzed by Method 8270. The PCP concentration (6.9 mg/l) in a groundwater sample collected in the first round of sampling from MW-6C is the same magnitude (14.3 mg/l) as the Method 8040 analysis of a sample collected during the same sampling round. Analysis of a sample collected from MW-16A in the third round of sampling indicated a low level (below the EPA quantitation limit) of PCP. Isomers of TCP were among the tentatively identified compounds detected in samples collected from MW-6C and MW-16A. (TCP is not on the target list for this method.) The levels are of similar magnitude as the Method 8040 values for these samples.

The only other Method 8270 compounds identified in groundwater samples were two of the possible PCP breakdown products, 2,4-dichlorophenol and 2,4,5-trichlorophenol detected in groundwater from MW-6C, and napthalene (a PAH compound) detected in groundwater collected from both MW-6C and MW-16C. All these values from Method 8270 analyses except the TCP and PCP at MW-6C, are below the health-based drinking water criteria; these criteria, however, are not applicable to this site because the groundwater is not potable.

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GLOSSARY

Advection:	The process by which solutes are transported by the bulk motion of flowing groundwater.
Aerobic:	Description of a biological reaction that requires the presence of air or oxygen.
Airlifting:	A means of removing water from a well using compressed air.
Alkalinity:	The capacity of a water to accept protons (i.e., hydrogen ions).
Alluvium:	Unconsolidated material (e.g., gravel, sand, silt, and clay) deposited by a river, stream, or other body of running water.
Anaerobic:	Description of a biological reaction that occurs in the absence of air or oxygen.
Anions:	An ion having a negative charge; anions in a liquid subjected to electric potential collect at the positive pole or anode.
Annular seal:	A sanitary seal consisting of a relatively impermeable material (e.g., bentonite and/or grout) that is placed in the annular space between a well casing and the borehole wall.
Anthropogenic:	Made or induced by man.
Aquifer:	A geologic formation, group of formations, or part of a formation that is capable of yielding significant quantities of water to a well or spring.
Brackish:	When used in reference to water, brackish indicates a salinity content less than seawater but more than water suitable for drinking.
Cations:	An ion having a positive charge; cations in a liquid subjected to electric potential collect at the negative pole or cathode.

Centralizer:	A device used to center a well screen and casing in a borehole during installation and stabilization of filter pack and seal materials.
Colloid:	Extremely small, insoluble particles (0.0001 to 1 micron in diameter) that will not settle out of a solution.
Detection limit:	The lowest concentration at which a chemical compound or element can be identified.
Detritus:	Loose particles of rock or organic debris separated from the parent material by mechanical means such as abrasion or disintegration.
Diurnal:	On a daily basis.
Eductor pipe:	A pipe through which water is discharged from a well during airlift pumping.
Filter pack:	A material generally consisting of clean, washed siliceous sand of uniform grain size distribution that is placed around a well screen to prevent smaller size formation material (e.g., fine sand, silt, and clay) from entering the well.
Gas chromatography:	The process in which a gaseous mixture is passed through a column packed with absorbent material to identify and quantify the chemical constituents (generally volatile organic compounds).
Head space:	(1) The space filled with air above the static water level in a well. (2) The space filled with air above a sample material in a sample container.
Heave:	When formation materials (i.e., sand, silt) are forced up into temporary drill casing or hollow-stem auger during drilling by hydrostatic pressure encountered below the water table.
Heterogeneous:	Nonuniform in structure and composition.

Hydraulic conductivity:	The rate at which water will move through a porous medium under a unit hydraulic gradient.
Hydraulic gradient:	The rate of change of hydraulic head per unit distance.
Hydraulic head:	Potential energy of a water mass due to elevation, pressure, or velocity.
Hydrographs:	A graph showing stage, flow, velocity, or other properties of water with respect to time.
Isomer:	(1) One or two or more molecules having the same number and kind of atoms and hence the same molecular weight, but differing in respect to the arrangement or configuration of the atoms. (2) Nuclides having the same atomic and mass numbers, but existing in different energy states.
Lithosphere:	The outer, rigid part of the earth's crust.
Microbial:	Refers to the activity and effects of microorganisms.
Monitoring well:	A well used to collect groundwater samples and hydrologic data such as groundwater elevations.
Partitioning coefficient:	The ratio of a chemical's concentration in the octanol phase to its concentration in the aqueous phase of a two-phase octanol/water system.
Peristaltic pump:	A type of suction pump.
Pleistocene:	An epoch of the Quarternary period, which occurred approximately 10,000 to 2 million years before present.
Practical quantitation limit:	The lowest concentration of a chemical compound or element at which acceptable precision and accuracy can be reliably maintained by an analytical laboratory.

Purge water:	Groundwater removed from a monitoring well before a groundwater sample is collected. Purging removes stagnant water from the well and allows collection of more representative groundwater sample.
Qualitative:	Refers to the identification of individual chemical compounds and elements in an environmental sample.
Quantitative:	Refers to the determination of a concentration or percentage of a known chemical compound or element in an environmental sample.
Recharge:	The addition of water to the groundwater system by natural or artificial processes.
Saline:	Any solution of sodium chloride and water, usually containing other salts.
Shelby tube:	A thin-walled steel tube used to collect relatively undisturbed soil samples.
Slug test:	A hydrologic test performed in a well to measure the hydraulic conductivity of the geologic materials surrounding the well screen.
Split-spoon:	A steel, cylindrical soil-sampling device, which splits in half to reveal the sample material. The split-spoon sampler is usually used with a drill rig and is driven through subsurface geologic strata to collect soil samples.
Static groundwater level:	The level of water in a well that is not being affected by artificial withdrawal (e.g., pumping) or recharge of groundwater.
Stratified:	Refers to beds or layers in sedimentary deposits formed during deposition.
Transducer:	A measurement device that converts an input signal to an output signal.

	Pressure transducers are commonly used to measure water levels in wells.
Turbidity:	The presence of nondissolved suspended solids in a solution.

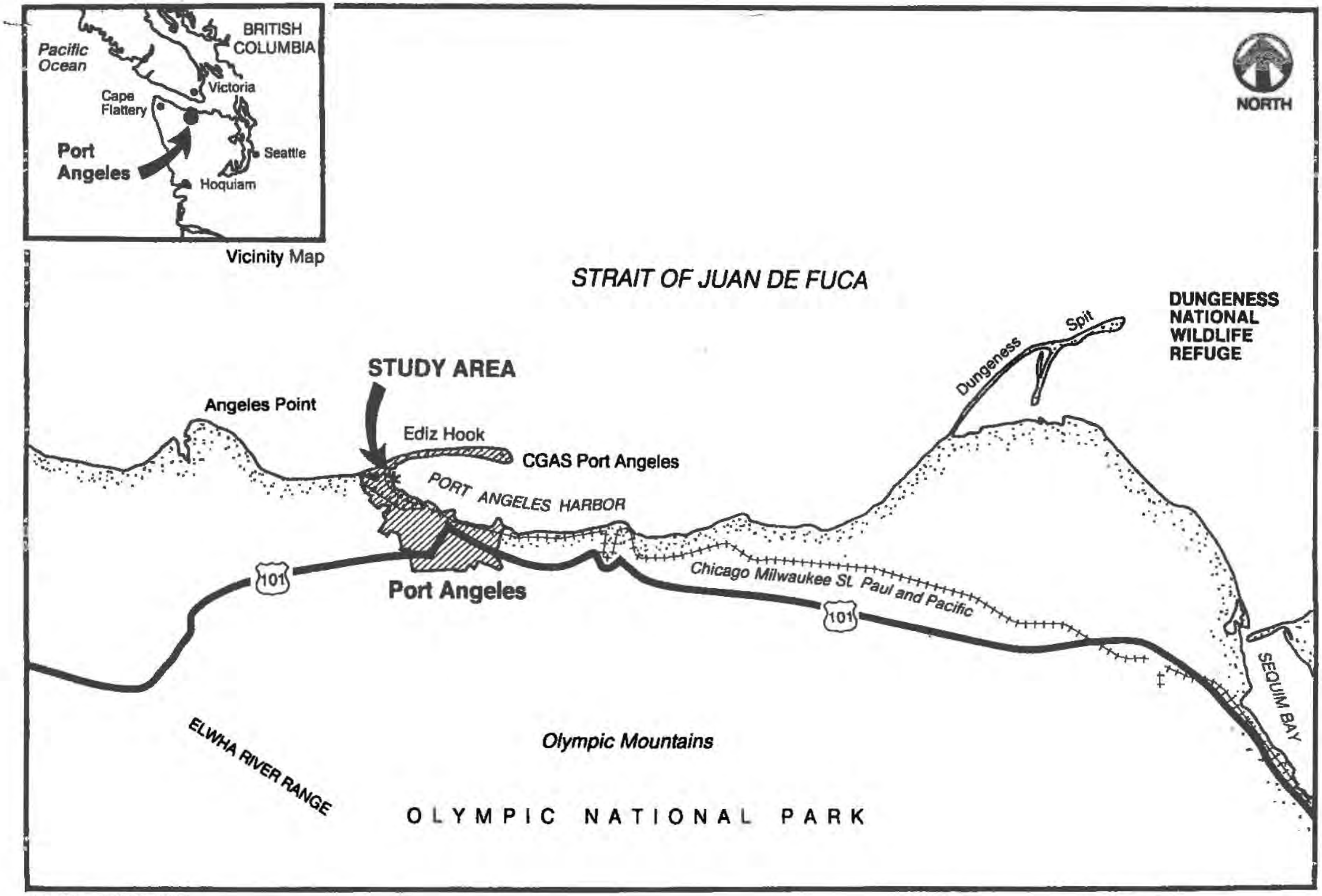
1 INTRODUCTION

In June 1988 Daishowa America Co., Ltd. (Daishowa), purchased outright and obtained the lease rights to approximately 50 acres of land along the Port Angeles Harbor shoreline. Formerly owned by the Merrill & Ring Lumber Company (M&R), the site is an artificially filled parcel situated along Ediz Hook and the shoreline of Port Angeles Harbor in Sections 4 and 5 of Township 30N, Range 6W of the Willamette Meridian. The property is bounded by Daishowa's Port Angeles Mill on the northwest, Marine Drive to the south and west, and the Port Angeles Marina on the southeast. All property is within the City of Port Angeles in Clallam County, Washington (see Figure 1-1). Approximately 20 acres of the parcel is owned by Daishowa while the remainder consists of leased land owned by the Port of Port Angeles. Daishowa intends to use this property for expansion of its Port Angeles paper mill operations.

Prior to the sale M&R (the seller) conducted an environmental assessment of the property to determine the potential of contamination caused by past practices. This property transfer environmental assessment (Hart Crowser, 1988) determined that wood preservatives including pentachlorophenol (PCP) had contaminated soils and possibly groundwater in the northeast corner of the property, at the site of the old planer mill. The source of PCP is attributed to drippage and spillage associated with application of the PCP to wood. The property transfer assessment did not define the extent and magnitude of PCP contamination. Neither did the assessment determine certain site-specific characteristics (geology, hydrogeology, etc.) that could be used to further characterize the extent of contamination and its potential consequences. In order to evaluate the nature, extent, and consequences of contamination in conjunction with site characteristics, a more detailed environmental investigation of the portion of the property near the old planer mill was necessary.

1.1 BACKGROUND INFORMATION

In May 1988, Hart Crowser (HC) performed a property transfer assessment (Hart Crowser, 1988) of the M&R Lumber Company Port Angeles property. The assessment included a paperwork and interview information-gathering effort and a subsurface boring and groundwater monitoring program. As a result of the findings of this assessment, Hart Crowser performed additional work, also in May 1988, that included further evaluation of potential contamination in the vicinity of the old and new planer mills. The areas of concern around the old planer mill, included an abandoned sawmill, the green chain



SOURCE: USGS, 1957

FIGURE 1-1
Location of Study Area

lumber conveyor, a spraybooth, and a dip tank where wood products were treated for sapstain control with Permatox 180, a product containing PCP. Today the old planer mill area is used to store logs. The new planer mill area was also further evaluated for potential soil contamination resulting from the use of PCP and a carbamate chemical called NP1. These wood treatment chemicals were applied to the lumber within a spray room equipped with a recirculating distribution system.

Hart Crowser concluded that contamination at the new planer mill was confined to the ground surface and posed no threat to groundwater. They also concluded that PCP-related contamination existed in soils and groundwater near the old planer mill. Upon disclosure of these results to Daishowa, Daishowa immediately notified the Washington State Department of Ecology (Ecology) requesting a review of the assessment results and guidance with regards to appropriate procedures that Daishowa must follow to ensure protection of human health and the environment. Ecology requested that Daishowa further investigate the site in order to substantiate Hart Crowser's findings. In response to this request, Daishowa contracted with CH2M HILL to determine the nature and extent of contamination, compare contamination to published guidance and regulations, and, if necessary, develop remedial action alternatives. Daishowa gave CH2M HILL two assignments in this effort.

1. Determine the nature and extent of PCP contamination in the vicinity of the old planer mill resulting from PCP spillage. If necessary, based upon comparison to requirements, identify remedial alternatives that could be used to control, manage, or otherwise correct the situation.

2. Conduct a review of the Hart Crowser preliminary evaluation in order to verify that available site information and records for the 50-acre parcel have been examined. Collect a limited number of soil and groundwater samples that would corroborate or deny Hart Crowser's findings.

1.2 SPECIAL PROJECT CONSIDERATIONS

The purpose of this focused site investigation is to determine the nature and extent of PCP contamination in the soils and the groundwater at the old planer mill. It is also the purpose of this study to identify potential remedial action alternatives to manage or otherwise correct the PCP contamination in this area if there is contamination that requires remedial action.

Because of mill construction activities scheduled to occur in the near future on site, CH2M HILL concentrated its first efforts in the planned construction area. This included the area in the vicinity of HC monitoring Wells MW-8, MW-6A, and MW-16A. Field efforts were then intensified throughout the area with fast analytical turnaround on results in order to define potential contamination. This intensified effort was undertaken to provide for worker safety and verify that proposed construction activities would not aggravate any environmental contamination present in that area. Potential site corrective measures would be identified during this investigation so that future mill construction could be initiated without undue risk to workers or unnecessary spread of any contamination.

1.3 ORGANIZATION OF THIS REPORT

This report summarizes activities performed by CH2M HILL in the investigation of the M&R property in the vicinity of the old planer mill. Section 2 describes in greater detail the focused site investigation area, its environment and use, and summarizes the pertinent conclusions of the Hart Crowser preliminary site assessment. Section 3 describes the site investigation methods, including the field methods and the analytical and QA/QC programs. Results from the site characterization and laboratory analyses are presented in Section 4. Section 5 presents the current regulatory criteria and guidance and compares the findings of this focused site investigation to those published levels. Finally, Section 6 summarizes major findings of this study and discusses remedial action alternatives for the focused site investigation area.

Results of the verification review of the Hart Crowser preliminary evaluation are presented in a technical memorandum attached as an addendum to this report.

2 SITE DESCRIPTION

2.1 LOCATION: FOCUSED SITE INVESTIGATION AREA

The former Merrill and Ring, Inc., property consists of approximately 50 acres of land located 1 mile northwest of Port Angeles along Marine Drive between the Port Angeles marina and the base of Ediz Hook (see Figure 1-1). It is bordered by Marine Drive on the south and Port Angeles Harbor on the north. Major historical structures present on the former M&R property included a sawmill, green chain, machine shop, lumber and log storage, length sorter, hog fuel boiler, dry kiln, lumber planing mill, sap stain control treatment operation, alder chipper and chip storage, dry shed, and truck maintenance shop. Many of these structures are no longer present.

The Focused Site Investigation area consists of approximately 2 acres and is located at the northeast corner of the M&R site. It is bounded by the green chain on the west, machine shop on the north, Port Angeles Harbor on the east, and a log storage yard on the south. The area includes approximately 600 feet of shoreline. The shoreline consists of a bulkhead constructed from treated timbers. There are three piers along this 600-foot shoreline, all constructed of treated timbers and approximately 200 feet in length. Figure 2-1 presents the layout of the Focused Site Investigation area.

The area west of the shoreline contains miscellaneous debris from log and lumber storage situated on filled material. The green chain is located approximately 500 feet from the shoreline. It runs north to south and is approximately 200 feet in length. Appendix B provides several photographs of the focused site investigation area.

2.2 ENVIRONMENTAL SETTING

2.2.1 CLIMATE

Port Angeles is characterized by a cool maritime climate. Temperatures are moderated by the Strait of Juan de Fuca, and precipitation varies greatly over the region because of the effects of the Olympic Mountains. Port Angeles is near the western edge of an area referred to as the "rain shadow" of the Olympic Mountains. The climate of the Port Angeles area is mostly a marine type with cool summers, mild and cloudy winters, moist air and a small daily variance in temperature. January is generally the coldest month and July the warmest. The mean daily winter temperature is 43°F with nighttime temperatures around 30°F. Afternoon average temperatures in the warmest summer months range from 65°F to 70°F.

The prevailing wind direction is from the west. Summer winds range up to 8 to 13 mph, while winter winds range up to 7 to 10 mph. On most summer afternoons a moderate to strong westerly breeze can be expected. Winds from the south and east occur more frequently during the winter.

The average annual precipitation, measured between 1931 and 1960, is 24.61 inches. The rainy season begins in October, reaching a peak in winter, then gradually decreasing in the spring. The dry season begins in late spring and reaches a peak in midsummer as marine air moves inland becoming warmer and drier. The rainy season averages 19.52 inches of precipitation while the dry season averages 5.09 inches. In lower elevations, snow rarely reaches an excess of 6 inches in depth. In the mountains, elevations above 5,000 feet, snow can be expected by the end of October, accumulating rapidly after mid-November (U.S. Department of Commerce, Annual Weather Summary for Port Angeles, Washington).

2.2.2 GEOLOGY AND TOPOGRAPHY

Geologic conditions in the Port Angeles area consist of Pleistocene glacial drift overlying folded mudstone, siltstone, and sandstone of the Twin River Formation (Tabor and Cady, 1978). The glacial sediments mantle the uplands in and around Port Angeles and are composed of stratified clay, silt, sand, and gravel. Alluvium consisting predominantly of sand and gravel is present in the numerous stream and river valleys that are incised into the glacial drift. The near-shore areas in the Port Angeles area are characterized by steep bluffs (150 to 200 feet) that have been formed by wave erosion; these expose underlying glacial drift materials. Beach deposits, generally consisting of silt, sand, and gravel, are present between the bluffs and shoreline and overlie the glacial drift that extends out under Port Angeles Harbor and the Strait of Juan de Fuca. Many of the near-shore areas in Port Angeles, including the Daishowa property, have been modified by the placement of fill materials.

Groundwater is present within the more permeable strata of the glacial drift and generally flows northward toward Port Angeles Harbor and the Strait of Juan de Fuca. Approaching the shoreline, groundwater levels are influenced by tidal fluctuations and groundwater becomes increasingly brackish because of seawater intrusion.

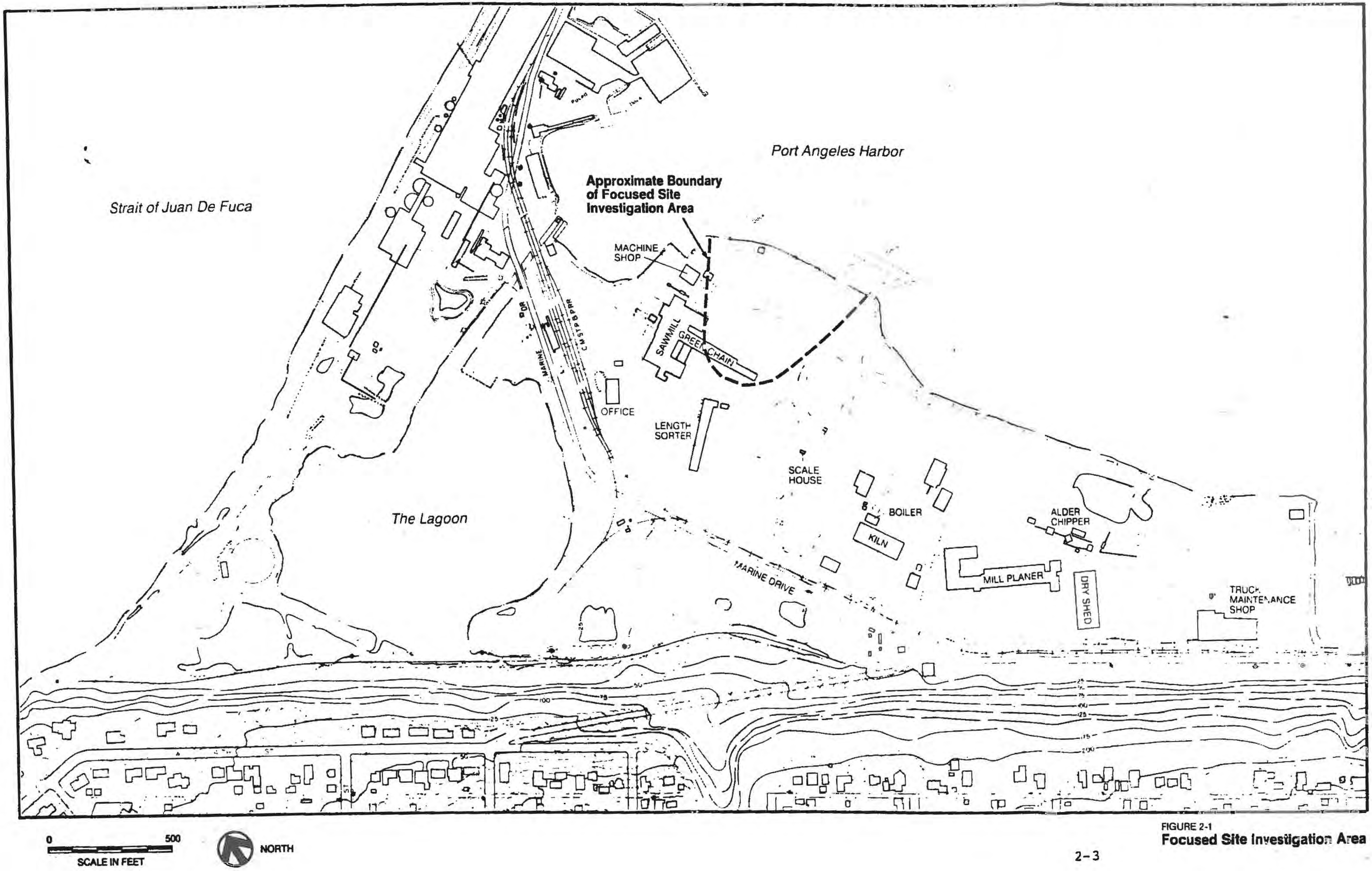


FIGURE 2-1
Focused Site Investigation Area

2.2.3 SURFACE WATER

The former M&R property is bounded by Port Angeles Harbor to the northeast which is a protected embayment of the Strait of Juan de Fuca. The strait of Juan de Fuca is the principal connection between the Pacific Ocean and the interior waters of British Columbia and Washington state including the Strait of Georgia and Puget Sound. Port Angeles Harbor is bordered on the south by the City of Port Angeles and on the north by Ediz Hook, a 3-mile-long spit that extends northeasterly from the Daishowa Mill into the Strait of Juan de Fuca.

Surface water runoff in the Port Angeles area is carried by numerous streams and rivers that flow northward from the Olympic Mountains and adjacent foothills to Port Angeles Harbor and the Strait of Juan de Fuca. Most of these streams and rivers are incised deeply into the uplands, forming steep-sided ravines. Tumwater Creek discharges into Port Angeles Harbor approximately 1 mile southeast of the Daishowa property; it is the closest stream to the site. Valley, Peabody, Whit, and Enurs Creeks discharge into Port Angeles harbor east of Tumwater Creek. The Elwah River discharges into the Strait of Juan de Fuca approximately 4 miles west of the Daishowa property.

A log storage pond (the lagoon), covering an area of 23 acres, is located about 300 feet west of the former M&R property (see Figure 2-1). This area is influenced by tides and, therefore, water levels fluctuate. The lagoon was previously used by industries located in the area to store logs. Currently the City of Port Angeles uses the lagoon to store boat ramps and floats during the winter months (Paul Hopkins and Dan Hansen, Daishowa, pers. comm.; December, 1988).

2.2.4 BIOTA AND ECONOMIC INFORMATION

Port Angeles Harbor has both commercial and natural resource values. Finfish including salmonids and marine fish can be found in Port Angeles Harbor near the Daishowa property. Salmon resources common to this area include chinook (king), coho, chum, and pink salmon. The Port Angeles area hosts one of the most concentrated salmon sport fisheries in Washington waters.

Marine fish common to Port Angeles Harbor include groundfish such as Pacific cod, rockfish, and rock sole. These fish are harvested commercially and are fished for recreation all year. Waters inland of Ediz Hook are classified by the Washington State Department of Fisheries (WDF) as a major resource/fishery area for groundfish (WDF, 1983).

Shellfish resources found in the Port Angeles Harbor include Dungeness crab, hardshell clams (in subtidal areas), and spot shrimp (WDF, 1983).

From a commercial standpoint, the harbor is important to the economic stability of the Port Angeles area. The major source of revenue for the port is raw and finished wood products such as timber and wood chips, which are loaded on vessels and shipped to other Pacific Rim nations. This industry brings to the Port of Port Angeles more than $3 million in revenue per year (William Oliver, Port of Port Angeles, pers. comm.; December, 1988). The harbor is also the home port for a lucrative sport and commercial fishing industry, which provides substantial revenues to the local Port Angeles economy.

2.3 HISTORICAL LAND USE

Existing records or Port sources indicate that the area referred to as the former M&R property is composed of two sections with separate mailing addresses: 1608 Marine Drive and 1313 Marine Drive. By 1972, M&R had leased or bought both sections. Prior to 1972 the two sections were developed separately and were occupied by different commercial entities.

Situated between 1608 Marine Drive and 1313 Marine Drive is another parcel of land (approximately 4 acres), which extends from Marine Drive to the harbor. The address of this parcel is 1417 Marine Drive (William Oliver, Port of Port Angeles, pers. comm.; August, 1988). The locations of all three properties are presented in Figure 2-2. The last parcel is owned by the Port of Port Angeles and is currently leased to Levaque Co., which produces cedar shingles. From 1959 until the present, this parcel has been leased by several shake companies.

A chronology of businesses operating on these parcels since 1912 as indicated in current records is included in Table 2-1. Land use information about this property preceding 1912 could not be found. In order to present the historical land use information of the former M&R site in as clear a manner as possible, the historical land use of each parcel is discussed separately in the following sections.

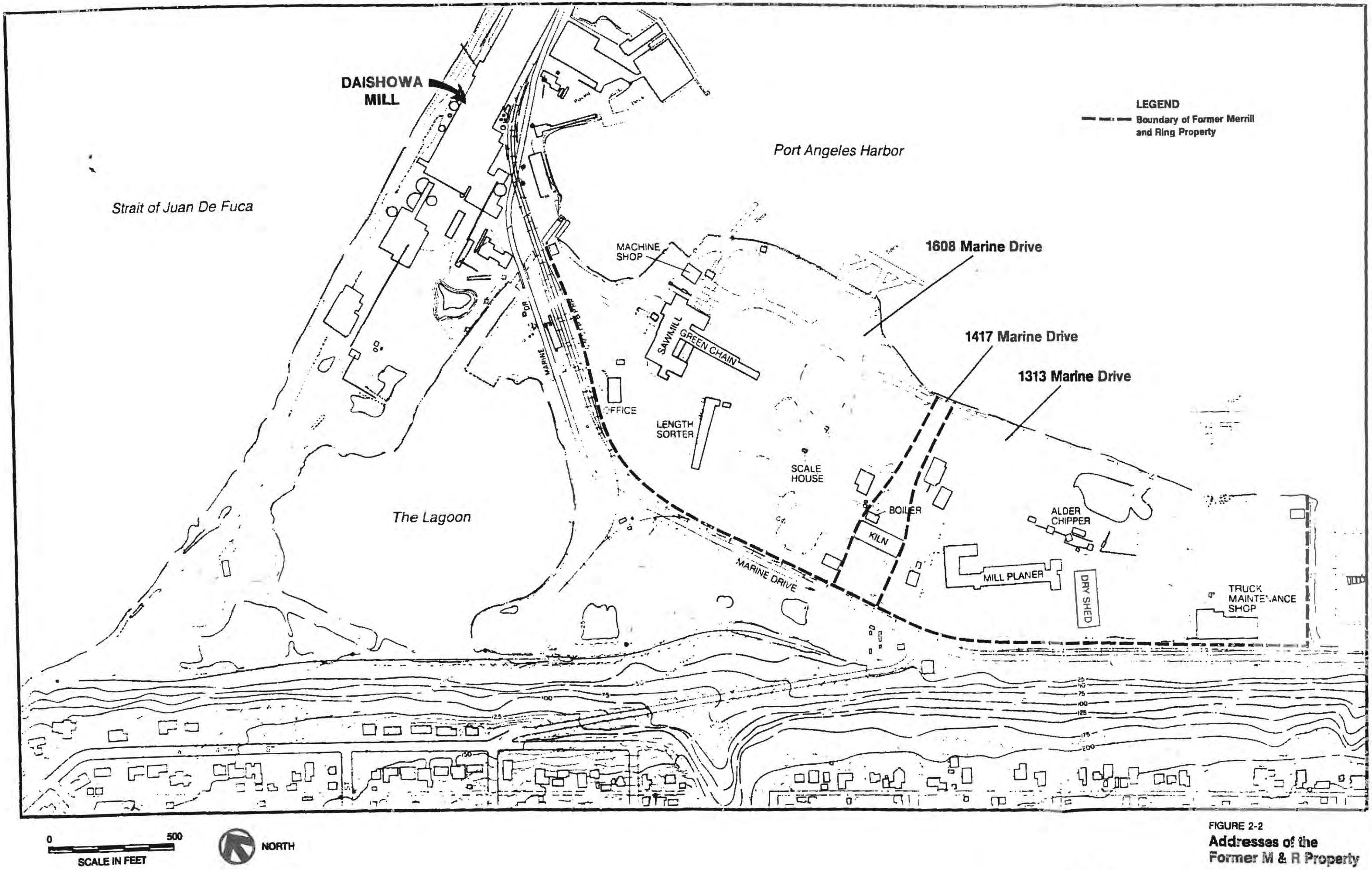


FIGURE 2-2
Addresses of the Former M & R Property

Table 2-1
BUSINESSES LOCATED ON THE FORMER M&R PROPERTY

Address	Name of Business	Approximate Years of Operation
1608 Marine Drive	Puget Sound Mill & Timber Co.	1912 - 1914
	Charles Nelson Mill	1914 - late 1920s
	Washington Cafeteria	1941 - 1948
	Western Lumber Co./ M&R Western Lumber Co.	1955 - 1988
	Hansen's Boat Yard	1959 - 1960
	Nelson Shipyard	1962 - 1967
	P. A. Hardwood	mid-1960s - 1977
	Daishowa America Co., Ltd.	1988 - present
1417 Marine Drive	Peninsula Shingle	1959 - 1964
	Angeles Shake & Shingle	1965 - 1972
	Levaque Co.	1973 - present
1313 Marine Drive	Fibreboard	1919 - 1972
	M&R Lumber Co.	1972 - 1988
	Daishowa America Co., Ltd.	1988 - present

1608 MARINE DRIVE

This parcel of land includes approximately 25 acres and is built on tideland that was filled over several years (William Oliver, Port of Port Angeles, pers. comm.; December, 1988). The first reported commercial development of this parcel occurred in 1912. The Puget Sound Mill & Lumber Company or Earles Mill was built on land that Michael Earles purchased from Charles Nelson, the first reported land owner. The owner operated a sawmill, a shingle mill, and a planing mill on the property in addition to providing log storage and drying kilns. The site also contained a power supply (boiler and engine room) and a shipping dock. In 1914, the mill was renamed the Charles Nelson Mill. It is assumed that the change in name was the result of land ownership reverting to Charles Nelson. The Charles Nelson Mill was in operation until the late 1920s. During the 1930s the site was not used, and it is believed the inactivity was caused by the Depression. By the mid 1940s, mill buildings were in disrepair and the site was condemned by the Port Angeles Fire Department. Shortly after the site was condemned, the P. G. Piedmont Co., a demolition firm, was hired to demolish the mill's dilapidated wood structures using a controlled fire. The fire was reportedly fueled by gasoline, crude oil, tar paper, and old tires (Port Angeles Library file, Chronicle, January 2, 1985, and an unnamed and undated Port Angeles area newspaper article from the mid 1940s).

Between late 1944 and early 1945, the Port of Port Angeles purchased the land from Charles Nelson (William Oliver, Port of Port Angeles, pers. comm.; August, 1988). Land use from the mid-1940s to 1955 is not well documented. It is believed that the land was vacant and at times was used for log storage (William Oliver, Port of Port Angeles, pers. comm.; December, 1988).

In 1955, the Western Lumber Co. opened a re-manufacturing mill on the site that milled rough-cut lumber. From the mid-1960s to the mid-1970s, P. A. Hardwood was also located on this site. P. A. Hardwood was an alder and hardwood sawmill cutting rough lumber from logs. P. A. Hardwood also operated a dry kiln. (Paul Hopkins, Daishowa, pers. comm.; December, 1988). In 1977 M&R acquired the lease for this parcel of land.

By 1962, Western Lumber changed its name to Merrill & Ring Western Lumber Company. This name remains today. M&R produced wood chips used for paper production and re-manufactured lumber. It was stated that one year's chip supply produced by M&R provided enough chips to meet the needs of the Crown Zellerbach paper mill for one month (Port Angeles Library File, anonymous newspaper article, March 7, 1962). By 1984, operations at M&R had been scaled down and only the chip mill was operating (Port Angeles Library File, Port Angeles Daily News, September 18, 1984). In February 1988, the Port of Port Angeles leased the land to Daishowa America Co., Ltd.

During the period from 1941 to 1967, other small businesses supporting mill operations were identified including a cafeteria and log-sort yard on this parcel. No additional information on their operation was obtained (Polk Guides 1940-1988).

1313 MARINE DRIVE

This parcel lies to the southeast of 1608 Marine Drive and is roughly 20 acres in size. This area was also formed by artificial filling to the harbor area (see Figure 2-2). Commercial development of this parcel began in 1919 when Fibreboard Paper Products Corporation (Fibreboard) opened a plant at this site. The plant produced boxboard, sulphite pulp, and wood chips. Feedstocks used to manufacture these products included aqueous ammonia, alum, resin, fuel oil, and sulphur (Testimony of Vern Basom, manager of Fibreboard, to Washington Pollution Control Commission; June; 1958). Fibreboard operated onsite until 1971 when the property was sold to M&R. In 1971 M&R removed many of the structures and built a new planer mill on the site. The old planer mill continued to treat wood until 1971, when a fire severely damaged the mill building. The new planer mill included a spray booth which treated finished lumber with Permatox 180 and later, NP-1. In 1988, M&R sold this parcel of land to Daishowa.

2.4 PREVIOUS ENVIRONMENTAL STUDIES

Hart Crowser performed an environmental property transfer assessment in 1988. Other environment-related information specific to this property is available and includes inspection reports conducted by the Washington Pollution Control Commission (WPCC), and its successor, the Washington Department of Ecology.

By the late 1940s, the WPCC observed that Port Angeles Harbor's water quality was degraded; WPCC attributed the pollution to sulphite waste liquor discharged by pulp mills operating in the Port Angeles area (WPCC, April 17, 1946). WPCC issued a wastewater discharge permit to Fibreboard in 1956 and reissued it in 1961. The only known reference to wastes produced specifically by M&R was located in WPCC files. These files refer to M&R wood waste that was disposed as solid waste or used as hog fuel (WPCC Inspection Report, 1964).

By 1972, sanitary sewage from the M&R office building on the site was connected to the municipal sewage system. Sanitary lines in the new planer mill area were connected later. Before the connection with the city sewer system, all sewage was treated in septic tanks (Ecology Archives, 1972).

In 1974, M&R applied for a National Pollutant Discharge Elimination System (NPDES) permit for four outfalls. The location of each outfall is presented in Figure 2-3. Discharges 001, 003, and 004 were noncontact cooling water and discharge 002 was surface water drainage from the site. Some city storm runoff is also collected and discharged from these outfalls. The NPDES permit (NOWA-0037942) was issued in 1975 and renewed in 1985 without any history of violations (Ecology, NPDES Files).

In a February 8, 1983 Ecology inspection report, it was stated that the spray booth in the new planer mill was a totally enclosed system with overspray and drippings recycled into a containment tank. Sludge from the bottom of the tank was disposed of as solid waste.

Until 1988 and the sale of the M&R property, no other records were found that documented site activities or environmental characteristics. The property transfer environmental assessment of the M&R property conducted by Hart Crowser in May, 1988 was performed to evaluate the potential for contamination from past site activities. Results of the preliminary investigation indicated that groundwater and soils in the vicinity of the old planer mill were contaminated with PCP. Figure 2-4 shows the approximate location of contamination as postulated by Hart Crowser.

As part of the same property transfer assessment, 17 groundwater monitoring wells were installed throughout the site. Eight of these wells are located in the area of suspected PCP contamination (Figure 2-4 and Figure 2-5). The remaining nine wells were located throughout the rest of the parcel. Each well was screened approximately 5 to 15 feet below ground surface. Reference point elevations for water level measurements were not established for each monitoring well; therefore, hydraulic gradient and groundwater flow direction at the site were not estimated.

Groundwater samples were obtained from existing wells at the site of suspected groundwater contamination. These were analyzed for PCP and TCP using a modified Method 8150 technique. [It should be noted that Method 8150 is not the EPA recommended test method in the Code of Federal Regulations (40 CFR Part 261) to analyze for PCP.] Analyses of groundwater in three wells (MW-6A, MW-16A, and MW-22) indicated detectable levels of PCP. The highest PCP concentration (5.7 mg/l) was reported at MW-6A. This value, however, was reported from a groundwater sample containing a significant amount of suspended sediments (Prel. Assessment, page 43, Hart Crowser; June, 1988). The PCP concentration at MW-16A was 0.59 mg/l; at MW-22, PCP was measured at the reported laboratory detection limit of 0.01 mg/l.

Soil samples were obtained from the ground surface and from various depths in the boreholes drilled at the site. PCP soil contamination in subsurface soils was reported at a number of borehole locations (B-15, B-16, B-17, B-18, B-21). The highest concentration (34 mg/kg) was reported at B-16 in soils found approximately 10 to 11.5 feet below the ground surface. Other PCP concentrations in subsurface soils ranged from <0.05 mg/kg to 11.0 mg/kg; TCP concentrations were reported from <0.05 mg/kg to 4.5 mg/kg.

PCP reported in surface soils ranged from <0.05 mg/kg to 0.67 mg/kg. TCP ranged from .09 mg/kg to 0.62 mg/kg. Soils in the vicinity of the former planer mill were analyzed for dioxins. The results indicated that there was no significant evidence of soil contamination from dioxins (Triangle Labs., Proj. No. 12456R submitted to Hart Crowser, 1988).

The property transfer environmental assessment reported inconsistent levels of PCP in soil and groundwater at five

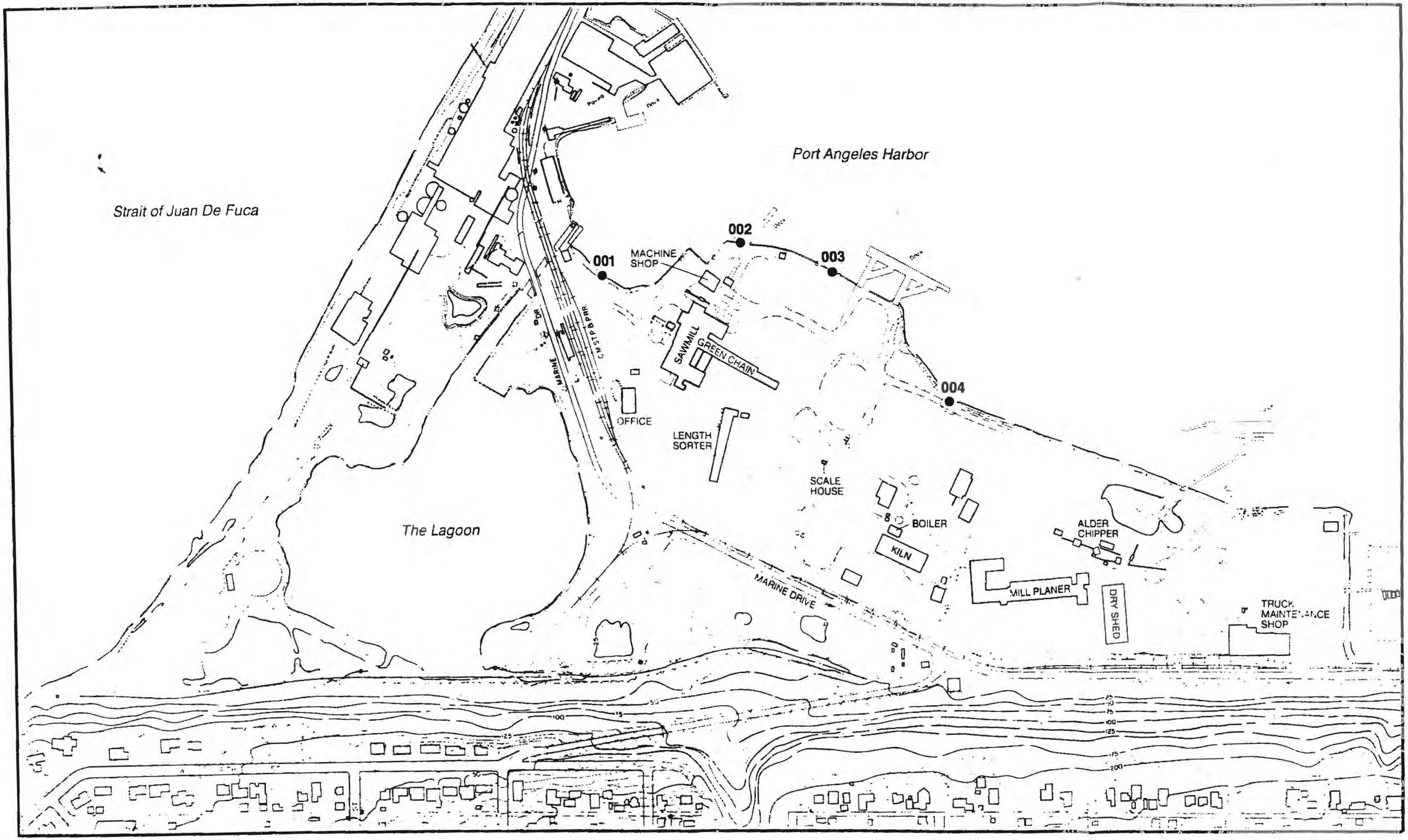


FIGURE 2-3

Location of NPDES Permitted Outfall from Former M & R Property

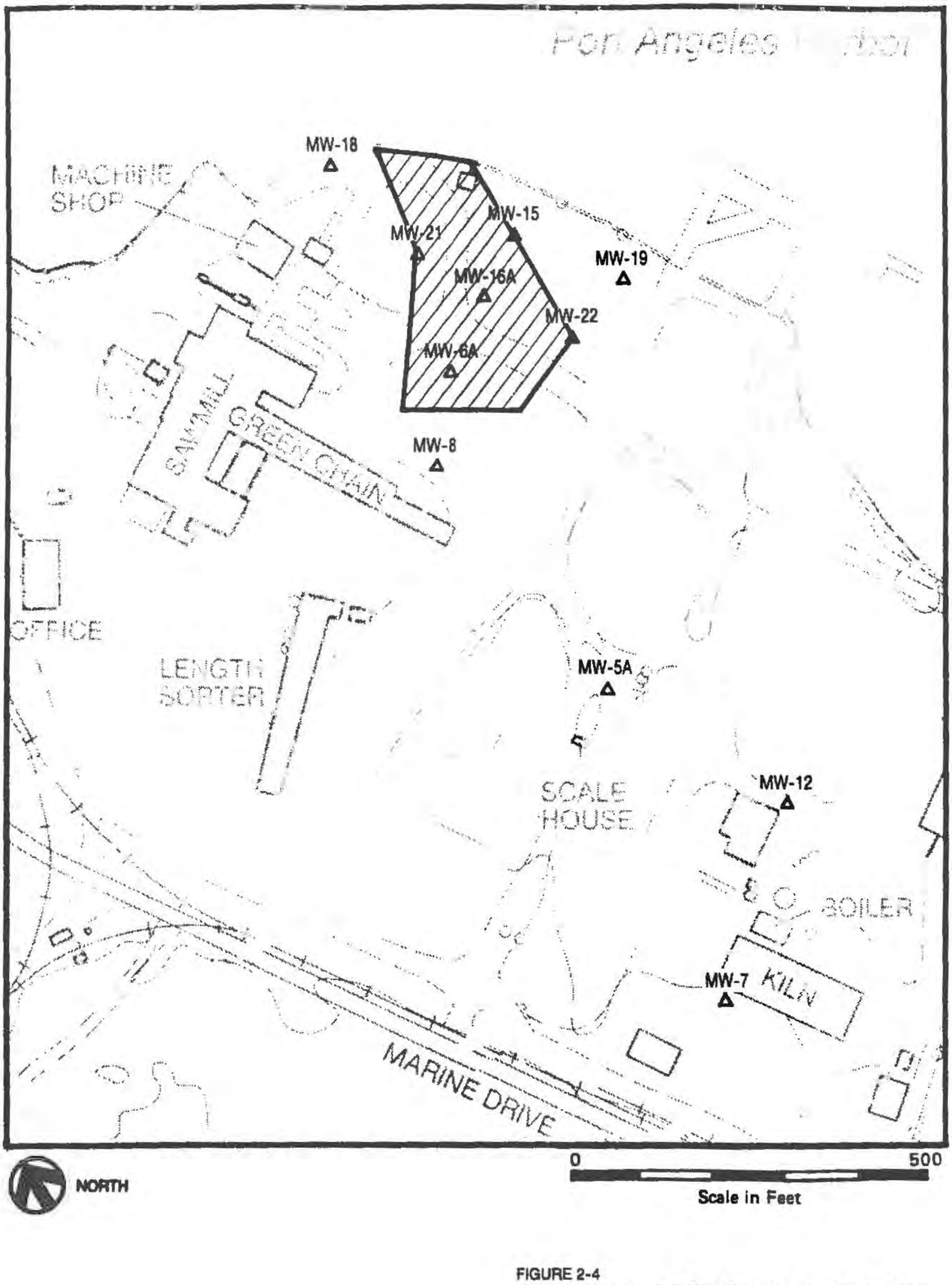


FIGURE 2-4
Approximated PCP Contamination Area as Proposed by Hart Crowser, June 1988

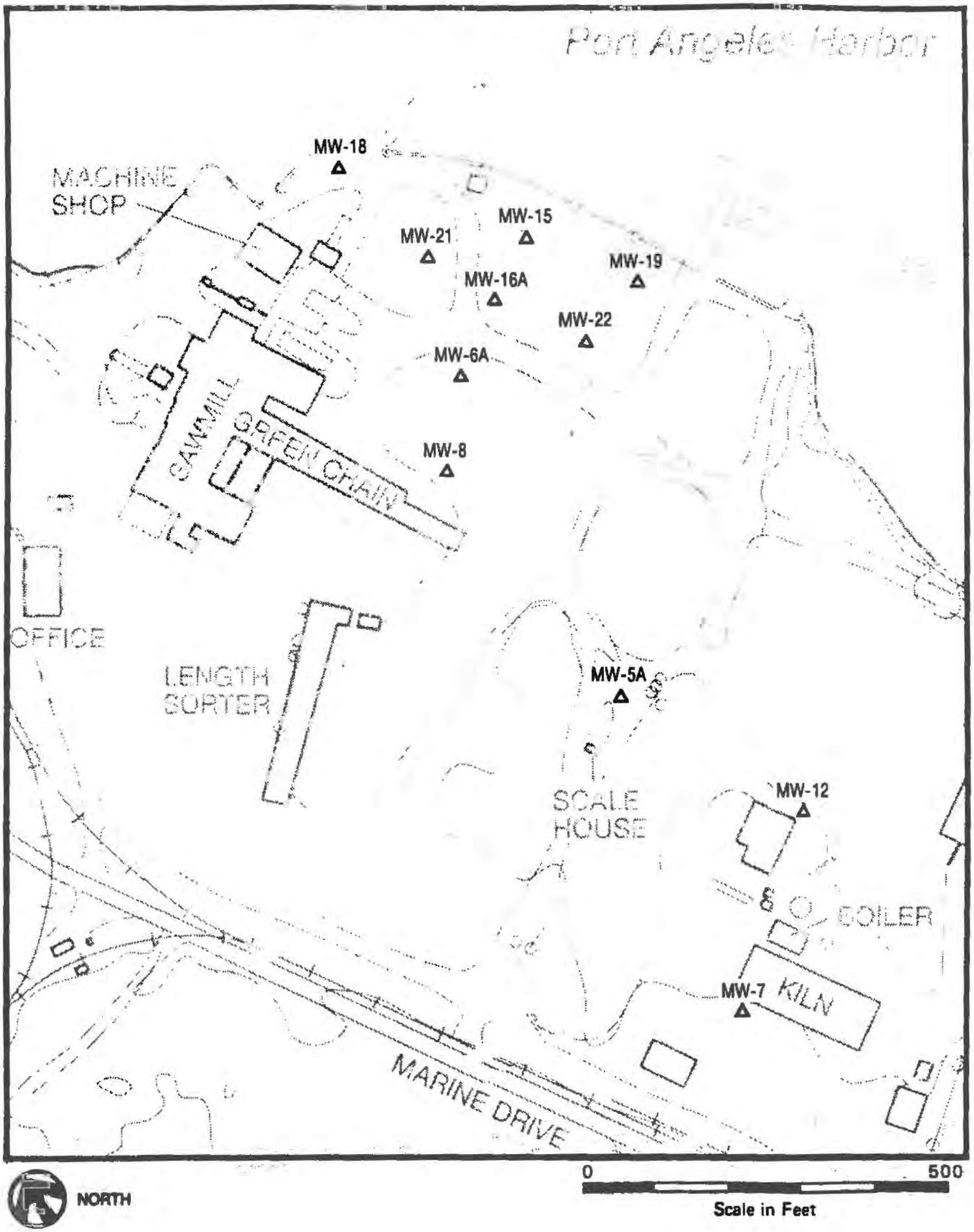


FIGURE 2-5
Hart Crowser Wells in Focused Site Investigation

locations. PCP was detected in soil samples from Boreholes B-15, B-17, B-18, and B-21, while it was not detected in groundwater at the same locations or adjacent to them. At B-22, PCP was detected in groundwater but was not detected in the soil. The assessment did not explain or interpret these inconsistencies.

A limited investigation of the marine environment (four sediments samples and four water samples) was conducted along the shoreline between the piers north of the suspected PCP contamination area. PCP in marine sediment samples ranged from 0.08 mg/kg to 0.3 mg/kg for sample numbers OSS-2 and OSS-1, respectively. The results for OSS-1 were questioned by Hart Crowser because a duplicate analysis reported an inconsistent result. No PCP contamination was detected in marine water samples collected from Port Angeles Harbor.

In summary, the findings of the Hart Crowser site investigation indicated that soil and groundwater near the old planer building was contaminated with PCP. The area of contamination was tentatively identified as approximately 150 to 250 feet wide extending from the old planer mill toward, but not as far as, Port Angeles Harbor (see Figure 2-4).

PCP contamination was also detected in surface soil samples collected west of the new planer mill. However, the contamination near the new planer mill was reported to be "isolated to a small area that is located between the new planer building and the adjacent asphalt road. Based on the available information the contamination appears to be surficial and does not appear to be migratory in the groundwater." (Prel. Env. Assessment, page 45; Hart Crowser; June, 1988.)

3 SITE INVESTIGATION METHODS

Section 3 provides information about the field and analytical procedures employed during the focused site investigation.

3.1 FIELD METHODOLOGY

Investigation field work was conducted at the former M&R site from August 1988 through November 1988. Detailed descriptions of the field methods used during the focused site investigation are presented in the Sampling and Analysis Plan (SAP) (CH2M HILL, August 1988). The SAP is provided as Appendix A.

3.1.1 REDEVELOPMENT AND SAMPLING OF EXISTING WELLS

Redevelopment of the monitoring wells previously installed at the site by Hart Crowser was necessary because the groundwater produced by the wells contained excessive amounts of formation sand and silt. On August 3, 1988, CH2M HILL personnel visited the site and determined that existing wells contained approximately 6 inches of fine grain sediment and organic material at the bottom of the well screens. The wells also produced additional entrained solid material as water was removed with a bailer.

On August 16, 1988, CH2M HILL began to redevelop the existing wells. Redevelopment was conducted by airlifting and surging the wells to remove fine-grained sediment from the filter pack and formation surrounding the well screens.

The air compressor used during airlifting was outfitted with an in-line water and oil filter to prevent contaminants from being introduced into the wells by the airlifting process. Air was delivered from the compressor to the wells via new, flexible polyethylene pipe.

Airlifting was used to redevelop the HC monitoring wells. Initially redevelopment was conducted using a 1-inch-diameter air line inserted into the sump at the bottom of the well. Compressed air was directed to the bottom of the well through the air line, thereby lifting water up the well casing to the ground surface where it was collected. This method was found to be ineffective as the quantity of fine grain material pulled into the well did not decrease with time. The airlift technique was then modified so that compressed air was directed through a 1/2-inch-diameter air line into the bottom of a 1-inch-diameter eductor pipe extending to the bottom of the well. This second method limited water with entrained air to the inside of the eductor

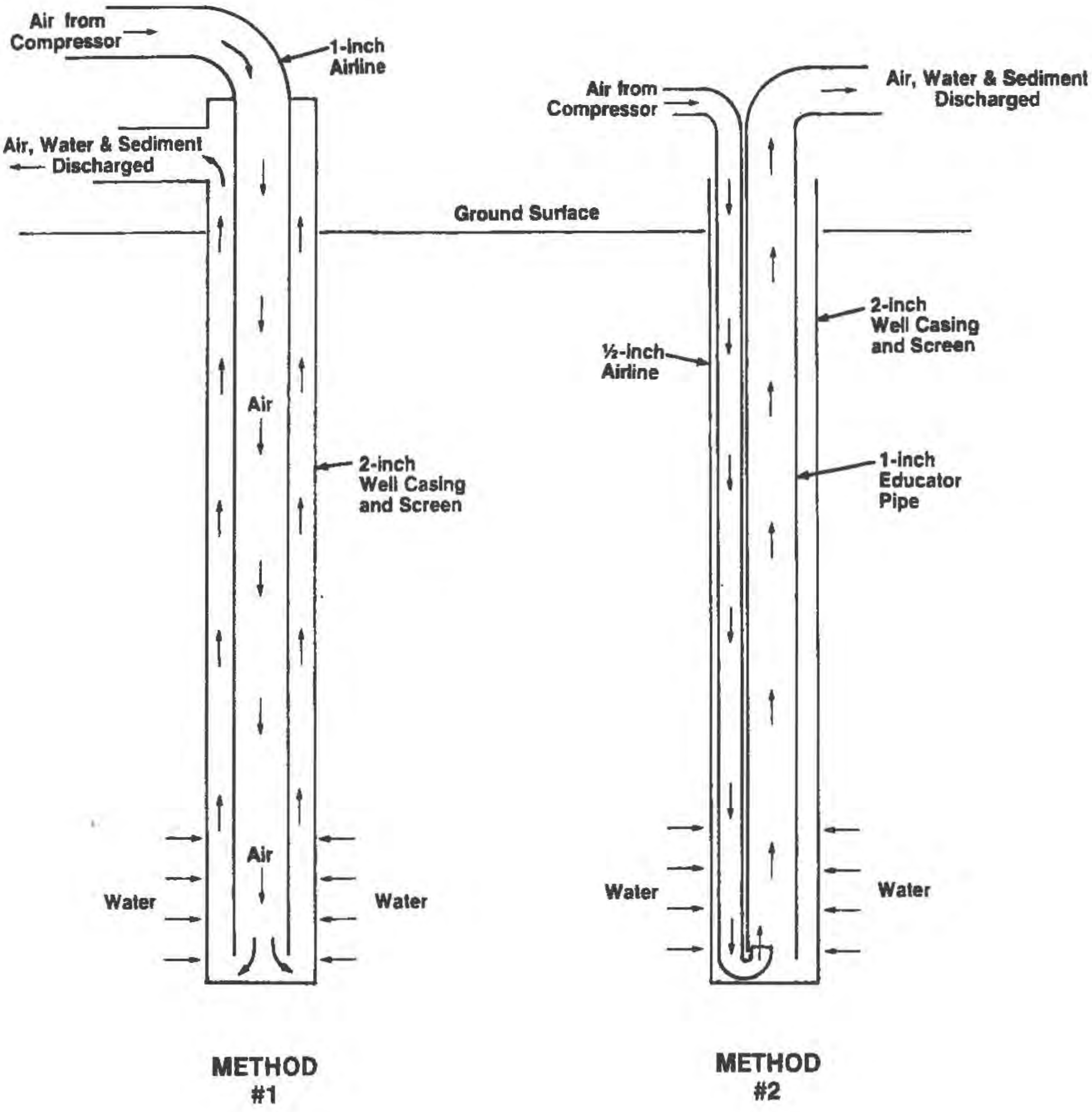


FIGURE 3-1
Airlift Methods Well Development

pumped into a 5,000-gallon holding tank. The sediment and plastic drum liners were composited and placed into several drums for disposal by Daishowa. Sediment and water were tested for PCP and TCP content before disposal.

The redevelopment of existing wells was generally unsuccessful in reducing the quantity of formation sand and silt produced by the wells. Although production of sand decreased during airlift pumping, sand production increased to its original levels when the well was surged. At most locations the production of formation sand and silt did not decrease over time. Typical wells (e.g., MW-6A and MW-8) produced 1/2 to 1 inch of sediment in a 5-gallon bucket as the bucket was filled. The production of sand and silt is attributed to the large slot size (0.020 inch) of the well screens and the coarse sand used as a filter pack.

3.1.2 DRILLING AND MONITORING WELL INSTALLATION

Drilling and well installation were performed by Pacific Testing Laboratories, Inc., under subcontract to CH2M HILL. A total of 10 additional groundwater monitoring wells were installed and two soil borings drilled at the site by CH2M HILL and Pacific Testing Laboratories. From August 29, 1988, through September 22, 1988, nine wells were installed and the two soil borings were drilled. On October 6 and October 7, 1988, a tenth well was drilled and installed. Figure 3-2 presents the location of the 10 monitoring wells and 2 soil borings drilled by CH2M HILL and the 17 monitoring wells installed by HC.

Drilling was conducted using 6-inch inside-diameter (ID) hollow-stem auger advanced by a truck-mounted drill rig. Soil samples were obtained during drilling with split-spoon and Shelby tube samplers. The monitoring wells were drilled and screened at two general depth intervals. Five deep wells were drilled to a total depth of 53 feet with well screens positioned from approximately 40 to 50 feet below ground surface. Five shallow wells were drilled to an approximate total depth of 18 feet with well screens positioned spanning 5 to 15 feet below ground surface. The geologic and well construction logs for the 10 monitoring wells installed by CH2M HILL are included in Appendix C. Table 3-2 summarizes well construction details for these 10 wells and nine wells installed by HC in the focused site investigation area.

To prevent cross contamination of soil and water samples obtained during this investigation, the drill rig and downhole equipment were thoroughly steam-cleaned prior to drilling at each soil boring or monitoring well location. Potentially contaminated soils generated during drilling were placed into lined DOT-approved, Type 17C, 55-gallon

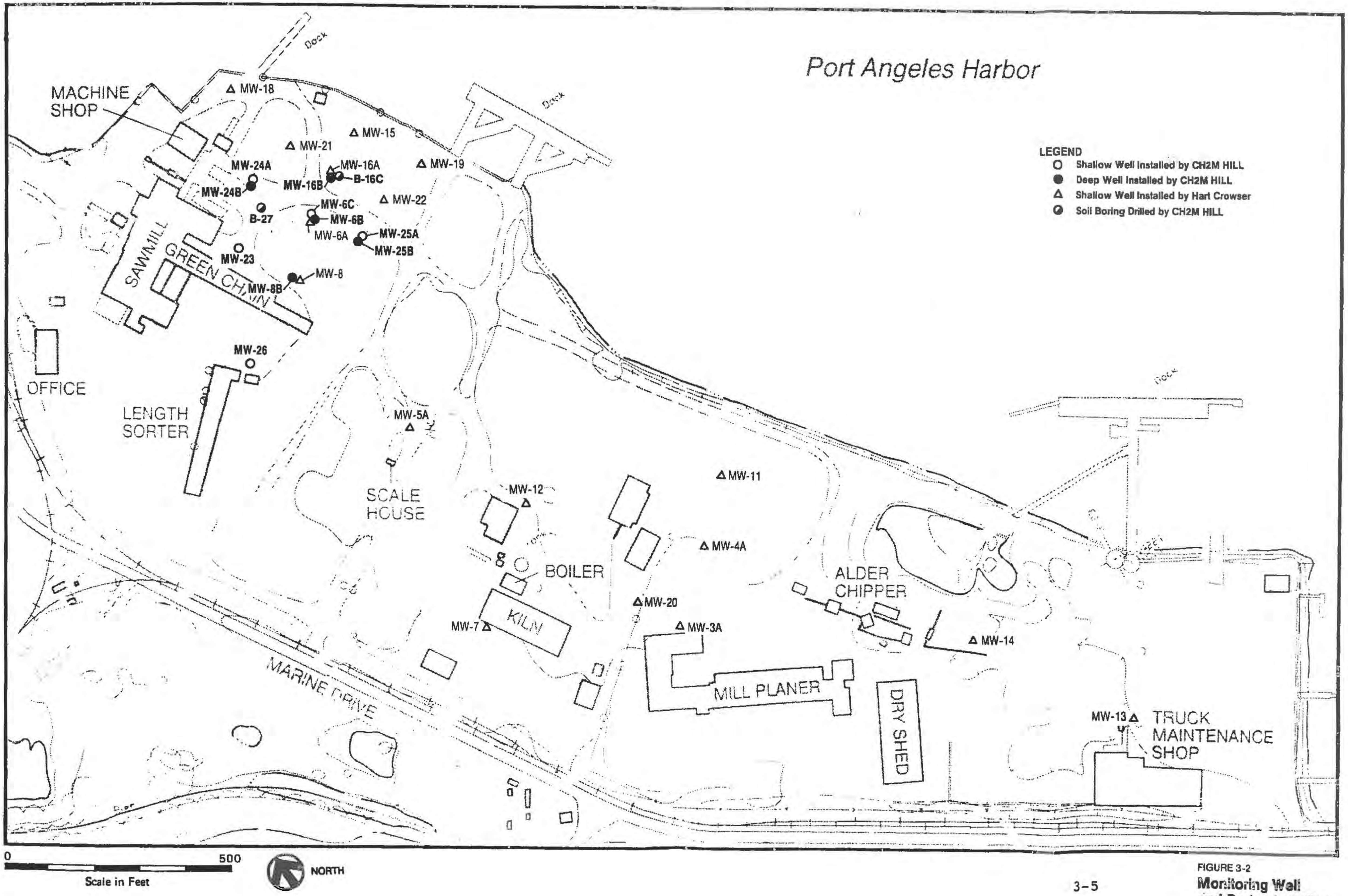


FIGURE 3-2
Monitoring Well and Boring Location

Table 3-2
WELL CONSTRUCTION SUMMARY

Well Designation	Firm	Date Drilled	Total Depth	Filter Pack Interval (ft bgs)[a]	Screen Interval (ft bgs)[a]	Elevation at Top of PVC Casing (feet)[b]	Comments
MW-5A	Hart Crowser	5/11/88	14.0	3.5-14.0	4.0-14.0	9.14	
MW-6A	Hart Crowser	5/13/88	14.0	3.0-14.0	4.0-14.0	8.63	
MW-8	Hart Crowser	5/16/88	14.0	3.0-14.0	4.0-14.0	9.76	
MW-15	Hart Crowser	6/9/88	16.5	4.0-16.5	5.0-15.0	7.85	
MW-16A	Hart Crowser	6/12/88	16.5	4.0-16.5	6.0-16.0	8.11	
MW-18	Hart Crowser	6/10/88	20.0	6.0-20.0	9.0-19.0	9.53	
MW-19	Hart Crowser	6/11/88	17.5	5.0-17.5	7.0-17.0	9.73	
MW-21	Hart Crowser	6/11/88	16.5	4.0-16.5	6.0-16.0	9.18	
MW-22	Hart Crowser	6/12/88	15.0	2.5-15.0	3.0-13.0	10.43	
MW-6B	CH2M HILL	8/30/88	55.5	36.8-53.0	40.0-50.0	8.77	
MW-6C	CH2M HILL	10/6/88	17.5	3.0-17.5	4.5-14.5	8.78	
MW-8B	CH2M HILL	9/12/88	53.0	37.0-52.5	39.5-49.5	9.17	
MW-16B	CH2M HILL	9/8/88	53.0	37.0-53.0	40.0-50.0	8.51	
MW-23	CH2M HILL	8/29/88	17.5	3.0-17.0	4.0-14.0	8.24	
MW-24A	CH2M HILL	9/1/88	20.0	3.5-18.0	5.0-15.0	9.33	
MW-24B	CH2M HILL	9/6/88	53.0	37.0-53.0	40.0-50.0	9.67	Cloth measuring tape, weight, and duct tape in filter pack.
MW-25A	CH2M HILL	9/15/88	17.0	3.0-17.0	4.0-14.0	9.01	
MW-25B	CH2M HILL	9/14/88	53.0	37.0-53.0	40.0-50.0	8.55	Cloth measuring tape, weight, and duct tape in filter pack.
MW-26	CH2M HILL	9/19/88	17.5	3.0-17.5	4.5-14.5	8.06	

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[a] ft bgs = feet below ground surface.

[b] Elevations referenced to Wilsey and Ham datum.

steel drums. The drums were labeled and sealed until they were tested for PCP and TCP. No soils or water contained in drums were qualified as dangerous wastes based on the analysis.

Geologic conditions at the site presented some difficulties to drilling and well installation. "Heaving" sand migrated into the bottom of the hollow-stem auger during drilling in the uppermost 20 feet at the site. Maximum heaving was 2 feet during drilling of MW-6C. To offset heaving conditions, water was added to the inside of the hollow-stem augers. The hydrostatic pressure of the additional water inside the auger was successful in preventing major problems in drilling or completing the wells.

Monitoring well materials were installed through the inside of the 6-inch ID hollow-stem auger after drilling the borehole to the termination depth. Each well consists of a PVC sump, screen, and casing. A stainless steel centralizer was placed below the well screen to center the screen and casing assembly in the borehole. Well materials were steam-cleaned before installation.

Well casing for all monitoring wells installed by CH2M HILL consists of Schedule 40 PVC pipe with flush joint threads. Well screen for all CH2M HILL wells is 10 feet long and consists of Schedule 40 PVC with 0.010-inch factory-milled slots. A 3-foot-long Schedule 40 PVC sump was installed below each screen.

Filter pack material was installed adjacent to each well screen as the augers were withdrawn from the borehole. The filter pack extends to approximately 3 feet above the top of the screen. Filter pack material consists of Monterey No. 16 sand for wells MW-23, MW-24A, MW-24B, MW-16B, MW-6B, and MW-26. The filter pack material for wells MW-25A, MW-25B, MW-8B, and MW-6C is Colorado Silica Sand, Grade 20-40. These two sand types are very similar in grain size gradation. The filter pack material was poured slowly into the well and allowed to settle around the screen. The depth to the top of the filter pack was measured regularly, during installation, with a weighted tape.

An annular seal was installed above the filter pack in each borehole. For shallow wells, the seal is approximately 2 feet thick and consists of 50 pounds of 1/2-inch-diameter bentonite pellets. For deep wells, the bentonite seal is approximately 5 feet thick and consists of 50 pounds of granular bentonite mixed with 17 gallons of water. The remainder of the borehole annulus in each deep well is filled with a cement slurry containing 3 to 5 percent powdered bentonite by dry weight.

The uppermost 2 feet of each borehole annulus was filled with concrete. An 8-inch-diameter steel protective casing was installed to a depth of 2 feet within the concrete seal. The steel protective casing extends approximately 2 feet above the ground surface and is equipped with a steel lid secured with a combination padlock. The top of the 2-inch-diameter casing is covered with a vented PVC slip cap. A 3-foot-square concrete pad was constructed around each well. The steel casings were marked with the well identification number using welding bead. Three-inch-diameter steel guard posts were installed around each well to a depth of approximately 2 feet. The guard posts were secured in place with concrete. The guard posts and protective casing were spray-painted fluorescent orange for optimum visibility. At least three steel guard posts were installed at each well. Four steel guard posts were installed at most wells.

Well development was conducted following completion of each well, allowing a minimum of 24 hours for the bentonite and cement seals to stabilize. Well development was accomplished by airlifting and surging in a similar manner to that used for redevelopment of the Hart Crowser wells as described in Section 3.1.1. Airlift Method No. 1 was used to initially remove sediment from the wells. Method No. 2 was used during the final stages of well development (see Figure 3-1). At least 55 gallons of water was removed from each monitoring well installed by CH2M HILL.

3.1.3 GROUNDWATER SAMPLING

Two rounds of groundwater samples were obtained from nine existing HC wells and from the 10 new wells constructed in the focused site investigation area. The first samples were obtained from the HC wells between August 25 and 26, 1988, prior to drilling new wells at the site. The first samples from newly constructed wells were obtained periodically during the project as the wells were completed and developed. The second round of groundwater samples was obtained from all 19 monitoring wells between October 3 and 5, 1988, excluding MW-6C, which was not drilled and constructed until October 6, 1988. Groundwater samples were obtained from MW-6C on October 13 and November 1, 1988. A third groundwater sample was obtained from MW-6C on November 21, 1988, to verify the presence of PCP found in the two previous samples.

Before sampling each well, the head space in the well was checked for volatile organic compounds with an HNu photoionization detector. This check was conducted immediately after opening the security casing and removing the PVC well cap. The depth to groundwater was then measured with an electric water level probe (Slope Indicator Model No. 51453) and recorded in the project logbook.

Presample purging of the wells was conducted with a peristaltic pump (Geotech Model No. Geopump 2) at a flow rate of approximately 0.2 gallons per minute. Purge water was withdrawn from each monitoring well using new Teflon® tubing below the static water level and Tygon tubing above the water level. The Teflon® tubing was dedicated to each well for use during subsequent sampling rounds. The Tygon tubing was not dedicated to each well, but was decontaminated between each use with a TSP-and-water wash followed by a distilled-water rinse.

A minimum of three wetted casing volumes was removed from each well before sampling. For shallow wells, 10 gallons were removed before sampling. For deep wells, 25 gallons were removed before sampling. All purge water was contained at the well head in DOT-approved, Type 17C, 55-gallon drums and then transferred to the 5,000-gallon-capacity tank.

Temperature, specific conductance, and pH of the purge water were measured periodically during purging to verify stabilization of these parameters prior to sample collection. Samples were collected directly from the peristaltic pump discharge in a disposable plastic container. All field parameters were measured immediately and the results recorded in the project logbook.

The field probes were rinsed with distilled water before each use. The pH meter was field-calibrated daily using standard calibration solutions in accordance with the manufacturer's specifications.

Stainless steel bailers with Teflon® check valves were used to collect groundwater samples after purging was completed. Dedicated lengths of monofilament fishing line were used to raise and lower the bailer and were discarded after use at each well. The bailers were decontaminated prior to use at other wells.

Water samples were transferred from the bailer directly into the sample bottle or vial. A final field sample was obtained after collection of all laboratory samples. The field parameters pH, conductivity, and temperature were then measured and recorded.

Equipment blanks were collected during the site investigation to confirm that the groundwater samples were not contaminated by sampling equipment or procedures. To obtain equipment blanks, a bailer was first decontaminated. Distilled water was then poured through the bailer and collected in sample containers.

3.1.4 SOIL SAMPLING

Soil samples were obtained from each boring for geological characterization. The samples were obtained at 2.5-foot intervals over the entire depth of the boring using a precleaned, 2-inch-ID, split-spoon sampler, or Shelby tube.

At most borings, two samples were obtained for grain size analyses (ASTM 422-63). These samples were transferred from the split-spoon sample into prelabeled Ziplock® plastic bags. At MW-6C and MW-6B, only one sample was collected for grain size analyses.

Shelby tube samples were obtained from the screen intervals of seven monitoring wells for laboratory permeability testing. Shelby tube samples were capped in the field and were kept in a vertical position until molten paraffin wax was used to seal the top of the sample tubes. Shelby tube samples were obtained at MW-6B, MW-24B, MW-24A, MW-16B, MW-8B, MW-25B, and MW-25A.

Selected soil samples were collected during drilling with split-spoon samplers for chemical analyses including PCP, TCP, semivolatile organic chemicals, and 40 CFR 264 Appendix IX parameters. Soil samples were collected for chemical analysis above the water table at 2.5-foot intervals in all boreholes. In shallow wells (generally 18 feet deep), samples were also obtained from immediately below the water table and at the bottom of the boring. For deep wells (generally 53 feet deep), samples were also obtained from immediately below the water table, at the bottom of the boring, and from an interval midway between the water table and the bottom of the boring.

After visually logging the soil material, it was transferred into a precleaned stainless steel mixing bowl. The soil was then thoroughly homogenized using a precleaned stainless steel spoon and placed directly into laboratory-prepared glass sample containers. Laboratory-prepared sample containers were provided by I-Chem Research, Inc.

Equipment blanks were collected during the site investigation to confirm that soil samples were not contaminated by sampling equipment or procedures. To obtain an equipment blank, a split-spoon sampler was first decontaminated. Distilled water was then poured through the sampler and discharged into a precleaned stainless steel mixing bowl. The collected water was then poured into sample containers.

3.1.5 GROUNDWATER LEVEL MEASUREMENTS AND SLUG TESTS

Four rounds of groundwater level measurements were obtained during the field investigation. Because groundwater levels fluctuate up to several feet in some wells in response to tidal influence, each round was completed within approximately 1-1/2 hours so that the measurements would be as contemporaneous as possible. Each round of groundwater level measurements included 25 monitoring wells on the former Merrill and Ring property, including those outside of the focused site investigation area.

Groundwater levels were measured in 15 Hart Crowser wells on August 3, 1988 to determine groundwater flow directions as part of the planning activities for the focused site investigation. An additional round of measurements was obtained on August 30, 1988. Two rounds of groundwater level measurements were obtained on September 24, 1988, after nine additional wells had been installed by CH2M HILL in the focused site investigation area. One of the two rounds occurred at high tide; the other occurred at low tide. Groundwater levels corresponding to high and low tide were measured to evaluate the change in groundwater flow directions near the shoreline at tidal extremes.

All groundwater-level measurements were obtained with an electronic well probe (Slope Indicator Model No. 51453). The probe was rinsed with distilled water after each use to prevent the possibility of cross-contamination of monitoring wells. The probe was thoroughly decontaminated periodically during the field investigation with a TSP wash and distilled-water rinse.

Depth to groundwater was measured from a marked reference point at the top of each PVC well casing. Vertical survey control was provided for the reference points by Northwest Territory Surveyors, under subcontract to Rust Engineering.

Continuous groundwater level measurements were obtained at the site from September 14, 1988 through September 28, 1988. Continuous water level measurements were obtained in five locations simultaneously, using 5- and 10-psi pressure transducers and a data logger (Terrasciences Model No. 8D). Two separate arrays of monitoring wells were established to monitor the hydraulic response of deep and shallow wells to tidal action.

The first array was established to evaluate the influence of tidal action on groundwater levels in shallow wells at the site. Transducers were placed in MW-15, MW-16A, MW-18, MW-21, and a stilling well located in Port Angeles Harbor. This array was monitored at 10-minute intervals for 5 days.

The second array was established to evaluate the influence of tidal action on groundwater levels in selected shallow and deep wells, including the relationship between a deep and shallow well pair. Transducers were placed in MW-16B, MW-21, MS-24A, MW-24B, and the stilling well in the harbor. This array was monitored at 15-minute intervals for 4 days.

The pressure transducers were steam cleaned prior to installation in wells at the site. After installing the transducers in the wells, the data logger was calibrated to record groundwater levels in feet relative to a common datum (Wilsey and Ham datum).

The data logger and transducers were also used to record data from noninvasive aquifer slug tests conducted at the site September 27 and 28, 1988. Slug tests were conducted in new wells MW-6B, MW-8B, MW-16B, MW-23, MW-24A, MW-24B, MW-25A, MW-25B, MW-26, and HC wells MW-6A, MW-8A, MW-15, and MW-16A.

Slug tests were conducted by inserting a rod or "slug" of known volume into the well being tested, thereby displacing and raising the water level in the well. After the water level equilibrated, the rod was removed, lowering the water level. A pressure transducer placed in the well below the inserted rod measured the rise and subsequent equilibration of the static water level in the well versus time. Time versus water level data were recorded by the data logger.

The rod used in the slug test procedure consisted of a weighted and sealed 1-inch-diameter polyethylene pipe. The pipe was cleaned prior to use at each well with a TSP-and-water wash followed by a distilled-water rinse.

3.1.6 MARINE SEDIMENT INVESTIGATION

CH2M HILL collected and analyzed a total of four marine sediment samples, one background sample, and one field duplicate in accordance with the Sampling and Analysis Plan (Appendix A). Table 3-3 identifies each sample by number, location, and physical description. Figure 3-3 identifies the sample location. Samples were analyzed for PCP and TCP using a modified EPA Method 8040, grain size (Method ASTM 422-63), total organic carbon (TOC) (Method No. EPA3-73), and percent moisture (Method No. ASTM D 2216). One sediment sample, DS-MS05, was also analyzed using EPA Method 8270 for semi-volatile organic chemicals as a performance check on the Method 8040 analysis.

Samples were collected between the hours of 0800 and 0940 on September 22, 1988. During this time the tide was flooding from -0.6 foot below mean lower low water to 7.1 feet above mean lower low water. At the time samples were collected, the water level was approximately 2.8 feet above mean lower low water.

Table 3-3
MARINE SEDIMENT SAMPLES COLLECTED AT M&R ON SEPTEMBER 22, 1988

Station	Odor	Bottom Description	Color	Composition	Field Sample No.	Sample Description	Analyses	Time Sample Collected	Depth of Water (feet)	Depth of Sample (inches)
DS-MS-01	Hydrogen sulfide	Approximately 2.5 feet of bark/chips on bottom	Grey brown with some black	Soft silty sand	DSA-MS1	Wood chips and bark in sample. Three grabs required to obtain adequate sample.	8040, Grain size, TOC, percent moisture	0915	16	6
DS-MS-02	Hydrogen sulfide	No logs, piles of wood chips and bark	Grey black	Soft silty sand	DSA-MS2	Wood chips and bark in sample. Two grabs required to obtain adequate sample.	8040, Grain size, TOC, percent moisture	0855	16	6
DS-MS-03	Strong hydrogen sulfide	Over 1 foot of wood chips	Brown	Soft silty sand	DSA-MS3	Wood chips in sample. Oil sheen observed. Two grabs required to obtain adequate sample.	8040, Grain size, TOC, percent moisture	0836	16.5	6
DS-MS-04	Strong hydrogen sulfide	Bark and timber	Black with some brown streaks	Soft silty sand	DSA-MS4	Bark intermingled with sediment. Oil sheen observed. Two grabs required to obtain adequate sample.	8040, Grain size, TOC, percent moisture	0815	20	6

Table 3-3
(continued)

Station	Odor	Bottom Description	Color	Composition	Field Sample No.	Sample Description	Analyses	Time Sample Collected	Depth of Water (feet)	Depth of Sample (inches)
DS-MS-05	None detected	Numerous timbers, few wood chips	Black grey	Well consolidated sandy silt	DSA-MS5	Few wood chips in sample. Three grabs required to obtain adequate sample. Performance audit and field duplicate collected at this site.	8040, Grain size, TOC, percent moisture	0940	18	6
DS-MS-05	None detected	Numerous timbers, few wood chips	Black grey	Well consolidated sandy silt	DSA-MS53	Few wood chips in sample. Three grabs required to obtain adequate sample. Performance audit and field duplicate collected at this site.	8270, Grain size, TOC, percent moisture	0940	18	6

Sediment sampling was performed by Global Diving and Salvage, Inc., under subcontract to CH2M HILL. A diver using a clam gun and working from a 24-foot Boston Whaler was used. See Appendix B for photographic documentation of sampling methods. The diver was tethered to the boat by the oxygen line and cable and was able to verbally communicate with field personnel on the Boston Whaler.

Sediment sample stations were positioned by aligning a transect connecting the piers and a third point onshore. The diver confirmed the location prior to submerging and sample collection. Once the diver reached the bottom, he described the bottom conditions and cleared away debris and wood chips that covered the sediments. The diver inserted the clam gun into the sediments until maximum penetration, approximately 6 inches to 1 foot, was obtained. The clam gun was then carefully removed and the bottom sealed to prevent the sample from leaking out of the sampler.

The diver surfaced and handed the sampler over to CH2M HILL personnel on the boat to process. This involved carefully draining the water overlaying the sample and then extruding the sample into a stainless steel bowl. This process was repeated until adequate sample material was obtained. The physical appearance of the sample was observed and recorded along with time, location, depth of water, depth of sample penetration, and description of bottom conditions. The sample was then homogenized using a precleaned stainless steel spoon and bowl. The sample material was transferred into laboratory-prepared (I-Chem Research, Inc.) containers.

Wood chips and wood debris were observed at all stations, although few wood chips were observed at the southernmost station, DS-MS-05. The amount of wood chips overlaying the bottom sediments increased from the southern dock to the northern dock. At Station DS-MS-01, approximately 2.5 feet of wood chips and bark were observed overlaying the surface of the sediments (see Table 3-3).

Six-inch cores were collected at each station. A hydrogen sulfide odor was emitted from all samples. At Stations DS-MS-03 and DS-MS-04 the hydrogen sulfide odor was strong. An oil sheen was observed in samples collected from Stations DS-MS-03 and DS-MS-04.

3.1.7 VERIFICATION SOIL SAMPLING

During the course of this study, in order to verify HC findings throughout the former M&R site, CH2M HILL collected a total of seven samples (two marine sediments and five soils). Discussion of the verification study is provided in a technical memorandum provided as an addendum to this

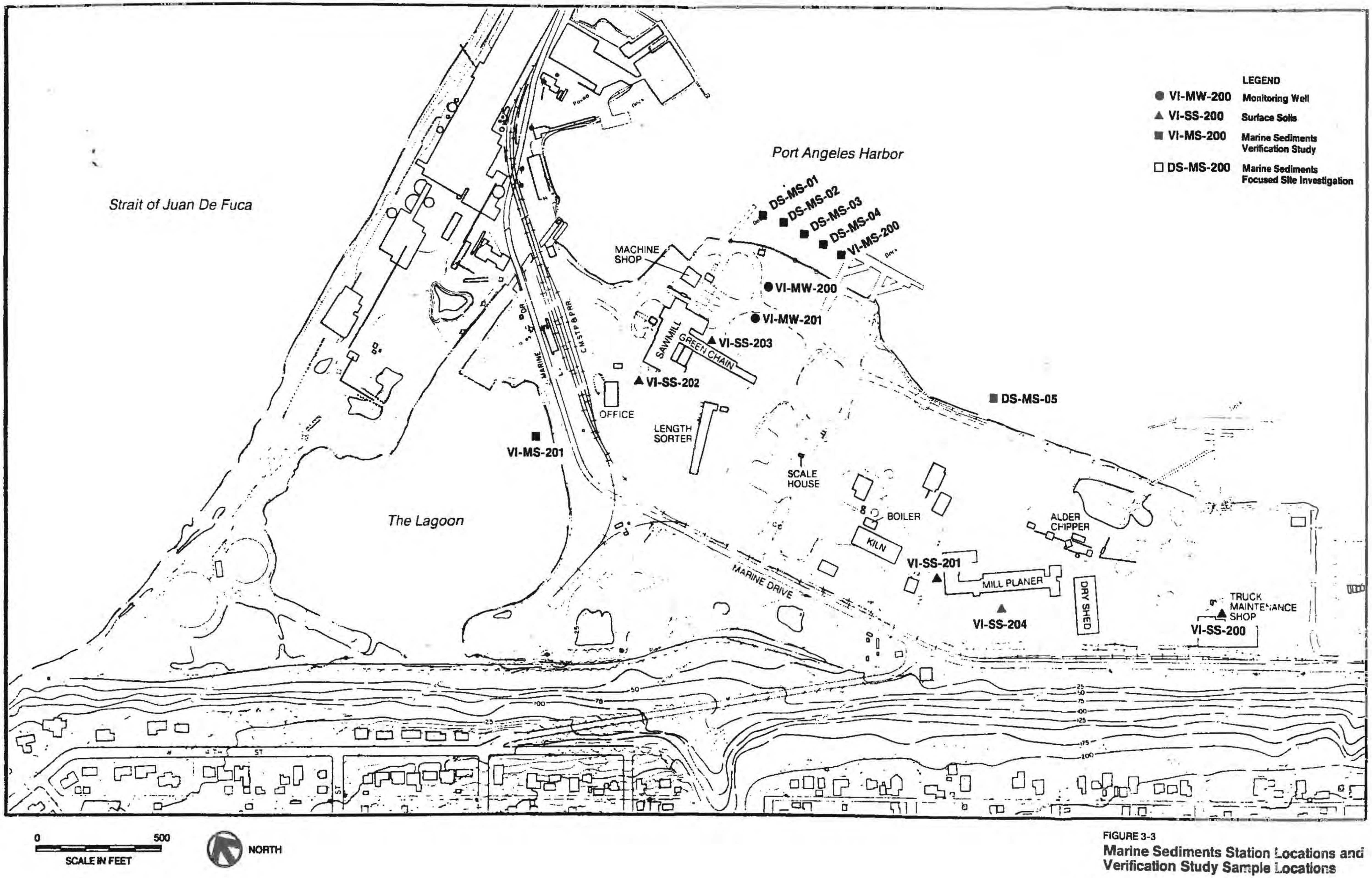


FIGURE 3-3
Marine Sediments Station Locations and Verification Study Sample Locations

report. All verification analytical results, however, are included both in the memorandum and in this report.

3.1.8 HANDLING AND DISPOSAL OF DRILL CUTTINGS AND WATER

Drill cuttings were containerized, as they were generated, in DOT-approved, plastic-lined, Type 17C, 55-gallon steel drums. Drums were sealed after being filled. The drums were labeled in the field with the date, boring number, and drum contents (soil or water). The drums were then transported with a forklift and flatbed truck from the boring location to a temporary onsite storage location.

Temporary onsite drum storage was located on an asphalt pad at the west end of the site. This location was specifically prepared for drum storage by building an 8-inch-high berm around the area with logs and covering the area and the berm with 40-millimeter-thick polyethylene sheeting. The outsides of the drums were steam-cleaned in the decontamination area to remove any contaminated cuttings that had spilled or splashed onto them. The drums were then placed on wooden pallets before moving them into the temporary storage location. Polyethylene sheeting was also placed over the top of the drums and secured. As additional drums were added to the area, the polyethylene liner and berm were extended to accommodate them. Appendix B includes photographs identifying the onsite temporary drum storage area.

The results of analytical tests on soil samples obtained from the borings were used to determine whether the drummed soils were contaminated. All drummed soils showing undetectable levels of TCP and PCP, or TCP and PCP present at concentrations less than the EPA PCP criterion for soil (EPA, Revised Draft RFI Guidance, Section 8, December 1984), were returned to the focused site investigation area and spread on the ground surface. Drummed soils obtained from borings with detectable levels of TCP and PCP (MS-24A and MW-24B) were also returned to the study area because analytical results did not exceed PCP soil criteria as established by EPA (EPA, Revised Draft RFI Guidance, Section 8, December 1984). Finally, all disposable plastic sheeting and clothing used during the project were drummed and sealed and turned over to Daishowa for disposal.

Well development water, including that generated during redevelopment of the Hart Crowser wells, and presample purge water generated during groundwater sampling activities was containerized at the wellhead in DOT-approved, Type 17-C, 55-gallon drums. Before September 7, 1988, the drummed water was moved and stored with the drummed soil cuttings as described earlier. On September 7, 1988, a 5,000-gallon holding tank was delivered to the site by Northwest Enviroservices. All drummed waters were then pumped into the tank. After September 7, all water generated by well development and purging was drummed at the wellhead, then transported and pumped into the holding tank. Approximately 4,000 gallons of water were containerized in the holding tank by the completion of this study.

On October 8, 1988, water in the holding tank was mixed and a sample was collected and analyzed for PCP and TCP using testing Method 8040. Neither compound was detected. The holding tank was subsequently moved to Daishowa's wastewater treatment plant. With the approval of Ecology, the water in the holding tank was then disposed of by slowly bleeding it into the wastewater treatment plant. Daishowa's treatment plant utilizes activated sludge for secondary treatment.

3.2 ANALYTICAL PROGRAM

The following sections describe the analytical methods selected for the focused site investigation at the former M&R property. A discussion explaining the rationale for specific analytical methods and a summary of all soil and water sample analyses is also provided. Physical soil characteristics (grain size and laboratory permeability tests) were discussed in Section 3.1.4.

3.2.1 CHEMICAL ANALYSIS TEST METHODS

Analytical procedures selected to test the presence or absence of PCP, TCP, or other chemicals were based on the appropriate test methods described in the Code of Federal Regulations (40 CFR, Part 261, Subpart D, Appendix III--Chemical Analysis Test Methods). Table 1 of Appendix III, the Analysis Methods for Organic Chemicals, specifies that Analytical Methods 8040 and 8250 are the appropriate procedures for PCP. Method 8270 is also an EPA recommended procedure for semivolatile organic compounds, including PCP, because it provides better chromatographic separation than Method 8250. These procedures are described in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (November, 1986). Other methods selected for this study include a scan of chemicals in selected soils and groundwater (40 CFR 264, Appendix IX parameters), mercury in soils (EPA Method number 7471), and physical parameters such as common ions and permeability procedures.

3.2.1.1 CH2M HILL Corvallis Laboratory Method 8040--PCP and TCP

Analytical Method Number 8040 is used to determine the concentration of phenolic compounds including PCP and TCP. Extraction of the target constituents is analyzed on a two-channel capillary gas chromatograph using a flame ionization detector (FID). CH2M HILL's Corvallis laboratory characterized site soils and groundwater using a modified 8040 analytical method that focused on PCP and TCP only. PCP as discussed in this report and analyzed by Method 8040 is 2,3,4,5,6-Pentachlorophenol. TCP as discussed in this report is the sum of the three isomers of tetrachlorophenol including 2,3,4,5-TCP, 2,3,4,6-TCP, and 2,3,5,6-TCP unless otherwise specified. This modification permitted a rapid matrix characterization to assess the potential for contamination and, consequently, to permit more accurate siting of monitoring wells. A detailed summary of the modified or close support laboratory (CSL) method is provided in the Quality Assurance Project Plan (QAPP). The QAPP is included as Appendix A.

Table 3-4 identifies the sample location, frequency, and matrix of all method 8040 samples collected for the focused site investigation.

3.2.1.2 Method 8270--Semivolatile Organic Chemicals

Approximately 30 percent of the soil samples that were analyzed for PCP and TCP by Method 8040 were split and sent to California Analytical Laboratory, Sacramento, California, for confirming analysis by Method 8270. Approximately 10 percent of the groundwater and marine sediment samples were also sent for Method 8270 analysis. Method 8270 is an EPA-approved gas chromatographic/mass spectraphotometric (GC/MS) procedure for the analysis of extractable semivolatile organic compounds from the hazardous substance list (HSL) including PCP and some of its breakdown products. The complete compound list is given in Table 3-5. Method 8270 is a more sensitive but less specific (more compound-inclusive) analysis procedure than Method 8040 and serves as a verification of the results obtained by the PCP and TCP screen. Sending the samples to an independent, laboratory provides a performance audit to ensure that laboratory-specific bias is not introduced into the data.

The samples chosen for analysis are listed in Table 3-4 and the rationale for choosing these samples is included in the SAP and QAPP (Appendix A).

3.2.1.3 Appendix IX Parameters

Four water samples and one soil sample were analyzed for the compounds identified in Appendix IX of 40 CFR 264. Although the Appendix IX list is intended for application to groundwater monitoring programs at RCRA facilities, it was selected for soil and groundwater analyses for the FSI only because it is a comprehensive list of contaminants potentially present at industrial sites. The soil sample included analysis for the presence of dioxins. This sample verified the favorable

Table 3-4
Summary of Soil and Groundwater Analyses

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW5A	DSA-MW5 (8320-5)	8/28/88	Groundwater	N/A	●			●	
	DSA-MW5 (8527-2)	10/6/88	Groundwater	N/A	●			●	
MW6A	DSA-MW6 (8318-4)	8/24/88	Groundwater	N/A	●			●	
	DSA-MW6A (8527-11)	10/6/88	Groundwater	N/A	●			●	
	DSA-MW6A (8552-1)	10/13/88	Groundwater	N/A	●				
MW6B	DSA-MW6B-SS2.5 (8334-6)	8/30/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MW6B-SS5.0 (8334-7)	8/30/88	Soil	5.0 to 6.5 ft.	●	●	●		
	DSA-MW6B-SS7.5 (8334-8)	8/30/88	Soil	7.5 to 9.0 ft.	●		●		
	DSA-MW6B-SS30.0 (8334-10)	8/30/88	Soil	30.0 to31.5 ft.	●		●		
	DSA-MW6B-SS50.0 (8334-11)	8/30/88	Soil	50.0 to 51.5 ft.	●		●		
	DSA-MW6B (8350-1)	9/21/88	Groundwater	N/A	●	●		●	
	DSA-MW6B (8552-2)	10/13/88	Groundwater	N/A	●	●		●	●
MW6C	DSA-MW6C-SS2.5 (8527-6)	10/6/88	Soil	2.5 to 4.0 ft.	●				
	DSA-MW6C-SS5.0 (8527-7)	10/6/88	Soil	5.0 to 6.5 ft.	●				
	DSA-MW6C-SS7.5 (8527-8)	10/6/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MW6C-SS17.5 (8527-9)	10/6/88	Soil	17.5 to 19.0 ft.	●				

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW6C	DSA-MW6C (8552-4)	10/13/88	Groundwater	N/A	●	●		●	●
	DSA-MW6C (8633-2)	11/1/88	Groundwater	N/A	●				
	DSA-MW6C (8680-1)	11/21/88	Groundwater	N/A	●				
MW8	DSA-MW8 (8288-1)	8/17/88	Groundwater	N/A	●			●	
	DSA-MW8 (8320-4)	8/26/88	Groundwater	N/A	●				
	DSA-MW8A (8512-1)	10/3/88	Groundwater	N/A	●			●	
MW8B	DSA-MW8B-SS2.5 (8401-2)	9/12/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MW8B-SS2.5D (8401-3)	9/12/88	Soil	2.5 to 4.0 ft.	●	●	●		
	DSA-MW8B-SS5.0 (8401-6)	9/12/88	Soil	5.0 to 6.5 ft.	●	●	●		
	DSA-MW8B-SS7.5 (8401-7)	9/12/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MW8B-SS30.0 (8401-8)	9/12/88	Soil	30.0 to 31.5 ft.	●				
	DSA-MW8B-SS50.0 (8401-10)	9/12/88	Soil	50.0 to 51.5 ft.	●		●		
	DSA-MW8B (8482-3)	9/26/88	Groundwater	N/A	●			●	
	DSA-MW8B (8512-2)	10/3/88	Groundwater	N/A	●			●	
MW15	DSA-MW15 (8318-3)	8/24/88	Groundwater	N/A	●			●	
	DSA-MW15 (8521-2)	10/4/88	Groundwater	N/A	●			●	

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW16A	DSA-MW16 (8320-1)	8/28/88	Groundwater	N/A	●			●	
	DSA-MW16A (8512-5)	10/14/88	Groundwater	N/A	●			●	
	DSA-MW16A (8552-6)	10/14/88	Groundwater	N/A	●	●			
MW16B	DSA-MW16B-SS2.5 (8380-3)	9/8/88	Soil	2.5 to 4.0 ft.	●	●	●		
	DSA-MW16B-SS5.0 (8380-4)	9/8/88	Soil	5.0 to 6.5 ft.	●	●	●		
	DSA-MW16B-SS7.5 (8380-5)	9/8/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MW16B-SS30.0 (8380-6)	9/8/88	Soil	30.0 to 31.5 ft.	●				
	DSA-MW16B-SS50.0 (8380-7)	9/8/88	Soil	50.0 to 51.5 ft.	●		●		
	DSA-MW16B-SS50.0D (8380-8)	9/8/88	Soil	50.0 to 51.5 ft.	●				
	DSA-MW16B (8458-1)	9/23/88	Groundwater	N/A	●			●	●
	DSA-MW16BD (8458-2)	9/23/88	Groundwater	N/A	●				
	DSA-MW16B (8512-6)	10/4/88	Groundwater	N/A	●			●	
Boring 16C	DSA-SB-16C-11 (8667-1)	11/16/88	Soil	9.0 to 14.0 ft.	●	●			
	DSA-SB-16C-11D (8667-11)	11/16/88	Soil	9.0 to 14.0 ft.	●				

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW18	DSA-MW18 (8318-2)	8/24/88	Groundwater	N/A	●			●	
	DSA-MW18 (8521-3)	10/4/88	Groundwater	N/A	●			●	
MW19	DSA-MW19 (8320-2)	8/26/88	Groundwater	N/A	●			●	
	DSA-MW19 (8521-1)	10/15/88	Groundwater	N/A	●			●	
MW21	DSA-MW21 (8318-1)	8/24/88	Groundwater	N/A	●			●	
	DSA-MW21 (8521-5)	10/5/88	Groundwater	N/A	●			●	
MW22	DSA-MW22 (8320-3)	8/28/88	Groundwater	N/A	●			●	
	DSA-MW22 (8521-4)	10/5/88	Groundwater	N/A	●			●	
MW23	DSA-MW23-SS2.5 (8334-1)	8/29/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MW23-SS5.0 (8334-2)	8/29/88	Soil	5.0 to 6.5 ft.	●		●		
	DSA-MW23-SS7.5 (8334-3)	8/29/88	Soil	7.5 to 9.0 ft.	●		●		
	DSA-MW23-SS10.0 (8334-4)	8/29/88	Soil	10.0 to 11.5 ft.	●	●	●		
	DSA-MW23.SS17.5 (8334-5)	8/29/88	Soil	17.5 to 19.0 ft.	●		●		
	DSA-MW23 (8345-1)	9/1/88	Groundwater	N/A	●			●	
	DSA-MW23 (8527-1)	10/6/88	Groundwater	N/A	●			●	

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW24A	DSA-MW24.SS2.5 (8345-2)	9/1/88	Soil	2.5 to 4.0 ft.	●	●	●		
	DSA-MW24-SS5.0 (8345-3)	9/1/88	Soil	5.0 to 6.5 ft.	●		●		
	DSA-MW24-SS7.5 (8345-4)	9/1/88	Soil	7.5 to 9.0 ft.	●	●	●		
	DSA-MW24-SS20 (8345-5)	9/1/88	Soil	20.0 to 21.5 ft.	●	●	●		
	DSA-MW24A (8401-12)	9/13/88	Groundwater	N/A	●			●	●
	DSA-MW24A (8512-3)	10/3/88	Groundwater	N/A	●			●	
MW24B	DSA-MW24B-SS2.5 (8356-1)	9/6/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MW24B-7.5 (8356-2)	9/6/88	Soil	7.5 to 9.0 ft.	●		●		
	DSA-MW24B-SS12.5 (8356-3)	9/6/88	Soil	12.5 to 14.0 ft.	●				
	DSA-MW24B-SS35.0 (8356-4)	9/6/88	Soil	35.0 to 36.5 ft.	●				
	DSA-MW24B-SS50.0 (8356-5)	9/6/88	Soil	50.0 to 51.5 ft.	●		●		
	DSA-MW24B-SS50.0D (8356-6)	9/6/88	Soil	50.0 to 51.5 ft.	●				
	DSA-MW24B (8401-11)	9/13/88	Groundwater	N/A	●			●	
	DSA-MW24BD (8512-4)	9/13/88	Groundwater	N/A	●			●	

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW25A	DSA-MW24A-SS2.5 (8419-1)	9/15/88	Soil	2.5 to 4.0 ft.	●	●			
	DSA-MW25A-SS5.0 (8419-2)	9/15/88	Soil	5.0 to 6.5 ft.	●	●			
	DSA-MW25A-SS7.5 (8419-3)	9/15/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MW25A-SS17.0 (8419-4)	9/15/88	Soil	17.0 to 18.5 ft.	●				
	DSA-MW25-SS17.0D (8419-5)	9/15/88	Soil	17.0 to 18.5 ft.	●				
	DSA-MW25A (8482-1)	9/26/88	Groundwater	N/A	●				
	DSA-MW25A (8512-7)	10/4/88	Groundwater	N/A	●			●	
	DSA-MW25AD (8512-9)	10/4/88	Groundwater	N/A	●				
MW25B	DSA-MW25B-SS0.0 (8410-3)	9/14/88	Soil	0.0 to 1.5 ft.	●	●	●		
	DSA-MW25B-SS2.5 (8410-6)	9/14/88	Soil	2.5 to 4.0 ft.	●	●	●		
	DSA-MW25B-SS5.0 (8410-4)	9/14/88	Soil	5.0 to 6.5 ft.	●				
	DSA-MW25B-SS5.0D (8410-5)	9/14/88	Soil	5.0 to 6.5 ft.	●				
	DSA-MW25B-SS30.0 (8410-7)	9/14/88	Soil	30.0 to 31.5 ft.	●		●		
	DSA-MW25B-SS50.0 (8401-8)	9/14/88	Soil	50.0 to 51.5 ft.	●				
	DSA-MW25B (8482-2)	9/26/88	Groundwater	N/A	●			●	
	DSA-MW25B (8512-8)	10/4/88	Groundwater	N/A	●			●	

Table 3-4
Summary of Soil and Groundwater Analyses (continued)

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX
MW26	DSA-MW26-SS2.5 (8429-1)	9/19/88	Soil	2.5 to 4.0 ft.	●	●			
	DSA-MW26-SS2.5D (8429-2)	9/19/88	Soil	2.5 to 4.0 ft.	●				
	DSA-MW26-SS5.0 (8429-3)	9/19/88	Soil	5.0 to 6.5 ft.	●	●			
	DSA-MW26-SS7.5 (8429-4)	9/19/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MW26-SS17.0 (8429-6)	9/19/88	Soil	17.0 to 18.5 ft.	●	●			
	DSA-MW26 (8482-4)	9/26/88	Groundwater	N/A	●			●	
	DSA-MW26 (8527-3)	10/5/88	Groundwater	N/A	●			●	
Boring 27	DSA-MWB27-SS2.5 (8432-1)	9/20/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MWB27-SS2.5D (8432-2)	9/20/88	Soil	2.5 to 4.0 ft.	●		●		
	DSA-MWB27-SS5.0 (8432-3)	9/20/88	Soil	5.0 to 6.5 ft.	●				
	DSA-MWB27B-SS7.5 (8432-4)	9/20/88	Soil	7.5 to 9.0 ft.	●				
	DSA-MWB27-SS20.0 (8432-5)	9/20/88	Soil	20.0 to 21.5 ft.	●				
	DSA-MWB27-SS40.0 (8432-6)	9/20/88	Soil	40.0 to 41.5 ft.	●				
Boring 28	DSA-B28-S1.5	9/20/88	Soil	1.5					●

Table 3-4

Summary of Soil and Groundwater Analyses (continued)

Marine Sediment Samples

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	8270	Mercury	Common Ions	Appendix IX	TOC	% Moisture	Grain Size
DS-MS-01	DSA-MS1 (8454-6)	9/22/88	Marine Sediment	0-6"	●					●	●	●
DS-MS-02	DSA-MS2 (8454-5)	9/22/88	Marine Sediment	0-6"	●					●	●	●
DS-MS-03	DSA-MS3 (8454-4)	9/22/88	Marine Sediment	0-6"	●					●	●	●
DS-MS-04	DSA-MS4 (8454-1)	9/22/88	Marine Sediment	0-6"	●					●	●	●
DS-MS-05	DSA-MS5 (8454-2)	9/22/88	Marine Sediment	0-6"	●					●	●	●
DS-MS-05	DSA-MS53 (Marine Sediment)	9/22/88	Marine Sediment	0-6"		●						

Verification Study Samples

Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	8040	TOC	% Moisture	Grain Size	TPH[a]	TOX[b]
VI-MS-200	VI-MS-200 (8454-8)	9/22/88	Marine Sediment	0-6"	●	●	●	●		
VI-MS-201	VI-MS-201 (8453-3)	9/22/88	Lagoon Sediment	0-4"	●	●	●	●		
VI-SS-200	VI-SS-200 (8453-8)	9/22/88	Truck Maintenance Area	0-3"	●		●		●	●
VI-SS-201	VI-SS-201 (8453-10)	9/22/88	New Planer Mill	0-3"	●		●			
VI-SS-202	VI-SS-202 (8453-6)	9/22/88	Sawmill	0-3"	●		●			
VI-SS-203	VI-SS-203 (8453-5)	9/22/88	Green Chain	0-3"	●		●			
VI-SS-204	VI-SS-204 (8453-9)	9/22/88	New Planer Mill	0-3"	●		●			
VI-SS-205D	VI-SS-205 (8453-7)	9/22/88	Green Chain	0-3"	●		●			

[a] TPH - Total Petroleum Hydrocarbons (See Verification Study)

[b] TOX - Total Organic Halides (See Verification Study)

Table 3-5
METHOD 8270 SEMIVOLATILE ORGANIC COMPOUNDS
(HAZARD SUBSTANCE LIST)

Parameter	Water Quantitation Limit (µg/l)	Soil and Sediment Quantitation Limit (µg/l)
2,4-Dinitrophenol	50	1,600
4-Dinitrophenol	50	1,600
Dibenzofuran	10	330
2,4-Dinitrotoluene	10	330
2,6-Dinitrotoluene	10	330
Diethyl phthalate	10	330
4-Chlorophenyl phenyl ether	10	330
Fluorene	10	330
4-Nitroaniline	50	1,600
4,6-Dinitro-2-methylphenol	50	1,600
4-Bromophenyl phenyl ether	10	330
Hexachlorobenzene	10	330
Pentachlorophenol	50	1,600
Phenanthrene	10	330
Anthracene	10	330
Di-n-butyl phthalate	10	330
3,3'-Dichlorobenzene	30	660
Benzo(a)anthracene	10	330
bis(2-ethylhexyl)phthalate	10	330
Chrysene	20	660
Di-n-octyl phthalate	10	330
Benzo(b)fluoranthene	10	330
Benzo(k)fluoranthene	10	330
Benzo(a)pyrene	10	330
Indeno(1,2,3-cd)pyrene	10	330
Dibenz(a,h) anthracene	10	330
Benzo(g,h,i)perylene	10	330
N-Nitrosodimethylamine	10	330
Phenol	10	330
bis(2-Chloroethyl) ether	10	330
2-Chlorophenol	10	330
1,3-Dichlorobenzene	10	330
1,4-Dichlorobenzene	10	330
Benzyl alcohol	10	330
1,2-Dichlorobenzene	10	330
2-Methylphenol	10	330
bis(2-Chloroisopropyl) ether	10	330
4-Methylphenol	10	330
N-Nitrosodipropylamine	10	330
Hexachloroethane	10	330
Nitrobenzene	10	330
Isophorone	10	330
2-Nitrophenol	10	330
2,4-Dimethylphenol	10	330
Benzoic acid	50	1,600

Table 3-5
(continued)

Parameter	Water Quantitation Limit (µg/l)	Soil and Sediment Quantitation Limit (µg/l)
bis(2-Chloroethoxyl) methane	10	330
2,4-Dichlorophenol	10	330
1,2,4-Trichlorobenzene	10	330
Naphthalene	10	330
4-Chloroaniline	10	330
Hexachlorobutadiene	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	10	330
2-Methylnaphthalene	10	330
Hexachlorocyclopentadiene	10	330
2,4,6-Trichlorophenol	10	330
2,4,5-Trichlorophenol	50	1,600
2-Chloronaphthalene	10	330
2-Nitroaniline	50	1,600
Dimethyl phthalate	10	330
Acenaphthylene	10	330
3-Nitroaniline	50	1,600
Acenaphthene	10	330

results presented by Hart Crowser, indicating that no dioxin is present in the vicinity of the old planer mill. The Appendix IX list contains 232 hazardous chemicals for which there are reliable analytical methods available including organic chemicals (volatile, semivolatile, pesticides, and herbicide compounds), metals and two anions (cyanide and sulfide). The complete list of compounds is presented in the QAPP (Appendix A). This is the most extensive and practical set of analyses for potentially regulated contaminants. Analyses of the nine organophosphate pesticides were not included in this study because there is no information about this site that suggests these compounds were ever used. All analyses were performed using methods specified in EPA's laboratory manual, Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW-846, September 1986).

The selection of Appendix IX analysis establishes a standard of concern by Daishowa; the company is interested in thoroughly investigating the potential presence of any contamination that may be associated with this property. Finally, the comprehensive analysis provided by Appendix IX can also serve as a useful benchmark for characterizing site conditions and verifying the Method 8040 and Method 8270 results.

3.2.1.4 Mercury

The information available on sapstain control chemicals such as Permatox 180 indicated there were several formulations on the market and at least one contained mercury (John Cult, American Wood Preserver's Institute, pers. comm., July, 1988). Soil samples in the target area were analyzed to determine if there was any mercury contamination present at the site. Analysis was performed at CH2M HILL's Corvallis laboratory using SW-846 Method 7471, a manual cold vapor atomic absorption procedure. Samples analyzed for mercury are indicated on Table 3-4.

3.2.1.5 Common Ions

Groundwater samples collected during the focused site investigation were analyzed for a suite of natural groundwater quality parameters. Natural groundwater quality data were obtained to:

- Evaluate the vertical and horizontal extent of saline water intrusion
- Assess the potential presence of anthropogenic inorganic constituents that may represent a hazard or be useful as indicators of other contaminants

- Determine the potential chemical behavior of the contaminants of interest (i.e., PCP) in response to the type and concentrations of natural groundwater constituents

Natural groundwater chemistry parameters included the common ions chloride, sulfate, nitrogen (as nitrate), calcium, potassium, magnesium, and sodium; pH, conductivity; alkalinity; and total dissolved solids. Groundwater samples were analyzed for common ions, alkalinity, and total dissolved solids only during the first round of sampling. Conductivity and pH were measured each time a groundwater sample was analyzed for organic contaminants.

3.2.2 LABORATORY AND FIELD QA/QC

Quality assurance (QA) and quality control (QC) programs were implemented to provide data of known quality. Data quality is assessed by representativeness, compatibility, accuracy, precision, and completeness.

The analyses of groundwater and soil samples for Appendix IX parameters and Method 8270 semivolatile organic compounds were carried out by the latest EPA Contract Laboratory Program (CLP) protocols for Superfund sites. These protocols are based on EPA's SW846 methods and are described in the EPA invitation for bid documents (IFBs WA 85 H646/680, WA 85 J838/833, WA 87 K025/027 and WA 87 J001/003). Guidelines for independent review and validation of Contract Laboratory Program (CLP) data are given in EPA Sample Management Office Technical Directive Document No. HQ-8410-01, Contract No. 68-01-6699. Final data reviews followed the above-noted guidelines. Analysis of PCP and TCP by Method 8040 was carried out under an equivalent level of effort. Specific QC details are provided in the QAPP (Appendix A).

4 RESULTS

Results of the focused site investigation are presented in the following sections commencing with the physical site characterization including geologic and hydrologic characteristics. The analytical QA/QC and results of all chemical tests are also summarized.

4.1 SITE CHARACTERIZATION

The physical characteristics of the focused site investigation area were evaluated for potential contaminant transport pathways. Site geology, groundwater hydrology and chemistry, and the nature of offshore marine sediments were also evaluated.

4.1.1 SUBSURFACE CONDITIONS

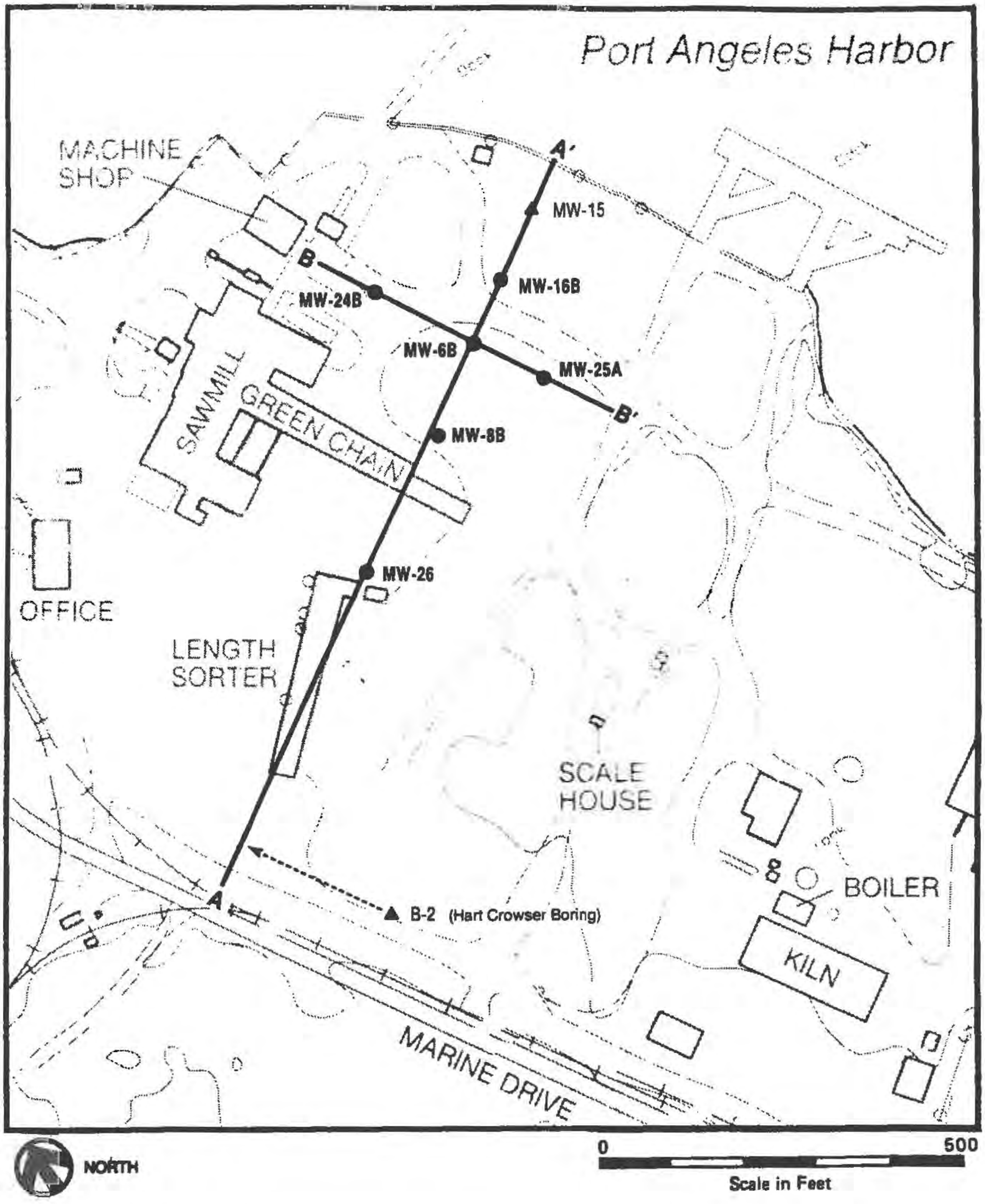
4.1.1.1 Site Geology

The geologic information presented in this section was obtained during the focused site investigation conducted from August through October 1988. A total of 10 groundwater monitoring wells and two soil borings were installed at the site. The geologic logs for the monitoring wells and borings, and well construction details, are included in Appendix C. Geologic information presented by Hart Crowser (May 1988) was also used in evaluating site geology.

Subsurface conditions within the focused site investigation area consist of artificial fill material overlying native sediments deposited in beach and shallow marine environments. Fill material is on the order of 10 to 20 feet deep in most areas. Unconsolidated fine sand and silt appears to underlie the entire site below this depth.

Figure 4-1 shows the location of two geologic cross sections prepared to illustrate the subsurface conditions. Figures 4-2 and 4-3 show geologic cross-sections oriented perpendicular and parallel to the shoreline at the site.

Figures 4-2 (A-A' cross section) and 4-3 (B-B' cross section) show the vertical extent of fill material as interpreted from soil samples collected during drilling. The fill material ranges from approximately 10 to 20 feet deep and is variable in composition. The fill materials consist mainly of poorly sorted sand and gravel with variable amounts of silt and clay. The fill material also contains rip rap, wood chips and sawdust, log and root debris, and concrete and brick fragments. In places, the fill also contains shell fragments, suggesting the presence of dredge spoils.

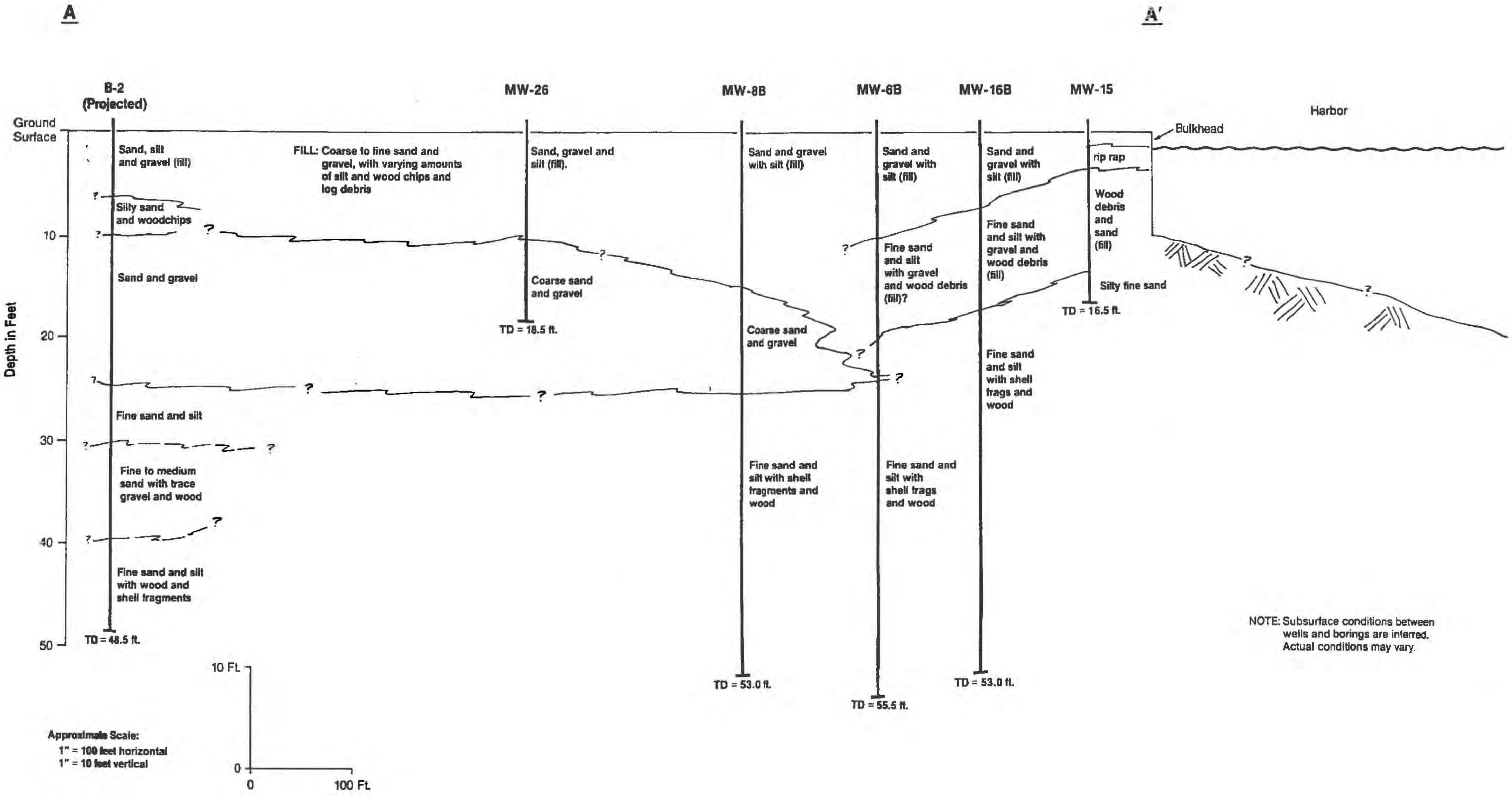


LEGEND

● CH2M HILL Monitoring Well

▲ Hart Crowser Monitoring Well or Boring

FIGURE 4-1
Location of Generalized Geologic Cross-Sections



NOTE: Subsurface conditions between wells and borings are inferred. Actual conditions may vary.

FIGURE 4-2

Generalized Geologic Cross Section A-A'

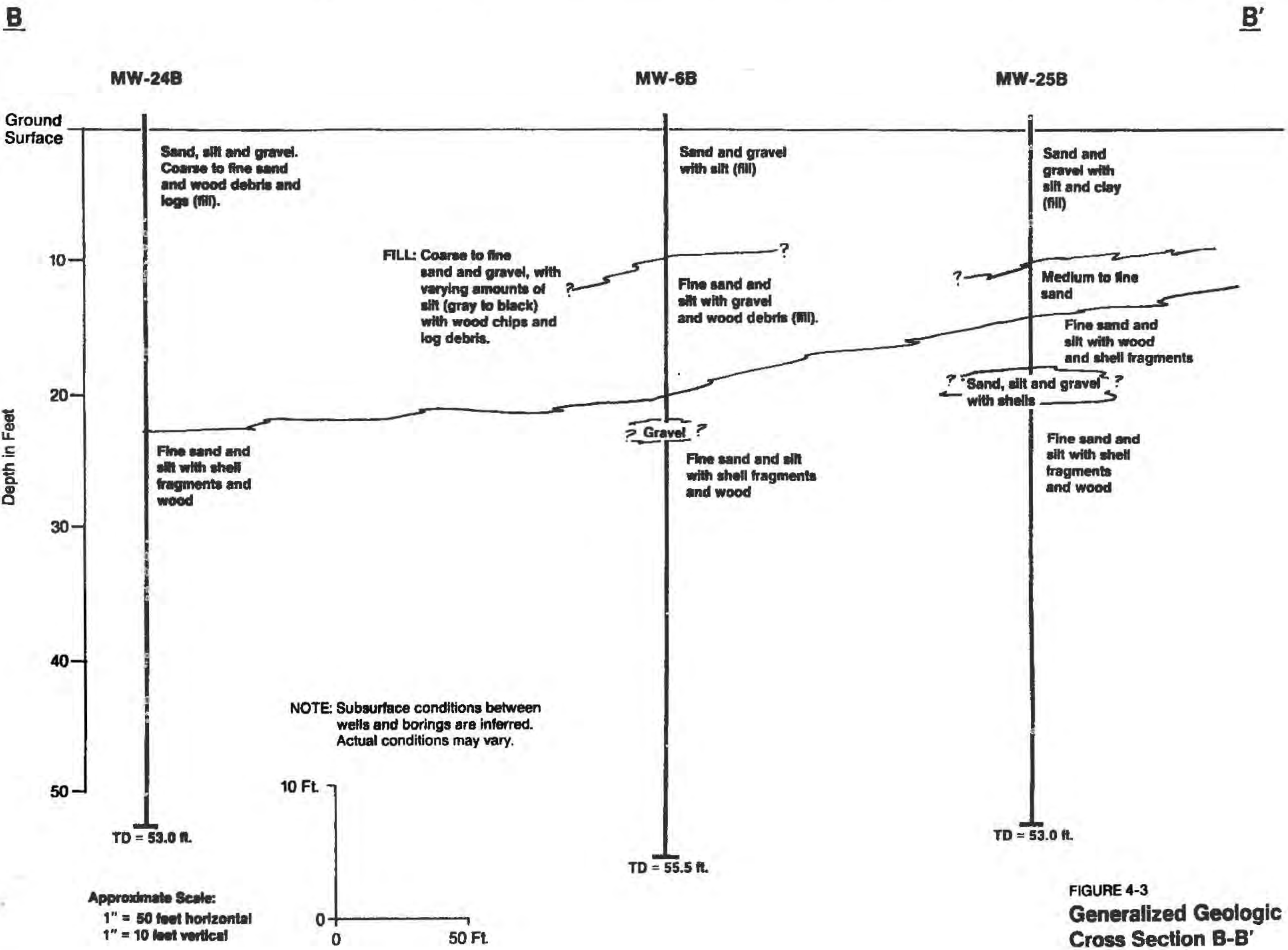


FIGURE 4-3

Generalized Geologic Cross Section B-B′

Grain-size analysis conducted on selected samples of the fill material indicate the soils are in the SP or SM group using the United Soil Classification System (USCS). The SP and SM groups are described as poorly graded sands and gravelly sands with little or no fine-grained material, to silty sands or sand-silt mixtures. The fill materials are generally coarser grained and contain more gravel than the native soils at the site.

Several feet of relatively clean sand and gravel directly underly the above-referenced fill in many areas, especially in the southwest portion of the site away from the harbor. The sand and gravel appear to be native in most areas. A mixture of unconsolidated fine sand and silt underlies the fill and native sand and gravel (where present). In most areas, the fine sand and silt are present in nearly equal proportions. The fine sand and silt is gray in color, unconsolidated, soft, and contains organic detritus and abundant shell fragments. The unconsolidated fine sand and silt appears to underly the entire site from a depth of approximately 20 feet to at least 50 feet, the limits of the boreholes drilled by CH2M HILL. Deep boreholes drilled by Hart Crowser (June 1988) indicate the presence of interbedded very dense sand and hard silt below a depth of approximately 60 feet.

The results of grain size distribution analyses for 14 subsurface soil samples are presented in Table 4-1 and are graphically illustrated in Figures 4-4 through 4-6. Based on the grain size analyses, the samples range from gravelly fine to coarse sand with little silt or clay, to varying mixtures of fine sand and silt. Samples recovered from depths greater than 20 feet display a consistent grain size distribution curve characteristic of silty fine sand and silt (SM and ML using the USCS).

4.1.1.2 Groundwater Hydrology

The groundwater hydrology of the former M&R site was evaluated during the focused site investigation. Although 17 monitoring wells were installed early in 1988 by Hart Crowser, no evaluation of the groundwater hydrology at the site was included as part of this previous investigation.

Ten monitoring wells were installed by CH2M HILL during the focused site investigation to collect groundwater samples and evaluate groundwater hydrology. Five of the wells (MW-6C, MW-2S, MW-24A, MW-25A, and MW-26) were screened adjacent to the water table from approximately 5 to 15 feet below the ground surface. The other five monitoring wells (MW-6B, MW-8B, MW-16B, MW-24B, and MW-25B) were screened from approximately 40 to 50 feet below the ground surface. The hydrogeologic conditions at these two depth intervals are different,

Table 4-1
SOIL GRAIN SIZE DISTRIBUTION

Well No.	Sample Interval (feet bgs[a])	U.S. Standard Sieve Size and Percent Passing							
		1 inch	No. 4 (0.187")	No. 10 (0.0787")	No. 20 (0.0331")	No. 40 (0.0165")	No. 60 (0.0098")	No. 100 (0.0059")	No. 200 (0.0029")
MW-8B	15.0-16.5	100.0	70.4	44.5	20.0	11.1	5.1	1.4	0.5
MW-8B	42.5-44.0	100.0	100.0	100.0	100.0	99.7	99.5	95.7	46.3
MW-16B	15.0-16.5	100.0	100.0	99.7	99.0	98.2	94.9	84.5	21.7
MW-16B	42.5-44.0	100.0	100.0	100.0	99.9	99.7	99.2	83.5	39.5
MW-23	10.0-11.5	100.0	63.5	50.5	38.5	23.9	8.3	2.9	1.3
MW-23	17.5-19.0	90.5	56.9	35.0	14.8	8.7	4.5	1.3	0.4
MW-24A	10.0-11.5	100.0	72.4	64.6	58.3	45.9	25.0	12.9	6.1
MW-24A	15.0-16.5	100.0	99.3	97.3	94.9	92.9	87.6	70.3	18.5
MW-24B	27.5-29.0	100.0	100.0	99.5	98.9	97.4	90.3	77.7	24.0
MW-24B	45.0-46.5	100.0	100.0	99.8	99.6	99.2	98.6	96.2	50.0
MW-25A	12.5-14.0	100.0	87.6	81.9	75.1	64.7	45.7	32.0	12.4
MW-25A	15.0-16.5	100.0	100.0	98.6	96.0	93.9	90.8	79.9	32.1
MW-26	10.0-11.5	94.7	81.3	69.1	56.0	32.6	5.1	0.9	0.4
MW-26	17.0-18.5	100.0	73.8	56.2	44.6	34.3	19.2	11.0	5.1

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[a] bgs = below ground surface.

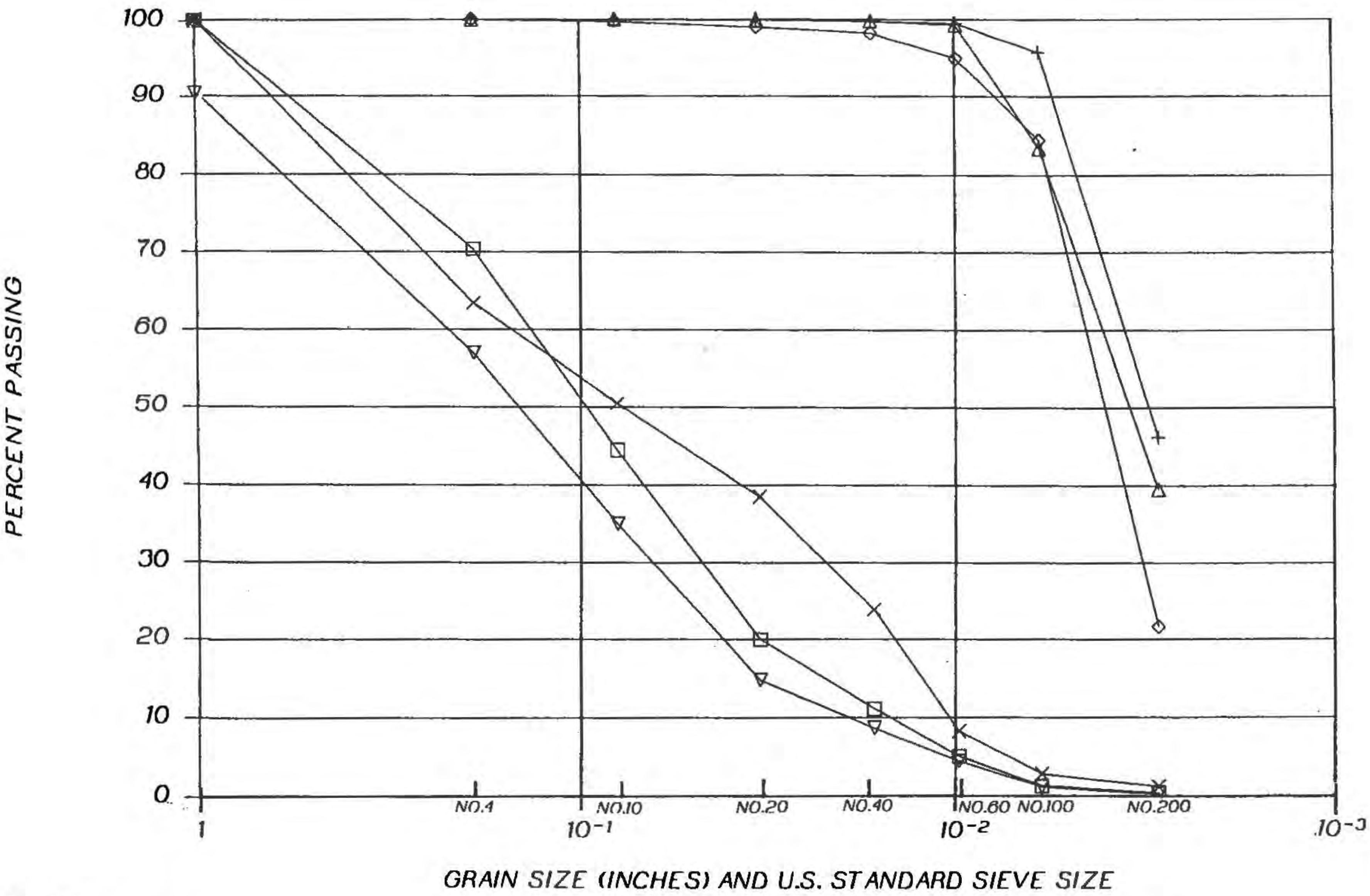


FIGURE 4-4
Grain Size Distribution for Soil

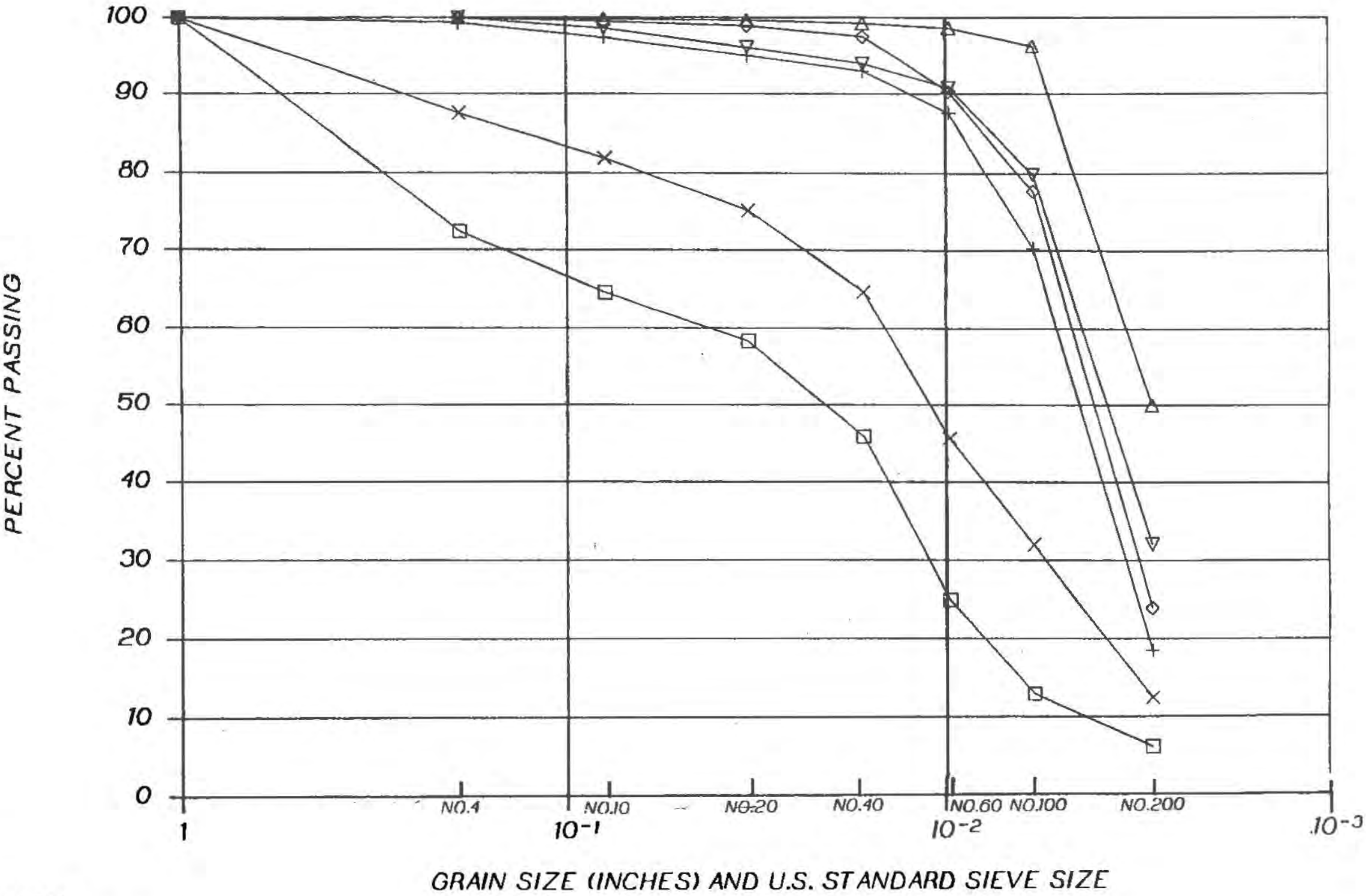
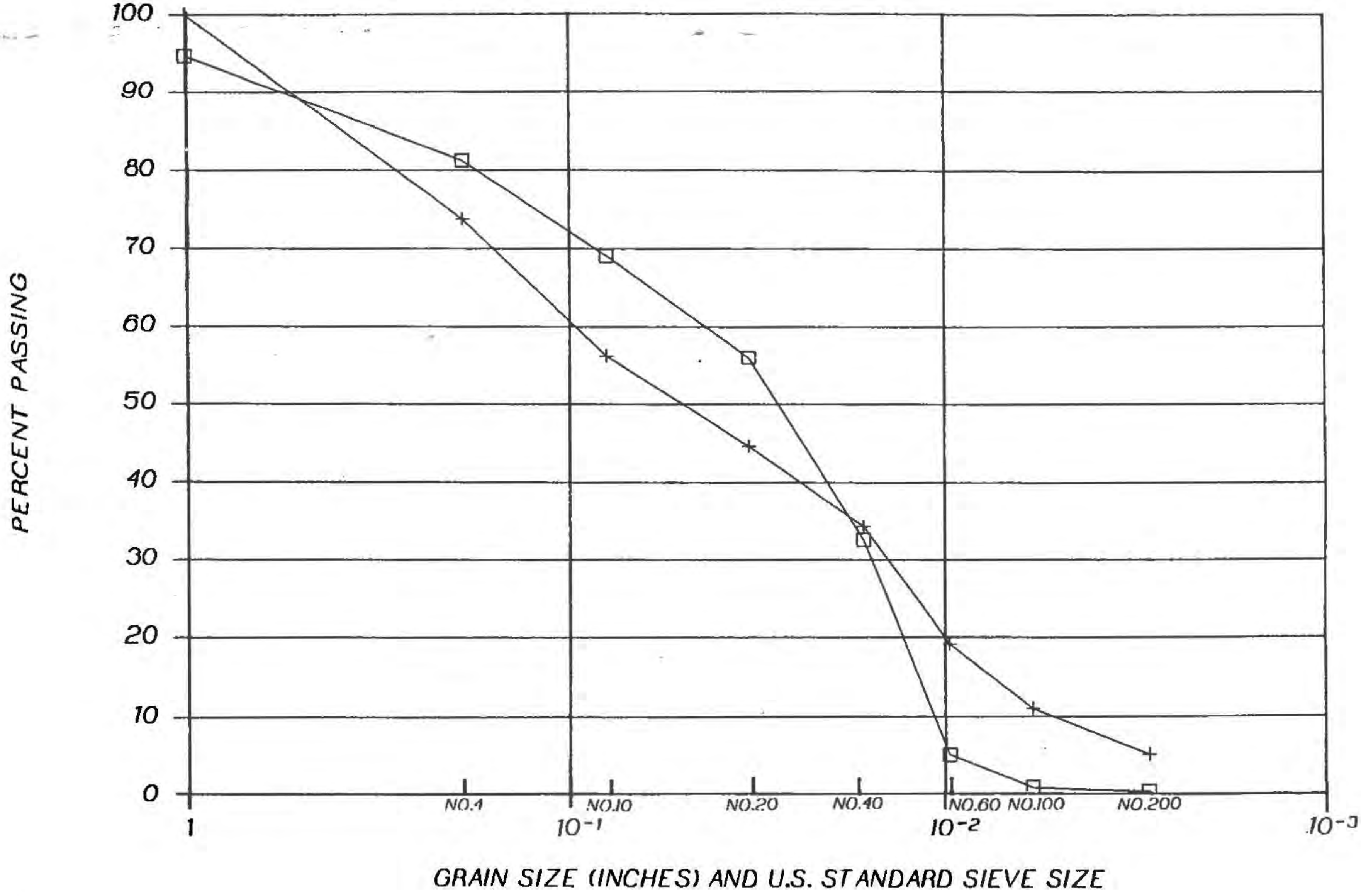


FIGURE 4-5
Grain Size Distribution for Soil



LEGEND
□ MW-26, 10.0-11.5 Ft.
+ MW-26, 17.0-18.5 Ft.

FIGURE 4-6
Grain Size Distribution for Soil

and for the purposes of discussion, they are referred to as the shallow and deep monitoring zones.

As described in Section 4.1.1.1, the shallow monitoring zone is characterized by both fill and native materials that consist primarily of gravelly sand with a minimal quantity of accessory silt and clay. The deep monitoring zone is characterized by silt and fine sand present in approximately equal proportions. No low-permeability confining unit of any appreciable thickness or lateral extent is known to separate the two zones. Based on boring logs and geologic cross sections presented by HC (June, 1988), interbedded hard silt and very dense silty sand are present at approximately 60 feet below the ground surface in the focused site investigation area.

Hydrologic information collected by CH2M HILL during the focused site investigation included:

- Static groundwater elevations for evaluation of groundwater flow directions and hydraulic gradients
- Slug test and laboratory permeability data for estimation of hydraulic conductivity
- Groundwater and tide elevations versus time for evaluation of tidal effects on groundwater movement

Groundwater Flow Directions and Gradients. The water table is within 4 to 5 feet of the ground surface in most areas of the former M&R site. Approaching Port Angeles Harbor, the groundwater levels fluctuate up to several feet in response to tidal influence.

Static groundwater levels were measured in all available monitoring wells on four occasions during the field investigation. As referenced in Section 3.1.5, groundwater levels were measured on August 3, August 30, and twice (at high and low tide) on September 24, 1988. During each measurement, groundwater levels were obtained within a period of approximately 1-1/2 hours so that they would be as contemporaneous as possible. Table 4-2 presents groundwater level elevations as measured on the above referenced dates.

Potentiometric contour maps representing groundwater elevations and flow directions on September 24, 1988 are presented in Figures 4-7, 4-8, 4-9, and 4-10. Figures 4-7 and 4-8 illustrate the potentiometric surface as determined from groundwater elevation data collected during high and low tide in the shallow monitoring wells, respectively. Figures 4-9 and 4-10 illustrate the potentiometric surface

Table 4-2
GROUNDWATER ELEVATION DATA

Well No.	Reference Point Elevation[b]	Groundwater Elevation[a] 03 Aug. 88	Groundwater Elevation[a] 30 Aug. 88[c]	Groundwater Elevation[a] Low Tide 24 Sept. 88[d]	Groundwater Elevation[a] High Tide 24 Sept. 88[e]
MW-3A	10.02	4.04	3.96	4.02	4.02
MW-4A	12.37	3.70	3.57	3.63	3.64
MW-5A	9.14	2.76	2.65	2.64	2.64
MW-6A	8.63	2.14	2.03	2.03	2.04
MW-6B	8.77	N/A	N/A	1.55	1.73
MW-6C[f]	8.78	N/A	N/A	N/A	N/A
MW-7	7.88	3.75	3.72	3.74	3.75
MW-8	9.76	2.43	2.30	2.20	2.30
MW-8B	9.17	N/A	N/A	2.11	2.21
MW-11	12.26	1.20	1.30	1.38	1.16
MW-12	10.92	N/A	2.97	2.98	2.98
MW-13	9.97	0.12	3.03	3.06	3.06
MW-14[g]	N/A	N/A	N/A	N/A	N/A
MW-15	7.85	-0.98	-0.05	-2.75	1.04
MW-16A	8.11	1.88	1.79	1.78	1.78
MW-16B	8.51	N/A	N/A	0.78	1.22
MW-18	9.53	-1.58	-1.38	-3.28	1.69
MW-19	9.73	-1.08	-0.96	-3.15	1.51
MW-20	10.14	3.23	3.89	3.95	3.95
MW-21	9.18	0.93	1.03	0.69	1.14
MW-22	10.43	1.80	1.76	1.75	1.66
MW-23	8.24	N/A	N/A	2.20	2.22
MW-24A	9.33	N/A	N/A	1.64	1.66
MW-24B	9.67	N/A	N/A	1.19	1.46
MW-25A	9.01	N/A	N/A	1.98	1.98
MW-25B	8.55	N/A	N/A	1.76	1.98
MW-26	8.06	N/A	N/A	2.45	2.43

---

[a] All elevations referenced to Wilsey and Ham datum.

[b] Top of PVC well casing used as reference point for all groundwater level measurements.

[c] Measurements taken between 9:56 a.m. and 11:13 a.m. High tide at 7:56 a.m.; low tide at 1:09 p.m.

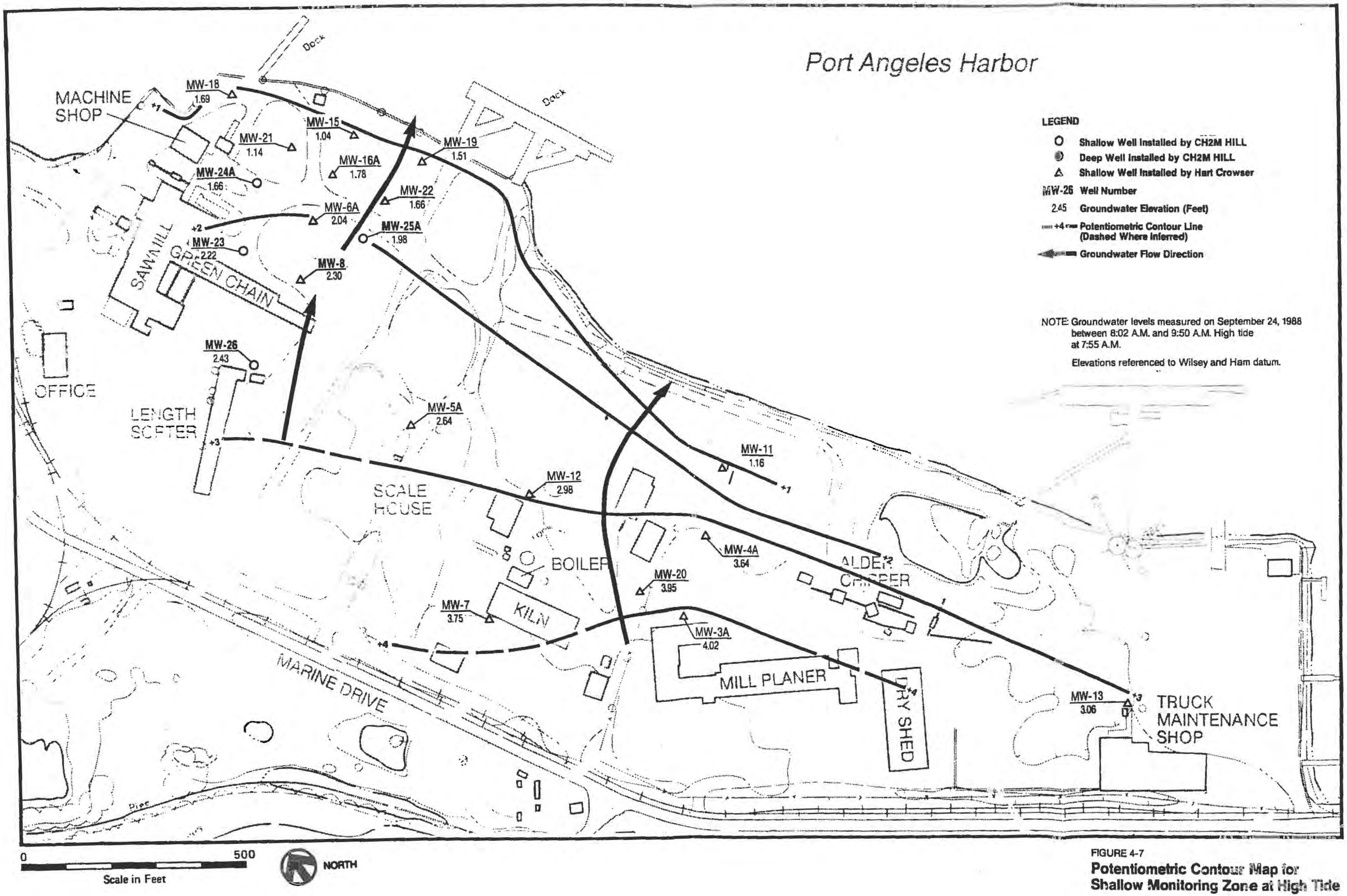
[d] Measurements taken between 8:02 a.m. and 9:50 a.m. Low tide at 7:55 a.m.

[e] Measurements taken between 1:25 p.m. and 2:55 p.m. High tide at 2:59 p.m.

[f] MW-6C installed in October 1988. Groundwater elevations not available.

[g] MW-14 buried under wood chip pile. Reference point and groundwater elevations not available.

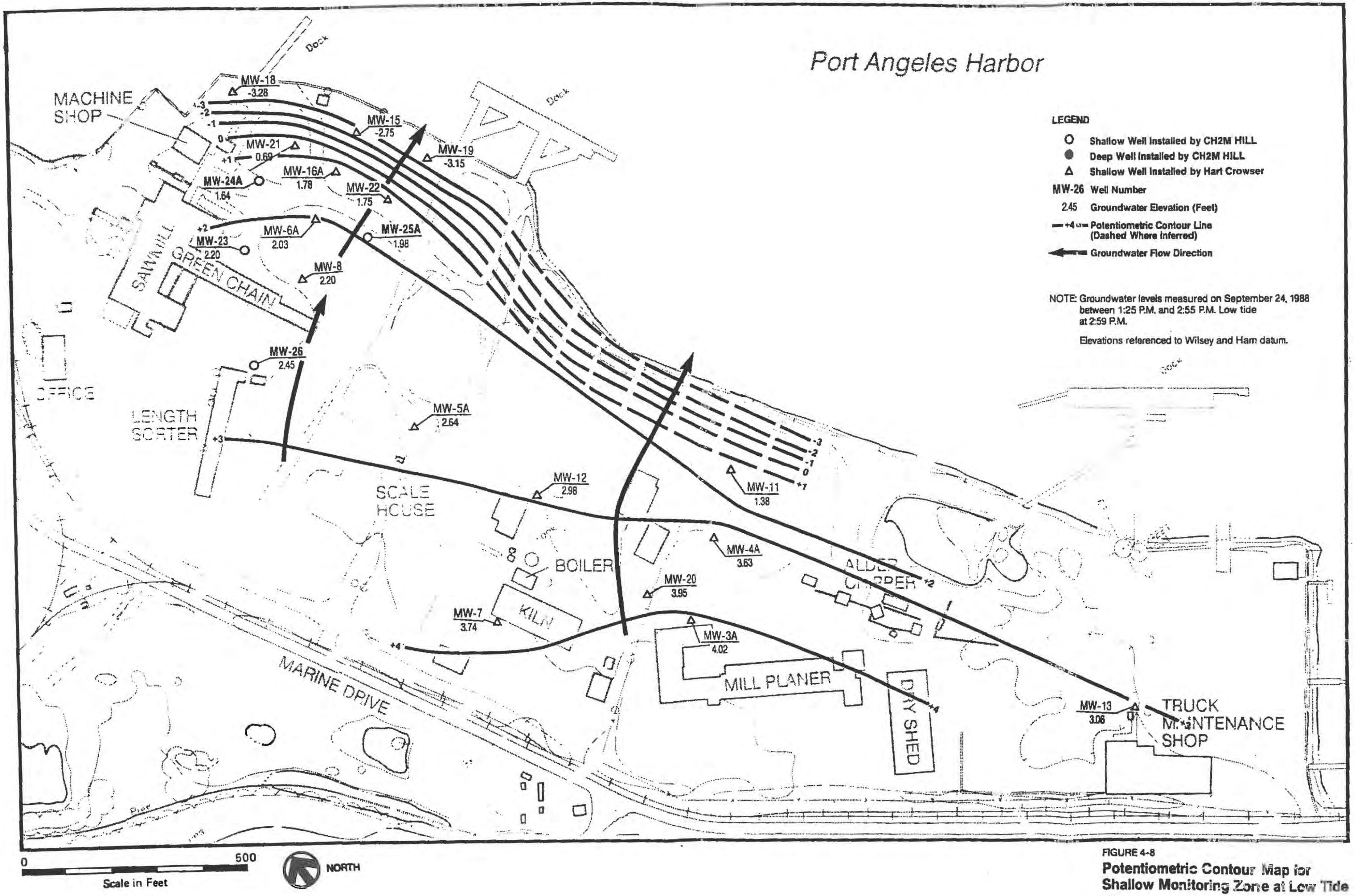
[h] N/A = Not applicable; well not installed or not accessible.



NOTE: Groundwater levels measured on September 24, 1988 between 8:02 A.M. and 9:50 A.M. High tide at 7:55 A.M.

Elevations referenced to Wilsey and Ham datum.

FIGURE 4-7
Potentiometric Contour Map for Shallow Monitoring Zone at High Tide

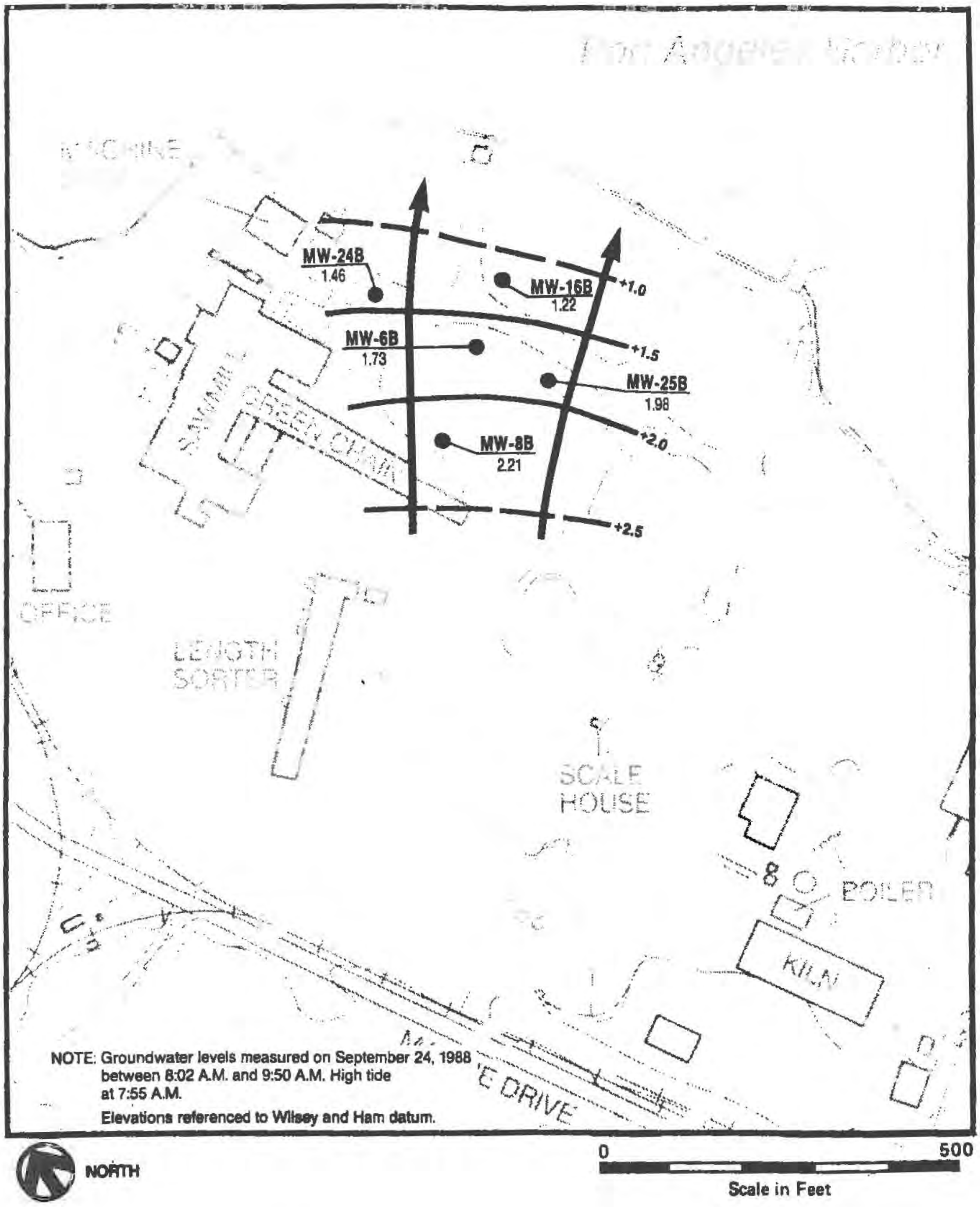


NOTE: Groundwater levels measured on September 24, 1988 between 1:25 P.M. and 2:55 P.M. Low tide at 2:59 P.M.

Elevations referenced to Wilsey and Ham datum.

FIGURE 4-8

Potentiometric Contour Map for Shallow Monitoring Zone at Low Tide



NOTE: Groundwater levels measured on September 24, 1988 between 8:02 A.M. and 9:50 A.M. High tide at 7:55 A.M.

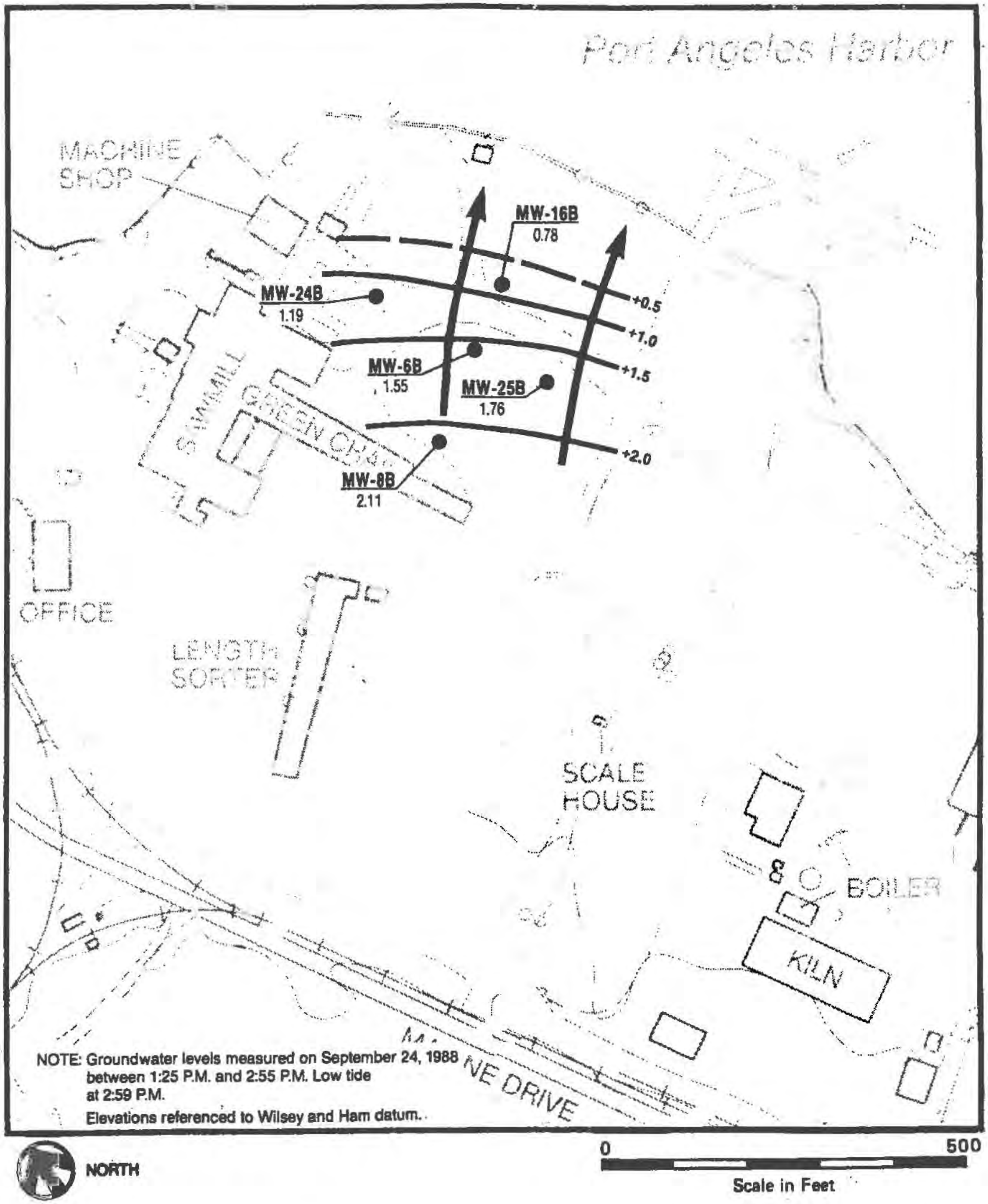
Elevations referenced to Wilsey and Ham datum.

LEGEND

●	Deep Well Installed by CH2M HILL
MW-26	Well Number
2.45	Groundwater Elevation (Feet)
— +4 —	Potentiometric Contour Line (Dashed Where Inferred)
←	Groundwater Flow Direction

FIGURE 4-9

Potentiometric Contour Map for Deep Monitoring Zone at High Tide



NOTE: Groundwater levels measured on September 24, 1988 between 1:25 P.M. and 2:55 P.M. Low tide at 2:59 P.M.

Elevations referenced to Wilsey and Ham datum.

LEGEND

●	Deep Well Installed by CH2M HILL
MW-26	Well Number
2.45	Groundwater Elevation (Feet)
— +4 —	Potentiometric Contour Line (Dashed Where Inferred)
←	Groundwater Flow Direction

FIGURE 4-10
Potentiometric Contour Map for Deep Monitoring Zone at Low Tide

as determined from groundwater elevation data collected during high and low tide in the deep monitoring wells, respectively.

The above referenced figures indicate that groundwater flow is northeast toward Port Angeles Harbor during both high and low tides in both the shallow and deep monitoring zones. Tidal fluctuations have a significant effect on groundwater levels in the shallow monitoring zone within about 150 feet of the harbor. Groundwater levels changed as much as 4.97 feet (monitoring well MW-18) in approximately six hours in response to the 7.2-foot tidal fluctuation for the same period.

As can be seen by comparing Figures 4-7 and 4-8, the horizontal hydraulic gradient in the shallow monitoring zone is greater at low tide than at high tide. Figures 4-9 and 4-10 indicate that the hydraulic gradient in the deep monitoring zone is less affected by tidal action. However, the response of the deep zone within about 175 feet of the harbor is not known because there are no wells deeper than approximately 15 feet in this area.

Based on groundwater level elevations measured on September 24, 1988, horizontal hydraulic gradients in the shallow monitoring zone range from approximately 0.002 (unitless) in the southwest portion of the site during both high and low tide, to approximately 0.05 near the harbor during low tide. Horizontal gradients in the deep monitoring zone are on the order of 0.004 to 0.008 during both high and low tide.

Vertical hydraulic gradients are presented in Table 4-3. These data are based on groundwater elevations measured in adjacent shallow and deep monitoring wells at high and low tide on September 24, 1988. Where measurable gradients exist, the vertical component of groundwater flow potential is in the upward direction. The vertical gradient was found to be greatest at monitoring well pair MW-16/MW-16B, ranging from 0.02 to 0.03 during high and low tides, respectively. Vertical gradients at other monitoring well pairs were generally found to be in the order of 0.01 to 0.001.

Tidal Influence. Groundwater and tide elevations were monitored over a period of several days to evaluate the response of groundwater levels to tidal fluctuation. As discussed in Section 3.1.5, two arrays of wells were monitored during the investigation. Each array included four monitoring wells and a stilling well located in Port Angeles Harbor.

Hydrographs are presented in Figure 4-11 for shallow monitoring wells MW-6, MW-15, MW-16, MW-18, and the tide. The hydrographs represent water level conditions during an 80-hour period between September 14 and 18, 1988. The wells are located approximately 35 feet (MW-18) to 285 feet (MW-6A) from the harbor. As depicted in Figure 4-11, MW-15 and MW-18 are strongly affected by tidal fluctuation because of their proximity to the shoreline. No significant groundwater level changes are apparent at monitoring wells MW-6A or MW-16, suggesting that tidal fluctuations only affect the shallow zone of saturation within about 150 feet of the harbor. For the period monitored, the hydrographs indicate that there were brief diurnal periods of reversal in the groundwater flow direction near the shore. This occurred when the elevation of the water table at monitoring wells MW-15 and MW-18 was higher than at monitoring wells MW-6A and MW-16A.

Table 4-3
VERTICAL HYDRAULIC GRADIENTS

Well Pair No.	Screen Separation (feet)[b]	Vertical Hydraulic Gradient[a] High Tide[c]	Vertical Hydraulic Gradient[a] Low Tide[d]
6A/6B	36	8.6×10^{-3}	1.3×10^{-2}
8/8B	36	2.5×10^{-3}	2.5×10^{-3}
16A/16B	34	1.6×10^{-2}	2.9×10^{-2}
24A/24B	35	5.7×10^{-3}	1.3×10^{-2}
25A/25B	36	0.00	6.1×10^{-3}

---

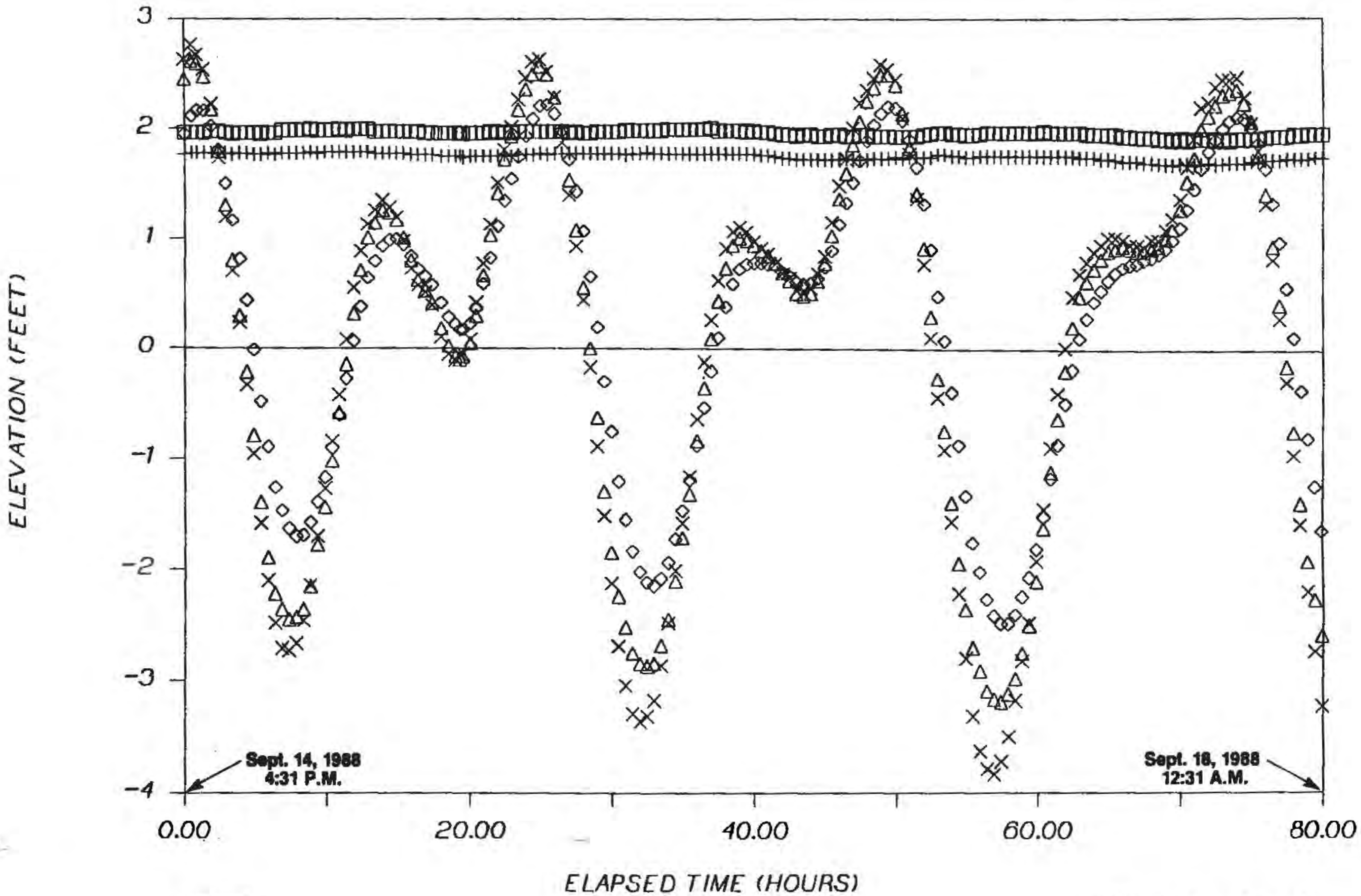
[a] Vertical component of groundwater flow potential is upward for all measurable gradients.

[b] Separation measured from middle of screens.

[c] Gradients based on groundwater levels measured on September 24, 1988 between 8:02 a.m. and 9:50 a.m.. High tide at 7:55 a.m.

[d] Gradients based on groundwater levels measured on September 24, 1988 between 1:25 p.m. and 2:55 p.m. Low tide at 2:59 p.m.

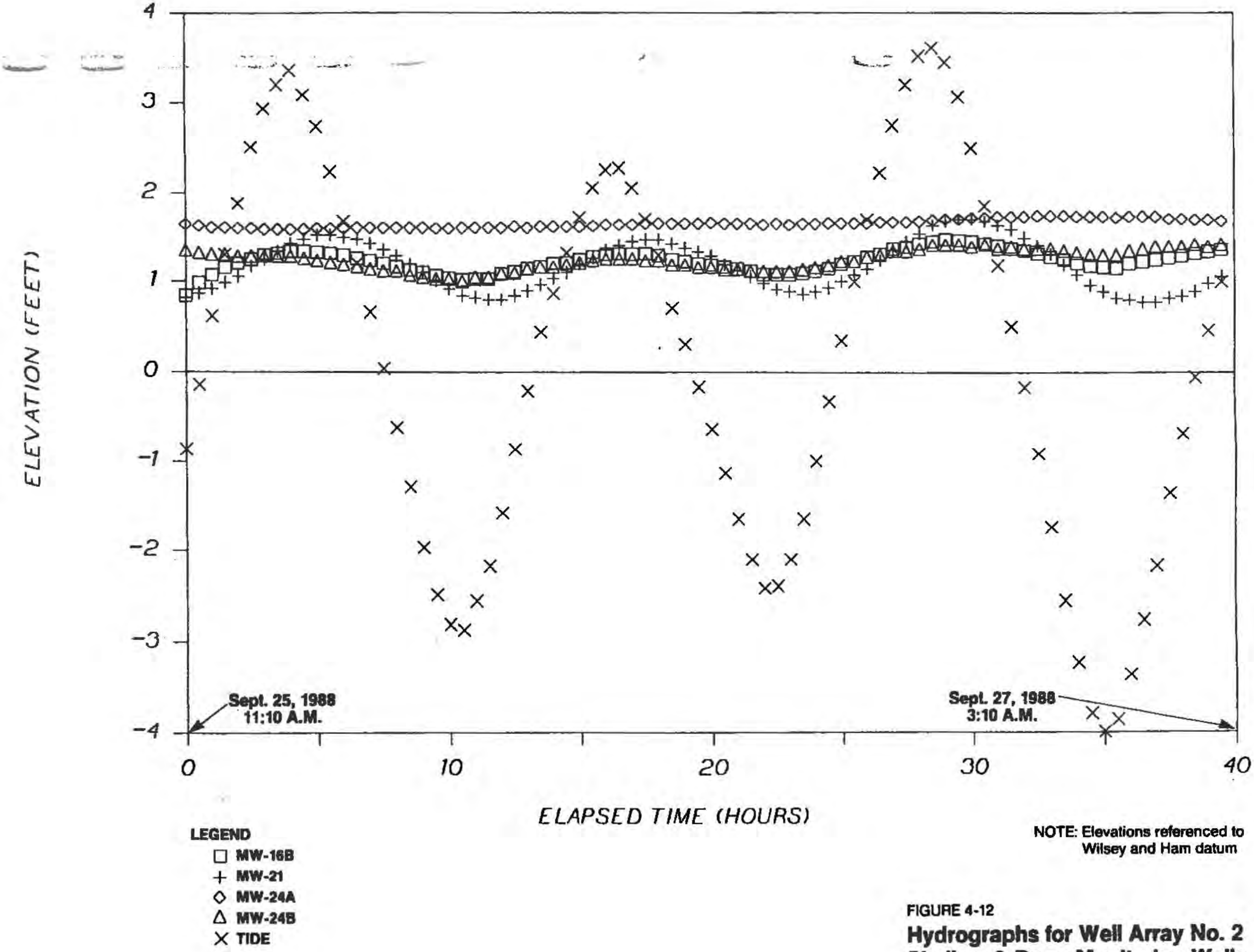
Hydrographs are presented on Figure 4-12 for shallow monitoring well MW-21, deep monitoring well MW-16B, paired (deep and shallow) monitoring wells MW-24A/MW-24B, and the tide. The hydrographs represent conditions during a 40-hour period between September 25 and 27, 1988. The wells are located approximately 140 (MW-21) to 175 feet (MW-24A/MW-24B) from the harbor. The hydrographs indicate that shallow monitoring



NOTE: Elevations referenced to Wilsey and Ham datum

FIGURE 4-11

Hydrographs for Well Array No. 1 Shallow Monitoring Wells



NOTE: Elevations referenced to Wilsey and Ham datum

FIGURE 4-12

Hydrographs for Well Array No. 2 Shallow & Deep Monitoring Wells

well MW-21 is influenced by the tide. No significant change in groundwater elevation was noted at monitoring well MW-24A during the monitoring period. Deep monitoring wells MW-16B and MW-24B are both influenced by tidal fluctuation even though the adjacent shallow wells were not apparently affected (the hydrograph for monitoring well MW-16A is shown on Figure 4-11).

Hydraulic Conductivity. As described in Section 3.1.5, slug tests were conducted in five Hart Crowser wells and eight CH2M HILL wells to estimate the hydraulic conductivity of the water-bearing materials. Eight shallow and five deep wells were tested. The wells tested and the calculated hydraulic conductivity values are presented in Table 4-4.

Slug tests provide a rapid way to approximate hydraulic conductivity. However, because the test duration is short and the radial area around the well being tested is relatively small, the results provide only a rough estimate of hydraulic conductivity.

The slug test data were analyzed using a method described by Bouwer and Rice (1976). The procedure is applicable to partially penetrating wells in unconfined aquifers. Negligible drawdown and no flow above the water table is assumed.

Using the analytical method described by Bouwer and Rice (1976), hydraulic conductivity is calculated by:

$$K = \frac{r_c \ln (R_e/r_w)}{2tL_e} \ln \frac{Y_o}{Y_t}$$

where: K = hydraulic conductivity
R_e = effective radial distance over which the head difference is dissipated
r_c = well screen radius
r_w = radial distance from center of the well to the borehole wall
L_e = length of screen
y_o = water level at time zero
y_t = water level at time t
t = time since y_o

Bouwer and Rice (1976) present an empirical formula to calculate R_e that requires an estimate of the aquifer thickness. However, R_e is relatively insensitive to large errors in the aquifer thickness approximation. Based on hydrogeologic data presented by Hart Crowser (June 1988), an aquifer thickness of 60 feet was assumed.

As described in Section 4.1.1.1, gravelly sand is predominate in the saturated zone screened by the shallow monitoring wells. Finer grained material consisting predominantly

Table 4-4
SLUG TEST RESULTS

Shallow Monitoring Wells

Well No.	Screen Interval (ft bgs[b])	Hydraulic Conductivity[a] (ft/day)
MW-6A	4-14	1.0×10^{-1}
MW-8	4-14	1.5×10^{-1}
MW-15	5-15	2.1×10^{-1}
MW-16A	6-16	1.6×10^{-1}
MW-22	3-13	1.8×10^{-1}
MW-24A	5-15	1.8×10^{-2}
MW-25A	4-14	1.4×10^{-1}
MW-26	4.5-14.5	1.1×10^{0}
	MEAN =	2.6×10^{-1}

Deep Wells

Well No.	Screen Interval (ft bgs[b])	Hydraulic Conductivity[a] (ft/day)
MW-6B	40-50	3.6×10^{-3}
MW-8B	39.5-49.5	4.3×10^{-3}
MW-16B	40-50	4.0×10^{-3}
MW-24B	40-50	7.6×10^{-3}
MW-25B	40-50	3.7×10^{-3}
	MEAN =	4.6×10^{-3}

---

[a] Hydraulic conducvity values presented are the mean of initial and recovery tests.

[b] bgs = below ground surface.

of silt and fine sand are prevalent in the deep monitoring zone. The range in calculated hydraulic conductivity values for the eight shallow monitoring wells tested is 0.018 to 1.1 feet/day, with a mean value of 0.26 feet/day. This range in hydraulic conductivity is relatively small considering several of the shallow wells are screened in fill materials that probably vary in their physical characteristics. The range in calculated hydraulic conductivity values for the five deep monitoring wells is 0.036 to 0.076 feet/day, with a mean value of 0.046 feet/day.

Seven undisturbed soil samples were recovered from the screen intervals of monitoring wells for laboratory permeability testing. Five of the samples tested were recovered from the screen intervals of deep monitoring wells. Only two samples were recovered from shallow wells. The coarse granular material prevalent at the shallower depths made recovery of undisturbed samples difficult. Each sample was tested using U.S. Army Corps of Engineers Method No. EM 110-2-19-06. Due to the orientation of the samples relative to the hydraulic head applied during testing, the laboratory analysis measures permeability in the vertical direction.

Table 4-5 presents the results of laboratory permeability testing. Permeability values range from 0.0074 to 0.12 feet/day for the samples collected from the deep zone and 0.048 and 3.1 feet/day for the two samples collected from the shallow zone. When compared to slug test results for some of the same wells (see Table 4-4), the laboratory values are generally about one order of magnitude higher.

Table 4-5
LABORATORY PERMEABILITY TEST RESULTS

Well No.	Sample Depth (ft bgs[a])	Laboratory Permeability[b] (ft/day)	Material Description
MW-6B	51.5-54.0	1.4×10^{-2}	Fine sand and silt
MW-8B	47.5-49.0	1.2×10^{-2}	Fine sand and silt
MW-16B	40.0-41.5	1.2×10^{-1}	Fine sand and silt
MW-24A	17.5-20.0	4.8×10^{-2}	Silty fine sand
MW-24B	40.0-41.5	2.1×10^{-2}	Fine sand and silt
MW-25A	10.0-12.5	3.1×10^{0}	Silty fine sand with gravel
MW-25B	47.5-50.0	7.4×10^{-3}	Fine sand and silt

---

[a] bgs = below ground surface

[b] Permeability Test Method EM 110-2-19-06 (U.S. Army Corps of Engineers).

Lower hydraulic conductivity values calculated from slug test data may be due to formation damage along the monitoring well borehole caused by drilling. In contrast, higher permeability values obtained from laboratory permeability analyses may have been caused by piping in the testing apparatus during analysis. The variation in results can also be attributed to the heterogeneity of the aquifer and the small volume of material tested at, or from, each well. Regardless, this degree of variability is low considering that the methods used are suitable only for providing estimates of hydraulic conductivity.

Groundwater Flow Velocities. Horizontal groundwater flow velocities in the focused site investigation area can be estimated from a modified version of Darcy's Law given values for hydraulic conductivity, horizontal gradient, and effective porosity. Flow velocity can be estimated from the equation:

$$V = \frac{KI}{n_e}$$

where:
V = average interstitial horizontal groundwater flow velocity
K = horizontal hydraulic conductivity
I = horizontal hydraulic gradient
n_e = effective porosity

Depending on tidal stage and location within the focused site investigation area, the horizontal groundwater flow velocity in the shallow monitoring zone is estimated to be in the range of 3 to 83 feet/year assuming:

$K = 0.26$ to 1.6 feet/day (mean of slug test and laboratory permeability results for shallow wells, respectively)

$I = 0.01$ to 0.05

$n_e = 0.35$ (reasonable values per Freeze and Cherry [1979] and Todd [1976])

4.1.1.3 Groundwater Chemistry

Groundwater samples were obtained from CH2M HILL wells and selected Hart Crowser monitoring wells and analyzed for common ion chemistry and water quality parameters. Table 4-6 summarizes the wells sampled, analyses conducted, and results.

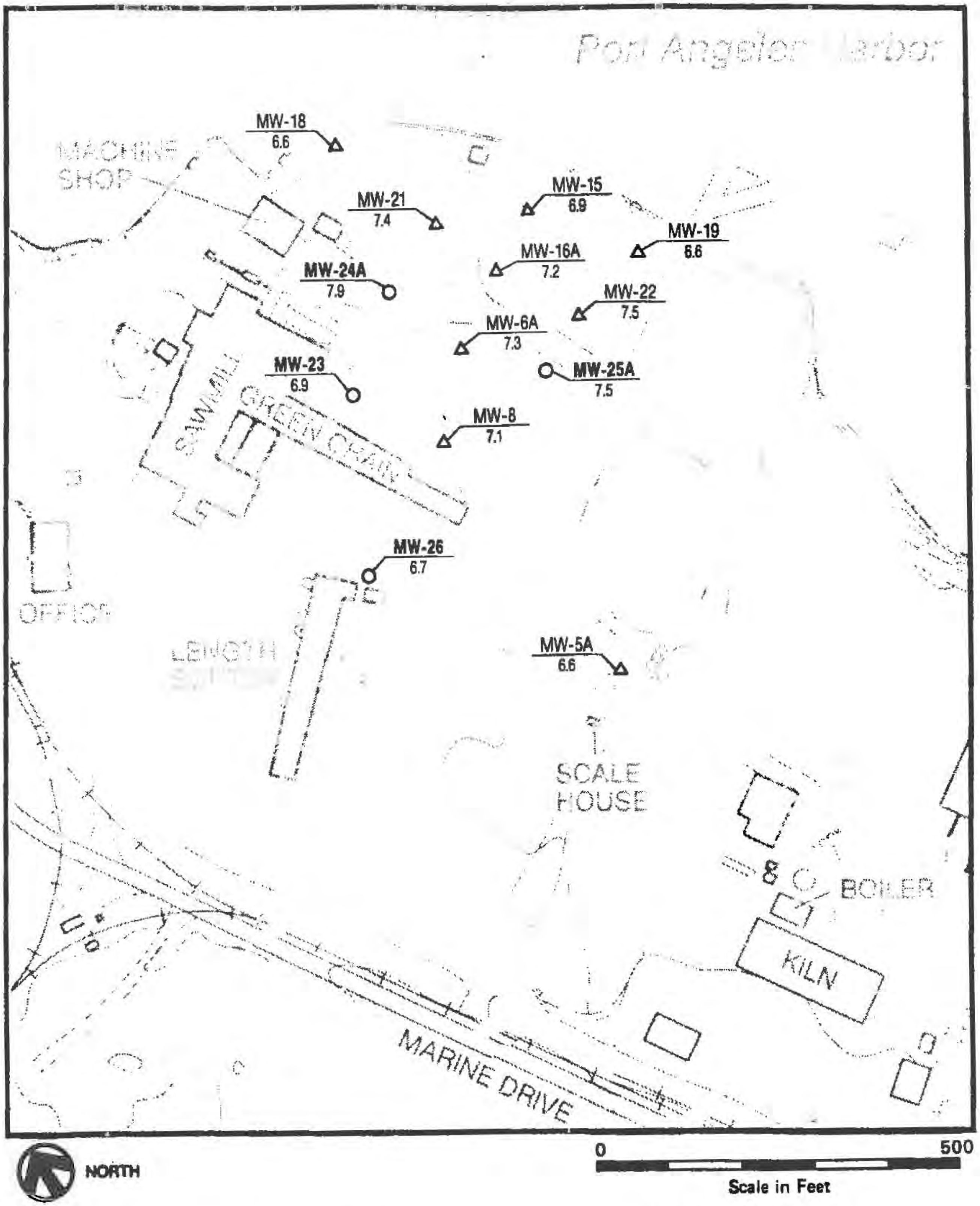
Figures 4-13 and 4-14 show the average laboratory pH values for water samples collected from shallow and deep wells,

Table 4-6
SUMMARY OF NATURAL WATER QUALITY DATA

Well No.	Sample Date	pH	Conductivity (µmhos/cm)	Alkalinity AS $CaCO_3$ mg/L	Chloride (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	Total Dissolved Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
MW-5	8/88	6.5	960	352	51.4	<1.0	<0.5	512	41.5	17.5	12.3	104
	10/88	6.6	825	256	62.2	<1.0	<0.5	534	18.5	9.8	12.7	101
MW-6A	8/88	7.2	2,380	900	173	21.5	<2.5	1,290	181	380	75.0	175
	10/88	7.4	1,175	913	81.3	13.1	<0.5	1,550	168	41.6	82.3	120
MW-6B	9/88	8.0	41,000	2,200	10,100	6.7	<0.5	19,500	252	736	171	5,300
	10/88	7.6	32,000	2,210	11,400	34.9	<5	20,400	246	620	171	6,060
MW-6C	10/88	7.7	2,000	924	99.7	9.9	<0.5	1,470	136	46.1	92.9	189
	10/88											
MW-8	8/88	7.0	1,400	431	110	10.6	<0.5	704	9.2	18.0	17.6	185
	10/88	7.2	1,250	433	111	10.8	<0.5	921	16.2	15.0	16.4	237
MW-8B	9/88	7.7	16,500	706	5,450	390	3.3	9,860	198	299	109	3,020
	10/88	7.8	15,500	759	6,160	454	<0.5	11,300	202	337	114	3,130
MW-15	8/88	7.0	28,500	1,280	7,850	430	<50	15,100	177	520	165	4,400
	10/88	6.9	24,000	1,290	6,370	329	3.6	12,500	126	337	158	4,160
MW-16A	8/88	7.2	2,460	943	180	<5.0	<2.5	1,320	98.0	57.0	74.0	238
	10/88	7.1	2,000	906	192	5.2	<0.5	1,320	71.0	50.5	82.3	258
MW-16B	9/88	7.3	35,800	2,050	10,300	15.7	8.0	19,500	350	249	800	5,940
	10/88	7.1	30,000	2,030	11,100	<1.0	84.7	19,700	260	438	239	6,310
MW-18	8/88	6.6	48,500	396	14,100	1,570	<50	25,300	282	800	25.6	7,220
	10/88	6.6	53,000	252	15,100	2,370	<50	29,100	276	425	318	1,010
MW-19	8/88	6.6	57,300	411	14,600	1,950	<100	27,600	320	930	280	8,950
	10/88	6.5	52,500	352	15,700	1,970	<50	28,900	348	1,010	338	1,020
MW-21	8/88	7.4	1,920	882	96.0	4.4	<0.5	1,140	122	57.0	26.7	141
	10/88	7.4	1,770	881	1,200	<1.0	<0.5	1,200	135	48.8	29.0	174
MW-22	8/88	7.3	1,990	766	123	41.3	<0.5	1,080	122	51.0	23.2	119
	10/88	7.7	1,780	793	114	24.7	<0.5	1,120	115	23.5	35.3	176
MW-23	9/88	6.9	1,120	461	97.0	5.2	<0.5	662	68.0	46.0	17.4	101
	10/88	6.9	1,250	501	98.8	3.6	<0.5	736	70.0	43.4	13.7	84.3

Table 4-6
(continued)

Well No.	Sample Date	pH	Conductivity (µmhos/cm)	Alkalinity AS $CaCO_3$ mg/L	Chloride (mg/L)	Sulfate (mg/L)	Nitrate (mg/L)	Total Dissolved Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Potassium (mg/L)	Sodium (mg/L)
MW-24B	9/88	7.4	43,700	1,820	10,600	15.6	12.5	20,700	248	760	199	6,080
	10/88	7.4	32,000	1,980	12,100	<100	<50	20,500	230	600	207	6,880
MW-24A	9/88	7.8	2,250	890	77.5	8.5	<0.5	1,175	55.0	66.5	31.9	272
	10/88	7.8	1,075	926	66.4	15.5	<0.5	1,120	50.5	51.3	26.9	252
MW-25A	9/88	6.7	1,300	542	92	51	<0.5	890	103	339	19.0	162
	10/88	7.7	1,430	545	97.4	44.2	<0.5	1,030	80.0	321	23.1	199
MW-25B	9/88	8.0	18,900	1,160	7,260	25	2.7	11,500	150	262	109	387
	10/88	8.1	17,000	1,130	6,850	104	3.9	12,100	119	279	126	4,180
MW-26	9/88	6.6	890	292	71	2	<0.5	576	15.2	17.6	13.5	109
	10/88	6.7	890	313	66.0	3.4	<0.5	928	19.0	10.8	12.3	104



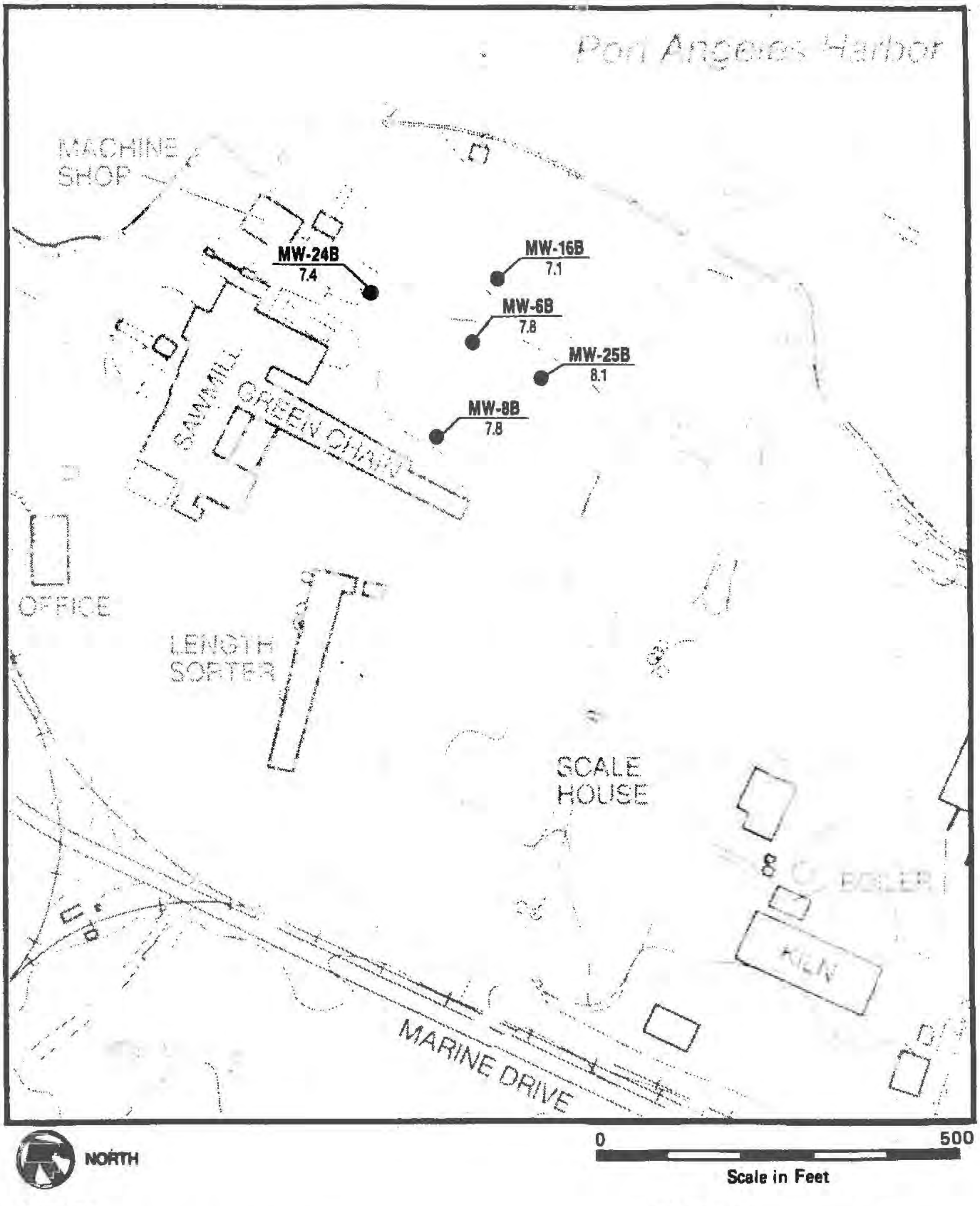
LEGE

○ Shallow Well Installed by CH2M HILL

△ Shallow Well Installed by Hart Crowser

FIGURE 4-13

Average Laboratory pH Values for the Shallow Monitoring Zone



LEGEND

● Deep Well Installed by CH2M HILL

FIGURE 4-14
Average Laboratory pH Values for the Deep Monitoring Zone

respectively. All pH values fall within the expected range for natural waters. In the shallow monitoring zone (Figure 4-13), pH values range from 6.6 to 7.9. Values are relatively low inland, higher in the middle of the focused site investigation area, then decrease in wells nearest the harbor. The low pH (e.g., 6.6) of wells nearest the harbor is not characteristic of seawater.

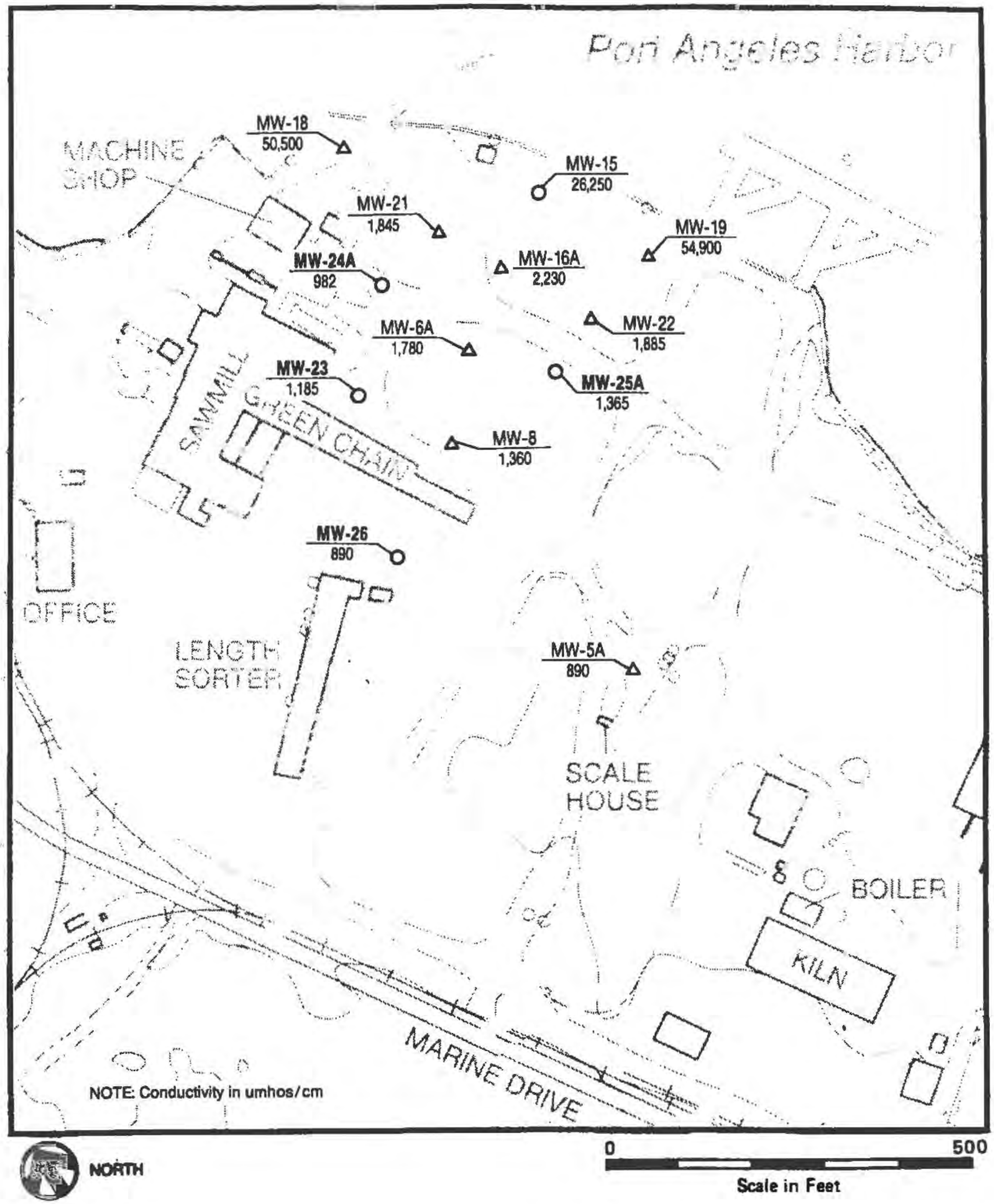
In the deep monitoring wells (Figure 4-14) the pH values range from 7.1 to 8.1. Groundwater from MW-25B indicates the highest pH value. The pH values of deep monitoring wells are nearer the expected value for seawater (7.9-8.2) than groundwater samples collected from the shallow monitoring wells.

Figures 4-15 and 4-16 show the average laboratory specific conductivity values for shallow and deep wells, respectively. In the shallow monitoring zone (Figure 4-15), conductivity is highest near the harbor. The increase in conductivity indicates that brackish or salt water from the harbor is mixing with the fresh groundwater approaching the shoreline. In the deep monitoring zone (Figure 4-16), conductivity values are high (e.g., 16,000 to 37,850 umhos/cm) and generally increase toward the harbor. If the conductivity values for shallow and deep monitoring well pairs are compared, conductivity of groundwater in the deep wells is consistently more than an order of magnitude higher. This marked change in conductivity with depth indicates intrusion of saline water beneath the site.

Figures 4-17 and 4-18 graphically illustrate on trilinear diagrams the relative concentrations of cations and anions in groundwater samples from selected wells. Figure 4-17 demonstrates the difference in chemistry between shallow wells located inland and shallow wells located near the harbor. Inland wells are characterized by water with sodium as the predominant cation and carbonate as the predominant anion. Wells nearer the harbor are characterized by sodium as the predominant cation and chloride as the predominant anion.

Comparison of the absolute values of ions in the different wells (Table 4-6) indicates that the inland groundwater is relatively fresh whereas groundwater near the harbor is relatively brackish.

Figure 4-18 illustrates the natural groundwater chemistry for groundwater samples collected from selected deep wells at the site. Typical seawater is also plotted on the trilinear diagram for comparison. Sodium and chloride are the dominant ions in groundwater collected from deep monitoring wells. The relative concentration of ions for deep wells and for shallow wells near the harbor is very similar to seawater except for elevated alkalinity values and below



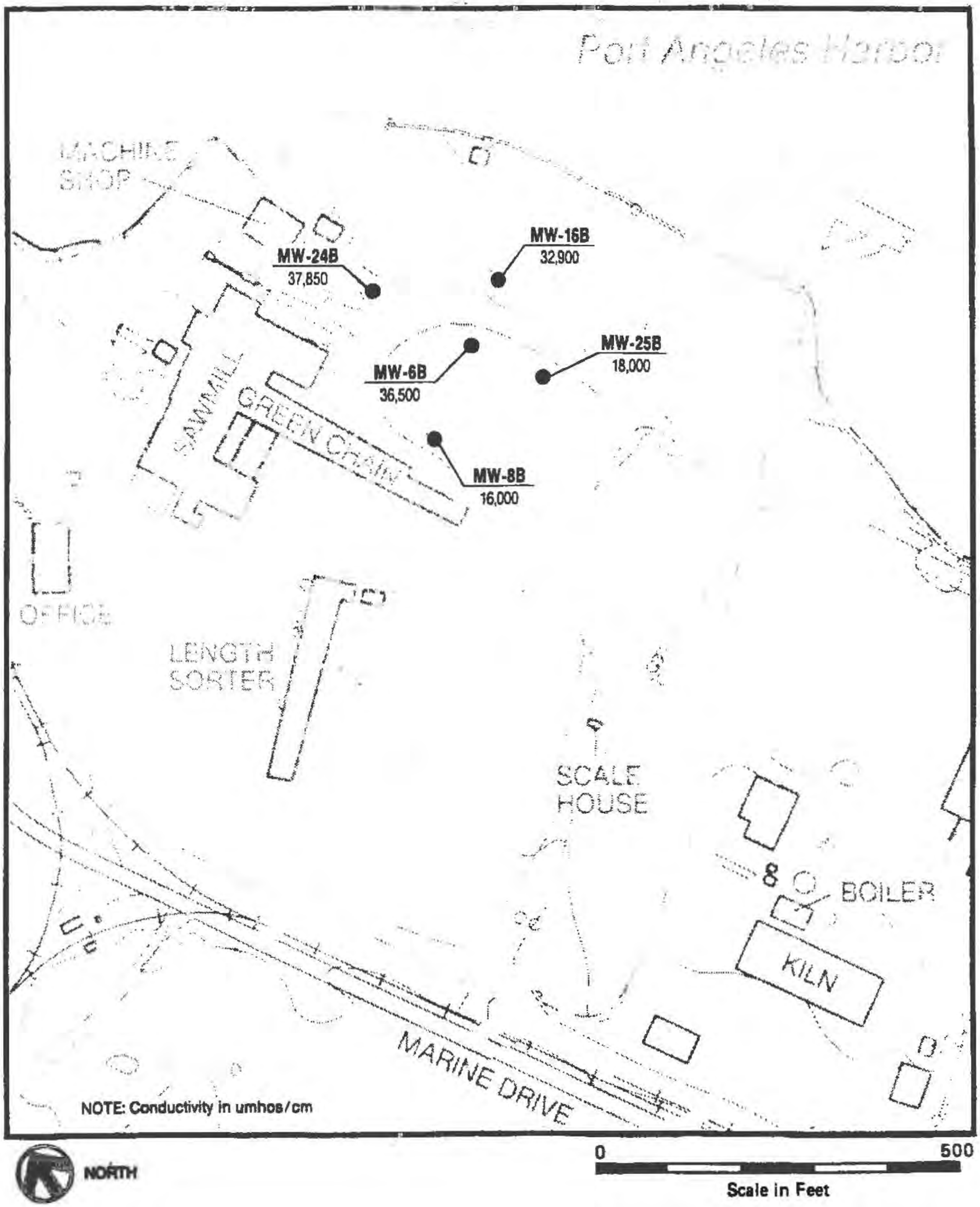
LEGEND

○ Shallow Well Installed by CH2M HILL

△ Shallow Well Installed by Hart Crowser

FIGURE 4-15

Average Laboratory Specific Conductivity Values for the Shallow Monitoring Zone

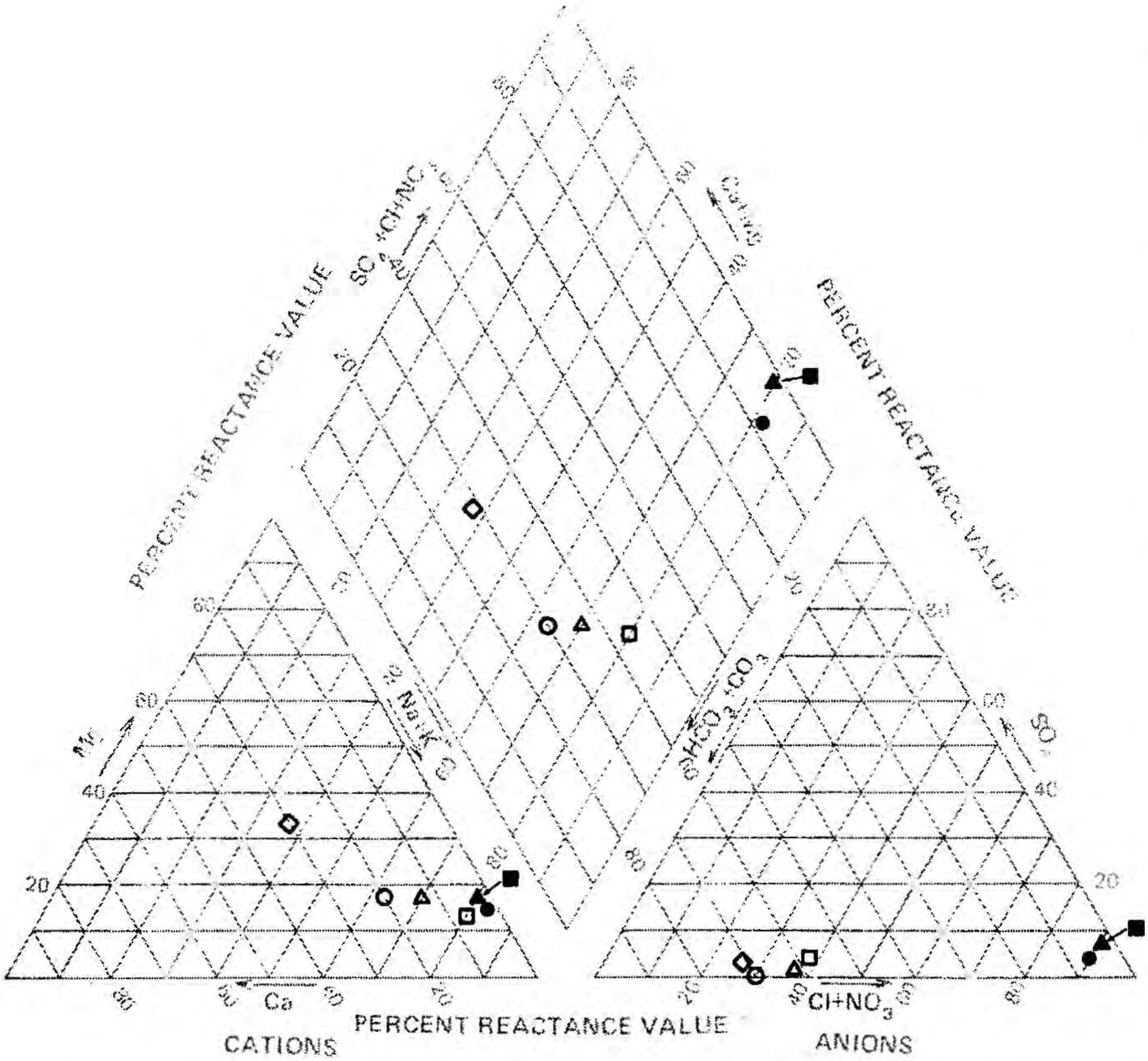


LEGEND

● Deep Well Installed by CH2M HILL

FIGURE 4-16

Average Laboratory Specific Conductivity Values for the Deep Monitoring Zone



Shallow Inland Wells

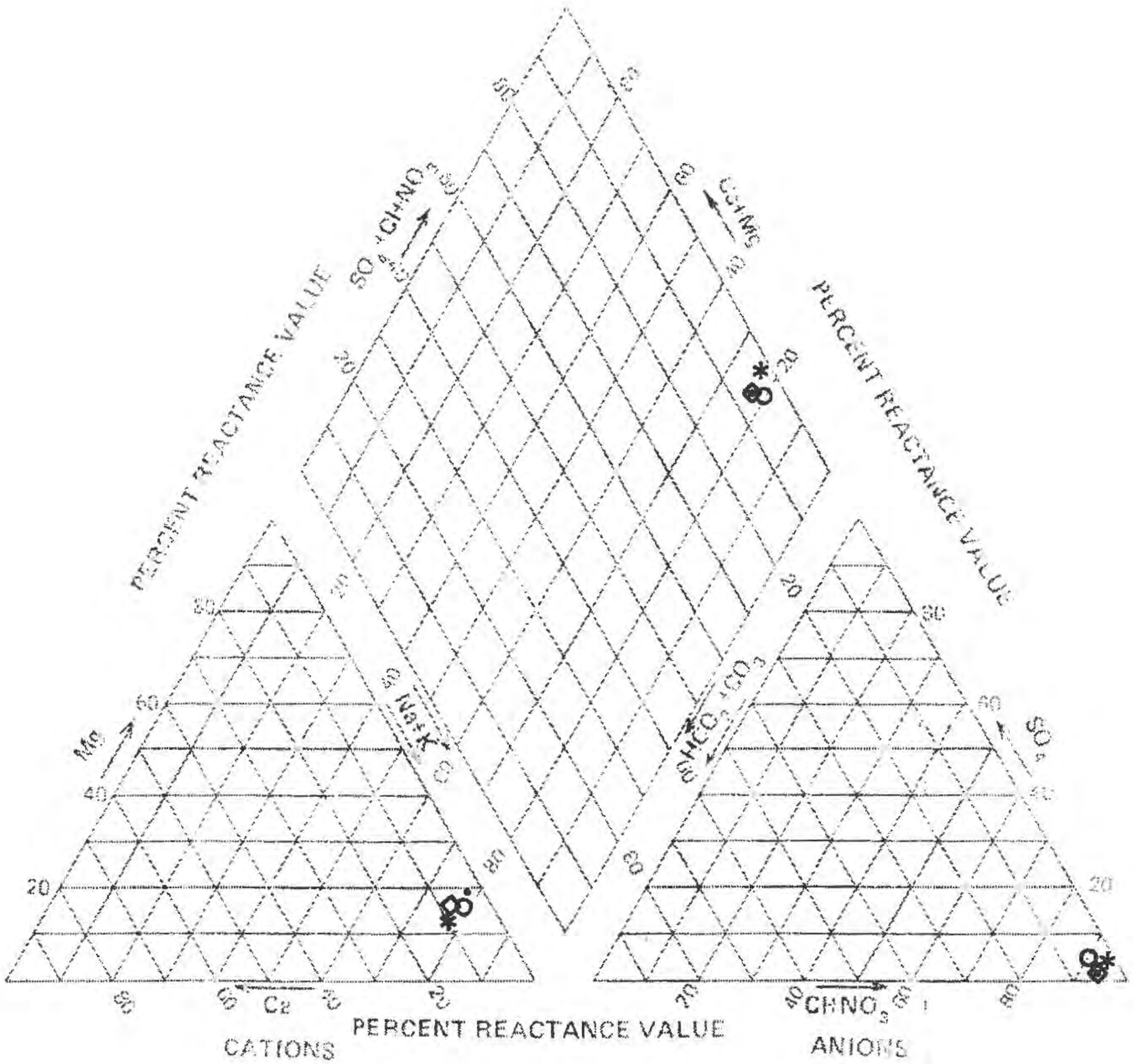
- △ MW-26
- ○ MW-5
- ◇ MW-23
- □ MW-8

Shallow Near-Shore Wells

- ▲ MW-18
- ● MW-15
- ■ MW-19

NOTE: MW-18 and MW-19 plot in same location

FIGURE 4-17
Comparison of Natural Groundwater Chemistry — Shallow Monitoring Wells



Deep Wells

○ MW-8B

• MW-24B

◇ MW-16B

∗ Seawater

FIGURE 4-18

Natural Groundwater Chemistry — Deep Monitoring Wells normal sulfate values among the deep well samples, and low magnesium values among deep and nearshore samples.

4.1.2 MARINE SEDIMENT AND VERIFICATION STUDY SOIL SAMPLES

Table 4-7 summarizes the physical characteristics of marine sediment samples collected during the focused site investigation. Moisture content of the five samples and one field duplicate ranged from 62.4 percent to 85.0 percent. The total organic carbon content ranged from 0.78 to 2.6 percent on wet weight basis.

The relative grain size distribution of these samples generally range from silty fine sand to sandy silt (SM to ML designation per the Unified Soil Classification System). Grain size distribution curves for both marine sediments and verification soils (Section 4.1.3) are illustrated in Figures 4-19 and 4-20.

A discussion of the verification study is provided in a technical memorandum as an addendum to this report. The technical memorandum includes a complete discussion of all sampling procedures performed during the course of verifying the HC Preliminary Environmental Assessment.

Table 4-7
MARINE SEDIMENT ANALYTICAL DATA COLLECTED
ON SEPTEMBER 22, 1988

Parameter	DS-MS-01	DS-MS-02	DS-MS-03	DS-MS-04	DS-MS-05	DS-MS-05[c]
% Moisture	85.0	81.0	78.8	82.7	62.4	62.4
TOC[a]	1.6	0.78	1.7	1.8	2.6	1.7
Grain size[b]						
<0.75"	0	5	0	21.8	0	0
0.374"	4.1	15.1	1.4	3.1	0	2.2
0.187"	3.0	10.7	8.4	4.7	0.5	0.2
0.0787"	2.5	9.5	6.9	2.9	0.2	1.1
0.0331"	1.4	6.3	2.8	1.6	0.2	0.8
0.0165"	2.8	3.2	2.7	6.0	0.5	1.0
0.0098"	7.7	8.1	4.2	13.6	2.3	1.0
0.0059"	11.1	6.8	5.7	9.8	16.8	3.0
0.0029"	21.6	10.8	11.1	11.3	43.6	38.8
Pan	45.9	24.5	26.9	25.1	35.9	57.9

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[a] Wet weight basis (percent).

[b] Percent retained on screen (100 percent organic material at screens ≥0.75 in; high organic content observed for all screen sizes).

[c] Field duplicate.

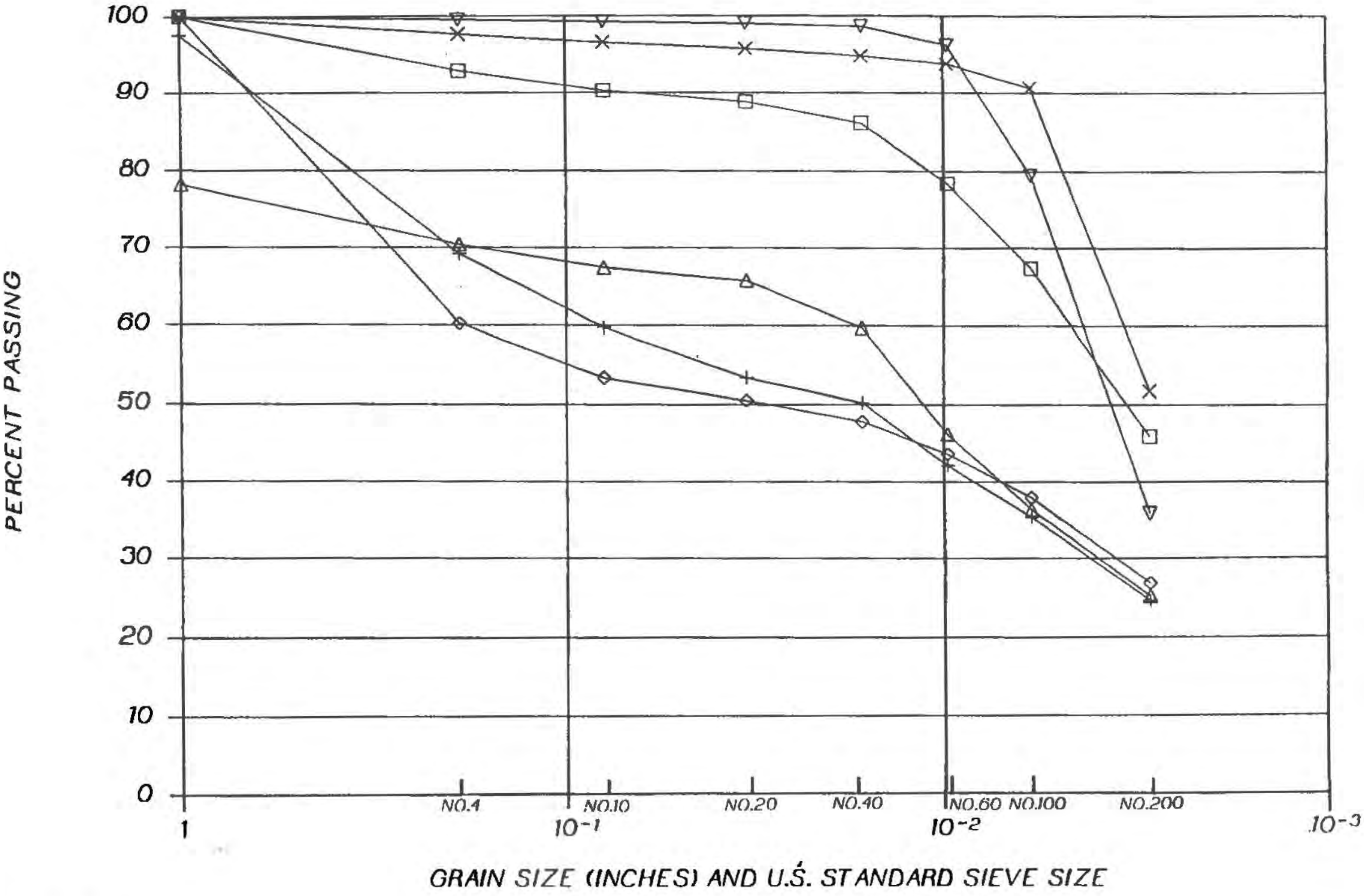

FIGURE 4-19
Grain Size Distribution for Marine Sediment

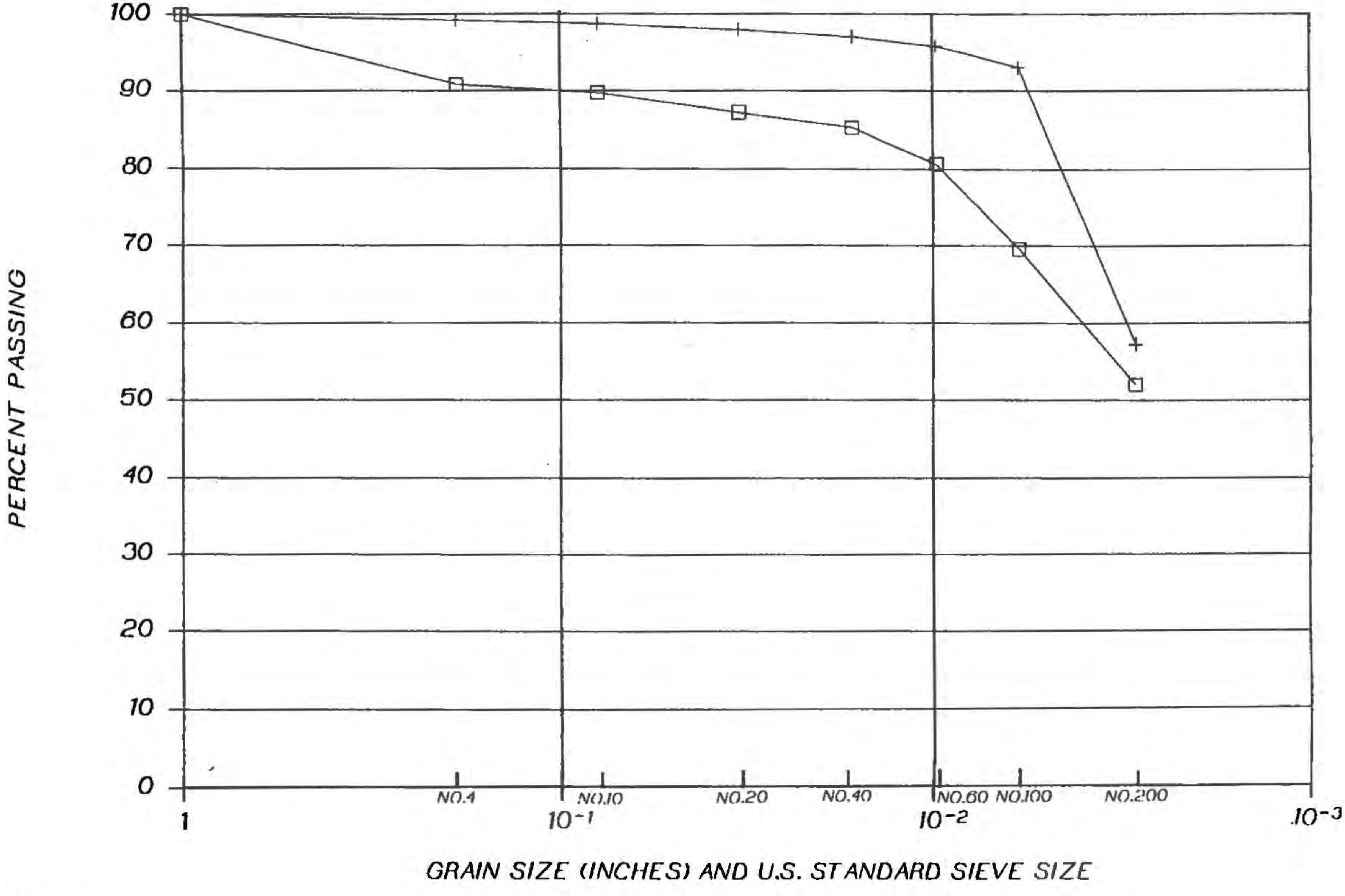

FIGURE 4-20

Grain Size Distribution for Marine Sediment

4.2 LABORATORY RESULTS

4.2.1 QUALITY ASSURANCE AND QUALITY CONTROL

CH2M HILL carried out an extensive quality assurance program that included final data validation reviews for conformance to EPA Contract Laboratory Program (CLP) protocols and project specific parameters.

The completeness of all data with regard to the EPA criteria and control limits was found to be above 95 percent. Completeness is defined as the percent of data found valid in 2accordance with EPA CLP control limits and criteria; these limits and criteria are noted for each section below. In general practice, 95 percent completeness represents very high quality data.

Sample chain-of-custody, sample preservation, and sample holding times were documented as described in the CLP protocols. Holding times were noted to be within guidelines. Sample preparation, analytical methodology, usage of standards as established by laboratory records, and instrument output were carried out in accordance with CLP methods and the methods previously defined in the quality assurance plan.

The analytical results were reviewed after analysis with regard to acceptability standards defined in the CLP protocols. The protocols define the level of effort for QC (the frequency with which the quality control procedures are to be carried out). Method blanks, accuracy, and precision measurements (defined below) were carried out at 10 percent frequency in general, as specified in the protocols. Instrument calibrations and tuning were also carried out at the level of frequency defined in the protocols, with an equivalent level of effort for other parameters.

The quality control data were also evaluated quantitatively. For the CLP parameters, EPA has established control limits for the evaluation of the data. These EPA limits are based on past data bases. Quality control data that are not within these limits were noted, and the impact on the results was evaluated. For non-CLP parameters, the quality control data were used for qualification of data with regard to precision and accuracy, as further discussed below.

Several compounds did not meet initial and/or continuing calibration criteria. None of these compounds were detected in the samples analyzed after these calibrations so only the quantitation limit is affected.

4.2.1.1 Accuracy, Precision, and Blank Measurements

Accuracy is a measure of the deviation between the true value and the observed test value. The accuracy of chemical test results is measured by establishing the average recovery. The recovery is determined by splitting a series of samples into two portions, spiking (adding a known quantity of the constituent of interest) one of the portions, and submitting both portions for laboratory analysis as independent samples. In general, two types of recoveries are measured: matrix spike recoveries and surrogate spike recoveries. For a matrix spike, known amounts of standard compounds identical to the compounds present in the sample of interest are added to the sample. For a surrogate spike, the standards are chemically similar but not identical to the compounds in the fraction being analyzed. The purpose of the surrogate spike is to provide quality control on every sample by constantly monitoring for unusual matrix effects and gross sample processing errors. Surrogate spikes are generally done for organic compounds analyses.

Perfect accuracy would be defined by 100 percent recovery. EPA control limits for CLP data for each parameter are noted in the tables in this section. Data that are outside these control limits have been flagged as noted in the footnotes. For non-CLP parameters, the accuracy measurement serves as a quantitative qualifier, as defined above. For the CLP parameters, data were found to be within the listed control limits for above 95 percent of measurements, indicating data of high quality.

Precision is a measure of the spread of the data when more than one measurement is taken on the same sample. For duplicate measurements, precision can be expressed as the relative percent difference (RPD). The EPA CLP control limits are noted, along with any data points outside the limits. For the CLP parameters, the data were again found to be within the listed control limits for above 95 percent of measurements.

A laboratory method blank is defined as an appropriate volume of "organic-free" water that has been processed exactly as a sample (same glassware, reagents, and solvents). A blank measurement helps distinguish observed test results that are caused by contamination or instrument error from those that are intrinsic to the sample. As part of this quality assurance program, the conclusions presented in this report were reviewed. All statements calling for corrective action in interpreting the data on the basis of measured quantities were noted, and these quantities were checked to ensure that they were not affected by any laboratory contaminants.

4.2.1.2 Close Support Laboratory Method 8040 QA/QC Results

All of the sample and QA data in this section are the results of work performed by staff at CH2M HILL's Corvallis, Oregon, laboratory. The laboratory's proximity and rapid analyses allowed it to serve as the close support laboratory (CSL) on this project rather than as an onsite field laboratory subject to problems inherent with field conditions.

The CSL performed modified EPA methods for the analysis of phenols: SW 846 Method 8040 for soil samples and Method 604 for water samples. (Method 604 is equivalent to Method 8040 for an aqueous matrix.) These methods were modified for detection and quantification of targeted chlorophenols, specifically tetrachlorophenols (sum of 2,3,4,5 and 2,3,5,6 isomers) and pentachlorophenol. Modifications to the methods are described in the CSL methods included in the QAPP (Appendix A).

An important sample preparation feature of these analyses, regardless of sample type, was acidification prior to extraction. Acidification converts pentachlorophenate, the anionic form of pentachlorophenol that was used at the site, to pentachlorophenol. Hence the analyses also measured both pentachlorophenate and pentachlorophenol as pentachlorophenol.

Performance criteria for Daishowa samples were established at the beginning of the project and are detailed in the QAPP (Appendix A). The project-specific quality assurance and performance criteria for Method 8040 are shown in Table 4-8. For comparative purposes, EPA Contract Lab Program criteria are also shown in Table 4-8, where applicable.

Other QA performance criteria include instrument calibration response factor variance (±15 percent of initial calibration) and quality control sample analysis (within 95 percent confidence limits).

The QA analyses were performed at the frequencies specified in the QAPP. The QA data were calculated daily to determine if the analytical system was "in control".

Accuracy. All spiking was performed with tetrachlorophenols and pentachlorophenol and 2-fluorophenol as a surrogate. Frequency of accuracy analysis was 1 in 20 or 1 per batch, whichever was more frequent. The percent recoveries of the matrix spikes, matrix spike duplicates, and surrogate spikes are shown on Table 4-9 and surrogate recoveries on Figure 4-21. Recovery data are also in Figures 4-22 and 4-23 for PCP and TCP respectively.

Table 4-8
PROJECT-SPECIFIC QUALITY ASSURANCE AND PERFORMANCE CRITERIA

	Project-Specific CSL Criteria		EPA CLP Criteria	
	Water	Soil	Water	Soil
Detection Limits*	0.005 mg/l	1.0 mg/kg	0.05 mg/l	1.6 mg/kg
Precision, % RPD				
Tetrachlorophenols	±40	±40	NS	NS
Pentachlorophenol	±40	±40	±50	±47
Accuracy, % Recovery				
Tetrachlorophenols	40-160	40-160	NS	NS
Pentachlorophenol	40-160	40-160	9-103	17-109
2-Fluorophenol (surrogate)	60-140	60-140	21-100	25-121
Retention Time, Min	±0.05	±0.05	±0.06	±0.06
Holding Time	24 hrs	48 hrs	7 days	7 days

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*CSL detection limits for Pentachlorophenol based on instrument detection limits

NS: Not specified.

At times the recovery of tetrachlorophenol and pentachlorophenol was adversely affected by high organic background, which masked the spike compounds. Conversely, the 2-fluorophenol displayed little effect from the organic background.

Frequency of precision analysis was 1 in 20 or 1 per batch, whichever is more frequent. Matrix spike/matrix duplicate data were used to calculate precision. The %RPD values are shown in Table 4-9.

Low concentrations of the analytes in the sample and spiked sample can cause duplicate analyses to exceed the target range for RPD. Near the instrument detection limit the measurements become inherently less repeatable (see the discussion in Section 5). Often, precision criteria are modified to allow duplicates of plus or minus the detection limit, where the results are less than 10 times the detection limit. No data were rejected if they met these alternative criteria.

Holding times were met for all of the Daishowa samples. Soil samples were analyzed within 24 hours and water samples were analyzed within 48 hours.

Table 4-9
MATRIX SPIKES, MATRIX SPIKE DUPLICATES, SURROGATE SPIKES
METHOD 8040

	Tetrachlorophenols					Pentachlorophenol					2-Fluor-Phenol (Surrogate)
Sample ID	Initial Value	% Recovery	Dupe Value	% Recovery	% RPD	Initial Value	% Recovery	Dupe Value	% Recovery	% RPD	% Recovery
H_2O Spike	0.367	94.3	0.334	85.8	9	0.152	77.1	0.174	88.4	-13	101
8318-4	2.32		2.03		13	2.52		2.66		-5	56
8318-4 S.	1.33	-180	1.29	-190	3	2.01	-328	2.27	-197.5	-12	67
8320-1	0.105		0.108		-3	0.052		0.049		6	58
8320-1 S.	0.076	-7.5	0.08	20.6	-5	0.007	-21.8	0.032	16.1	-128	87
8334-11	<0.005		<0.005		0	<0.005		<0.005		0	84
8344-11 S.	29.7	79.2	28	80	6	13.4	70.4	12.5	70.7	7	90
8345-5	<0.005		<0.005		0	3.74		2.13		55	75
8345-5 S.	23		22.4	80.4	3	8.5		8.76	40.8	-3	78
8350-1	0.007		0.008		-13	<0.005		<0.005		0	90
8356-6	<1		<1		0	<1		<1		0	110
8356-6 S.	21.9	65.2	18.5	62.7	17	9.71	56.9	7.81	52.2	22	141
8380-3	<1				ERR	<1				ERR	71
8380-3 S.	24.6	70.8	21.3	67.8	14	11.7	66.2	11.4	71.4	3	102
8401-10	<1		<1		0	<1		<1		0	57
8401-10 S.	11	45.8	13	56.3	-17	9.81	80.6	11.8	110.7	-18	77
8401-12	<0.005		<0.005		0	<0.005		<0.005		0	107
8410-8	<1		<1		0	<1		<1		0	73
8410-8 S.	7.65	22.4	8.13	32.6	-6	4.9	28.3	5.32	42.1	-8	85
8410-2	<0.005		<0.005		0	<0.005		<0.005		0	92
8419-5	<1		<1		0	<1		<1		0	95
8419-5 S.	27	78	15.4	65.2	55	12.8	73.3	6.88	57.4	60	100
8429-6	<1		<1		0	<1		<1		0	112
8426-6 S.	9.22	40.4	25.7	93.3	-94	4.09	35.3	13.1	93.7	-105	106
H_2O Spike	31.5	81.1			ERR	17	86.1			ERR	94
8432-1	<1		<1		0	<1		<1		0	104
8432-1 S.	17.9	58.7	24.5	92.4	-31	10.1	65.2	14.1	104.8	-33	99
8432-5	<1		<1		0	<1		<1		0	86
8432-5 S.	15.8	83.5	16.5	84.1	-4	8.5	88.8	8.33	83.9	2	110
H_2O Spike	0.324	83.3			ERR	0.148	75.1			ERR	91
8453-5	<1		<1		0	<1		<1		0	87
8453-5 S.	22	59.8	25.5	80.4	-15	11.4	59.5	14.1	85.6	-21	77
8453-10	<1		<1		0	<1		<1		0	70
8453-10 S.	19.2	46	29	52.1	-41	7.37	34.9	18.4	65.5	-86	82
8453-1	<0.005		<0.005		0	<0.005		<0.005		0	70
8453-1 S.	0.185	47.6	0.172	44.2	7	0.039	19.8	0.036	18.2	8	80
8482-1	0.045		0.046		-2	<0.005		<0.005		0	102
8482-1 S.	0.359	92.2	0.309	79.3	15	0.108	54.6	0.08	40.5	30	73
8512-5	0.006		0.006		0	<0.005		<0.005		0	93
8512-5 S.	0.32	82.1	0.326	83.7	-2	0.177	89.9	0.169	85.7	5	74
8527-3	<0.005		<0.005		0	<0.005		<0.005		0	79
8527-3 S.	0.271	69.5	0.29	74.4	-7	0.152	77	0.086	43.8	55	94
8527-9	<1		<1		0	<1		<1		0	40
8527-9 S.	3.89	15.1			ERR	0.202	1.6			ERR	84
H_2O Spike	0.239	61.5	0.276	71	-14	0.107	54.1	0.116	58.9	-8	90
8552-6	0.092		0.055		50	0.064		0.038		51	

NOTE: ERR signifies that duplicates were not analyzed.
RPD is the relative percent difference between the two values.

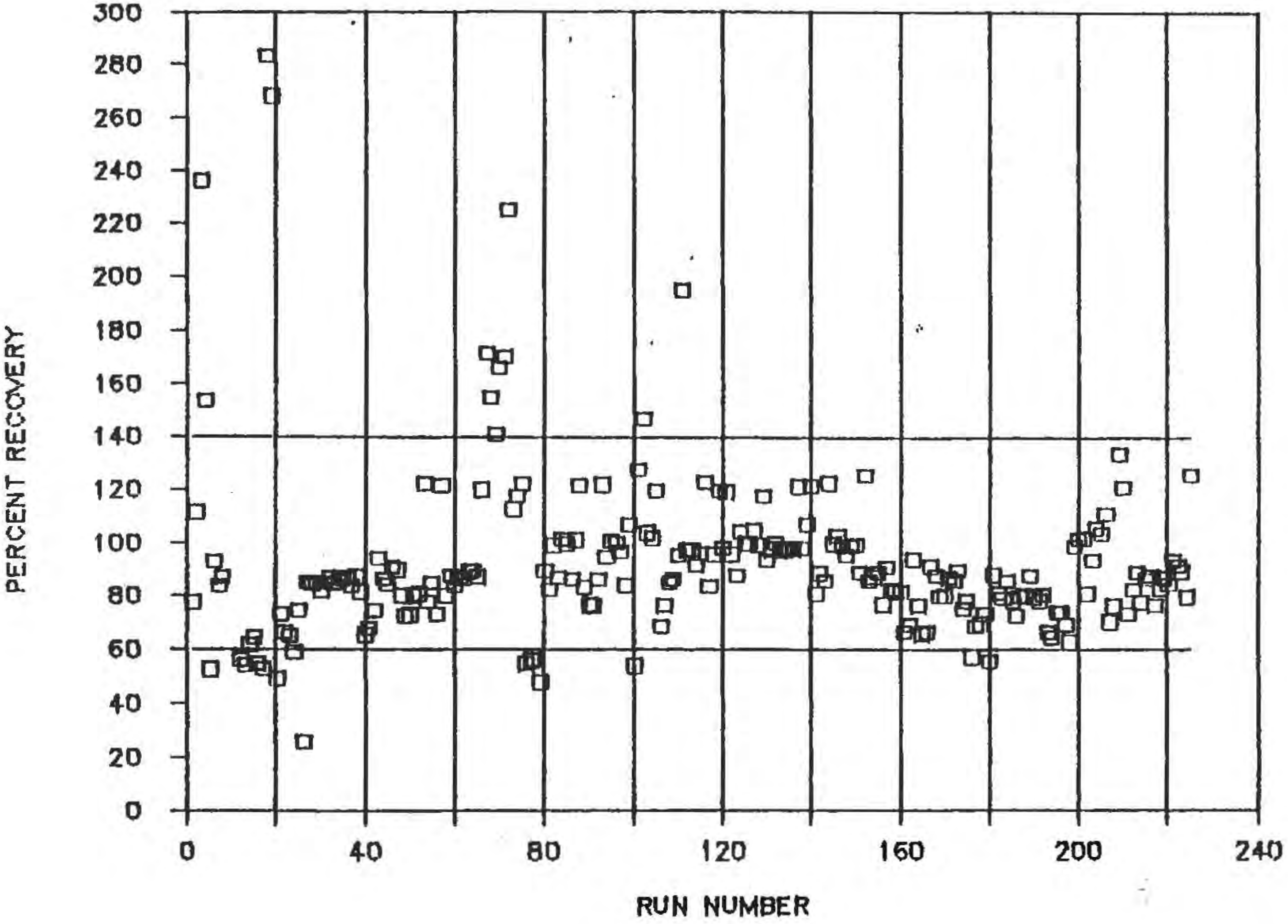

FIGURE 4-21
**Close Support Laboratory Method (8040)
Surrogate Recoveries 2-Fluorophenol**

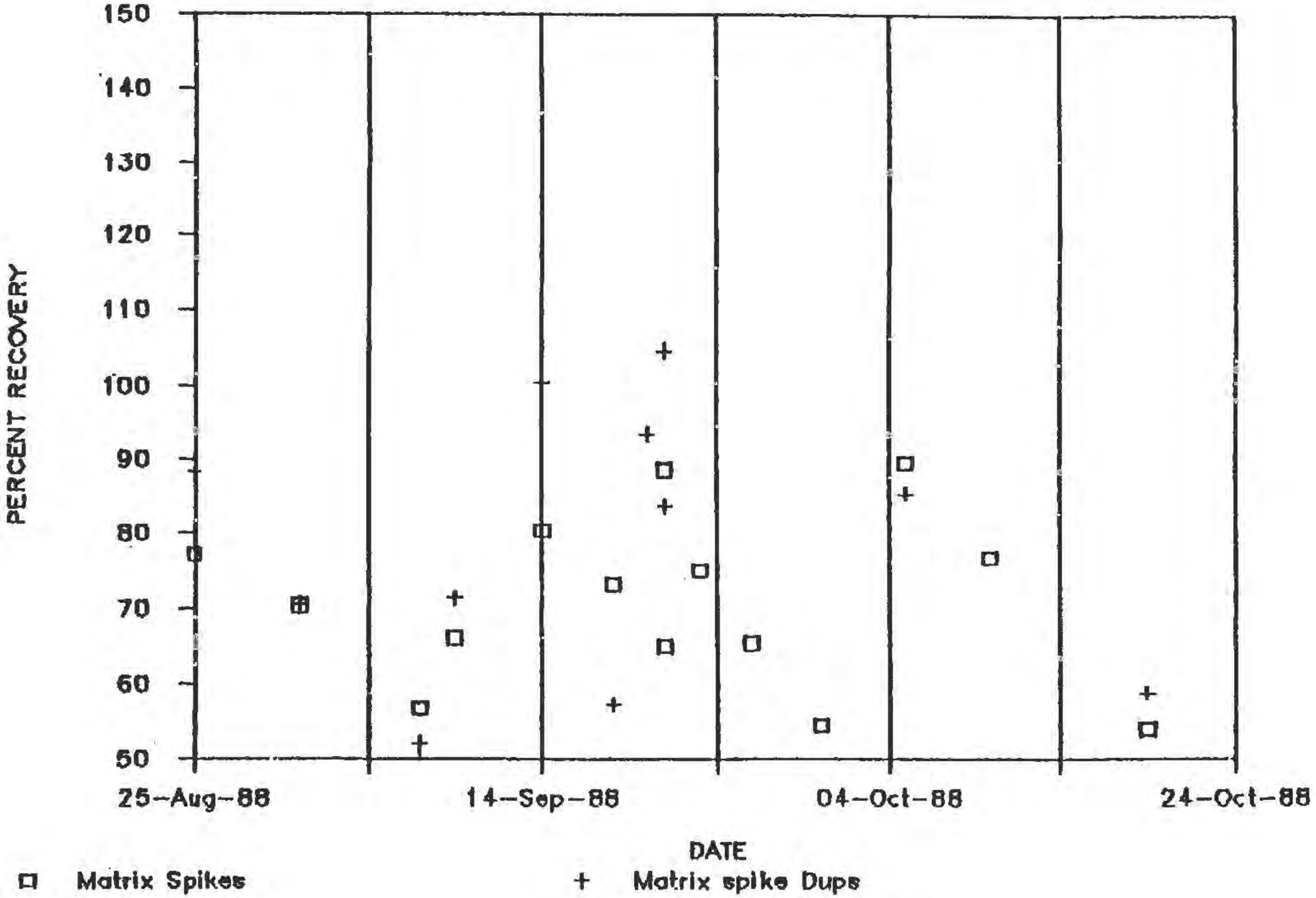

FIGURE 4-22
Close Support Laboratory Method (8040)
Matrix Spike Recoveries Pentachlorophenol

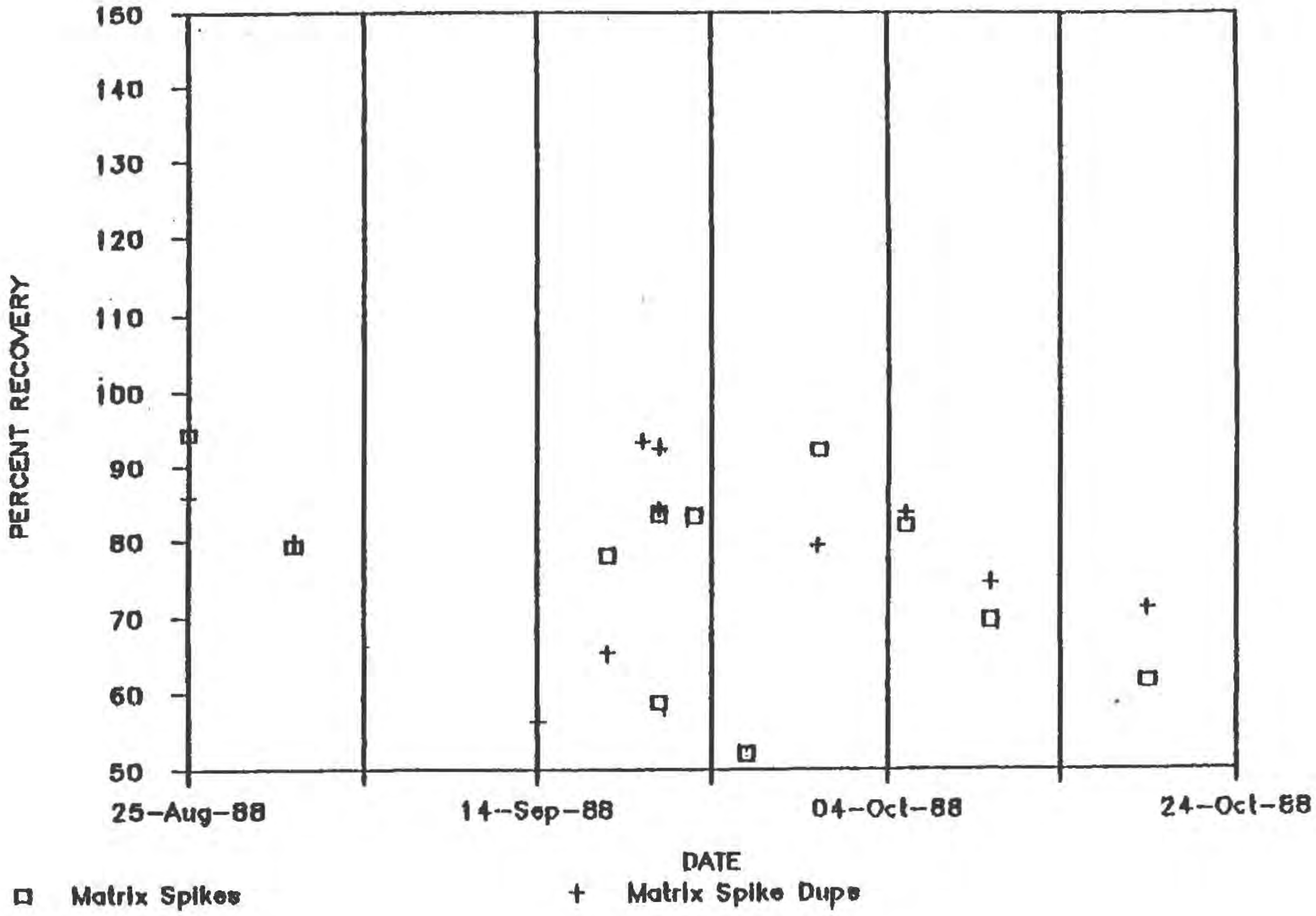

FIGURE 4-23
Close Support Laboratory Method (8040)
Matrix Spike Recoveries Tetrachlorophenols

Blanks were used to determine the existence and magnitude of contamination, if any, introduced by laboratory and field procedures. Field and laboratory blanks were both used in this investigation. Blank data are compared to detection limit criteria.

Distilled water was used as a water blank and sodium sulfate was used as a soil blank by the lab. These blanks were treated identically as samples in sample preparation and analysis procedures. Frequency of blank analysis was 1 in 20 or 1 per batch, whichever was more frequent. Throughout the Daishowa project, there were no detectable compounds found in any lab blanks.

Equipment blanks were also analyzed. All equipment blanks showed no contamination except for DSA-MW6C-EB-11/8/88 which had 0.030 mg/l PCP and DSA-16C-EB with 0.009 mg/l TCP and 0.016 mg/l PCP. For sample MW-6C, the sample value was greater than five times the blank contamination and is valid according to EPA data validation guidelines. In sample MW-16C, no PCP was found above the detection limit and the TCP value was greater than five times the blank contamination level so no action was taken.

Detection limits for the analytes were set at 1.0 mg/kg for soil samples and 0.005 mg/l for water. These were based on method and instrumental performance and did not take into account the potential matrix effects. This should be considered when interpreting the data. Considering the effects of water matrix on the instrumental detection limit, it is apparent that the practical quantification limit for analysis of Daishowa water samples is 0.03 mg/l. The practical quantification limit for Daishowa soil samples is 1.0 mg/kg as originally specified.

Daily mid-range calibration checks were performed prior to the analysis of each day's samples or with each lot of 20, whichever was more frequent. The initial linear range can be seen on Table 4-10. If the daily response factors varied by more than ±15 percent from the initial calibration, a fresh standard was prepared and recalibration performed.

A retention time marker, 2,4,6-tribromophenol, was used in all samples to monitor the instrument performance. Figure 4-24 shows that retention times stayed within the ±0.05 minutes, except for three outliers in the first week of work.

Water pollution quality control samples (WP 281) (obtained from from EPA-EMSL repository) were run to monitor the extraction procedure and quality of lab standards. With the exception of phenol and 2,4-dimethylphenol, all compounds were within the 95 percent confidence intervals. This can be seen on Table 4-11.

Table 4-10
DAISHOWA
INITIAL CALIBRATION DATA
Date: 8/22/88

Compound	Estd 1 Area 50 ppm	Estd 2 Area 5 ppm	Estd 3 Area 0.5 ppm	Linearity
2-Fluorophenol	14026000	1200000	282320	0.999491
Phenol	2967300	252950	52750	0.999568
2-Chlorophenol	2062800	182670	38268	0.999664
2-Nitrophenol	1906000	171750	33853	0.999738
2,4-Dimethylphenol	3207000	278760	57623	0.999625
2,4-Dichlorophenol	1880800	163800	34989	0.999609
4-Chloro3-Methylphenol	13632000	1163900	250490	0.999552
2,4,6-Trichlorophenol	4732000	419920	88349	0.999666
2,4-Dinitrophenol	4395900	346270	40857	0.999622
4-Nitrophenol	12031000	1130200	240330	0.999790
Tetrachlorophenols	16309000	1524300	327330	0.999792
2-Me-4,6-Dinitrophenol	9760800	888300	154260	0.999815
Pentachlorophenol	7105900	598790	127970	0.999520

Table 4-11
WATER POLLUTION QUALITY CONTROL SAMPLES
EPA STANDARD WP281

Parameter	True Value	$\bar{X}$	95 Percent Confidence Interval	8/25/88 Value	8/25/88 Dupe Value	8/25/88 % RPD	9/23/88 Value
Phenol	0.100	0.0431	0.0269 - 0.0593	0.065	0.067	-3	0.065
2,4-dimethylphenol	0.0833	0.0507	0.0217 - 0.0797	0.119	0.116	3	0.069
2-chlorophenol	0.110	0.0905	0.0509 - 0.130	0.107	0.108	1	0.098
4-chloro-3-methylphenol	0.175	0.150	0.0992 - 0.201	0.174	0.169	3	0.167
2,4-dichlorophenol	0.070	0.0572	0.0354 - 0.0790	0.070	0.069	1	0.064
2,4,6-trichlorophenol	0.125	0.107	0.0744 - 0.140	0.125	0.125	3	0.124
Pentachlorophenol	0.090	0.0768	0.0404 - 0.113	0.105	0.093	12	0.081
2-nitrophenol	0.175	0.141	0.0938 - 0.188	0.172	0.168	2	0.158
4-nitrophenol	0.120	0.060	0.0276 - 0.0924	0.085	0.084	1	0.074
2,4-dinitrophenol	0.275	0.218	0.0820 - 0.354	0.297	0.276	7	0.221

Note: Concentrations in mg/l.

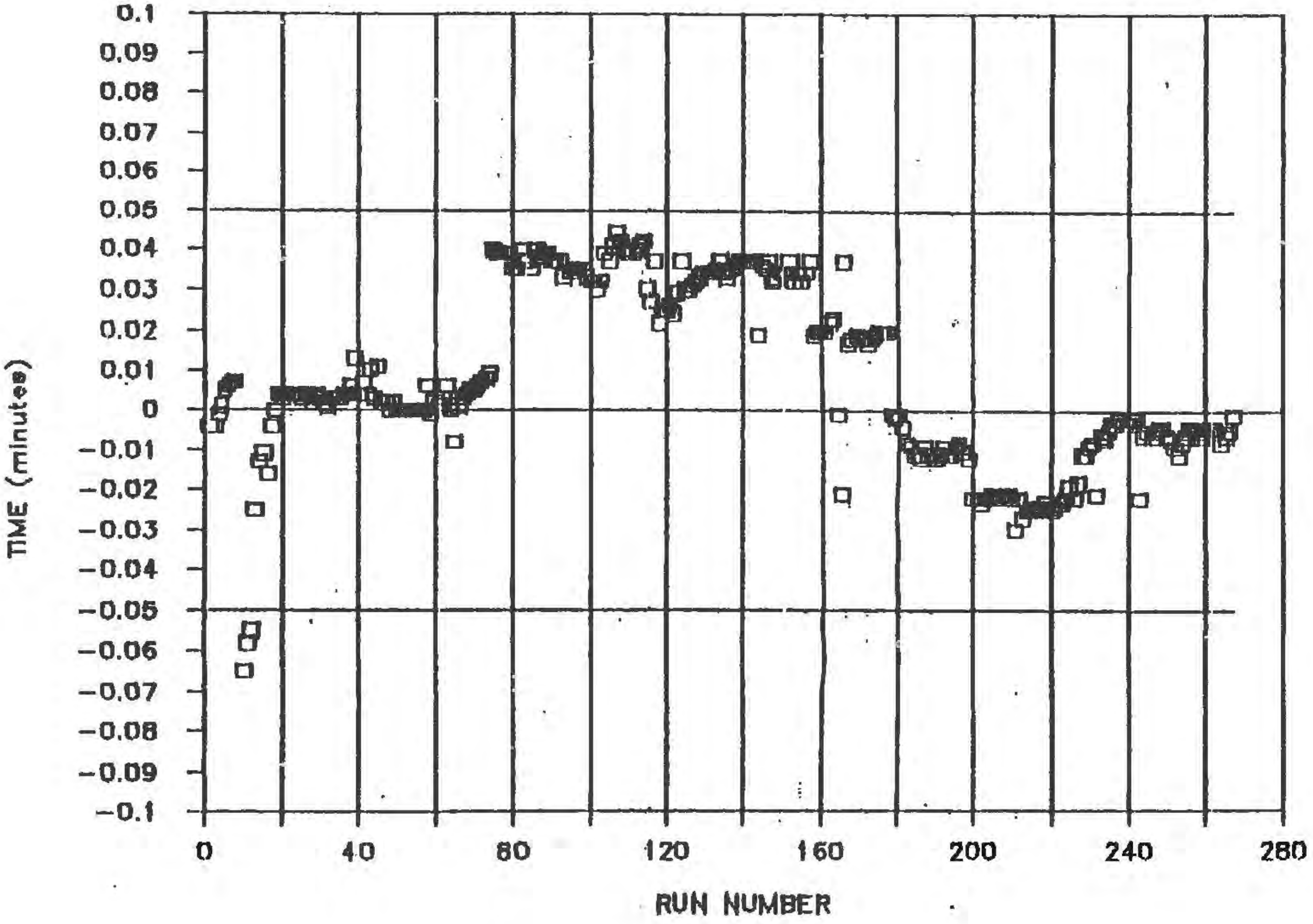

FIGURE 4-24
**Close Support Laboratory Method (8040)
Retention Time Marker Variation**

4.2.2. Chemical Data Quality Assurance--Method 8270 and Appendix IX Parameters

Groundwater and soil samples were analyzed for semivolatile organic compounds by Method 8270 for Appendix IX parameters. The specific parameters are presented in the QAPP (Appendix A).

Analyses were carried out by Enseco's California Analytical Laboratory and Rocky Mountain Analytical Laboratory using the EPA Contract Laboratory Program (CLP) protocols. The semivolatile organic compounds analyzed for were the compounds listed in the target compound list (TCL) used by the EPA CLP for Superfund sites. The TCL includes the priority pollutants plus other compounds from the Hazardous Substances List (HSL). The presence and nature of other existing organic contaminants were also established as defined by the EPA CLP protocols. The Appendix IX parameters were analyzed by standard EPA methods (volatile compounds 624 and 8240, semivolatile compounds 625 and 8270, pesticides/PCBs 608 and 8080, metals 200.7, 206.2, 239.2, 245.1, 270.2, 279.2, 6010, 7060, 7421, 7471, 7740, and 7841; cyanide 335.3 and 9010, and sulfide 376.2 and EPA/OSW) with an equivalent level of quality assurance effort with regard to the CLP protocols. Only the Method 8270 QA tables appear in this section. Appendix IX data is provided in Appendix J.

The quality control measurements that aided in the quantitative assessment of the Method 8270 data are summarized in Tables 4-12 through 4-17 presented in this section. These include accuracy, precision, and blank measurements; the meaning and usage of these measures are explained in Section 4.2.1. Other quality control parameters have been documented in accordance with EPA CLP protocols and are on file at CH2M HILL and the subcontracted laboratory (California Analytical); this constitutes over a thousand pages of documentation. Quality assurance review notes are also filed with these data. This documentation provides data of known quality from the most extensive state-of-the-art quality control procedures designed in this area of study.

Accuracy, Precision, and Blank Measurements. Matrix spike and matrix spike duplicate results for groundwater samples are presented in Table 4-12. Table 4-13 has matrix spike results for soil samples. Surrogate spike recovery values for the samples are presented in Table 4-14 for groundwater and Table 4-15 for soils.

For duplicate measurements, precision can be expressed as the relative percent difference (RPD). Acceptable precision limits are based on past data bases. Precision measurements for samples are presented in Table 4-12 for groundwater and Table 4-13 for soil samples. The EPA CLP control limits are

Table 4-12
GROUNDWATER MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RECOVERY
METHOD 8270

Fraction	Compound	Conc. Spike Added (µg/l)		Sample Result	MS (µg/l)	Conc. Percent Rec	Conc. MSD (µg/l)	Percent Rec	RPD	EPA QC Limits	
		Spike	Duplicate							RPD	Recovery
VOA Sample Name	1,1-Dichloroethene									14	61-145
	Trichloroethene									14	71-120
	Chlorobenzene									13	75-130
	Toluene									13	76-125
	Benzene									11	76-127
B/N Sample Name	1,2,4-Trichlorobenzene	100	100	0	76	76	81	81	6	28	39-98
	Acenaphthene	100	100	0	86	86	89	89	3	31	46-118
DSA-6B (9/7/88)	2,4-Dinitrotoluene	100	100	0	92	92	92	92	0	38	24-96
	Pyrene	100	100	0	86	86	97	97	12	31	26-127
	N-nitrosodi-N-propylamine	100	100	0	76	76	75	75	1	38	41-116
	1,4-Dichlorobenzene	100	100	0	74	74	76	76	3	28	36-97
Acid Sample Name	Pentachlorophenol	200	200	0	230	115[a]	250	125[a]	8	50	9-103
	Phenol	200	200	0	110	55	110	55	0	42	12-89
DSA-6B (9/7/88)	2-Chlorophenol	200	200	0	220	110	230	115	4.4	40	27-123
	4-Chloro-3-methylphenol	200	200	0	200	100[a]	210	105[a]	5	42	23-97
	4-Nitrophenol	200	200	0	86	43	90	45	5	50	10-80
Pesticide Sample Name	Lindane									15	56-123
	Heptachlor									20	40-131
	Aldrin									22	40-120
	Dieldrin									18	52-126
	Endrin									21	56-121
	4,4'-DDT									27	38-127

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[a] Value is outside EPA QC limits.

RPD:			Recovery:	
VOAs	NR		VOAs	NR
B/N	0 of 6 outside QC limits		B/N	0 of 12 outside QC limits
Acid	0 of 5 outside QC limits		Acid	4 of 10 outside QC limits
Pest	NR		Pest	NR

Abbreviations:

VOAs	Volatile organics	Rec	Recovery
B/N	Bases/neutrals	MSD	Matrix spike duplicate
Pest	Pesticides	RPD	Relative percent deviation
MS	Matrix spike	QC	Quality control
NR	Not required		

Table 4-13
SOIL MATRIX SPIKE AND MATRIX SPIKE DUPLICATE RECOVERY
METHOD 8270

Fraction	Compound	Conc. Spike Added (µg/kg)		Sample Result	MS (µg/kg)	Conc. Percent Rec	Conc. MSD (µg/kg)	Percent Rec	RPD	EPA QC Limits	
		Spike	Duplicate							RPD	Recovery
VOA Sample Name	1,1-Dichloroethene									22	59-172
	Trichloroethene									24	62-137
	Chlorobenzene									21	60-133
	Toluene									21	59-139
	Benzene									21	66-142
B/N Sample Name	1,2,4-Trichlorobenzene	1,960	1,960	0	1,410	72	1,530	78	8	23	38-107
	Acenaphthene	1,960	1,960	0	1,530	78	1,530	78	0	19	31-137
DSA-MW23	2,4-Dinitrotoluene	1,960	1,960	0	1,530	78	1,530	78	0	47	28-89
	Pyrene	1,960	1,960	0	1,760	90	1,880	98	7	36	35-142
	N-nitrosodi-N-propylamine	1,960	1,960	0	1,290	66	1,290	66	0	38	41-126
	1,4-Dichlorobenzene	1,960	1,960	0	1,410	72	1,530	78	8	27	28-104
Acid Sample Name	Pentachlorophenol	3,920	3,920	0	2,350	60	2,120	54	10	47	17-109
	Phenol	3,920	3,920	0	2,700	69	2,820	72	4	35	26-90
DSA-MW23	2-Chlorophenol	3,920	3,920	0	3,760	96	4,000	102	6.2	50	25-102
	4-Chloro-3-methylphenol	3,920	3,920	0	3,060	78	3,180	81	4	33	26-103
	4-Nitrophenol	3,920	3,920	0	3,060	78	2,940	75	4	50	11-114
Pesticide Sample Name	Lindane									50	46-127
	Heptachlor									31	35-130
	Aldrin									43	34-132
	Dieldrin									38	31-134
	Endrin									45	42-139
	4,4'-DDT									50	23-134

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[a] Value is outside EPA QC limits.

RPD:	VOAs	NR	Recovery:	VOAs	NR
	B/N	0 of 6 outside QC limits		B/N	0 of 12 outside QC limits
	Acid	0 of 5 outside QC limits		Acid	0 of 10 outside QC limits
	Pest	NR		Pest	NR

Abbreviations:	VOAs	Volatile organics	Rec	Recovery
	B/N	Bases/neutrals	MSD	Matrix spike duplicate
	Pest	Pesticides	RPD	Relative percent deviation
	MS	Matrix spike	QC	Quality control
	NR	Not required		

Table 4-14
GROUNDWATER SURROGATE PERCENT RECOVERY SUMMARY
METHOD 8270

	Volatile Organics			Semivolatile Organics						Pesticide	Herbicide
Sample Name	Toluene-d8 (88-110)	Bromo-fluoro-benzene (86-115)	1,2-Dichloro-ethane-d4 (76-114)	Nitro-benzene-d5 (35-114)	2-Fluoro-biphenyl (43-116)	Terphenyl-d14 (33-141)	Phenol-d5 (10-94)	2-Fluoro-phenol (21-100)	2,4,6-Tribromo-phenol (10-123)	Dibutyl-chlorendate[a] (24-154)	2,4-D[c]
DSA-MW6B (9/7/88)	NR	NR	NR	104	69	91	55	67	100	NR	NR
DSA-MW6B MS	NR	NR	NR	103	66	80	56	65	102	NR	NR
DSA-MW6B MSD	NR	NR	NR	106	69	92	56	66	106	NR	NR
DSA-MW6C	NR	NR	NR	55	45	70	44	55	74	NR	NR
DSA-MW6B (10/19/88)	NR	NR	NR	64	54	85	62	62	78	NR	NR
DSA-MW16A	NR	NR	NR	66	54	101	22	25	68	NR	NR
Blank 1	NR	NR	NR	98	65	81	42	63	90	NR	NR
Blank 2	NR	NR	NR	72	50	77	48	63	76	NR	NR

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[a] Advisory limits only.

[b] Values are outside of contract-required QC limits.

[c] No established EPA contract-required QC limits.

[d] Surrogates diluted out.

Notes: Numbers in parentheses indicate EPA contract-required QC limits.

Volatiles: NR
Semivolatiles: 0 of 48 outside QC limits
Pesticides: NR

Abbreviations:
MS = matrix spike.
MSD = matrix spike duplicate.
NR = not required.

Table 4-15
SOIL SURROGATE PERCENT RECOVERY SUMMARY
METHOD 8270

	Volatile Organics			Semivolatile Organics						Pesticide
Sample Name	Toluene-d8 (88-110)	Bromo-fluoro-benzene (86-115)	1,2-Dichloro-ethane-d4 (76-114)	Nitro-benzene-d5 (35-114)	2-Fluoro-biphenyl (43-116)	Terphenyl-d14 (33-141)	Phenol-d5 (10-94)	2-Fluoro-phenol (21-100)	2,4,6-Tribromo-phenol (10-123)	Dibutyl-chlorendate[a] (24-154)
DSA-MS53 Marine Sed	NR	NR	NR	63	60	69	65	57	80	NR
DSA-MW6B	NR	NR	NR	78	55	76	71	77	61	NR
DSA-MW8B-SS2.5	NR	NR	NR	98	70	84	92	85	89	NR
DSA-MW8B-SS5.0	NR	NR	NR	91	68	85	87	83	98	NR
DSA-MW-16B-SS2.5	NR	NR	NR	81	54	74	74	75	72	NR
DSA-MW-16B-SS5.0	NR	NR	NR	81	56	84	71	72	72	NR
DSA-MW23	NR	NR	NR	84	56	87	72	70	58	NR
DSA-MW23 MS	NR	NR	NR	86	59	81	79	78	82	NR
DSA-MW23 MSD	NR	NR	NR	94	64	90	90	91	87	NR
DSA-MW24-SS2.5	NR	NR	NR	78	57	81	74	57	79	NR
DSA-MW24-SS7.5	NR	NR	NR	87	58	86	78	75	74	NR
DSA-MW24-SS20.0	NR	NR	NR	78	55	78	77	77	68	NR
DSA-MW25A-SS2.5	NR	NR	NR	94	56	62	64	57	80	NR
DSA-MW25A-SS5.0	NR	NR	NR	104	58	71	68	61	86	NR
DSA-MW-25B-SS-0.0	NR	NR	NR	89	67	94	89	80	83	NR
DSA-MW-25B-SS2.5	NR	NR	NR	94	65	86	87	84	95	NR
DSA-MW26-SS2.5	NR	NR	NR	82	60	76	84	81	73	NR
DSA-MW26-SS5.0	NR	NR	NR	85	57	73	81	78	71	NR
DSA-MW26-SS17.0	NR	NR	NR	95	57	77	87	86	64	NR
DSA-SB-16CD-11	NR	NR	NR	59	61	86	79	62	78	NR
Blank 1	NR	NR	NR	105	70	96	97	93	89	NR
Blank 2	NR	NR	NR	81	55	82	73	76	58	NR
Blank 3	NR	NR	NR	81	57	85	72	78	63	NR
Blank 4	NR	NR	NR	91	61	76	70	62	67	NR
Blank 5	NR	NR	NR	81	55	82	76	73	58	NR
Blank 6	NR	NR	NR	88	60	83	88	84	56	NR
Blank 7	NR	NR	NR	81	63	82	91	82	79	NR

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[a] Advisory limits only.

[b] Values are outside of contract-required QC limits.

[c] No established EPA contract-required QC limits.

[d] Surrogates diluted out.

Notes: Numbers in parentheses indicate EPA contract-required QC limits.

Volatiles:	NR
Semivolatiles:	0 of 162 outside QC limits
Pesticides:	NR

Abbreviations:
MS = matrix spike.
MSD = matrix spike duplicate.
NR = not required.

Table 4-16
GROUNDWATER METHOD BLANK SUMMARY
METHOD 8270

Method Blank Name	Date of Analysis	Fraction	Matrix	Level	Inst. ID	CAS Number	Compound (HSL, TIC, or unknown)	Concentration (µg/1)	CRDL
Blank 1	10/14/88	SVOA	Water	Low	F19	117-81-7	Bis(2ethyhexyl)phthalate	9	10
Blank 2	11/10/88	SVOA	Water	Low	F16	117-81-7	Bis(2ethylhexyl)phthalate	9	20
							Unknown	72	
							Unknown	32	

CRDL = contract required detection limit.
HSL = hazardous substance list.
TIC = tentatively identified compound.

Table 4-17
SOIL METHOD BLANK SUMMARY
METHOD 8270

Method Blank Name	Date of Analysis	Fraction	Matrix	Level	Inst. ID	CAS Number	Compound (HSL, TIC, or unknown)	Concentration (µg/kg)	CRDL
Blank 1	10 14 86	SVOA	Soil	Low	F19	84-74-2	Di-n-butylphthalate	30	330
						117-81-7	Bis(2-ethylhexyl)phthalate	140	330
						110-02-1	Thiophene	96	
						625-23-0	2-Hexanol, 2methyl	2,000	
						1187-58-2	Propanamide, n-methyl	130	
						620-05-3	Benzene (iodomethyl)	750	
Blank 2	10 13 '88	SVOA	Soil	Low	F19	117-81-7	Bis(2thylhexyl)phthalate	290	330
						110-02-1	Thiophene	220	
						4337-65-9	Hexanediotic acid	1,100	
Blank 3	10 13 '88	SVOA	Soil	Low	F19	84-74-2	Bi-n-butyl-phthalate	55	330
						117-81-7	Bis(2-ethylhexyl)phthalate	140	330
						110-02-1	Thiophene	168	
						625-23-0	2-Hexanol, 2-methyl	3,800	
						3970-62-5	3-Pentanol, 2,2-dimethyl	280	
						16487-65-3	Benzene, 3-pentenyl	55	
						1984-04-9	Naphthalene, 1-isocyano-	2,100	
Blank 4	10/22/88	SVOA	Soil	Low	F19	84-74-2	Di-n-butylphthalate	98	330
						117-81-7	Bis(2-ethylhexyl)phthalate	110	330
							Unknown	360	
							Unknown	300	
							Unknown	8,250	
							Unknown	260	
				--		5074-71-5	(DFTPP) Phosphine, bis (pentaflurophenyl)phenyl	730	
						545783-80-8	D4-Di-N-octyl phthalate	2,000	
Blank 5	10/13/88	SVOA	Soil	Low	F19	117-81-7	Bis(2-ethylhexyl)phthalate	290	330
						110-02-1	Thiophene	200	
						625-23-0	2-Hexanol	3,900	
						3970-62-5	3-Pentanol	300	
						620-05-3	Phenoxy methyl benzene	590	
						23403-41-0	L threonine	1,700	
Blank 6	10/22/88	SVOA	Soil	Low	F19	117-81-7	Bis(2-ethylhexyl)phthalate	150	330
							Substituted benzene	790	
							Unknown	500	
							Unknown	330	
							Unknown	11,000	
							Unknown	290	
Blank 7	12/6/88	SVOA	Soil	Low	F21	117-81-7	Bis(2-ethylhexyl)phthalate	51	330
						00-00-0	Unknown	660	

CRDL = contract required detection limit.
HSL = hazardous substance list.
TIC = tentatively identified compound.

noted, along with any data points outside the limits. For the CLP parameters, the data were again found to be within the listed control limits for above 95 percent of measurements.

The laboratory contaminants found in method blank measurements for samples are summarized in Table 4-16 for groundwater and Table 4-17 for soils. All blanks meet CLP criteria in that laboratory contaminants were found to be below EPA-specified quantitation levels. The data set has been qualified with regard to organic compounds observed in blanks by adjusting the detection limits for those compounds and flagging the data "UJ."

4.2.2.3 Chemical Data Quality Assurance--Mercury

Samples received for mercury analysis were analyzed according to SW846 Method 7471 for soil analysis. A sample size of 1 gram was used for soil. The digestion procedure was according to SW846 manual cold vapor technique and then the samples were analyzed on a Model MAS-50B mercury analyzer system.

Thirty-four samples were received for mercury analysis; three duplicates and three spikes were performed. Table 4-18 presents the QA/QC results of all mercury analysis.

Table 4-18
MERCURY PRECISION AND ACCURACY
Concentrations in mg/kg

PRECISION

Determination No.	Sample Value	Duplicate Value	Percent RPD
1	0.04	0.04	±0.0
2	0.06	0.05	-18.2
3	0.008	0.009	+11.8

ACCURACY

Determination No.	Sample Size(g)	Sample Value	Spike Added	Spike Sample Value	Percent Recovery
1	1.09	0.008	0.100	0.113	96
2	1.00	0.008	0.100	0.113	105
3	1.03	0.008	0.100	0.113	102

Both precision and accuracy for these determinations were within QA requirements: RPD of ±20 percent and percent recovery of 80-120.

4.3 SOIL RESULTS

4.3.1 METHOD 8040-PCP/TCP

Close Support Laboratory (CSL) Method 8040 was used to analyze 60 soil samples collected during monitoring well installation for the presence of PCP and TCP. Six marine sediment samples were also analyzed by Method 8040 for PCP/TCP.

All samples were analyzed by the modified Method 8040 described in Section 3.2.1.1 and in the SAP and QAPP (Appendix A). Neither PCP nor TCP were detected in any background soil sample (MW-26). Results for the Method 8040 analysis for all samples (soils and groundwater) are presented in Table 4-19. Table 4-19 also presents the PCP results from the Method 8270 semivolatile organic compounds analysis in order to compare the PCP results of the two analytical methods.

In addition to the 60 soil samples discussed above, six additional surface soils and two additional marine sediments were collected from adjacent to the former M&R property and offshore locations (see Figure 3-3). Finally, as part of the verification of the Preliminary Environmental Assessment (HC, 1988), samples were analyzed for PCP and TCP. A summary of the verification data gathering efforts, selected analyses, and sampling rationale are presented in the Technical Memorandum, "Verification Study of the Former M&R Property." The memorandum is provided as an addendum to this report.

4.3.1.1 SUBSURFACE SOIL SAMPLES

PCP was detected in only two of the 60 soil boring samples analyzed by Method 8040. Both of the two 8040 results were collected from MW-24B (2.81^{J} mg/kg dry weight at 7.5 feet and 2.22^{N} mg/kg dry weight at 35 feet, respectively). Both results were flagged by the laboratory, one as quantitatively (J) suspect and the remaining sample as qualitatively (N) suspect. According to the CSL designation, quantitatively suspect means the compound is likely to be present but the exact concentration is unknown. It is believed by the laboratory, however, that the flagged value represents the upper limit of possible compound concentration, and that the actual concentration will not exceed the reported value. The qualitatively suspected value means that the exact compound's identity is not clearly identifiable (i.e., something was detected, but the identification is questioned).

TCP was detected in seven of the 60 soil boring samples. The seven samples were collected from four borings (MW-6B, MW-16C, MW-24A, and MW-24B). Five of the seven Method 8040

Table 4-19
Soil and Groundwater Results for TCP/PCP and Mercury by Methods 8040 and 8270

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	Concentration Units
MW5A	DSA-MW5 (8320-5)	8/28/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW5 (8527-2)	10/6/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW6A	DSA-MW6 (8318-4)	8/24/88	Groundwater	N/A	2.84		3.07					mg/l
	DSA-MW6A (8527-11)	10/6/88	Groundwater	N/A	0.28 N		0.51 J					mg/l
	DSA-MW6A (8552-1)	10/13/88	Groundwater	N/A	1.35 J		2.13					mg/l
MW6B	DSA-MW6B-SS2.5 (8334-6)	8/30/88	Soil	2.5 to 4.0 ft.	1.0 U		1.0 U			0.245	0.259	mg/kg
	DSA-MW6B-SS5.0 (8334-7)	8/30/88	Soil	5.0 to 6.5 ft.	1.0 U		1.0 U		1.6 U	0.235	0.286	mg/kg
	DSA-MW6B-SS7.5 (8334-8)	8/30/88	Soil	7.5 to 9.0 ft.	1.0 U		1.0 U			0.055	0.070	mg/kg
	DSA-MW6B-SS30.0 (8334-10)	8/30/88	Soil	30.0 to31.5 ft.	1.4 N		1.0 U			0.03 U	0.039 U	mg/kg
	DSA-MW6B-SS50.0 (8334-11)	8/30/88	Soil	50.0 to 51.5 ft.	1.0 U		1.0 U			0.03 U	0.043 U	mg/kg
	DSA-MW6B (8350-1)	9/21/88	Groundwater	N/A	0.010		0.005 U		0.050 U			mg/l
	DSA-MW6B (8552-2)	10/13/88	Groundwater	N/A	0.005 U		0.005 U		0.010 U			mg/l
MW6C	DSA-MW6C-SS2.5 (8527-6)	10/6/88	Soil	2.5 to 4.0 ft.	1.0 U	1.1 U	1.0 U	1.1 U				mg/kg
	DSA-MW6C-SS5.0 (8527-7)	10/6/88	Soil	5.0 to 6.5 ft.	1.0 U	1.3 U	1.0 U	1.3 U				mg/kg
	DSA-MW6C-SS7.5 (8527-8)	10/6/88	Soil	7.5 to 9.0 ft.	1.0 U	1.2 U	1.0 U	1.2 U				mg/kg
	DSA-MW6C-SS17.5 (8527-9)	10/6/88	Soil	17.5 to 19.0 ft.	1.0 U	1.2 U	1.0 U	1.2 U				mg/kg

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19

Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		Concentration Units
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	
MW6C	DSA-MW6C (8552-4)	10/13/88	Groundwater	N/A	10.2 J		14.3		6.9			mg/l
	DSA-MW6C (8633-2)	11/1/88	Groundwater	N/A	0.23		0.27					mg/l
	DSA-MW6C (8680-1)	11/21/88	Groundwater	N/A	0.04		0.16					mg/l
MW8	DSA-MW8 (8288-1)	8/17/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW8 (8320-4)	8/26/88	Groundwater	N/A	0.005 U		0.005					mg/l
	DSA-MW8A (8512-1)	10/3/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW8B	DSA-MW8B-SS2.5 (8401-2)	9/12/88	Soil	2.5 to 4.0 ft.	1.0 U	1.07 U	1.0 U	1.07 U		0.05 U	0.05 U	mg/kg
	DSA-MW8B-SS2.5D (8401-3)	9/12/88	Soil	2.5 to 4.0 ft.	1.0 U	1.06 U	1.0 U	1.06 U	1.6 U	0.05 U	0.05 U	mg/kg
	DSA-MW8B-SS5.0 (8401-6)	9/12/88	Soil	5.0 to 6.5 ft.	1.0 U	1.24 U	1.0 U	1.24 U	1.6 U	0.05 U	0.06 U	mg/kg
	DSA-MW8B-SS7.5 (8401-7)	9/12/88	Soil	7.5 to 9.0 ft.	1.0 U	1.13 U	1.0 U	1.13 U				mg/kg
	DSA-MW8B-SS30.0 (8401-8)	9/12/88	Soil	30.0 to 31.5 ft.	1.0 U	1.31 U	1.0 U	1.31 U				mg/kg
	DSA-MW8B-SS50.0 (8401-10)	9/12/88	Soil	50.0 to 51.5 ft.	1.0 U	1.43 U	1.0 U	1.43 U		0.05 U	0.07 U	mg/kg
	DSA-MW8B (8482-3)	9/26/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW8B (8512-2)	10/3/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW15	DSA-MW15 (8318-3)	8/24/88	Groundwater	N/A	0.005 U		0.009					mg/l
	DSA-MW15 (8521-2)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l

J = Quantitatively suspect
U = Undetected above this concentration

N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19
Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	Units
MW16A	DSA-MW16 (8320-1)	8/28/88	Groundwater	N/A	0.105N		0.052					mg/l
	DSA-MW16A (8512-5)	10/14/88	Groundwater	N/A	0.006N		0.005 U					mg/l
	DSA-MW16A (8552-6)	10/14/88	Groundwater	N/A	0.092 J		0.064		0.017 J			mg/l
MW16B	DSA-MW16B-SS2.5 (8380-3)	9/8/88	Soil	2.5 to 4.0 ft.	1.0 U	1.03 U	1.0 U	1.03 U	1.6 U	0.05 U	0.05 U	mg/kg
	DSA-MW16B-SS5.0 (8380-4)	9/8/88	Soil	5.0 to 6.5 ft.	1.0 U	1.11 U	1.0 U	1.11 U	1.6 U	0.05 U	0.06 U	mg/kg
	DSA-MW16B-SS7.5 (8380-5)	9/8/88	Soil	7.5 to 9.0 ft.	1.0 U	1.22 U	1.0 U	1.22 U				mg/kg
	DSA-MW16B-SS30.0 (8380-6)	9/8/88	Soil	30.0 to 31.5 ft.	1.0 U	1.30 U	1.0 U	1.30 U				mg/kg
	DSA-MW16B-SS50.0 (8380-7)	9/8/88	Soil	50.0 to 51.5 ft.	1.0 U	1.42 U	1.0 U	1.42 U		0.05 U	0.07 U	mg/kg
	DSA-MW16B-SS50.0D (8380-8)	9/8/88	Soil	50.0 to 51.5 ft.	1.0 U	1.39 U	1.0 U	1.39 U				mg/kg
	DSA-MW16B (8458-1)	9/23/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW16BD (8458-2)	9/23/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW16B (8512-6)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
Boring 16C	DSA-SB-16C-11 (8667-1)	11/16/88	Soil	9.0 to 14.0 ft.	4.7	6.2	1.0 U	1.3 U				mg/kg
	DSA-SB-16C-11D (8667-1D)	11/16/88	Soil	9.0 to 14.0 ft.	4.6	6.1	1.0 U	1.3 U	24			mg/kg

J = Quantitatively suspect
U = Undetected above this concentration

N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19

Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP Method 8040		PCP Method 8040		PCP Method 8270	Mercury		
Location	**Sample ID No.**	**Date Sampled**	**Matrix**	**Soil Depth**	**As Received**	**Dry Wt.**	**As Received**	**Dry Wt.**	**As Received**	**As Received**	**Dry Wt.**	**Units**
MW16A	DSA-MW16 (8320-1)	8/28/88	Groundwater	N/A	0.105N		0.052					mg/l
	DSA-MW16A (8512-5)	10/14/88	Groundwater	N/A	0.006N		0.005 U					mg/l
	DSA-MW16A (8552-6)	10/14/88	Groundwater	N/A	0.092 J		0.064		0.017 J			mg/l
MW16B	DSA-MW16B-SS2.5 (8380-3)	9/8/88	Soil	2.5 to 4.0 ft.	1.0 U	1.03 U	1.0 U	1.03 U	1.6 U	0.05 U	0.05 U	mg/kg
	DSA-MW16B-SS5.0 (8380-4)	9/8/88	Soil	5.0 to 6.5 ft.	1.0 U	1.11 U	1.0 U	1.11 U	1.6 U	0.05 U	0.06 U	mg/kg
	DSA-MW16B-SS7.5 (8380-5)	9/8/88	Soil	7.5 to 9.0 ft.	1.0 U	1.22 U	1.0 U	1.22 U				mg/kg
	DSA-MW16B-SS30.0 (8380-6)	9/8/88	Soil	30.0 to 31.5 ft.	1.0 U	1.30 U	1.0 U	1.30 U				mg/kg
	DSA-MW16B-SS50.0 (8380-7)	9/8/88	Soil	50.0 to 51.5 ft.	1.0 U	1.42 U	1.0 U	1.42 U		0.05 U	0.07 U	mg/kg
	DSA-MW16B-SS50.0D (8380-8)	9/8/88	Soil	50.0 to 51.5 ft.	1.0 U	1.39 U	1.0 U	1.39 U				mg/kg
	DSA-MW16B (8458-1)	9/23/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW16BD (8458-2)	9/23/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW16B (8512-6)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
Boring 16C	DSA-SB-16C-11 (8667-1)	11/16/88	Soil	9.0 to 14.0 ft.	4.7	6.2	1.0 U	1.3 U				mg/kg
	DSA-SB-16C-11D (8667-1D)	11/16/88	Soil	9.0 to 14.0 ft.	4.6	6.1	1.0 U	1.3 U				mg/kg

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19
Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	Units
MW18	DSA-MW18 (8318-2)	8/24/88	Groundwater	N/A	0.005 U		0.006					mg/l
	DSA-MW18 (8521-3)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW19	DSA-MW19 (8320-2)	8/26/88	Groundwater	N/A	0.005 U		0.015					mg/l
	DSA-MW19 (8521-1)	10/15/88	Groundwater	N/A	0.345 J		R					mg/l
MW21	DSA-MW21 (8318-1)	8/24/88	Groundwater	N/A	0.005 U		0.021					mg/l
	DSA-MW21 (8521-5)	10/5/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW22	DSA-MW22 (8320-3)	8/28/88	Groundwater	N/A	0.005 U		0.025					mg/l
	DSA-MW22 (8521-4)	10/5/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW23	DSA-MW23-SS2.5 (8334-1)	8/29/88	Soil	2.5 to 4.0 ft.	1.0 U		1.0 U			0.064	0.069	mg/kg
	DSA-MW23-SS5.0 (8334-2)	8/29/88	Soil	5.0 to 6.5 ft.	1.0 U		1.0 U			0.03 U	0.031 U	mg/kg
	DSA-MW23-SS7.5 (8334-3)	8/29/88	Soil	7.5 to 9.0 ft.	1.0 U		1.0 U			0.056	0.071	mg/kg
	DSA-MW23-SS10.0 (8334-4)	8/29/88	Soil	10.0 to 11.5 ft.	1.0 U		1.0 U		1.6 U	0.03 U	0.034 U	mg/kg
	DSA-MW23.SS17.5 (8334-5)	8/29/88	Soil	17.5 to 19.0 ft.	1.0 U		1.0 U			0.03 U	0.035 U	mg/kg
	DSA-MW23 (8345-1)	9/1/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW23 (8527-1)	10/6/88	Groundwater	N/A	0.005 U		0.005 U					mg/l

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19
Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	**Sample ID No.**	**Date Sampled**	**Matrix**	**Soil Depth**	**As Received**	**Dry Wt.**	**As Received**	**Dry Wt.**	**As Received**	**As Received**	**Dry Wt.**	**Units**
MW24A	DSA-MW24.SS2.5 (8345-2)	9/1/88	Soil	2.5 to 4.0 ft.	1.0 U	1.1 U	1.0 U	1.1 U	3.2 U	0.064	0.071	mg/kg
	DSA-MW24-SS5.0 (8345-3)	9/1/88	Soil	5.0 to 6.5 ft.	3.72 N	4.55 N	1.0 U	1.2 U		0.05 U	0.06 U	mg/kg
	DSA-MW24-SS7.5 (8345-4)	9/1/88	Soil	7.5 to 9.0 ft.	3.44 N	3.83 N	1.0 U	1.1 U	1.6 U	0.043	0.048	mg/kg
	DSA-MW24-SS20 (8345-5)	9/1/88	Soil	20.0 to 21.5 ft.	1.0 U	1.3 U	1.0 U	1.3 U	1.6 U	0.05 U	0.07 U	mg/kg
	DSA-MW24A (8401-12)	9/13/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW24A (8512-3)	10/3/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW24B	DSA-MW24B-SS2.5 (8356-1)	9/6/88	Soil	2.5 to 4.0 ft.	2.28 N	2.66 N	1.0 U	1.17 U		0.13	0.15	mg/kg
	DSA-MW24B-7.5 (8356-2)	9/6/88	Soil	7.5 to 9.0 ft.	1.16 N	1.35 N	2.41 J	2.81 J		0.05 U	0.06 U	mg/kg
	DSA-MW24B-SS12.5 (8356-3)	9/6/88	Soil	12.5 to 14.0 ft.	1.0 U	1.35 U	1.0 U	1.35 U				mg/kg
	DSA-MW24B-SS35.0 (8356-4)	9/6/88	Soil	35.0 to 36.5 ft.	1.0 U	1.33 U	1.67 N	2.22 N				mg/kg
	DSA-MW24B-SS50.0 (8356-5)	9/6/88	Soil	50.0 to 51.5 ft.	1.0 U	1.41 U	1.0 U	1.41 U		0.05 U	0.07 U	mg/kg
	DSA-MW24B-SS50.0D (8356-6)	9/6/88	Soil	50.0 to 51.5 ft.	1.0 U	1.39 U	1.0 U	1.39 U				mg/kg
	DSA-MW24B (8401-11)	9/13/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW24BD (8512-4)	9/13/88	Groundwater	N/A	0.005 U		0.005 U					mg/l

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19

Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	Units
MW25A	DSA-MW24A-SS2.5 (8419-1)	9/15/88	Soil	2.5 to 4.0 ft.	1.0 U	1.05 U	1.0 U	1.05 U	1.6 U			mg/kg
	DSA-MW25A-SS5.0 (8419-2)	9/15/88	Soil	5.0 to 6.5 ft.	1.0 U	1.10 U	1.0 U	1.10 U	1.6 U			mg/kg
	DSA-MW25A-SS7.5 (8419-3)	9/15/88	Soil	7.5 to 9.0 ft.	1.0 U	1.16 U	1.0 U	1.16 U				mg/kg
	DSA-MW25A-SS17.0 (8419-4)	9/15/88	Soil	17.0 to 18.5 ft.	1.0 U	1.26 U	1.0 U	1.26 U				mg/kg
	DSA-MW25-SS17.0D (8419-5)	9/15/88	Soil	17.0 to 18.5 ft.	1.0 U	1.26 U	1.0 U	1.26 U				mg/kg
	DSA-MW25A (8482-1)	9/26/88	Groundwater	N/A	0.045 N		0.005 U					mg/l
	DSA-MW25A (8512-7)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW25AD (8512-9)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
MW25B	DSA-MW25B-SS0.0 (8410-3)	9/14/88	Soil	0.0 to 1.5 ft.	1.0 U	1.08 U	1.0 U	1.08 U	1.7	0.17	0.18	mg/kg
	DSA-MW25B-SS2.5 (8410-6)	9/14/88	Soil	2.5 to 4.0 ft.	1.0 U	1.10 U	1.0 U	1.10 U	0.28 J	0.05 U	0.06 U	mg/kg
	DSA-MW25B-SS5.0 (8410-4)	9/14/88	Soil	5.0 to 6.5 ft.	1.0 U	1.10 U	1.0 U	1.10 U				mg/kg
	DSA-MW25B-SS5.0D (8410-5)	9/14/88	Soil	5.0 to 6.5 ft.	1.0 U	1.11 U	1.0 U	1.11 U				mg/kg
	DSA-MW25B-SS30.0 (8410-7)	9/14/88	Soil	30.0 to 31.5 ft.	1.0 U	1.34 U	1.0 U	1.34 U		0.05 U	0.07 U	mg/kg
	DSA-MW25B-SS50.0 (8401-8)	9/14/88	Soil	50.0 to 51.5 ft.	1.0 U	1.48 U	1.0 U	1.48 U				mg/kg
	DSA-MW25B (8482-2)	9/26/88	Groundwater	N/A	0.005 U		0.005 U					mg/l
	DSA-MW25B (8512-8)	10/4/88	Groundwater	N/A	0.005 U		0.005 U					mg/l

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

Table 4-19
Soil and Groundwater Results TCP, PCP and Mercury by Methods 8040 and 8270 (continued)

					TCP		PCP					
					Method 8040		Method 8040		Method 8270	Mercury		
Location	Sample ID No.	Date Sampled	Matrix	Soil Depth	As Received	Dry Wt.	As Received	Dry Wt.	As Received	As Received	Dry Wt.	Units
DS-MS-01	DSA-MS1 (8454-6)	9/22/88	Marine Sediment	0-6"	1.0 U	6.7 U	1.0 U	6.7 U				mg/kg
DS-MS-02	DSA-MS2 (8454-5)	9/22/88	Marine Sediment	0-6"	1.0 U	5.3 U	1.0 U	5.3 U				mg/kg
DS-MS-03	DSA-MS3 (8454-4)	9/22/88	Marine Sediment	0-6"	1.0 U	4.7 U	1.0 J	4.7 J				mg/kg
DS-MS-04	DSA-MS4 (8454-1)	9/22/88	Marine Sediment	0-6"	1.0 U	5.8 U	1.0 U	5.8 U				mg/kg
DS-MS-05	DSA-MS5 (8454-2)	9/22/88	Marine Sediment	0-6"	1.0 U	2.7 U	2.4 J	6.4 J				mg/kg
DS-MS-05	DSA-MS53 (Marine Sediment)	9/22/88	Marine Sediment	0-6"					1.6 U			mg/kg

J = Quantitatively suspect
U = Undetected above this concentration

N = Qualitatively suspect
R = Unable to calculate due to interference

detected values were flagged by the laboratory as being qualitatively suspect (i.e., precise compound identification is unknown). These five are MW-6B (30 feet), MW-24A (5 feet and 7.5 feet), and MW-24B (2.5 feet and 7.5 feet). The last two TCP results, 6.2 mg/kg dry weight and 6.1 mg/kg (MW-16C at 9 feet and MW-16C field duplicate at 9 feet), are considered qualitatively and quantitatively acceptable. The significance of these results is discussed in Section 5.3.2.

4.3.1.2 MARINE SEDIMENT SAMPLES

Marine sediment results for all PCP and TCP analysis are presented in Table 4-19. PCP was detected in two out of a total of five and one duplicate samples by Method 8040. Both detected results DS-MS-3 (4.7 mg/kg dry weight) and DS-MS-5 (6.4 mg/kg) were flagged by the laboratory as quantitatively suspect, meaning that PCP was detected in both samples, buth the quantity is uncertain. As with the monitoring well soils, the probability that the actual concentration exceeds the flagged value is considered to be highly unlikely.

Tetrachlorophenol (TCP) was not reported in any marine sediment sample by Method 8040.

4.3.1.3 VERIFICATION SOILS SAMPLES

Table 4-19 presents the TCP results of soil and marine sediment samples collected for the verification study (see addendum). Pentachlorophenol (PCP) was not detected in any of the eight verification samples, six soil and two marine sediments. TCP was detected in one soil sample (VI-SS-200) at 2.2 mg/kg dry weight). This result is considered qualitatively and quantitatively acceptable and is discussed in Section 5.3.

4.3.1.4 Summary of Method 8040 PCP/TCP Soil Results

Table 4-20 presents a summary of all PCP/TCP detected values for soil and sediments by analytical Method 8040. Of the 12 reported detections, only three (monitoring 16-C and 16-C duplicate and verification sample V1-SS-200) are considered qualitatively and quantitatively acceptable by the analytical laboratory.

Table 4-20
METHOD 8040 SOIL AND SEDIMENT SAMPLE RESULTS SUMMARY

Detected Compound	Location	Results	Comments
PCP	MW-24B, 7.5 ft	2.81J	Quantitatively Suspect
PCP	MW-24B, 35.0 ft	2.22N	Qualitatively Suspect
TCP	MW-6B, 30.0 ft	1.40N	Qualitatively Suspect
TCP	MW-24A, 5.0 ft	4.55N	Qualitatively Suspect
TCP	MW-24A, 7.5 ft	3.83N	Qualitatively Suspect
TCP	MW-24B, 2.5 ft	2.66N	Qualitatively Suspect
TCP	MW-24B, 7.5 ft	1.35N	Qualitatively Suspect
TCP	MW-16C, 9.0 ft	6.2	
TCP	MW-16C, 9.0 ft	6.1	
PCP	Station DS-MS-3	4.7J	Quantitatively Suspect
PCP	Station DS-MS-5	6.4J	Quantitatively Suspect
TCP	V1-SS-200	2.2	

4.3.2 METHOD 8270 SEMIVOLATILE ORGANIC COMPOUNDS

Table 4-21 presents a summary of the Method 8270 soils analyses. Method 8270 analyzes for the presence of 65 semivolatile organic compounds from the hazardous substance list. Method 8270 analysis is described in Section 3.2.1.2 and in the SAP and QAPP (Appendix A). The complete hazardous substance list and quantification limit for each compound is presented in Table 3-5 and in the QAPP (Appendix A).

4.3.2.1 SUBSURFACE SOIL SAMPLES

Sixteen soil samples collected during monitoring well installation were analyzed by Method 8270. Only ten of the semivolatile target compounds (out of a total of 65) were detected in soils for a total of 40 reported detects in monitoring well soils (see Table 4-21).

As shown in Table 4-21, 22 of the 40 results are qualified by the laboratory because of probable laboratory contamination. The accuracy of these sample results is suspect because of contamination in the laboratory method blanks. Consequently, the sample quantitation limits have been elevated for these samples and flagged "UJ." The sample results listed in Table 4-21 were not detected above these adjusted levels.

Sixteen of the remaining eighteen reported results are qualified as estimates (flagged by the laboratory as "J") because they are below the quantitation limit but above the instrument detection limit. These results are qualitatively

Table 4-21
DETECTED HAZARDOUS SUBSTANCE LIST COMPOUNDS[a]
(µg/kg)

Soil Sample Number	Phenol Result[b]	4-Methylphenol Result[b]	Benzoic Acid Result[b]	2,4,5-Trichlorophenol Result[b]	Fluorene Result[b]	Pentachlorophenol Result[b]
DSA-MS53Marine	330 U	330 U	96 J	1,600 U	66 J	1,600 U
DSA-MW6B-SS5.0	660 U	660 U	3,200 U	3,200 U	660 U	3,200 U
DSA-MW8B-SS2.5	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW8B-SS5.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW16B-SS2.5	330 U	120 J	1,600 U	1,600 U	330 U	1,600 U
DSA-MW16B-SS5.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW23-SS10.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW24-SS2.5	900	660 U	3,200 U	3,200 U	110 J	3,200 U
DSA-MW24-SS7.5	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW24-SS20.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW25A-SS2.5	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW25A-SS5.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW25B-SS0.0	330 U	330 U	1,600 U	1,600 U	330 U	1,700
DSA-MW25B-SS2.5	330 U	330 U	1,600 U	1,600 U	330 U	280 J
DSA-MW26-SS2.5	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-MW26-SS5.0	330 U	330 U	40 J	1,600 U	330 U	1,600 U
DSA-MW26-SS17.0	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
DSA-SB16CD-11	1,300 U	1,300 U	6,400 U	2,300 J	1,300 U	24,000
Blank 1[c]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 2[d]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 3[e]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 4[f]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 5[g]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 6[h]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U
Blank 7[i]	330 U	330 U	1,600 U	1,600 U	330 U	1,600 U

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[a] The other analytes requested were analyzed for but not detected by the laboratory.

[b] U: Parameter analyzed for but not detected above this concentration.
J: Indicates an estimated value. Result is less than the specified detection limit but greater than zero.
UJ: The parameter was analyzed for, but not detected above this limit. Because of contamination and/or analytical deficiencies, adjustment of the sample quantitation limit was necessary.

[c] Semivolatile method blank associated with samples DSA-MW8B-SS2.5, DSA-MW8B-SS5.0, DSA-MW25A-SS2.5, DSA-MW25A-SS5.0, DSA-MW25B-SS2.0, DSA-MW25B-SS5.0.

[d] Semivolatile method blank associated with samples DSA-MW23-SS10.0, DSA-MW6B-SS5.0.

[e] Semivolatile method blank associated with samples DSA-MW16B-SS2.5, DSA-MW16B-SS5.0.

[f] Semivolatile method blank associated with sample DSA-MS53Marine.

[g] Semivolatile method blank associated with samples DSA-MW24-SS2.5, DSA-MW24-SS5.0, DSA-MW24-SS17.0.

[h] Semivolatile method blank associated with samples DSA-MW26-SS2.5, DSA-MW26-SS5.0, DSA-MW26-SS17.0.

[i] Semivolatile method blank associated with samples DSA-SB16CD-11.

Table 4-21
(continued)

Soil Sample Number	Phenanthrene Result[b]	Di-n-butylphthalate Result[b]	Fluoranthene Result[b]	Pyrene Result[b]	bis(2-Ethylhexyl) phthalate Result[b]
DSA-MS53Marine	560	330 UJ	580	570	330 UJ
DSA-MW6B-SS5.0	660 U	98 J	660 U	660 U	660 UJ
DSA-MW8B-SS2.5	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW8B-SS5.0	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW16B-SS2.5	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW16B-SS5.0	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW23-SS10.0	330 U	84 J	330 U	330 U	650 UJ
DSA-MW24-SS2.5	470 J	210 J	180 J	140 J	330 UJ
DSA-MW24-SS7.5	330 U	260 J	330 U	330 U	330 UJ
DSA-MW24-SS20.0	330 U	150 J	330 U	330 U	330 UJ
DSA-MW25A-SS2.5	330 U	330 UJ	330 U	300 U	330 UJ
DSA-MW25A-SS5.0	330 U	330 U	330 U	330 U	330 UJ
DSA-MW25B-SS0.0	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW25B-SS2.5	40 J	330 U	43 J	54 J	330 UJ
DSA-MW26-SS2.5	330 U	330 U	330 U	330 U	330 UJ
DSA-MW26-SS5.0	330 U	330 U	330 U	330 U	442 UJ
DSA-MW26-SS17.0	330 U	51 J	330 U	330 U	330 UJ
DSA-SB16CD-11	1,300 U	1,300 U	1,300 U	1,300 U	1,300 UJ
Blank 1[c]	330 U	30 J	330 U	330 U	140 J
Blank 2[d]	330 U	330 U	330 U	330 U	290 J
Blank 3[e]	330 U	55 J	330 U	330 U	140 J
Blank 4[f]	330 U	98 J	330 U	330 U	110 J
Blank 5[g]	330 U	330 U	330 U	330 U	290 J
Blank 6[h]	330 U	330 U	330 U	330 U	150 J
Blank 7[i]	330 U	330 U	330 U	330 U	51 J

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[a] The other analytes requested were analyzed for but not detected by the laboratory.

[b] U: Parameter analyzed for but not detected above this concentration.
J: Indicates an estimated value. Result is less than the specified detection limit but greater than zero.
UJ: The parameter was analyzed for, but not detected above this limit. Because of contamination and/or analytical deficiencies, adjustment of the sample quantitation limit was necessary.

[c] Semivolatile method blank associated with samples DSA-MW8B-SS2.5, DSA-MW8B-SS5.0, DSA-MW25A-SS2.5, DSA-MW25A-SS5.0, DSA-MW25B-SS2.0, DSA-MW25B-SS5.0.

[d] Semivolatile method blank associated with samples DSA-MW23-SS10.0, DSA-MW6B-SS5.0.

[e] Semivolatile method blank associated with samples DSA-MW16B-SS2.5, DSA-MW16B-SS5.0.

[f] Semivolatile method blank associated with sample DSA-MS53Marine.

[g] Semivolatile method blank associated with samples DSA-MW24-SS2.5, DSA-MW24-SS5.0, DSA-MW24-SS17.0.

[h] Semivolatile method blank associated with samples DSA-MW26-SS2.5, DSA-MW26-SS5.0, DSA-MW26-SS17.0.

[i] Semivolatile method blank associated with samples DSA-SB16CD-11.

Table 4-21
(continued)

Soil Sample Number	Naphthalene Result[b]	Acenaphthene Result[b]	Dibenzofuran Result[b]	Anthracene Result[b]	Benzo(a)anthracene Result[b]
DSA-MS53Marine	42 J	40 J	38 J	140 J	210 J
DSA-MW6B-SS5.0	660 U	660 U	660 U	660 U	660 U
DSA-MW8B-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW8B-SS5.0	330 U	330 U	330 U	330 U	330 U
DSA-MW16B-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW16B-SS5.0	330 U	330 U	330 U	330 U	330 U
DSA-MW23-SS10.0	330 U	330 U	330 U	330 U	330 U
DSA-MW24-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW24-SS7.5	330 U	330 U	330 U	330 U	330 U
DSA-MW24-SS20.0	330 U	330 U	330 U	330 U	330 U
DSA-MW25A-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW25A-SS5.0	330 U	330 U	330 U	330 U	330 U
DSA-MW25B-SS0.0	330 U	330 U	330 U	330 U	330 U
DSA-MW25B-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW26-SS2.5	330 U	330 U	330 U	330 U	330 U
DSA-MW26-SS5.0	330 U	330 U	330 U	330 U	330 U
DSA-MW26-SS17.0	330 U	330 U	330 U	330 U	330 U
DSA-SB16CD-11	1,300 U	1,300 U	1,300 U	1,300 U	1,300 U
Blank 1[c]	330 U	330 U	330 U	330 U	330 U
Blank 2[d]	330 U	330 U	330 U	330 U	330 U
Blank 3[e]	330 U	330 U	330 U	330 U	330 U
Blank 4[f]	330 U	330 U	330 U	330 U	330 U
Blank 5[g]	330 U	330 U	330 U	330 U	330 U
Blank 6[h]	330 U	330 U	330 U	330 U	330 U
Blank 7[i]	330 U	330 U	330 U	330 U	330 U

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[a] The other analytes requested were analyzed for but not detected by the laboratory.

[b] U: Parameter analyzed for but not detected above this concentration.
J: Indicates an estimated value. Result is less than the specified detection limit but greater than zero.
UJ: The parameter was analyzed for, but not detected above this limit. Because of contamination and/or analytical deficiencies, adjustment of the sample quantitation limit was necessary.

[c] Semivolatile method blank associated with samples DSA-MW8B-SS2.5, DSA-MW8B-SS5.0, DSA-MW25A-SS2.5, DSA-MW25A-SS5.0, DSA-MW25B-SS2.0, DSA-MW25B-SS5.0.

[d] Semivolatile method blank associated with samples DSA-MW23-SS10.0, DSA-MW6B-SS5.0.

[e] Semivolatile method blank associated with samples DSA-MW16B-SS2.5, DSA-MW16B-SS5.0.

[f] Semivolatile method blank associated with sample DSA-MS53Marine.

[g] Semivolatile method blank associated with samples DSA-MW24-SS2.5, DSA-MW24-SS5.0, DSA-MW24-SS17.0.

[h] Semivolatile method blank associated with samples DSA-MW26-SS2.5, DSA-MW26-SS5.0, DSA-MW26-SS17.0.

[i] Semivolatile method blank associated with samples DSA-SB16CD-11.

Table 4-21
(continued)

Soil Sample Number	Chrysene Result[b]	Benzo(b)-fluoranthene Result[b]	Benzo(k)-fluoranthene Result[b]	Benzo(a)-pyrene Result[b]	Indeno(1,2,3-cd)-pyrene Result[b]	Benzo(g,h,i)-perylene Result[b]
DSA-MS53Marine	320 J	180 J	150 J	150 J	63 J	71 J
DSA-MW6B-SS5.0	660 U	660 U	660 UJ	660 U	660 U	660 UJ
DSA-MW8B-SS2.5	330 U	330 U	330 U	330 U	330 UJ	330 U
DSA-MW8B-SS5.0	330 U	330 U	330 U	330 U	330 UJ	330 U
DSA-MW16B-SS2.5	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW16B-SS5.0	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW23-SS10.0	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW24-SS2.5	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW24-SS7.5	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW24-SS20.0	330 U	330 U	330 UJ	330 U	330 U	330 UJ
DSA-MW25A-SS2.5	330 U	330 U	330 U	330 U	330 U	330 U
DSA-MW25A-SS5.0	330 U	330 U	330 U	330 U	330 U	330 U
DSA-MW25B-SS0.0	330 U	330 U	330 U	330 U	330 U	330 U
DSA-MW25B-SS2.5	330 U	330 U	330 U	330 U	330 U	330 U
DSA-MW26-SS2.5	330 U	330 U	330 U	330 U	330 U	330 UJ
DSA-MW26-SS5.0	330 U	330 U	330 U	330 U	330 U	330 UJ
DSA-MW26-SS17.0	330 U	330 U	330 U	330 U	330 U	330 UJ
DSA-SB16CD-11	1,300 U	1,300 U	1,300 U	1,300 U	1,300 U	1,300 U
Blank 1[c]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 2[d]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 3[e]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 4[f]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 5[g]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 6[h]	330 U	330 U	330 U	330 U	330 U	330 U
Blank 7[i]	330 U	330 U	330 U	330 U	330 U	330 U

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[a] The other analytes requested were analyzed for but not detected by the laboratory.

[b] U: Parameter analyzed for but not detected above this concentration.
J: Indicates an estimated value. Result is less than the specified detection limit but greater than zero.
UJ: The parameter was analyzed for, but not detected above this limit. Because of contamination and/or analytical deficiencies, adjustment of the sample quantitation limit was necessary.

[c] Semivolatile method blank associated with samples DSA-MW8B-SS2.5, DSA-MW8B-SS5.0, DSA-MW25A-SS2.5, DSA-MW25A-SS5.0, DSA-MW25B-SS2.0, DSA-MW25B-SS5.0.

[d] Semivolatile method blank associated with samples DSA-MW23-SS10.0, DSA-MW6B-SS5.0.

[e] Semivolatile method blank associated with samples DSA-MW16B-SS2.5, DSA-MW16B-SS5.0.

[f] Semivolatile method blank associated with sample DSA-MS53Marine.

[g] Semivolatile method blank associated with samples DSA-MW24-SS2.5, DSA-MW24-SS5.0, DSA-MW24-SS17.0.

[h] Semivolatile method blank associated with samples DSA-MW26-SS2.5, DSA-MW26-SS5.0, DSA-MW26-SS17.0.

[i] Semivolatile method blank associated with samples DSA-SB16CD-11.

acceptable but quantitatively unreliable because of uncertainties in the analytical precision near the limit of detection. Despite the quantitative uncertainties, if one examines the magnitude of these results as shown in Table 4-21, it can be safely concluded that these detected values will not exceed the quantitation limit even when accounting for normal variability.

The last two results (0.90 mg/kg phenol at MW-24A and 1.7 mg/kg PCP at MW-25B) are considered qualitatively and quantitatively acceptable. The significance of these results is discussed in Section 5.3.2.

The only other indication of PCP and TCP in subsurface soils are PCP at 2.5 feet (0.28 mg/kg) and TCP at the surface (0.9 mg/kg) and at 2.5 feet (0.71 mg/kg) below the surface in MW-25B. All of these detected concentrations, however, have been qualified by the laboratory. Further, TCP is not a target compound of Method 8270. The TCP reported here is tentatively identified.

One additional soil boring sample was collected to verify the results found at MW16A. A composite sample from this boring was analyzed by Method 8270. Three of the semivolatile target compounds were detected in this sample (Table 4-21).

One compound is qualified by the laboratory because of probable laboratory contamination. The accuracy of this sample result is suspect because of contamination in the laboratory method blank. The sample quantitation limit has been elevated and the result flagged "UJ." The compound was not detected at a level above this adjusted level.

The second result was qualified as an estimate (flagged "J" by the laboratory) because it was below the quantitation limit but above the instrument detection limit. This result is qualitatively acceptable but quantitatively unreliable because of uncertainties in the analytical precision near the limit of detection.

The last result (24 mg/kg PCP) is qualitatively and quantitatively acceptable. The significance of this result is discussed in Section 5.3.2.

4.3.2.2 MARINE SEDIMENT SAMPLES

Five marine sediment samples and one field duplicate sample were collected in the course of this study. One sample, Station DSA-MS53, was analyzed for Method 8270 semivolatile organic compounds as a performance check of the 8040 Method and as a screen for additional organic compounds. The results of this analysis are presented in Table 4-21.

Eighteen of the 65 semivolatile compounds were detected in the marine sample. These are presented in Table 4-21.

Two of the 18 detected compounds are qualified because of probable laboratory contamination. The accuracy of these sample results is suspect because of contamination in the method blanks. The sample quantitation limits have been elevated for these compounds; the results should not be considered detected above the flagged levels. Thirteen of the remaining detected compounds are qualified (flagged with the letter "J") as estimates because they are below the quantitation limit but are above the instrument detection limit. These compounds are qualitatively acceptable but quantitatively unreliable because of uncertainties in the analytical precision near the detection limit.

The remaining three detected compounds, (phenanthrene 0.56 mg/kg, fluoranthrene, 0.58 mg/kg, and pyrene 0.57 mg/kg in DS-MS53) are above the quantitation limit and are considered qualitatively and quantitatively acceptable. The significance of these results are discussed in Section 5.3.2.

4.3.2.3 VERIFICATION SOILS

No verification samples were analyzed for semivolatile analysis using Method 8270.

4.4 APPENDIX IX PARAMETERS

Only one soil sample (Boring 28, Sample No. DSA B28) was analyzed for Appendix IX parameters. Boring 28 was collected in the vicinity of the old planer mill where a fire occurred in 1971.

A summary of the Appendix IX analysis is as follows:

- No volatile chemicals (out of a total of 52 compounds analyzed) were detected.
- No semivolatile chemicals (out of a total 112 compounds analyzed) were detected.
- No organochlorine pesticides or polychlorinated biphenyl (PCBs) compounds analyzed(out of 30 total) were detected.
- No organochlorine herbicides were detected (out of three total).
- Reactive sulfide was detected at 0.7 mg/kg.
- No cyanide was detected.

The following metals (total) were detected:

Arsenic	3.4 mg/kg
Barium	12.0 mg/kg
Beryllium	0.2 mg/kg
Chromium	16.0 mg/kg
Cobalt	6.0 mg/kg
Lead	5.1 mg/kg
Nickel	16.0 mg/kg
Vanadium	34.0 mg/kg
Zinc	36.0 mg/kg

These metal concentrations are within the range naturally occuring in soil (see Section 5.3.4).

4.5 MERCURY ANALYSIS (METHOD 7470 and 7471)

Table 4-19 presents all detected mercury results in subsurface soils. Twenty-nine soil boring samples were tested for mercury. Of these 29, nine soils were identified by the CSL as having detectable concentrations of mercury (three samples from MW-6B, two samples from MW-23, two samples from MW-24A, one sample from MW-24B, and one sample from MW-25B.) These concentrations are within the range naturally occuring in soil (see Section 5.3.3).

4.6 GROUNDWATER RESULTS

4.6.1 METHOD 8040--PCP/TCP

The Close Support Laboratory (CSL) used Method 8040 to analyze 44 groundwater samples collected during two to three sampling events between August and October 1988. Table 4-19 presents all Method 8040 groundwater results. Method 8270 semivolatile performance check results for PCP are also listed in Table 4-19 for comparison. Pentachlorophenol (PCP) was detected in 14 groundwater samples using the 8040 method. PCP was not detected in background wells MW-5 and MW-26. One detected groundwater result, 0.51 mg/l (MW-6A, Round Two), was flagged by the CSL as quantitatively suspect. The remaining 13 samples are considered qualitatively and quantitatively acceptable. The 13 reported results are as follows:

MW-6A:	Sampling Round One (3.07 mg/l); and Three (2.13 mg/l)
MW-6C:	Round One (14.3 mg/l), Two (0.27 mg/l) and Three (0.16 mg/l)
MW-8A:	Round One (0.005 mg/l)

MW-15: Round One (0.009 mg/l)

MW-16A: Round One (0.052 mg/l) and Three (0.064 mg/l)

MW-18: Round One (0.006 mg/l)

MW-19: Round One (0.015 mg/l)

MW-21: Round One (0.021 mg/l)

MW-22: Round One (0.025 mg/l)

Tetrachlorophenol (TCP) was detected in 12 out of 44 groundwater samples. These results are presented in Table 4-19. Four of the detected values were flagged by the laboratory as quantitatively suspect: MW-6A, Round Three; MW6C, Round One; MW-16A, Round Three; and MW-19, Round 2. Four of the remaining eight detected values: MW-6A, Round Two; MW-16A, Round One and Round Two; and MW-25A, Round One were flagged by the laboratory as qualitatively suspect "N" (i.e., the compound identification is not reliable). Four detected values remain and are considered quantitatively and qualitatively acceptable (MW-6A, Round One (2.8 mg/l); MW6B Round One, (0.10 mg/l) and MW6C, Round Two (10.2 mg/l) and Three (0.04 mg/l).

4.6.2 METHOD 8270 SEMIVOLATILE ORGANIC COMPOUNDS

Table 4-22 presents the Method 8270 groundwater results. A total of six of the 65 semivolatile compounds were detected in one or more of the four total groundwater samples analyzed by Method 8270. Three monitoring wells (MW-6B, MW-6C, and MW16A) were where these organic compounds, 11 total, results occurred.

Four of the 11 results are qualified as estimates due to probable laboratory method blank contamination. The accuracy of these sample results is suspect due to this contamination. Consequently, sample quantitation limits have been elevated for these samples and flagged "UJ"; sample results were not detected above these elevated levels.

Five of the remaining seven results are qualified as estimates because they are below the quantitation limit (flagged as "J" in Table 4-22) but are above the instrument detection limit. They are qualitatively acceptable but quantitatively unreliable due to uncertainties in the analytical precision near the limit of detection.

The last two results [naphthalene (0.77 mg/l) and PCP (6.9 mg/l) both from MW-6C] are above the quantitation limit

Table 4-22
DETECTED HAZARDOUS SUBSTANCE LIST COMPOUNDS[a]
(μg/l)

Water Sample Number	2,4-Dichloro-phenol Result[b]	Naphthalene Result[b]	2,4,5-Trichloro-phenol Result[b]	Pentachloro-phenol Result[b]	Di-n-butyl-phthalate Result[b]	Bis(2-ethylhexyl)-phthalate Result[b]
DSA-MW6B(9/7/88)	10 U	10 U	10 U	50 U	10 U	44 UJ
DSA-MW6B(10/19/88)	20 U	20 U	20 U	100 U	20 U	20 UJ
DSA-MW6C	11 J	77	80 J	6,900	2 J	20 UJ
DSA-MW16A	20 U	2 J	20 U	17 J	20 U	20 UJ
Blank 1[c]	10 U	10 U	10 U	50 U	10 U	9 J
Blank 2[d]	20 U	20 U	20 U	100 U	20 U	9 J

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[a] The other analytes requested were analyzed for but not detected by the laboratory.

[b] U: Parameter analyzed for but not detected above this concentration.
J: Indicates an estimated value. Result is less than the specified detection limit but greater than zero.
UJ: The parameter was analyzed for, but not detected above this limit. Because of contamination and/or analytical deficiencies, adjustment of the sample quantitation limit was necessary.

[c] Semivolatile method blank associated with sample DSA-MW6B(9/7/88).

[d] Semivolatile method blank associated with samples DSA-MW6B(10/19/88), DSA-MW6C, DSA-MW16A.

and are considered qualitatively and quantitatively acceptable. These results are discussed in Section 5.4.3.

4.6.3 Appendix IX Parameters

Four groundwater samples from MW6B, MW6C, MW16B, and MW24A were analyzed for Appendix IX parameters.

A summary of the Appendix IX analyses is as follows:

- All 4 samples and two trip blanks were analyzed for 52 volatile organic compounds. The only detected compound was benzene at 0.0087 mg/l in MW6C. The trip blanks were analyzed only for volatile organics because there is a small possibility of cross contamination of samples packed together during shipping.
- The 4 groundwater samples were analyzed for 112 semivolatile compounds. Only 2,3,4,6-TCP was detected (at 14.0 mg/l) in MW6C.
- No organochlorine pesticides or polychlorinated biphenyls (PCB's) were detected (of the 30 analyzed) in any of the samples.
- No organochlorine herbicides (of the 3 analyzed) were detected in any sample.
- No cyanide was detected in any sample. Sulfide was detected only in the sample from MW6B at 0.05 mg/l.
- Table 4-23 shows the results of the total metal analyses.

Table 4-23
APPENDIX IX METALS DETECTED IN GROUNDWATER
(Concentration in mg/l)

Metal	MW6B	MW6C	MW16B	MW24A
Arsenic	0.04	ND	0.014	ND
Barium	0.12	0.19	0.19	0.016
Chromium	ND	0.02	ND	ND
Copper	ND	0.013	ND	0.008
Lead	ND	0.003	0.022	0.003
Vanadium	ND	0.02	ND	0.01
Zinc	ND	0.05	ND	0.02

ND = Not detected.

5 SIGNIFICANCE OF FINDINGS

Section 5 includes a summary of the current regulatory status of PCP and TCP. Current and proposed regulations and guidelines for pentachlorophenol (PCP) and tetrachlorophenol (TCP) are included in this section pertaining to hazardous waste, surface water, drinking water, and soil. Using these regulations and guidelines, the qualitatively and quantitatively validated results identified in Section 4 are compared and evaluated. A discussion of this evaluation is then presented for soils, marine sediments, and groundwater.

5.1 CURRENT REGULATORY CRITERIA AND GUIDELINES

The following discussion presents the current published criteria and guidelines for PCP and TCP.

5.1.1 RCRA REGULATIONS FOR PCP/TCP

PCP was used at the old planer mill site as a wood preservative; it was not manufactured onsite. This is an important distinction, since Federal RCRA hazardous waste regulations and Washington State Dangerous Waste regulations list PCP wastes derived from the production or manufacturing use of PCP (F021) and discarded unused formulations containing tri-, tetra-, or pentachlorophenol (F027) (40 CFR 261 and WAC 173-303). The use of PCP at the old planer mill is not included in either of these categories and therefore is not a RCRA listed hazardous waste. When the PCP hazardous waste listing regulations were being developed, the preamble in the Federal Register specifically stated that the listing does not include residues from wood preservation: ..."the term 'manufacturing use' does not include residues from the use of chlorophenoxy pesticide formulations, e.g. in wood preservation" (48 FR 14515). The preamble also noted the types of wastes not covered by the regulations including "sludges from wood preserving using pentachlorophenol" (48 FR 14523). Since the promulgation of these regulations, EPA has been investigating whether wastes from wood preservation processes using PCP should be listed as hazardous wastes. EPA has proposed (53 FR 53282, December 30, 1988) listing surface-applied wood preservative formulations containing PCP as hazardous wastes under a new category F033. The proposed health-based water concentration limit for PCP is 1 mg/l; 2,3,4,6-TCP is proposed as 1 mg/kg and 2,4,6-trichlorophenol is proposed as 0.0018 mg/kg.

5.1.2 WATER QUALITY STANDARDS

PCP in surface waters is regulated by the State of Washington Water Quality Standards (WAC 173-201-047). The

Washington State Water Quality Standards for PCP are the same as the federal water quality criteria [EPA, Water Quality Criteria (Gold Book), as revised by Federal Register, December 3, 1986]. The state and federal water quality criteria are presented in Table 5-1. It is important to note that these criteria apply to surface waters, not groundwater.

Tetrachlorophenol is not listed in WAC 173-201-047. There are no published federal water quality criteria for TCP. There is a federal marine chronic lowest observed effect level of 440 µg/l for 2,3,4,6-tetrachlorophenol (EPA, Revised Draft RFI Guidance, Volume 1, Section 8, December 1987). The Revised Draft RFI Guidance states that there are insufficient data to develop marine chronic water quality criteria for TCP.

5.1.3 DRINKING WATER STANDARDS

There are currently no drinking water standards for PCP or TCP. A draft proposed maximum contaminant level goal (MCLG) for PCP is in internal EPA review (U.S. EPA, February 1, 1988, Safe Drinking Water Update). These proposed concentrations are presented in Table 5-1. There are no proposed drinking water standards for TCP.

5.1.4 RCRA FACILITY INVESTIGATION (RFI) CRITERIA

EPA has developed PCP criteria for human ingestion of water and fish, and health-based criteria for systemic toxicants. The health-based criteria are the only criteria that apply to PCP in soil. These values are presented in Table 5-1. These criteria are federal guidelines and are not codified in regulations. No published EPA criteria exist for tetrachlorophenol for human ingestion of water and fish. However, the health-based criteria for systemic toxicants for 2,3,4,6-TCP are the same values as for PCP (EPA, Revised Draft RFI Guidance, Volume 1, Section 8, December 1987).

5.1.5 WASHINGTON STATE PCP CLEANUP CRITERIA

Ecology does not currently have any published cleanup standards for soil or water contaminated with PCP. However, Ecology had previously prepared a draft cleanup goal for soil contaminated with PCP at a specific site. These draft cleanup goals were presented in correspondence from Ecology to McFarland Cascade (November 12, 1987), a wood preserving plant. The proposed levels were not finalized. Ecology based its draft cleanup goal for soil contaminated with PCP on a 1.0 ppb of 2,3,7,8-TCDD toxicity equivalence factor (TEF): "With respect to pentachlorophenol (PCP), the soil cleanup level is set at PCP levels that correspond to 1.0 ppb of 2,3,7,8-TCDD equivalents. This is 10 ppm and is

Table 5-1

Published Criteria and Guidelines on Pentachlorophenol

CRITERIA SOURCE	MEDIA		
		WATER	
	SOIL	Drinking	Marine
Proposed Federal SDWA MCLG[1]	NA	220 μg/l	NA
Federal CWA[2] Water Quality Criteria for Aquatic Life	NA	9 μg/l[3]/5.7 μg/l[3]	13.0 μg/l/7.9 μg/l[8]
Federal CWA Limits for Human Ingestion of Water and Fish[4]	NA	1010 μg/l[5]	NA
Federal Health-Based Criteria for Systemic Toxicants[4]	500 mg/kg[6]	1000 μg/l[7]	NA
WAC 173-201-047 Surface Water Toxic Substances Criteria	NA	9 μg/l[3]/5.7 μg/l[3]	13.0 μg/l/7.9 μg/l[8]

NA = Not applicable

[1] Draft proposed MCLG currently in internal EPA review (US EPA SDWA Fact Sheet 2/88)

[2] EPA, Water Quality Criteria (Gold Book), as revised by Federal Register, December 3, 1986

[3] Acute/chronic values shown are for pH of 7 using $e^{[1.005\,(pH) - 4.830]}$ and $e^{[1.005\,(pH) - 5.290]}$ as prescribed in 51 FR 43666 and WAC 173-201-047; pH values measured in the field ranged from 6.2 to 8.5

[4] EPA, Revised Draft RFI Guidance, Volume 1, Section 8, December 1987

[5] EPA Revised Draft RFI Guidance implies that entire limit based on water ingestion

[6] Based on 17kg child over a 5 year exposure period ingesting 1.0 gram/day of soil (EPA Revised Draft RFI Guidance, Volume 1, Section 8, December 1987)

[7] Based on 70kg adult over 70 year lifetime exposure at 2 liters/day (EPA Revised Draft RFI Guidance, Volume 1, Section 8, December 1987)

[8] 13.0 μg/l is the acute criteria, 7.9 μg/l is the chronic criteria

10 percent of the dangerous waste level (WAC 173-303-102 and WAC 173-303-9907)." (Ecology, November 1987)

The 1.0 ppb 2,3,7,8-TCDD TEF is not a written criterion or a codified regulation. Since Ecology developed this draft criterion, EPA has re-examined the hazard identification and dose-response assessment for the potential human carcinogenicity of 2,3,7,8-TCDD. A draft report (EPA/600/6-88/007Aa) has been prepared that concludes the following as stated in 53 FR 24141:

> "The draft report concludes that (1) the 1985 assessment that associates a 0.006 pg/kg/day (picogram/kilogram/day) dose with a plausible upper bound increased cancer risk of one in a million should be reconsidered, and (2) a change to a 0.1 pg/kg/day dose as a plausible upper bound associated with an increased lifetime risk of one in a million is consistent with the available data and theories, and represents a reasonable science policy position for the Agency."

The information proposed by EPA suggests a lower health risk associated with 2,3,7,8-TCDD. The above conclusion represents a 17-fold increase in dosage (0.006 x 17 = 0.1). Using the increased dosage, Ecology's cleanup level would proportionately increase to 17.0 ppb 2,3,7,8-TCDD TEF (if this cleanup level were going to be used). Consequently, pentachlorophenol cleanup levels would increase to approximately 170 ppm.

The only other known cleanup policy established by Ecology is not contaminant-specific. Ecology developed this cleanup policy, titled Final Cleanup Policy-Technical, with an effective date of July 10, 1984. The standard/background cleanup levels established in this policy are as follows:

1. Soil
    a. 10X the appropriate drinking water or water quality standard, or
    b. If no standard exists, 10X water quality background
    c. If water quality background is not detectable, soil background
2. Groundwater and Surface Water
    a. Appropriate drinking water or ambient water quality standard

    b. If no standard exists, background

Ecology's Final Cleanup Policy also provides protection levels that may be used after the Preliminary Technical Assessment shows that Standard/Background Levels are not achievable or appropriate for the site. These protection levels are as follows:

1. Soil Protection Level--Threat to Water

    a. 100X the appropriate water quality standard, or

    b. 100X water quality background, or

    c. 10X soil background, or

    d. Defined based on site-specific contaminant and soil characteristics, leaching tests, biologic tests, etc. If sufficient data are available, predictive models may be used to define the protection levels.

5.1.6 OTHER PCP CRITERIA

The RCRA Extraction Procedure (EP) Toxicity Test for hazardous waste does not include criteria for PCP or TCP (WAC 173-303-090). EPA has proposed another extraction method known as the toxicity characteristic leaching procedure (TCLP) which does include criteria for PCP and TCP; however, the TCLP regulations are only in draft form (51 FR 21685 supplemented by 53 FR 18024). These proposed limits are based upon analytical procedures in which solubilized chemical constituents released from a soil or waste in a water extract are compared against designation limits based on risk factors at a municipal solid waste landfill. For the TCLP procedure, 1 gram of soil is extracted with 20 grams of fluid, then the fluid is filtered off and analyzed. To be considered a toxic waste, the extract must have a PCP or 2,3,4,6-TCP level of 3.6 mg/l or higher. The TCLP regulations are due to be published as final regulations in 1989 (RCRA Hotline, M. Stevens, personal communication, 11/29/88).

For illustrative purposes, a worst case can be assumed (all PCP and TCP present in the soil would leach out) in order to assess whether TCLP levels for PCP and TCP would be exceeded. For example, one gram of soil with a PCP concentration of 20 mg/kg would, when totally solubilized in 200 milliliters of water, results in a worst case concentration of 1.0 mg/l in the extract.

Ecology is currently in the process of developing Sediment Quality Standards (WAC 173-204), which will be based on chronic marine biological test data for Puget Sound marine organisms. PCP is an organic chemical proposed to be included in the sediment standards when they are complete (estimated completion date is late 1989) (B. Betts, Ecology, personal communication, 12/88).

The most recent apparent biological effects threshold (AET) for Puget Sound organisms includes 0.36 mg/kg-amphipod toxicity, 0.69 mg/kg-benthic toxicity, and >0.14 mg/kg for oyster larvae toxicity and microtox testing (the latter represents the highest level tested to date in which there are no reported effects) (B. Barrick, PTI Environmental Services, personal communication 12/88). These reported AETs are not sediment criteria but represent measured effects data only.

5.2 ANALYSIS OF SAMPLES CONTAINING LOW LEVELS OF CONTAMINATION

As can be seen in Sections 4.3 (Soil Results) and 4.4 (Groundwater Results), most compounds detected in this study were at low concentrations at or very near the testing laboratory's method detection limit for both Method 8040 (PCP and TCP) and Method 8270 (Semivolatile Organic Compounds).

When samples containing low levels of contamination are analyzed, seemingly contradictory results are often obtained. One analysis of a sample may yield one estimated concentration while another analysis of the same or similar sample may yield a different concentration estimate. Yet a third analysis may indicate that the contaminant is undetectable.

All measurements have some variability. For a complex measuring system such as a gas chromatograph, used in this study, and with multiple sample extraction and cleanup processing steps, there is inherent variability in determining a true concentration for a soil or water sample.

In order for a laboratory result to confirm the presence of contamination in a sample, it is generally accepted that the value of the reported concentration should be significantly greater than any value reported in background samples or the laboratory method blank. Further, EPA believes that establishing a practical quantitation limit (PQL) of an analytical method detection limit is important in order to establish the lowest concentration at which acceptable precision and accuracy can be reliably maintained by laboratories practicing acceptable standard procedures. EPA, therefore, has reported it believes that setting PQLs in a range between 5 and 10 times the method detection limit is a fair expectation (50 FR 16306).

For some compounds such as phthalate esters, which are commonly found in laboratory method blanks, EPA has raised the

PQLs to even higher levels. Because phthalate esters are commonplace in the environment, their presence in any sample is not unusual. Phthalates are used as plasticizers and as a common intermediate and primary ingredient in finished plastic products (e.g., plastic bags, litter, protective laboratory gloves). Furthermore, recent evidence suggests that these compounds may occur naturally in the environment (Versar, Inc., 1974). The EPA guidance document "Laboratory Data Validation, Functional Guidelines for Evaluating Organic Analysis" states that if certain compounds including phthalate esters are found in a matrix at concentrations less than ten times the method blank, the compounds are not to be reported (EPA, 1988).

Any concentration estimate less than the instrument detection limit is regarded as being an uncontaminated sample. This estimate would then be classified as a nondetect. In our study, the Method 8040 results indicate this by designating a nondetect as a given value, i.e., ≤1.0 ppm. Method 8270 flags the concentration with the letter "U." The U means that the parameter was analyzed but was not detected above the specified concentration.

A sample for which the true concentration is the same as the method detection limit will have almost no chance of being mistaken for a noncontaminated sample, using the PQL as the criterion for reporting contamination. This is the minimum concentration in a sample that would almost certainly be classified as a positive detect when analyzed. Finally, the nature of the media undergoing analysis is also an important consideration when establishing PQLs.

For example, EPA has used the level of 10 times the method detection limit as the PQL for water samples for Method 8040. This limit has been established as the level of concern for compounds that are generally found at low or nondetectable concentrations (SW-846, 9/86).

The PQL for Method 8040 soils, however, is much greater: 670 times the method detection limit for low-level contamination (SW-846 page 8040-2 9/86). This is due to the complexities of the soil matrix as compared to water.

Thus the PQLs reflect not only the uncertainties inherent in the measurement process but also the additional uncertainties that derive from the more complex media being analyzed (e.g., heterogeneity of soils, soil particle size and characteristics, other chemicals).

Using the information from this discussion, all detected results from the focused site investigation are compared and discussed in the following sections.

5.3 SOILS AND MARINE SEDIMENT ANALYTICAL RESULTS

Using the regulations and guidelines discussed earlier, the validated soil and sediment results are evaluated in the following sections.

5.3.1 METHOD 8040--PCP AND TCP RESULTS

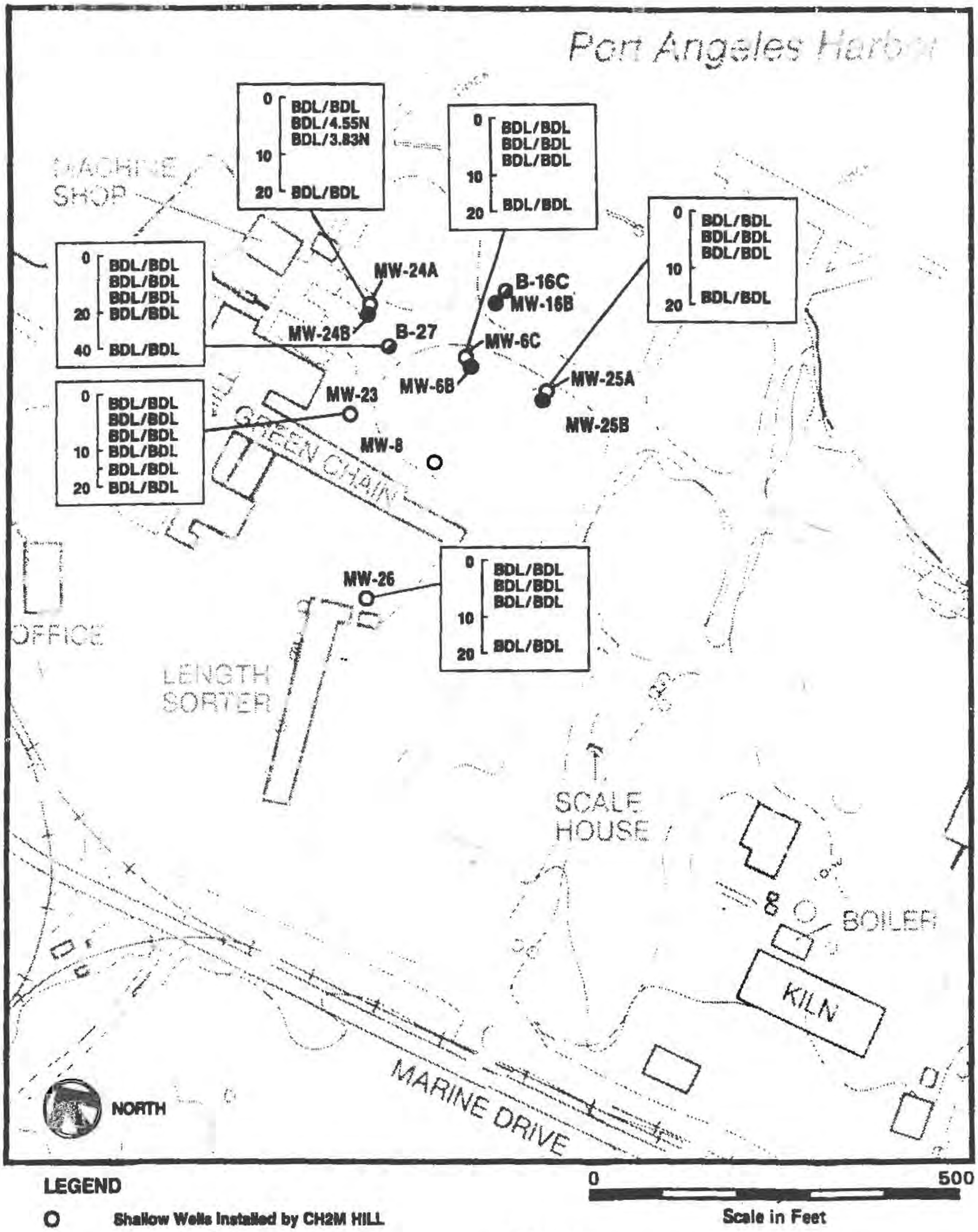
Table 4-20 presents a summary of all the PCP and TCP results detected by Method 8040 in soils and sediments collected during this study. All Method 8040 soil and sediment results are reported on a dry-weight basis.

5.3.1.1 Subsurface Soil Samples

Figure 5-1 illustrates the Method 8040 results for soil samples collected from boreholes drilled to install shallow monitoring wells. Figure 5-2 presents the results for soil samples collected from the boreholes drilled to install deep wells.

PCP was detected in only two (MW-24B, 7.5 ft and 35.0 ft) of the 60 soil samples analyzed by Method 8040. Using the convention presented in Section 5.2 that the PQL is 5 to 10 times the laboratory detection limit as a guideline, it appears that the concentration of PCP in soils collected from MW-24B is not significant. Both of the results (2.8 mg/kg and 2.22 mg/kg, respectively) in soil samples collected from MW-24B are less than three times the laboratory detection limit (DL) of 1.0 mg/kg for Method 8040. Both of these values were also qualified by the laboratory as suspect values. The 7.5-foot sample is quantitatively suspect (i.e., PCP is present but the exact amount reported is not reliable). The 35.0-foot sample is qualitatively suspect (i.e., the detected compound is only tentatively identified as PCP). Neither PCP concentration reported in samples collected from MW-24B would exceed the federal health-based criterion of 500 mg/kg for systemic toxicants (EPA, Revised Draft RFI Guidance, 1987). These PCP concentrations in soils are relatively low. For comparison, the average PCP concentration measured in urban Bellevue, Washington, residential street dust samples was 1.8 mg/kg with a reported standard deviation of ±2.3 mg/kg (Metro, Toxicants in Urban Runoff, 12/82).

Finally, PCP soil concentrations in samples collected from boreholes drilled by Hart Crowser were compiled and plotted (Figure 5-3). PCP ranged from a low of below detection at monitoring wells MW-8 and MW-22 to a high of 34.0 mg/kg from subsurface soils sampled at MW-16A. During the course of their study, Hart Crowser used two analytical methods, neither of which is recommended by EPA for the analysis of PCP. The first was a modified Method 8150, and the second was a

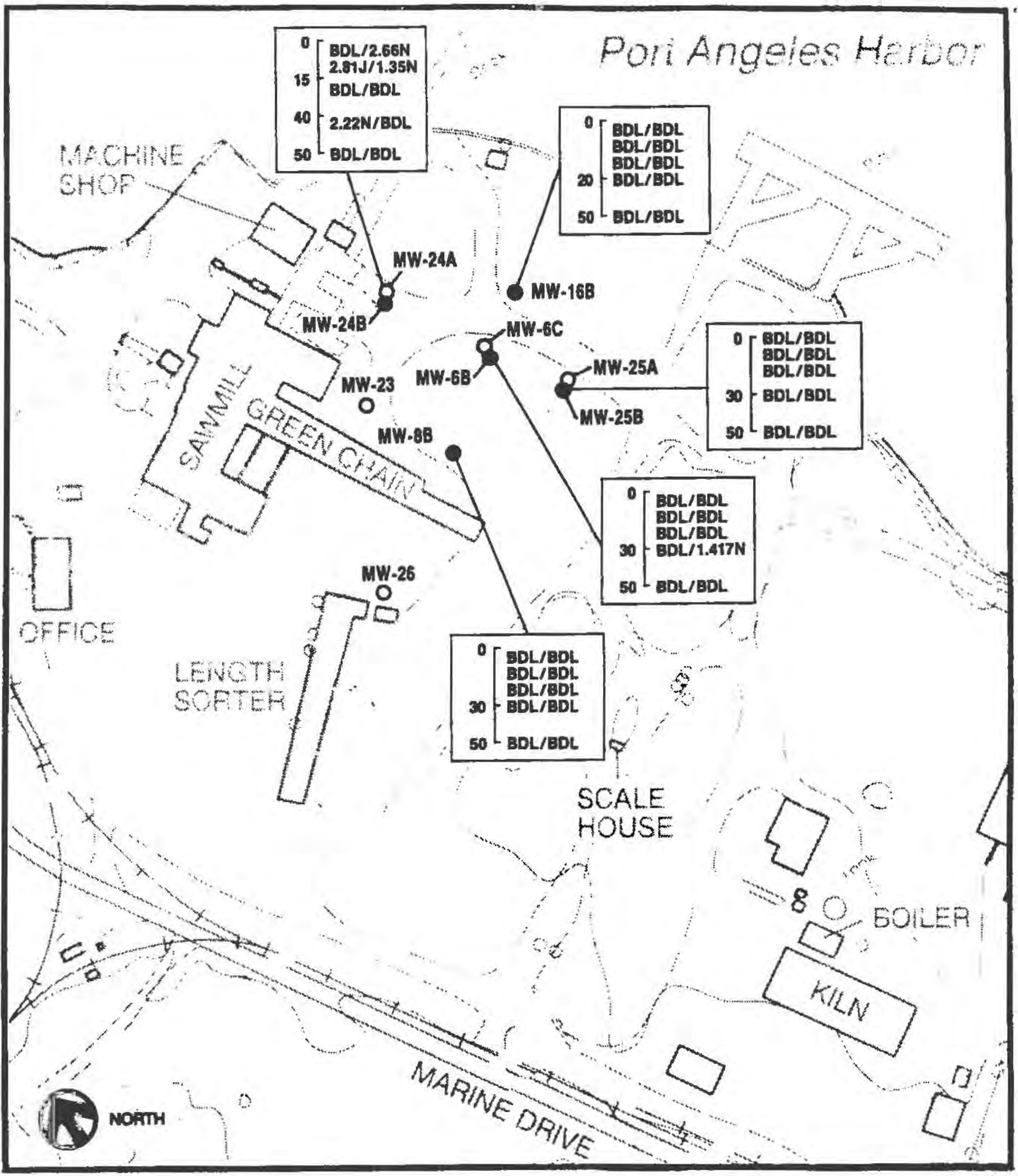


LEGEND

○	Shallow Wells Installed by CH2M HILL
●	Deep Wells Installed by CH2M HILL
◐	Borings Installed by CH2M HILL
0 10 20	Vertical Bar Represents Depth Below Ground Surface in Feet. Analytical Results (PCP/TCP) are Referenced to Approximate Depth.
BDL	Below Detection Limit
N	Qualitatively Suspected Compound

FIGURE 5-1

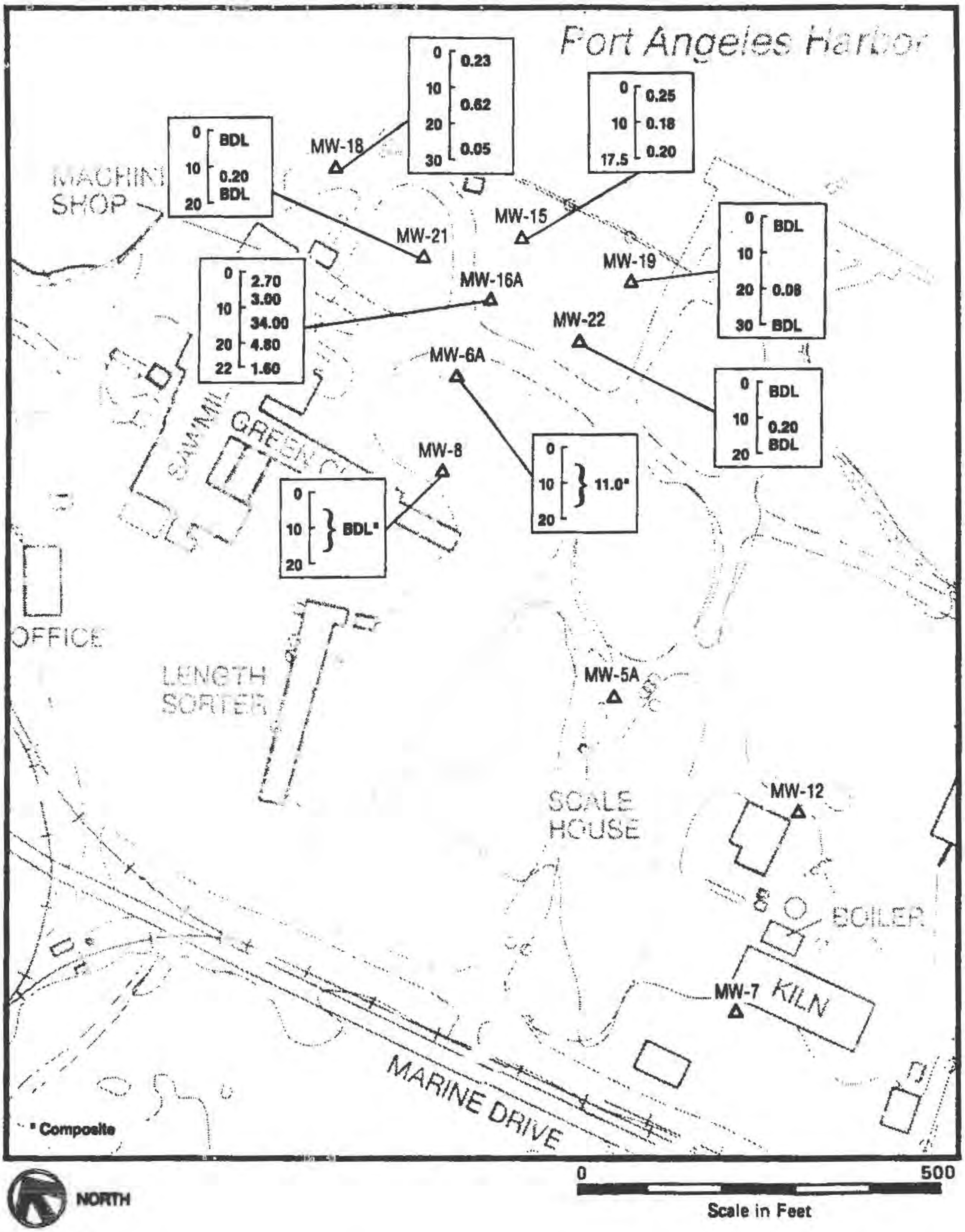
**CH2M HILL Wells
Pentachlorophenol and Tetrachlorophenol
Analytical Results for Soil (mg/kg)
Shallow Wells — CH2M HILL Results**



LEGEND

○	Shallow Wells Installed by CH2M HILL
●	Deep Wells Installed by CH2M HILL
0 10 20	Vertical Bar Represents Depth Below Ground Surface in Feet. Analytical Results (PCP/TCP) are Referenced to Approximate Depth.
BDL	Below Detection Limit
N	Qualitatively Suspected Compound
J	Quantitatively Suspected Results

FIGURE 5-2
CH2M HILL Wells
Pentachlorophenol and Tetrachlorophenol
Analytical Results for Soil (mg/kg)
Deep Wells — CH2M HILL Results



LEGEND

△	Shallow Wells Installed by Hart Crowser
0 10 20	Vertical Bar Represents Depth Below Ground Surface in Feet. Analytical Results (PCP) are Referenced to Approximate Depth.
BDL	Below Detection Limit
*	Composite Sample

FIGURE 5-3

Hart Crowser Wells Pentachlorophenol Analytical Results for Soil (mg/kg) Hart Crowser Results

field gas chromatography method using an electron capture detector. Standard laboratory quality control/quality assurance procedures are not available for either method. Both methods, while providing useful qualitative data, should not be relied on for quantitative accuracy. The purpose of the Hart Crowser evaluation was to perform a property transfer audit and not a detailed site inspection for PCP contamination.

In general, the concentrations of PCP reported by Hart Crowser fall within the same order of magnitude as results detected during this investigation. Based on both studies, it appears that PCP is randomly dispersed in soils throughout the focused study area. None of the reported concentrations, however, exceed EPA's health-based criterion for soils (500 mg/kg).

Table 4-20 presents all reported TCP results detected in this study for soils and sediments. Figures 5-1 and 5-2 illustrate these results for shallow and deep monitoring wells, respectively.

Method 8040 identified TCP at 6.2 mg/kg in a composite soil sample (9 to 14 feet) collected from MW-16C. The field duplicate result of this sample (MW-16CD) was comparable (6.1 mg/kg). Both values are less than five times the detection limit and therefore are not significant. TCP was reported in the equipment blank (0.009 mg/l), suggesting the possibility of contamination by field procedures.

Method 8040 identified TCP in two soil samples from MW-24A (4.55 mg/kg at 5.0 feet and 3.83 mg/kg at 7.5 feet). These values, however, were flagged by the laboratory as being qualitatively suspect (i.e., tentatively identified compounds). The concentrations reported fall within 3 to 4 times the detection limit and are below significant levels.

Two additional monitoring wells, MW-6B and MW-24B, yielded three soil samples in which TCP was detected; MW-6B (1.4 mg/kg at 30 feet); MW-24B (2.66 mg/kg at 2.5 feet); and MW-24B (1.35 mg/kg at 7.5 feet). All three results are also flagged by the laboratory for qualitative reasons, are less than three times the detection limit, and therefore are not significant. No TCP value detected exceeds the health-based criterion of 500 mg/kg for systemic toxicants (2,3,4,6-TCP).

It is not surprising to report the presence of PCP and TCP in soils at the site, particularly when one considers that historical land use included activities such as lumber sapstain control with PCP and TCP. One would anticipate the presence of wood waste and debris throughout the focused site investigation area that could have originated from the green chain wood treatment area. The entire M&R property is composed of artificial fill material, a significant component of which is wood waste, as can be seen in geologic logs (Appendix C) and site photographs (Appendix B). Furthermore, the practice of log sorting and storage on the site is accomplished by heavy equipment which conceivably can disperse wood debris widely throughout the entire property.

Other considerations concerning the occurrence of PCP (and TCP) in soils may include natural background sources. Detectable levels of PCP have been reported in untreated Ponderosa pine and Douglas fir wood samples using either a GC method similar to Method 8040 or a GC/MS method similar to Method 8270 (Arsenault, 1976).

Compounds that are similar to PCP and TCP in chemical structure and molecular weight will respond in a like manner when analyzed using GC methods. It is possible to mistake these compounds for PCP (Arsenault, 1976) resulting in false detections when no PCP is present, or higher reported concentrations when these other compounds are quantified with any PCP that is truly present. This shortcoming is inherent in the GC technique, although it is an EPA-approved method for phenols. Many of these problems are avoided using the GC/MS method for analysis. However, laboratory turnaround time is longer.

5.3.1.2 Marine Sediment Samples

Table 4-20 summarizes the PCP detected in marine sediments by Method 8040. TCP was not reported in any marine sediment using this analytical method. PCP was detected at two stations: DS-MS-03 (4.7 mg/kg) and DS-MS-05 (6.4 mg/kg). (See Figure 3-3 for the locations of these stations.) Both of these results are flagged by the laboratory as being quantitatively suspect. In fact, DS-MS-03 is at the adjusted method detection limit, and DS-MS-05 is less than three times the method detection limit (after moisture content is taken into account) of 2.7 mg/kg dry weight.

It is important to note that the method detection limit (1.0 mg/kg) used in the Method 8040 analysis is based on the wet weight (as received) basis, and all sediments received are analyzed according to that detection limit. When the laboratory adjusts the results to a dry weight basis, there will be an increase in both the apparent concentration level of the sample and the method detection limit (e.g., DS-MS-03, 1.0 mg/kg; DS-MS-05, 2.4 mg/kg). However, dry weight concentrations are preferred for reporting soil or sediment results since the result is the most uniform; it eliminates moisture content as a variable.

No reported value exceeds the federal health-based criterion for PCP in soils as a systemic toxicant (500 mg/kg). The most recent reported apparent biological effects for PCP in Puget Sound sediments range from >0.14 mg/kg to 0.69 mg/kg dry weight, depending on the organism listed (B. Barrich, PTI, personal communication, 12/88). The reported AET levels are based on a recommended analytical method with detection limits that are lower than can be achieved by the EPA Method 8040 used for this study.

Since the two reported results are near or at the method detection limit, it is not possible to further evaluate these results relative to the AETs discussed above. It is important to note, however, that these AETs are not regulatory standards but measures of biological responses.

5.3.1.3 Verification Study Soil Samples

PCP was not detected in any soil sample collected for the verification study (see the technical memorandum provided as an addendum to this report for a discussion on verification study samples). TCP was reported in sample number VI-SS-200 at 2.2 mg/kg, collected in the vicinity of the truck maintenance shop (see Figure 3-3). The presence of TCP in this soil sample is not believed to be from direct chemical application as there is no record of wood treatment occurring in this area. It is reasonable to assume that the TCP found in soil near the maintenance shop may have originated as TCP, or TCP-contaminated soil, that was either washed or dropped from a truck brought to the site for maintenance. The detected value (2.2 mg/kg) is less than three times the method detection limit and it is well below the 500 mg/kg health-based criterion established by EPA.

5.3.2 SOIL RESULTS--METHOD 8270, SEMIVOLATILE ORGANIC COMPOUNDS

Table 4-21 presents all Method 8270 results for subsurface soils and sediments. All Method 8270 results are presented on a wet-weight basis. The PCP results for Method 8270 also are in Table 4-19 to facilitate comparison to Method 8040 results.

5.3.2.1 Subsurface Soil Results

PCP was detected at 1.7 mg/kg in a soil sample collected from a depth of 0.0 to 2.5 feet at MW-25B. This same sample was below the detection limit using Method 8040. The Method 8270 concentration is only slightly greater than the EPA practical quantitative level (PQL) of 1.6 mg/kg. The reported values are comparable to the levels of PCP detected in residential street sweeping debris (Metro, Toxicant Program, 12/82) as discussed in Section 5.3.1.1.

PCP was also detected in the composite sample SB-16CD-11 at 24 mg/kg. A separate composite sample analyzed in duplicate by Method 8040 had no detected PCP. It is possible that in compositing the samples one portion may have contained treated wood fragments that are found throughout the fill material.

TCP was tentatively identified in MW-25B at the surface (0.71 mg/kg) and at 2.5 feet below ground surface (0.19 mg/kg), and in soil boring SB-16CD-11 (27 mg/kg). TCP was only "tentatively" identified because Method 8270 does not include TCP as a target compound. Therefore, there is no detection limit or PQL that can be used for comparison. However, the detected levels are substantially less than the federal health-based criterion of 500 mg/kg for 2,3,4,6-TCP.

The 2,4,5-trichlorophenol was detected in soil boring SB-16CD-11 at an estimated concentration of 2.3 mg/kg, which is below the PQL. This isomer is not a constituent of concern in PCP formulations, and is not one that EPA has listed in the proposed regulations due to health effects (53 FR 53295).

All phthalate esters detected in soil samples were also detected in the laboratory blanks. Using EPA's guidelines, none of these phthalate esters would be reported because they are not greater than ten times the level found in the associated blanks.

Several PAH compounds (fluorene, 0.11 mg/kg; phenanthrene, 0.04 mg/kg and 0.47 mg/kg; flouranthene, 0.043 mg/kg and 0.18 mg/kg; and pyrene, 0.054 mg/kg and 0.14 mg/kg) were detected in soil samples collected from MW-24A and MW-25B. All PAH concentrations were below the PQL. All detected values occurred in samples collected from 2.5 ft or less below the ground surface. In addition, all of the detected PAH values are less than the lowest AET documented (Tetra Tech, 8/86).

4-Methylphenol was detected in one soil sample collected from MW-16B (0.12 mg/kg at 2.5 ft) at one-third the PQL. Phenol was detected in one MW-24A sample (0.9 mg/kg at 2.5 ft). The phenol is less than 1.5 times the PQL. No other compounds from the Method 8270 parameter list were detected in any soil sample.

There are no criteria, guidelines, or regulations for 4-methylphenol. The range of AETs for this compound is 0.067 to 1.2 mg/kg. Phenol has a health-based criterion of 700 mg/kg and an AET range from 0.042 to 1.2 mg/kg. While the detected value occurs within the reported AET range, the value is three orders of magnitude below the health-based criteria.

The occurrence of all of these semivolatile organic compounds on or near the surface is not surprising. The fact that these compounds were not reported from any lower depths suggests their presence does not extend to subsurface soils. It is likely the compounds originate from onsite structures or possibly from creosote-treated wood that may have been used as fill material. (Creosote was not used at this site as a wood preservative.)

Another possible explanation for the occurrence of PAH compounds such as these, with small-ringed structures, is that they may be by-products of past fires or fill material that was burned. The proximity of these sample locations to the building that burned in 1971 supports this possibility. The site has a history of controlled burning for demolition (see Section 2.3).

The presence of phenol may also be from natural sources including the timber stored on the property. Phenols have been reported to occur naturally in leaves and other woody materials at concentrations similar to that reported in MW-24A (Arsenault, 1976).

5.3.2.2 Marine Sediment Samples

The Method 8270 analysis of sediment sample DS-MS-53 did not detect the presence of PCP. Method 8270 did not detect any compounds that would be tentatively identified as TCP.

Phthalate esters were detected in sediment sample DS-MS-53 (Di-n-butylphthalate at 0.16 mg/kg; and bis(2-ethylhexyl)-phthalate at 0.18 mg/kg). Using EPA's guidelines, these levels of phthalate esters would not be reportable because they are not greater than ten times the contamination reported in the laboratory method blank (0.098 mg/kg and 0.11 mg/kg for di-n-butyl-phthalate and bis(2-ethylhexyl) phthalate, respectively).

Fifteen PAHs were detected in sample DS-MS-53 by Method 8270. These compounds are listed with their respective concentrations in Table 4-21. All of the PAH compounds are consistent with those found in creosote mixtures used to treat wood products. The concentrations for 12 of the compounds fall between the laboratory method detection limit and the PQL. For all of the PAHs for which there are AETs, none of the detected values from sample DS-MS-53 exceed the lowest apparent effects threshold. It is likely that the source of these compounds is creosoted bulkheads, piers, and other treated marine timber surrounding the sample area (see Appendix B for photographs of these structures).

Finally, benzoic acid was the only other semivolatile organic compound from the Method 8270 target list detected in sample DS-MS-53 at 0.096 mg/kg. The concentration is far below the PQL and AET.

5.3.2.3 Verification Study Soil Samples

No Method 8270 analyses were performed on soil samples collected for the verification study.

5.3.3 SOIL RESULTS, MERCURY ANALYSIS

Twenty-nine subsurface soil samples were analyzed for the presence of mercury. Mercury was detected in nine of the samples at concentrations greater than the detection limit (0.03 to 0.05 mg/kg), with a concentration range of 0.048 mg/kg to 0.286 mg/kg. Mercury occurs naturally in soil with a common range of 0.01 mg/kg to 0.3 mg/kg (Lindsay, 1979). All the results are within this naturally occurring range. There are no criteria for mercury in soils (USEPA, RCRA Hotline, K. Mitchell personal communication, 12/88). In fact, the proposed TCLP trigger concentration for mercury hazardous waste designation is 0.2 mg/l (51 FR 21685, 6/13/86). (The TCLP measures the concentration of a compound or element that can be leached from a soil or other solid using a slightly acidic solution.) Considering the 20:1 dilution factor used in the TCLP (see Section 5.1.6), none of the soil samples analyzed for mercury would exceed the TCLP trigger level.

5.3.4 SUBSURFACE SOILS, APPENDIX IX RESULTS

Only metals (total) and sulfide were found in the soil sample collected near the old planer mill and fire location and analyzed for 40 CFR 264 Appendix IX constituents. Table 5-2 presents values for the detected metal results compared with available regulatory standards [EP-Toxicity, TCLP, and health-based criteria for carcinogens (arsenic only) and systemic toxicants]. Table 5-2 also presents the normal range of the detected metals and the average elemental values found in soils and in the lithosphere (Lindsay, 1979). As can be seen in Table 5-2, no detected metal value exceeds natural soil conditions, would exceed EP toxicity trigger levels when dilution factors are considered, or poses health risks, based on EPA's criteria.

5.4 DISCUSSION OF GROUNDWATER RESULTS

Using the regulations and guidelines discussed in Section 5.1, the validated groundwater results are evaluated.

Table 5-2
METALS DETECTED BY 40 CFR APPENDIX IX SOIL ANALYSIS AND PUBLISHED CRITERIA AND GUIDELINES
(concentrations in mg/kg)

Analyte	Reported Level	Naturally Occurring Range in Soils[b]	Average Natural Range[b]	EP Toxicity Levels[c]	TCLP Levels[d]	Health-Based Criteria[e] Carcinogens	Health-Based Criteria[e] Systemic Toxicants
Arsenic	3.4	1-500	5	5.0	5.0	0.022	NL
Barium	12.0	100-3,000	430	100	100	NL	900
Beryllium	0.2	0.1-40	6	NL	NL	NL	900
Chromium	16.0	1-1,000	100	5.0	5.0	NL	f
Cobalt	6.0	1-40	8	NL	NL	NL	NL
Copper	26.0	2-100	30	NL	NL	NL	g
Lead	5.1	2-200	10	5.0	5.0	NL	NL
Nickel	16.0	5-500	40	NL	NL	NL	300
Vanadium	34.0	20-500	100	NL	NL	NL	h
Zinc	36.0	10-300	50	NL	NL	NL	i

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[a] From Appendix IX analysis of MW-B28.

[b] Lindsay, Chemical Equilibrium in Soils, Table 1.1, pages 7 and 8.

[c] 40 CFR Part 261.24.

[d] 51 FR 21685.

[e] EPA, Revised Draft RFI Guidance, Vol. 1, Section 8, December 1987.

[f] Chromium (III) criterion is 20,000 mg/kg and Chromium (VI) criterion is 90 mg/kg. Value is for total chromium present and oxidation states are not known.

[g] Copper cyanide is the only copper entry in the regulations with a value of 1,000 mg/kg. This analysis was for total copper present so no information on possible compounds is available. Cyanide was analyzed for and not detected in the sample.

[h] Vanadium pentoxide at 300 mg/kg is the only vandium compound listed. Analysis was for total vandium and no information on the possible compounds are available.

[i] Two zinc compounds are listed: zinc cyanide at 5 mg/kg and zinc phosphide at 900 mg/kg. No information on compounds present is available since the analysis was for total zinc.

NL = Not listed.

5.4.1 METHOD 8040 RESULTS--PCP

Table 5-3 summarizes the Method 8040 results for groundwater. No PCP was reported in background wells (MW-26 and MW-5A), nor was PCP detected in any deep well (Figures 5-4 and 5-5). (Figures 5-4 through 5-6 illustrate all Method 8040 results by sampling event and by monitoring well.)

PCP was found in 14 out of 44 groundwater samples analyzed by Method 8040. These 14 samples were collected from nine shallow monitoring wells. The nine monitoring wells and the concentrations of PCP in groundwater samples are presented in Table 5-3.

Table 5-3
METHOD 8040 PCP GROUNDWATER RESULTS SUMMARY

Monitoring Well	Company	Concentration (mg/l) Round 1	Round 2	Additional Analysis
6A	HC	3.07	0.51J	2.13
6C	CH2M HILL	14.3[a]	0.27[a]	0.16
8	HC	0.005[b]	BDL	Not sampled
15	HC	0.009	BDL	Not sampled
16A	HC	0.052	BDL	0.064
18	HC	0.006	BDL	Not sampled
19	HC	0.015	BDL	Not sampled
21	HC	0.021	BDL	Not sampled
22	HC	0.025	BDL	Not sampled

---

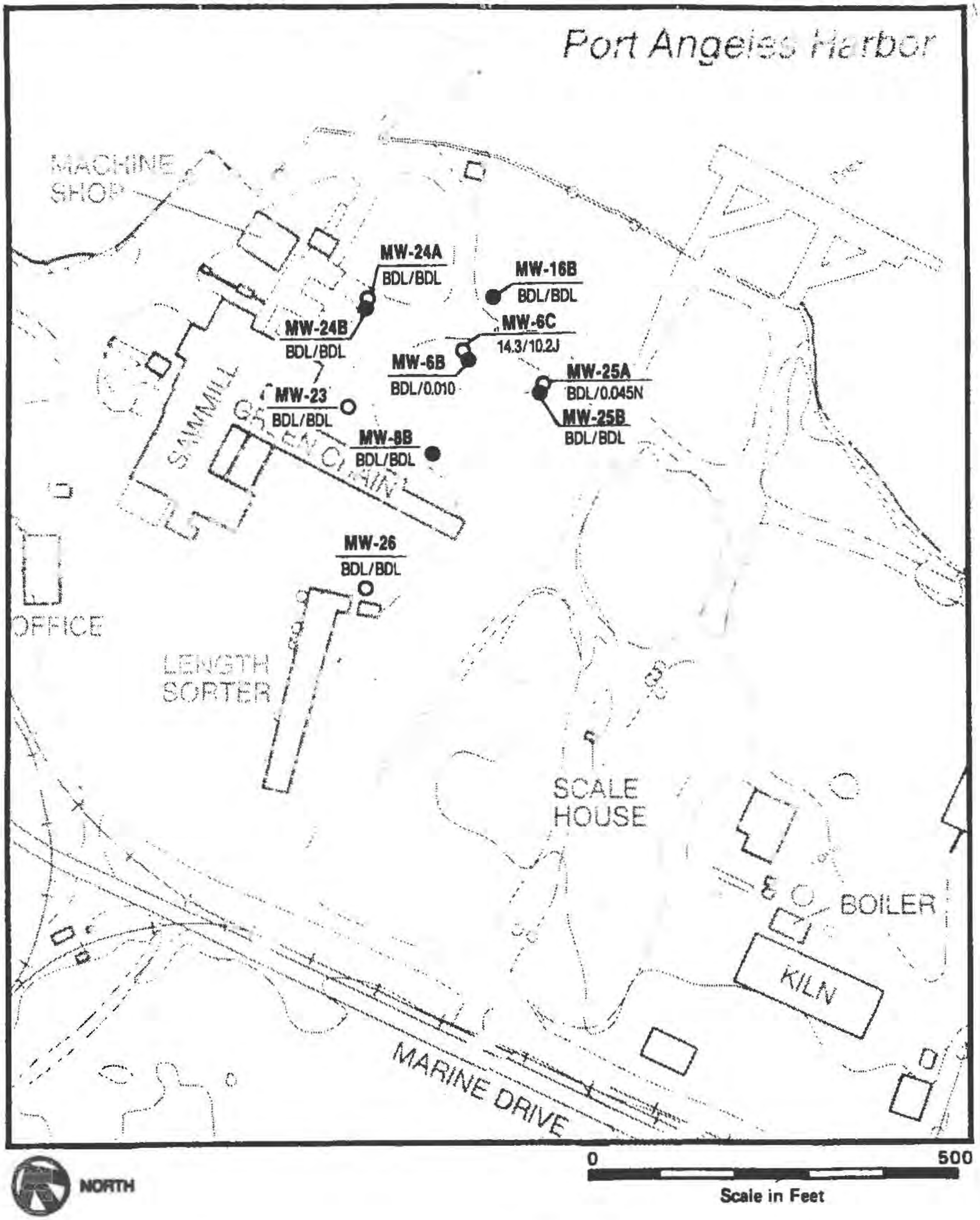
[a] MW-6C sampled later than specified dates for Rounds 1 and 2 because it was installed last.

[b] 0.005 is the Method 8040 detection limit.

BDL = below detection limit.

J = quantitatively suspected value.

With the exception of monitoring wells MW-6A, MW-6C, and MW-16A, the detected levels of PCP are at low levels, slightly above the method detection limit (MDL) of 0.005 mg/l, but well below a PQL set at ten times the MDL. During Round 1, MW-8 and MW-18 contained PCP at the MDL, PCP in MW-15 was twice the MDL, PCP in MW-19 was three times the MDL, PCP in MW-21 was less than five times the MDL, and PCP in MW-22 was five times the MDL. PCP in MW-16A only slightly exceeds the PQL. The PCP concentration in MW-16A

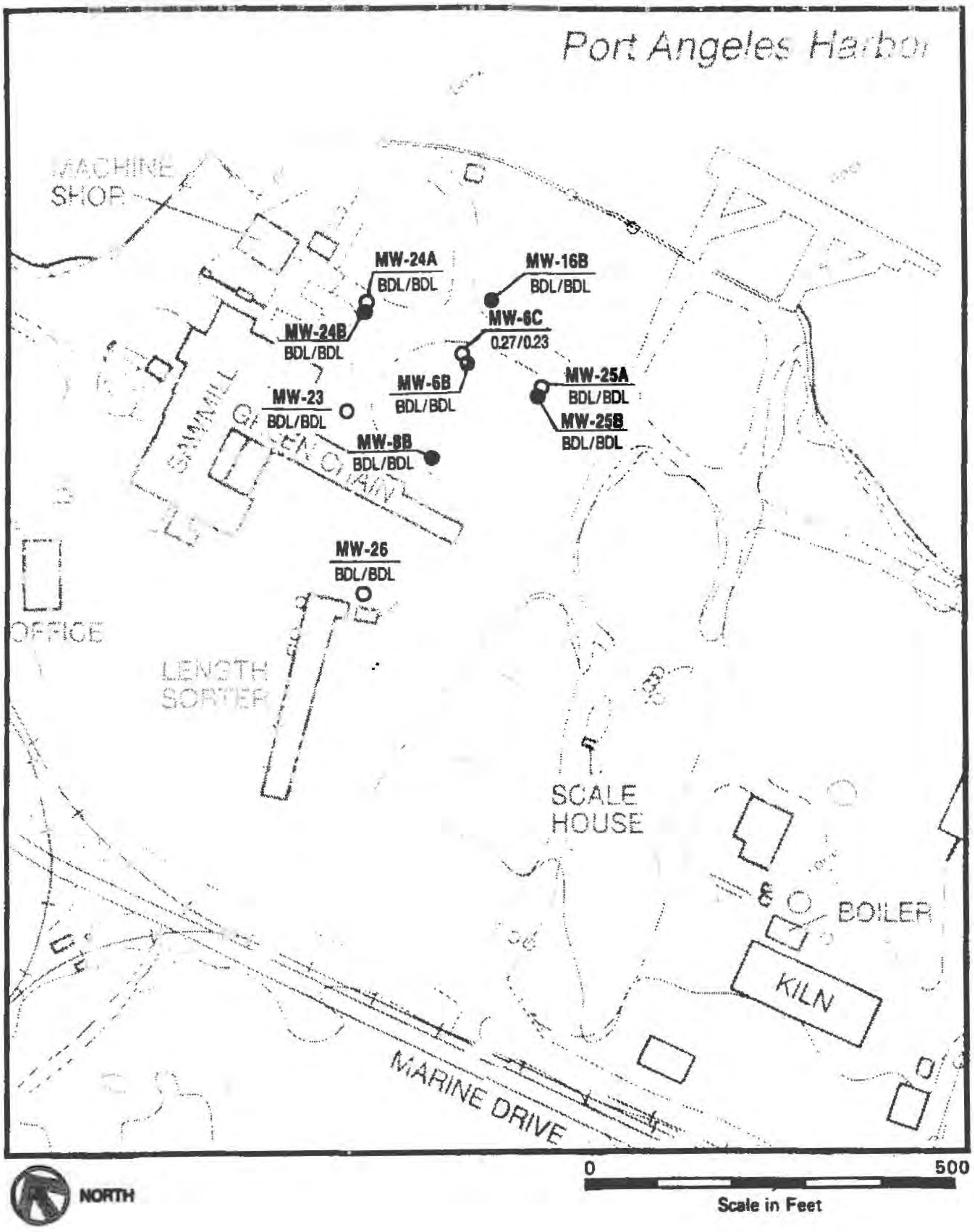


LEGEND

- ● Deep Wells Installed by CH2M HILL
- ○ Shallow Wells Installed by CH2M HILL
- N Qualitatively Suspect
- J Quanitatively Suspect
- R Unable to Calculate Due to Interference
- BDL Below Detection Limit
- Analytical Results — PCP/TCP

FIGURE 5-4

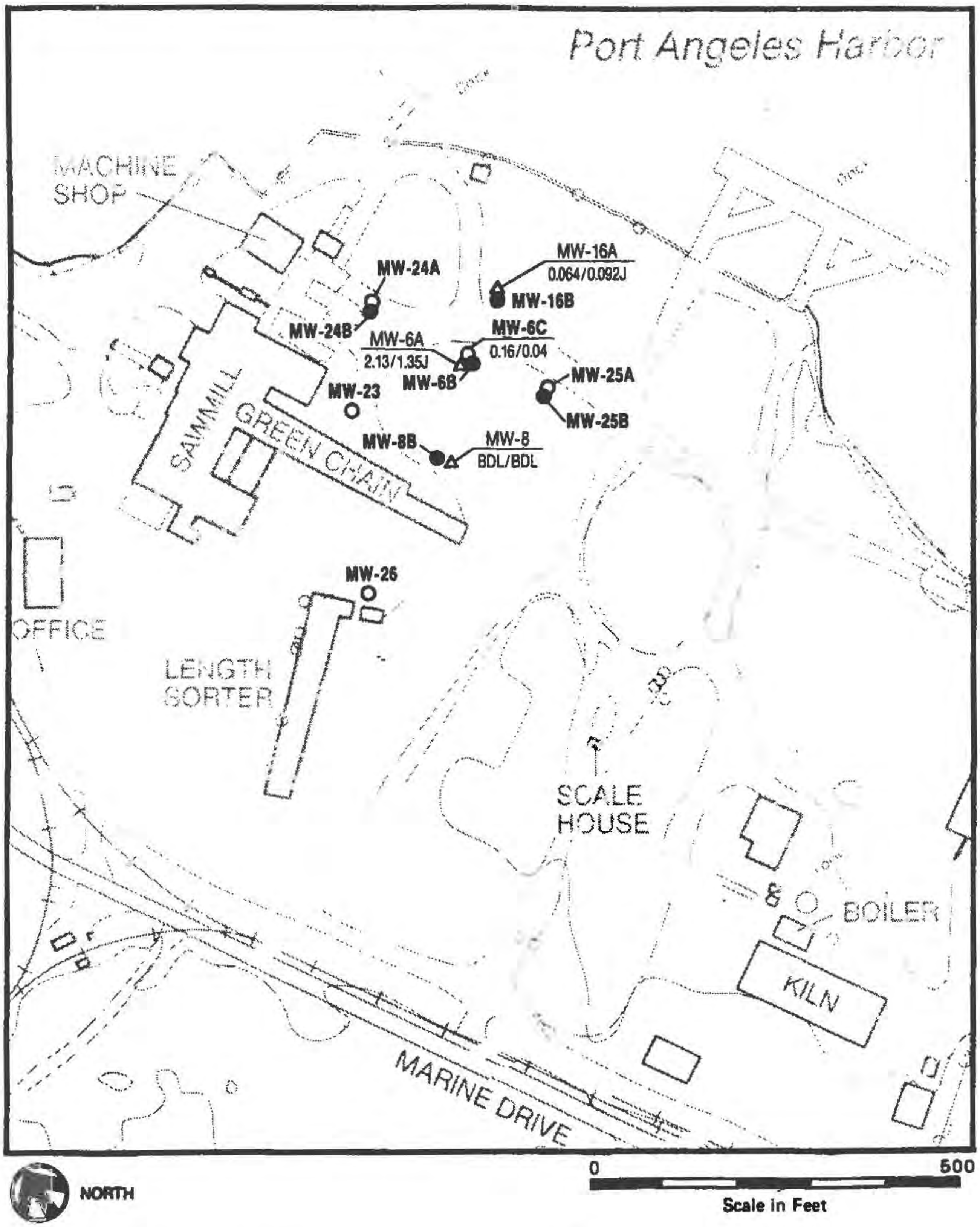
Pentachlorophenol and Tetrachlorophenol Analytical Results for Groundwater (mg/l) Round 1 — CH2M HILL Wells



LEGEND
- ● Deep Wells Installed by CH2M HILL
- O Shallow Wells Installed by CH2M HILL
- N Qualitatively Suspect
- J Quantitatively Suspect
- R Unable to Calculate Due to Interference
- BDL Below Detection Limit
- Analytical Results — PCP/TCP

FIGURE 5-5

Pentachlorophenol and Tetrachlorophenol Analytical Results for Groundwater (mg/l) Round 2 — CH2M HILL Wells



LEGEND

●	Deep Wells Installed by CH2M HILL
○	Shallow Wells Installed by CH2M HILL
△	Shallow Well Installed by Hart Crowser Analytical Results — PCP/TCP
J	Quantitatively Suspected Result
BDL	Below Detection Limit

FIGURE 5-6

Pentachlorophenol and Tetrachlorophenol Analytical Results for Groundwater (mg/l) Additional 8040 Analysis

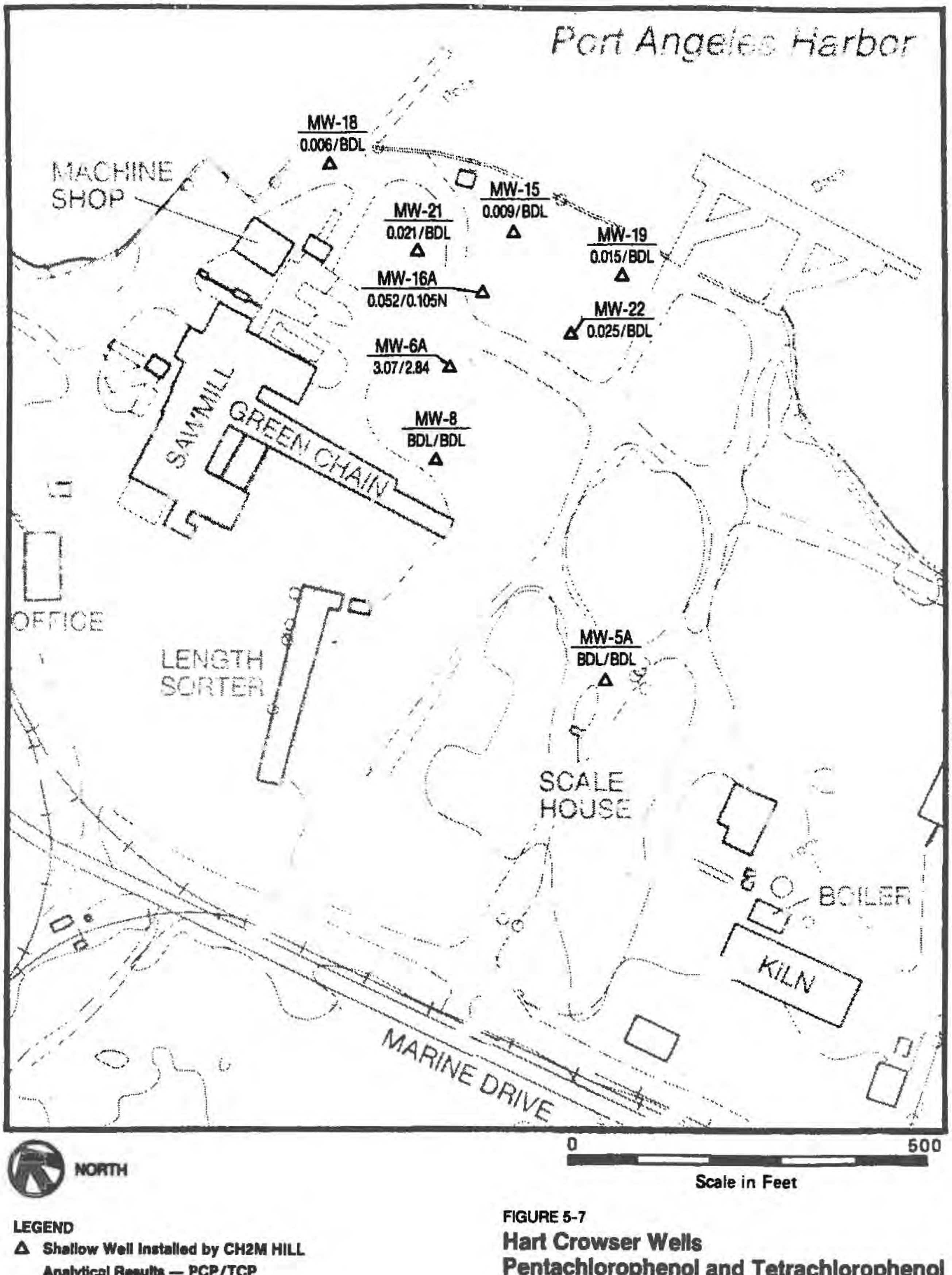
(0.052 mg/l) was several orders of magnitude less than the concentration of PCP found in MW-6A and MW-6C.

It is interesting to note that these very low-level detections in samples collected from Hart Crowser monitoring wells MW-8, MW-15, MW-16A, MW-18, MW-19, MW-21, and MW-22 all occurred in Round 1 of sampling. During Round 2, no detectable PCP was reported in any of these seven wells. This may be a result of the field sampling methods, particularly the redevelopment methods reported in Section 3.1.1. Except for MW-6C, all the PCP detections reported during Round 1 are in samples from Hart Crowser wells that required the special well development techniques.

The monitoring wells constructed by Hart Crowser may not have been designed optimally for the subsurface conditions present at the site. The presence of fine sand and silt in the subsurface required the use of a finer filter pack and smaller screen openings. Colloidal material, which was also present, could not be filtered out of the groundwater, but the suspended particulates could be screened and removed. Of the nine monitoring wells in which detectable concentrations of PCP were reported, eight of the wells were constructed with a screen-opening size of 0.020 inch, which is twice that of the wells constructed by CH2M HILL. Further, the diameter of the filter pack material used to surround the well screen in the eight preliminary assessment (Hart Crowser) wells may also be too large for the subsurface materials that exist at the site. Consequently, the presence of particulates, including wood splinters, was observed in these wells by CH2M HILL staff.

The presence of particulates in groundwater was particularly evident to CH2M HILL during well redevelopment in August 1988. CH2M HILL had to use two methods to attempt to develop these wells. Ultimately, however, these wells continued to yield formation material (see Section 3.1.1). Hence, it is not clear whether PCP detected in the groundwater samples was in solution or whether it adhered to wood or soil particles included in the sample.

Figures 5-7, 5-8, and 5-9 present the Method 8040 analytical results for groundwater samples collected from nine Hart Crowser wells. As can be seen by comparing the occurrence of PCP in groundwater samples collected from the Hart Crowser property transfer assessment wells with those constructed later by CH2M HILL, more PCP (and TCP) detections are associated with the property transfer monitoring wells. It should also be noted that the results reported in Figure 5-9 were analyzed by a modified Method 8150 (chlorinated herbicides), not the recommended procedure for PCP.



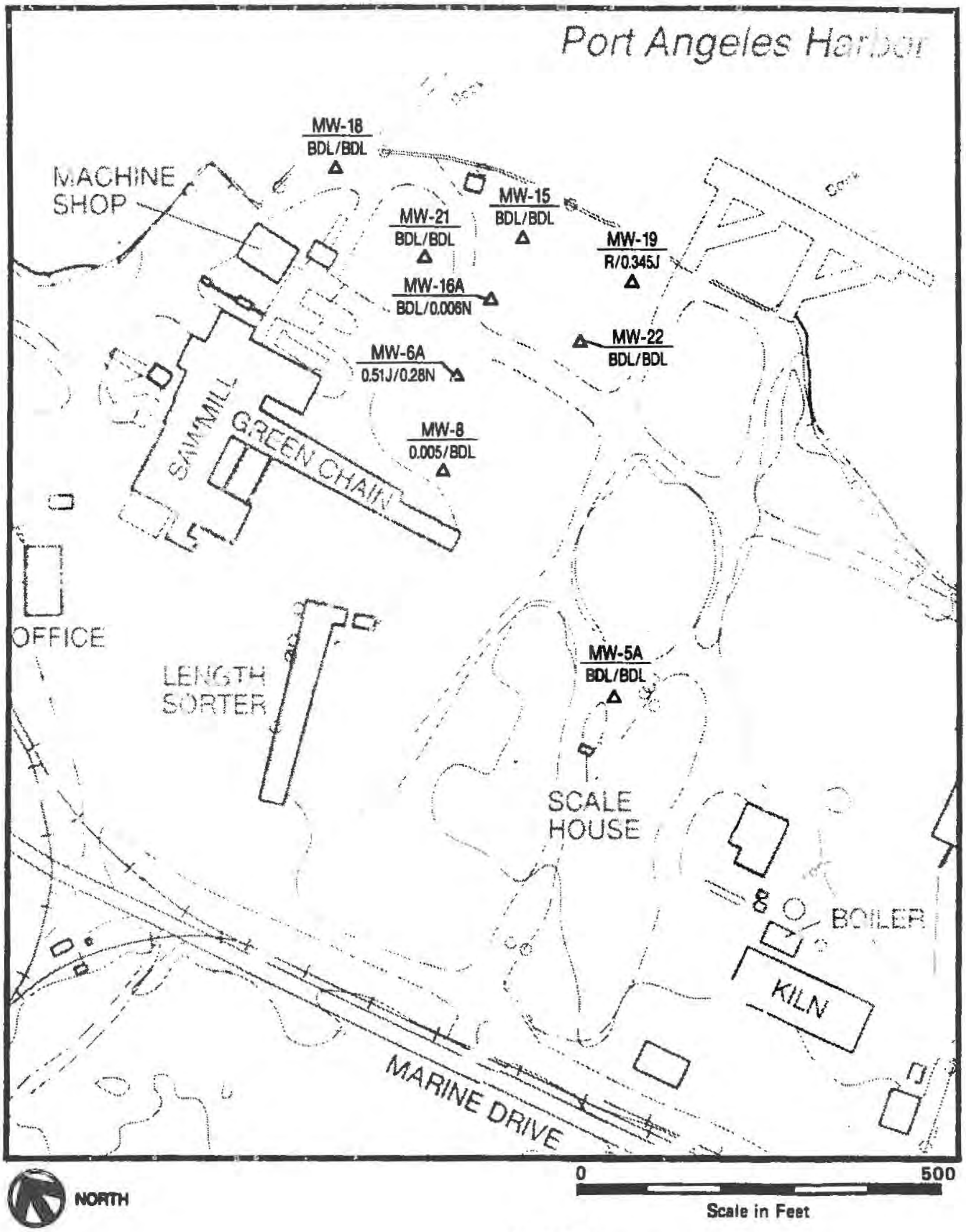
LEGEND

△ **Shallow Well Installed by CH2M HILL**

Analytical Results — PCP/TCP

FIGURE 5-7

Hart Crowser Wells
Pentachlorophenol and Tetrachlorophenol
Analytical Results for Groundwater (mg/l)
Round 1 — CH2M HILL Results



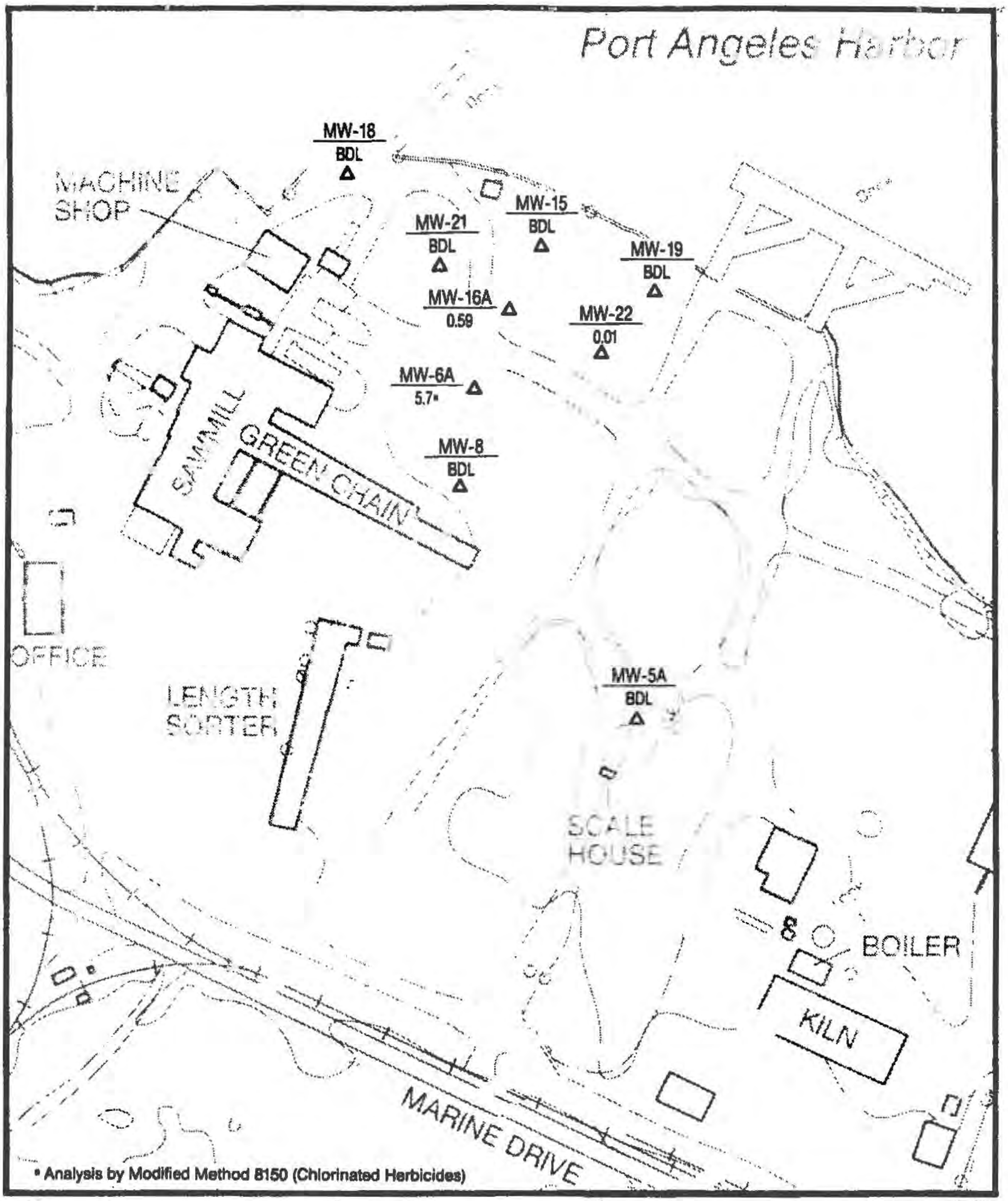
LEGEND

- △ Shallow Well Installed by Hart Crowser
- N Qualitatively Suspect
- J Quanitatively Suspect
- R Unable to Calculate Due to Interference
- BDL Below Detection Limit

Analytical Results — PCP/TCP

FIGURE 5-8

Hart Crowser Wells
Pentachlorophenol and Tetrachlorophenol analytical Results for Groundwater (mg/l)
Round 2 — CH2M HILL Results



LEGEND

△ Shallow Well Installed by Hart Crowser

FIGURE 5-9

Hart Crowser Wells
Pentachlorophenol Analytical Results for Groundwater (mg/l)
Hart Crowser Results

In comparison to the Hart Crowser property transfer assessment wells, only one of 11 monitoring wells (MW-6C) constructed by CH2M HILL yielded groundwater with detectable levels of PCP (14.3 mg/l). Interestingly, only 0.27 mg/l PCP was detected in monitoring well MW-6C during Round 2, a substantial decrease from the Round 1 result. It was decided to sample MW-6C a third time because of the discrepancy in the first two values. The third sample collected from MW-6C tested at 0.16 mg/l PCP (see Figure 5-6). The last value compared favorably to the Round 2 result and is believed to be more representative of PCP levels in groundwater from this well.

It is possible that the high value obtained from the first round was due to suspended particulates, particularly the colloidal material that can not be screened out. If groundwater turbidity in the monitoring well had not stabilized following development, an anomolous value could have resulted. It is believed, however, that PCP is present in shallow subsurface soils and localized groundwater in the vicinity of monitoring wells MW-6A and MW-6C. Deep well MW-6B does not show PCP in groundwater. Similarly, PCP has not been detected in monitoring wells MW-24A, MW-24B, and MW-16B, located downgradient of MW-6C. MW-25A and MW-25B located to the south are also free of detectable PCP, as are MW-23, MW-24A, and MW-24B located to the north. If a major source of PCP were present near these wells, its presence almost certainly would be detected.

It is believed that, as with MW-6A and MW-6C, there is a potential for limited PCP contamination in the immediate vicinity of MW-16A. It is difficult, however, to ascertain whether these detected values represent soluble PCP in groundwater or PCP adhering to particulates in the groundwater samples. The partitioning coefficient of PCP is high, indicating a high preference for adsorption to particles and, in particular, organic material. Pentachlorophenol behaves similarly to many other organic compounds in its tendency to adsorb onto the surface of soil, particulate material, and suspended solids from aqueous solution. The degree of adsorption is strongly influenced by three factors: the nature and quantity of organic matter associated with the solid phase; the pH of the water; the specific surface area of the solids.

The strong tendency of PCP to adhere to soil, particulate material, and suspended solids that contain (non-PCP) organic matter is reflected in the octanol-water partitioning coefficient, $\log P_{ow} = 5.01$ (Verschueren, K., Handbook of Environmental Data on Organic Chemicals, Van Nostrand Reinhold Company, New York, 1983). This coefficient is derived from laboratory data on the relative concentrations of PCP in octanol (the prototypical soil-organic phase) and water (representing soil or sediment pore water), and is treated as an indication of the degree of partitioning between pore water and the organic-rich solid phase under environmental conditions. A value for log P_{ow} of 5.01 indicates that PCP would be about 100,000 times more concentrated in pure octanol than in an equal quantity of pure water in contact with the octanol. Allowing for the fact that the sediments analyzed averaged approximately 1.6 percent organic carbon (wet weight), the degree of partitioning between soil and water would be lower than that for octanol and water. Nevertheless, there would be a tendency for PCP to be strongly adsorbed onto the soil. PCP adsorption coefficients from laboratory studies (Banerji et al., 1986) indicate significant retardation of any PCP contamination is expected during groundwater flow through a source of PCP.

Increasing pH of the pore water increases the solubility of PCP in water and decreases its solubility in octanol. At typical groundwater pH values for the study area (6.8 to 8.1) the soil affinity of PCP would be lower than would be predicted from octanol-water partitioning, after adjustments for the reduced organic content of soil and sediments.

While the extent to which the PCP is partitioned between soil and water cannot be quantitatively predicted from the octanol-water partitioning coefficient, the high-specific surface area of soils (surface area per volume of bulk soil) suggests that some degree of PCP adsorption should occur. One consequence of this adsorption is that the PCP would migrate at a slower rate than the groundwater flow velocity. Another consequence is that groundwater samples that are reported to contain PCP, but which also contained suspended solids (including colloidal-sized particles) could be the result of solids-associated PCP, rather than soluble PCP that might migrate with the groundwater. The noticeable reduction in the detected level of PCP from the first sampling event to the later sampling events indicates that the levels from the first round may be due in part to colloids that could not be centrifuged out of the solution.

Groundwater at the site does not fall under marine surface water or drinking water classifications, but the federal and state criteria provide useful comparisons. The federal MCLG for PCP in drinking water is 0.22 mg/l. MW-6A and MW-6C exceeded this value during all sampling except during the third sample collected from MW-6C. The PCP concentration in all other groundwater samples falls below this level.[1]

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[1] The proposed regulation of wood treatment solutions would set a health-based water limit at 1 mg/l for PCP. This level would have been exceeded only at MW-6A, Round 1 and 3, and MW-6C, Round 1 only. All other values are below this level.

Federal and state marine surface water criteria are 0.013 mg/l (acute) and 0.0079 mg/l (chronic). MW-18 is nearest the harbor and does not exceed either the chronic or acute limits. The other two monitoring wells near the harbor are MW-15 and MW-19. MW-19 exceeds both the chronic and acute criteria (the result, 0.015 mg/l, exceeds the chronic criterion and is marginally over the acute criterion). MW-15, with a detected level of 0.009 mg/l, exceeds the chronic but not the acute standards. It should be noted that even though these two concentrations are above the criteria for marine surface water, they are below the PQL for PCP in water. The second round of sampling for all three wells did not show any detectable PCP, and thus they do not exceed any marine chronic or acute criteria.

It should be restated that surface water criteria are not applicable to groundwater, and that the comparison of groundwater PCP levels to surface water criteria is for illustration only. The values detected in these groundwater samples are on the order of the detected PCP contamination in urban (Bellevue, Washington) residential storm runoff for which concentrations have been measured in the range of 0.003 mg/l to 0.115 mg/l (Metro Toxicant Program, 1982).

In summary, it appears that limited amounts of PCP may be localized in soils and possibly in groundwater in the vicinity of MW-6A, MW-6C, and MW-16A. There are no groundwater criteria or standards for PCP. Because this water is not potable, drinking water criteria (or proposed criteria as in the case of PCP) do not apply to this site.

Groundwater movement in the central portion of the focused site investigation area does not appear to be conducive to rapid migration of contaminants by advection. An upper bound estimate for horizontal groundwater flow velocity between monitoring wells MW-6A and MW-16A is 10 to 15 feet per year. This estimate is based on horizontal hydraulic gradients illustrated in Figures 4-7 and 4-8, and hydraulic parameters presented in Section 4.1.1.2. In addition, downward vertical migration of contaminants is inhibited by vertical groundwater flow potentials that are upward and the relative low hydraulic conductivity of the silt and fine sand present below a depth of about 20 feet.

Based on the groundwater velocity presented above and other hydrologic information presented in Section 4.1.1.2, any potentially contaminated groundwater near MW-6C being transported by advection is likely migrating to the northeast at a very slow rate. This scenario is supported by the analytical data. With the exception of monitoring wells MW-6A and MW-6C, MW-16A is the only shallow monitoring well in which PCP has been detected more than once (0.052 and 0.064 mg/l during Rounds 1 and 2, respectively). Neither

TCP nor PCP has been detected in monitoring wells MW-24A and MW-25A, indicating that the contamination is not distributed laterally relative to groundwater flow past MW-6A. Furthermore, neither TCP nor PCP has been detected in deep zone monitoring wells, except for monitoring well MW-6B during Round 1 (TCP at 0.010 mg/l), indicating that the vertical extent of any contamination is limited.

This slow movement of potentially contaminated groundwater would also serve to facilitate biological degradation of PCP and TCP before the groundwater is discharged to Port Angeles Harbor. It has been shown (Kauffman, 1978 and Arsenault, 1976) that PCP will degrade to numerous mono-, tri-, and dichlorinated phenols, and ultimately to carbon dioxide and water. These chlorinated compounds represent a lesser health risk than PCP (U.S. EPA, RFI Guidance, December 1987). The breakdown of PCP can occur by chemical, microbiological, and photochemical means. Interestingly, Kauffman reported that PCP degrades more rapidly in flooded or anaerobic soil than in aerobic, moist soil. The soils found in the focused site investigation area are perennially flooded and would appear to provide enhanced degradation conditions.

The EPA Office of Research and Development (Ada, Oklahoma) has published a report on the treatability of soils contaminated with PCP (McGinnis et al., 1988). The report draws from literature data and laboratory experiments with soil from eight wood processing plants. The general conclusions are:

- In studies going back to 1950, the rate of decomposition of PCP in soils was faster under flooded or near saturation conditions.
- In soils from wood processing plants that had used PCP, added PCP had a half life of 2 to 3 months.
- "The general conclusions from this study are that PAH's and PCP are readily degraded in soil systems ... PCP was transformed much more quickly in soils with long term exposure to PCP."

5.4.2 METHOD 8040 RESULTS--TCP

Table 5-4 summarizes the Method 8040 TCP results reported in groundwater. Figures 5-4 through 5-6 summarize all groundwater analytical results for the CH2M HILL wells. Figures 5-6 through 5-9 present the results for the Hart Crowser property transfer assessment wells.

TCP was found in 12 of 44 groundwater samples analyzed by Method 8040. The detected values were found in samples collected from the six monitoring wells presented in Table 5-4.

Table 5-4
METHOD 8040 TCP GROUNDWATER RESULTS SUMMARY

Monitoring Well	Company	Concentration (mg/l) Round 1	Round 2	Additional Analysis
6A	HC	2.84	0.28N	1.35J
6B	CH2M HILL	0.010	BDL	Not sampled
6C	CH2M HILL	10.2J[a]	0.23[a]	0.04
16A	HC	0.105N	0.006N	0.092J
19	HC	BDL	0.345J	Not sampled
25A	CH2M HILL	0.045N	BDL	Not sampled

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[a] MW-6C sampled later than specified dates for Rounds 1 and 2 because it was installed later.

BDL = below detection limit.

N = Qualitatively suspected compound.

J = Quantitatively suspected value.

As with PCP levels, TCP was reported in samples collected from the MW-6 series wells. In MW-6A and MW-6C, high levels of TCP were detected in the first round of sampling at 2.84 mg/l and 10.2 mg/l respectively. The 10.2 mg/l concentration was qualified by the laboratory as being quantitatively suspect. During the second round of sampling, TCP was detected in samples from MW-6A and MW-6C at 0.28 mg/l and 0.23 mg/l, respectively. The significant drop in TCP detected may again be associated with well development and the optimum length of time required for groundwater turbidity to stabilize before sampling should ideally occur. In MW-6B, TCP was detected at 0.010 mg/l (less than three times the method detection limit) in Round 1 and was not detected in Round 2. TCP was not reported in samples from any other deep well. Monitoring well MW-16A detected TCP at 0.105 mg/l in Round 1 and at 0.006 in Round 2. Both values were flagged by the laboratory as being qualitatively suspect. The additional sampling of MW-16A yielded a detected value that is just above the detection limit of 0.005 mg/l. TCP was detected in the Round 1 sample collected from MW-25A. This value was flagged by the analytical laboratory as qualitatively suspect. TCP was not detected in Round 2. MW-19 had no TCP detected in the first round and 0.345 mg/kg for the second round. The laboratory flagged this value as quantitatively suspect.

Based on the results discussed above, only shallow monitoring wells MW-6C and MW-6A appear to show reliable levels of

TCP. As with the PCP, the TCP contamination appears localized and may be associated with suspended particulates or colloidal matter in groundwater samples. The presence of a large source or area of TCP contamination is not supported by the data.

There are no water quality criteria available for groundwater contaminated with TCP.

5.4.3 METHOD 8270 GROUNDWATER ANALYSIS

Results of the Method 8270 (semivolatile organic chemicals) analysis of groundwater are presented in Table 4-21. Four groundwater samples were collected from three monitoring wells (MW-6B, MW-6C, MW-16A) and analyzed using Method 8270. PCP was reported in wells MW-6C (6.9 mg/l) and MW-16A (0.017 mg/l). The concentration detected in MW-16A was qualified by the laboratory as an estimate only. This compound was detected between the MDL and the PQL. The value reported in MW-16A is less than one-fifth of the PQL. The Method 8270 PCP value for MW-6C (6.9 mg/l) compares favorably with the CSL 8040 result for the same sample (14.3 mg/l), indicating good agreement between the methods and laboratories.

Method 8270 does not include TCP as one of the 65 target compounds, but it was tentatively identified in two of the four groundwater samples. The sample collected from MW-6C contained two TCP isomers with a combined level of approximately 3.5 mg/l; the sample from MW-16A had one isomer at a level of 0.02 mg/l.

Other semivolatile compounds detected by Method 8270 included phthalate esters, which were found in all four samples and two method blanks. Because phthalate esters are ubiquitous, the Data Validation Guidelines (EPA, 1988) state that phthalate esters and other common contaminants should be present at levels greater than ten times blank contamination levels before they are considered to be present in the sample. None of the samples exceeded this 10-fold criterion, indicating that phthalate contamination is not a concern at the site.

Two possible PCP breakdown products were detected in groundwater samples collected from MW-6C. 2,4-dichlorophenol (at 0.011 mg/l) and 2,4,5-trichlorophenol (at 0.080 mg/l) were both detected below the EPA quantitation limit and are considered to be estimated quantities. Naphthalene was detected in MW-16A at an estimated level of 0.002 mg/l and in MW-6C at 0.077 mg/l.

Although groundwater around all of the study's wells are neither marine surface waters nor a source of drinking water, it is useful to compare the federal and state criteria to the levels detected in these four samples. The level of PCP found in MW-6C is above the federal MCLG of 0.22 mg/l. This represents only one sample result (Round 1), and it is not known if subsequent analyses by Method 8270 would decrease in value as was observed in the Method 8040 PCP analysis for this monitoring well. Appendix IX analysis of this groundwater did not detect the presence of PCP during the third groundwater sample collected five weeks later.

The 0.017 mg/l concentration in groundwater collected from MW-16A is considerably below the drinking water standard (0.22 mg/l) and marginally exceeds the marine life acute and chronic criteria (0.013 mg/l and 0.0079 mg/l, respectively).

Two isomers of TCP were found among the nontarget compounds detected at MW-6C. A regulatory criterion exists only for 2,3,5,6-TCP in drinking water (0.44 mg/l). The estimated level in MW-6C was 3.44 mg/l. As referenced earlier, however, the groundwater beneath the focused site investigation is not suitable for use as drinking water.

There are no regulatory criteria for 2,3,4,5-TCP, but the two detected values (0.18 mg/kg at MW-6C and 0.0196 mg/kg at MW-16A) are below the drinking water criteria for both PCP and 2,3,5,6-TCP. The 2,4,5-trichlorophenol at MW-6C and naphthalene at MW-6C and MW-16A are two orders-of-magnitude below the regulatory limits. The 2,4-dichlorophenol detected at MW-6C, at an estimated concentration of 0.011 mg/l, is near the MDL and is well below the criterion of 0.1 mg/l.

5.4.4 APPENDIX IX GROUNDWATER ANALYSIS

Only benzene, sulfide, and TCP were reported from four Appendix IX groundwater samples collected from MW-6B and MW-6C. None of the dioxin or dibenzofuran compounds were detected in any of the groundwater samples. There are no known criteria for 2,3,4,6-TCP in groundwater. The presence of TCP reported by Appendix IX analyses supports evidence based on other analytical methods that there is localized contamination in the vicinity of MW-6A and MW-6C. Benzene was reported at 0.0087 mg/l at MW-6C, which is above the health-based criterion for benzene (0.0011 mg/l) in drinking water. The acute and chronic marine concentration limits for aquatic life are both greater than the 0.0087 mg/l reported value. Sulfide was detected at 0.05 mg/l at MW-6B.

Table 5-5 presents the criteria and guidelines for metals detected in groundwater by Appendix IX analyses. As can be seen from Table 5-5, none of the detected values are above the concentrations found generally in Puget Sound and are at or below the guidelines.

Table 5-5
METALS DETECTED BY 40 CFR APPENDIX IX GROUNDWATER ANALYSES AND PUBLISHED CRITERIA AND GUIDELINES
(concentration in mg/l)

Metal	MW-6B[a]	MW-6C[a]	MW-16B[a]	MW-24A[a]	Proposed MCL[b]	Health-Based Criteria[b]		Federal Clean Water Act		Concentrations Found in Puget Sound[d] (Minimum-Maximum)
						Carcinogens	Systemic Toxins	Criteria for Marine Aquatic Life (Acute/Chronic)[b]	Limits for Human Consumption of Water and Fish[c]	
Arsenic	0.04	ND	0.014	NA	0.05	0.0000022	NCL	NCL	0.0000022	0.001-3.815
Barium	0.12	0.19	0.190	0.016	1.0	NCL	2.0	NCL	1.0	NL
Chromium[e]	ND	ND	ND	ND	0.05 NCL	NCL NCL	0.2 40	1.1/0.05 10.3/NCL	0.05 170	0.001-0.320
Copper	ND	ND	ND	0.008	NCL	NCL	f	0.0029/0.0029	NCL	0.001-1.240
Lead	ND	0.003	0.022	0.003	0.05	NCL	NCL	0.14/0.0056	0.050	ND-1.750
Vanadium	ND	ND	ND	0.01	NCL	NCL	g	NCL	NCL	NL
Zinc	ND	ND	ND	0.02	NCL	NCL	h	0.095/0.086	NCL	ND-11.800

ND = not detected.
NCL = no criteria listed.
NA = not analyzed.
NL = not listed.

[a] Values are from Appendix IX analyses for total recoverable metals.

[b] EPA, Revised Draft RFI Guidance, Volume 1, Section 8, December 1987.

[c] Based on a 70-kg adult over 70 years lifetime exposure at 2 liters/day (b).

[d] EPA, Pollutant of Concern Matrix, 1986. Ranges are for receiving water in non-reference areas (e.g., urban bays and the central basin).

[e] Upper value is for chromium (VI), the lower value is for chromium (III). The analysis gives only total chromium so no information on the oxidation state is available.

[f] The only listed value for copper is copper cyanide at 2.0 mg/l. No information on what copper compounds are present in sample is available.

[g] Vanadium pentoxide is the only listed vanadium compound. No information on what vanadium compounds are present is available for these samples.

[h] Zinc cyanide, 2.0 mg/l; zinc phosphide, 0.01 mg/l. No information on what zinc compounds are present is available for these samples.

6 CONCLUSIONS

A focused environmental site investigation was conducted at the former Merrill & Ring wood treating facility located in Port Angeles, Washington. The site investigation was undertaken in the late summer and autumn of 1988 and was focused on a 2-acre area of the former Merrill & Ring Lumber Company. The main objective of the study was to evaluate the magnitude and extent of the wood preservatives pentachlorophenol (PCP) and tetrachlorophenol (TCP) potentially released to soil, groundwater, and marine sediments by Merrill & Ring. The practice of applying PCP and TCP to wood was discontinued in the focused site investigation area over 15 years ago. The study was performed by CH2M HILL under contract to Daishowa America Company, Ltd., which recently purchased the site.

The subsurface investigation verified the general distribution and type of subsurface materials identified by Hart Crowser in their property transfer assessment. Fill materials were found to be heterogeneous and characterized by significant quantities of wood and other organic debris in many locations. Much of this wood may have been treated prior to burial and is partially responsible for the presence of PCP and TCP in soil (soil containing treated wood fragments) and groundwater.

Analysis of subsurface soils by both Method 8040 and Method 8270 show that in the samples where PCP or TCP were detected it was at very low levels (PCP at 0.28 to 2.81 mg/kg; TCP at 0.19 to 1.35 mg/kg) except at MW16C (TCP at 6.2 mg/kg by Method 8040 and 27 mg/kg by Method 8270; PCP not detected by Method 8040 and 24 mg/kg by Method 8270). None of the samples exceed EPA's health-based PCP criterion of 500 mg/kg.

Other results from the Method 8270 analysis for semivolatile organic compounds indicated the presence of some polynuclear aromatic hydrocarbon (PAH) compounds, phenol, and 4-methylphenol in surface soils (2.5 feet or less). None of these compounds were detected in soils below the surface. These compounds also were reported at very low concentrations, all of which fall below apparent biological effects thresholds (AETs) proposed to evaluate marine sediments in the draft Puget Sound Marine Sediment Criteria Evaluation (Ecology, 1988). These samples are surface soils, so the comparison to marine sediment standards is for illustration only. There are no other health-based or regulating criteria with which to compare these results. The AETs, however, are considered stringent criteria.

Mercury analyses of soils (29 samples) indicated that no soil tested exceeded the range of mercury found naturally in soils.

Appendix IX analyses of soil did not identify any significant contamination. The Appendix IX results confirmed Hart Crowser's conclusion that dioxin contamination is unlikely at the Merrill & Ring site. No dioxins were detected in any of the Appendix IX analyses conducted during the focused site investigation.

Groundwater flow is toward Port Angeles Harbor. Therefore, groundwater at the site does not appear to recharge any aquifer or discharge to any surface water used as a source of drinking water. Groundwater at the site is not used for any beneficial purpose and, because of its brackish quality, it is not suitable as a future source of drinking water.

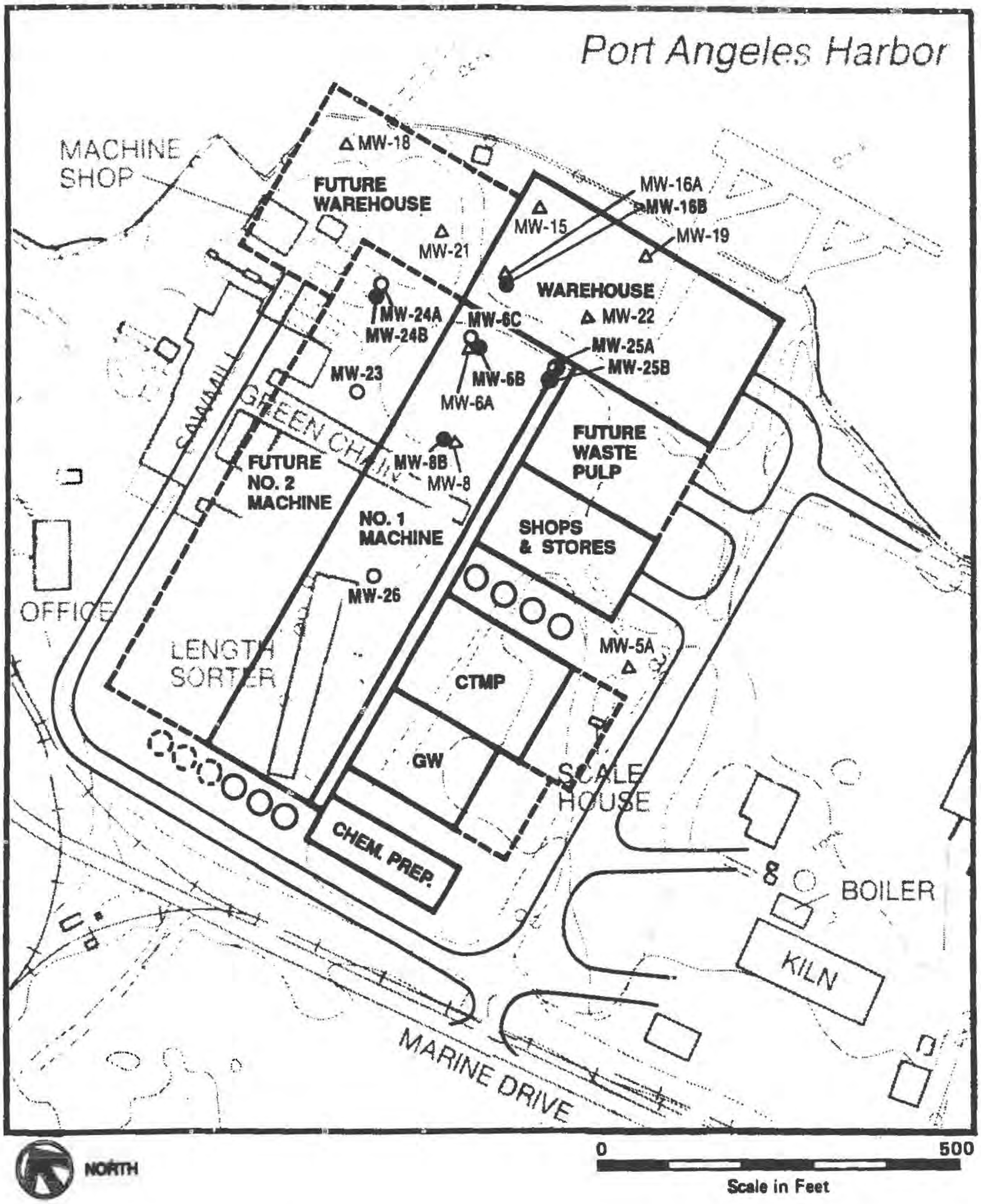
Because groundwater at the site moves almost entirely in a horizontal direction to the northeast, any groundwater contamination migrating by means of advection ultimately will be discharged to Port Angeles Harbor. The small vertical component of the groundwater flow potential was found to be upward. This means that the downward migration of contaminants into deeper groundwater effectively is prevented.

The influence of the tide on groundwater movement in the shallow zone of saturation appears to be limited to within about 150 feet of the harbor. This means that groundwater gradients and flow directions, and contaminant migration in most of the focused site investigation areas are relatively constant and are not affected by tidal fluctuations.

Groundwater gradients and hydraulic conductivity are such that horizontal flow rates are estimated to be relatively slow (i.e., in the range of 3 to 83 feet per year). Likewise, the spread of groundwater contamination by advection would be slow.

Based on analytic results and on characterization of subsurface conditions and groundwater at the former Merrill & Ring property, there is no technical precedent or human health or environmental criteria that would indicate that remedial action is required at this site. Although there is some limited PCP and TCP contamination in soil that can be detected in localized groundwater, these circumstances do not require further remedial action because:

- o No reported soil value exceeds any published criteria for PCP or TCP in soils
- o The planned expansion of Daishowa's paper production facility includes the construction of a new



LEGEND

- ○ Shallow Well Installed by CH2M HILL
- ● Deep Well Installed by CH2M HILL
- △ Shallow Well Installed by Hart Crowser

FIGURE 6-1
Proposed Mill Expansion
Daishowa America Co., Ltd.

paper mill. The mill will be positioned directly over the focused site investigation area. All identified zones of contamination will therefore be effectively "capped," preventing infiltration and inflow of surface runoff. Figure 6-1 shows the layout of the proposed mill relative to the existing monitoring wells.

- The slow movement of groundwater facilitates degradation of PCP and TCP by chemical and microbiological means before it is discharged into Port Angeles Harbor. The anaerobic conditions and periodic flooding of the site further enhance microbial breakdown of PCP (Mikesell and Boyd, 1988). This fact appears to be supported by the low levels and absence of PCP and TCP in groundwater and soil samples collected from monitoring wells nearest the Port Angeles Harbor and for marine sediments downgradient and offshore of the study area.

- Based on groundwater analytical data, the extent of PCP and TCP in groundwater appears to be limited to shallow depths (i.e., 5 to 15 feet below ground surface) in small areas near MW-6A, MW-6C, and MW-16A. This is corroborated by the lack of PCP and TCP in soil and groundwater adjacent and downgradient of these locations. Further, PCP or TCP do not appear to be present in groundwater in the deep monitoring zone (approximately 40 to 50 feet below ground surface).

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ATTACHMENT

VERIFICATION STUDY AT M&R SITE

TECHNICAL MEMORANDUM

TO: Daishowa America Company, Ltd.

FROM: CH2M HILL

DATE: February 17, 1989

RE: Verification Study at M&R Site

PROJECT: SEA26655.V1

CONTENTS

TABLES

FIGURES

TECHNICAL MEMORANDUM

February 17, 1989
SEA26655.V1

1.0 INTRODUCTION

An environmental verification study was conducted for the former Merrill and Ring (M&R) property in Port Angeles, Washington. The study consisted of reviewing historical information and interviewing persons knowledgeable about past uses of the site to evaluate the potential for existing environmental problems. A limited number of soil, groundwater, and sediment samples were also collected and analyzed.

Based on recent studies completed by Hart Crowser (1988) and CH2M HILL (1988), areas of minor soil and groundwater contamination have been identified and evaluated in certain areas of the site. These include soil contaminated with hydrocarbons near the truck maintenance facility, and soil and groundwater near the former green-chain area that contains low concentrations of pentachlorophenol (PCP) and tetrachlorophenol (TCP). The personal interviews, research, and sampling and analyses conducted for the verification study indicate that there are no other areas of potential concern. With the exception of motor fuels, and other petroleum products used for the repair and maintenance of vehicles and machinery, there is no evidence that chemicals other than those used to treat wood products were ever used or stored at the former M&R property. Furthermore, there is no indication that chemical processes other than wood preservation were conducted at the site, or that chemicals or wastes were routinely or deliberately disposed of on the property.

1.1 OBJECTIVE OF THE VERIFICATION STUDY

In June 1988, Daishowa America Co., Ltd. (Daishowa), acquired land adjacent to Port Angeles Harbor through purchase and lease arrangements with M&R and the Port of Port Angeles, respectively. As part of the property transaction, M&R retained Hart Crowser to conduct an environmental assessment of the property to evaluate the potential for environmental contamination caused by past land use practices. The Hart Crowser assessment was completed in May and June of 1988.

During the environmental assessment conducted by Hart Crowser, chemicals used for wood preservation, including PCP, were found to be present in soil and groundwater samples collected from certain areas of the property. As a result of Hart Crowser's findings, Daishowa retained CH2M HILL to conduct a verification study of the initial environmental assessment. The two objectives of the verification study were to: (1) review the environmental assessment conducted by Hart Crowser and pursue and review other available sources of information to determine if information and records for the site had been fully examined, and (2) collect a limited number of groundwater, soil, and marine sediment samples at selected locations throughout the property to corroborate the findings of the Hart Crowser study.

1.2 SITE DESCRIPTION

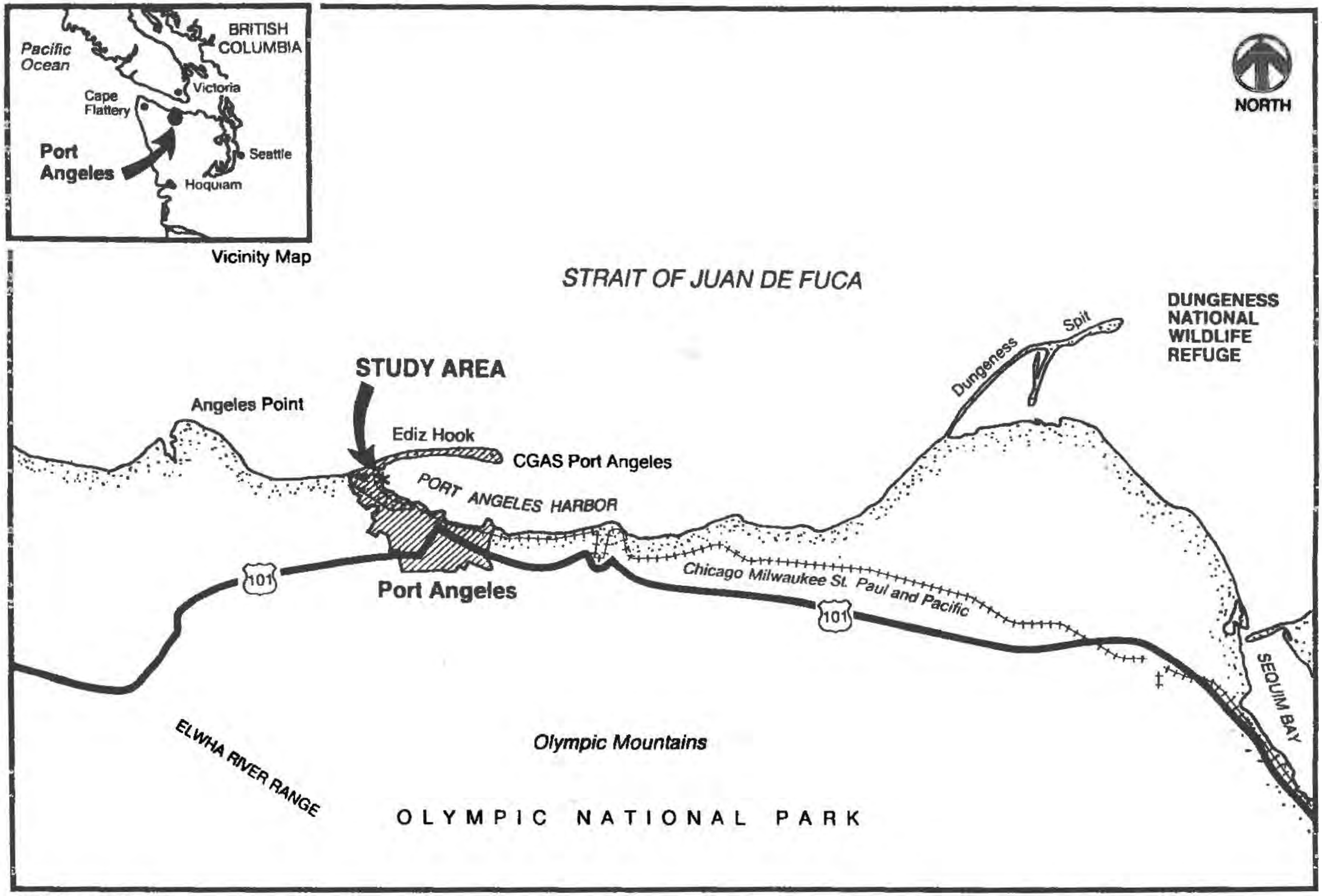
The site formerly occupied by the Merrill & Ring Lumber Company is approximately 50 acres in size and located at the base of Ediz Hook, adjacent to the shoreline of Port Angeles Harbor in Sections 4 and 5 of Township 30N, Range 6W of the Willamette Meridian (Figure 1). The property is bounded by Daishowa's Port Angeles paper mill on the northwest, Marine Drive to the south and west, and the Port Angeles Marina on the southeast (Figure 2). The entire parcel is located within the city limits of Port Angeles.

The property formerly owned by M&R is composed of two sections with separate mailing addresses. These addresses are 1608 Marine Drive and 1313 Marine Drive. The property locations are shown on Figure 2. By 1972, M&R had leased or bought both parcels. Prior to 1972, the two parcels were developed separately and were occupied by different commercial businesses.

Situated between 1608 Marine Drive and 1313 Marine Drive is another parcel of land (approximately 4 acres) that extends from Marine Drive to Port Angeles Harbor. The address of this parcel is 1417 Marine Drive. It is owned by the Port of Port Angeles and is currently leased to the Levaque Company, a cedar shake and shingle manufacturer.

2.0 METHODS

To obtain a better understanding of the site and its history, an investigation of past land use activities was conducted. In addition, groundwater and soil samples were collected from selected areas that were sampled by Hart Crowser during the initial environmental assessment. Additional soil and marine sediment samples were also collected in areas not previously sampled, but identified as areas of potential concern based on a review of historical information.



SOURCE: USGS, 1957

FIGURE 1
Location of Study Area

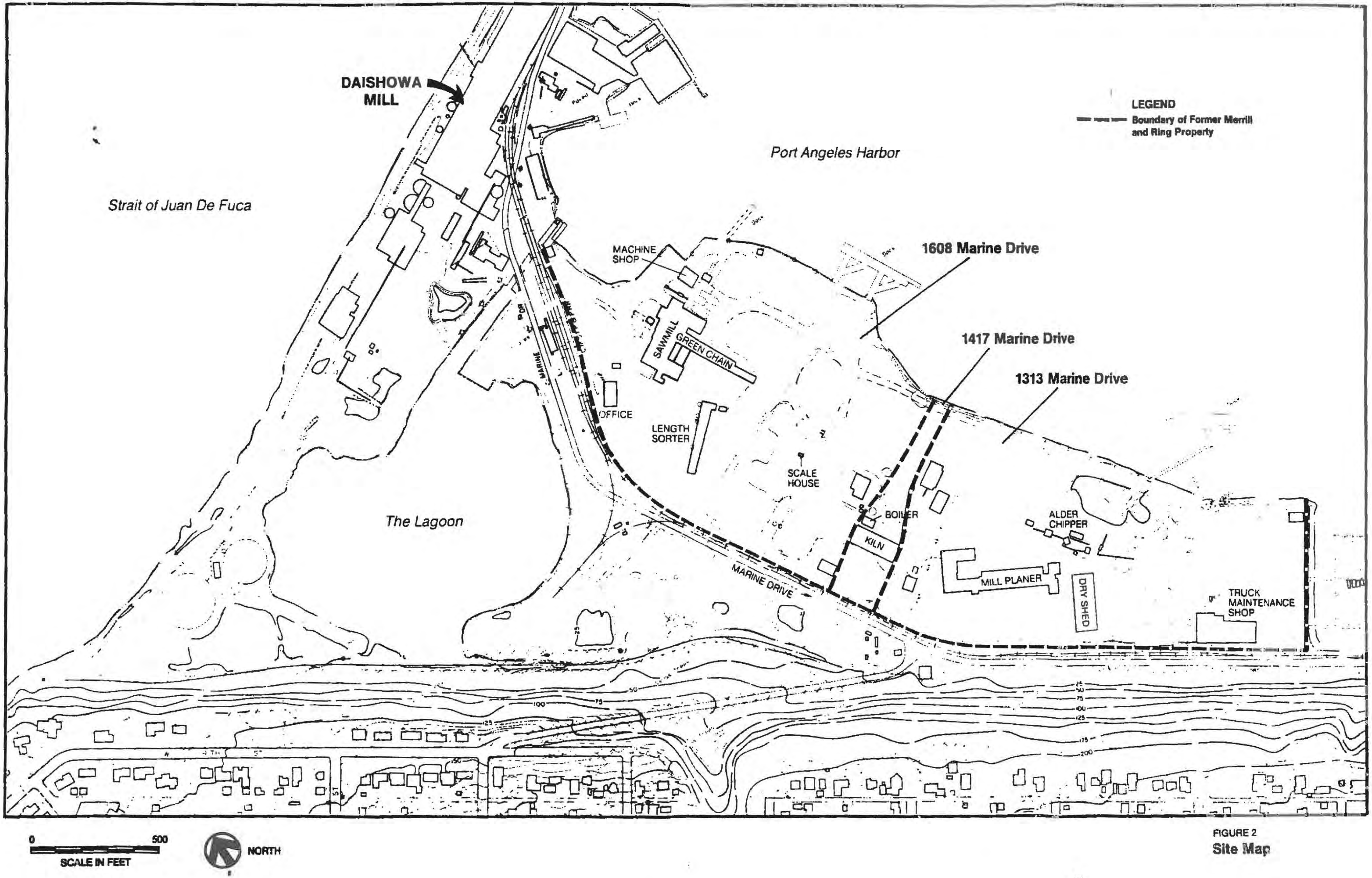


FIGURE 2
Site Map

2.1 DATA SOURCES

In order to obtain historical data regarding the site, its historical land uses, and any areas potentially affected by contamination, CH2M HILL gathered and reviewed available information and conducted personal interviews. Information was collected from a variety of state and local government agencies. Current or former employees of Daishowa and M&R who are familiar with historical site activities were interviewed. The following were pursued as sources of information:

- U.S. Environmental Protection Agency (EPA)--Region X
- U.S. Coast Guard
- Washington State Department of Ecology (Ecology)--Southwest Regional Office and Records Management Division
- State of Washington Department of Social and Health Services (DSHS)
- Clallam County Planning Department
- City of Port Angeles Planning Department
- Port of Port Angeles
- Port Angeles Fire Department
- Past employees of M&R and current employees of Daishowa who had knowledge of site operations
- Newspaper archives at the Port Angeles Public Library

2.2 SAMPLE COLLECTION AND ANALYSIS

As part of the verification study, CH2M HILL collected 5 surface soil samples, 2 marine sediment samples, 1 field duplicate marine sediment, and 18 groundwater samples from 9 monitoring wells installed by Hart Crowser (monitoring wells MW-5, MW-6A, MW-8, MW-15, MW-16A, MW-18, MW-19, MW-21, and MW-22). All soil, sediment, and groundwater samples were analyzed for phenolic compounds, including PCP and TCP, using EPA Method 8040.

In order to provide supplemental information, several other types of analyses were conducted on selected samples. The marine sediment samples were analyzed for total organic carbon (TOC) as a general indication of potential anthropogenic sources of contamination that might be present in marine sediments. One soil sample collected from near the maintenance shop was also analyzed for total petroleum hydrocarbons (TPH) and total organic halogens (TOX) as petroleum products and chlorinated solvents are commonly used in the repair and maintenance of vehicles and machinery.

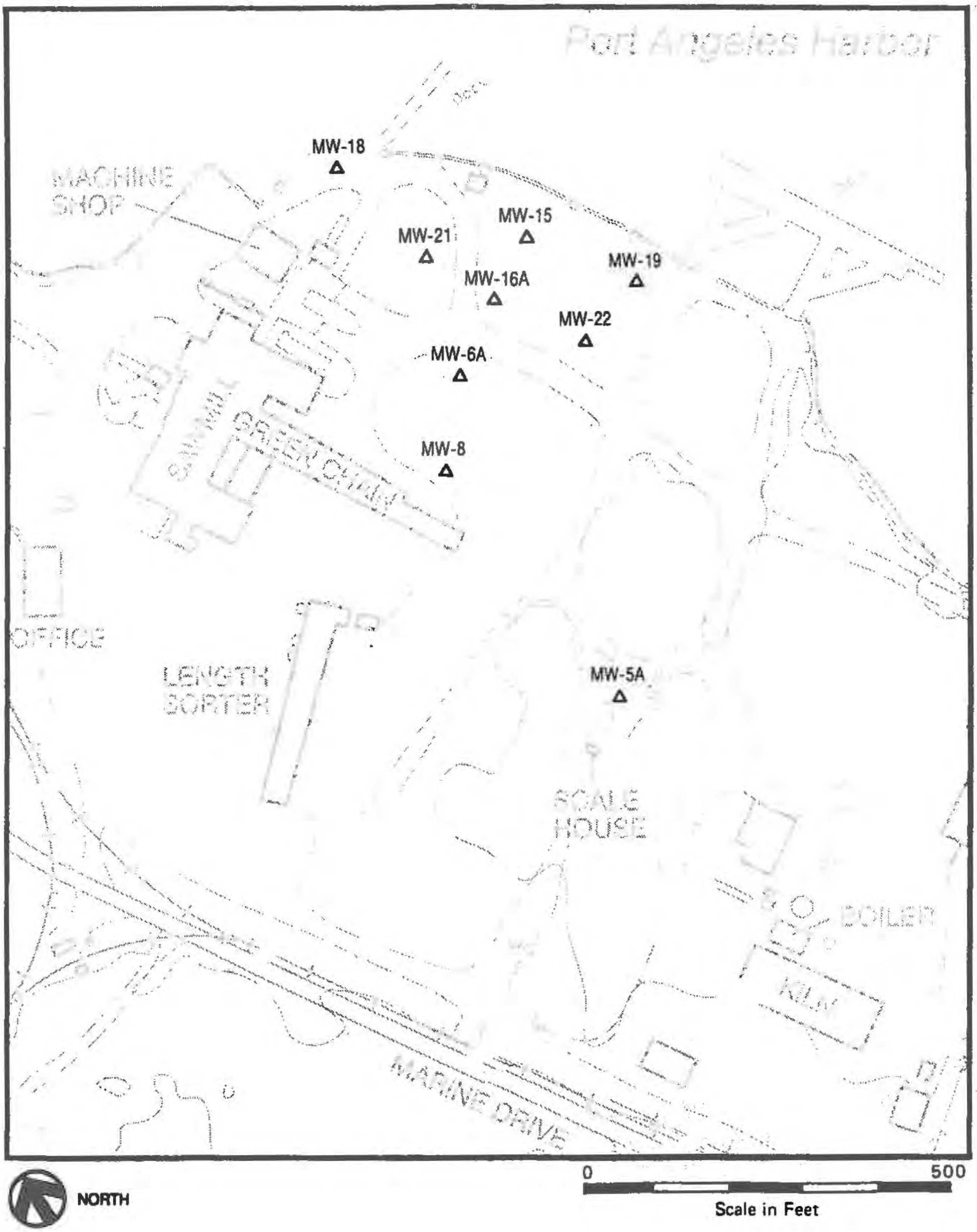
The location and analyses conducted for each sample are presented in Table 1. Sample locations are shown on Figures 3 and 4.

Most of the samples collected were taken at, or near, the same locations as samples collected by Hart Crowser. This fulfilled one of the primary objectives of the verification study, i.e., to verify the results reported by Hart Crowser. However, one sediment sample (sample VI-MS-201) and two soil samples (samples VI-SS-202 and VI-SS-204) were also collected from areas not sampled by Hart Crowser. These are areas where it seemed plausible that contamination may have occurred as a result of past practices at the site. Sediment sample VI-MS-201 was collected from the lagoon at the outfall of a drainage pipe for an adjacent car wash. Soil sample VI-SS-202 was collected from the west side of the old saw mill based on a statement from a former M&R employee who indicated that Permatox 180 was used to treat wood at this location (Paul Hopkins, pers. comm., September 1988). Soil sample VI-SS-204 was collected from near the new planer mill to determine if PCP or TCP might be present in surface soils near this facility.

In addition to the samples described above, other soil, marine sediment, and groundwater samples were collected concurrently with the verification study samples as part of the Focused Site Investigation conducted by CH2M HILL. The Focused Site Investigation report (CH2M HILL, 1988) summarizes the results of sampling conducted within the Focused Site Investigation Area. The Focused Site Investigation Area is located at the north end of the former M&R site, between the former green chain and Port Angeles Harbor.

Table 1
VERIFICATION SAMPLE LOCATIONS

Sample Identification No.	Matrix	Date Sampled	Location Description	Depth of Sample	Analyses
V1-MS-200	Marine sediment	9/22/88	End of southern pier, inside log boom, 10 feet northwest of corner of pier head, closest to the shoreline	6 in.	8040 TOC Grain size % moisture
V1-MS-201	Marine sediment	9/22/88	Eastern shore of lagoon, along drainage ditch from car wash facility	3 in.	8040 TOC Grain size % moisture
V1-SS-200	Soil	9/22/88	East side of maintenance shop, south side of driveway to maintenance shop	3 in.	8040 TPH (method 418.1) TOX
V1-SS-201	Soil	9/22/88	West side of planer mill, 100 feet from southwest corner	3 in.	8040
V1-SS-202	Soil	9/22/88	Northwest corner of sawmill	3 in.	8040
V1-SS-203	Soil	9/22/88	East of green chain at northern end of green chain	3 in.	8040
V1-SS-204	Soil	9/22/88	Two hundred feet west corner of planer mill and 220 feet from Marine Drive	3 ft	8040
V1-SS-205	Soil	9/22/88	Field duplicate, collected at V1-SS-203	3 ft	8040
V1-SS-206	Water	9/22/88	Equipment blank	N/A	8040
DSA-MW5	Groundwater	8/22/88	Monitoring well No. 5	N/A	8040
	Groundwater	10/6/88	Monitoring well No. 5	N/A	8040
DSA-MW6	Groundwater	8/24/88	Monitoring well No. 6A	N/A	8040
DSA-MW6A	Groundwater	10/6/88	Monitoring well No. 6A	N/A	8040
DSA-MW8	Groundwater	8/17/88	Monitoring well No. 8	N/A	8040
DSA-MW8A	Groundwater	10/3/88	Monitoring well No. 8	N/A	8040
DSA-MW15	Groundwater	8/24/88	Monitoring well No. 15	N/A	8040
DSA-MW15	Groundwater	10/4/88	Monitoring well No. 15	N/A	8040



LEGEND

△ **Hart Crowser Well Used For Verification Sampling**

FIGURE 3

Monitoring Wells Sampled During The Verification Study

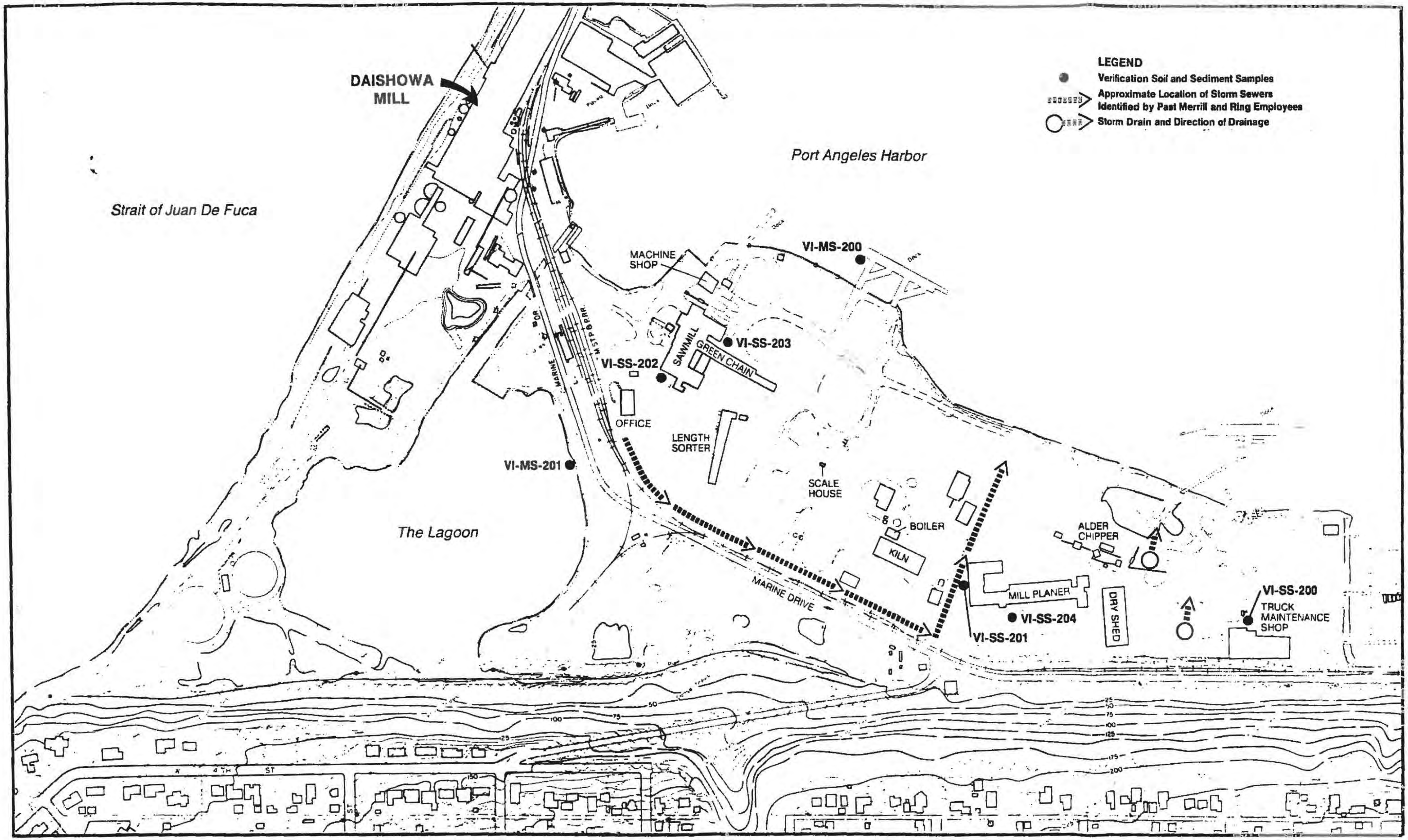


FIGURE 4

Location of Verification Soil and Sediment Samples and Approximate Location of Storm Drains

Although the samples collected as part of the Focused Site Investigation were not specifically collected to replicate or verify work conducted by Hart Crowser, the results are significant to this study. For example, 34 soil samples were collected from within the Focused Site Investigation Area from depths of up to approximately 50 feet and analyzed for mercury. Mercury was selected for analysis because available information on sapstain control chemicals indicate that at least one formulation historically used in the wood products industry contained mercury (John Cult, American Wood Preserver's Institute, pers. comm., July 1988).

All groundwater samples referenced in this Technical Memorandum were collected from monitoring wells located within the Focused Site Investigation Area. All soil, sediment, and groundwater samples were collected and analyzed in accordance with the protocol outlined in the Focused Site Investigation Sampling and Analysis Plan (CH2M HILL, 1988).

3.0 RESULTS

The results of the records search and review, interviews, and laboratory analyses are presented below.

3.1 RECORDS SEARCH AND INTERVIEWS

The data collected during the records search and personal interviews are discussed below by each source of information.

3.1.1 U.S. Environmental Protection Agency, Region X

CH2M HILL requested available files or information pertaining to the former M&R site from EPA Region X on September 2, 1988. EPA's Freedom of Information Officer reported that EPA did not have any records regarding operations or environmental problems at the former M&R site (M. Neilson, U.S. EPA, pers. comm., September 1988).

3.1.2 U.S. Coast Guard

CH2M HILL requested information on any oil or chemical spills that may have occurred in Port Angeles Harbor adjacent to the former M&R site. From 1973 to October 1987, approximately 322,000 barrels of oil were spilled into Port Angeles

Harbor (U.S. Coast Guard, computer printout, September 1988). Two separate spills released a total of 13 gallons of creosote into Port Angeles Harbor. These spills occurred on March 28, 1980, and March 20, 1984. The precise location of the spills is not stated in the computer printout provided by the U.S. Coast Guard. The sources of the spills were also not identified, but Ecology records indicate that they were not associated with the M&R facility.

3.1.3 Washington State Department of Ecology

In August 1988, CH2M HILL requested any available Ecology records pertaining to the M&R site. In addition, CH2M HILL reviewed Ecology archive records and current files on October 4 and 13, 1988.

Available archived records (from the mid-1940s to the present) were reviewed. These records included inspection reports prepared by the Washington Pollution Control Commission (WPCC) and Ecology. Based on these reports, it appears that site inspections were not conducted regularly. A former Ecology employee reported that the frequency of inspections through the years was based on awareness of environmental problems, size of the regulated industry, and the budget of the regulatory agency (F. Monahan, pers. comm., September 1988). When agency funds were reduced or limited, inspections were curtailed, particularly at facilities without a record of major problems and located long distances from the regulatory agency's office. Since there were no significant problems at M&R, Ecology appears to have investigated the facility infrequently.

The first record of a wastewater discharge permit issued to the M&R facility (1608 Marine Drive) by WPCC was in 1964. However, according to a 1974 discharge report, no specific wastewater abatement practices were in use (Ecology, 1974). In 1975, M&R applied for, and was issued, a National Pollutant Discharge Elimination (NPDES) permit to discharge surface runoff and noncontact cooling water to Port Angeles Harbor from four outfalls. There are no records in Ecology files indicating permit violations or fines. The permit required that M&R monitor the effluent weekly for total oil and grease and quarterly for total flow and temperature. The permit (No. WA-0037942) was renewed in 1985.

In 1972, a sanitary sewer from the M&R office building was connected to the city sewer system (Ecology, Inspection Report, 1972). Sanitary wastewater from M&R process areas were not tied to the city's system until later. Prior to connecting the onsite sewage systems to the city, all sewage waste went to septic tanks.

At 1313 Marine Drive, a company called Fibreboard operated between 1919 and 1972, producing paper packaging materials and wallboard from virgin pulp and waste paper stock. Raw products used in the production process were wood, ammonia, sulphur, waste paper, resin, alum, and fuel oil. Based on Ecology records, the major documented source of pollution at the Fibreboard section of the M&R site appears to have been pulp mill effluent discharged to the Port Angeles Harbor. Fibreboard was issued its first wastewater discharge permit in 1956. The permit was renewed in 1961.

Sludge beds with a high fiber content were observed near the wastewater discharged at Fibreboard according to the WPCC (1969). These beds were removed by M&R in 1973 (Ecology, 1978). The WPCC was also concerned with air pollution from the main boiler stack at Fibreboard. It was reported that vegetation on the hillside west of the plant tended to turn brown during the summer; this was attributed to sulfur dioxide in the exhaust system (WPCC, 1968).

Other areas of concern according to Ecology included log storage and wood debris piles located close to the harbor (Ecology 1977, Ecology 1973, Ecology 1975). Some leakage of oil from storage containers was also documented (Ecology 1975).

The first Ecology record of wood preservative being used at the site was found in an inspection report dated February 8, 1983. The report described a spray booth located in the new planer mill where Permatox 180 was used. No problems were identified in the inspection report.

3.1.4 State of Washington Department of Social and Health Services (DSHS)

CH2M HILL requested information from DSHS regarding community or municipal drinking water wells located in the vicinity of the M&R site. DSHS has no record of community or municipal wells located in Sections 4 or 5 of Township 30N, Range 6W (S. Tung, pers. comm., September 1988).

3.1.5 City of Port Angeles Planning Department

The City of Port Angeles Planning Department reported that they had no information on operations or ownership of the M&R site (City of Port Angeles Planning Department, pers. comm., September 1988).

3.1.6 Port of Port Angeles

William Oliver (pers. comm., August 1988), the Marine Terminals Manager for the Port of Port Angeles, reported that the Port purchased a portion of the site (1608 Marine Drive) from the Charles Nelson Corporation in December 1944 and January 1945. The property was first leased to M&R for a mill site in 1958. From 1963 to 1969, the lease agreement was amended to include newly filled harbor land. In 1977 the site occupied by P. A. Hardwood was included in the lease agreement with M&R. Mr. Oliver reported that in 1967 M&R constructed a dock on the land leased from the Port.

In the late 1960s or early 1970s, M&R acquired the Fibreboard mill site. Mr. Oliver reported that the origin of the fill material used by the Port, M&R, and Fibreboard to create the filled land is not known.

3.1.7 Port Angeles Fire Department

Hazardous material and fire prevention specialists for the Port Angeles Fire Department reported that, since 1980 when the department began maintaining files on hazardous waste releases, there is no record of spills at the M&R site (Ed Bonollo, Hazardous Materials Specialist, and Jeff Abram, Fire Prevention Specialist, pers. comm., September 1988).

3.1.8 Interviews with Current and Former Employees of M&R and Daishowa

Former employees of M&R report that Permatox 180, diluted at 55:1 with water, was used in a dip tank at the green chain, in an old spray booth (removed in the mid-1980s) located southwest of the green chain, and in a spray booth in the new planer mill. Small amounts of dilute Permatox 180 may have spilled or dripped from the wood as it moved along the green chain. Since there is no concrete or asphalt surface underneath the green chain, liquid dripping from the moving logs presumably infiltrated into the soil below. (Paul

Hopkins, Bill Lester, John Strean, Daishowa, pers. comm., September 1988; Dale Woodside, pers. comm., August 1988).

In 1971 the old planer mill was destroyed by fire. An unknown number of barrels containing undiluted Permatox 180 were in the building and burned during the fire. The building had a concrete floor, but some of the Permatox 180 may have drained to surrounding soils during fire suppression (P. Hopkins, B. Lester, and J. Strean, Daishowa, pers. comm., September 1988).

According to employees who worked for M&R, Permatox 180 was used to treat wood at the old planer mill for at least 15 years (P. Hopkins, B. Lester, and J. Strean, Daishowa, pers. comm., September 1988). In addition to Permatox 180, fungicides, fuel oil, and sulphur were used at the Fibreboard site. The names or types of fungicides used are not known (D. Woodside, pers. comm., August 1988).

Permatox 180 was also applied with a sprayer to wood at the southwest side of the sawmill. To the knowledge of M&R's past employees, Permatox 180 did not drain from the area during the spray process as the material was applied on a concrete slab. All preservative residues in dip tanks and spray booths were either used in process or disposed of at the Port Angeles solid waste landfill; they were not disposed of on the site.

It was also reported that lumber was sealed with a wax-based paint at a location west of the new planer mill. This paint was green in color and may have caused green stains on the soil near the area of application. M&R removed the stained soils in June 1988 (P. Hopkins, B. Lester, and J. Strean, Daishowa, pers. comm., September 1988).

Former M&R employees report that the City of Port Angeles stormwater drains located onsite follow the railroad tracks in a southeast direction, then traverse the M&R property and discharge to the harbor at the approximate midsection of the property (Figure 4). It was reported that there are two drains west and north of the truck maintenance shop that are plugged. In the past, a black oozing material was observed in the drains (P. Hopkins, B. Lester, and J. Strean, Daishowa, pers. comm., September 1988, and D. Woodside, pers. comm., August 1988). The source of this material is not known.

3.1.9 Newspaper Archives, Paper Mill File, Port Angeles Public Library

Newspaper articles in the "Paper Mill File" at the Port Angeles Public Library were reviewed on August 3, 1988. The file contained newspaper articles from the mid 1940s to the early 1980s. These articles provided historical land use and economic information for industries located at the site.

3.2 ANALYTICAL RESULTS

Table 2 presents analytical data for soil, marine sediment, and groundwater samples. Sample locations are shown on Figures 3 and 4.

PCP and/or TCP were detected in groundwater samples collected from six of the nine Hart Crowser wells that were sampled. PCP and TCP concentrations in groundwater ranged up to 3.07 and 2.84 mg/l, respectively (the highest concentrations were for samples collected from well MW-6A).

With the exception of TCP at 2.2 mg/kg in the soil sample collected from near the maintenance shop, PCP or TCP was not detected in any soil sample collected for the verification study. The same soil sample collected from near the maintenance shop was also analyzed for TPH and TOX. TPH was detected at 3,400 mg/kg. No organic halogens were detected. Mercury was detected in nine soil samples collected in the Focused Site Investigation Area. Where detected, mercury concentrations ranged from 0.048 to 0.286 mg/kg. These concentrations are within the published background range for mercury (0.01 to 0.3 mg/kg) in soil (Lindsay, 1979).

No PCP or TCP was detected in either sediment sample collected. TOC was detected in both sediment samples at 15,000 and 17,000 mg/kg.

A complete summary of the Method 8040 data and the Quality Assurance/Quality Control (QA/QC) data is presented in Section 4.0 of the Focused Site Investigation Report (CH2M HILL, 1988). A complete summary of the analytical results associated with the Focused Site Investigation Area is presented in the same report.

Table 2
Summary of Verification Study Results for TCP and PCP

				Hart Crowser Data		Verification Study Method 8040							
						Round 1		Round 2					
Location	Corresponding HC Sample No.	Verification Sample No.	Matrix	TCP	PCP	TCP	PCP	TCP	PCP	TOC	TPH	TOX	Units
MW5	MW-5A	DSA-MW5	Groundwater	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U				mg/l
		DSA-MW5	Groundwater					0.005 U	0.005 U				
MW6A	MW6A	DSA-MW6	Groundwater	Data Not Reported	5.7	2.84	3.07	0.28 N	0.51 J				mg/l
		DSA-MW6A	Groundwater										
MW8	MW-8	DSA-MW8	Groundwater	0.001 U	0.001 U	0.005 U	0.005 U	0.005 U	0.005 U				mg/l
		DSA-MW8A	Groundwater										
MW15	MW-15	DSA-MW15	Groundwater	0.01 U	0.01 U	0.005 U	0.005 U	0.005 U	0.005 U				mg/l
		DSA-MW15	Groundwater										
MW16A	MW-16	DSA-MW16	Groundwater	0.01 U	0.59	0.105 N	0.052	0.006 N	0.005 U				mg/l
		DSA-MW16A	Groundwater										
MW18	MW-18	DSA-MW18	Groundwater	0.01 U	0.01 U	0.005 U	0.006	0.005 U	0.005 U				mg/l
		DSA-MW18	Groundwater										
MW19	MW-19	DSA-MW19	Groundwater	0.01 U	0.01 U	0.005 U	0.015	0.345 U	R				mg/l
		DSA-MW19	Groundwater										

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

TOC = Total Organic Carbon
TPH = Total Petroleum Hydrocarbon
TOX = Total Organic Halogens

Table 2 (continued)
Summary of Verification Study Results for TCP and PCP

				Hart Crowser Data		Verification Study Method 8040							
						Round 1		Round 2					
Location	**Corresponding HC Sample No.**	**Verification Sample No.**	**Matrix**	**TCP**	**PCP**	**TCP**	**PCP**	**TCP**	**PCP**	**TOC**	**TPH**	**TOX**	**Units**
MW21	MW-21	DSA-MW21	Groundwater	0.01 U	0.01 U	0.005 U	0.21	0.005 U	0.005 U				mg/l dry wt.
		DSA-MW21	Groundwater										
MW22	MW-22	DSA-MW22	Groundwater	0.01 U	0.01	0.005 U	0.025	0.005 U	0.005 U				mg/l dry wt.
		DSA-MW22	Groundwater										
Marine Sediment	OSS-1	VI-MS-200	Sediment	0.09	0.30	3.9 U	3.9 U			17,000			mg/kg dry wt.
Lagoon	Area Not Sampled	VI-MS-201	Sediment	NA	NA	1.4 U	1.4 U			15,000			mg/kg dry wt.
Maintenance Shop	SS-3	VI-SS-200	Soil	0.10	0.09	2.2	1.8 U				3,400	<0.020	mg/kg dry wt.
New Planer Mill	SS-1	VI-SS-201	Soil	0.44	0.64	2.5 U	2.5 U						mg/kg dry wt.
Saw Mill	Area Not Sampled	VI-SS-202	Soil	NA	NA	1.2 U	1.2 U						mg/kg dry wt.
Green Chain	SS-6	VI-SS-203	Soil	0.05 U	0.05 U	1.9 U	1.9 U						mg/kg dry wt.
New Planer Mill	Area Not Sampled	VI-SS-204	Soil	NA	NA	1.5 U	1.5 U						mg/kg dry wt.

J = Quantitatively suspect
U = Undetected above this concentration
N = Qualitatively suspect
R = Unable to calculate due to interference

TOC = Total Organic Carbon
TPH = Total Petroleum Hydrocarbon
TOX = Total Organic Halogens

4.0 DISCUSSION

Included in this section is a discussion of the verification study data with emphasis on historical land use and use of PCP at the site. The analytical data collected during the verification study is also compared to the results reported by Hart Crowser in the initial environmental assessment report.

4.1 HISTORICAL LAND USE OF THE M&R SITE

In order to present the historical land use information for the M&R site in as clear a manner as possible, the historical land use of each of the three parcels is discussed separately (i.e., by address) in the following sections. A chronology of businesses operating on these parcels since 1912 is included in Table 3.

Table 3
BUSINESSES LOCATED ON THE M&R SITE

Address	Name of Business	Approximate Years of Operation
1608 Marine Drive	Puget Sound Mill & Timber Co.	1912 to 1914
	Charles Nelson Mill	1914 to late 1920s
	Washington Cafeteria	1941 to 1948
	Western Lumber Co./ M&R Western Lumber Co.	1955 to 1988
	Hansen's Boat Yard	1959 to 1960
	Nelson Shipyard	1962 to 1967
	P. A. Hardwood	mid-1960s to 1977
	Daishowa America Co. Ltd.	1988 to present
1417 Marine Drive	Peninsula Shingle	1959 to 1964
	Angeles Shake & Shingle	1965 to 1972
	Levaque Co.	1973 to present
1313 Marine Drive	Fibreboard	1919 to 1972
	M&R Lumber Co.	1972 to 1988
	Daishowa America Co. Ltd.	1988 to present

1608 Marine Drive

The parcel of land identified as 1608 Marine Drive is approximately 25 acres and consists of tideland that was filled over a period of several years (William Oliver, Port of Port Angeles, pers. comm., August 1988). The first reported commercial development of this parcel occurred in 1912. The Puget Sound Mill & Lumber Company (also known as Earles Mill) was built on land that Michael Earles purchased from Charles Nelson, the first reported land owner. The Puget Sound Mill & Lumber Company operated a saw mill, a shingle mill, and a planing mill on the property in addition to storing logs and operating drying kilns. The site also contained a power supply facility (boiler and engine room) and a shipping dock (Hart Crowser, 1988).

In 1914, the mill was renamed the Charles Nelson Mill. It is assumed that the change in name was the result of land ownership reverting back to Charles Nelson, the original property owner. The Charles Nelson Mill was in operation until the late 1920s. During the 1930s, the site was not used, presumably because of the Great Depression.

By the mid-1940s, mill buildings were in disrepair and the site was condemned by the Port Angeles Fire Department. Shortly after, the demolition firm P. G. Piedmont Co. was hired to demolish the mill's dilapidated wood structures using a controlled fire. The fire was reportedly fueled by gasoline, crude oil, tar paper, and old tires (Port Angeles Library File, Chronicle, January 2, 1985, and an unknown Port Angeles area newspaper article from the mid-1940s).

Between late 1944 and early 1945, the Port of Port Angeles purchased the land from Charles Nelson (William Oliver, Port of Port Angeles, pers. comm., August 1988). Land use from the mid-1940s to 1955 is not well documented. It is believed that the land was vacant and at times was used for log storage. Hart Crowser (1988) reports that Port Angeles Forest Products used the site during the 1940s. Records reviewed by CH2M HILL did not document this business.

In 1955, the Western Lumber Co. opened a remanufacturing mill on the site that cut rough-cut lumber. From the mid-1960s to the mid-1970s, P. A. Hardwood was also located on this site. P. A. Hardwood operated an alder and hardwood sawmill with a dry kiln and cut rough lumber from logs (Paul

Hopkins, Daishowa, pers. comm., December 1988). In 1977 M&R acquired the lease for this parcel of land.

By 1962, the Western Lumber Co. changed its name to Merrill & Ring Western Lumber Company; this name remains today. M&R produced wood chips used for paper production and remanufactured lumber. By 1984, operations at M&R had been scaled down and only the chip mill was operating (Port Angeles Library File, Port Angeles Daily News, September 18, 1984). In February 1988, the Port of Port Angeles leased the land to Daishowa America Co., Ltd.

During the period from 1941 to 1967, several small businesses were located on the site. These included a cafeteria and log sorting yard (Polk Guides 1940 to 1988). No additional information on the operation of these businesses was available.

1313 Marine Drive

The parcel of land at 1313 Marine Drive is approximately 20 acres in size. Commercial development of this parcel began in 1919 when Fibreboard opened a plant. The plant produced boxboard, sulphite pulp, and wood chips. Feedstocks used to manufacture these products included aqueous ammonia, alum, resin, fuel oil, and sulphur (Testimony of Vern Basom, manager of Fibreboard, to Washington Pollution Control Commission, June 1958).

Fibreboard operated at the site until 1971 when the property was sold to M&R. In 1971, M&R purchased the property, removed many of the structures, and built a new planer mill on the site. The new planer mill included a spray booth, which was used for treating finished lumber with Permatox 180 (P. Hopkins, B. Lester, J. Strean, Daishowa, pers. comm., September 1988 and D. Woodside, pers. comm., August 1988). M&R sold this parcel of land to Daishowa in 1988.

4.2 COMPARISON OF ANALYTICAL DATA TO HART CROWSER RESULTS

The TCP and PCP data collected during the verification study were compared to the corresponding TCP and PCP data presented in the Hart Crowser (1988) report. Table 2 presents analytical data for samples collected by both Hart Crowser and CH2M HILL. Because different analytical methods were used during the Hart Crowser and CH2M HILL studies, the two data sets are not directly comparable, particularly on a quantitative basis. The modified EPA Method 8150 data provided by the laboratory that analyzed the samples for Hart Crowser did not include any QA/QC data to demonstrate quantitative accuracy. The quantitative reliability of data is generally established with calibration factors, accuracy measurements (spikes), precision measurements (replicates), and blank measurements. These data were not presented. Furthermore, the methods used by the laboratories that performed the analyses for Hart Crowser were not the EPA recommended procedures for analysis of PCP and TCP. The data do, however, provide some qualitative information that is useful for comparison of the verification study results.

Other factors to consider when comparing the data include the following: First, marine sediments for the verification study were not collected at the same locations as those collected by Hart Crowser. This was because Hart Crowser collected the samples from the intertidal zone during a minus tide. During the sampling conducted for the verification study, minus tides were not occurring. Therefore, samples were collected by a diver working from a boat. Sample locations were not as close to shore as those collected by Hart Crowser. Second, surface soil samples collected during the verification study may not be representative of the same material sampled by Hart Crowser, even though samples were collected in the same area. For example, after Hart Crowser collected their soil samples, M&R removed some of the soils exhibiting hydrocarbon stains (Hart Crowser, 1988 and P. Hopkins, B. Lester, J. Strean, pers. comm., September 1988).

As referenced earlier, nine groundwater monitoring wells installed by Hart Crowser were sampled for verification purposes. TCP was not detected in any sample collected and analyzed by Hart Crowser. TCP was detected in verification study samples collected by CH2M HILL from wells MW-6A and MW-16A at concentrations of up to 2.84 mg/l. PCP was detected by Hart Crowser in wells MW-6A, MW-16A, and MW-22 at concentrations of 5.7, 0.59, and 0.01 mg/l, respectively. PCP was detected during the verification study in all three of these wells at concentrations of up to 3.07 mg/l. The PCP concentrations in the verification study samples collected from MW-6A and MW-16A were lower than those detected by Hart Crowser. The PCP concentration detected in the verification study sample collected from MW-22 was slightly higher than that detected by Hart Crowser. In addition, PCP was detected in the verification study samples collected from wells MW-18, MW-19, and MW-21 at concentrations of up to 0.21 mg/l. PCP was not detected in samples collected by Hart Crowser from these three wells. Possible explanations for the differences between the results reported by Hart Crowser and CH2M HILL are addressed in the Focused Site Investigation Report (CH2M HILL, 1988).

Only one marine sediment sample was collected from Port Angeles Harbor during the verification study. This sample was collected from near the large dock located at the 1608 Marine Drive property. Neither PCP nor TCP were detected above the detection level of 3.9 mg/kg. Hart Crowser reported both PCP and TCP at concentrations of 0.30 and 0.09 mg/kg, respectively, in a marine sediment sample collected from a nearby location. It is not possible to compare these results directly because of the difference in the method detection levels used during the two studies. A sediment sample was collected from the lagoon west of the former M&R property during the verification study. Neither PCP nor TCP was detected.

Five surface soil samples were collected from the former M&R property during the verification study. With the exception of TCP at 2.2 mg/kg in the sample collected from near the maintenance shop, no PCP or TCP was detected. Three of these five samples were collected from the same approximate locations as samples collected by Hart Crowser. Both PCP and TCP were detected by Hart Crowser in two of these three samples. PCP and TCP were detected at 0.09 and 0.10 mg/kg, respectively, in a sample collected from near the maintenance shop. PCP and TCP were detected at 0.64 and 0.44 mg/kg, respectively, in a sample collected from near the new planer mill.

In summary, the verification study conducted by CH2M HILL did not reveal any areas of soil or sediment contamination that were not previously identified by Hart Crowser.

4.3 ANALYTICAL CRITERIA AND QA/QC

Section 5.0 of the Focused Site Investigation Report (CH2M HILL, 1988) presents a complete description of the comparison of laboratory data to accepted analytical criteria. A detailed explanation of the QA/QC data collected for the verification study is included in Section 4.0 of the same report. In general, the QA/QC data for the verification study were within acceptable ranges.

4.4 USE OF PCP AT THE SITE

It is not known when PCP was first used at the site although it was mentioned in an Ecology inspection report written in February 1983 (Ecology Inspection Report, February 8, 1983). During this inspection, the spray booth located in the new planer mill was inspected. It was reported that the spray booth was fully enclosed and that all overspray and drippings were directed into a containment tank. Prior to this inspection report, there was no mention in the Ecology files of PCP being used at the site. This implies that if PCP was used prior to 1984, there were no major problems associated with its storage, use, or disposal.

Past employees of M&R were asked when PCP was first used at the site. All stated that PCP or Permatox 180 was used for at least 15 to 20 years (P. Hopkins, B. Lester, J. Strean, Daishowa, pers. comm.). They also reported that Permatox 180 was expensive and, therefore, care was taken not to spill or waste any of the product.

Research into the commercial use of PCP indicates that it was first used in the 1940s (Hunt and Garrat, 1953). This information, when considered in conjunction with historical site information, indicates that the earliest PCP use at the site was most likely the mid-1950s when the Western Lumber Company began operations there.

5.0 CONCLUSIONS

Review of available information for the former M&R site indicates that there is one area in which information and data are minimal and further investigation may be warranted. The exact location of storm drains on the property is not known. Preliminary data obtained in this study indicate that the potential for significant contamination at the site is low. However, storm drains and drainage ditches may be a source of contamination and/or a pathway for transporting contamination to and from the site. An accurate plan of the storm drains and ditches on the site needs to be developed. An investigation to characterize the storm drains may include one or more of the following:

- Identify the location of any seeps entering Port Angeles Harbor.
- Identify the location of storm drains that parallel railroad tracks and traverse the former M&R property.
- Identify the location and source of storm drains northwest of the truck maintenance shop and collect samples from these drains for chemical analysis.
- Collect water and soil (sludge) samples from randomly selected seeps and drains to characterize material conveyed and accumulating in the drains.

Chemical analyses should focus on PCP, TCP, and TPH.

6.0 RECOMMENDATIONS

Based on the personal interviews, research, sampling, and analyses conducted for this verification study, it is believed that chemical contamination at the former M&R property is known (hydrocarbons at the truck maintenance area and PCP/TCP near the former green chain), it is low-level contamination, and the contamination is limited to the areas where the chemicals were used. Specific recommendations for the site are included in Section 6.0 of the Focused Site Investigation report (CH2M HILL, 1988).

gm/se7012/011

HARTCROWSER

Earth and Environmental Technologies

Preliminary Environmental Site Evaluation and Focused Pentachlorophenol Explorations
Merrill and Ring, Inc.
Port Angeles, Washington

Volume I

Prepared for
Merrill and Ring, Inc.
and
Davis Wright & Jones

June 28, 1988
J-2159-03

1910 Fairview Avenue East Seattle, Washington 98102-3699 206.324.9530

EXECUTIVE SUMMARY

The major findings and conclusions detailed in this report are as follows:

- In general, the M&R site appears to be a relatively clean piece of industrial property. The PCP-related contamination at the old planer mill location is the most significant contamination identified. Low levels of contamination identified at other locations on the site have either been mitigated by M&R or they are insignificant enough that additional investigation or mitigation does not appear warranted.

- PCP-related contamination was detected in surface soils, subsurface soils, and groundwater near the old planer building. It appears the contamination is from pre-1972 activities, is at moderately low levels, and forms a plume extending north just short of the bay. Although we found traces of PCP in marine sediments, values are low and questionable. Marine water samples detected no PCP. Therefore, this PCP contaminant plume does not appear to pose an imminent health or environmental hazard.

- Data indicate that a significant dioxin contamination problem is unlikely in the PCP contaminated area, near the old planer mill.

- Based on our experience, we would expect that Ecology would likely require a hydrogeologic study and possibly a risk assessment at the old planer mill location. But with no data indicating toxic PCP concentrations in marine water, further remediation is not expected.

- PCP-related contamination was detected in surface soil samples taken west of the new planer building. Based on the available information the contamination at the new planer building appears to be surficial and does not appear to be migrating to the groundwater.

- The surface stains identified at the M&R site appear to be primarily petroleum products and are limited in extent based on visual observations, laboratory data, and discussions with M&R employees. In order to reduce potential sources of subsurface contamination we recommend that all surface stains be removed down to a depth where visual evidence and odors no longer exist. It is our understanding that M&R has removed stained soils identified during the preliminary site assessment for disposal at the Port Angeles landfill with the landfill operator's permission.

- Sample TR-5 from the transformer located at the alder chip wall loading facility contained low levels of PCB at 4,800 ug/kg (Aroclor 1260). Conversations with M&R employees indicates that visual stains have been removed from around the alder chip wall transformer.

1 ug/kg ≅ 1 ppb

- Test results indicated that the diesel tank at the scale house area leaked. The gasoline tank at the kiln appeared to be sound. Hart Crowser has been informed by M&R that the underground diesel tank located in the log scale house area has been removed along with an unspecified amount of contaminated soil.

- The monitoring wells located in the shallow saturated zone on the 13th and M Street Pen Ply Landfill site are unlikely to intercept leachate if it migrated from the M&R landfill. Therefore, impacts from M&R's landfill are not known.

- We were unable to determine what the COE dredging permit meant by "Polluted Material." It is likely that "polluted material" refers to suspended solids and/or biological oxygen demand (BOD) from fresh dredge spoils which could adversely affect water quality in the harbor if runoff were not controlled.

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J-2159-03

PRELIMINARY ENVIRONMENTAL SITE EVALUATION
AND FOCUSED PENTACHLOROPHENOL EXPLORATIONS
MERRILL AND RING, INC.
PORT ANGELES, WASHINGTON

1.0 INTRODUCTION

1.1 PROJECT UNDERSTANDING

Hart Crowser understands that Daishowa America Company, Ltd. (Daishowa) is conducting negotiations with Merrill and Ring, Inc. (M&R) for property owned by M&R for future expansion of Daishowa pulp mill operations. M&R has contracted with Hart Crowser to provide an environmental assessment to evaluate whether the M&R property is potentially contaminated due to current or past activities. We have also contracted with M&R to further explore selected areas of contamination found during our assessment.

We understand past activities on the facility have primarily involved wood products and included a former lumber planer and a former Fiberboard pulp mill, both of which have generally been removed, except for slabs and foundations. Current operations continue to involve wood products and related activities.

We also understand that M&R owns a landfill located at 13th and M Streets in Port Angeles. The landfill is permitted to accept wood wastes.

The surrounding properties are not included in the assessment except to the extent that their activities may have caused potential environmental liabilities for M&R due to their proximity. Also, a small strip of land that is leased by PA Shake from the Port of Port Angeles, located at the approximate boundary of M&R's leased and fee lands, was not assessed.

This work was performed and this report prepared in accordance with generally accepted professional practices for the nature of the work completed in the same or similar localities, at the time the work was performed and within the allotted time frame. It is intended for the exclusive use of M&R and Davis Wright & Jones for specific application to the job site. No other conditions, express or implied, should be understood.

1.2 PLANT LOCATION AND DESCRIPTION

The M&R site consists of approximately 50 acres of land located adjacent to the shoreline of Port Angeles Harbor. It is located near the base of Ediz Hook, a long, thin, sand spit forming a natural breakwater for the harbor (see Figure 1). Approximately 30 acres of the site consist of leased lands and the remaining 20 acres are fee lands. The M&R site is bordered to the northwest by Daishowa and on the southeast by a marina. Port Angeles Harbor occupies the northeastern border of M&R and a steep bank is located approximately 200 yards to the southwest. In this report, plant north is toward the harbor. Major facilities on the site include a sawmill, lumber and log storage, lumber planing mill and sap stain control treatment operation, dry kiln, hog fuel boiler, alder chipper and chip storage, end seal line, machine shop, above-ground and underground fuel storage areas, electrical transformers associated with facility operations, and a truck maintenance shop (see Figure 2).

1.3 SCOPE OF WORK

Our evaluation of the M&R site was conducted in three phases. The work, accomplished in each phase is described below.

1.3.1 Preliminary Site Assessment (Phase I)

The preliminary assessment contract signed on May 9, 1988, was conducted in two parts consisting of 1) information gathering, and 2) a subsurface boring and groundwater monitoring program.

The information gathering work consisted of three tasks as follows:

- Historical Background Search - A brief historical search of past uses and activities at the site and adjacent properties was conducted using information provided by M&R employees and retired personnel, historic maps, aerial photographs, city land-use maps, and other data as available. The information was used to evaluate whether past activities may have introduced contaminants into the soil and/or groundwater and whether contaminants from adjacent properties may have migrated onto the M&R site. In addition, the historical information was used in the selection of drilling and sampling locations;

- Regulatory Agency File Review - Currently available files related to the M&R site were reviewed at the Washington State Department of Ecology, Southwest Regional Office. Particular attention was given to inspection reports, permits, enforcement actions, waste disposal records, underground storage tank notifications, and site assessment activities. Information from the review was used in selecting subsurface boring locations and for identifying areas of potential concern that required special emphasis during the site reconnaissance task; and

- Site Reconnaissance - Two Hart Crowser personnel experienced in site inspection procedures toured the M&R site in the presence of knowledgeable M&R employees. A visual reconnaissance of the site and its buildings and operations was conducted in order to identify signs of potential soil and groundwater contamination resulting from current or past practices. During the reconnaissance, the presence of drums, spills, stained soils, or stressed vegetation were noted. Photographs and field notes were taken to document our observations. Particular attention was paid to the two known underground storage tanks, the two known areas of past and current wood treatment operations, and transformers. Surface grab and composite samples were collected as deemed appropriate by the site reconnaissance team.

The second part of the preliminary assessment consisted of subsurface borings, well installations, and soil and groundwater sampling in order to evaluate potentially contaminated areas. Samples were analyzed primarily for screening parameters by a contract laboratory. The parameters were selected based on information collected during the first part of the assessment.

Subsurface borings and groundwater monitoring wells were placed at the two underground storage tank locations (B-5/MW-5A and MW-7) and the two suspected wood treatment areas (MW-8 and B-3/MW-3A). One boring was placed in the vicinity of the two former above-ground bulk petroleum storage tanks (B-4/MW-4A) and one boring was placed in the vicinity of the old planer building (B-6/MW-6A). Several borings were converted to monitoring wells and identified with a MW-(boring number)A.

Information gathered was analyzed and the findings and conclusions are included in this final report. Methods and procedures are described in the appendices. Suspected or detected contamination are discussed with respect to the possible magnitude of the contamination. Information on potential costs for additional evaluations and explorations, cleanup, or waste disposal recommendations were provided to M&R, as appropriate.

Per contract between M&R and Hart Crowser, dated May 25, 1988, the initial scope of work was amended to include a review and evaluation of available information concerning M&R's landfill located at 13th and M Streets. We were asked to review records at the Clallam County Health Department regarding an assessment of the groundwater aquifer in the vicinity of the M&R landfill. A site tour was also performed and observations were documented.

1.3.2 Additional Site Assessment Work (Phase II)

As a result of the findings and recommendations of the preliminary site assessment, additional site assessment work was authorized by M&R on May 31, 1988.

The purpose of the additional site assessment work was to further evaluate the potential environmental impacts to areas of concern identified in Phase I and to further assess whether the two known underground storage tanks were leaking. In addition, Hart Crowser assisted M&R in defining visually identified areas of contamination for cleanup and appropriate disposal.

Specifically, tasks performed to accomplish this additional work include the following:

- A total of four soil borings were drilled in presumed downgradient locations from each of four areas of interest identified as a result of the preliminary assessment (Phase I). One boring was advanced in an area north of the new truck shop and power wash area (B-13), one in the vicinity of the old truck maintenance shop (B-12), one in the vicinity of the old above-ground fuel oil storage tanks (B-11), and one north of the presumed location of the former Fiberboard mill (B-14). Each boring was converted into a groundwater monitoring well and designated with an MW- prefix. Soil samples were collected during drilling operations and groundwater samples were collected from each new monitoring well. Samples were analyzed by contract laboratory for screening parameters selected on the basis of information collected during the preliminary assessment.

- A tank testing firm was subcontracted to evaluate the potential for leaks in the two known underground storage tanks located at the M&R site.

- Hart Crowser met on-site with Mr. Paul Hopkins of M&R to point out areas requiring mitigation of visible surface contamination.

- Upon receipt of the analytical data from this additional work, Hart Crowser met with M&R to discuss the data and their significance. In addition, data from the preliminary assessment were presented and discussed. Recommendations for appropriate follow-up actions were made.

1.3.3 Focused Pentachlorophenol-Related Contamination Exploration (Phase III)

This section provides a summary of the contracted scope of work, dated June 14, 1988, to conduct a focused exploration of apparent pentachlorophenol(PCP)-related contamination at M&R identified during Phases I and II.

The purpose of this additional work was to evaluate apparent PCP-related contamination identified at two locations found during the preliminary assessment, the old and new planer mills, and to present selected options for potential mitigation.

This focused exploration was not intended to be a comprehensive evaluation of the PCP-related contamination at the site. Rather, it was intended to provide information as to the general extent of vertical and horizontal PCP-related contamination at the two suspect locations.

Tasks performed to accomplish this exploration included the following:

- Borings were advanced and monitoring wells were installed near the old planer mill (MW-15, B-16, MW-16A, B-17, B-18, MW-18, B-19, MW-19, MW-21, and MW-22). Soil and groundwater samples were collected and analyzed for PCP-related contamination in an on-site mobile laboratory using gas chromatography electron capture detection (GC-ECD) and thin-layer chromatography (TLC) methods. This provided quick turnaround on sample results which aided in the selection of subsequent boring locations. Surface soil grab samples were also collected and analyzed (SS-1 through SS-11);

- The presence of apparently shallow subsurface soil contamination was evaluated near the new planer mill using a hand auger and a hollow-stem auger to collect soil samples (HA-1 through HA-6). One groundwater monitoring well was installed in the assumed downgradient location from the contaminated area (MW-20). All samples were analyzed for PCP-related contaminates in the on-site mobile laboratory;

- Marine surface water and surface sediment samples were collected adjacent to the old planer mill site and at a background location on Ediz Hook for on-site analysis (OSS-1 through OSS-6 and OSW-1 through OSW-4 and OSSBG-1);

- Five samples were collected for dioxin and dibenzo furan analysis including three soil samples from the PCP-contaminated area in the vicinity of the old planer mill, one off-site background soil sample, and one groundwater sample;

- Five soil samples were split between the on-site laboratory and a contract laboratory in Seattle for verification analysis; and

- Data collected were analyzed and the results were verbally presented to M&R and Daishowa.

We did not perform a hydrogeologic analysis of the site, i.e. groundwater flow directions were not determined, aquifers were not characterized, etc.

1.4 GENERAL GEOLOGY AND HYDROGEOLOGY

The property is situated on filled ground. A 150- to 200-foot-high bluff, located just south of the property, forms the boundary of the uplands to the south. The site area was part of the intertidal zone prior to being filled. The bluffs, composed of glacially consolidated sediments, were formed by wave erosion and originally formed the boundary between the beach and the uplands. The geologic map and regional cross section, Figure 3, illustrates the overall geologic relationships.

The bluff and the soils underlying the original beach deposits consist of an interlayered and very dense sequence of glacially derived sediments ranging from relatively permeable sands and gravels to silts of very low permeability.

The fill was placed over the original beach deposits prior to the 1920s. Much of the fill is reported to be dredge material, and at the site, consists of sandy gravel and gravelly sand. Based upon the explorations at the site, the upper portions of the fill (generally above 5 feet in depth) consist of a loose to medium dense mixture of sand with silt and gravel, and containing varying amounts of bark and wood debris, coarse gravel, and angular riprap used as ballast on the dirt log haul roads. The most recent fill is reported to have been placed in the mid- to late-1970s, in the vicinity of the alder chipper and chip stockpile, in the eastern portion of the site. The more detailed site geologic conditions are illustrated on Figures 4, 5, and 6.

Regional maps indicate that the fresh groundwater system is largely contained within confined and semi-confined aquifers distributed within the glacial sediments forming the bluffs and underlying the fill and beach deposits beneath the site. Regionally, flow of the upland groundwater system is north toward the harbor.

The groundwater flow system at the site has two major components, fresh water flowing from within the glacial sediments, and tidal waters from the harbor. Within the shallow flow system, these waters mix beneath the property.

The shallow groundwater system was encountered in borings on the site from between 3.5 and 7 feet in depth. The direction of flow within the shallow system is likely to be relatively complex, with flow reversals, depending upon the tidal conditions and other factors such as existing drain lines or other buried features that can act as conduits.

1.5 SITE HISTORY

Historical commercial and industrial activities on and adjacent to the site were researched in order to identify potential sources of contamination. For this history, the following documents were reviewed: historical maps (Sanborn, 1917, 1924, and 1924 corrected to 1949), aerial photographs

(USACOE, 1972; USDA, 1981; M&R, 1959 - 1967, 1970, 1973 - 1975, and 1987), city atlases (Metsker, 1925 and 1935), topographic maps (USGS, 1950, 1961, and 1978), city directories (Polk, 1941/42, 1958, 1962, 1966, 1971, 1976/77, 1981, 1986/87), and two histories of Port Angeles (Lauridsen, 1937 and Welsh, 1968). In addition, interviews were conducted with Virginia Fitzpatrick of the Port Angeles Historical Society, Ken Sweeny of the Port of Port Angeles, and Ed dosRemedios and Jim Hendrickson of M&R. Figure 7 presents historical features associated with the site.

1.5.1 Historic Site Use

Although early settlers were present in the late 1850s, Port Angeles was officially established in 1862 as a lighthouse and military and naval reserve station. The first attempt at formal settlement occurred in 1887, when the Puget Sound Co-Operative Colony was established near Ennis Creek. However, wide ranging commercial development did not occur until the Seattle, Port Angeles, and Western Railroad was constructed in 1912 to 1913.

The first known commercial development on the leased part of the site were the saw, shingle, and planing mills of the Puget Sound Mill & Timber Company. Established on fill around World War I, operational structures associated with the saw, shingle, and planing mills, were machine shops, employee housing and offices, steam dry kilns, log storage areas, a lathe mill and finishing mill, brick-lined iron waste burner, box factory, boiler house and engine room, and a lumber shipping dock. The 1917 Sanborn map showed ruins of a fire. The Seattle, Port Angeles, and Western Railroad ran along the south side of the property and sidings served the mills' shipping dock and log storage areas.

Over the next several years facilities remained basically the same, although in the mid-1920s, much of the employee housing was gone and a new box factory was in operation on the northwest end of the site. An overhead covered fuel conveyor was erected. By the late 1940s, however, the Puget Sound Lumber & Mill Company no longer existed and the few remaining structures belonged to Port Angeles Forest Products. Included were a few lumber storage areas, a small saw mill, planer shed, used machinery storage, dry kiln, sawdust bin, and two above-ground fuel oil tanks--one with a capacity of 5,000 gallons and the other with a capacity of perhaps 10,000 to 15,000 gallons. Apparently, the company was on-site until M&R leased the land in the late 1950s.

The first known commercial development on the fee side of the site, was Paraffine Companies' Crescent Boxboard Paper and Cardboard Mill. Established on fill around World War I, on-site operations included a machine shop, finishing and packing room, pulp beaters, digester, paper warehouse, sulphite manufacturing shop; acids and stock pulp tanks, pulp wood grinding shop, fuel house, engine room, chipping mill, cutoff mill, oil house, and dock. On-site structures remained the same through the late 1940s and early 1950s, although the site had changed ownership to Fiberboard Products Inc. Apparently, the mill was closed in the late 1950s and the property purchased by M&R in the late 1960s or early 1970s.

Since the late 1950s, M&R Lumber Company has conducted sawmill related activities on-site. Facilities on the leased land include a sawmill and green chain, a parts and maintenance shop, a former planing mill now occupied by log storage, shake plant, dry kiln and boiler house, a lumber dock, and acres of log and lumber storage. Facilities on the fee land include a planing mill, lumber storage shed, heavy vehicle maintenance shop and truck depot, and a chipping yard. Aerial photographs from 1965 to 1966 show that two above-ground storage tanks (estimated capacity of 1,000,000 and 270,000 gallons) were erected on the site in the early 1960s; they were removed in 1973 or 1974. The M&R head office is located on land leased from Daishowa. According to long-time employee Jim Hendrickson (1988) the central portion of the site, which includes the shake plant, is leased from the city of Port Angeles.

According to historic Sanborn Fire Insurance maps from 1917 to 1951, M&R and its predecessors were the primary commercial occupants of the property. However, earliest available city directories show that Hanson's Boat Yard and Peninsula Shingle Company occupied the address in the late

1950s and early 1960s. A restaurant also occupied that address in the mid-1970s. Apparently, Port Angeles Shake has leased a small strip of land located between M&R's fee and lease acreage for about 10 years -- unconfirmed information indicates that it used to be the Peninsula Shingle Company. Yet, aerial photographs do not show any structures on that strip of land until the early 1970s. Appendix A contains a list of on-site non-residential uses.

1.5.2 Historic Uses of Adjacent Property

The character of surrounding development is similar to that of the site. Early twentieth century residential development occurred along the bluff overlooking the site. The lagoon adjacent to the northwest end of the site was probably backfilled around World War I, and in the mid-1920s, a large boarding house occupied the fill. However, by the time M&R moved on-site, the area was apparently used only for log storage.

Perhaps the first commercial activity west of the site was Earles Mill, located at the head of Port Angeles Bay from about 1909 to about mid-1920s. The primary commercial development probably began in the mid-1920s. Washington Pulp and Paper Corporation's paper mill consisted of a sulphite pulp mill, chipping mill, pulp grinding shop, two machine shops, steam fired power plant, cooling shed, paper warehouse, and fuel oil tank and concrete water tank. By the late 1940s, ownership of the property had changed to Crown Zellerbach, and over the years it expanded east along Ediz Hook. Apparently, the first commercial development adjacent to the eastern boundary of the site was the Port Angeles small boat harbor, established in about 1957.

1.5.3 Potential for Contamination

The nature of the on-site commercial use suggests a possibility that contaminants are present in the soils and groundwater at the site. Primary sources of contamination would be associated with sawmill operations that have occurred since about 1917. Secondary sources of contamination would be associated with sawmill support services, such as machine shops, fuel storage, waste burners, boiler and engine rooms, auto/truck shops, and aboveground and underground fuel storage tanks. Contaminants related to primary sawmill activities might include Permatox (pentachlorophenol and tetrachlorophenol) and other chemicals used to prevent fungus and staining on lumber. Contaminants related to sawmill support services might include petroleum products or solvents used to maintain and repair heavy equipment, and diesel, fuel oil, and other petroleum products stored in underground and above-ground tanks.

Because of the nature of off-site use, there is a possibility that contaminants have migrated to the site. Primary sources of contamination would be associated with sawmill and pulp operations that have occurred west of the site since about 1909. Migratory contaminants might include chemicals used to preserve and protect wood, acids used in pulp manufacturing, and petroleum products stored in tanks and used for machining and repair activities.

1.6 AGENCY FILE REVIEWS

Several sets of regulatory agency records and/or files were reviewed during the performance of the environmental assessment. These are discussed below.

1.6.1 Ecology

We conducted a file review of the Washington State Department of Ecology (Ecology), Southwest Regional Office file on M&R. The file review was conducted in Olympia on Thursday May 5, 1988. Files on adjacent properties were not reviewed. The M&R files were reviewed in an effort to identify areas of concern from inspections, permits, complaints, penalties, or enforcement actions.

The agency's file on M&R was mainly an NPDES permit-related file. The earliest information in the file was dated 1974. The file contained three NPDES inspection reports dated 1979, 1983, and 1984. All three inspections found the facility's operations to be satisfactory. The 1979 inspection report noted, however, that the facility's oil barrel storage needed improvement and suggested that a storage house be constructed. The 1983 inspection report addresses the use of Permatox on the wood, but stated there were no problems because it was applied in a fully-enclosed spray booth. The overspray and drippings were reportedly fed back into a containment tank. The report did note, however, that "in the past" sludge from the bottom of the Permatox tank did go to the garbage until an inspector instructed them not to do this. After that time the sludge was burned in the hog fuel boiler. This disposal method appeared to be approved by the regulatory agency.

Millbrite 50 was also noted as a chemical used on-site but no details on its use were provided.

The file contained a 1980 NPDES permit summary for four discharge points into the harbor. The 1974 application for an NPDES permit said that the facility had been discharging since June 1958.

The file also contained a 1978 application for a Disposal Site Permit. The wastes to be disposed of were characterized as "construction and demolition wastes" and unspecified "industrial wastes." The industrial wastes were reported as 500 cubic yards as the 1978 volume with an estimated 275,000 cubic yards projected through 1988. The landfill application also stated the facility would include "dewatered dredge spoils" as they developed.

No details were given in the file on the location of the landfill which was being permitted in the 1978 application. In December of 1983, however, the Clallam County Health Department issued a solid waste landfill permit for a site located at 13th and M Streets in Port Angeles.

A 1977 letter from Ecology to M&R stated there were no problems with contamination of storm water from the log yard and that M&R's plans to improve the ditch system would help prevent future problems. M&R planned, at that time, to improve the ditch system and "place a weir at the downstream end to trap floating debris and oils". The letter also mentioned that log handling in some areas was pushed on or close to the beach and that this should be stopped and the debris cleaned up.

Effluent monitoring records since issuance of the NPDES permit stated there were no problems and at one point the agency suggested they eliminate the monitoring and reporting requirements in the permit except for weekly inspections for visible oils.

Both known underground storage tanks at M&R have had notifications filed with Ecology.

1.6.2 Clallam County Health Department

At M&R's request we obtained from Clallam County Health Department copies of Landau Associates' well locations, boring logs, and groundwater data from Pen Ply's 13th and M Streets Landfill. Pen Ply's landfill is immediately adjacent to the M&R landfill (Figure 1). We reviewed this material to get an overview of the hydrogeology of this area and to see if monitoring wells associated with Pen Ply's site are likely to intercept leachate if it migrates from M&R's adjacent landfill. Our conclusions based on information in the Landau report follow.

1.6.2.1 Local Hydrogeology

The landfill hydrogeology is presented here, separated from Section 1.4 because the landfill is not adjacent to the M&R landfill.

- Soils are predominantly sand and gravel with subordinate layers of clay and silt.
- Laterally discontinuous perched water-bearing zones exist at shallow depths (12 to 80 feet below the ground surface).

- The shallow configuration of saturated and unsaturated zones probably changes seasonally. Therefore, the volume of water, the direction of flow, and the rate of flow all change with time.
- The flow direction in the shallow saturated zone is generally north to northeast.
- Estimated average hydraulic conductivity of the shallow saturated zone is 5.8×10^{-4} ft/min.
- Estimated seepage velocity of the shallow saturated zone is 106.1 ft/yr.
- An aquifer near sea level exists 218 to 268 feet below ground surface. Preliminary information indicates groundwater in this aquifer flows in a westerly direction beneath this site.
- Some chemical analyses were done in April 1987. Manganese, chloride, sulfate, pH, COD, and TOC exceeded water quality guidelines.

1.6.2.2 Pen Ply's Landfill Monitoring System

Based on the above information and conclusions we received from the county, the monitoring wells located in the shallow saturated zone on the Pen Ply site are unlikely to intercept leachate if it migrated from the M&R landfill. The basis for this is that the groundwater in this zone generally flows toward the north-northeast and therefore when groundwater leaves M&R property it will flow away from the Pen Ply landfill.

With regard to the monitoring wells in the deeper "sea level aquifer", because of the northeasterly flow of the shallow groundwater system, any potential contaminant from the M&R landfill would likely be picked up by the shallow flow system. The contaminant would move northeasterly. In the unlikely event the contaminant eventually reached the sea level aquifer, it would be a considerable distance northeast of the site before moving within the sea level aquifer. Therefore the chance any deep monitoring well on the 13th and M Street site would detect a contaminant in the deep zone is very remote.

1.6.3 Corps of Engineers

During the performance of the environmental assessment, Army Corps of Engineers (COE) permits to construct a bulkhead and buildings and place fill and riprap at the M&R site were reviewed. These permits stated that "polluted dredge material" would be placed as fill on-site. The COE was contacted to access those associated permits concerning the "polluted dredge material". Review of associated permits showed the source of the polluted materials (also described as "unsuitable dredge materials") to be from the Port of Port Angeles, near Terminals 1 and 3, adjacent to the M&R site. No chemical data on the materials were presented in the associated permits; the materials were described in the permits only as being "silty material" and "granular material".

As part of our investigations, a boring was advanced through this fill (B-11) and a monitoring well was installed (MW-11). Soil and groundwater samples were taken and analyzed. No BTEX was found in soil or groundwater (all < 1 ug/kg or ug/L). A GC/FID screen showed soil to have 16,000 ug/kg solvent extractable hydrocarbons. Less than 200 ug/L solvent extractable hydrocarbons were detected in the water. The boring is within 200 feet of a fuel oil tank (now removed) which may have leaked. These data are not considered significant.

Hart Crowser was unable to determine what the COE dredging permit meant by "polluted material". However, based on the date of the permits (circa 1970) it is likely that "polluted material" refers to suspended solids and/or biological oxygen demand (BOD) from fresh dredge spoils which could adversely affect water quality in the harbor if runoff were not controlled.

2.0 PRELIMINARY SITE ASSESSMENT AND FOCUSED EXPLORATION

The discussion of our site assessment is broken into four major groupings: surface stained soils, transformer leakage, underground storage tanks, and pesticide spray areas. Other miscellaneous items are contained in Appendix J. Each discussion includes the rationale for assessments, reconnaissance/exploration, sample data evaluation results, recommendations or options, and any appropriate follow-up actions. The discussions for the site assessments are introduced through a review of potential contamination sources.

2.1 POTENTIAL CONTAMINATION SOURCE REVIEW

Potential sources of environmental contamination were identified prior to conducting the site reconnaissance. This was accomplished using the following sources:

- Hart Crowser's experience with lumber mill operations;
- Hart Crowser's experience with other projects in the Port Angeles area;
- Historical search;
- Agency file reviews; and
- Interviews with M&R employees and retired personnel.

Sawmill operations normally have log yards, planers, kilns, painting shops, maintenance and machine shops, fuel storage, chemical storage, transformers, boilers, packaging areas, and finished product storage. These types of operations may result in environmental contamination from petroleum products, solvents and thinners, paints, wood treatment operations, boiler ash, log sort yard runoff, lead/acid batteries, and PCB.

Through the historical search, agency file review, and employee interviews we learned of two underground fuel storage tanks, the former Fiberboard mill, the old truck maintenance shop, the old planer building, and a landfill at M Street and 13th Street. These areas are all potential sources of environmental contamination.

Potential contamination source areas were selected for relatively intensive evaluation during the site reconnaissance. This information was also used to preliminarily select environmental boring locations.

In order to make a reasonable attempt to identify other potential areas of concern the site reconnaissance included a walk through the entire 50-acre site, except where operational hazards prevented observation.

2.2 SURFACE STAINS

2.2.1 Assessment Rationale

Evidence of leaks and spills, such as stained soil, discoloration, stressed vegetation, proximity to suspected spill sources, and unexplained mounds or swales can provide information for use in focused evaluations or in determining appropriate mitigative measures. As part of the site reconnaissance we made detailed observations of suspected surface contamination during tours of buildings, operations, areas adjacent to operations, and the water front area. Observations included photographs, notes on suspected sources, and probable contaminants. These observations lead to recommendations for mitigative action and additional field exploration activities including the installation of additional borings and groundwater monitoring wells as well as hand auger borings and surface samples.

2.2.2 Reconnaissance

The areas of noticeable surface stains observed during the site reconnaissance are shown on Figure 8 and are discussed below. Appendix B contains photographic documentation of the reconnaissance including stained soils. Appendix C contains sampling procedures and exploration logs.

- The drum disposal yard ("boneyard"), west of the sawmill, was covered with heavy vegetation and small trees. Rusted machinery, scrap metal, wood debris, and miscellaneous 55-gallon drums were observed at the site. Corroded, rusted, and dented drums were scattered around the area. Small (i.e., ten square foot) visible soil stains and vegetation distress were also observed under the corroded/leaking drums. A drum of assumed green end-paint with visible soil stains was observed.

- There are two product storage areas west of the sawmill. Approximately twenty 55-gallon drums of product were stored at this location. Visible signs of minor staining were noted on soils in this area. Across the drive an oil storage area was located with 55-gallon drums lying prone on a wooden tip rack. The tip rack was stained with an oil-like material as was the surrounding soil under the drum spigots.

  South of the sawmill, several drums of assumed lubricating oil were located under a cherry picker. The surrounding soil was heavily stained with an oil-like material. The stains on the soil appeared to be from leaking hydraulics associated with the cherry picker.

- An oil-like stain (approximately nine feet square) was observed on the machine shop concrete floor. No obvious floor drains were noted and the spilled material did not appear to have exited the building.

- The western portion of the old alder mill/old truck maintenance shop contained drums of assumed waste oils. The 55-gallon drums were rusted, dented, and appeared to have leaked. The surrounding soil was heavily stained with an oil-like material.

- Several areas of potential concern noted during the tour of the new planer building were:

  - A large, brown puddle of liquid at the NP-1 storage area was observed the day after the site tour with M&R employees. It appears the NP-1/Millbrite overspill at the spray room (in the planer mill) was swept outside directly onto the concrete and asphalt. A surface soil sample (SS-1) was retrieved for potential analysis at a subcontracted laboratory;

  - A section stained with an oil-like material was observed along the northwest side of the planer building, just north of the door entering the treatment area. Unknown green and brown stained soil were also noted at this location. Several open drums, a dumpster, and a wooden box were also observed. A surface soil sample (SS-2) was retrieved from the stained areas for potential analysis at a subcontracted laboratory;

  - The surrounding soil and vegetation at the two above-ground tanks west of the planer showed evidence of minor staining with an oil-like material.

- During a later site visit to the new planer mill, a Hart Crowser representative noticed a green material on the soil along the northwest corner of the planer building at the approximate location of sampling site SS-2. The green material appeared to be rainwater runoff from the dumpster located in the area.

- Adjacent to the alder chip yard, minor leakage from four 55-gallon drums labeled lubricating oil and/or hydraulics associated with the alder chipper were observed on the asphalt along the south side of the chipper. Two 55-gallon drums lying prone on a tip rack also appeared to be lubricating oils. The surrounding asphalt was stained with an oil-like material.

- West of the new truck maintenance shop, several drums contained an unknown material, some of which appeared to have leaked onto the soil. A leaking truck saddle tank had stained the surrounding soil and vegetation with an oil-like material.

  A pressure wash area was observed at the northwest entrance to the truck shop. Emulsified oils and standing water were observed on the surrounding soils. Although most of the shop area is covered with asphalt or concrete, the pressure wash area drains into a wedge of soil with no apparent containment.

North of the truck shop were drums of waste oils. The soil around the drums was stained with a black, oil-like material. A surface soil sample (SS-3) was retrieved from this stained area for laboratory analysis.

2.2.3 Sample Data Evaluation

Two surface soil samples were analyzed by Laucks Testing Laboratories, Inc. in Seattle (SS-2 and SS-3). Sample SS-1 (a grab sample of the NP-1 solution) was not analyzed; refer to subsection 2.5.1.1 for the rational. Laboratory certificates containing raw data sheets and laboratory QA/QC results are presented in Appendix D. Table 1 presents analytical results.

Visual observations revealed stained soils at a number of locations shown on Figure 8. The surface soil sample (SS-2) collected near the new planer mill was found to contain phenols. Pentachlorophenol (270,000 ug/kg) and tetrachlorophenol (40,000 ug/kg) were measured at relatively high concentrations as were sodium tetrachlorophenate (4,000 ug/kg) and sodium pentachlorophenate (17,000 ug/kg). Data evaluation of sample SS-2 is discussed in subsection 2.5.3.2. The other surface soil sample (SS-3), obtained at the east end of the property, was analyzed using the GC/FID screen. A concentration of 2,400,000 ug/kg, was detected indicating that significant levels of solvent extractable compounds exist in the surface soil at this location.

After identifying areas of potential concern during Phase I of the field work based on reconnaissance and analytical results as presented in Table 2, additional sampling and analysis were authorized. Our Phase II work involved installation of additional borings in four locations as indicated on Figure 4 (MW-12 through MW-14). Two of the four locations were associated with surface stain identification (MW-12 and MW-13). The borings were converted to monitoring wells. These borings/wells are in presumed downgradient positions of identified surface stain sources of contamination. Five soil samples at each boring, obtained during drilling, were composited into a single sample for each location and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and other selected volatile organic compounds using GC-FID technique. Groundwater samples from the two monitoring wells were analyzed for BTEX, solvent extractable compounds and total organic halogens (as chlorine). Table 3 presents analytical results.

The only halogenated volatile compound detected in soil samples was methylene chloride, where MW-13 had the highest concentrations at 170 ug/kg. Methylene chloride is a common laboratory solvent. Contamination from laboratory procedures is possible but two method blanks analyzed at the same time as the soil samples did not detect any contamination from this source. GC/FID screens of the composited soil samples detected solvent extractable hydrocarbons at 4,500 ug/kg in MW-13.

Solvent extractable compounds were measured at 420 ug/L in MW-13. No total organic halogens, measured as chlorine, were detected in wells MW-12 or MW-13.

The concentrations of solvent extractable organic compounds detected in the areas of surface staining are typical of industrial property around Puget Sound. If the subject soils are within an area of proposed excavation, special handling and disposal (such as at a sanitary landfill) may be appropriate.

The presence of methylene chloride in the composite soil sample from MW-12 and MW-13 is likely because of contamination introduced to the sample in the laboratory. However, since this compound did not show up in laboratory blank samples, its presence in the site soils cannot be ruled out at this time.

2.2.4 Recommendations

The surface stains identified at the M&R site appear to be primarily petroleum products and are limited in extent based on visual observations, laboratory data, and discussions with M&R employees. In general, the sizes of the stains ranged from approximately 5 to 400 square feet at the surface. In order to reduce potential sources of subsurface contamination we recommend that all surface stains be removed down to a depth where visual evidence and odors no longer exist.

As discussed with M&R, disposal of stained soils should be in accordance with federal, state, and local regulations governing solid waste. The majority of the soils can probably go to the Port Angles landfill with the permission of the Clallam County Health Department and the landfill operator. Prior to disposal, the county or landfill operator may require some of the soils that are highly contaminated with petroleum products be aerated for a period of time to reduce volatile organic concentrations and to provide additional biodegradation to reduce the overall hydrocarbon content. Unknown materials may require testing to indicate proper disposal.

We recommended that PCP-contaminated soils be removed from the area just west of the new planer building and placed in drums for disposal at a permitted hazardous waste disposal facility. Preliminary laboratory data indicate this material probably meets the definition of a state dangerous waste due to persistence per WAC 173-303-084(6). Additional details on this area are contained in subsection 2.5.

We suggested that representative samples be collected from the bottom of the excavations prior to backfilling with clean fill. These samples should be kept cool in a secure location in the event that Daishowa requests verification analysis.

2.2.5 Follow-Up Actions

At the request of M&R, Hart Crowser met with Mr. Paul Hopkins of M&R on June 2, 1988, to tour the site and point out areas of visual surface staining identified during the preliminary assessment. Areas addressed during this follow-up tour included the following:

- Power wash area near the new truck shop;
- Waste oil storage north of the new truck shop;

- Drum and debris storage area west of the new truck shop;
- Oil-like stains at the alder chipper;
- Transformer at the alder chipper;
- Transformer at the alder chip wall loading facility;
- Paint spray booth;
- West end of the new planer mill;
- Transformer at the west end of the new planer mill;
- Old truck maintenance shop area;
- Underground diesel storage tank near the scale house;
- Cherry picker at the south end of the sawmill;
- Empty Permatox tank at the head of the green chain;
- Transformers on the east and west ends of the sawmill;
- Lube oil product storage area west of the sawmill; and
- Boneyard located on the western boundary of the property.

During the tour stained soil removal and disposal methods were discussed. Procedures for collecting verification samples after removing stained soils were also discussed.

It is our understanding that M&R has removed stained soils identified during the preliminary site assessment for disposal at the Port Angeles landfill with their permission. Verification samples apparently were not collected.

Soils located on the west end of the new planer building that were found to be contaminated with PCP have been removed and placed in a container. During excavation a concrete slab was discovered underlying the area of contamination at a depth of approximately six inches. This concrete barrier along with the surrounding asphalt may have prevented the migration of significant levels of PCP to the underlying soils. At last report the ultimate disposal of this material is being evaluated by M&R. Additional information on this area is contained in subsection 2.5.

2.3 TRANSFORMER LEAKAGE

2.3.1 Assessment Rationale

Polychlorinated biphenyls (PCB) have historically been used as transformer and capacitor dielectric fluids due to their stability and low flammability. Subsequent to the development of PCB in the early 1930s, it was discovered that PCB presented a significant threat to human health and the environment due to persistence, bioaccumulation, and suspected human carcinogenicity.

The Toxic Substances Control Act (TSCA) administered by the EPA regulates the use and disposal of PCB in Washington State. By definition, oils containing less than 50 mg/kg PCB are considered to be non-PCB oils and are not subject to TSCA regulation. PCB transformers that have been flushed and refilled with non-PCB dielectric fluids often contain residual PCB below the 50 mg/kg threshold. Even though PCB are no longer manufactured in the United States many transformers and capacitors contain PCB oils or PCB-contaminated oils.

The regulations require transformers containing more than 500 mg/kg PCB be labeled as PCB transformers. We cannot assume that the transformer owner is aware of this labeling requirement. Leaks from PCB-contaminated transformers (i.e., 50 to 500 mg/kg PCB) or non-PCB transformers (i.e., < 50 mg/kg PCB) may present a substantial threat to human health or the environment due to residual levels of PCB depending on site specific conditions.

During the preliminary assessment, Hart Crowser observed all transformers known to be on site. Samples for PCB analysis were obtained, if possible, adjacent to transformers that appeared to be leaking. Figure 9 shows transformer locations and sampling points. Documentation of transformer identification label information and close observation of the transformers were not possible due to electrical hazard.

2.3.2 Reconnaissance

The transformer reconnaissance results are shown on Figure 9 and are discussed below. Appendix B contains photographic documentation of the walk through and any leaking transformers. We do not know whether all transformers on-site have been analyzed for PCBs. Appendix C contains sampling procedures.

- Three transformers were located in a locked vault on the west side of the new planer building. The transformers sat on a bermed, concrete floor covered with sawdust. Two of the transformers appeared to be leaking, evidenced by staining on the sides of the transformers and on the surrounding concrete floor. A sample for PCB analysis (TR-1) was obtained from the center transformer.

- A bermed, concrete vault containing three transformers was located at the west end of the sawmill near the product storage areas. The metal vault door was locked to restrict access to the transformers. The transformers stood on a concrete floor that was covered with sawdust. The center and eastern-most transformers showed evidence of leakage. There were visible oil-like stains on the floor around the two transformers. A sample (TR-2) was collected from the stained area for PCB analysis. Jim Hendrickson thought the transformers had been tested for PCBs and the oil changed approximately five or six years ago. The City Light employee stated that the transformers were tested around that time period.

- South of the sawmill, a transformer on a concrete pad was located east of the cherry picker. The transformer did not appear to be leaking and so no samples were taken, in keeping with our scope of work.

- Five transformers were located just north of the green chain. Four of the transformers are small pole-mounted types and one is a large transformer mounted on a concrete slab without berms. All of the transformers are located inside a fenced area with a locked gate. Hart Crowser was unable to gain access to these transformers.

Minor signs of leakage were observed at the drain valve on the large transformer, but no noticeable stains were observed on the concrete pad. Two of the four pole transformers showed signs of leakage, evidenced by black stains down the sides of the transformers. The transformers are located in a high traffic area and much of the soil within the fenced area was covered with water during our site tour. No obvious signs of transformers oil were observed on the surrounding soil or surface water. However, recent leakage from the pole transformers may have been obscured due to traffic and/or surface water.

- A transformer mounted on a concrete pad was located at the old alder mill/old truck maintenance shop. The transformer was surrounded by approximately twenty drums of assumed waste oil. It was difficult to detect if the transformer leaked due to the amount of soil stainage. We assumed the oil-like residue on the transformers was from the drums. However, a sample for PCB analysis (TR-3) was retrieved from the stained area adjacent to the transformer to verify this assumption.

- Three transformers were located north of the alder chipper on a concrete pad with metal railings on three sides. Several compressed gas cylinders were also stored in the vicinity of the transformers. It was difficult to ascertain if the transformers showed evidence of leaking due to the amount of sawdust accumulated on the pad. A sample for PCB analysis (TR-4) was retrieved from the base of two transformers. The stains that were observed on the concrete pad may have been from an open-top, 5-gallon bucket containing what appeared to be lubricating oil and which appeared to have overflowed.

- A transformer was located along the waterfront in the northeast section of the property, behind the concrete wall used as a backstop for chip loading operations at the eastern-most pier on the M&R site. The transformer was mounted on a concrete pad and appeared to be leaking, evidenced by stains coming from near the top of the transformer. The surrounding concrete pad was stained with an oily material that may have splashed onto the transformer base. The oily material at the base may have come from two 55-gallon drums of assumed lubricating oil that were situated on a tip rack adjacent to the transformer pad. A sample for PCB analysis (TR-5) was scraped from the side of the transformer.

2.3.3 Sample Data Evaluation

The five PCB samples collected were analyzed by Laucks Testing Laboratories, Inc. in Seattle using Method 8080, described in Test Methods for Evaluating Solid Waste (SW-846), EPA. 1986.

Laboratory certificates containing raw data sheets and laboratory QA/QC results are presented in Appendix D. Table 1 presents analytical results.

All five samples contained a large amount of wood debris which presented matrix interferences in the initial low level extraction. The remaining sample materials were then subjected to medium level extraction in an attempt to generate valid data. However, sample TR-1, collected at the west end of the new planer building was exhausted during initial low level extraction and no data are available. In addition, the medium level extraction increased the detection limits for the remaining samples to approximately 2,400 ug/kg instead of the 100 ug/kg level that should have been obtainable with low level extraction. However, the medium extraction detection limit appears to be adequate for the purposes of this preliminary assessment.

PCB was not detected in samples TR-2 (west of the sawmill), TR-3 (northwest of the kiln), and TR-4 (alder chipper). Sample TR-5 from the transformer located at the alder chip wall loading facility contained low levels of PCB at 4,800 ug/kg (Aroclor 1260), twice the detection limit.

The EPA guidelines for PCB acute and chronic criteria for protection of saltwater aquatic organisms are 0.030 ug/kg and 10.0 ug/kg, respectively, on a 24-hour average. These criteria are 5 and 2 orders of magnitude lower than the concentration reported in sample TR-5. However, due to the extremely low water solubility of PCB it normally requires massive contamination for a long duration to produce PCB concentrations in the water that approach the published criteria.

The National PCB Spill Cleanup Policy (52FR10688), issued on April 2, 1987, sets requirements for the reporting of spills involving PCB-contaminated materials and sets cleanup performance standards. This policy only applies to spills of PCB at concentrations that are above the regulated concentration (i.e. > 50 mg/kg). The most stringent cleanup standard in the policy for solid surfaces located at other than indoor or residential areas is that the affected area receive a double rinse/wash. For soil cleanup standards involving new spills containing PCB between 50 to 500 mg/kg the EPA requires the removal of visible traces plus a one-foot lateral buffer.

The Washington State Department of Ecology (Ecology) has had an unwritten policy that soils contaminated with PCB should be cleaned up until the remaining residue is at 1 mg/kg or less.

The leaking transformer at the alder chip wall loading area does not appear to be in a concentration or volume to require reporting under federal regulation. No imminent or substantial endangerment to human health or the environment has been identified at the site.

2.3.4 Recommendations

We suggest transformers that have not been tested should be evaluated. Appendix E contains the results of testing done on transformer oils from M&R site. This testing was done in 1982 on four transformers. Trace levels (less than 1 mg/kg) of Arachlor were detected in one transformer. Leaking transformers should be replaced or repaired to eliminate a potential source of contamination to the environment, regardless of their PCB content.

It does not appear that the minor PCB contamination discovered at the alder chip wall loading facility requires cleanup under federal regulation. The State Department of Ecology, however, may require removal of PCB contaminated debris down to a level of 1 mg/kg or less. Accordingly, the transformer, transformer pad, and any visually stained soils should be removed from around the transformer located at the alder chip wall loading facility. This can probably be accomplished by removing visual stains and washing the transformer with a strong detergent. The work should be performed by an individual familiar with PCB cleanups and the residue should be properly disposed of at the Port Angeles Landfill, with the permission of the Health Department and the landfill operator, or at a facility permitted by the EPA to handle PCB waste.

2.3.5 Follow-Up Actions

Conversations with M&R employees indicates that visual stains have been removed from around the alder chip wall transformer. The debris was placed in a plastic bag and deposited in the drum containing PCP contaminated soil removed from the west end of the new planer mill. Although various conversations have occurred between M&R and Hart Crowser regarding transformers located at the site, we are unaware of any other actions.

2.4 UNDERGROUND STORAGE TANKS

2.4.1 Assessment Rationale

The potential for an underground tank to leak depends on a variety of factors such as construction materials, soil type, tank contents, and age of the tank. We have evaluated hundreds of underground storage tanks for a variety of clients. The vast majority of the tanks over 10 years of age that we have evaluated have been found to leak to some degree. Thus, it is important to address potential leaking underground storage tanks in any environmental assessment.

It is often difficult to adequately evaluate underground tanks without installing borings. On occasion there may be surficial evidence of leakage from such things as corroded piping, subsidence, or unexplained product loss from daily inventory logs. Tank integrity testing is also often employed to detect leaks in underground tanks.

During the site reconnaissance known underground storage tank (UST) locations were viewed and available information was obtained as to tank size, age, construction materials, installation procedures, leak monitoring methods, and spill or leak history. The site reconnaissance team looked for evidence of unreported underground tanks while touring the remainder of the site.

2.4.2 Reconnaissance

During the site visit, the locations of the USTs were observed. These locations are shown on Figure 8. M&R employees were interviewed about the existence of additional tanks at the site. In addition, we looked for visual signs of additional tanks (i.e. swales, vent pipes, fill ports). No signs of additional underground tanks were observed.

The underground storage tank areas observed are shown on Figure 8 and are discussed below:

- At the log scale house area a metered pump mounted on a concrete pad was located in the middle of the dirt turn-around road. No visible signs of soil stains were observed in this area during our site tour.

  Jim Critchfield and Jim Hendrickson stated the tank had been previously used for unleaded gasoline. Reportedly, three to four years ago, the tank was converted to diesel. The tank size was thought to be 500-gallon capacity. We asked M&R to contact Texaco and the tank size was determined to be 2,000 gallons.

A rupture in the pump hose was later observed by a Hart Crowser representative while conducting drilling operations at the site. An unknown quantity of diesel was pumped directly onto the surrounding soil. The spilled diesel left an oily sheen in surface puddles of water.

- At the dry kiln an underground storage tank that was thought to contain leaded gasoline was located south of the kiln. A metered pump was mounted on a concrete pad surrounded by asphalt. The size of the tank was unknown by Mr. Hendrickson. M&R employees contacted Texaco and determined the tank capacity to be 1,000 gallons. Obvious signs of potential environmental concern were not observed at the underground gasoline tank during the site tour.

To further assess conditions associated with the two underground storage tanks, borings B-5, and B-7 were installed to assess contamination from these tanks. Boring B-7 was converted to a monitoring well and monitoring well MW-5A was installed immediately adjacent to boring B-5. Appendix C contains field investigation procedures and boring logs. See Figure 4 for these boring locations.

2.4.3 Sample Data Evaluation

The soil and groundwater samples collected during the preliminary assessment were analyzed by Laucks. Laboratory certificates containing raw data sheets and laboratory QA/QC results are presented in Appendix D. Table 2 presents analytical results.

Xylenes were detected in soil samples from B-5 (34 ug/kg) and in water samples from MW-5A (2 ug/L) and MW-7 (2 ug/L) indicating the presence of low level volatile organic compounds at these locations. Qualitative GC/FID screens indicated the presence of solvent extractable compounds in soil from B-5 (4,700 ug/kg).

Chemical Data Conclusions

The xylenes detected in the composite soil sample from boring B-5 and in the groundwater samples collected from wells MW-5A and MW-7 are well below the EPA Water Quality Criteria (400 ug/L) and the Maximum Concentration Limit (MCL) of 440 ug/L proposed by the EPA. Based on the data available it does not appear that xylenes detected at these two well locations present a threat to human health or the environment.

GC-FID screen data collected from the vicinity of the underground diesel tank at B-5/MW-5A are slightly elevated above background values we normally see at industries of this type (i.e., 1,000 to 2,500 ug/kg). These data indicate that soil and groundwater near the underground diesel tank contain minor amounts of solvent extractable organic compounds.

2.4.4 Underground Storage Tank Testing

The two known petroleum underground storage tanks were tested for "tightness" by Petroleum Equipment Maintenance Company (Pemaco) under subcontract to Hart Crowser using the "Petro-Tite" system to evaluate the tanks potential for leaks. The Petro-tite system is capable of detecting losses as small as 0.05 gallon per hour. This detection limit is recommended by the National Fire Protection Association (NFPA). NFPA guidelines state that if detected losses exceed 0.05 gallon per hour, a leak is likely and corrective action is warranted.

Both tanks use a suction pump system to retrieve fuel from the tank through the supply lines to the dispensor nozzle. Suction systems limit the amount of supply vent line testing since the lines are often buried. Back pressurizing lines assumes that in-line check valves will hold pressure which may or may not be the case.

The 1000-gallon gasaline tank vent was removed and plugged to the lower elbow, located just above the pipes entrance into the concrete ground-surface slab. The supply lines connected to the pump were left intact during testing.

The 2000-gallon diesel tank supply line running at a 45° angle from the concrete surface slab above the tank to the pump dispensor was slightly loose. Initial connection of the tank testing gear indicated these connections leaked. After discussions with M&R, this piping was disconnected, and plugged at the 45° elbow. The vent pipe was disconnected and plugged near ground surface.

Testing commenced on the tanks and the buried vent supply/line piping. Groundwater monitoring wells installed adjacent to both tanks during Phase I were used to record groundwater levels during tank testing.

Test results indicated that the diesel tank at the scale house area leaked. The gasoline tank at the kiln appeared to be sound. A description of the "Petro-Tite" test system, and test results are included in Appendix F.

2.4.5 Recommendations

The underground diesel tank located in the log scale house area should be removed and contaminated soils should be excavated for proper disposal. In that only minor soil and groundwater contamination was detected in well MW-5A, an indication of either a minor or short term leak, contamination can probably be adequately mitigated by removing soils with visual stains or obvious petroleum odors. Representative verification samples should be collected from the bottom of the excavation in case Daishowa requests to have them analyzed to verify that adequate cleanup has been conducted.

2.4.6 Follow-up Actions

Hart Crowser has been informed by M&R that the underground diesel tank located in the log scale house are has been removed along with an unspecified amount of contaminated soil. Disposal was apparently at the Port Angeles Landfill. Verification samples were not collected.

2.5 PESTICIDE SPRAY AREAS

2.5.1 Assessment Rationale

Lumber mills often have wood treating operations to control sap stain discoloration prior to reaching the consumer. Historically these types of operations have used various formulations of chlorinated phenol pesticides to produce desired results. Due to increased restrictions placed on chlorinated phenol use by the EPA, less persistent substitutes have recently appeared on the market, such as NP-1.

All pesticides are designed to kill unwanted organisms and, as a result, they are all toxic to one degree or another and can present an environmental concern. Pesticide use areas are a prime target for evaluation when conducting environmental assessments.

In order to assess the potential for contamination from known and suspected pesticide use area, surface grab samples were taken at the new planer mill. Borings and groundwater monitoring wells were installed at three locations on the M&R site:

- The new planer mill (known use area) - B-3/MW-3A;
- The green chain (known use area) - B-8/MW-8; and
- The old planer mill, currently a log sort yard (suspected use area) - B-6A/MW-6A.

The initial assessment detected elevated levels of PCP-related contamination in surface soil samples collected near the new planer building and soil and groundwater samples collected in the vicinity of the old planer mill. The source of the contamination near the old planer mill was not clear at that time. Further communication with retired M&R personnel revealed that the old planer mill was the site of a Permatox treatment operation until approximately 1971 or 1972 when the building was severely damaged in a fire. If PCP was burned in the fire, dioxin could be generated, in addition to the potential burst drum spillage.

Based on this information, Hart Crowser was contracted to initiate a fast-tracked investigation to obtain information as to the approximate vertical and horizontal extent of the contamination at both locations. The investigation was not intended to characterize the site, rather it was designed to obtain data on the general magnitude to the problem on a very short time frame so that decisions could be made by M&R and Daishowa with respect to the sale of the property.

Because the pesticide spray areas were of greatest concern during the site assessments, we have provided limited human health/environmental assessments of NP-1, PCP, and TCP. More detailed assessments can further the understanding of the impacts these pesticides may have on any property transfers.

2.5.1.1 Limited Assessment of NP-1

We originally intended to sample and analyze for the active ingredients in NP-1, the current sap stain control chemical used at the new alder mill. In consultation with Laucks Laboratories, Inc., we were informed that standard analytical methods were not readily available for the active ingredients in NP-1 and that researching the methods would be time consuming and costly. In lieu of sampling and testing, Hart Crowser agreed to conduct a brief literature review into the potential environmental hazards associated with NP-1.

The current wood treatment operation at the new planer mill is conducted using a 200:1 mixture of water:NP-1. Usually this water/NP-1 mixture is mixed with a wood toner called Millbrite 50 Brown 583 at a ratio of 75 parts water/NP-1 to one part Millbrite. The resultant mixture is then sprayed onto each board as it comes out of the planer.

According to the Material Safety Data Sheet (MSDS) supplied to M&R by the manufacturer (Koppers Company, Inc.) NP-1 contains the following hazardous ingredients:

Didecyl dimethyl ammonium chloride	65%
Iodopropanyl butyl carbamate	20%
Petroleum naphtha	5%
Ethanol	10%
Dimethyl sulfoxide	5%

The MSDS for NP-1 states that the DOT hazard class is "corrosive material". Health warnings include corrosive to eyes, causes severe burns, and it may be fatal if inhaled, ingested, or absorbed through the skin. The pure undiluted product would be a designated hazardous waste due to ignitability (flash point - 104° F - TCC) if it were being disposed.

Millbrite 50 contains the following hazardous ingredients according to the manufacturer (Chapman Chemical Company):

Amino-2 meth-2 propanol-1	1-10%
Proprietary surfactant	1-10%
Proprietary dispersion pigments	2-20%
Alkanolamine	1-10%

The MSDS states that Millbrite can cause severe irritation to the eyes, may cause skin irritation, and causes gastrointestinal irritation upon ingestion.

Appendix G contains copies of the MSDS for NP-1 and Millbrite.

Review of the chemical information supplied in the MSDS indicates that Millbrite is relatively innocuous with respect to human health concerns and it does not appear to be a major environmental threat, especially in the concentrations used in the working solution. Accordingly, we concentrated our limited assessment efforts on NP-1.

The primary ingredient in NP-1 with respect to pesticide activity is the carbamate compound. Carbamates are relatively new substitutes for PCP in the wood treatment area. Carbamates are a class of aliphatic compounds that have a triple carbon-carbon bond. Iodopropanyl butyl carbamate has the following structure:

$\mathrm{I{-}C{\equiv}C{-}CH2O{-}CO{-}NH{-}Bu}$

We conducted searches of three computer databases in an attempt to obtain information on the carbamate of concern. No information pertinent to our limited assessment was available in any of the searches. NIOSH and the EPA Spill Table were reviewed for pertinent toxicity information without success. We contacted Koppers repeatedly and requested toxicity information on their product. Koppers was less than cooperative, but they informed us that the half-life of NP-1 is four days and that some mammalian toxicity information on NP-1 was available and that they would send it to us. At this writing we have not received the information from Koppers.

In summary, we were unable to obtain information that would allow us to conduct a conclusive limited assessment of NP-1. An exhaustive search for pertinent information concerning toxicity, environmental fate, and transport mechanisms would probably produce some useful information. This level of effort was not possible due to time constraints. However, some general statements can be made based on our experience:

- NP-1 appears to be much less persistent than PCP based on the chemical structure and reports from Koppers;

- The carbamate is probably the most toxic ingredient in the product;

- NP-1 is probably fairly mobile in the soil based on the probable water solubility of the compound; however, information on the octanol/water partition coefficient was not available.

With available information, Hart Crowser designated the NP-1/Millbrite working solution in accordance with the State Dangerous Waste designation procedures per WAC 173-303-070(3)(a). The only designation procedure that was of real concern was the toxicity procedure per WAC 173-303-084(5). Hart Crowser calculated the toxicity of the NP-1/Millbrite working solution and arrived at an Equivalent Concentration (EC) of 0.0003458 percent. Based on the Toxic Dangerous Waste Mixtures Graph (WAC 173-303-9906) the wood treatment working solution is not a toxic dangerous waste and, thus, it does not appear to be a state dangerous waste. Testing against the Dangerous Waste Criteria is not necessary unless Ecology specifically requires it per WAC 173-303-070(4). Appendix H presents the calculations and assumptions used in determining the toxicity calculations.

2.5.1.2 Limited Assessments of PCP and TCP

M&R used Permatox 180 for a number of years to control sap stain on lumber prior to changing to NP-1, approximately three years ago. Permatox 180 is a mixture of sodium pentachlorophenate and sodium tetrachlorophenate and is manufactured by Chapman Chemical Company. Unlike the phenol forms, these sodium salts have the advantage of being water soluble at high pH ranges alleviating the need to use a solvent carrier which is the normal method of applying pentachlorophenol.

During the initial preliminary assessment soil samples from three areas were analyzed for both the phenol and phenate forms because of uncertainties in which forms might be present. This required two different extraction methods on each soil sample.

Extraction methods for the groundwater samples converted the sodium salts, if present, to the phenol forms. Thus, analysis for sodium salts on groundwater samples was not necessary.

Biodegradation of PCP normally proceeds with the removal of chlorine atom from the phenol ring. It is not uncommon to find tetra-, di-, and chlorophenol in decreasing concentrations at sites with historic PCP releases. Chromatograms from the mobile laboratory used during the focused investigation gave indications that these biodegradation products may be present in low concentrations in soils analyzed near the old planer building. However, this was not verified due to time constraints.

In general, the more chlorine atoms attached to the phenol ring the more toxic the compound. Highly chlorinated compounds are normally more persistent in the environment than compounds with fewer chlorine atoms. The marine chronic criteria for PCP is more restrictive than published marine criteria for the other chlorophenols. Thus, PCP was selected as a relative datum for the purposes of this investigation.

2.5.2 Preliminary PCP Reconnaissance and Sample Data Evaluation

Locations where pesticides have been used on-site are as follow:

- The green chain area was an open-sided building located on the east end of the sawmill and was surrounded by asphalt and pallets of lumber. Jim Hendrickson informed us that the green chain was the former location of a PCP treatment operation for rough cut lumber. PCP treatment at the green chain ceased in 1974 according to Dick Stroble. The operation consisted of a spray booth and, for a short period of time, a dip tank PCP treatment operation. A metal storage tank used during the former PCP operation appeared to be empty and was observed sitting in a wooden cradle on the asphalt at the west end of the green chain line. No visible signs of leakage or damage to the PCP storage tank was observed. The former treatment line had been removed from the green chain area, with the exception of the storage tank.

- The old planer area is presently used as a log sort yard. Current M&R employees were not aware of any wood treatment operations at the old planer mill.

- The new planer building is located east of the boiler/dry kiln. M&R employees stated that the kiln-dried lumber used to be treated with PCP (i.e., Permatox 180). Approximately three years ago they stopped using PCP. According to the employees, NP-1, a carbamate based, sapstain control chemical is presently used. A product called Millbrite 50 is often added to the NP-1 as a wood toner. The employees explained that all planed lumber is normally treated with NP-1 and/or Millbrite.

During the preliminary investigation surface samples were taken and three borings/wells (i.e., B-3/MW-3A, B-8/MW-8, and B-6A/MW-6A) were placed in the vicinity of three areas of suspected or known PCP use (Figure 4). PCP-related contamination was detected in surface soil samples west of the new planer building (discussed in subsection 2.2) and in soil and groundwater samples obtained from boring B-6A and well MW-6A, respectively (see Table 2). A composite soil sample from B-6A showed levels of PCP and TCP of 11,000 ug/kg and 3,600 ug/kg, respectively. PCP and TCP concentrations in groundwater were 5,700 ug/L and 7,400 ug/L, respectively. This turn of events initiated a focused investigation at both planer mill locations (old and new) to establish a rough outline of the contaminant plumes, both horizontally and vertically.

Field methods, boring logs, procedures, and rationale for the preliminary and focused investigations are provided in Appendices C and I.

2.5.3 Focused PCP Exploration

2.5.3.1 Sample Data Evaluation

Field work during the third phase provided a focused exploration of apparent PCP-related contamination at two locations. An on-site mobile laboratory operated by Farr Friedman & Bruya, Inc. (FFB), of Seattle, Washington was utilized to analyze for PCP and TCP. Discrete soil samples from 11 surface soil locations (SS-1 through SS-11) and at 1.5 foot intervals from 7 borings located near the site of the old planer mill (B-15 through B-19, B-21 and B-22) were collected and analyzed for PCP and TCP (Figure 10). Water from monitoring wells associated with these borings was also analyzed for these compounds. Marine water and sediment samples were obtained at four locations just offshore from the site, and one background location, and analyzed for PCP and TCP as well. Figure 4 presents these sampling locations.

Table 4 presents a summary of the data from the focused investigation.

The highest concentration of PCP (34 mg/kg) was found in soil from MW-16 at a depth of 10 to 11.5 feet. Concentrations in the upper 10 feet at this location ranged from 0.48 mg/kg to 3.0 mg/kg. Below 12 feet concentrations ranged from 6.3 mg/kg to 1.6 mg/kg at a depth of 20 feet. Duplicate samples run a few days later confirmed these findings. The only other significant PCP findings with depth were found at 12 to 14.5 feet in soil from a boring at MW-17 (6.8 mg/kg). PCP concentrations at all other depths in soil from this boring ranged from 0.33 mg/kg to < 0.05 mg/kg. Lower PCP concentrations (0.05 to 0.62 mg/kg) were detected in soil at all depths at MW-18 with the highest concentration once again observed at the 12.5 to 14 foot interval. PCP was also detected in soil at low concentrations (0.18 to 0.25 mg/kg) at all depths at MW-15. Little or no PCP was found in soil from MW-21 or MW-22. PCP may be found with depth at MW-6A. A composited soil sample analyzed from the preliminary investigation work resulted in a PCP concentration of 11 mg/kg but lack of depth-specific results make it difficult to define concentrations with depth at this location. TCP concentrations generally followed the same trends as PCP but was detected at lower concentrations, ranging from < 0.05mg/kg to 4.5 mg/kg.

PCP concentrations in surface soil samples collected in this same general area ranged from < 0.05 mg/kg to 0.67 mg/kg. The highest concentrations occured at locations SS-1 and SS-4. TCP was detected in only four locations at concentrations ranging from a .09 mg/kg to 0.62 mg/kg.

The highest concentration of PCP in groundwater, 5.7 mg/L, was obtained from MW-6A during the initial sampling (Table 2). This sample was analyzed at Laucks Testing Laboratories. Somewhat lower concentrations of 0.1 mg/L (sampled 6/8/88) and 0.09 mg/L (sampled 6/12/88) were obtained by from MW-6A by FFB, Inc., during focused investigation work. PCP was detected in groundwater from two other wells, MW-16A (0.59 mg/L) and MW-22 (0.01 mg/L). No PCP was found in groundwater samples from any other monitoring wells in this area. TCP was detected at detection limits (0.01 mg/L) at MW-6A only.

A possible explanation for the variability noted in PCP concentration at well MW-6A is that the PCP detected may be associated with suspended solids in the sample. We know that PCP is more likely to be associated with soil and organic particles than to remain soluble in water.

The wells were installed, developed to the extent possible to remove the majority of the fine-grained material in the sand pack, and then purged and sampled. Normally we would attempt to develop the wells to a point where little or no suspended solid remained in the sand pack. However, in fine-grained materials and under time constrains this is not always possible. The field sampling team noted that the groundwater samples contained a significant amount of suspended sediment during the focused phase of the investigation at M&R.

In reviewing the groundwater data from well MW-6A we noted that the PCP concentration decreased by about one order of magnitude each time the well was purged and sampled. Purging of the wells prior to each sample would provide further development of the wells and would reduce the amount of solids in each subsequent sample. If the PCP detected in the groundwater samples were associated with suspended solid, and if the solid fraction was being reduced with each subsequent sample, one would expect to see a decrease in the PCP concentration with each successive sample.

Current information does not allow us to substantiate this theory. In order to obtain the information needed to do this, split samples would need to be obtained for analysis and one of the splits would need to be centrifuged to remove suspended solids before extraction.

Marine sediment samples taken at location OSS-1 and OSS-2 (Figure 4) were found to contain PCP at concentrations of 0.3 mg/kg and 0.08 mg/kg respectively. TCP was detected in only one sediment sample, OSS-1, at a concentration of 0.09 mg/kg. Neither PCP nor TCP were detected in any marine water samples.

Both marine sediment samples were subjected to duplicate analysis on the day after they were collected. Duplicate results were less than 0.05 mg/kg for both PCP and TCP in OSS-1 with 0.08 mg/kg PCP and less than 0.05 mg/kg TCP in OSS-2. Data from marine sediment sample OSS-1 are questionable based on the inconsistant duplicate results.

Marine sediment station OSS-1 and OSS-2 were resampled due to the apparent detection of PCP-related contamination. OSS-5, collected at the approximate location of OSS-1, and OSS-6, collected at the approximate location of OSS-2, did not contain detectable levels of PCP or TCP.

The presence of PCP-related contamination in marine sediments adjacent to the old planer mill is questionable based on inconsistent data. In addition, these two marine stations are not in the vicinity of where one would expect to find contamination based on the plume location.

A second potentially contaminated PCP site, located near the new planer mill was also investigated. Previous testing indicated a high concentration of PCP and TCP in surface soils at this location (SS-2; 270 mg/kg PCP and 40 mg/kg TCP (Table 1)). Sodium salts of PCP and TCP were also identified at 17 mg/kg and 4 mg/kg, respectively. One additional soil boring (MW-20) was installed at this location and discrete soil samples from this boring were analyzed on-site for PCP and TCP, as was water from the corresponding monitoring well. Surface soil samples from 6 locations at this site were obtained by hand auger to a depth of approximately 2 to 3 feet and also analyzed for PCP and TCP.

No PCP or TCP was detected in soil or groundwater obtained from MW-20. PCP was found in soils at only one location, HA-1, which was the location nearest to prior site SS-2. The concentration decreased from 0.25 mg/kg at the surface to 0.06 mg/kg at a depth of 2.5 feet. TCP was detected in the surface interval only, at 0.6 mg/kg. See Table 4 for analytical results.

Based on these data significant amounts of PCP and TCP appear to be isolated to a small soil area that is located between the new planer building and the adjacent asphalt road. Based on the available information the contamination appears to be surficial and does not appear to be migrating in the groundwater.

2.5.3.2 Focused PCP Exploration - Hydrogeologic Evaluation

Soil Stratigraphy

There are a variety of soil materials underlying the surface between the old planer mill and the harbor. Soils disclosed in auger borings advanced for this investigation are shown on the generalized subsurface cross sections C, D, and E, on Figures 11, 12, and 13, respectively. These cross sections represent our interpretation of subsurface conditions in the area based on limited site-specific and regional information. Actual soil conditions may vary from those depicted.

The area around the old planer building site has been used in the past for log storage. Significant amounts of wood, bark, and log yard debris are present in the near-surface soils. Borings disclosed 0 to 5 feet of fill material composed of damp to wet, black to gray-brown trace to very silty, slightly gravelly to gravelly, fine sand. Explorations conducted with M&R's loader, disclosed areas adjacent to MW-6A containing brick asphalt, and concrete rubble, miscellaneous scrap metal, and charcoal fragments (burned timbers?).

This fill is generally underlain by a gray fine sand containing occasional silt and gravel zones to a depth of approximately 15 feet below ground surface and interpreted to be fill materials.

Underlying the fine sand is an approximately 2- to 5-foot-thick zone of gray, slight silty to silty, fine sand with shell fragments encountered in borings B-16, B-21, and B-22, also interpreted to be fill materials. Below the silty, fine sand unit is a gray, fine sand with shell fragments, interpreted to be natural soils. There appears to be some lateral variability in the described units, which locally may grade silty or gravelly and contain wood debris.

Section C shows that significant amounts of wood were encountered in borings placed near the shoreline, along with varying amounts of angular riprap probably placed as roadway ballast or behind the timber seawall. The shoreline in this area may have undergone several "build-out" phases with successive seawalls placed and backfilled with rocks and wood. Borings B-17 and B-18 disclosed an approximate 25-foot-thick sequence of wood, back, timber, sawdust, and varying amounts of sand.

In summary, there is 5 to 15 feet of miscellaneous fill material immediately below the site surface. Fine sands with interbeds of other materials underlie the fill material. The upper 20 feet of these fine sands grade laterally to riprap and wood toward the harbor. MW-21 intersected a significant pocket of gravelly sand to sandy gravel below the fill.

The hydraulic conductivity of the soils underlying the PCP site is heterogeneous and anisotrophic. Zones of coarser sediments with high permeability will behave as aquifers and zones of finer sediments with relatively low permeability will behave as aquitards. However, without additional groundwater and hydraulic conductivity data, it is not possible to define the configuration of aquifers and aquitards in this hydraulic system. In particular, without further testing, it is not possible to determine if the fine-grained material which occurs approximately 25 feet below surface is an effective impermeable flow boundary.

Groundwater Flow

The overall geomorphology of the site and surrounding area indicates that fresh groundwater will flow generally north toward the harbor under the PCP site. Deviation from the general flow direction will occur when groundwater intersects and travels along high permeability zones. We would need at least three deep groundwater monitoring wells to determine if a vertical gradient exists at the site.

As is common at marine-freshwater interfaces, marine water invades and mixes with the fresh groundwater beneath the site. Saline water was found approximately 15 feet below surface in monitoring wells MW-18 and MW-19.

Estimated Contamination Boundary at Old Planer Mill

Pentachlorophenol is the primary contaminant of concern and other associated contaminants generally follow the same pattern; therefore, for the soils and groundwater discussion, we will refer only to pentachlorophenol.

Soil with pentachlorophenol concentrations above .79 mg/kg occurs at SS-1 and SS-3 in the vicinity of the old planer mill. This is most likely the area where pentachlorophenol and associated chemicals crossed the surface and entered the subsurface soil environment. Pentachlorophenol then migrated as an aqueous phase with the groundwater through the soil matrix. Some pentachlorophenol left the aqueous phase and remained in the soil. Pentachlorophenol and associated chemicals are easily adsorbed by wood, which occurs as disseminated material in soils and in large pockets throughout the site.

The estimated areal extent of soils with pentachlorophenol occurring above .79 mg/kg is outlined on Figure 10. Note that this is a conservative estimate; the true areal extent of soil with pentachlorophenol greater than .79 mg/kg may be smaller.

Vertical extent of the soil contamination is at least to 25 feet as shown on Figures 11, 12, and 13. Note that soil in B-16 contained 1.6 mg/kg at its base. We therefore do not know the maximum vertical extent of soil contamination.

The highest values of pentachlorophenol were found in B-6 and B-16. These locations are directly downgradient of the suspected surface source. The maximum value of pentachlorophenol was found in a wood zone in B-16 between 10 and 15 feet below surface. Excess PCP is probably adsorbed to the wood in this zone.

Soils containing less pentachlorophenol were sampled in B-15, B-18, and MW-21. These probably represent the lateral boundaries of the contaminated zone.

Soils sampled in B-17 contained lower levels of pentachlorophenol than upgradient borings. Possibly the marine waters flushing the soil near the harbor reduce the concentration of pentachlorophenol in B-17 and even in B-18 and B-15. High wood content at these locations may be acting as a sponge to bind PCP and slow its migration.

2.5.3.3 Dioxin Evaluation

Dioxin analyses were performed on 4 soil samples and one water sample by Triangle Labs, North Carolina. Results were reported for total dioxin and total furan for the tetra through octa-homologues. Sampling locations are shown on Figures 14 and 15. Sampling procedures are outlined in Appendix C. Laboratory certificates containing raw data sheets and laboratory QA/QC results are presented in Appendix D. Results were also presented for 6 dioxin isomers with 2,3,7,8 chlorine substitutions and 10 furan isomers with 2,3,7,8 chlorine substitutions. Detection limits in soils ranged from .003 to .07 ug/kg and from .022 to 0.9 ng/L in water.

Low concentrations of the 2,3,7,8 isomer of dioxin were detected in soil from the upper foot of MW-16 (.03 ug/kg) and from the 10 to 11.5 foot interval at the same location (.273 ug/kg). Only low concentrations of hepta and octa isomers were detected at this location. Soil from the upper 1.5-foot interval from MW-15 contained no 2,3,7,8 TCDD, but higher concentrations of the hepta- and hexa- chlorinated isomers of both dioxin and furan were detected. The concentrations measured for the homologues ranged from 0.018 ug/kg for the hexa-chlorinated furans (HxCDF) to 63.5 ug/kg for the octa-chlorinated dioxins (OCDD) (63.5 ug/kg). No dioxin was detected in the water sample which was taken from MW-16A.

One soil sample was taken to analyze background levels of dioxin in the vicinity of the property. The sample was collected at a site east of the property within the Port Angeles Yacht Harbor (BG-1). Though no 2378-TCDD was detected 2378-TCDF was measured at .013 ug/kg. A number of other TCDD and TCDF isomers containing chlorines at the 2,3,7,8 positions were measured in concentrations ranging from .019 ug/kg to 12.265 ug/kg. The highest concentration was measured for OCDD at 81.462 ug/kg. In general, concentrations of the higher chlorinated isomers, both the individual congeners and the homologue groups, were found at higher levels in the background sample as compared to any of the soil samples obtained on the site.

To better assess the potential risk involved with the presence of dioxin the Environmental Protection Agency (EPA) has published an "Interim Procedure for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzodioxins and Dibenzofurans (CDDs and CDFs)" (EPA, 1986). This procedure involves assigning the various dioxin and furan congeners unique "toxicity equivalence factors (TEFs)" which express the significance of the exposure to each congener as an "equivalent amount of 2,3,7,8-TCDD. These TEFs have been estimated by the EPA using available toxicity data and are presented in the previously referenced document along with toxicity information which can be used to estimate risks associated with the mixture in question. These TEFs and the calculated TCDD equivalents for the three soil samples and the one background soil sample collected are presented in Table 5. Total TCDD equivalents were calculated from the dioxin/furan data obtained by Triangle Labs and found to be less than one for all samples, including the background sample. The highest value was .273, for the sample at 10 feet in MW-16. The eqiuvalent toxicity of the background sample (.038) was higher than either of the surface soil samples obtained on the site. Overall, these values indicate that the mixtures found on the site are one half to one order of magnitude less toxic than pure 2378-TCDD. These values indicate that a significant dioxin contamination problem is unlikely at the M&R site.

2.5.4 Discussion of Action Options

Based on the information presented in the previous subsections on the PCP contaminant plume, we were asked to develop mitigation options that could be used to address this type of problem. Our review and presentation was not supposed to be exhaustive, and therefore only represents typical options. The options we reviewed did represent what we consider appropriate in this case.

- No action - "do nothing"

  In this option, M&R takes no further action. No monitoring or further characterization would be done.

- Continue monitoring, but perform no mitigation

  Continue to monitor in the existing wells, but take no further actions. This option assumes that PCP concentrations in monitoring wells and in offshore stations do not increase over time. Monitoring would continue indefinitely.

- Refine hydrogeologic and chemical information, monitor, but perform no mitigation

  This option assumes that our investigation is not complete enough to describe the plume. A hydrogeologic investigation could be performed to address the rate and direction of flow. A tidal study would be included to define the tide's effects on the plume. New monitoring locations might be suggested, based on this new information. More chemical information would increase our confidence level in current data. Without health and environmental effects being noted, no mitigation activities would be planned.

- Perform risk assessment - monitoring identifies significant PCP in marine water

  Should repeat monitoring identify significant levels of PCP (approaching 79 ug/kg), a full risk assessment could be warranted. This risk assessment would be used to develop an appropriate risk level for PCP in the environment. This assessment would be based on a comprehensive geohydrologic study and sampling of potentially affected receptors. This option assumes that there are not available standards or that the standards are not feasible.

- Risk levels exceeded - mitigation required

  Should risk levels be exceeded, mitigation of the health or environmental risk would begin. There are unlimited variations on standard remedial options. Possibilities include removal, stabilization, isolation, treatment, interception, and solidification. Based on the levels of contamination found at this site, we looked at two in-situ options: isolation and interception/treatment.

  Isolation is a method in which the contaminant is immobilized by encapsulation. An example of this type of option is a slurry wall and cap. A clay slurry wall could be installed around the plume to prevent horizontal movement caused by groundwater gradients. A cap over the plume would prevent rain and recharge water from mobilizing the contaminant. This is a passive option, and requires little maintenance.

  Treatment is an option used in combination with interception wells. Interception wells would be placed just downgradient and in the path of the plume. Wells would be pumped at a rate that would match the plume's rate of movement. Pumped water would be treated using a carbon filter or equivalent device. Treated water would need to be discharged through a permitted facility. This option would have a continual operation and maintenance cost.

2.5.5 Conclusions

Based on information available at this time, it appears that cleanup levels for soil and groundwater at the M&R site should be set to achieve water quality criteria standards for protection against marine waters impacts. Penta- and tetrachlorophenols should be based on chronic criteria, and phenol on acute criteria. These levels are as follows:

Substance	Target Standard
Pentachlorophenol	7.9 ug/L[1]
Tetrachlorophenol	440 ug/L
Phenol	5,800 ug/L

[1] Value is a 4-day average concentration, not to be exceeded more than once every three years.

Soil and groundwater cleanup levels (or alternative remedial actions) should be designed to achieve these target levels. Risk assessment to identify alternate remedial action is probably desirable, as long as the assessment is oriented to meeting the water quality target levels.

2.5.6 Summary

In general, the M&R site appears to be a relatively clean piece of industrial property, excepting the PCP-related contamination at the old planer mill location. Low levels of contamination identified at other locations on the site have either been mitigated by M&R or they are insignificant enough that additional investigation or mitigation does not appear warranted.

Through our investigation, as indicated in more detail above, we discovered a plume of PCP contamination in soil and groundwater. The PCP used on-site was a water soluble PCP salt, which has not been used for some years.

Based on available environmental information, construction activities in the vicinity of the PCP-related contamination near the old planer mill should not be adversely effected except for the following possibilities:

- Worker health and safety concerns should be addressed if workers are in contact with contaminated soils;
- If soils are excavated in the area where the highest contamination was detected (i.e., > 10 feet) the contaminated soils may require special handling and disposal in accordance with county, state, and federal solid waste regulations.
- If dewatering is planned near the contaminated plume, precaution should be made to either prevent pulling the plume toward the dewatering activities or monitoring and treating contaminated dewatering flows.

Based on the information gathered, the PCP contamination does not appear to require that M&R or its purchaser report to EPA or Ecology. This conclusion was arrived at because the contamination likely occurred prior to 1972 and our preliminary information indicates a low level of contamination and no imminent threat to health or the environment has been established.

Were Ecology to be notified of the existence of the plume, action might be required by Ecology under RCW 90.48 and RCW 70.105B in an effort to protect health or the environment. The level of action would be dependent on the establishment of a level of protection. Ecology may set protection levels that trigger some type of remediation, based on references or risk assessments.

Protection levels for PCP can be set using appropriate references, such as EPA's "Quality Criteria for Water" (1987) that lists the marine water fish chronic level at 7.9 ug/kg. Records of other EPA decisions can also be used. For example, a Florida case that used a 10 mg/kg PCP level in soil and 1 mg/kg in drinking water. If the above levels are not feasible, risk assessments can be used to develop more site-specific protection levels.

We have experience with a number of other PCP contamination sites. Of the sites we have investigated, this site is the least contaminated by at least one to two orders of magnitude. Further, we are aware of at least one site with substantially higher PCP concentrations (including a short-term release and fish kill) where Ecology has required no soil cleanup at the source of contamination.

We have been asked to suggest what level of action can be expected from Ecology. At this site, the relatively low levels of PCP contamination would likely trigger a proportionately low level of action by the agency. Our data indicate that the highest value of PCP found in soil was 34 mg/kg, and in groundwater was 5 mg/kg. The presence of PCP contamination in marine sediments is questionable. Based on industrialized bays in the Puget Sound, the native marine life is likely to already be somewhat depressed and therefore we expect the marine population near this contamination to be smaller than normal.

Based on our past experience with Ecology, they will probably go through the following action steps upon discovery of this contamination:

- Ecology would probably require more information on the hydrogeology of the area. They would probably want verification of contaminant concentrations, rate of movement, direction, and likely points of entry (if any) to marine water;

- Ecology may next establish protection levels, require a risk assessment to establish protection levels, or the owner may suggest a risk assessment should Ecology establish levels that are not feasible or realistic;

- Based on either of the above steps, Ecology may required remedial action or no action. Continued monitoring is probably the minimum effort that could be expected.

Based on our experience, we would expect that Ecology would likely require a hydrogeologic study and possibly a risk assessment. But with no data indicating toxic PCP concentrations in marine water, further remediation is not expected. Some remediation, however, would likely reduce monitoring requirements.

HART CROWSER, INC.

William B. Abercrombie

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R215903/JOBS

Table 1 - Phase I - Transformer and Surface Soil Analytical Data

ALL CONSTITUENTS REPORTED
IN UG/KG UNLESS NOTED

PARAMETER	SAMPLE:	TR-1	TR-2	TR-3	TR-4	TR-5	SS-2	SS-3
	TIME:	8:30	9:25	9:50	10:10	11:40	8:45	10:20
	DATE:	MAY 10 1988	MAY 10 1988	MAY 10 1988	MAY 10 1988	MAY 10 1988	MAY 10 1988	MAY 10 1988
SIEVE ANALYSIS NO. 10 % RETAINED		<2	<2	<2	<2	<2	45	55
TOTAL SOLIDS (METHOD 209F) % TOTAL SOLIDS		41.4	68.5	74.1	47.1	90.2	50.6	66.0
PCB AROCLOR *		**	<2,400	<2,400	<2,400	4,800 C		
PHENOLS (METHOD 8150)								
TETRACHLOROPHENOL							40,000	
PENTACHLOROPHENOL							270,000	
SODIUM TETRACHLOROPHENATE							4,000	
SODIUM PENTACHLOROPHENATE							17,000	
GC/FID BAN SCREEN								
CALCULATED ON THE RESPONSE OF PHENANTHRENE								2,400,000

NOTES:

*	AROCLOR QUANTITATED
C	AROCLOR 1260
**	SAMPLE EXHAUSTED IN INITIAL LOW LEVEL EXTRACTION. NO DATA AVAILABLE FROM THAT ANALYSIS. NO SAMPLE REMAINING FOR MEDIUM LEVEL EXTRACTION.

Table 2 - Phase I - Soil and Groundwater Analytical Data

ALL CONSTITUENTS REPORTED
IN UG/KG UNLESS NOTED

SOIL

SAMPLE:	1000*	S-6**	1001*	1002*	1003*	1004*	1005*
BORING:	B-3	B-3	B-4A	B-5	B-6A	B-7	B-8
DATE:	MAY 9 1988	MAY 9 1988	MAY 11 1988	MAY 12 1988	MAY 13 1988	MAY 16 1988	MAY 16 1988
PARAMETER							
SIEVE ANALYSIS NO. 10							
% RETAINED	34	64	43	42	39	<2	40
TOTAL SOLIDS (METHOD 209F)							
% TOTAL SOLIDS	84.2	83.0	84.1	85.1	83.7	86.0	82.4
BETX (METHOD 8020)							
BENZENE			<12	<12		<12	
ETHYLBENZENE			<12	<12		<12	
TOLUENE			<12	<12		<12	
XYLENES			24	34		<12	
PHENOLS (METHOD 8150)							
TETRACHLOROPHENOL	<25	<25			3,600		<25
PENTACHLOROPHENOL	<25	<25			11,000		<25
SODIUM TETRACHLOROPHENATE	<25	<25			25		<25
SODIUM PENTACHLOROPHENATE	<25	<25			47		<25
GC/FID BAN SCREEN							
CALCULATED ON THE RESPONSE OF PHENANTHRENE			9,700	4,700			

NOTES:

* COMPOSITE SAMPLE 1000 = SAMPLES S-1 THROUGH S-5, BORING B-3, 2.5'-13.5'
COMPOSITE SAMPLE 1001 = SAMPLES S-4 THROUGH S-6, BORING B-4A
COMPOSITE SAMPLE 1002 = SAMPLES S-3 THROUGH S-4, BORING B-5
COMPOSITE SAMPLE 1003 = SAMPLES S-1 THROUGH S-5, BORING B-6A
COMPOSITE SAMPLE 1004 = SAMPLES S-1 THROUGH S-5, BORING B-7
COMPOSITE SAMPLE 1005 = SAMPLES S-1 THROUGH S-5, BORING B-8

** SAMPLE S-6, BORING B-3, 15.0'-16.5'

Table 2 - Phase I - Soil and Groundwater Analytical Data

ALL CONSTITUENTS REPORTED
IN UG/L UNLESS NOTED

GROUNDWATER

SAMPLE:	MW-3A	MW-4A	MW-5A	MW-6A	MW-7	MW-8
TIME:	13:10	13:40	10:56	9:50	12:35	10:45
DATE:	MAY 17 1988	MAY 17 1988	MAY 17 1989	MAY 17 1988	MAY 17 1988	MAY 17 1988
PARAMETER						
WELL CASING LENGTH (FEET)	15.50	14.00	14.00	14.00	14.00	14.00
DEPTH TO WATER IN CASING (FEET)	5.59	8.24	6.38	6.55	3.83	7.58
DATE:	JUN 9 1988	JUN 9 1988	JUN 8 1988	JUN 8 1988	JUN 9 1988	JUN 8 1988
pH (-LOG[H+])	6.91	6.97	6.37	6.79	6.62	6.90
CONDUCTIVITY (UMHOS/CM)	320	910	710	1740	770	1092
TEMPERATURE (C)	11	13	13	14	18	15
BETX (METHOD 8020)						
BENZENE		<1	<1		<1	
ETHYLBENZENE		<1	<1		<1	
TOLUENE		<1	<1		<1	
XYLENES		5	2		2	
PHENOLS (METHOD 8150)						
TETRACHLOROPHENOL	<1			7,400		<1
PENTACHLOROPHENOL	<1			5,700		<1
GC/FID BAN SCREEN						
CALCULATED ON THE RESPONSE OF PHENANTHRENE		280	<200			

Table 3 - Phase II - Soil and Groundwater Analytical Data

ALL CONSTITUENTS REPORTED
IN UG/KG UNLESS NOTED

SOIL

SAMPLE:	1000*	1001*	1002*	1003*
BORING:	B-11	B-12	B-13	B-14
DATE:	JUN 2 1988	JUN 2 1988	JUN 2 1988	JUN 3 1988
PARAMETER				
SIEVE ANALYSIS NO. 10 % RETAINED	57	33	39	<2
WATER SOLUBLE SULFITE (MG/KG)				30
BETX (METHOD 8020)				
BENZENE	<1	<1	<1	
ETHYLBENZENE	<1	<1	<1	
TOLUENE	<1	<1	<1	
XYLENE	<1	<1	<1	
HALOGENATED VOLATILE ORGANICS (METHOD 8010)				**
VINYL CHLORIDE		<120	<120	<3
CHLOROMETHANE		<120	<120	<3
BROMOMETHANE		<120	<120	<3
CHLOROETHANE		<120	<120	<9
TRICHLOROFLUOROMETHANE		< 58	< 58	<3
2-CHLOROETHYL VINYL ETHER		<1200	<1200	<3
DICHLORODIFLUOROMETHANE		<1200	<1200	<30
1,1-DICHLOROETHENE		< 12	< 12	<3
METHYLENE CHLORIDE		140	170	5
TRANS-1,2-DICHLOROETHENE		< 12	< 12	<3
1,1-DICHLOROETHANE		< 12	< 12	<3
CHLOROFORM		< 12	< 12	<3
1,1,1-TRICHLOROETHANE		< 12	< 12	<3
CARBON TETRACHLORIDE		< 12	< 12	<3
1,2-DICHLOROETHANE		< 12	< 12	<3
TRICHLOROETHENE		< 12	< 12	<3
1,2-DICHLOROPROPANE		< 12	< 12	<3
BROMODICHLOROMETHANE		< 12	< 12	<3
TRANS-1,3-DICHLOROPROPENE		< 12	< 12	<9
CIS-1,3-DICHLOROPROPENE		< 12	< 12	<9
1,1,2-TRICHLOROETHANE		< 12	< 12	<3
1,1,2,2-TETRACHLOROETHENE		< 12	< 12	<3

Table 3 - Phase II - Soil and Groundwater Analytical Data

ALL CONSTITUENTS REPORTED
IN UG/KG UNLESS NOTED

SOIL

SAMPLE:	1000*	1001*	1002*	1003*
BORING:	B-11	B-12	B-13	B-14
DATE:	JUN 2 1988	JUN 2 1988	JUN 2 1988	JUN 3 1988
PARAMETER				
METHOD 8010 (CONT'D)				
DIBROMOCHLOROMETHANE		< 12	< 12	<9
CHLOROBENZENE		< 12	< 12	<9
BROMOFORM		< 58	< 58	<3
1,1,2,2-TETRACHLOROETHANE		< 12	< 12	<9
1,3-DICHLOROBENZENE		< 12	< 12	<3
1,4-DICHLOROBENZENE		< 12	< 12	<3
1,2-DICHLOROBENZENE		< 12	< 12	<3
GC/FID BAN SCREEN				
CALCULATED ON THE RESPONSE OF PHENANTHRENE	16,000	<3,000	4,500	46,000

NOTES:

* COMPOSITE SAMPLE 1000 = SAMPLES S-1 THROUGH S-3, BORING B-11, 2.5'- 9.0'
COMPOSITE SAMPLE 1001 = SAMPLES S-1 THROUGH S-5, BORING B-12, 2.5'- 14.0'
COMPOSITE SAMPLE 1002 = SAMPLES S-1 THROUGH S-5, BORING B-13, 2.5' - 14.0'
COMPOSITE SAMPLE 1003 = SAMPLES S-1 THROUGH S-5, BORING B-14, 2.5' - 14.0'

** COMPOSITE SAMPLE 1003 WAS ANALYZED BY ALTERNATE METHOD 8240;
INSTRUMENT FAILURE PREVENTED COMPLETION OF METHOD 8010 ANALYSIS

Table 3 - Phase II - Soil and Groundwater Analytical Data

ALL CONSTITUENTS REPORTED
IN MG/L UNLESS NOTED

GROUNDWATER

SAMPLE:	MW-11	MW-12	MW-13	MW-14	FIELD
TIME:	14:00	15:30	16:00	16:30	BLANK
DATE:	JUN 3	JUN 3	JUN 3	JUN 3	JUN 3
PARAMETER	1988	1988	1988	1988	1988
TOTAL ORGANIC HALOGENS AS CL		<0.02	<0.02	0.03	
SULFITES		--	--	<0.5	
BETX (METHOD 8020)					
BENZENE	<1	<1	<1		<1
ETHYLBENZENE	<1	<1	<1		<1
TOLUENE	<1	<1	<1		<1
XYLENE	<1	<1	<1		<1
GC/FID BAN SCREEN					
CALCULATED ON THE RESPONSE OF PHENANTHRENE	<200	<200	420	240	

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

SOIL

ALL CONSTITUENTS REPORTED IN PPM UNLESS NOTED

SAMPLE NUMBER		PARAMETER DATE 1988	PENTACHLOROPHENOL	TETRACHLOROPHENOL
BORING B-15				
S-1,	0.0' - 1.5'	JUN 9	0.25	0.75
S-3,	5.0' - 6.5'	JUN 9	0.23	<0.05
S-4,	7.5' - 9.0'	JUN 9	0.18	<0.05
S-5,	10.0'- 11.5'	JUN 9	0.15	0.19
S-6,	12.5'- 14.0'	JUN 9	0.12	<0.05
S-7,	15.0'- 16.5'	JUN 9	0.20	<0.05
BORING B-16				
S-1,	0.0' - 1.5'	JUN 9	2.70	2.70
S-2,	2.5' - 4.0'	JUN 9	0.48	0.18
S-3,	5.0' - 6.5'	JUN 9	3.00	1.90
S-4,	7.5' - 9.0'	JUN 9	1.80	2.10
S-5,	10.0'- 11.5'	JUN 9	34.00	4.50
S-1,	10.0'- 11.5'	JUN 12	36.00	<0.10
S-6,	12.5'- 14.0'	JUN 9	3.10	0.41
S-6,	DUPLICATE	JUN 10	3.80	<0.10
S-7,	15.0'- 16.5'	JUN 10	6.30	<0.10
S-2,	15.0'- 16.5'	JUN 12	3.20	<0.10
S-8,	17.5'- 19.0'	JUN 10	4.80	<0.10
S-9,	20.0'- 21.5'	JUN 9	1.60	0.13
BORING B-17				
S-1,	0.0' - 1.5'	JUN 10	0.12	<0.05
S-1,	REPLICATE	JUN 10	0.13	<0.05
S-1,	DUPLICATE	JUN 10	<0.05	<0.05
S-2,	2.5' - 4.0'	JUN 10	0.28	<0.05
S-3,	5.0' - 6.5'	JUN 10	0.33	<0.05
S-4,	7.5' - 9.0'	JUN 10	0.18	0.08
S-4,	REPLICATE	JUN 10	0.16	<0.05
S-5,	10.0'- 11.5'	JUN 10	0.12	<0.05
S-6,	12.5'- 14.0'	JUN 9	6.80	0.45
S-6,	DUPLICATE	JUN 9	1.90	0.33
S-6,	DUPLICATE	JUN 12	0.62	
S-6,	DUPLICATE	JUN 12	0.85	
S-7,	15.0'- 17.5'	JUN 10	<0.05	<0.05
S-8,	17.5'- 19.0'	JUN 10	<0.05	<0.05
S-9,	20.0'- 21.5'	JUN 10	<0.05	<0.05
S-10,	22.5'- 24.0'	JUN 10	<0.05	<0.05
S-10,	DUPLICATE	JUN 10	0.09	0.09

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

ALL CONSTITUENTS REPORTED
IN PPM UNLESS NOTED

SOIL

SAMPLE NUMBER	PARAMETER DATE 1988	PENTACHLOROPHENOL	TETRACHLOROPHENOL
BORING B-17 (CONT'D)			
S-11, 25.0'- 26.5'	JUN 10	0.09	0.13
S-11, 25.0'- 26.5'	JUN 12	0.05	<0.05
S-12, 27.5'- 29.0'	JUN 10	0.08	<0.05
S-12, 27.5'- 29.0'	JUN 12	<0.05	<0.05
S-13, 30.0'- 31.5'	JUN 10	0.11	<0.05
S-13, REPLICATE	JUN 10	0.10	<0.05
S-13, 30.0'- 31.5'	JUN 12	0.05	<0.05
BORING B-18			
S-1, 0.0' - 1.5'	JUN 10	0.23	<0.05
S-1, REPLICATE	JUN 10	0.17	<0.05
S-2, 2.5' - 4.0'	JUN 10	0.18	<0.05
S-3, 5.0' - 6.5'	JUN 10	0.09	<0.05
S-4, 7.5' - 9.0'	JUN 10	0.11	<0.05
S-5, 10.0'- 11.5'	JUN 10	0.07	<0.05
S-6, 12.5'- 14.0'	JUN 10	0.62	0.06
S-7, 17.5'- 19.0'	JUN 10	0.27	<0.05
S-8, 20.0'- 21.5'	JUN 10	0.10	<0.05
S-9, 22.5'- 24.0'	JUN 10	0.12	<0.05
S-10, 25.0'- 26.5'	JUN 10	0.05	<0.05
S-11, 27.5'- 29.0'	JUN 10	0.05	<0.05
BORING B-19			
S-1, 0.0' - 1.5'	JUN 11	<0.05	<0.05
S-2, 2.5' - 4.0'	JUN 11	<0.05	<0.05
S-3, 5.0' - 6.5'	JUN 11	0.06	<0.05
S-4, 7.5' - 9.0'	JUN 11	<0.05	<0.05
S-5, 10.0'- 11.5'	JUN 11	0.09	<0.05
S-6, 12.5'- 14.0'	JUN 11	0.06	<0.05
S-7, 15.0'- 16.5'	JUN 11	<0.05	<0.05
S-7, DUPLICATE	JUN 11	<0.05	<0.05
S-8, 17.5'- 19.0'	JUN 11	0.11	<0.05
S-8, DUPLICATE	JUN 11	<0.05	<0.05
S-9, 20.0'- 21.5'	JUN 11	<0.05	<0.05
S-10, 22.5'- 24.0'	JUN 11	<0.05	<0.05

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

ALL CONSTITUENTS REPORTED
IN PPM UNLESS NOTED

SOIL

SAMPLE NUMBER	DATE 1988	PENTACHLOROPHENOL	TETRACHLOROPHENOL
BORING B-20			
S-1, 1.0' - 2.5'	JUN 16	<0.05	<0.05
S-2, 2.5' - 4.0'	JUN 16	<0.05	<0.05
S-3, 5.0' - 6.5'	JUN 16	<0.05	<0.05
S-4, 7.5' - 9.0'	JUN 16	<0.05	<0.05
S-5, 10.0'- 11.5'	JUN 16	<0.05	<0.05
S-6, 12.5'- 14.0'	JUN 16	<0.05	<0.05
S-6, DUPLICATE	JUN 16	<0.05	<0.05
BORING B-21			
S-1, 0.0' - 1.5'	JUN 12	<0.05	<0.05
S-2, 2.5' - 4.0'	JUN 12	<0.05	<0.05
S-3, 5.0' - 6.5'	JUN 12	<0.20 A	
S-4, 7.5' - 9.0'	JUN 12	0.10	<0.05
S-5, 10.0'- 11.5'	JUN 12	0.20	<0.05
S-6, 12.5'- 14.0'	JUN 12	0.10	<0.05
S-7, 15.0'- 16.5'	JUN 12	<0.05	<0.05
BORING B-22			
S-1, 0.0' - 1.5'	JUN 12	<0.05	<0.05
S-2, 2.5' - 4.0'	JUN 12	<0.05	<0.05
S-3, 5.0' - 6.5'	JUN 12	<0.05	<0.05
S-4, 7.5' - 9.0'	JUN 12	<0.05	<0.05
S-5, 10.0'- 11.5'	JUN 12	<0.05	<0.05
S-6, 12.5'- 14.0'	JUN 12	<0.05	<0.05
S-6, DUPLICATE	JUN 12	<0.05	<0.05
S-7, 15.0'- 16.5'	JUN 12	<0.05	<0.05
SURFACE SAMPLES			
SS-1	JUN 10	0.64	0.44
SS-2	JUN 10	0.35	0.62
SS-3	JUN 10	0.09	0.10
SS-3 REPLICATE	JUN 10	0.88	0.62
SS-4	JUN 10	0.67	0.09
SS-5	JUN 10	0.13 B	<0.05
SS-5 REPLICATE	JUN 10	0.06	<0.05
SS-6	JUN 10	<0.05	<0.05
SS-7	JUN 10	<0.05	<0.05

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

ALL CONSTITUENTS REPORTED
IN PPM UNLESS NOTED

SOIL

SAMPLE NUMBER	PARAMETER DATE 1988	PENTACHLOROPHENOL	TETRACHLOROPHENOL
SURFACE SAMPLES (CONT'D)			
SS-8	JUN 10	0.06	<0.05
SS-9	JUN 10	<0.05	<0.05
SS-10	JUN 10	<0.05	<0.05
SS-10 DUPLICATE	JUN 10	<0.05	<0.05
SS-11	JUN 10	<0.05	<0.05
HAND AUGER			
HA-1			
S-1, 0.5' - 1.0'	JUN 11	0.25	0.60
S-2, 1.0' - 2.0'	JUN 11	0.10	<0.05
S-3, 2.0' - 2.5'	JUN 11	0.06	<0.05
HA-2			
S-1, 0.5' - 1.0'	JUN 11	<0.05	<0.05
S-2, 1.0' - 2.0'	JUN 11	<0.05	<0.05
HA-3			
S-1, 0.4" - 1.0'	JUN 12	<0.05	<0.05
S-2, 1.0' - 2.0'	JUN 12	<0.05	<0.05
S-3, 2.0' - 2.5'	JUN 12	<0.05	<0.05
HA-4			
S-1, 0.5' - 1.0'	JUN 12	<0.05	<0.05
S-2, 1.0' - 2.0'	JUN 12	<0.05	<0.05
HA-5			
S-1	JUN 12	<0.05	<0.05
HA-6			
S-1	JUN 12	<0.05	<0.05
S-2	JUN 12	<0.05	<0.05

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

ALL CONSTITUENTS REPORTED
IN PPM UNLESS NOTED

SEDIMENT

	PARAMETER	PENTACHLOROPHENOL	TETRACHLOROPHENOL
SAMPLE NUMBER	DATE 1988		
BACKGROUND BG-1	JUN 12	<0.05	<0.05
OFF SHORE SEDIMENT BG-1	JUN 12	<0.05	<0.05
OFF SHORE SEDIMENT			
OSS-1	JUN 11	0.30	0.09
OSS-1 DUPLICATE	JUN 12	<0.05	<0.05
OSS-2	JUN 11	0.08	<0.05
OSS-2 REPLICATE	JUN 11	0.08	<0.05
OSS-2 DUPLICATE	JUN 12	0.08	<0.05
OSS-3	JUN 12	<0.05	<0.05
OSS-4	JUN 12	<0.05	<0.05
OSS-5 OSS-1 RESAMPLE	JUN 12	<0.05	<0.05
OSS-6 OSS-2 RESAMPLE	JUN 12	<0.05	<0.05

NOTES:

A MATRIX EFFECTS PREVENTED LOWER LEVEL QUANTITIATION
B VALUE PROBABLY CARRY-OVER FROM THE PREVIOUS INJECTION.
THE REPLICATE ANALYSIS GAVE A VALUE OF 0.06.

Table 4 - Phase III - Soil, Sediment, Groundwater and Off-Shore Water Analytical Data

ALL CONSTITUENTS REPORTED
IN PPM UNLESS NOTED

GROUNDWATER

SAMPLE NUMBER		PARAMETER DATE 1988	PENTACHLOROPHENOL	TETRACHLOROPHENOL	TOTAL HYDROCARBONS	PHENOLS
MW-3A		JUN 11	<0.01	<0.01		
MW-4A		JUN 11	<0.01	<0.01		
MW-5A		JUN 9	<0.01	<0.01		
MW-3A	REPLICATE	JUN 9	<0.01	<0.01		
MW-6A		JUN 8	0.10	<0.10		
MW-6A		JUN 12	0.09	0.01		
MW-7		JUN 11	<0.01	<0.01		
MW-11		JUN 11	<0.01	<0.01		
MW-12		JUN 9	<0.01	<0.01		
MW-13		JUN 11	<0.01	<0.01		
MW-14		JUN 11	<0.01	<0.01		
MW-15		JUN 9	<0.01	<0.01		
MW-16		JUN 12	0.59	<0.01		
MW-16		JUN 16			4.00	<1.00
MW-18		JUN 12	<0.01	<0.01		
MW-19		JUN 12	<0.01	<0.01		
MW-20		JUN 12	<0.01	<0.01		
MW-21		JUN 12	<0.01	<0.01		
MW-22		JUN 12	0.01	<0.01		

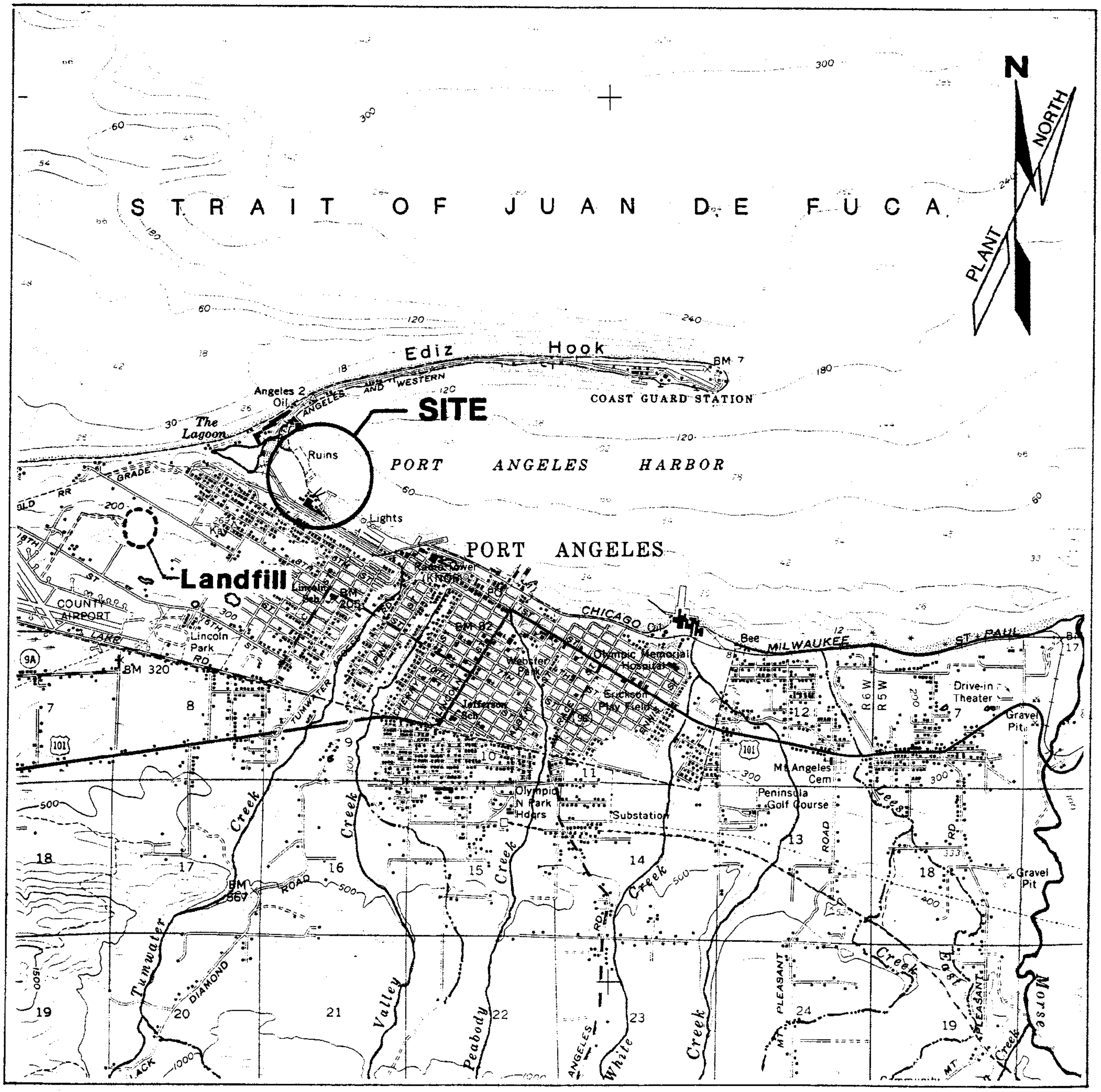
OFF SHORE

OFF SHORE WATER					
OSW-1	JUN 11	<0.01	<0.01		
OSW-2	JUN 11	<0.01	<0.01		
OSW-3	JUN 12	<0.01	<0.01		
OSW-4	JUN 12	<0.01	<0.01		

Table 5 - Relative Toxicity Estimates for PCDPs and PCDFs

		MW-15		MW-16		MW-16		Background	
Compounds	EPA TEFs	0-1.5 feet soil (ug/kg)	TCDD equivalent	0-1.5 ft soil (ug/kg)	TCDD equivalent	10-11.5 ft soil (ug/kg)	TCDD equivalent	soil (ug/kg)	TCDD equivalent
DIOXINS									
2,3,7,8 TCDD	1.0000	ND	0.0000	0.0300	0.0300	0.2730	0.2730	ND	0.0000
other TCDDs	0.0100	ND	0.0000	0.0300	0.0003	ND	0.0000	ND	0.0000
2378-PeCDDs	0.5000	ND	0.0000	ND	0.0000	ND	0.0000	ND	0.0000
other PeCDDs	0.0050	ND	0.0000	ND	0.0000	ND	0.0000	0.0310	0.0002
2378-HxCDDs	0.0400	0.1490	0.0060	ND	0.0000	ND	0.0000	0.3860	0.0154
other HxCDDs	0.0004	0.7820	0.0003	ND	0.0000	ND	0.0000	1.3750	0.0006
2378-HpCDDs	0.0010	4.9940	0.0050	ND	0.0000	ND	0.0000	12.2650	0.0123
other HpCDDs	0.0000	8.8610	0.0001	ND	0.0000	ND	0.0000	20.8810	0.0002
OCDD	0.0000	63.0560	0.0000	ND	0.0000	0.4300	0.0000	81.4620	0.0000
FURANS									
2378-TCDFs	0.1000	ND	0.0000	ND	0.0000	ND	0.0000	0.0130	0.0013
other TCDFs	0.0010	ND	0.0000	ND	0.0000	ND	0.0000	0.2340	0.0002
2378-PeCDFs	0.1000	ND	0.0000	ND	0.0000	ND	0.0000	0.0190	0.0019
other PeCDFs	0.0010	ND	0.0000	ND	0.0000	ND	0.0000	0.2840	0.0003
2378-HxCDFs	0.0100	0.0300	0.0003	ND	0.0000	ND	0.0000	0.2800	0.0028
other HxCDFs	0.0001	0.8250	0.0001	0.1960	0.0000	ND	0.0000	2.0980	0.0002
2378-HpCDFs	0.0010	1.2170	0.0012	0.1740	0.0002	ND	0.0000	2.7380	0.0027
other HpCDFs	0.0000	3.3330	0.0000	0.5630	0.0000	ND	0.0000	7.4850	0.0001
OCDF	0.0000	2.7400	0.0000	ND	0.0000	ND	0.0000	6.3750	0.0000
TOTAL ESTIMATED TCDD EQUIVALENTS (TEF):			0.0130		0.0305		0.2730		0.0382

Vicinity Map



Base map prepared from USGS 15-minute quadrangle map of Port Angeles, Washington

0 1 2

Scale in Miles

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Figure 1

Current Features Site Plan

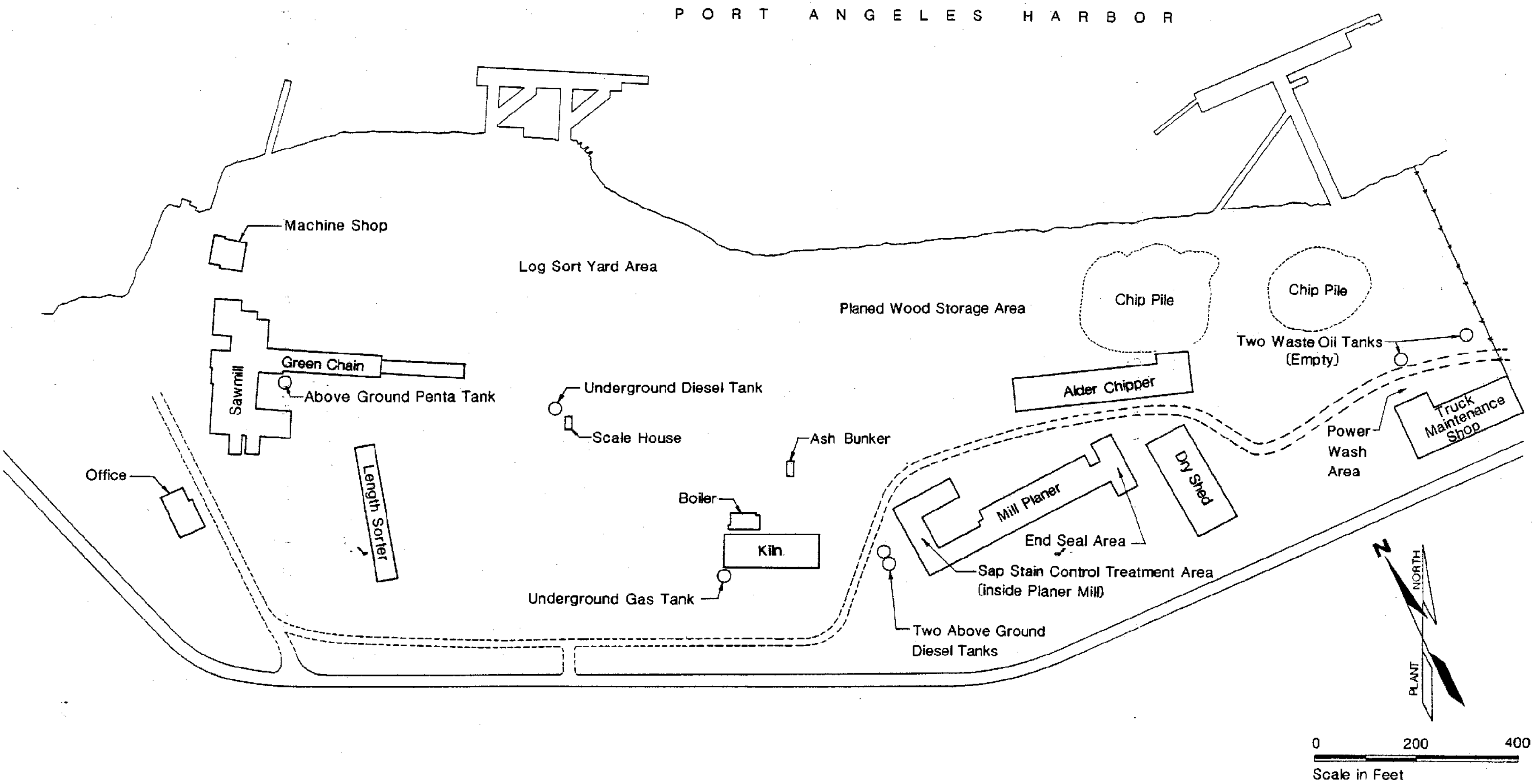

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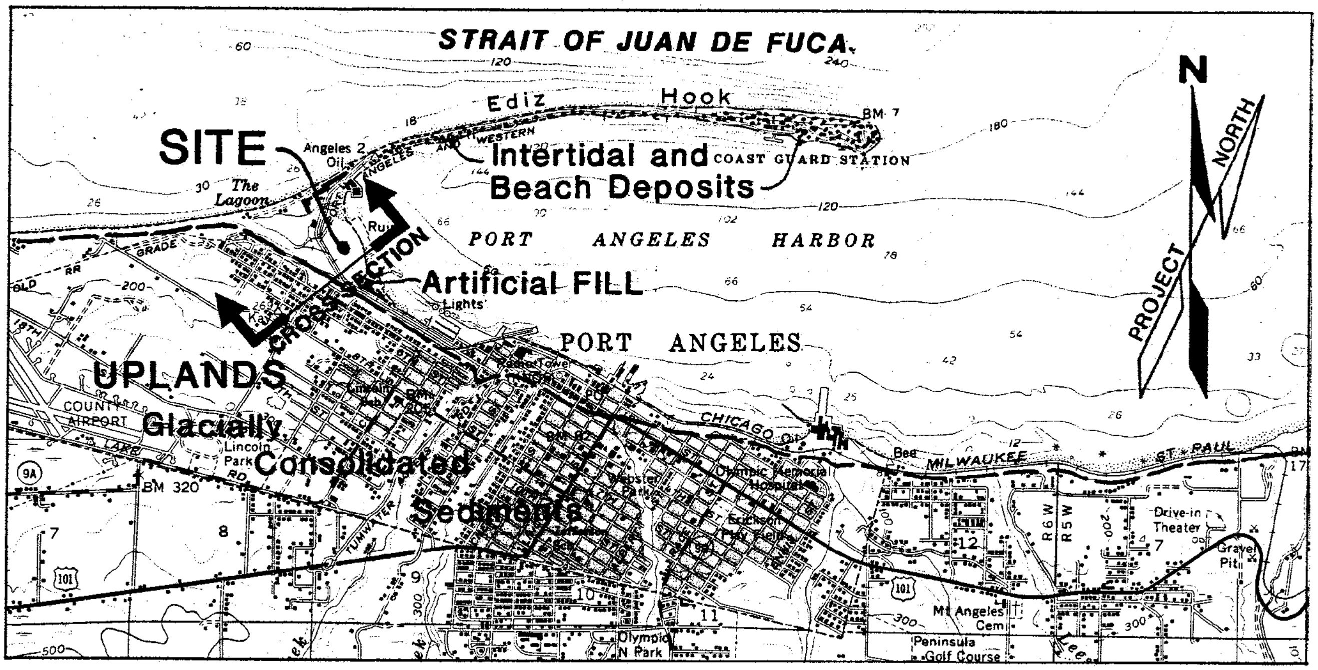
Figure 2

Geologic Map

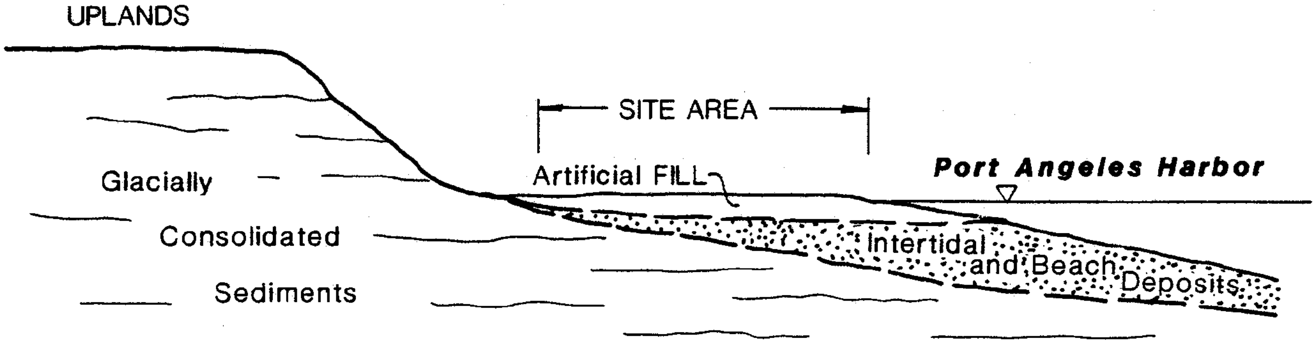


Base map prepared from USGS 15-minute quadrangle map of Port Angeles, Washington

0 1 2

Scale in Miles

Schematic Geologic Cross Section



NOT TO SCALE

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Figure 3

Site and Exploration Plan

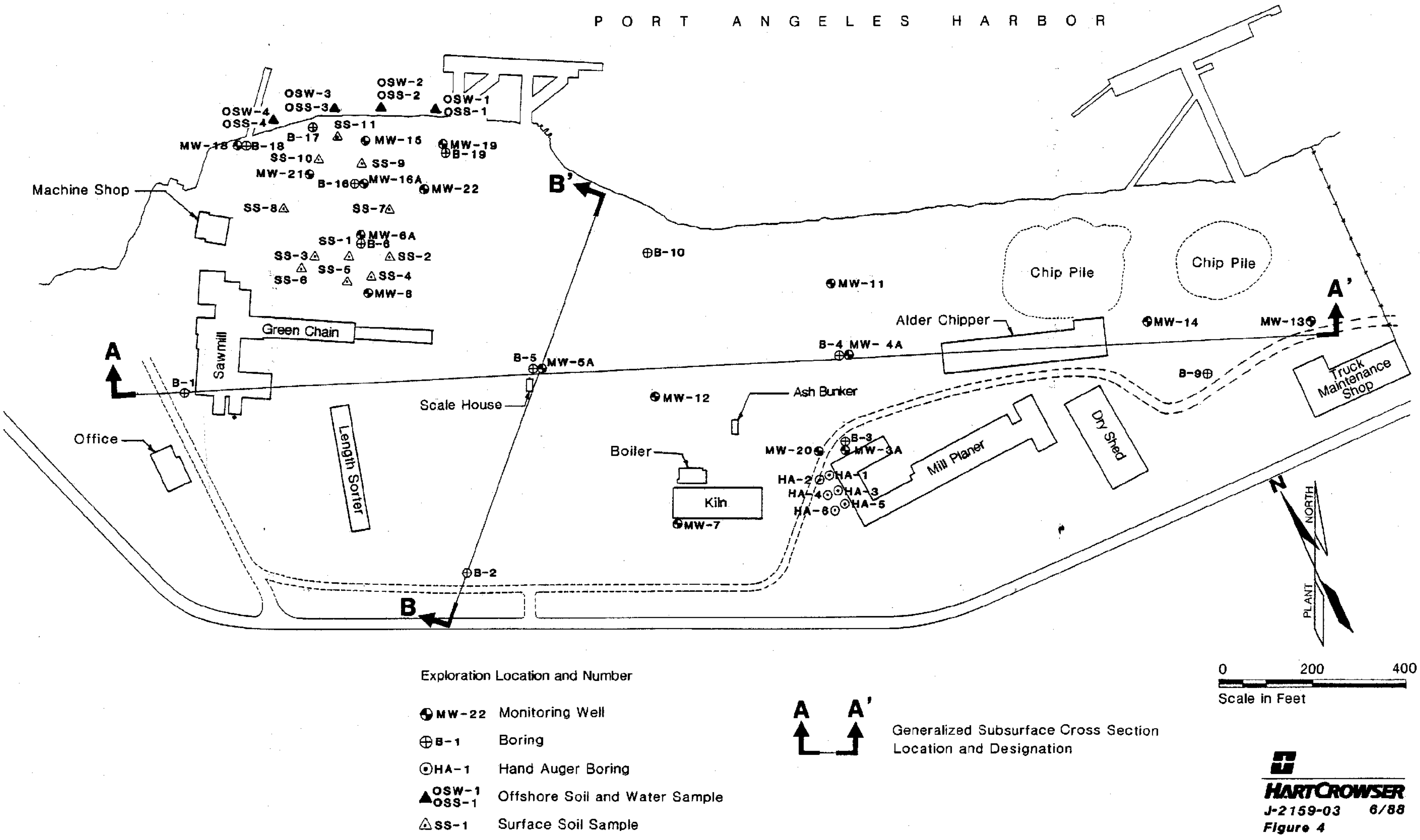

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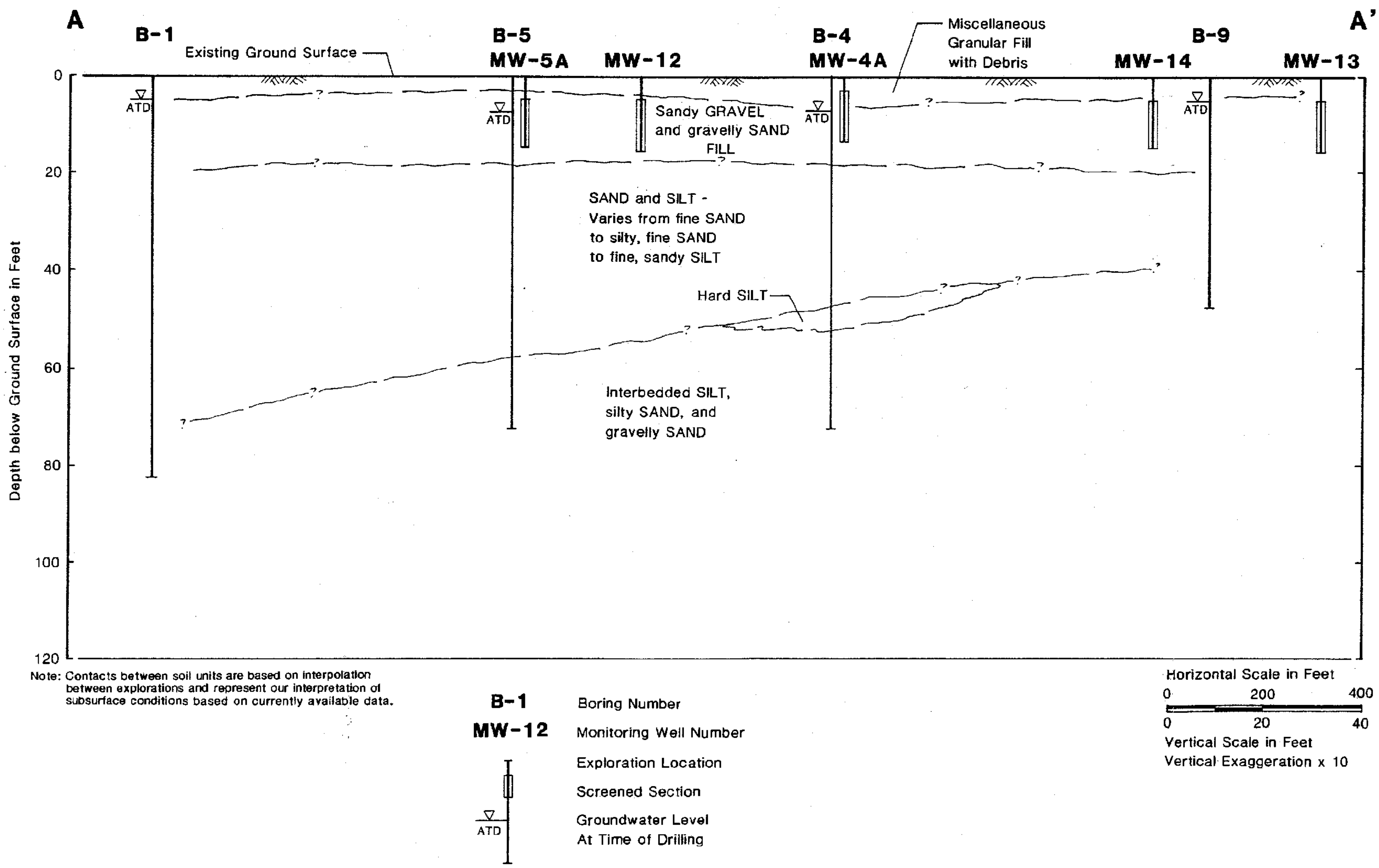
Figure 4

Generalized Subsurface Cross Section A-A'



Note: Contacts between soil units are based on interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

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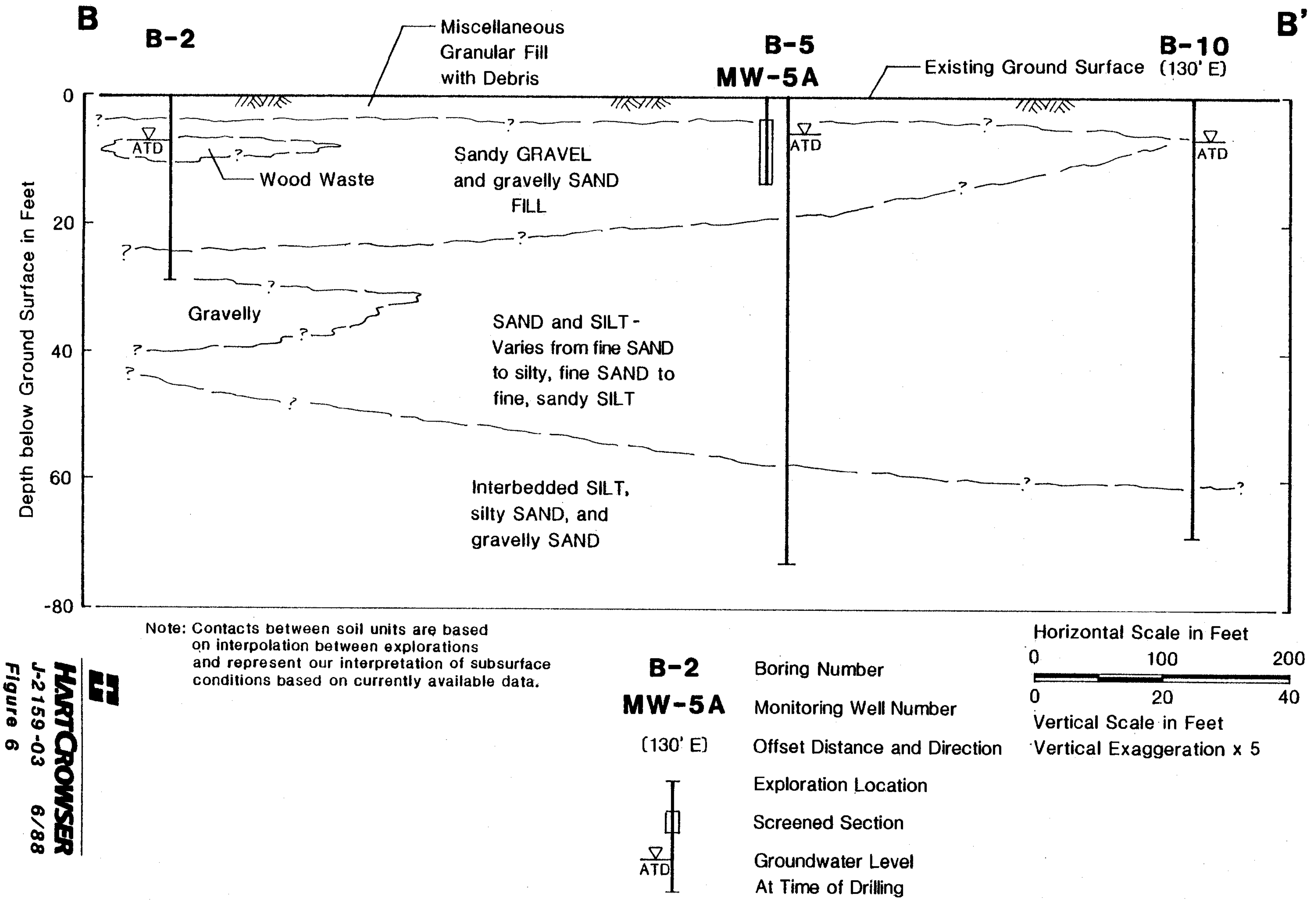
Figure 5

Generalized Subsurface Cross Section B-B'



Note: Contacts between soil units are based on interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

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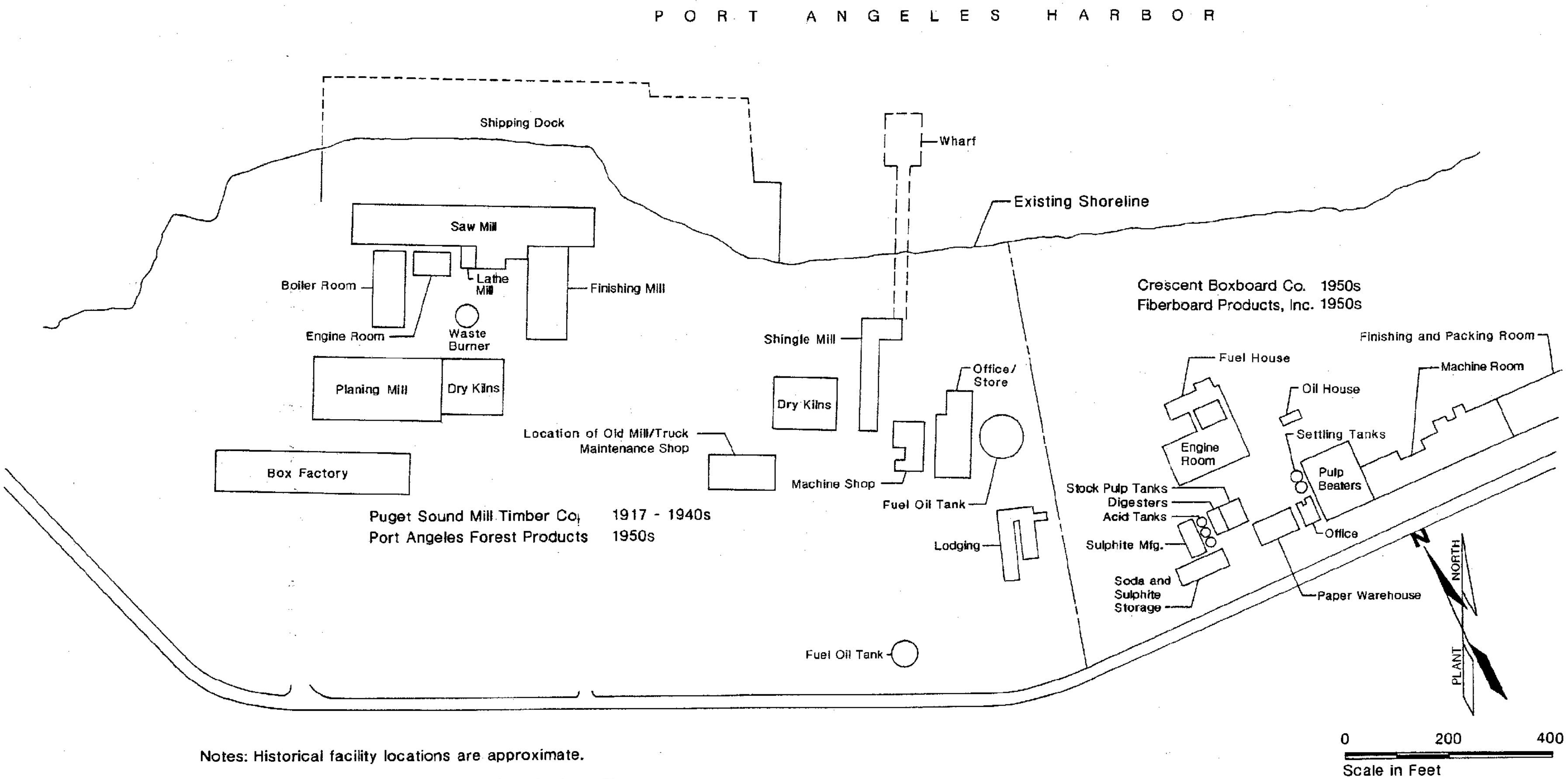
Figure 6

Historical Features Map



Notes: Historical facility locations are approximate.

Historical facility locations based on Sanborn Fire Insurance Co. maps dated 1917 to 1951.

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Figure 7

Soil Staining Storage Tanks and Surface Soil Sampling Locations Plan

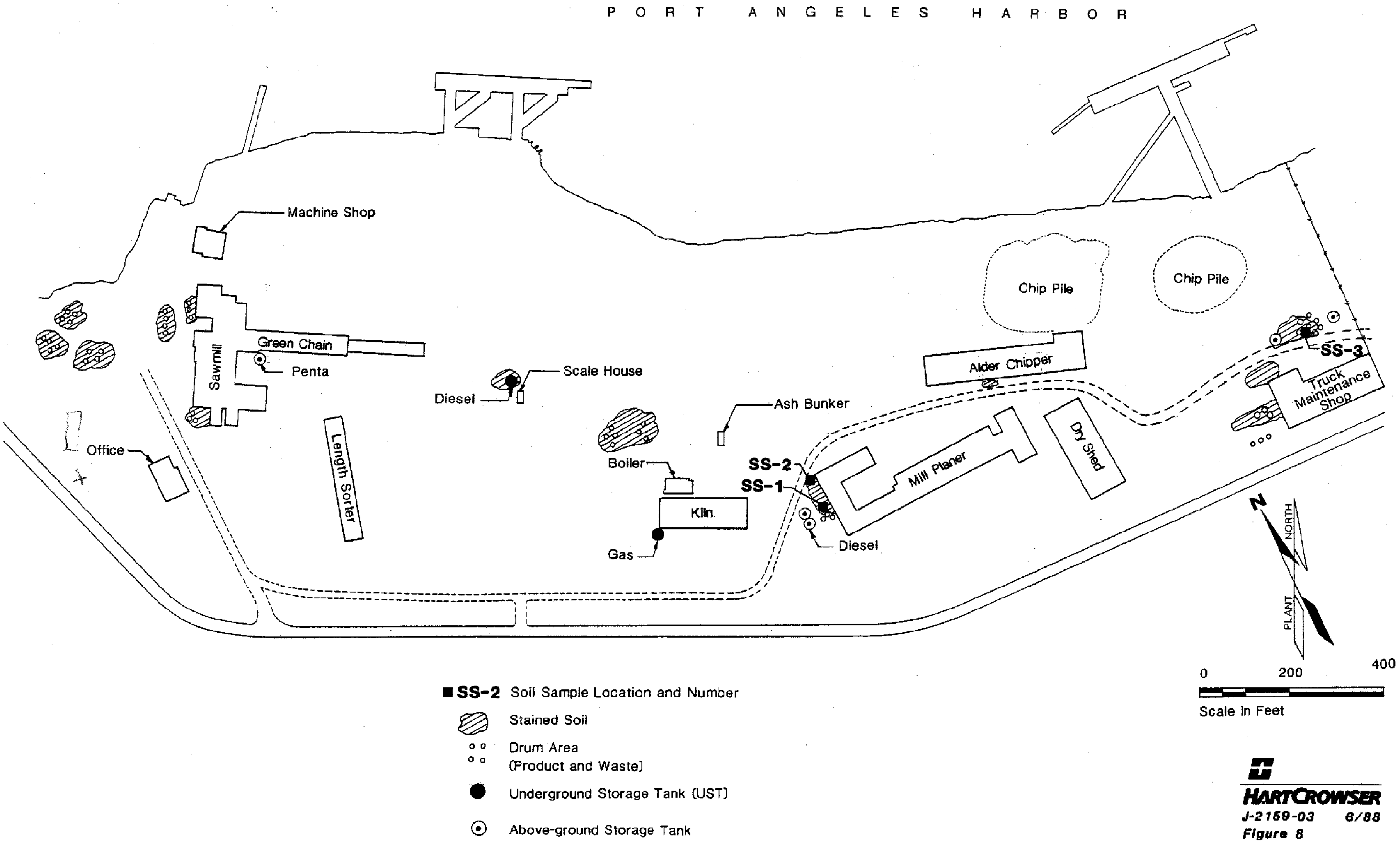

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Figure 8

Transformer Sampling Location Plan

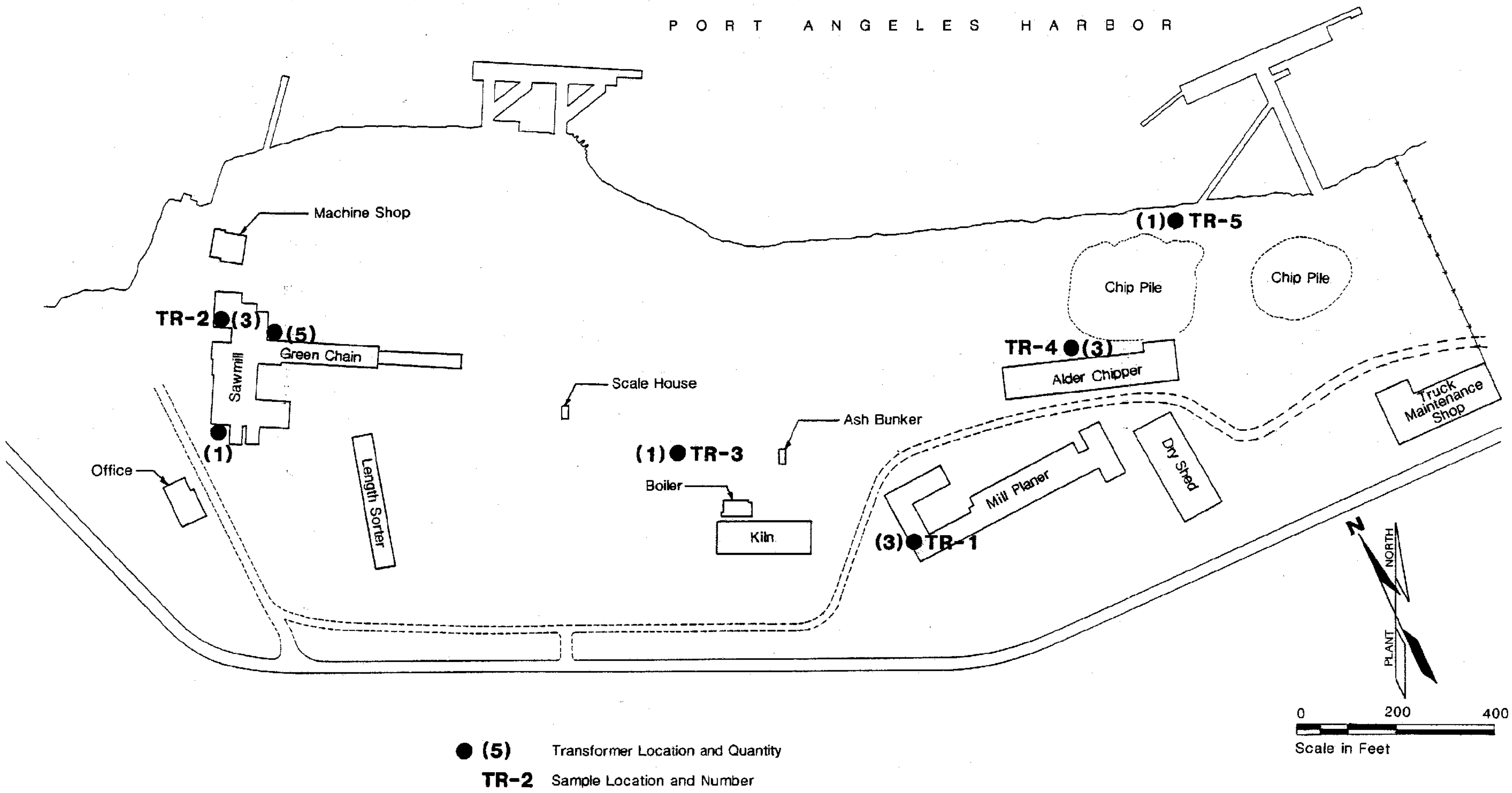

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Figure 9

Site and Exploration Plan

Penta Area

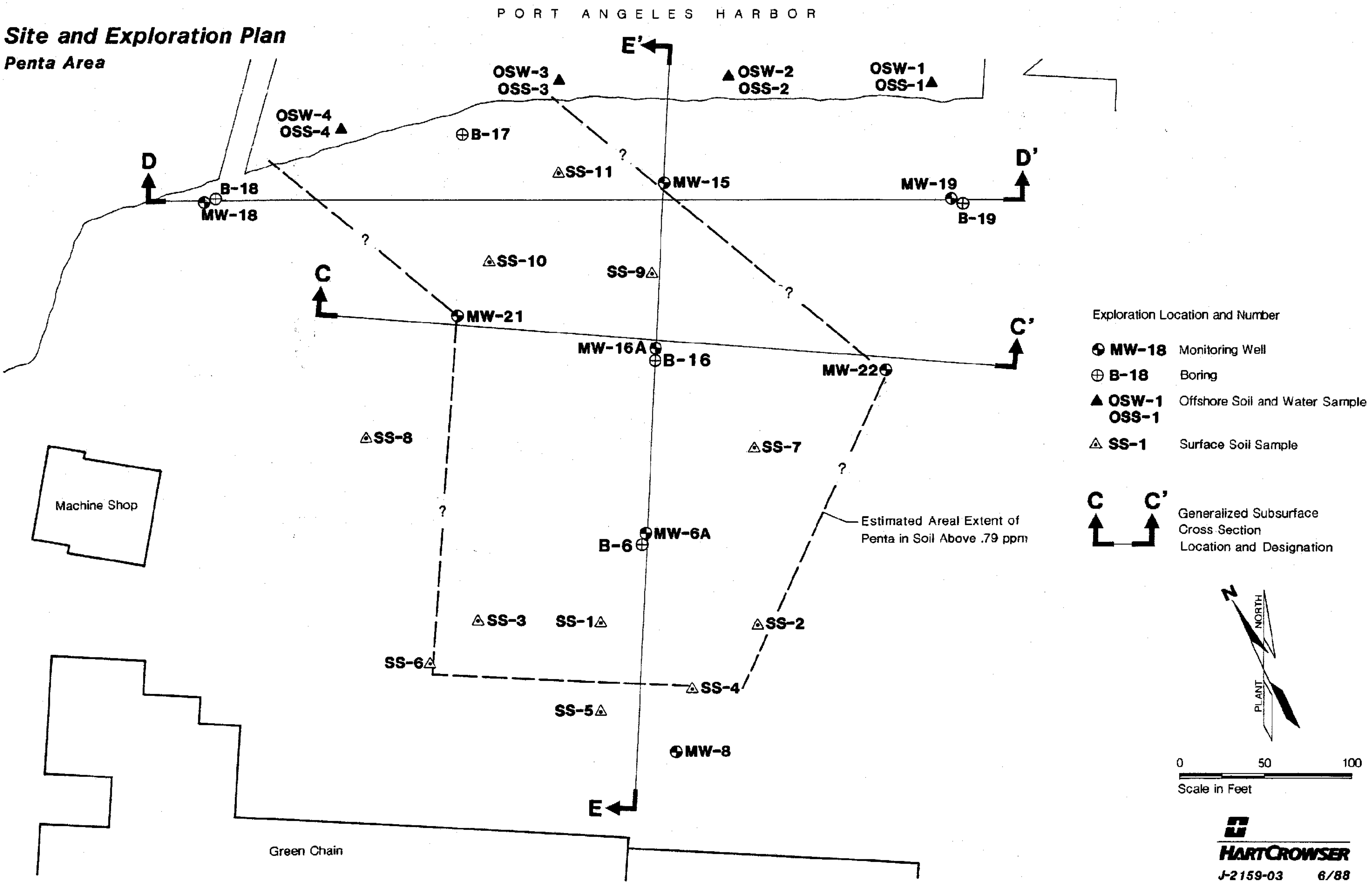

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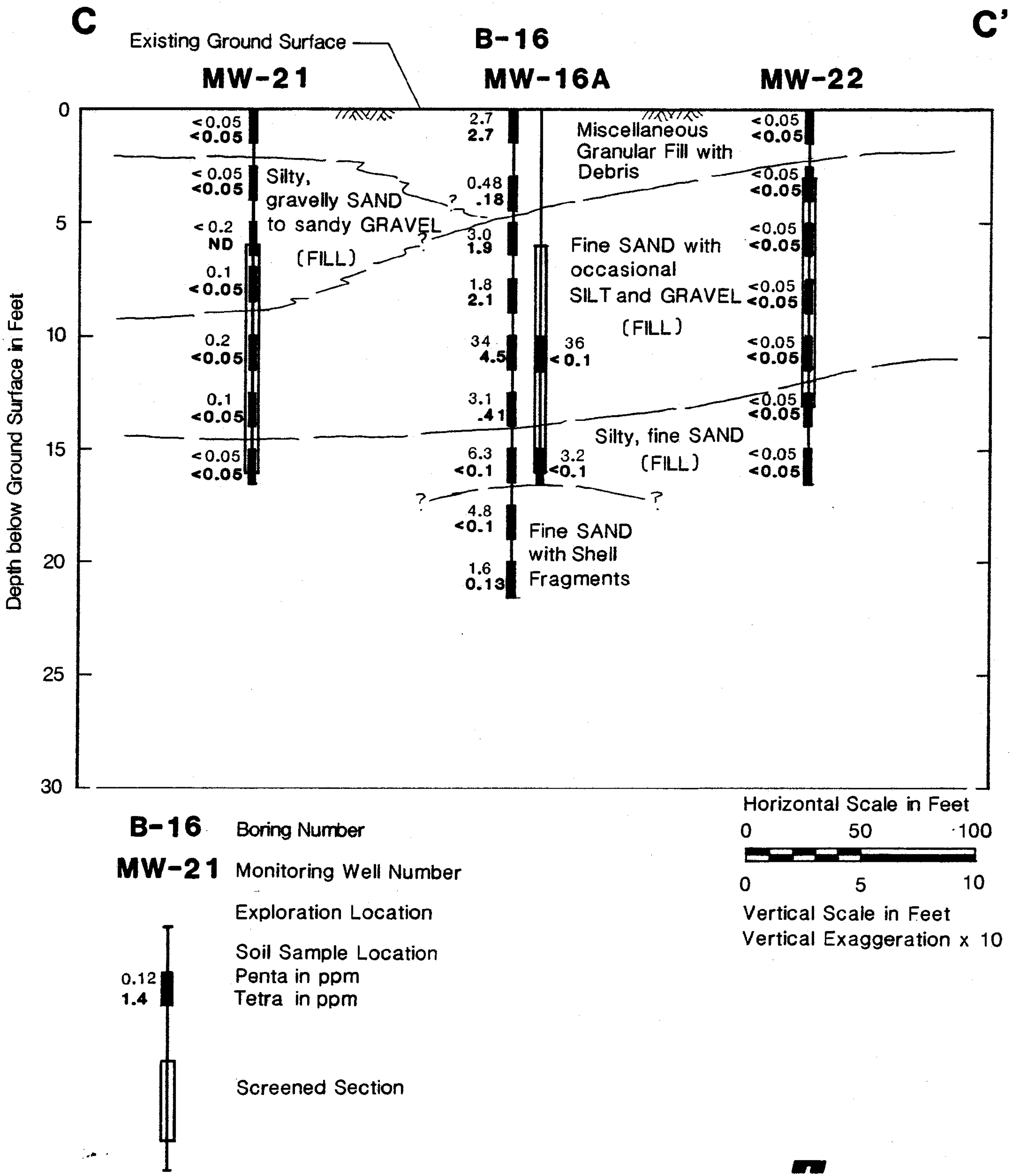
Figure 10

Generalized Subsurface Cross Section C-C'



Note: Contacts between soil units are based upon interpolation between explorations and represent our interpretation of subsurface conditions based on currently available data.

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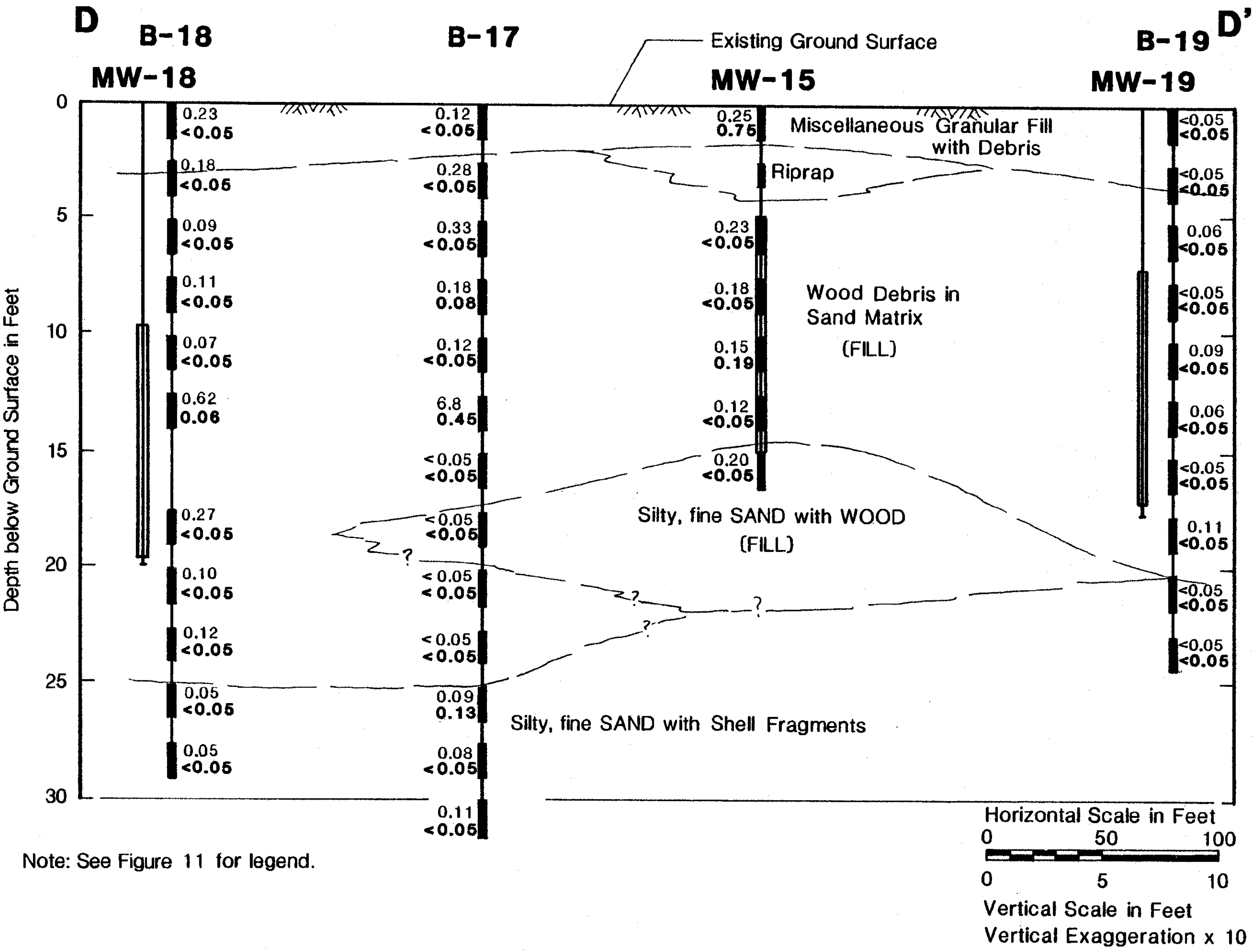
Figure 11

Generalized Subsurface Cross Section D-D'



Note: See Figure 11 for legend.

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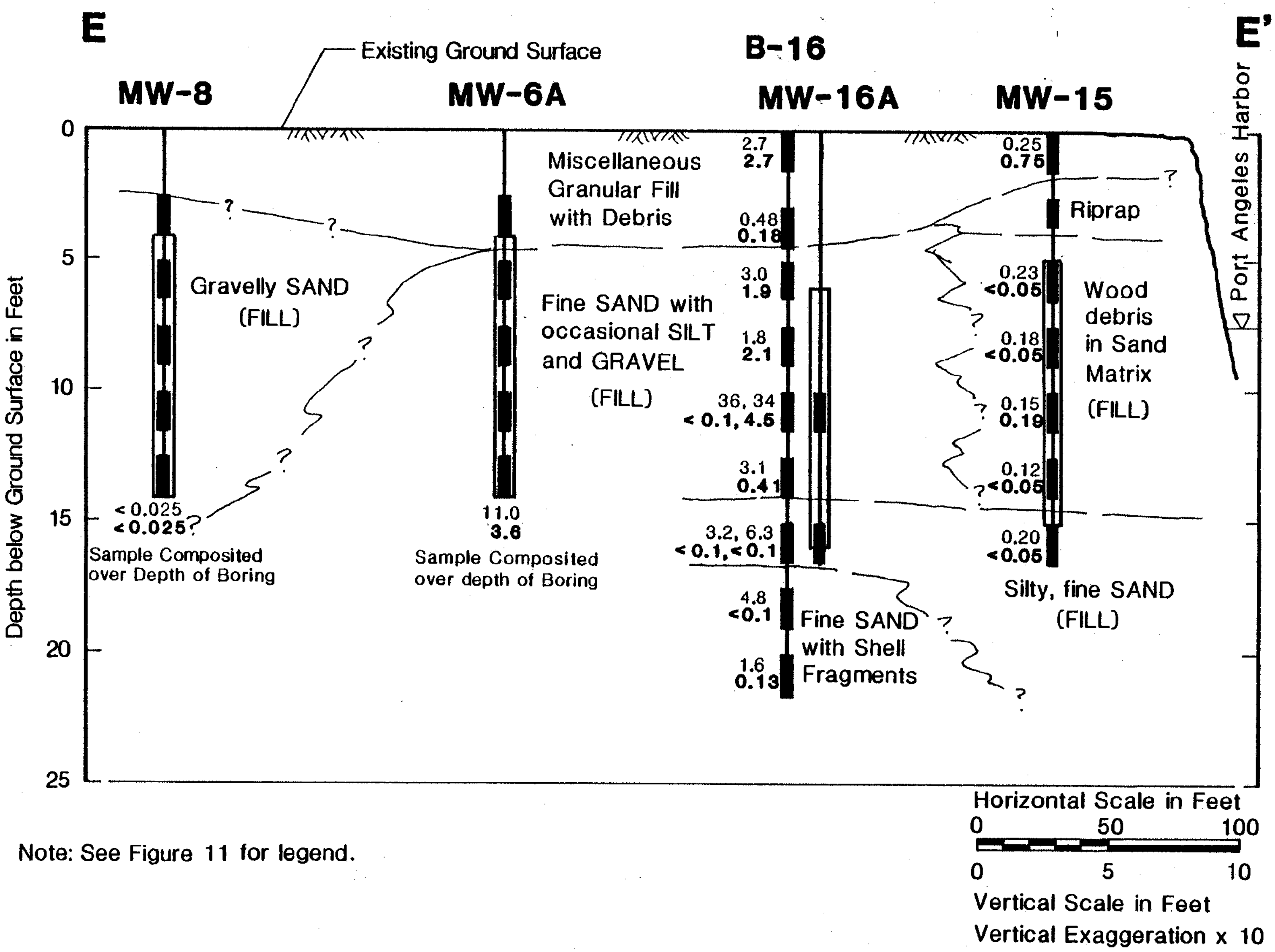
Figure 12

Generalized Subsurface Cross Section E-E'



Note: See Figure 11 for legend.

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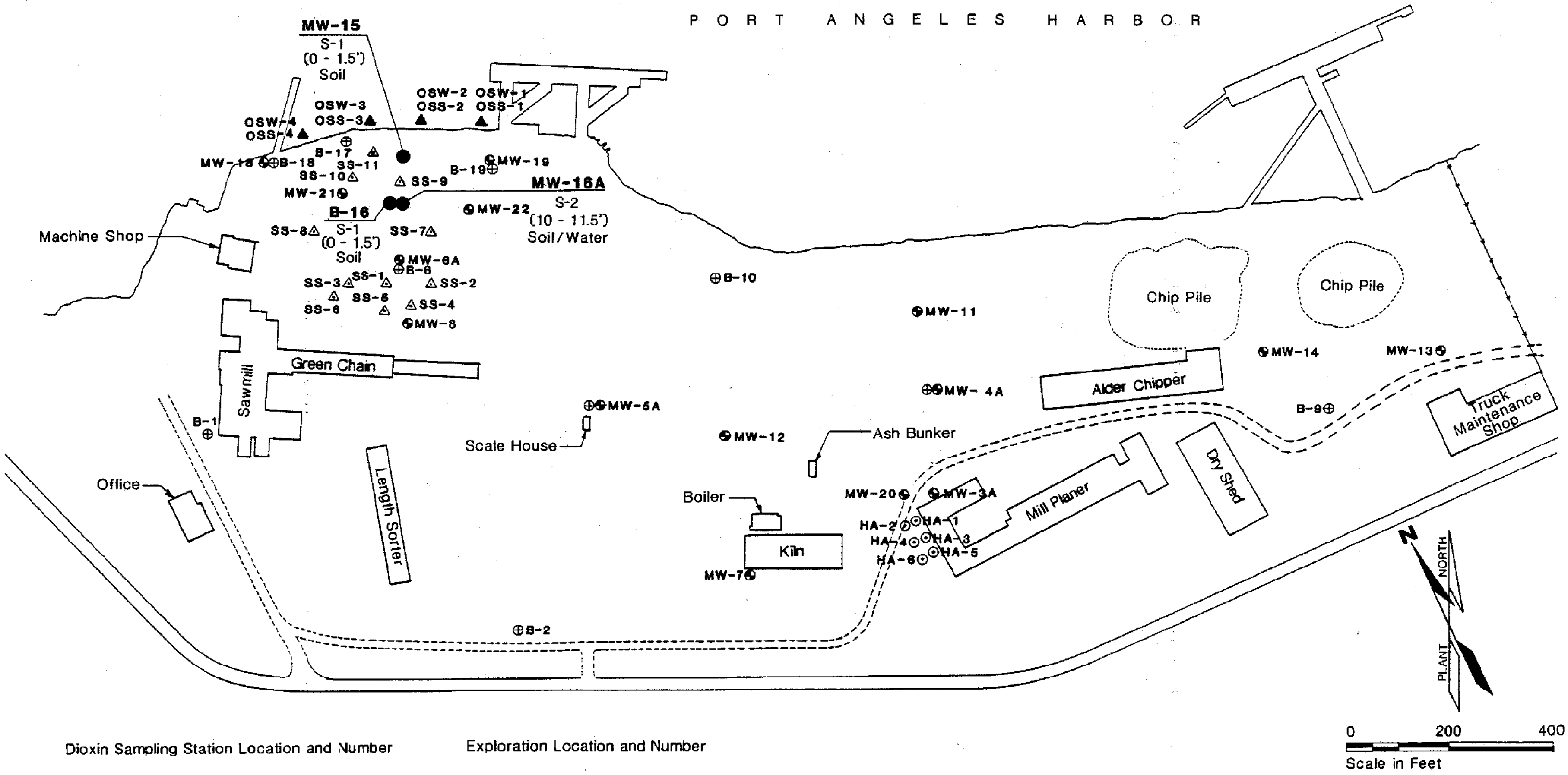
Figure 13

Dioxin Sampling Location Plan



Dioxin Sampling Station Location and Number

MW-15	Monitoring Well
B-16	Boring
S-1	Sample Number
● (0 - 1.5')	Sample Depth
Soil	Media

Exploration Location and Number

MW-22	Monitoring Well
⊕ B-19	Exploratory Boring
⊙ HA-1	Hand Auger Boring
▲ OSW-1 OSS-1	Offshore Soil and Water Sample
△ SS-1	Surface Soil Sample

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Figure 14

Background Sediment Sampling Location Plan

Base map prepared from USGS 15-minute quadrangle map of Port Angeles, Washington

Sediment Sample Location and Number

BG-1 ● On-shore

OSSBG-1 ⊕ Off-shore

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Figure 15

PLATT-POPA. BG DOE. 13

TACOMA FILE COPY

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Earth and Environmental Technologies

Preliminary Environmental Site Evaluation and Focused Pentachlorophenol Explorations
Merrill and Ring, Inc.
Port Angeles, Washington

Volume II - Appendices

Prepared for
Merrill and Ring, Inc.
and
Davis Wright & Jones

June 28, 1988
J-2159-03

1910 Fairview Avenue East Seattle, Washington 98102-3699 206.324.9530

J-2159-03

CONTENTS - VOLUME II

J-2159-03

APPENDIX A
HISTORICAL BACKGROUND INFORMATION

APPENDIX A
HISTORICAL BACKGROUND INFORMATION

ON-SITE NON-RESIDENTIAL USES

Crown Zellerbach Corporation	1608 Marine Drive	1940s to 1980s
Washington Cafeteria	1608 Marine Drive	1940s
Peninsula Shingle Compandy	1608 Marine Drive	1950s
Hanson's Boat Yard	1608 Marine Drive	1950s
Merrill and Ring Lumber	1608 Marine Drive	1960s to 1980s
Nelson Shipyard Buildings	1680 Marine Drive	1960s
Restaurant	1680 Marine Drive	1970s

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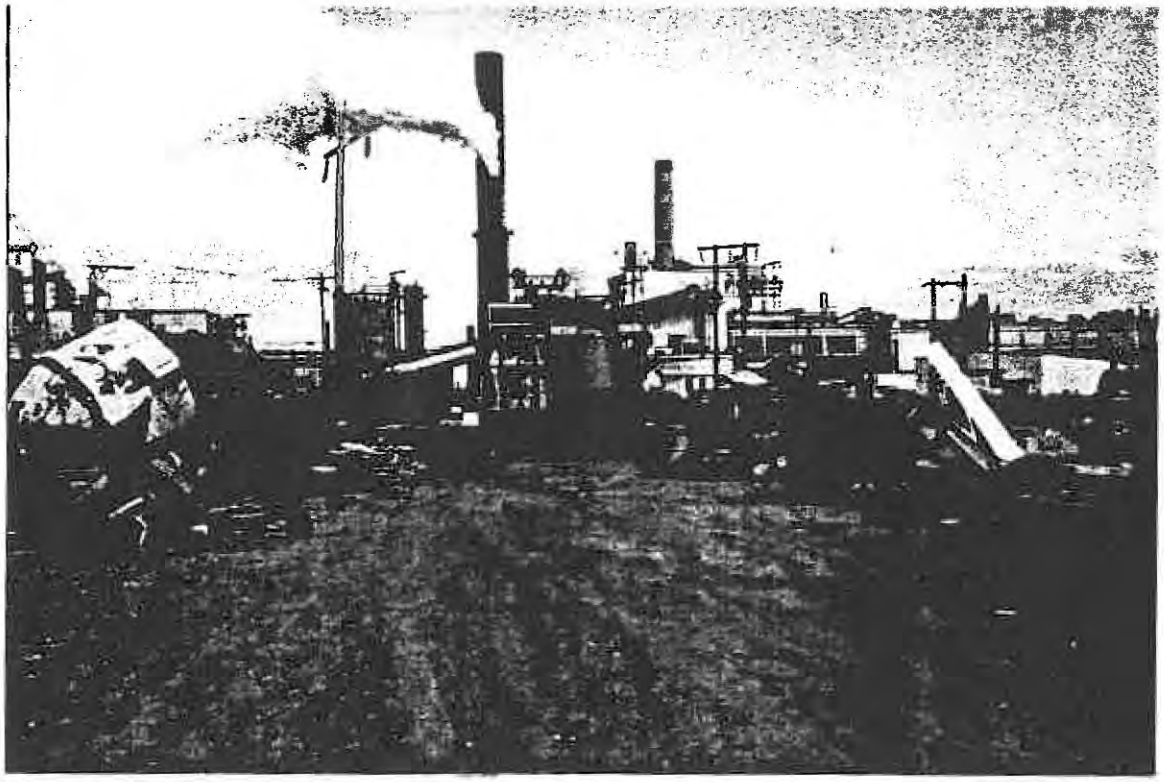
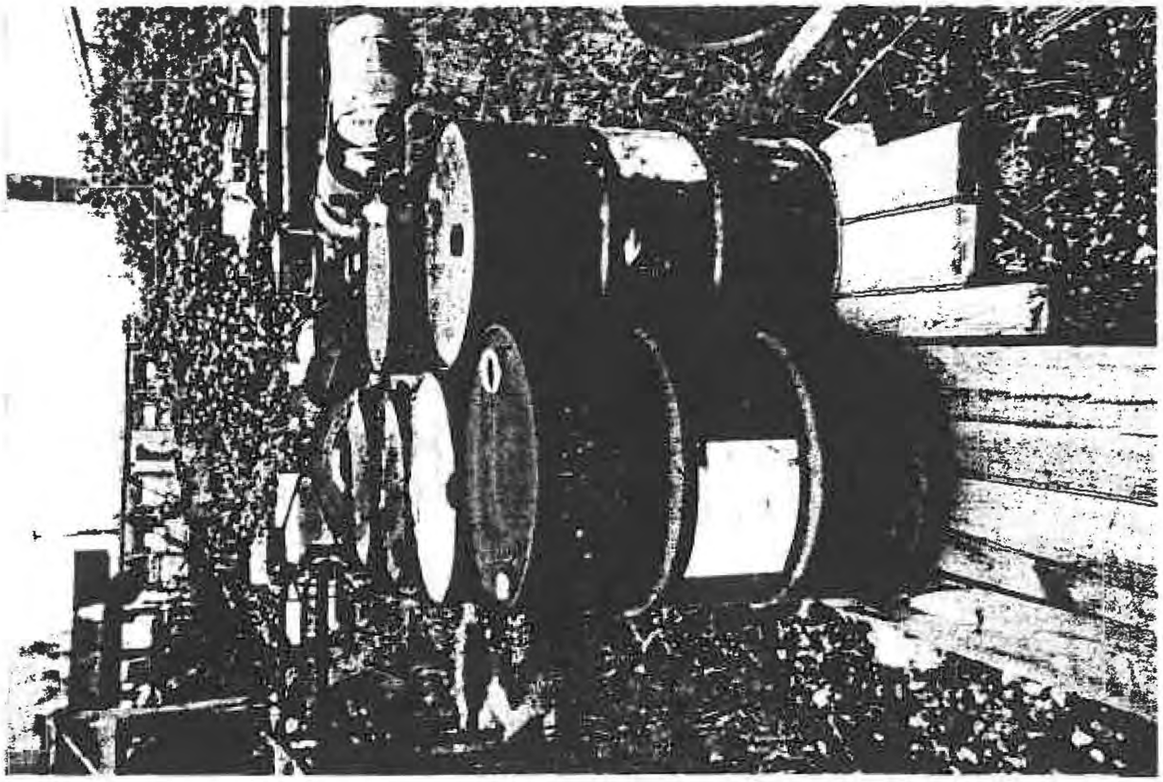
APPENDIX B
PHOTOGRAPHIC DOCUMENTATION
PRELIMINARY ASSESSMENT

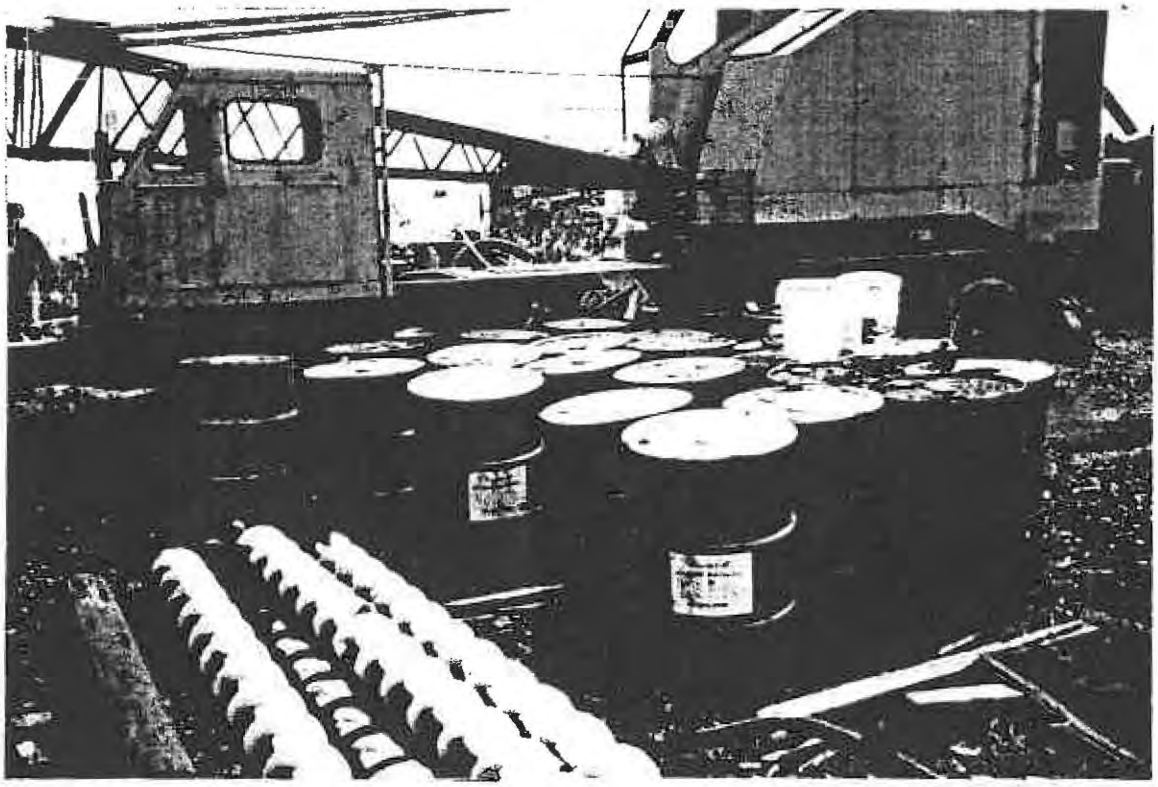


1 Drum disposal yard west of sawmill



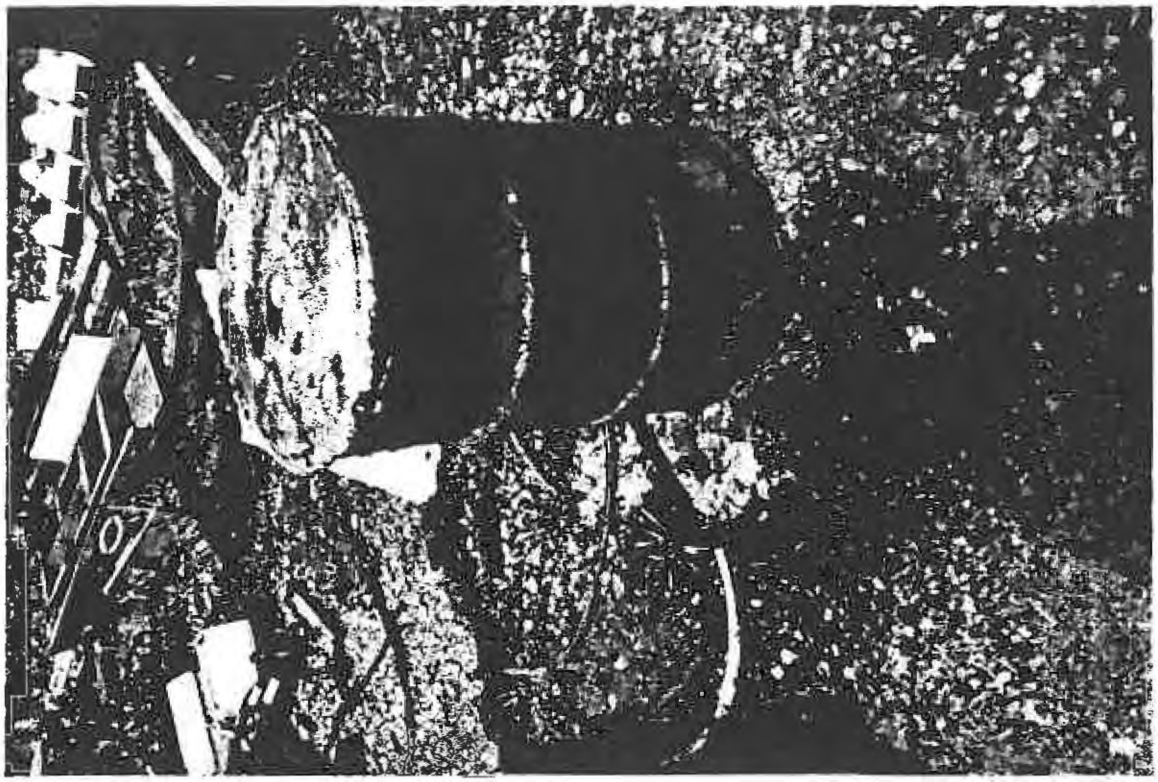
2 Misc. drums in disposal yard

J-2159

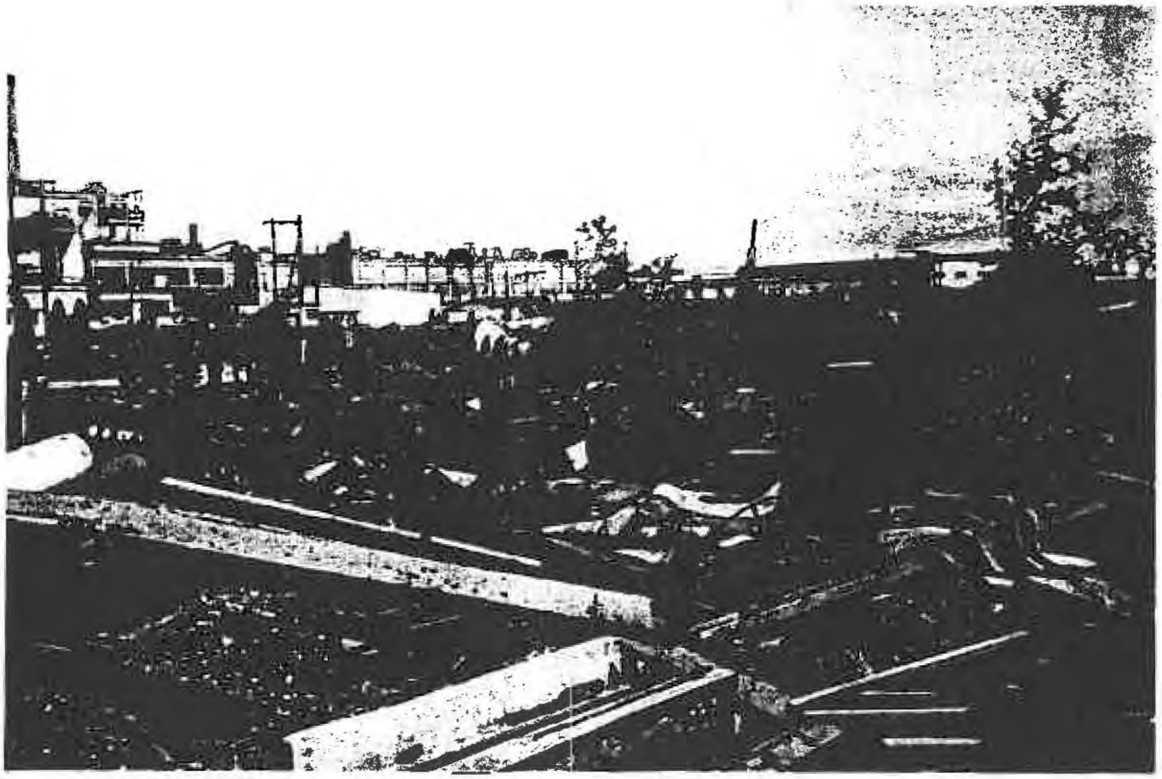


3 Misc. drums in disposal yard

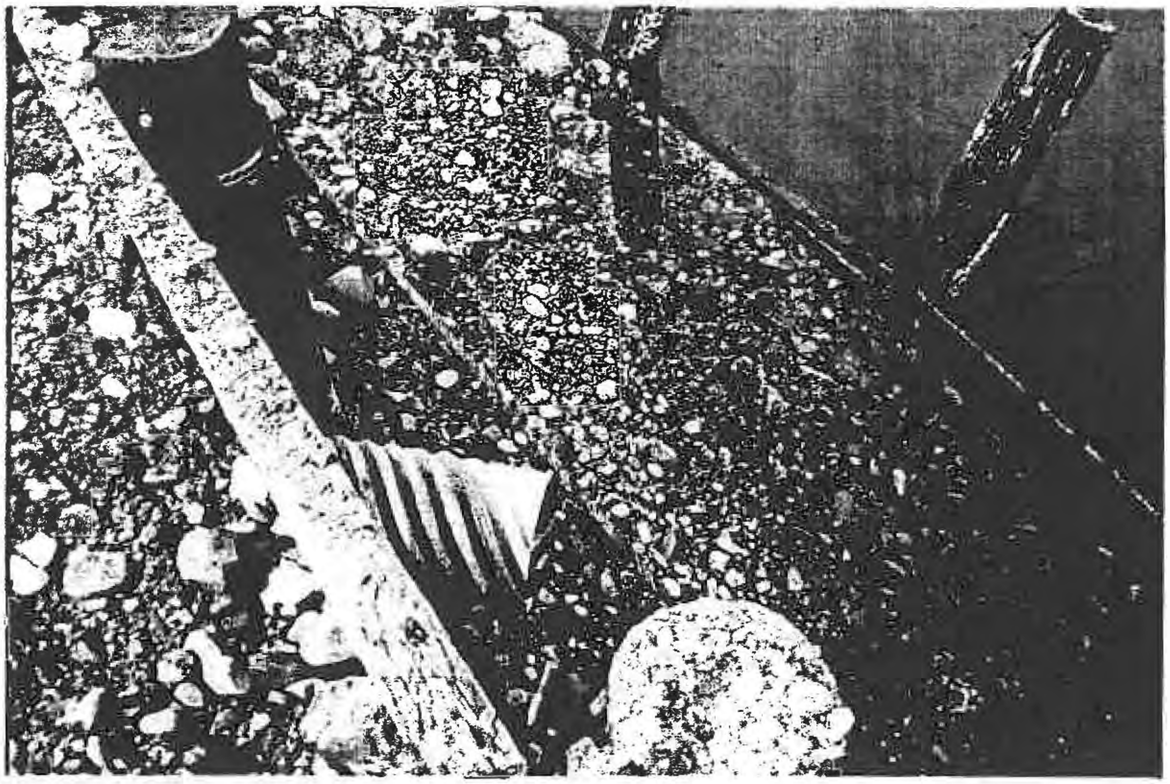
4 Misc. drums in disposal yard and stressed vegetation



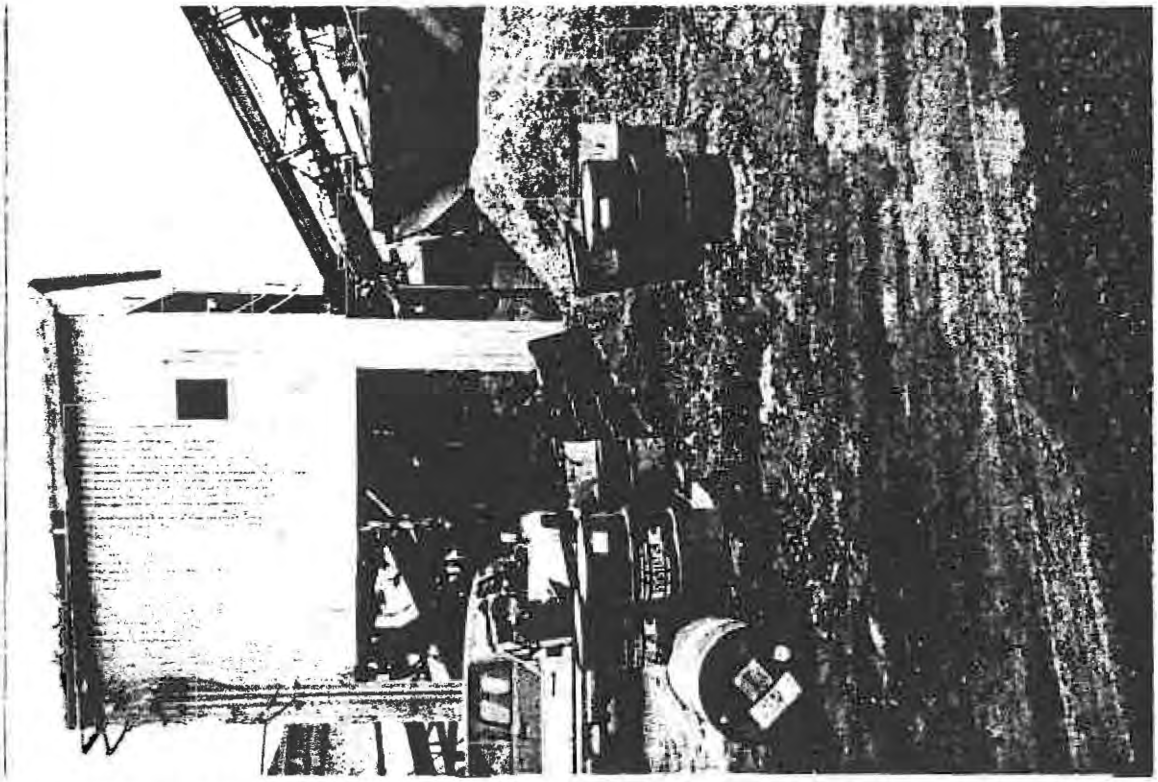
5 Drum of unknown material



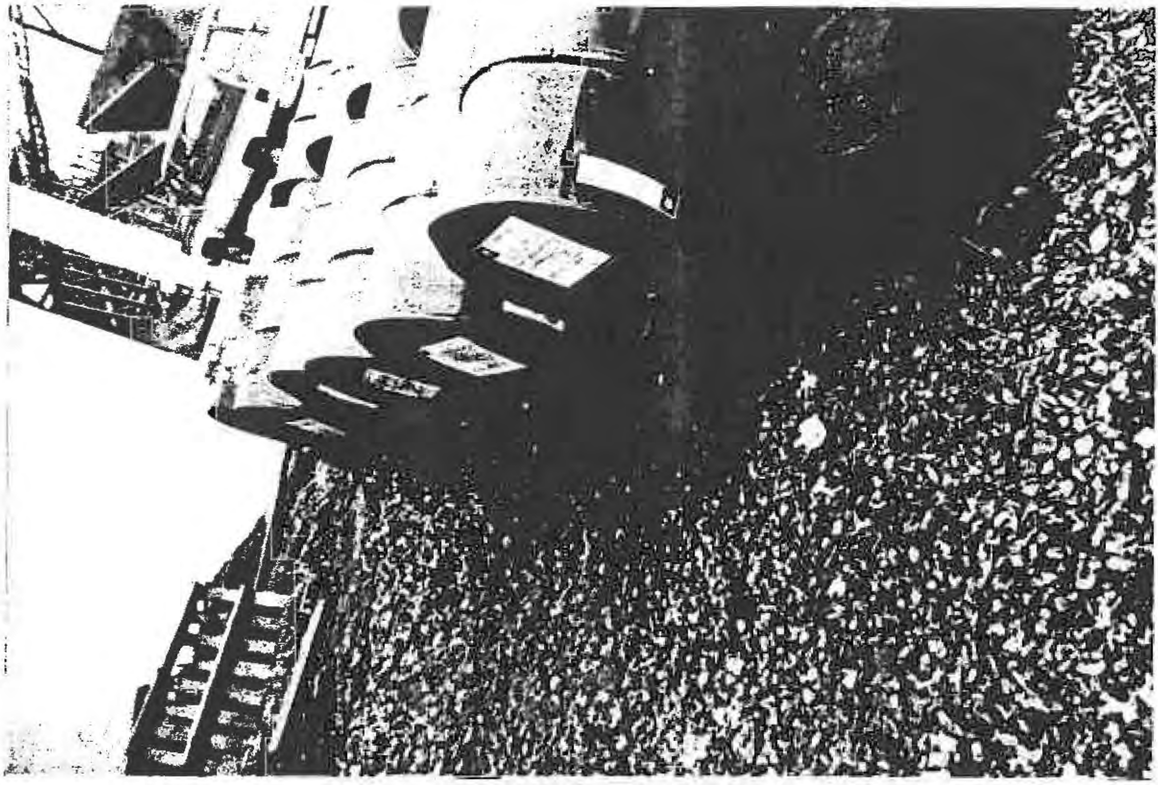
6 Overview of scrapyard



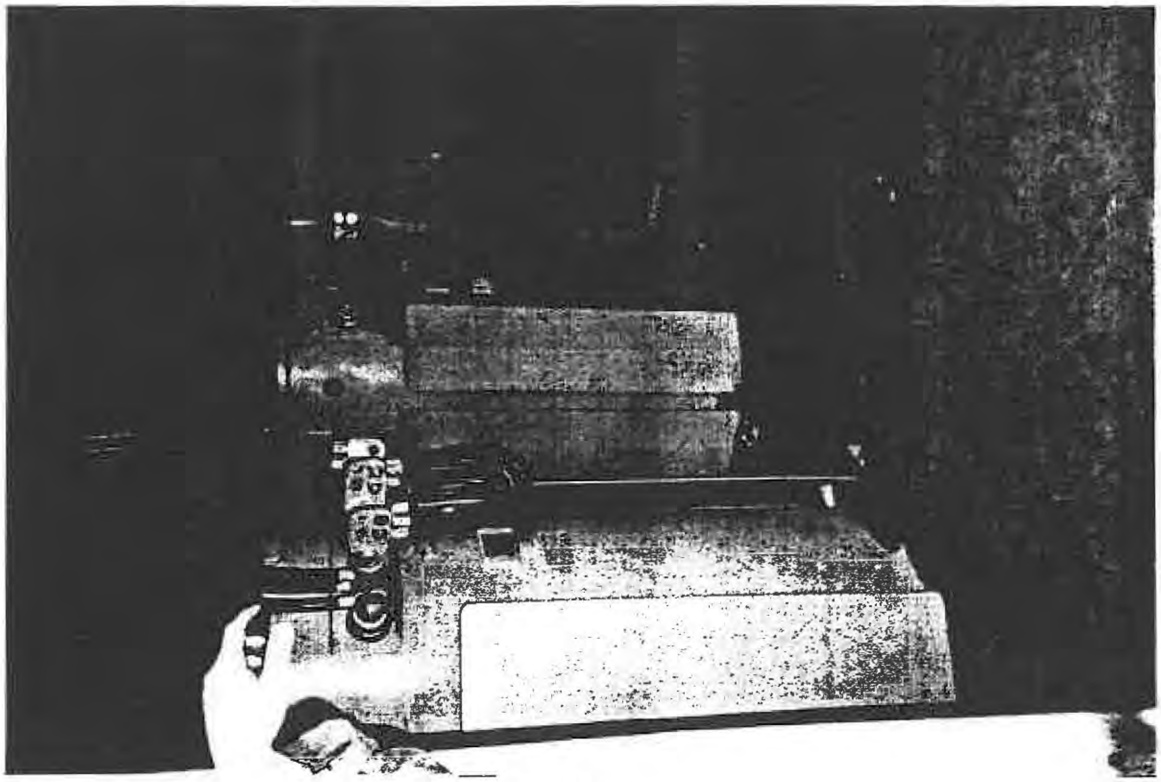
7 Western outfall drain



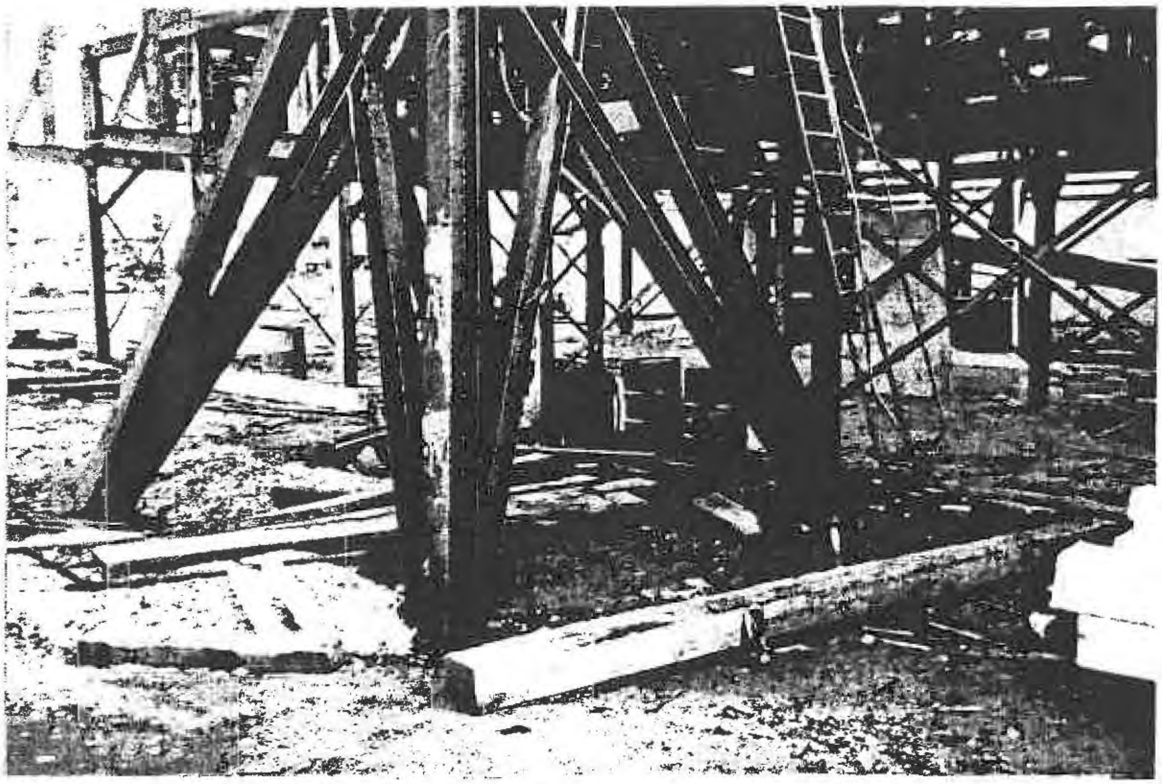
8 Product storage area at sawmill



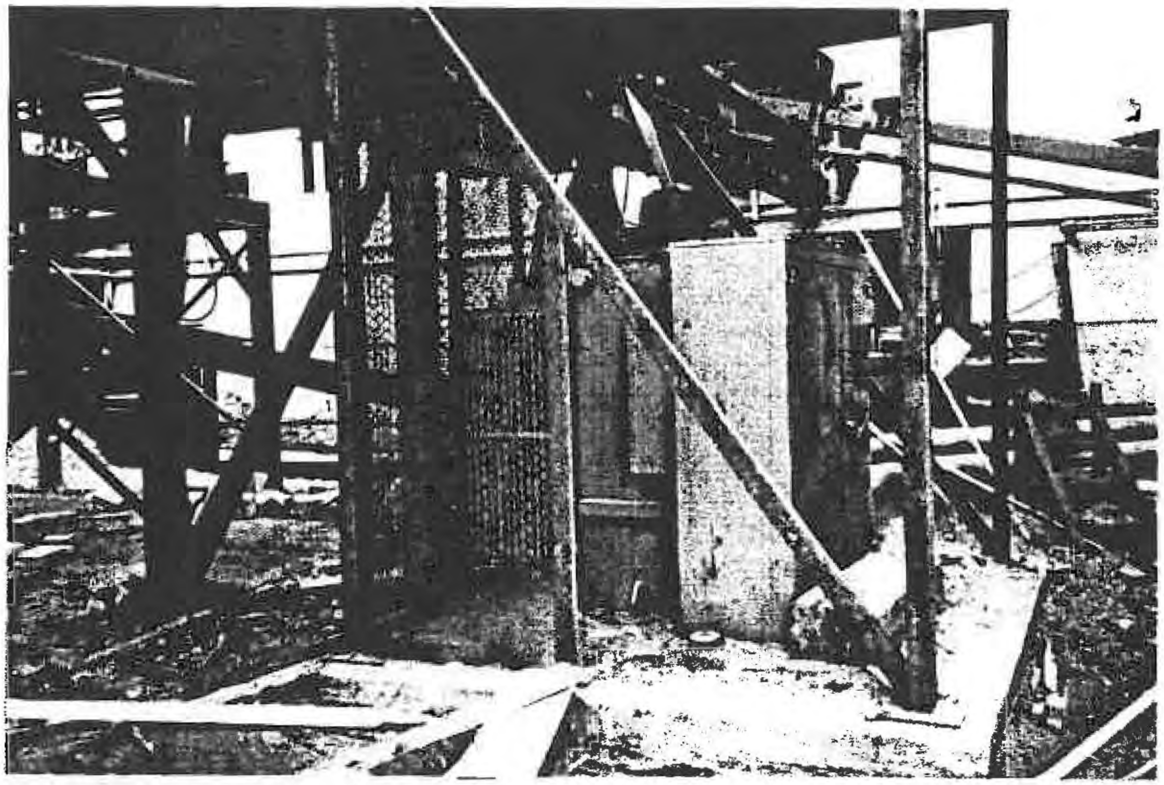
9 Product storage area and stained soil



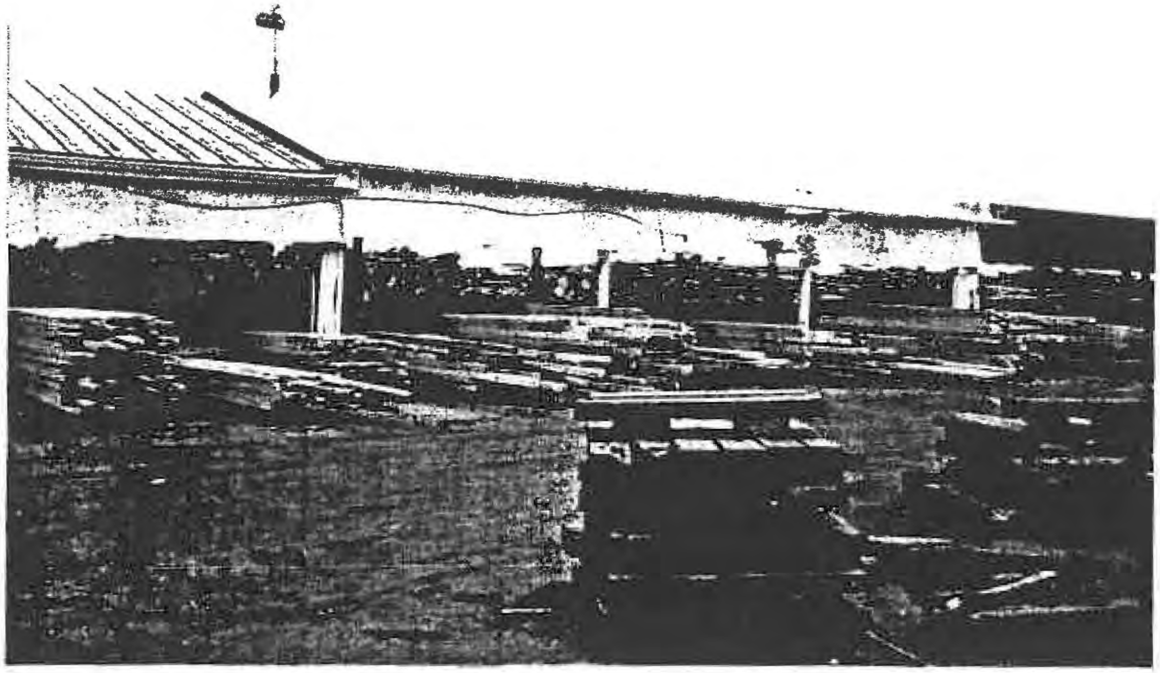
10 3 Transformers at sawmill (TR-2)



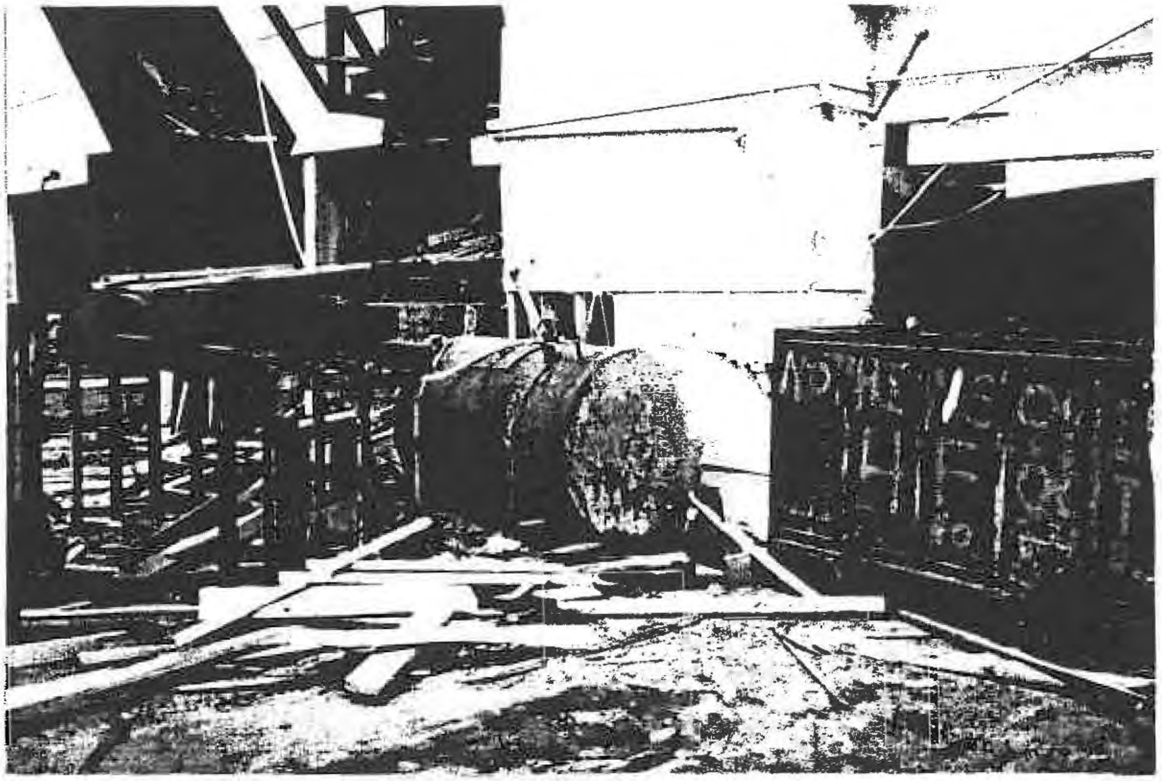
11 Cherry picker and stained soil south of sawmill



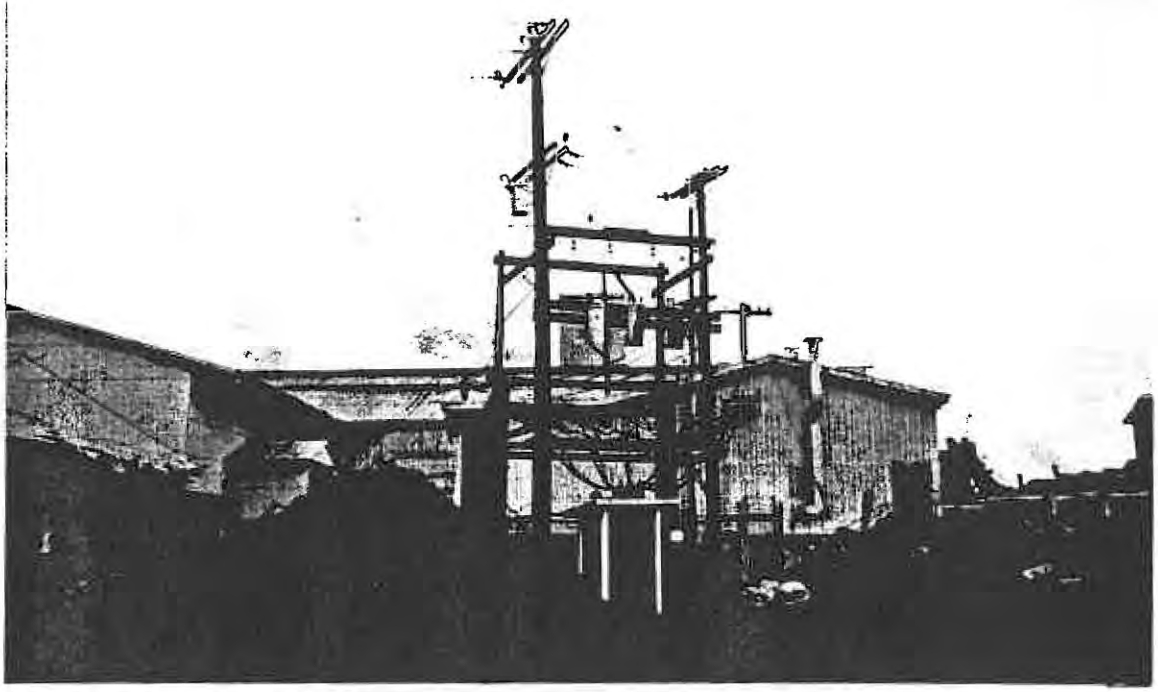
12 Transformer south of sawmill



13 Overview of green chain

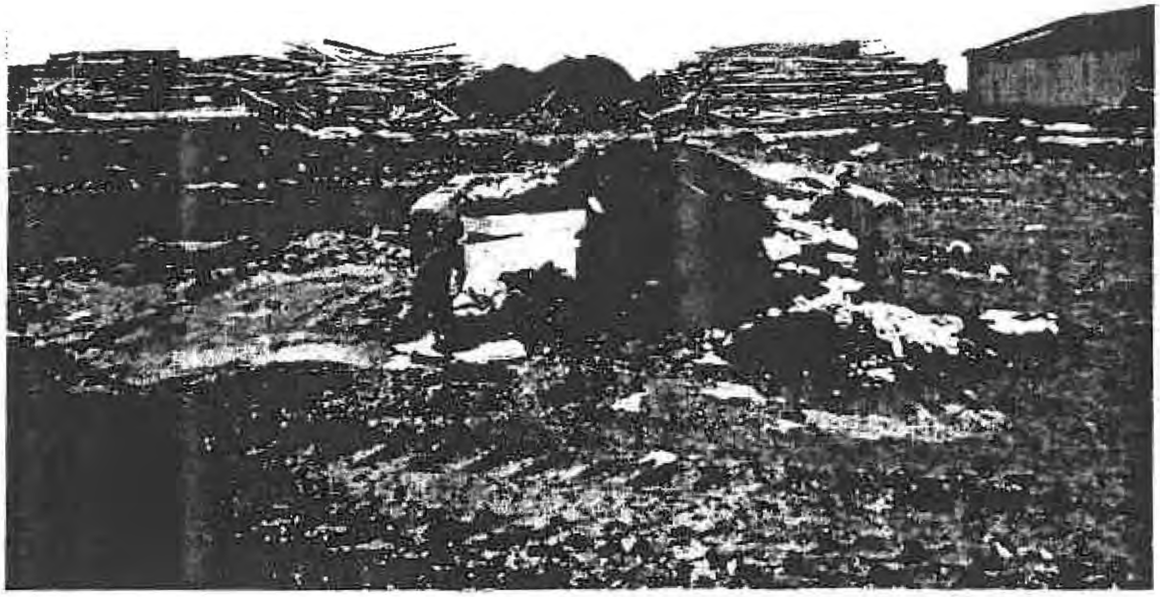


14 Old penta tank west of green chain

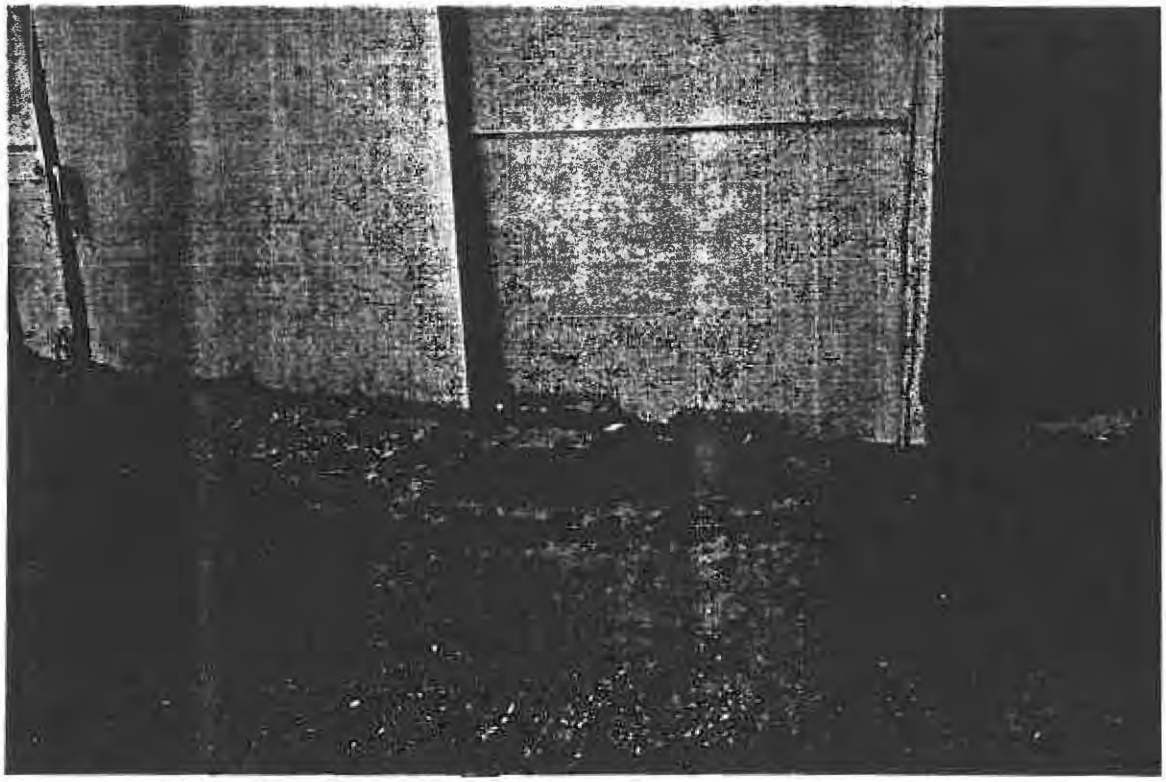


15 4 pole and 1 pad-mount transformers north of green chain

16 Outfall discharge from boiler to Port Angeles Harbor



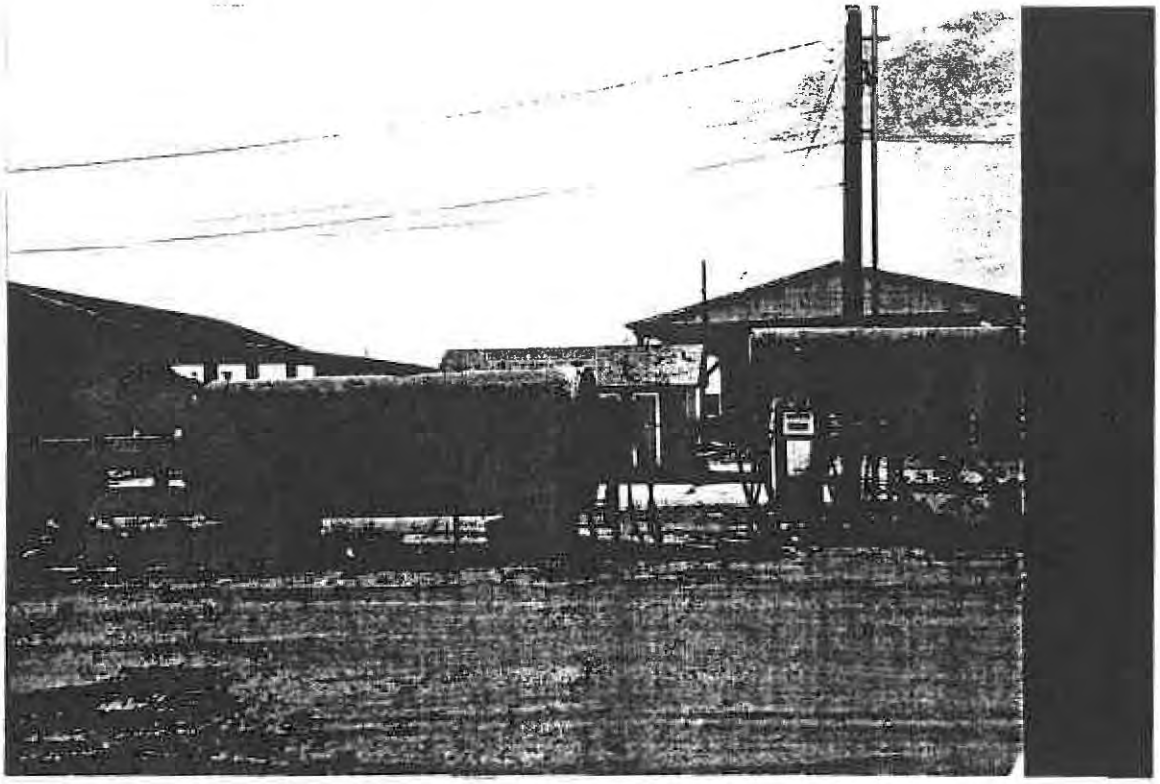
17 Boiler soot bunker north of boiler



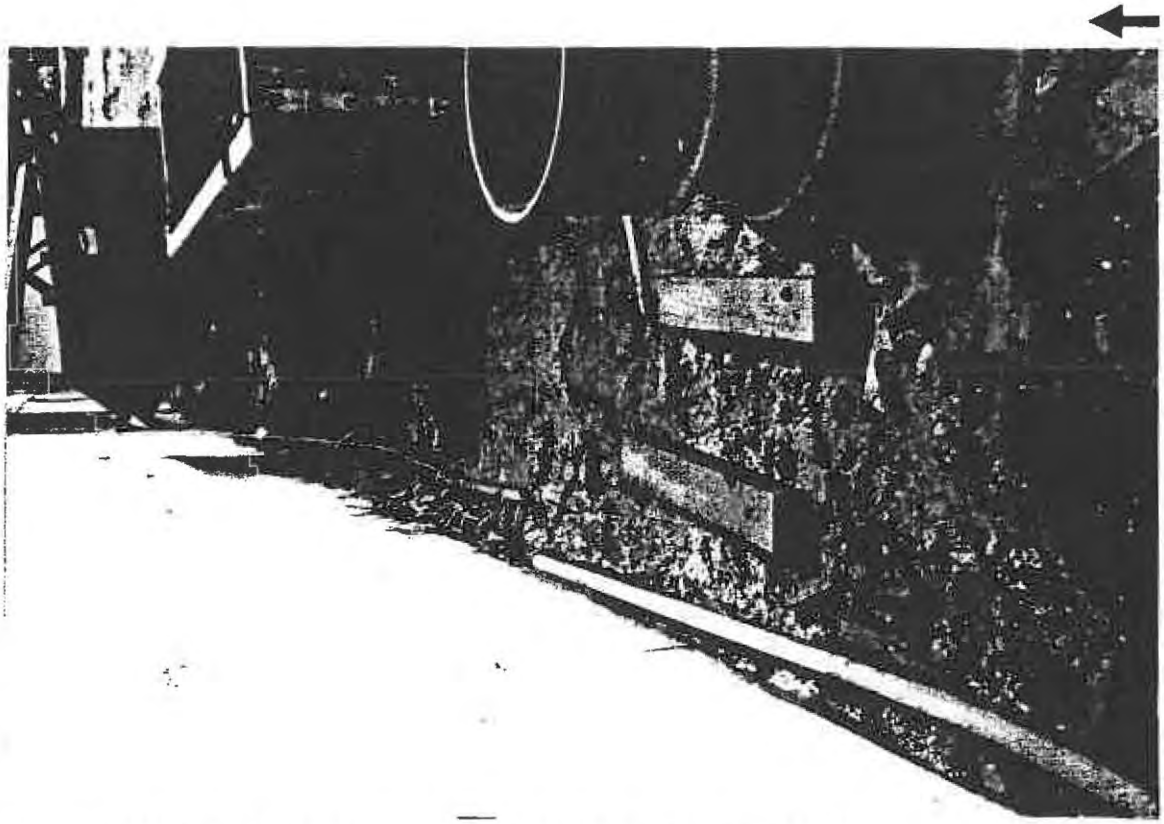
18 Discarded batteries at old truck maintenance site

19 Misc. waste drums and transformer at old truck maintenance site (TR-3)

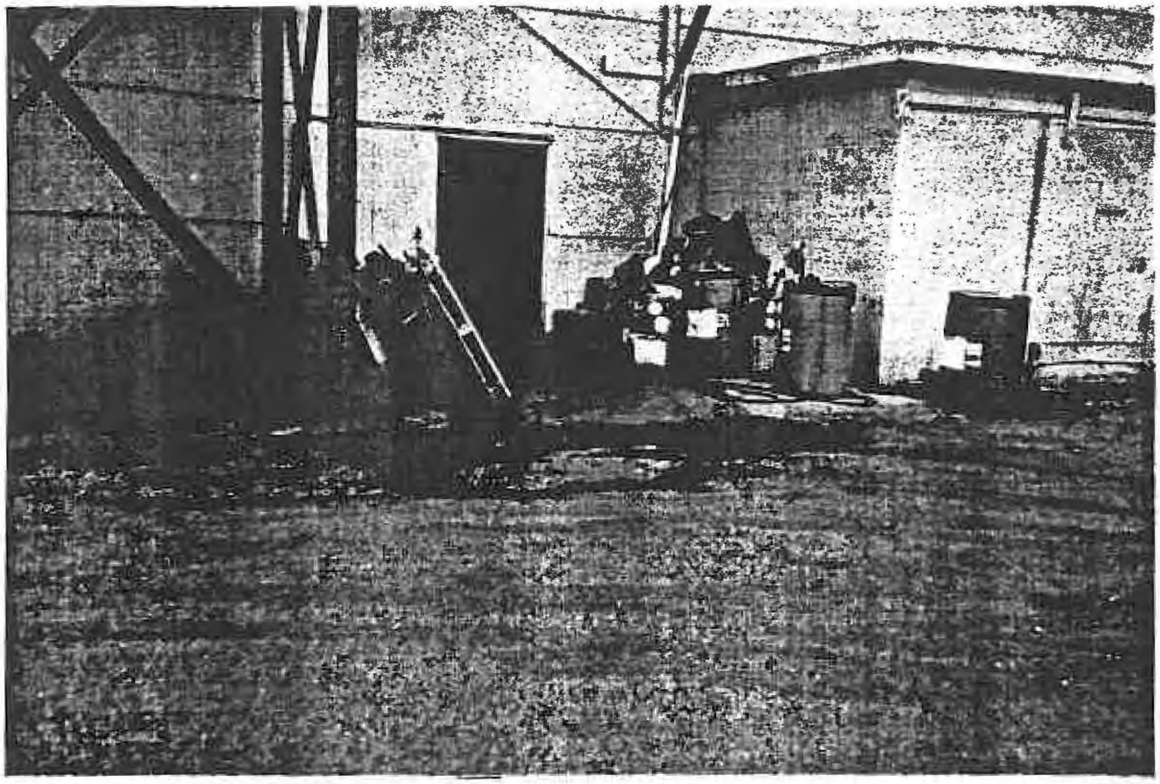
20 Stained soil around drums



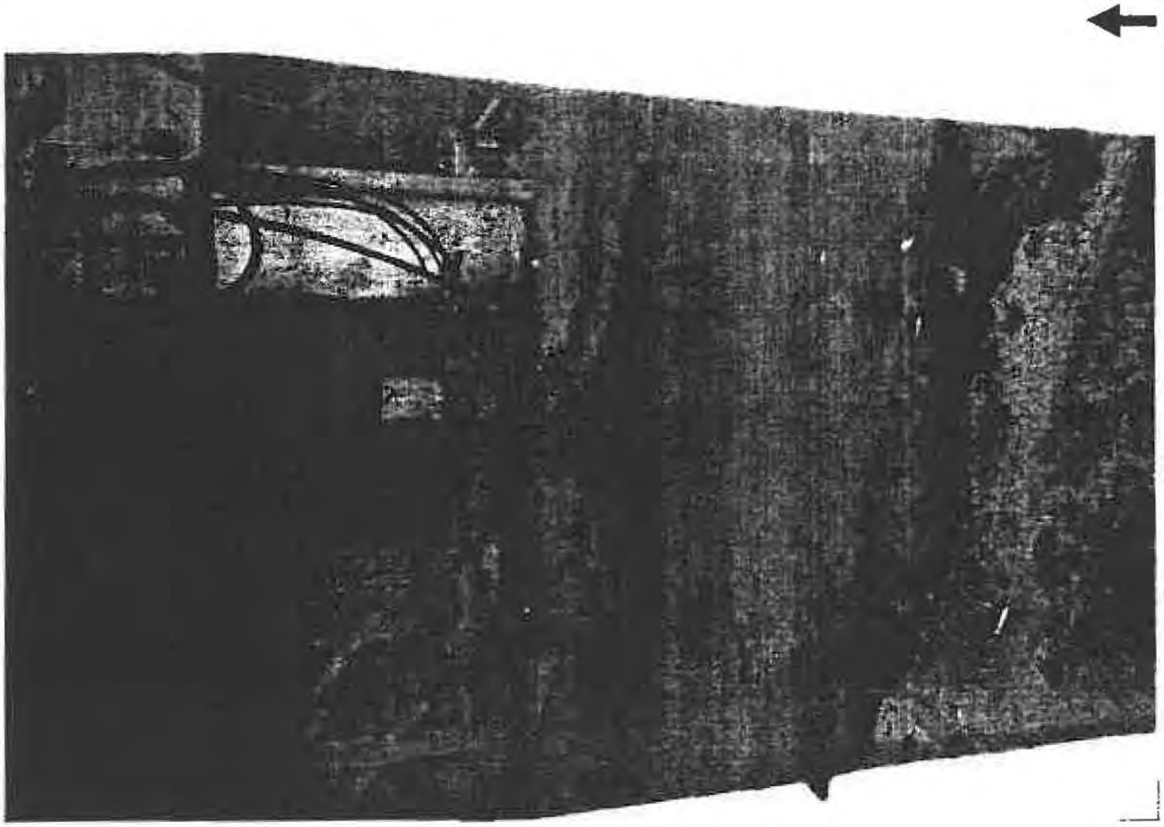
21 2 above-ground diesal tanks west of planer



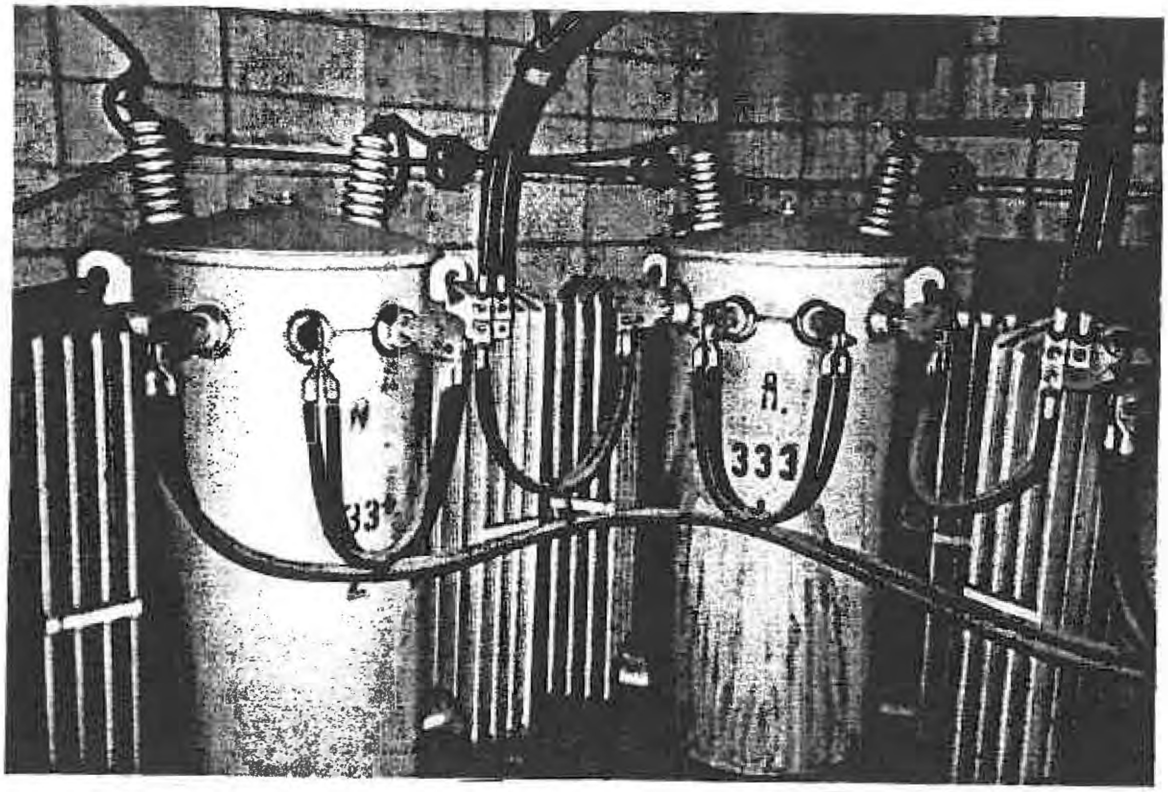
22 Stained soil NW corner of planer building (SS-2)



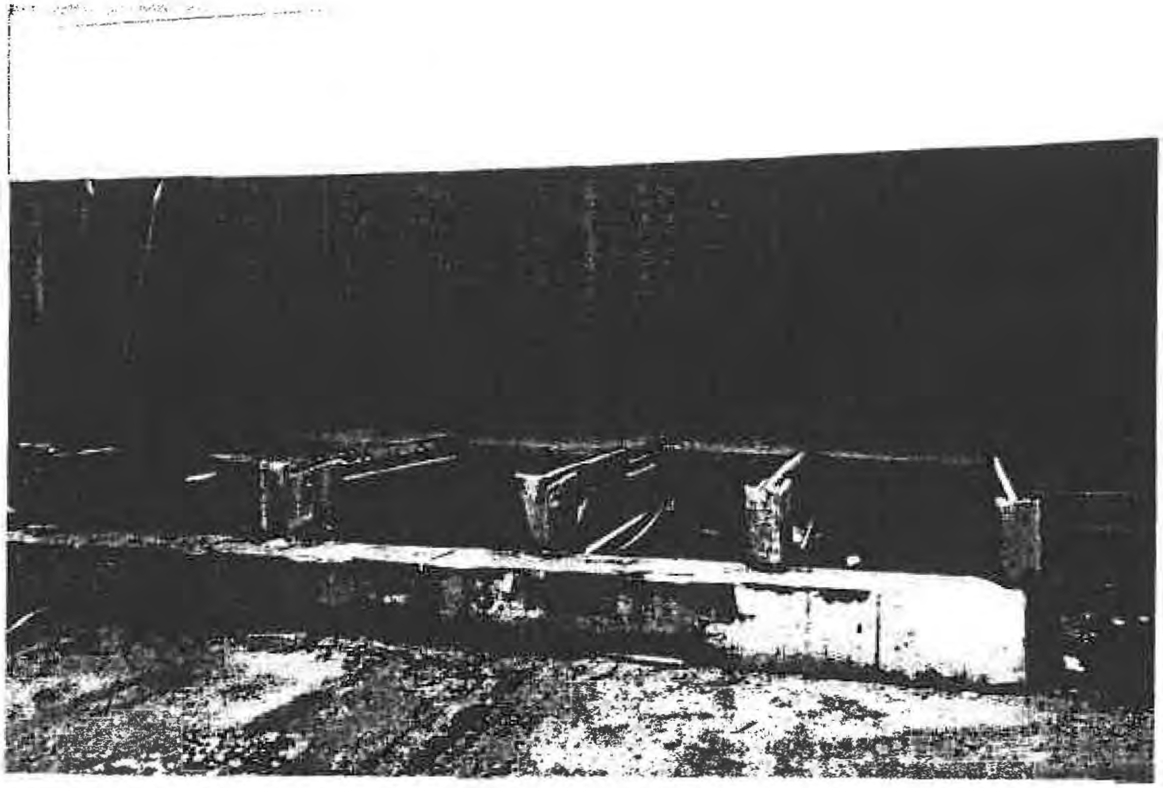
23 Overview of west entrance to planer building and stained soil (SS-1)



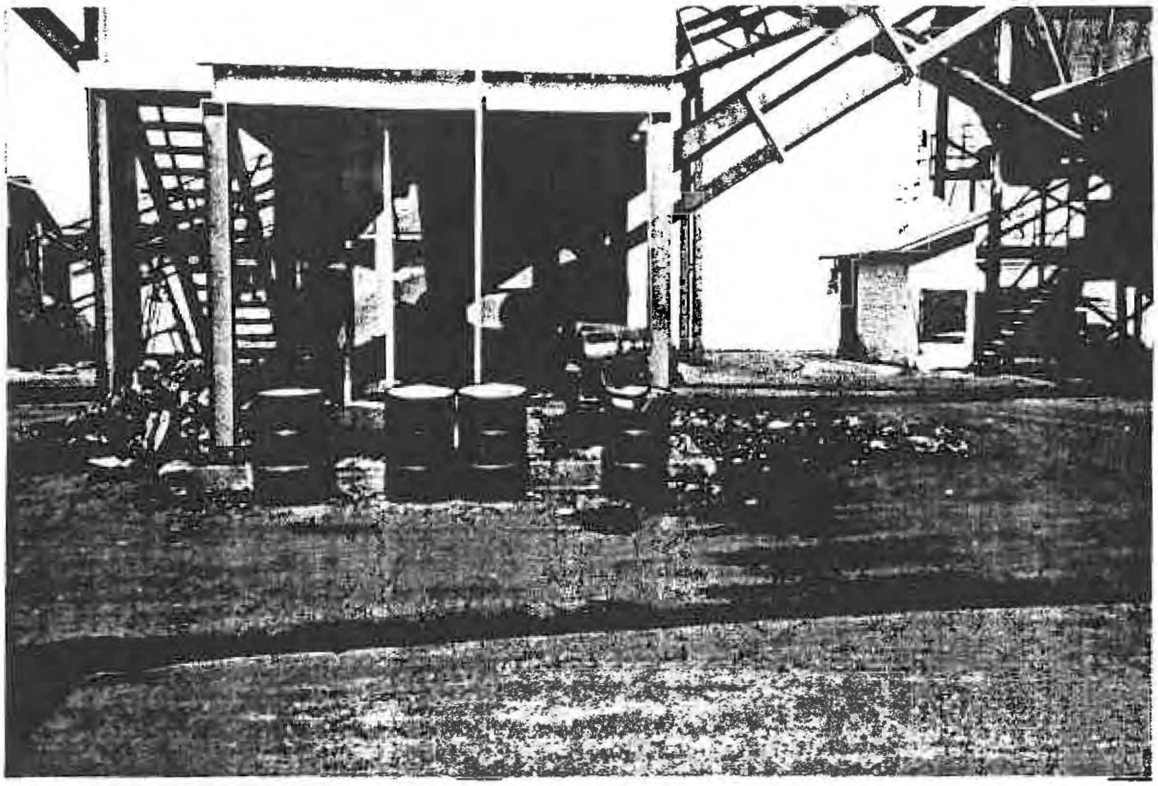
24 Millbrite/NP-1 puddle inside planer building



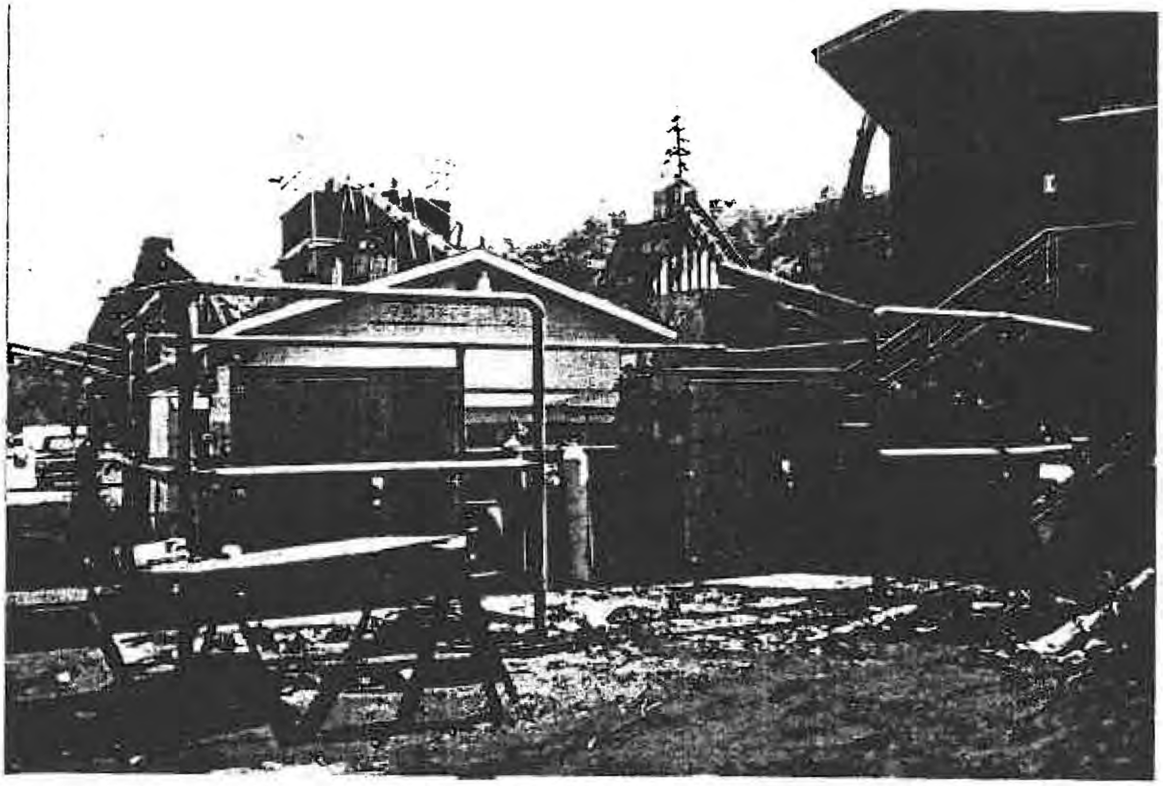
25 3 Tranformers at planer (TR-1)



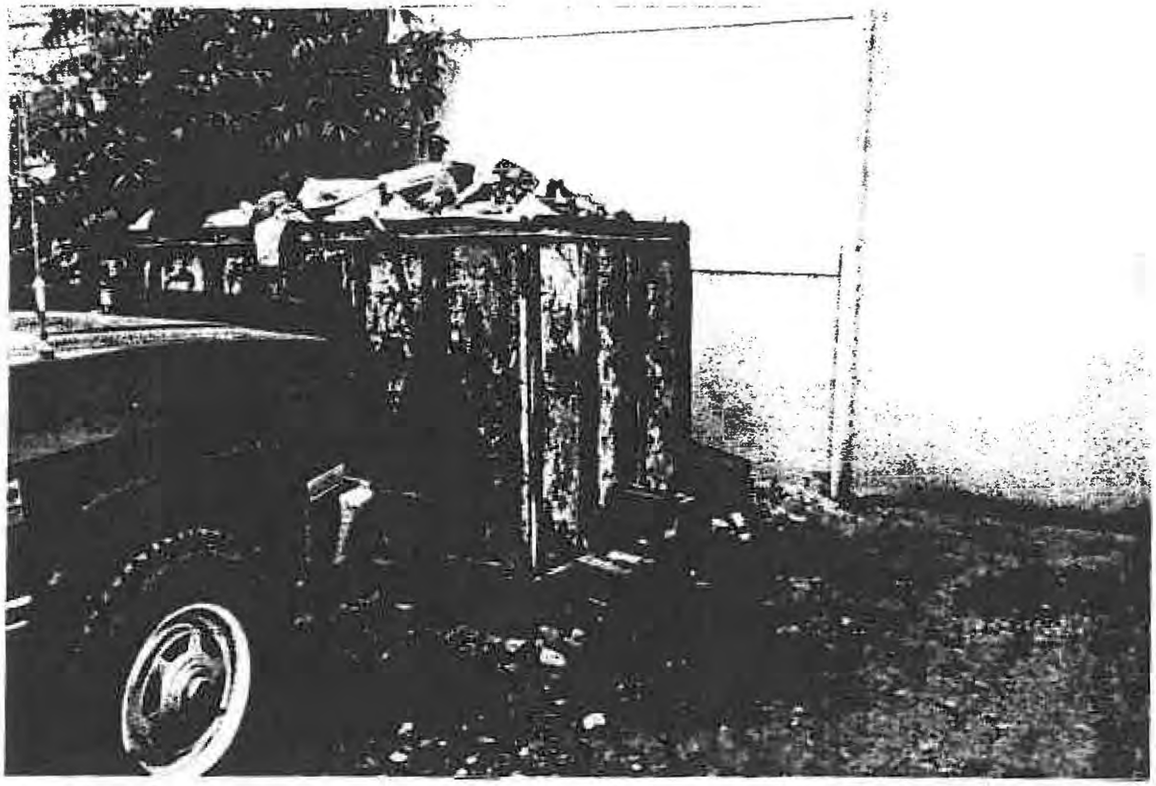
26 Overview of paint spray booth



27 Alder chip yard and stained area

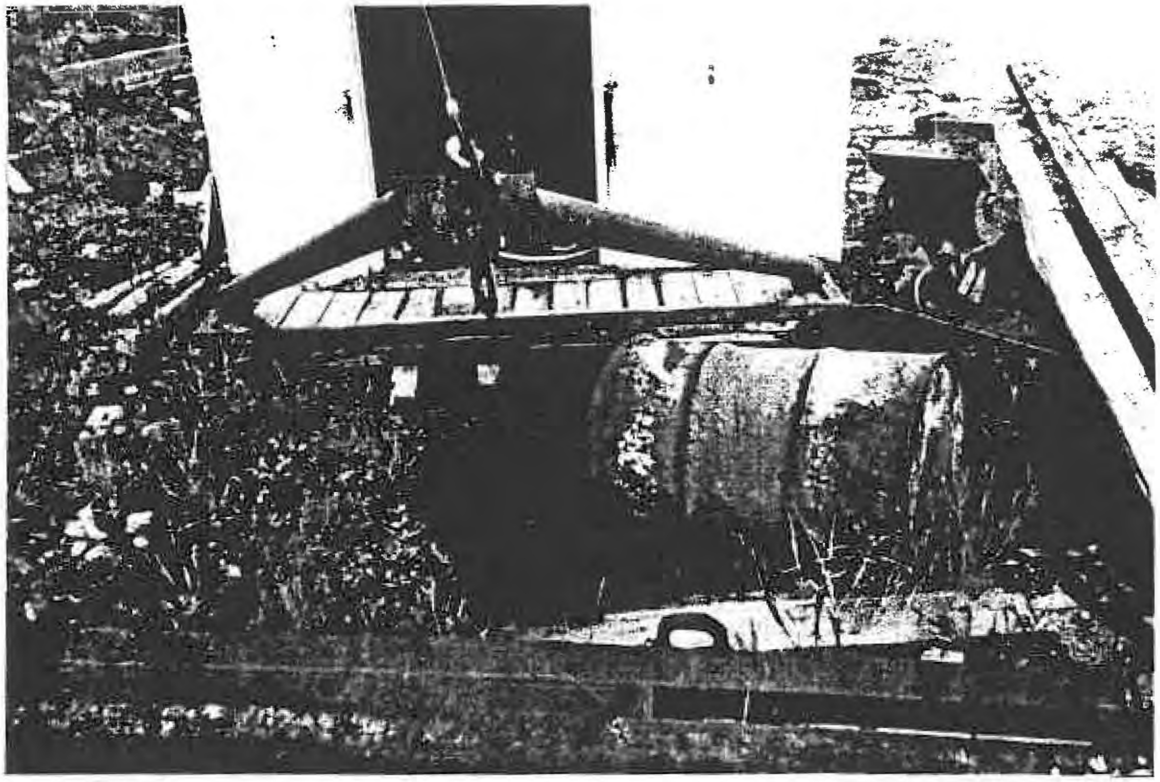


28 3 Transformers north of alder chip yard (TR-4)

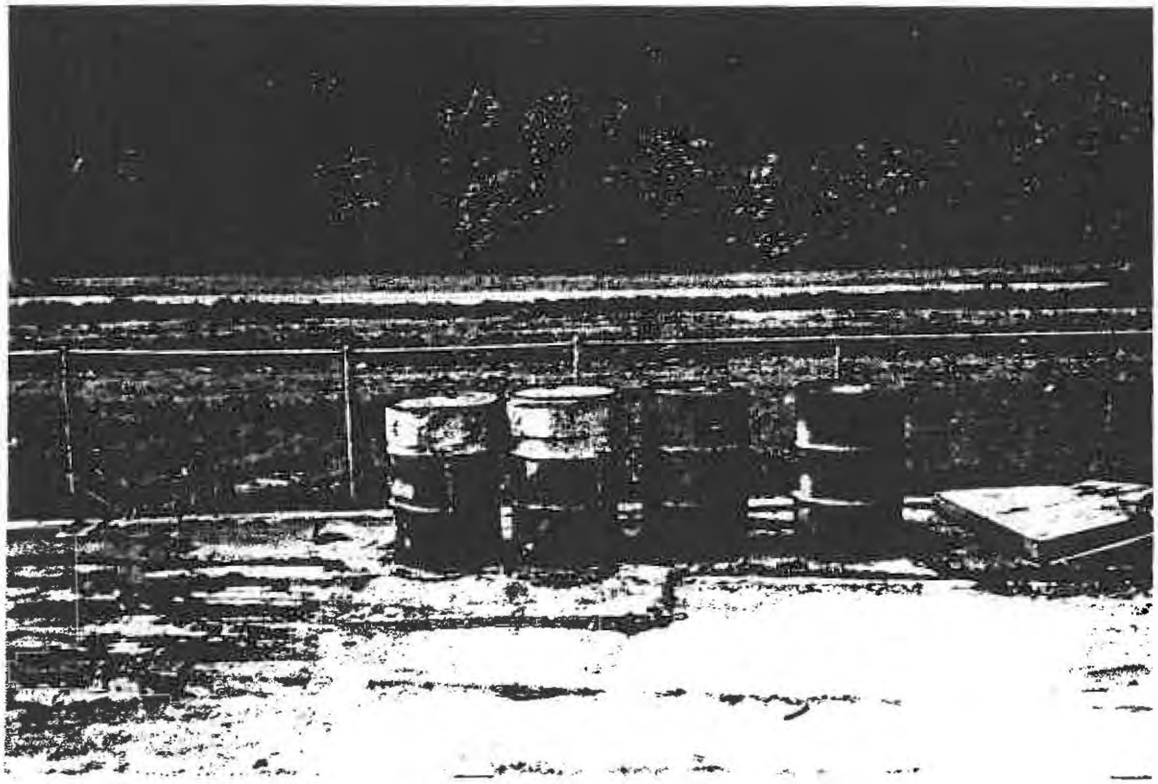


29 NW corner of truck maintenance building and stained soil

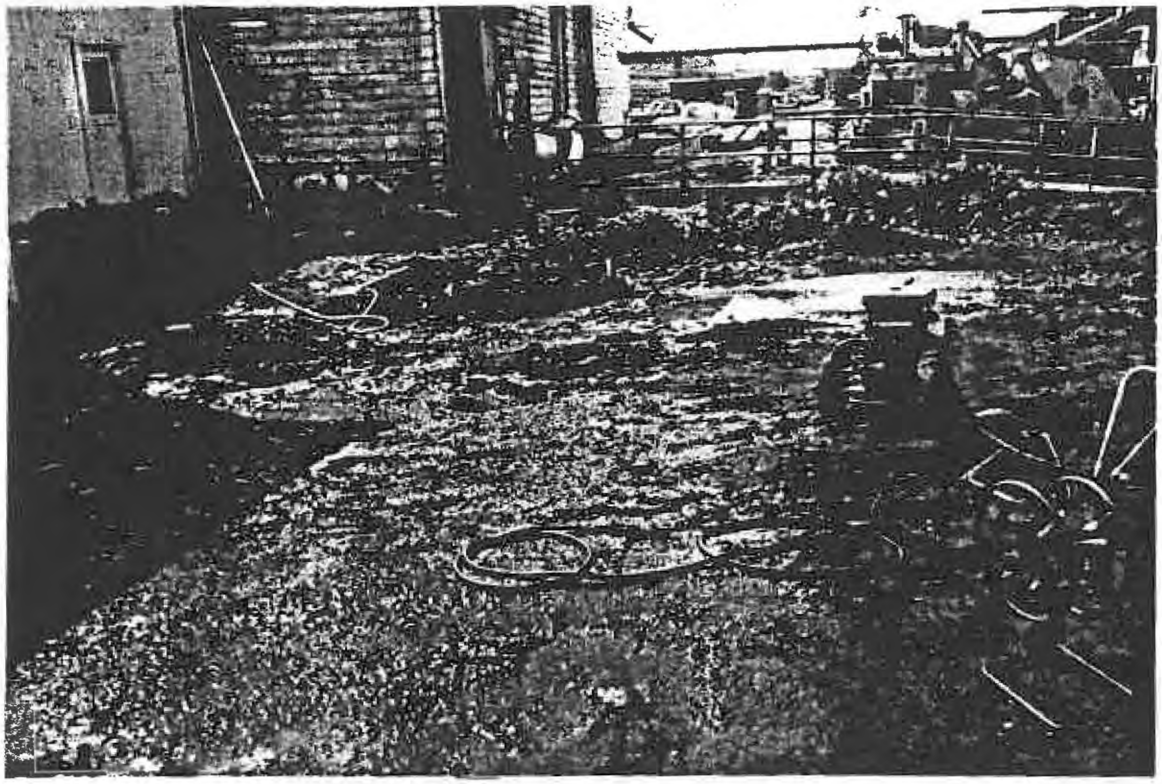
30 Misc. debris west of truck maintenance



31 Spilled drum west of truck maintenance

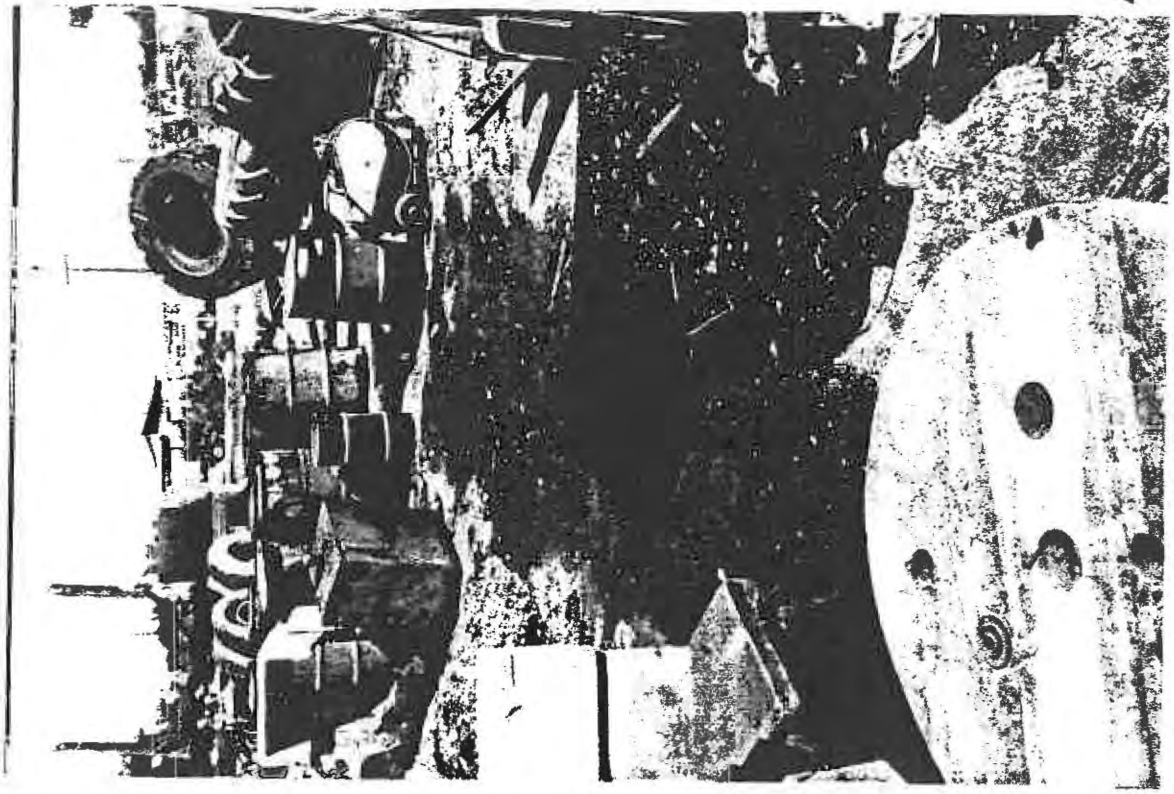


32 Misc. waste drums west of truck maintenance

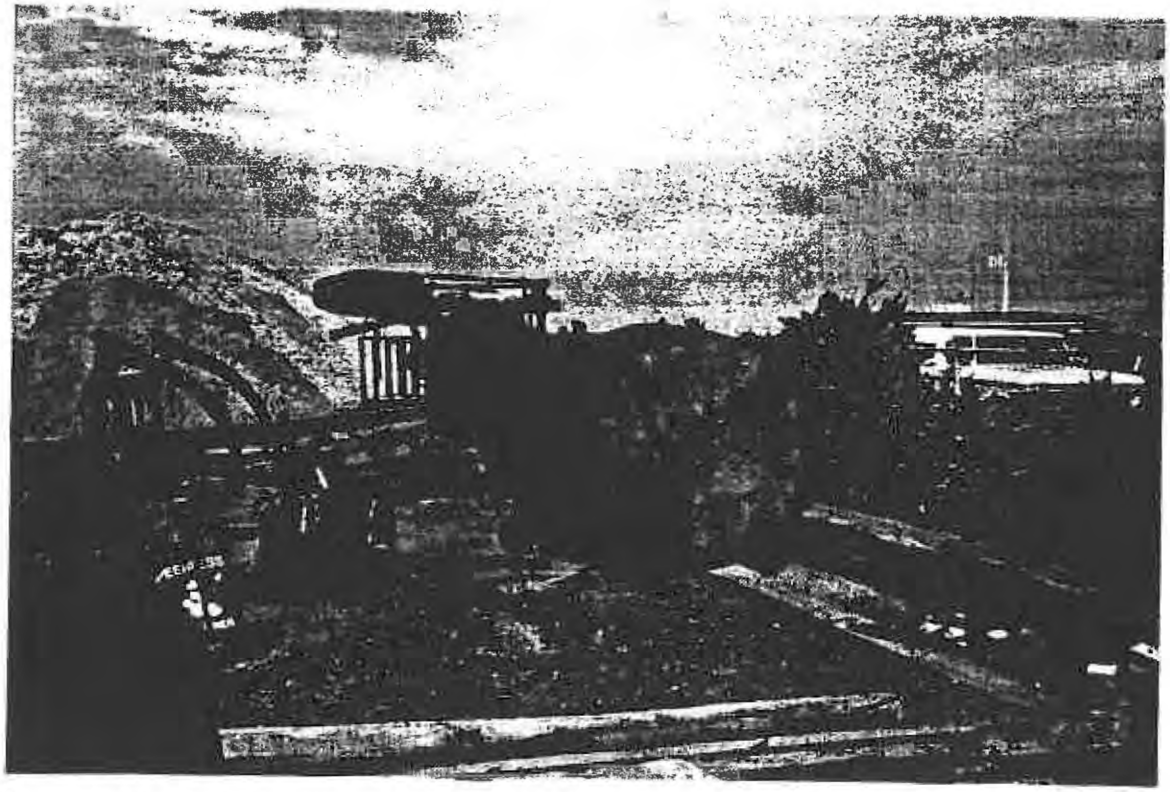


33 Power wash area north of truck maintenance

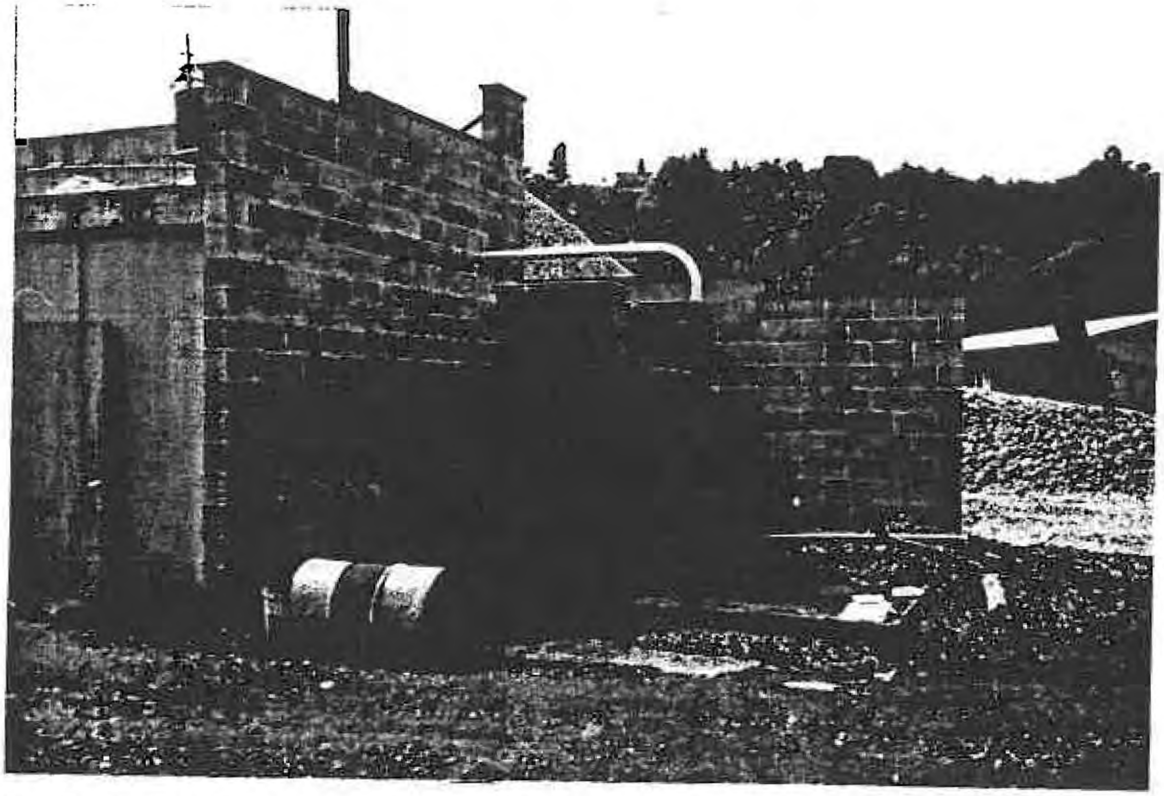
34 Misc. waste oil drums north of truck maintenance



35 Stained soil north of truck maintenance (SS-3)



36 Empty above-ground tank north of truck maintenance



37 Transformer north of chip pile, by ship loading area (TR-5)

Boring Log B-1

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense, moist, gray to black, medium to fine SAND with trace gravel and silt. (FILL)

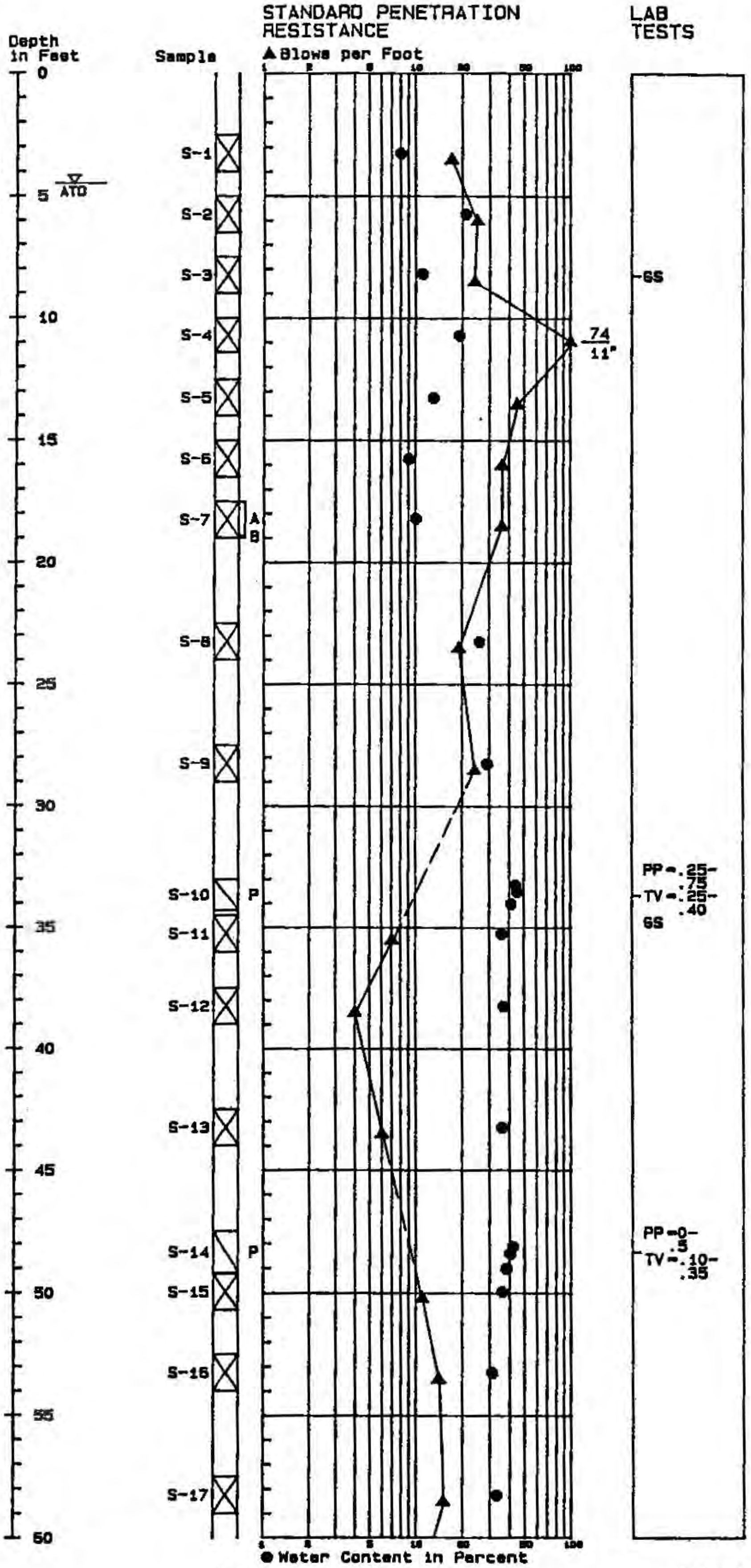
Medium dense, wet, gray, gravelly SAND and sandy GRAVEL.

- Grades dense.

Medium dense, wet, gray, silty, fine SAND with organics, wood, and shell fragments.

- Becomes loose to medium stiff, very silty SAND to fine sandy SILT.

- Becomes medium dense.



J-2160 May 1988

HART-CROWSER & associates, inc.

Sheet 1 of 2 Figure C-2

Boring Log B-1

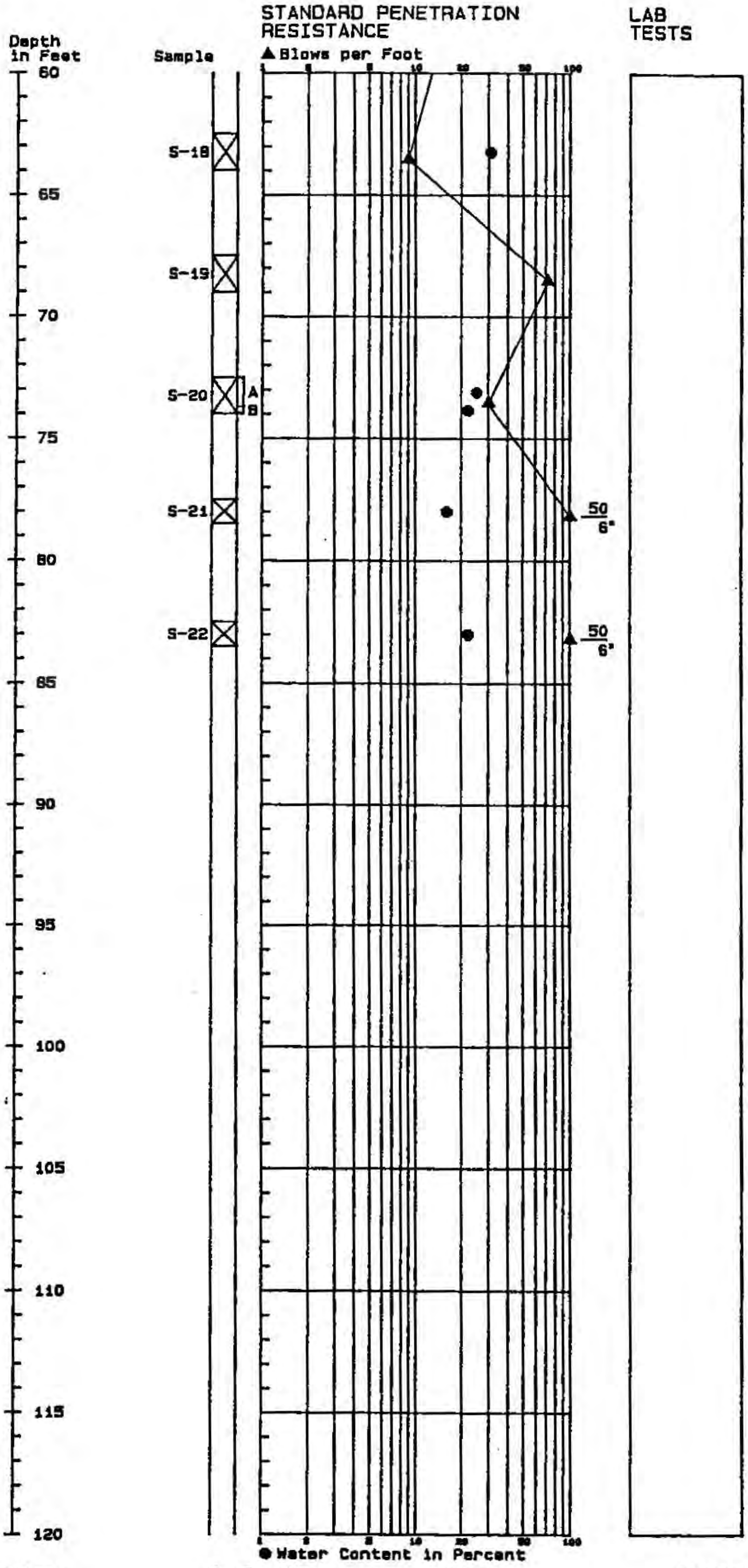
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Loose to medium dense, wet, gray, silty, fine SAND with wood and shell fragments.

Very dense to hard, wet, gray, slightly gravelly, very silty SAND to fine sandy SILT.

Bottom of Boring at 83.5 Feet.
Completed 5/9/88.



1. Refer to Figure C-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.

J-2160 May 1988
HART-CROWSER & associates, inc.
Sheet 2 of 2 Figure C-2

Boring Log B-2

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense, moist to wet, oxidized brown to brown, gravelly, silty to very silty, fine SAND. (FILL)

Loose, wet, gray, gravelly SAND and black, silty, fine SAND interlayered. (FILL)

Loose, wet, brown and black, gravelly, silty SAND with substantial wood chips varying from <5% to nearly 100%. (FILL)

Medium dense to dense, wet, gray, gravelly SAND to very sandy GRAVEL.

- Grades very dense.

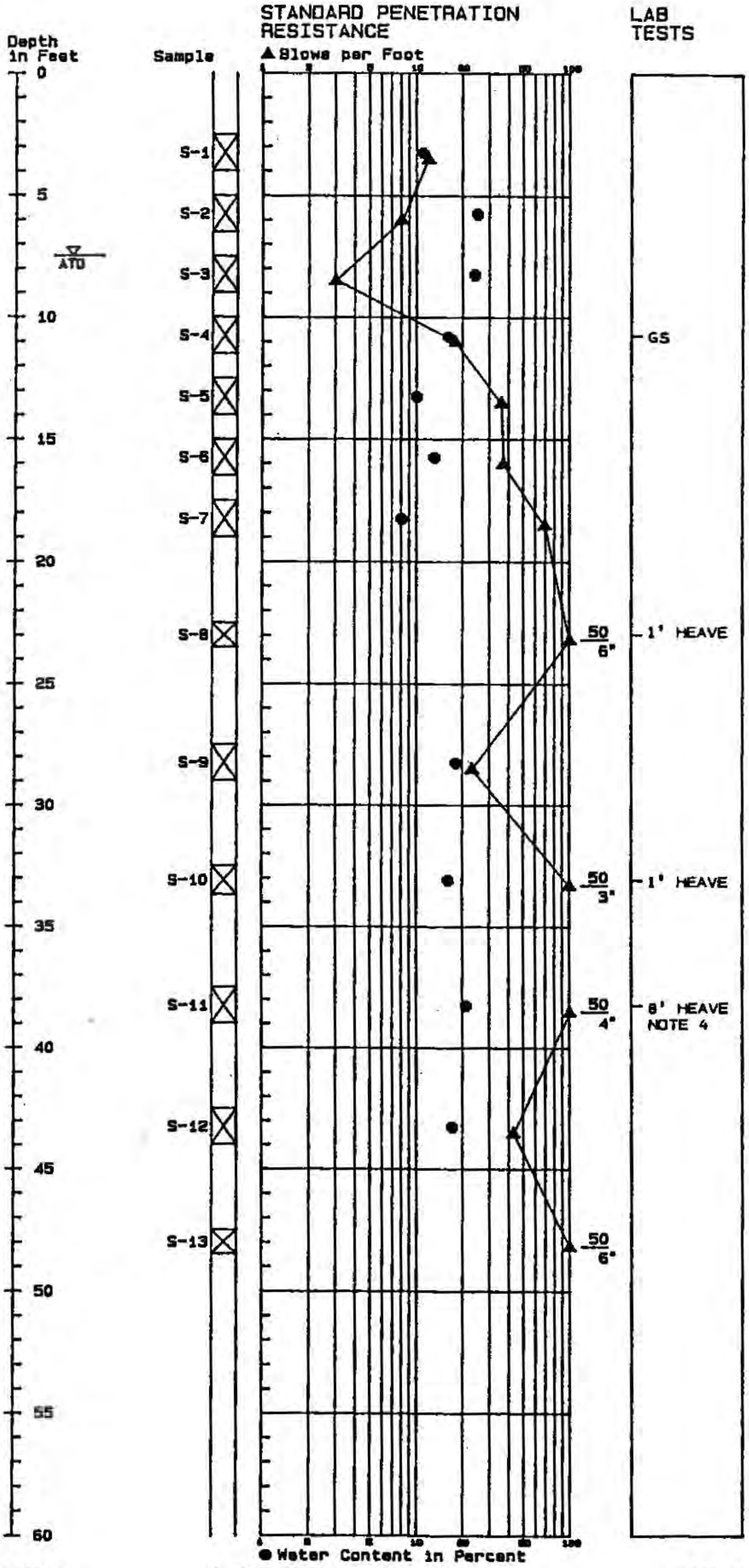
Medium dense to very dense, wet, gray, trace to slightly silty, fine SAND.

Very dense, wet, gray, trace to slightly gravelly, fine to medium SAND to SAND with trace wood.

Dense, wet, gray, silty, fine SAND with wood and shell fragments.

Very dense, wet, dark gray, interbedded, very silty, fine SAND and fine sandy SILT with trace gravel.

Bottom of Boring at 48.5 Feet. Completed 5/9/88.



1. Refer to Figure C-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. BLOW COUNT MAY NOT BE REPRESENTATIVE OF ACTUAL MATERIAL DENSITY.

J-2160 May 1988

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Figure C-3

Boring Log B-3

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

ASPHALT.

Loose, moist, dark gray to black, silty, gravelly SAND. (FILL)

(Medium dense to very dense), wet, gray, gravelly SAND to very sandy GRAVEL.

Medium dense, wet, gray, fine SAND with shell fragments, scattered fine gravel and wood.

- Grades to loose.

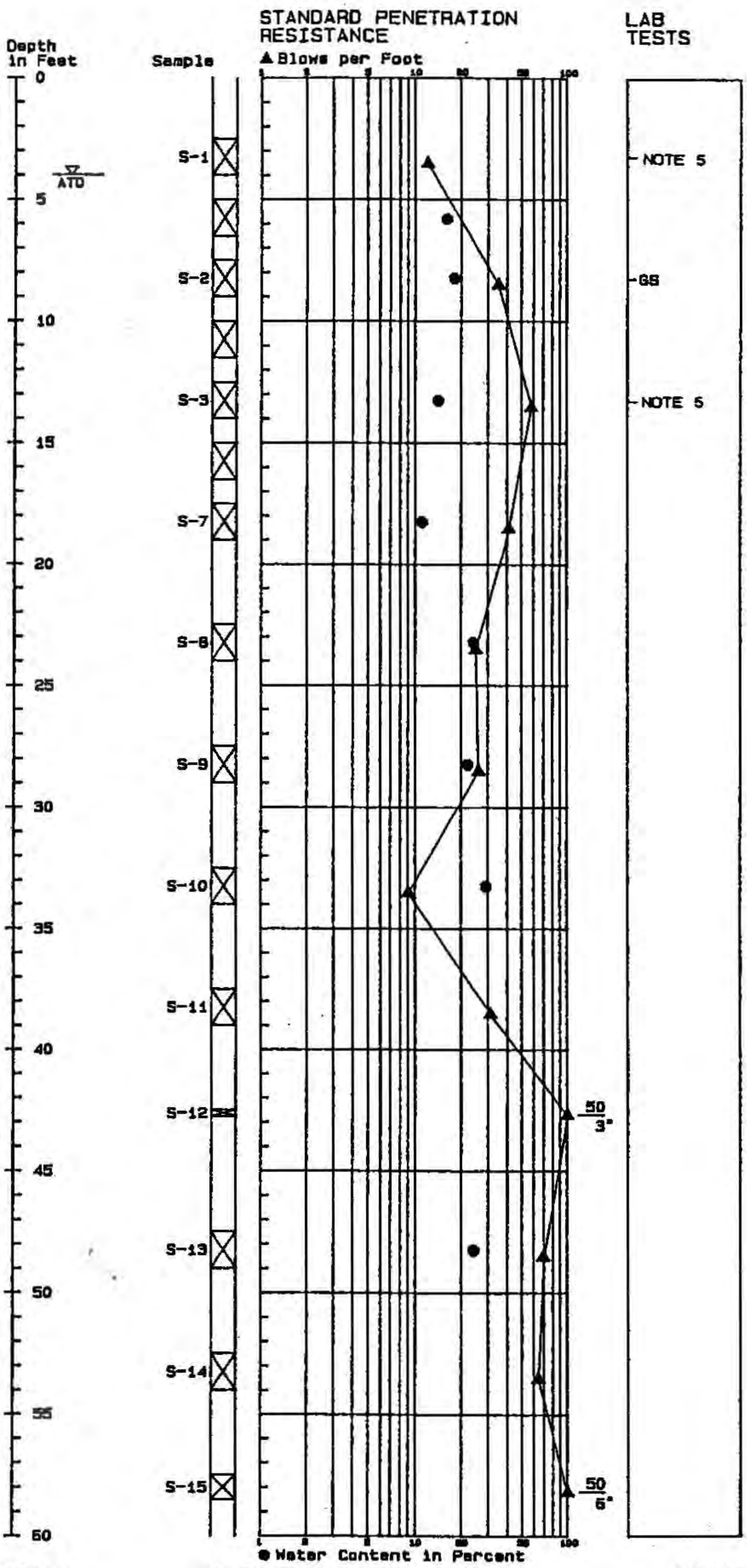
- Grades to dense.

Very dense, wet, gray, interbedded fine SAND and SILT with scattered gravels and shells.

Very dense, wet, gray, interbedded silty, fine SAND, gravelly, silty, fine SAND and hard, gray, moist to wet SILT.

Very dense, wet, gray, very gravelly SAND.

Bottom of Boring at 58.5 Feet.
Completed 5/10/88.



1. Refer to Figure C-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. BLOW COUNT MAY NOT BE REPRESENTATIVE OF ACTUAL MATERIAL DENSITY.

[illegible]

J-2160 May 1988

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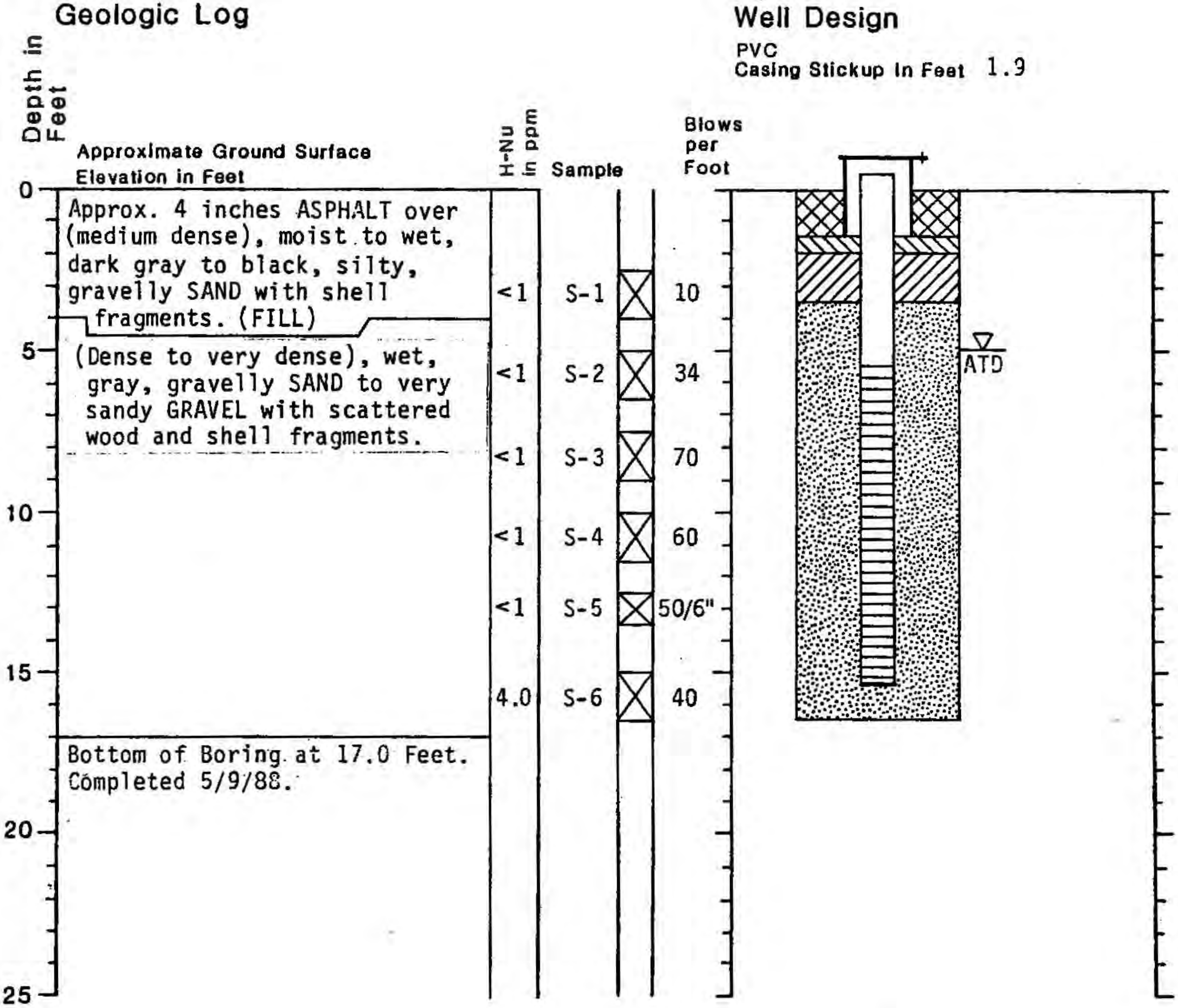
Figure C-4

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



Approx. 4 inches ASPHALT over (medium dense), moist to wet, dark gray to black, silty, gravelly SAND with shell fragments. (FILL)

(Dense to very dense), wet, gray, gravelly SAND to very sandy GRAVEL with scattered wood and shell fragments.

Bottom of Boring at 17.0 Feet. Completed 5/9/88.

H-Nu in ppm	Sample	Blows per Foot
<1	S-1	10
<1	S-2	34
<1	S-3	70
<1	S-4	60
<1	S-5	50/6"
4.0	S-6	40

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159 6/88
Figure C-5

Boring Log B-4

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense, moist to wet, black to gray, slightly silty, gravelly, medium to fine SAND with scattered rip rap, cobbles, and wood. (FILL)

Dense to very dense, wet, gray-brown, very gravelly SAND to very sandy GRAVEL.

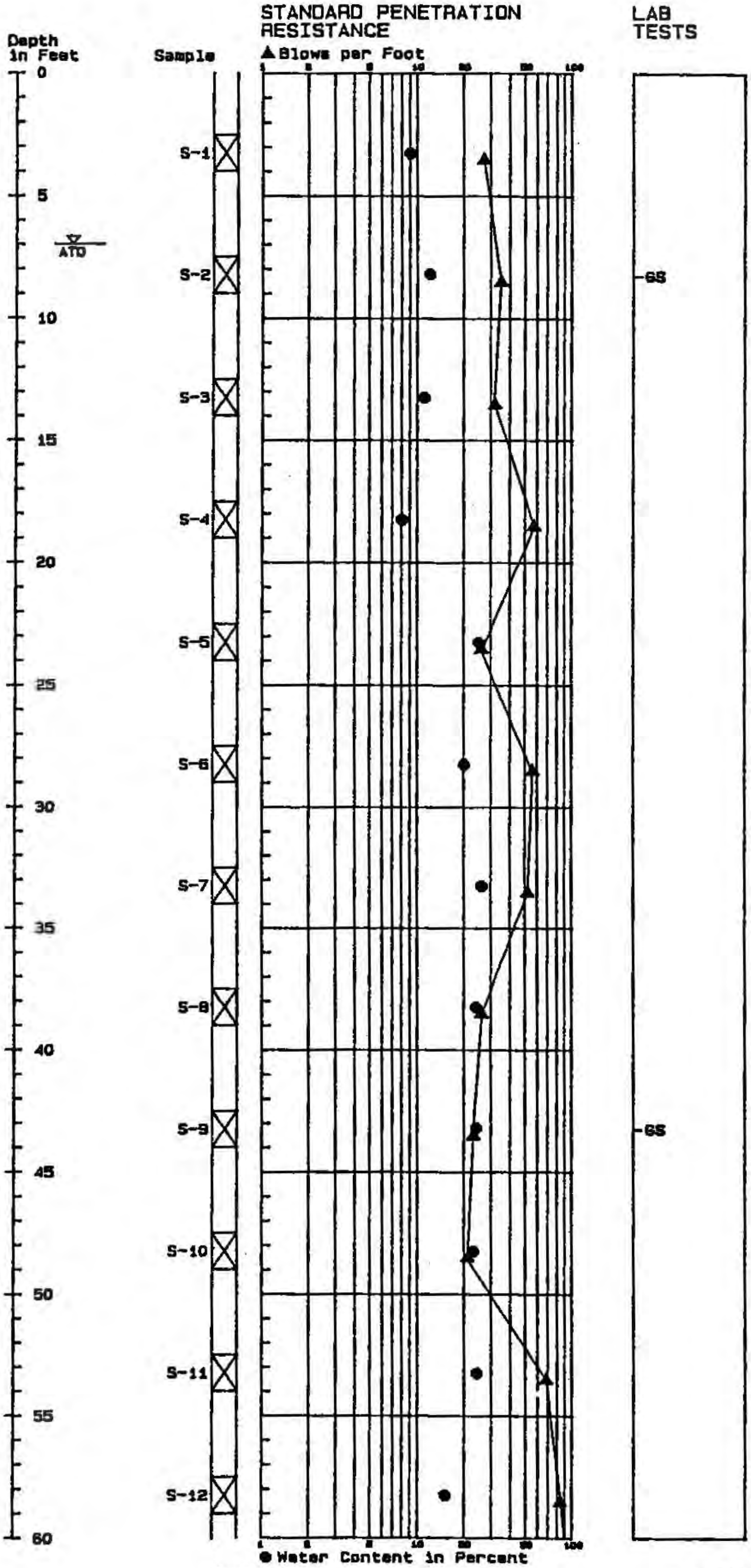
Medium dense, wet, gray, silty, very fine SAND with scattered gravel, wood, and shell fragments.

Grades to very dense.

Grades to medium dense.

Hard, wet, gray SILT to slightly fine sandy SILT with trace gravels.

Very dense, wet, gray, trace to slightly silty, slightly gravelly SAND to fine to medium SAND.



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Sheet 1 of 2 Figure C-6

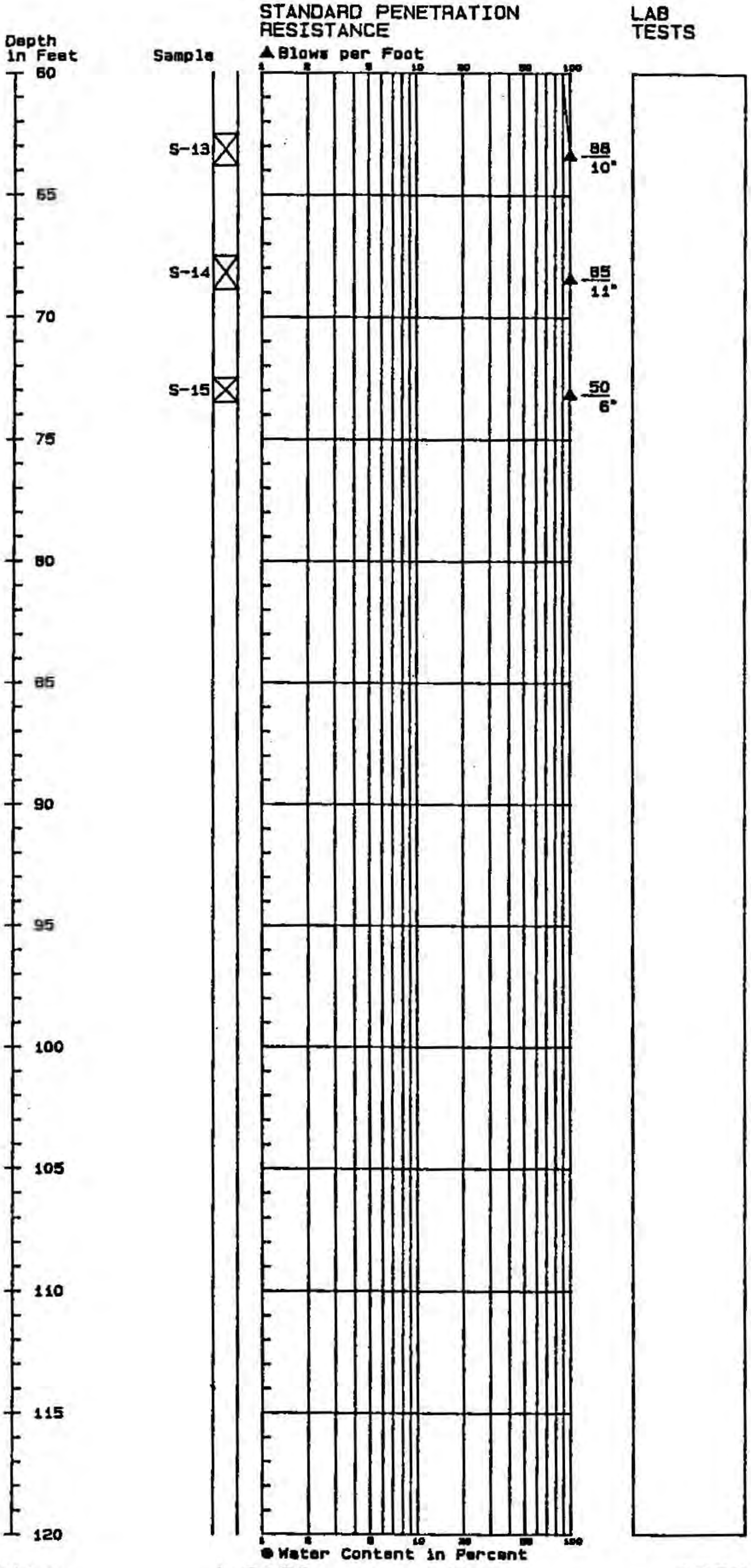
Boring Log B-4

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Very dense (hard), moist to wet, gray, interbedded, finely laminated SILT, fine sandy SILT with trace gravels, and slightly gravelly SAND.

Bottom of Boring at 73.5 Feet.
Completed 5/11/88.



1. Refer to Figure C-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.

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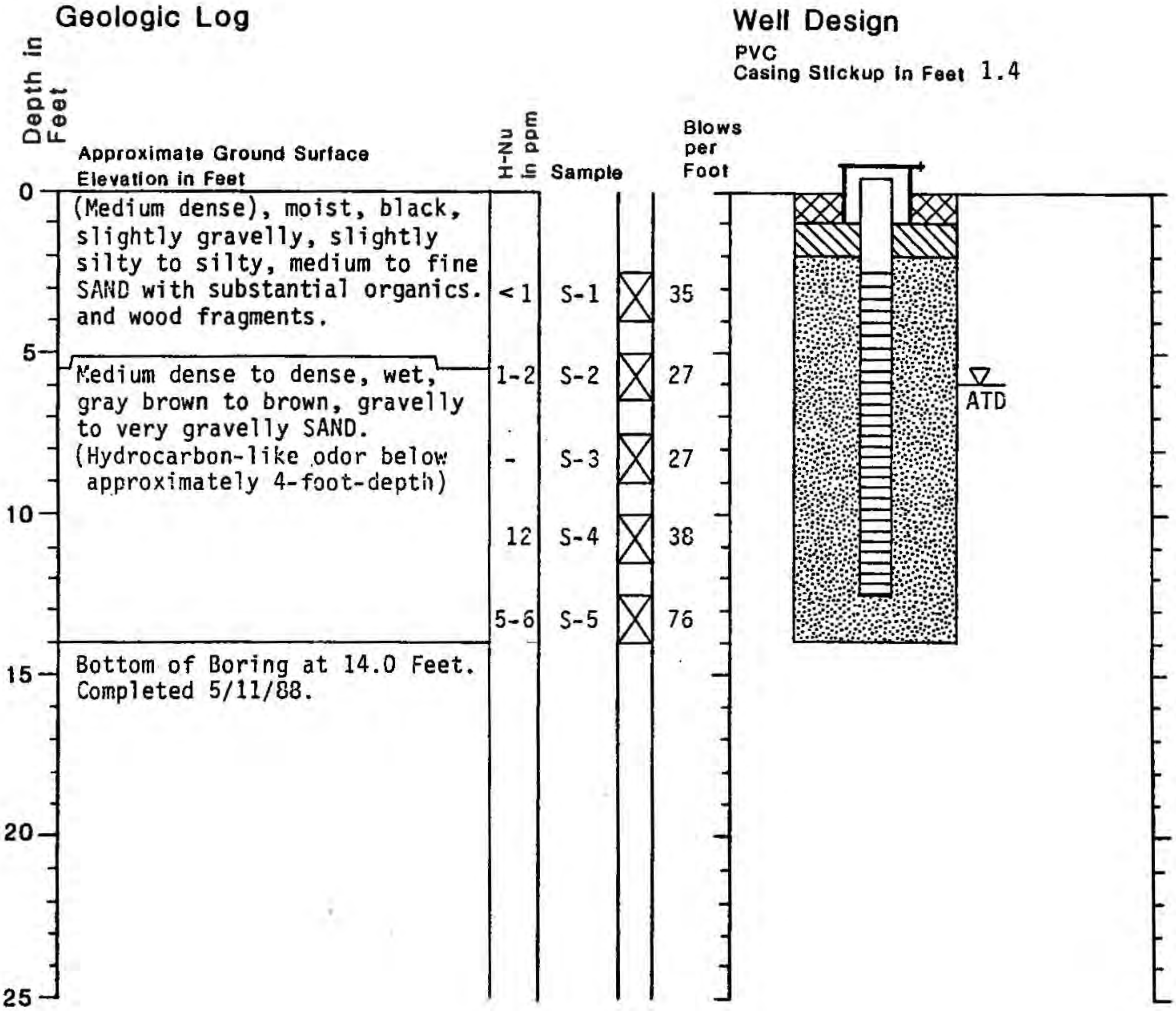
Sheet 2 of 2 Figure C-6

Boring Log and Construction Data for Monitoring Well MW-4A



(Medium dense), moist, black, slightly gravelly, slightly silty to silty, medium to fine SAND with substantial organics. and wood fragments.

Medium dense to dense, wet, gray brown to brown, gravelly to very gravelly SAND. (Hydrocarbon-like odor below approximately 4-foot-depth)

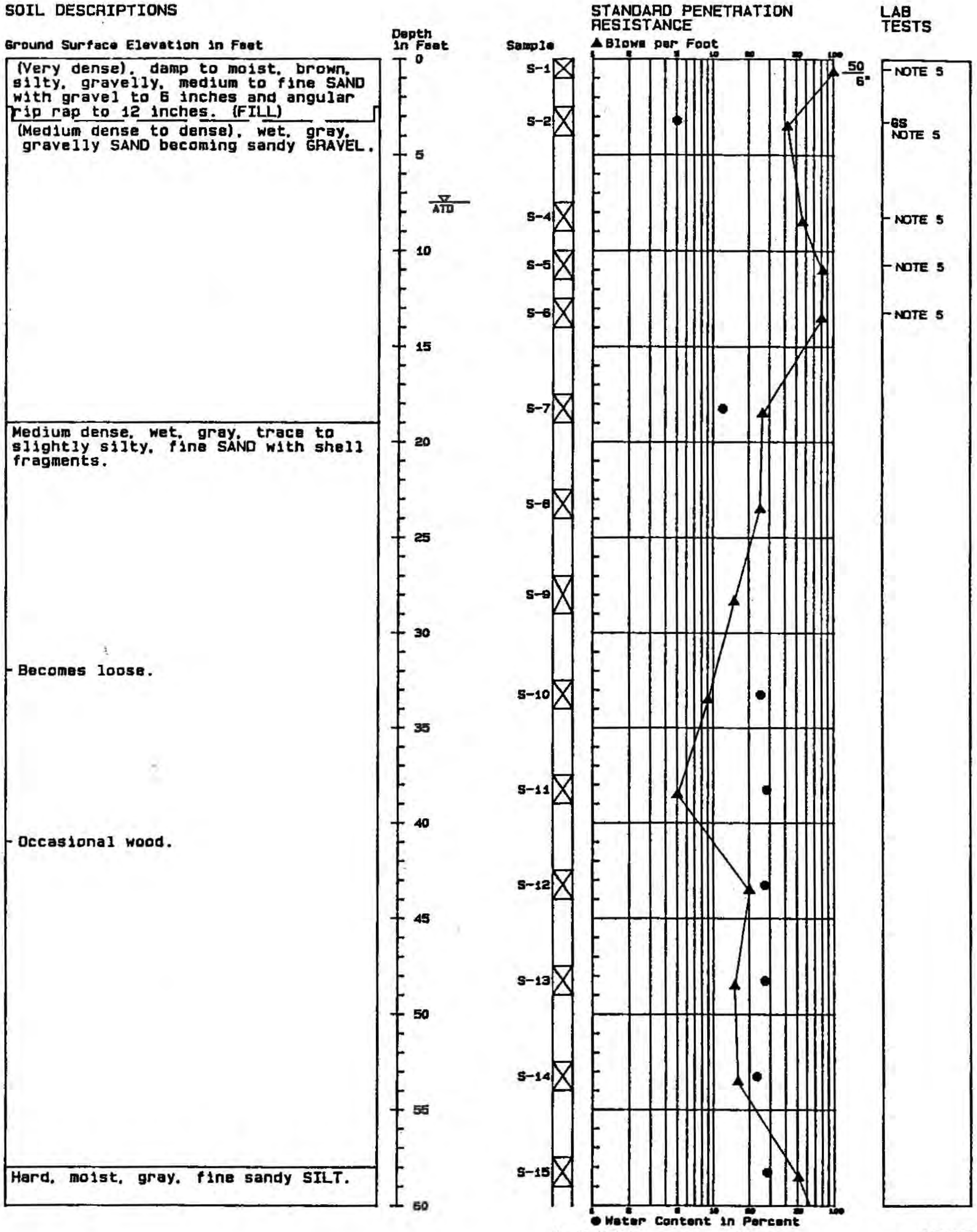
Bottom of Boring at 14.0 Feet. Completed 5/11/88.

H-Nu in ppm	Sample	Blows per Foot
< 1	S-1	35
1-2	S-2	27
-	S-3	27
12	S-4	38
5-6	S-5	76

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159 6/88
Figure C-7

Boring Log B-5



(Very dense), damp to moist, brown, silty, gravelly, medium to fine SAND with gravel to 6 inches and angular rip rap to 12 inches. (FILL)

(Medium dense to dense), wet, gray, gravelly SAND becoming sandy GRAVEL.

Medium dense, wet, gray, trace to slightly silty, fine SAND with shell fragments.

- Becomes loose.

- Occasional wood.

Hard, moist, gray, fine sandy SILT.

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Sheet 1 of 2 Figure C-8

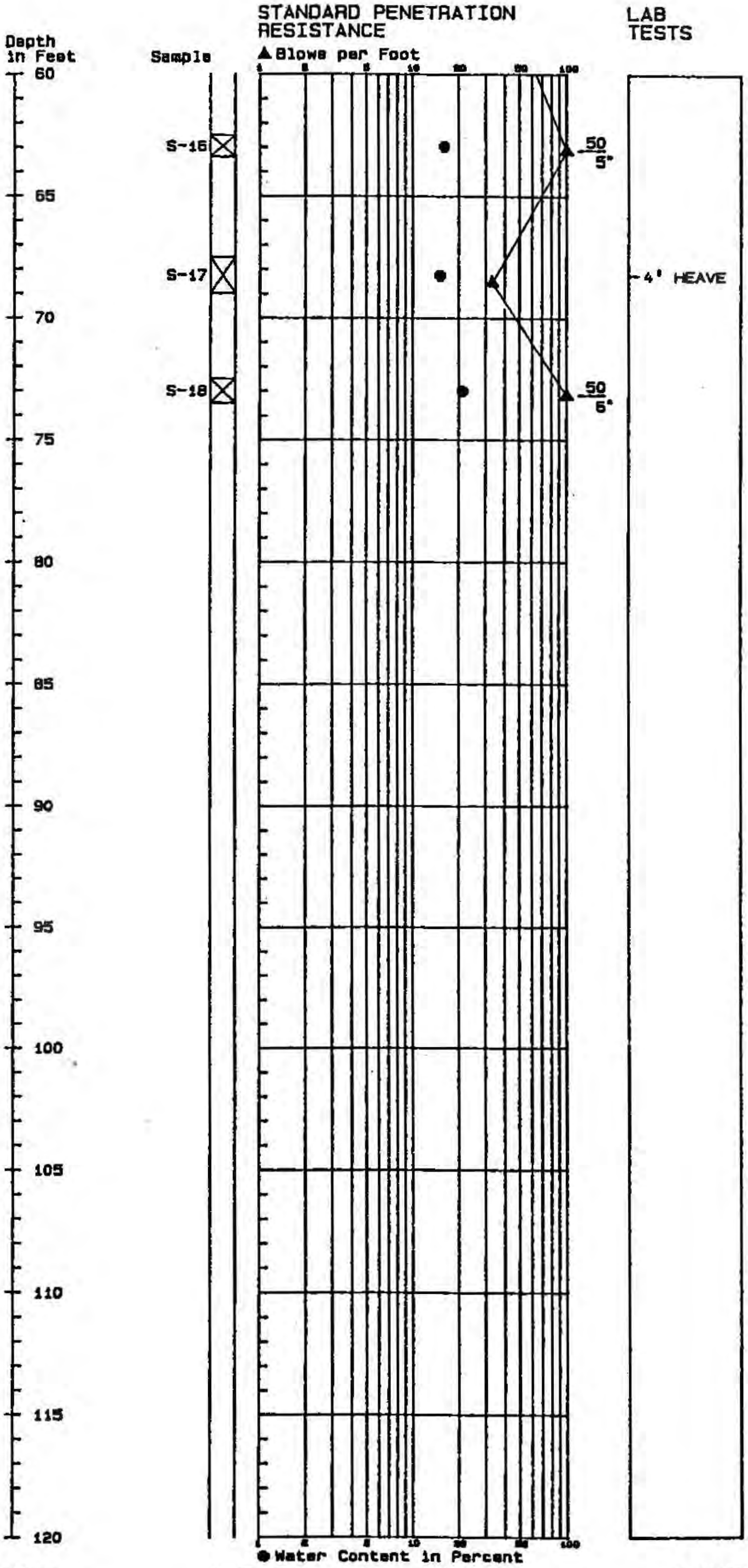
Boring Log B-5

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Very dense (hard), wet, gray, interbedded, silty, fine SAND and fine sandy SILT with scattered shell fragments and wood.

Bottom of Boring at 73.5 Feet.
Completed 5/12/88.



1. Refer to Figure C-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. BLOW COUNT MAY NOT BE REPRESENTATIVE OF ACTUAL MATERIAL DENSITY.

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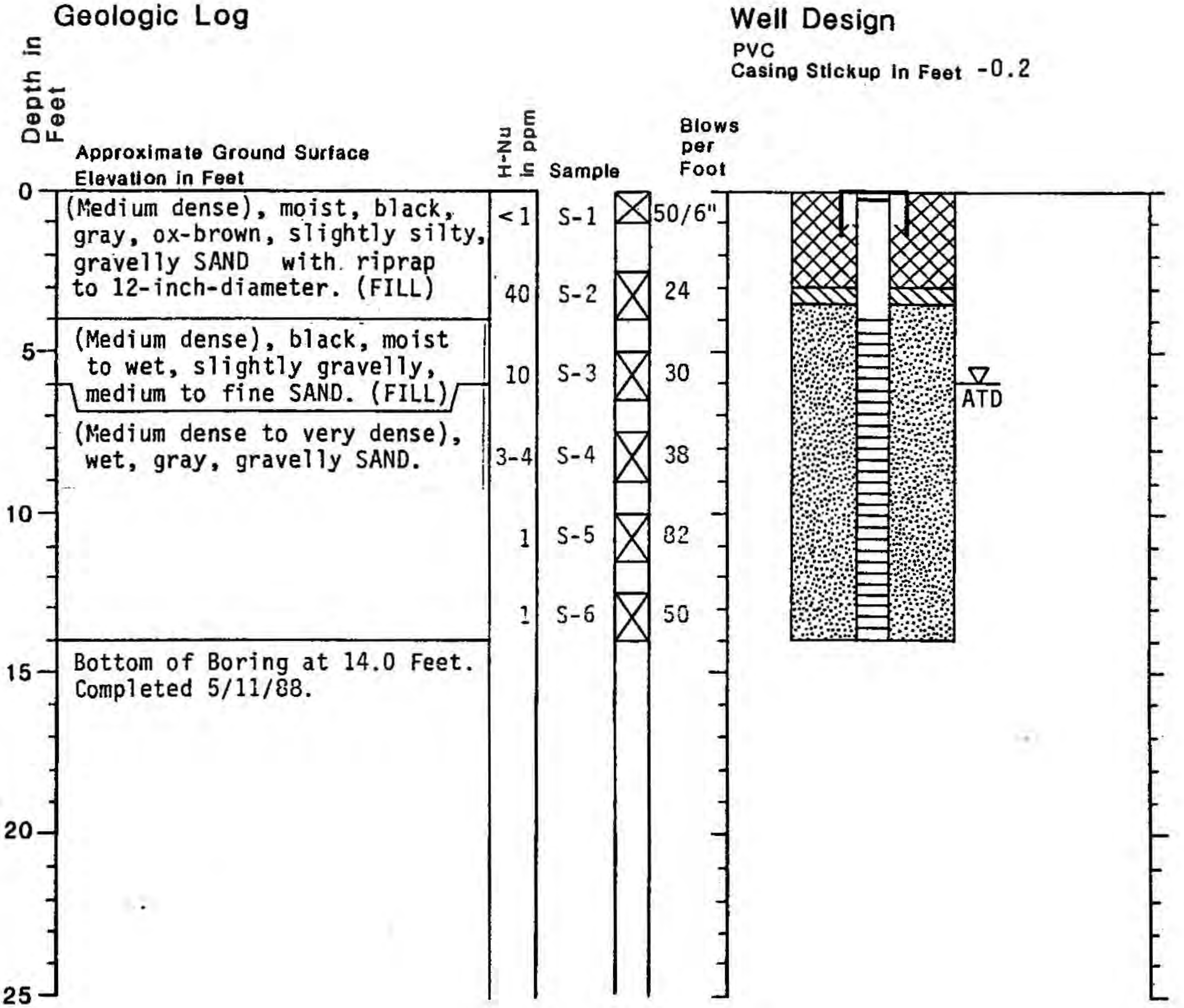
HART-CROWSER & associates, inc.
Sheet 2 of 2 Figure C-8

Boring Log and Construction Data for Monitoring Well MW-5A



(Medium dense), moist, black, gray, ox-brown, slightly silty, gravelly SAND with riprap to 12-inch-diameter. (FILL)

(Medium dense), black, moist to wet, slightly gravelly, medium to fine SAND. (FILL)

(Medium dense to very dense), wet, gray, gravelly SAND.

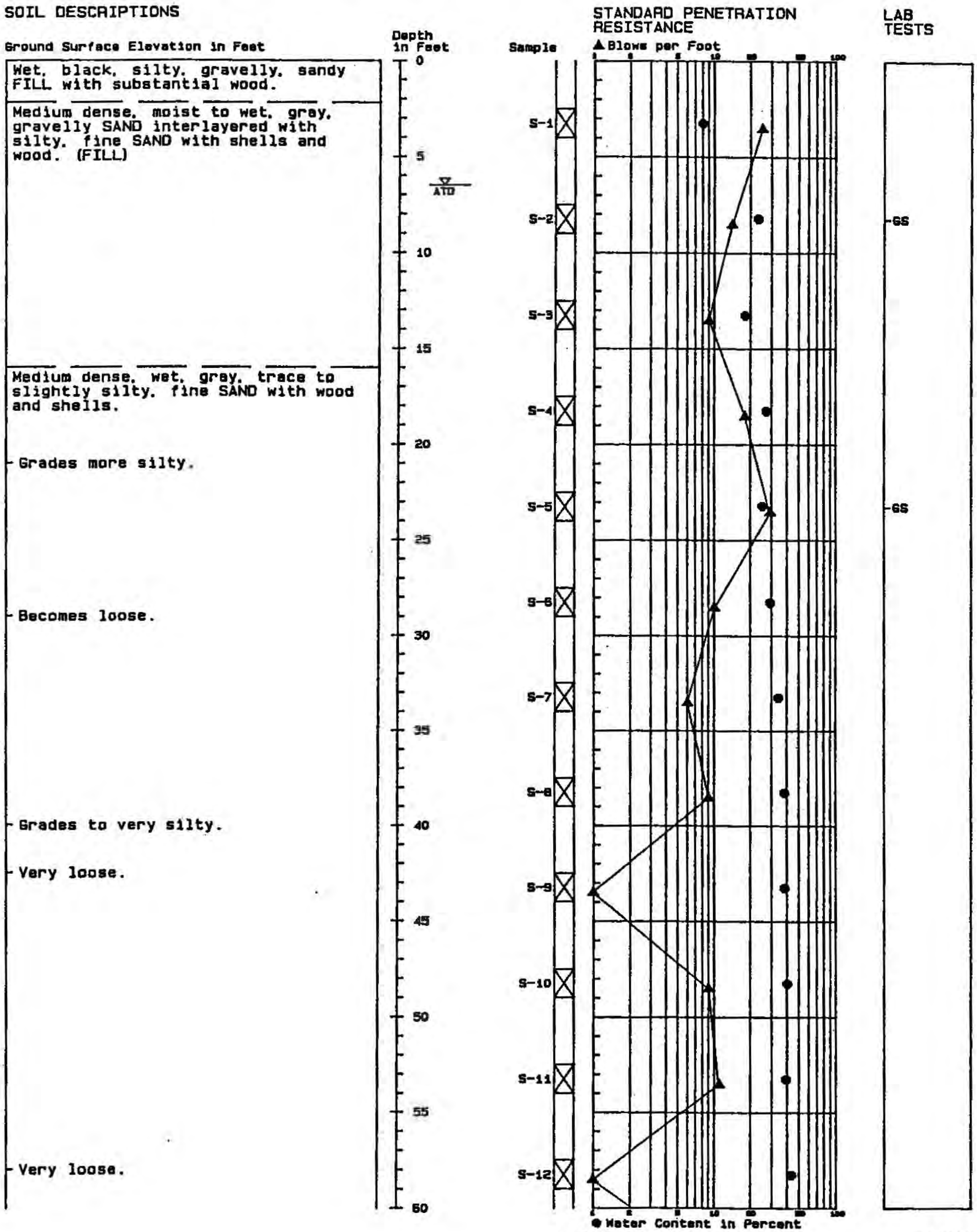
Bottom of Boring at 14.0 Feet. Completed 5/11/88.

H-Nu in ppm	Sample	Blows per Foot
<1	S-1	50/6"
40	S-2	24
10	S-3	30
3-4	S-4	38
1	S-5	82
1	S-6	50

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year. ATD: At Time of Drilling

HARTCROWSER
J-2159 6/88
Figure C-9

Boring Log B-6



Wet, black, silty, gravelly, sandy FILL with substantial wood.

Medium dense, moist to wet, gray, gravelly SAND interlayered with silty, fine SAND with shells and wood. (FILL)

Medium dense, wet, gray, trace to slightly silty, fine SAND with wood and shells.

- Grades more silty.

- Becomes loose.

- Grades to very silty.

- Very loose.

- Very loose.

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HART-CROWSER & associates, inc.
Sheet 1 of 2 Figure C-10

Boring Log B-6

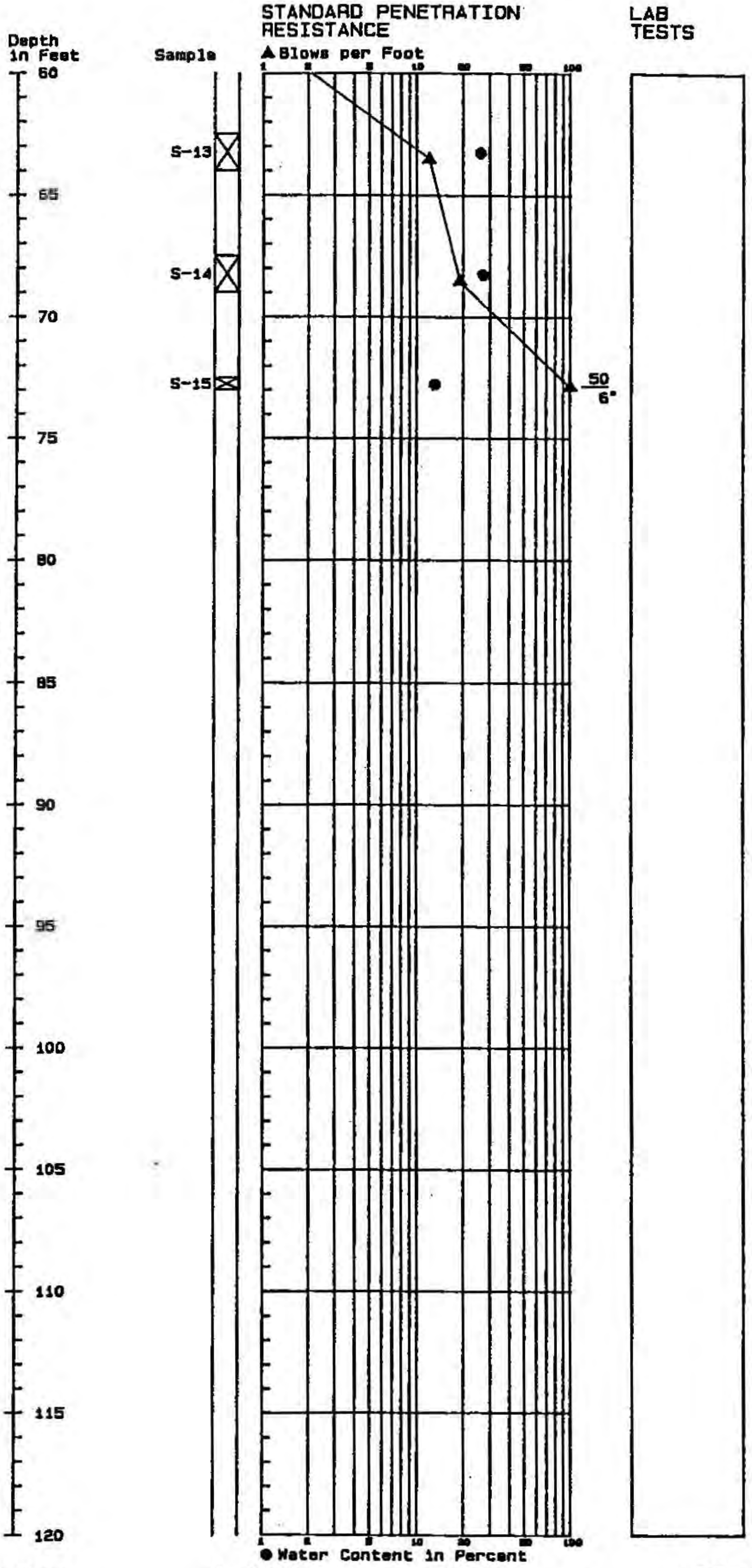
SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Medium dense, wet, gray, slightly silty to silty, fine SAND with wood and shell fragments.

Very dense, wet, gray, trace to slightly gravelly SAND with occasional shells.

Bottom of Boring at 73.0 Feet.
Completed 5/13/88.



1. Refer to Figure C-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.

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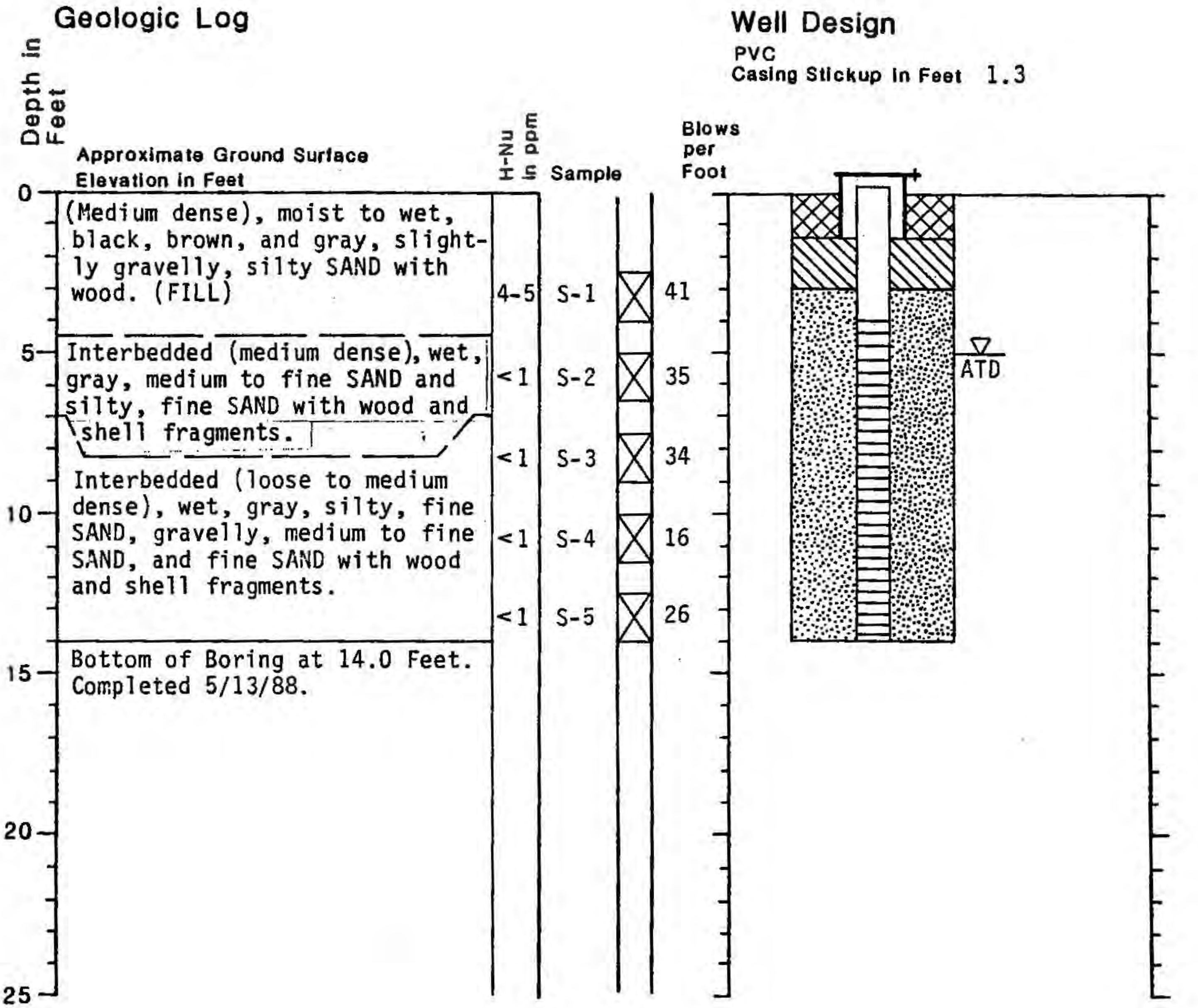
HART-CROWSER & associates, inc.
Sheet 2 of 2 Figure C-10

Boring Log and Construction Data for Monitoring Well MW-6A



(Medium dense), moist to wet, black, brown, and gray, slightly gravelly, silty SAND with wood. (FILL)

Interbedded (medium dense), wet, gray, medium to fine SAND and silty, fine SAND with wood and shell fragments.

Interbedded (loose to medium dense), wet, gray, silty, fine SAND, gravelly, medium to fine SAND, and fine SAND with wood and shell fragments.

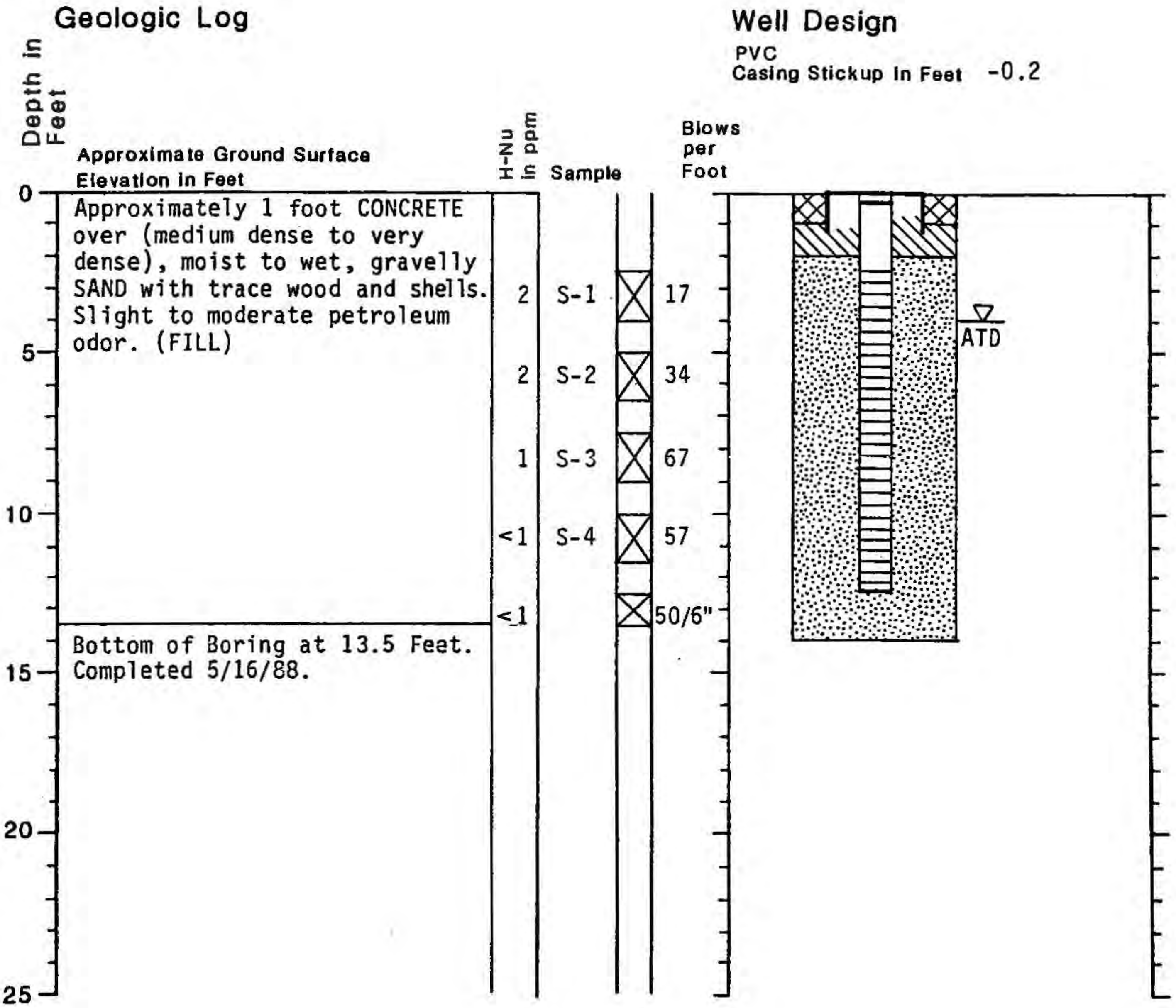
Bottom of Boring at 14.0 Feet. Completed 5/13/88.

H-Nu in ppm	Sample	Blows per Foot
4-5	S-1	41
<1	S-2	35
<1	S-3	34
<1	S-4	16
<1	S-5	26

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159 6/88
Figure C-11

Boring Log and Construction Data for Monitoring Well MW-7



Approximately 1 foot CONCRETE over (medium dense to very dense), moist to wet, gravelly SAND with trace wood and shells. Slight to moderate petroleum odor. (FILL)

Bottom of Boring at 13.5 Feet. Completed 5/16/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
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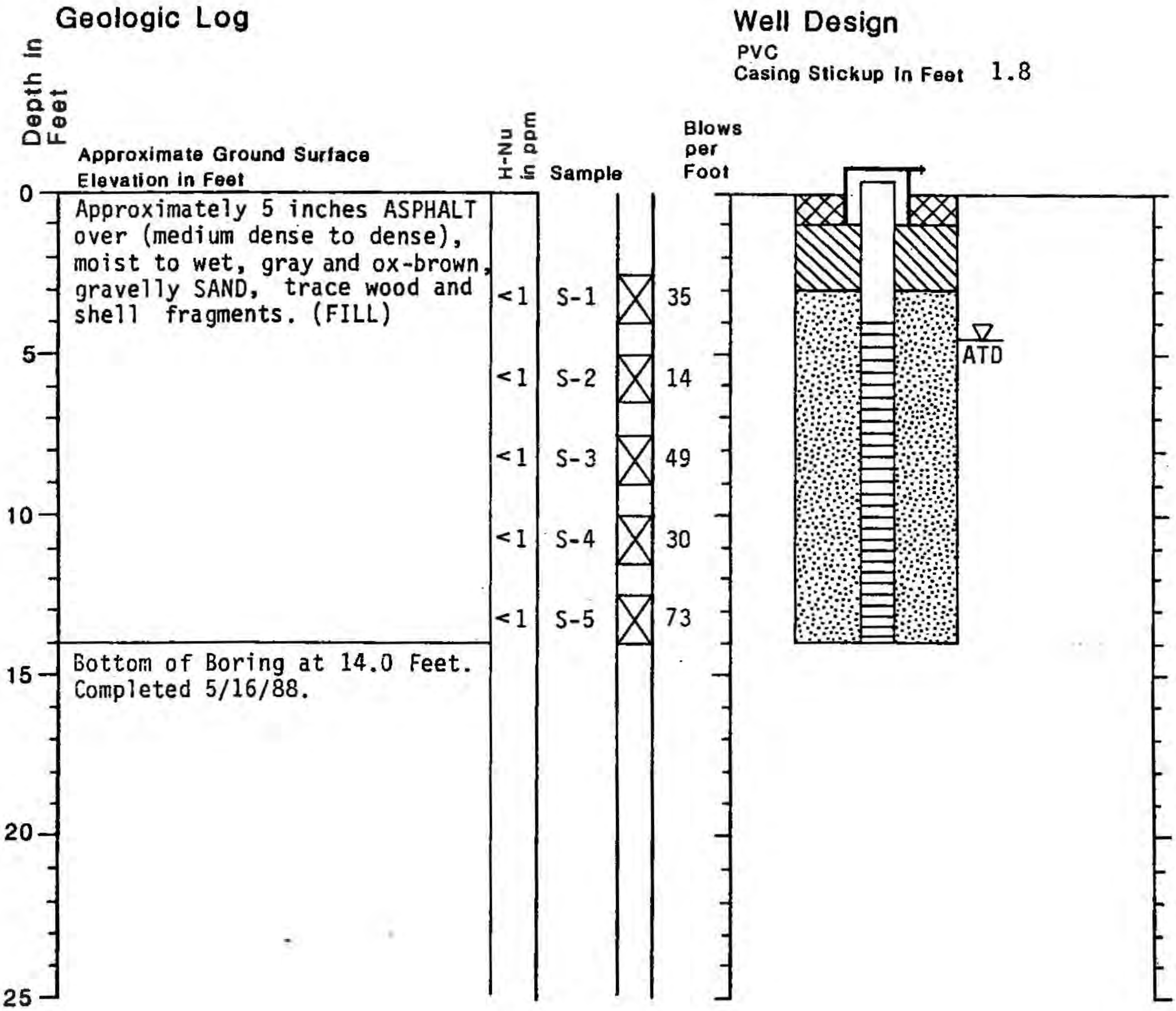
Figure C-12

Boring Log and Construction Data for Monitoring Well MW-8



1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER

J-2159 6/88

Figure C-13

Boring Log B-9

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

CONCRETE.

Medium dense to very dense, wet, gray, gravelly, medium to fine SAND to very sandy GRAVEL.

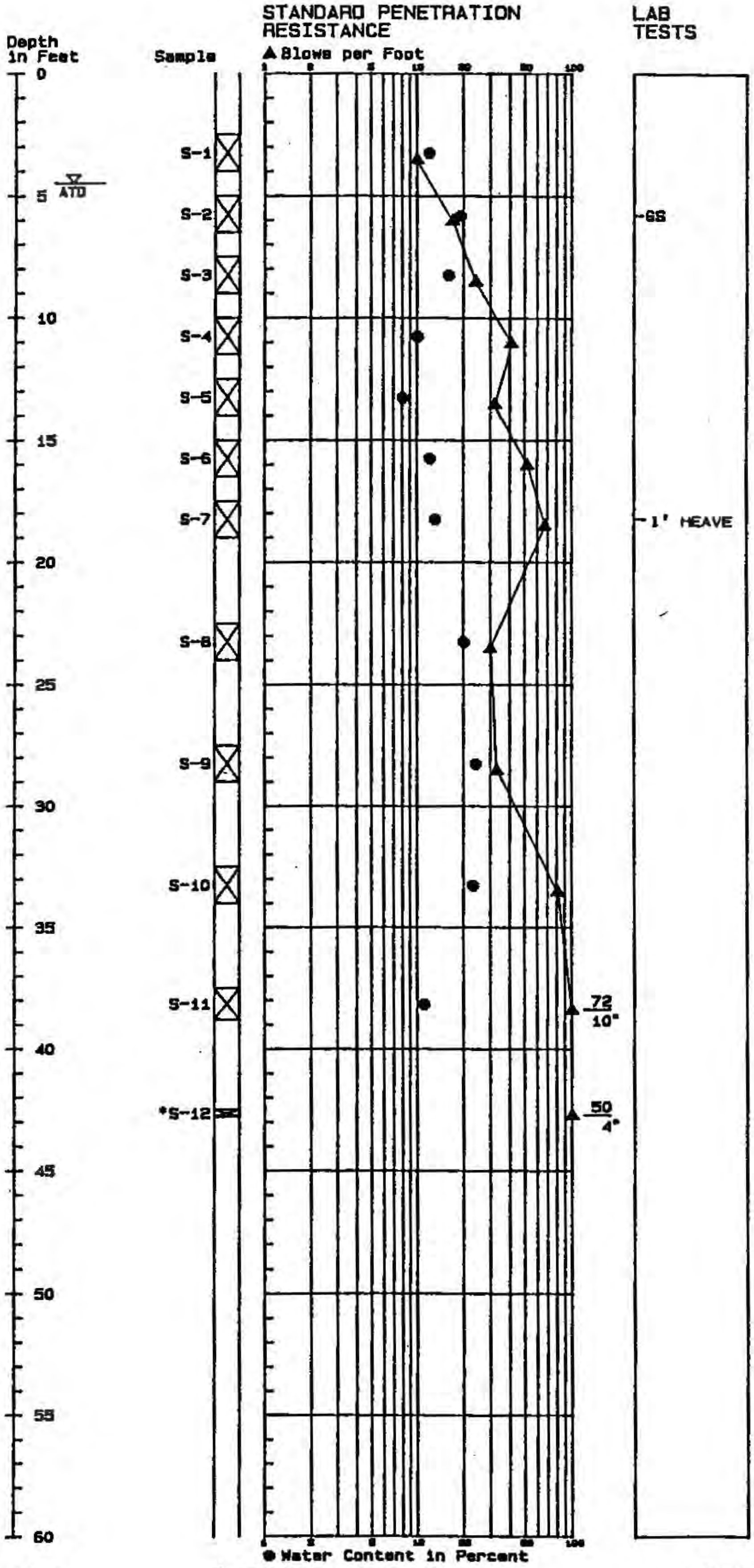
Very dense, wet, gray, very gravelly SAND grading to slightly silty, slightly gravelly to gravelly, fine SAND.

Dense, clean to slightly silty, fine to medium SAND.

- Grades very dense.

Very dense, wet, gray, gravelly, coarse SAND.

Bottom of Boring at 47.5 Feet.
Completed 5/17/88.



1. Refer to Figure C-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.

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Figure C-14

Boring Log B-10

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Dense, wet, gray, black and brown, silty, gravelly, medium to fine SAND with wood. (FILL)

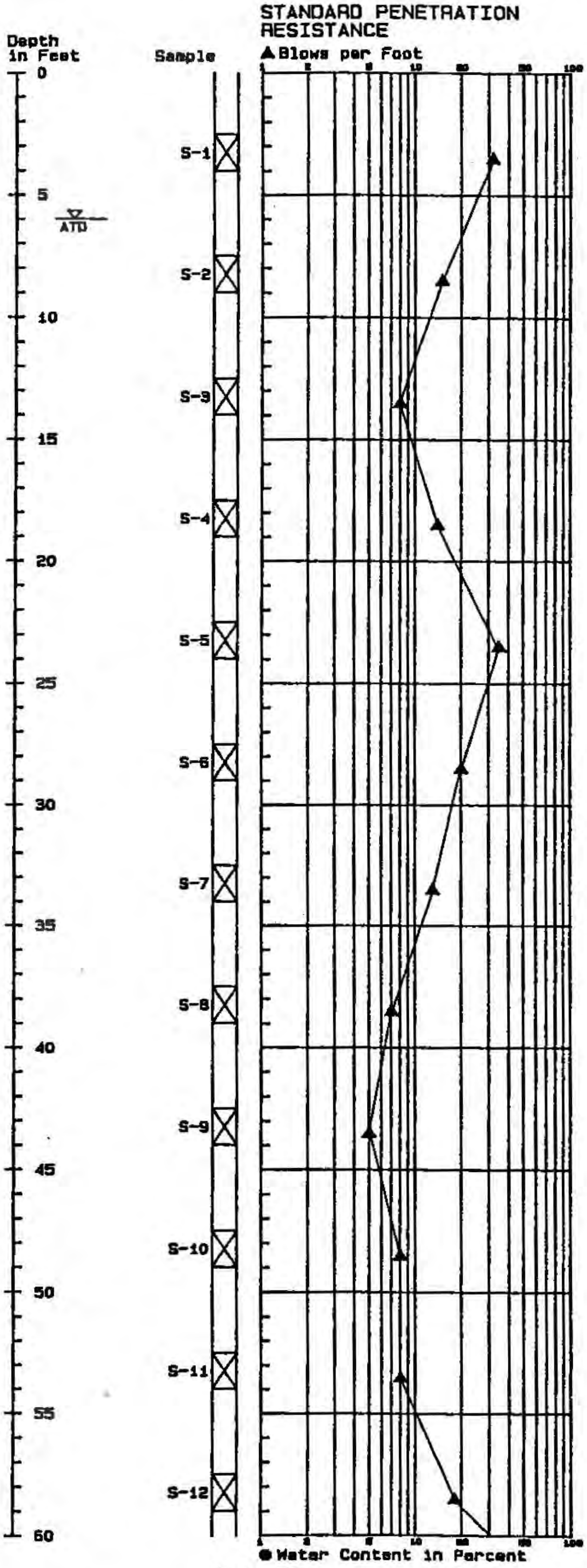
Medium dense, wet, gray, trace to slightly silty, slightly gravelly, fine SAND grading to fine SAND with wood and shell fragments.

- Loose.

- Dense.

Loose, wet, gray, slightly silty to silty, fine SAND with trace wood and shell fragments.

- Becomes medium dense.



LAB TESTS

J-2160 May 1988

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Sheet 1 of 2 Figure C-15

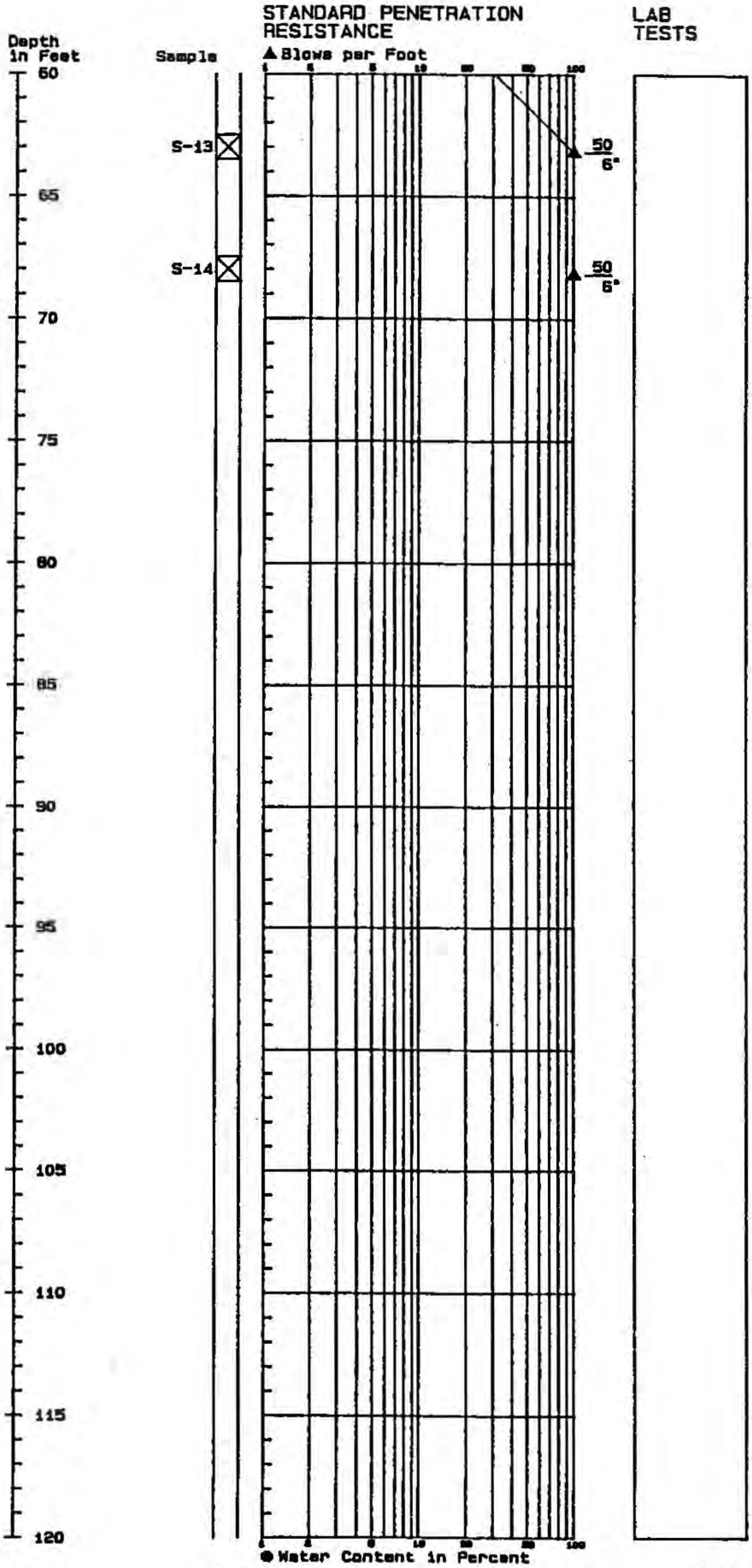
Boring Log B-10

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

Very dense, wet, gray, interbedded, slightly silty to silty, fine SAND, clean fine SAND, and SILT with trace wood and shell fragments.

Bottom of Boring at 68.5 Feet.
Completed 5/17/88.



1. Refer to Figure C-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.

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HART-CROWSER & associates, inc.
Sheet 2 of 2 Figure C-15

Boring Log and Construction Data for Monitoring Well MW-11

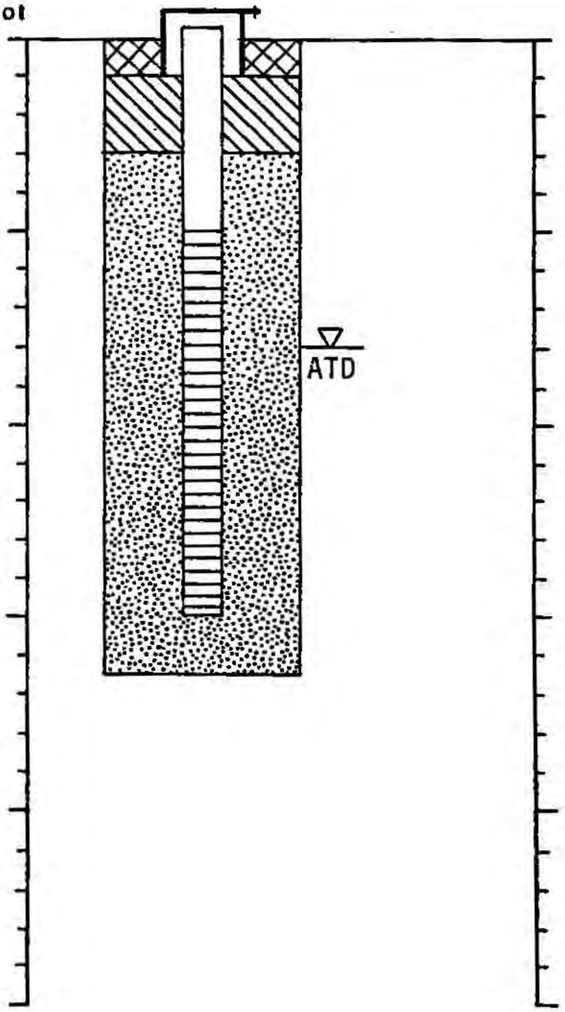
Geologic Log

Approximate Ground Surface Elevation in Feet

Depth in Feet	Description	H-Nu in ppm	Sample	Blows per Foot
0	(Medium dense), moist to wet, black, brown, red and yellow, silty, gravelly, medium to fine SAND with substantial wood.	2	S-1	15
5	Medium dense, moist to wet, gray, slightly silty, gravelly SAND with silty, fine SAND to fine sandy SILT interbeds, shell fragments and wood. (Moderate hydrocarbon-like odor associated with SILT layers.)	1	S-2	19
		2	S-3	8
10		<1	S-4	11
		<1	S-5	7
15		<1	S-6	5
	Bottom of Boring at 16.5 Feet. Completed 6/2/88.			
20				
25				

Well Design

PVC
Casing Stickup in Feet 1.7



1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.

ATD: At Time of Drilling

HARTCROWSER
J-2159-01 6/88
Figure C-16

Boring Log and Construction Data for Monitoring Well MW-12

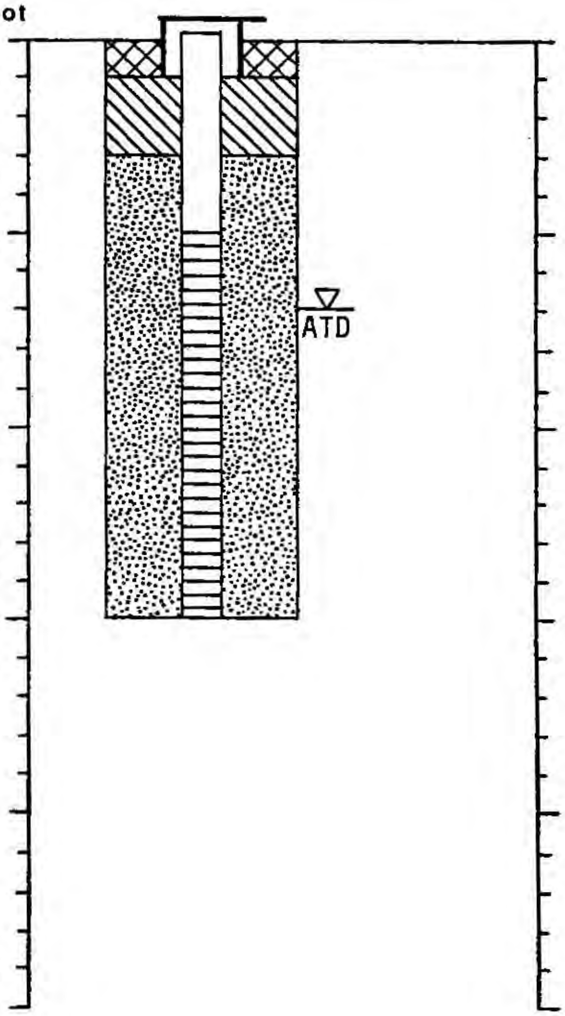
Geologic Log

Approximate Ground Surface Elevation in Feet

Depth in Feet	Description	H-Nu in ppm	Sample	Blows per Foot
0	(Medium dense), wet, black, buff and pink, slightly gravelly, silty, fine SAND with wood and substantial shells. (FILL)	< 1	S-1	35
5	(Medium dense to very dense), moist to wet, black grading to gray, slightly gravelly, medium to fine SAND to SAND.	< 1	S-2	19
		< 1	S-3	34
10		< 1	S-4	23
	Becomes gravelly.	< 1	S-5	63
15	Bottom of Boring at 15.0 Feet. Completed 6/2/88.			
20				
25				

Well Design

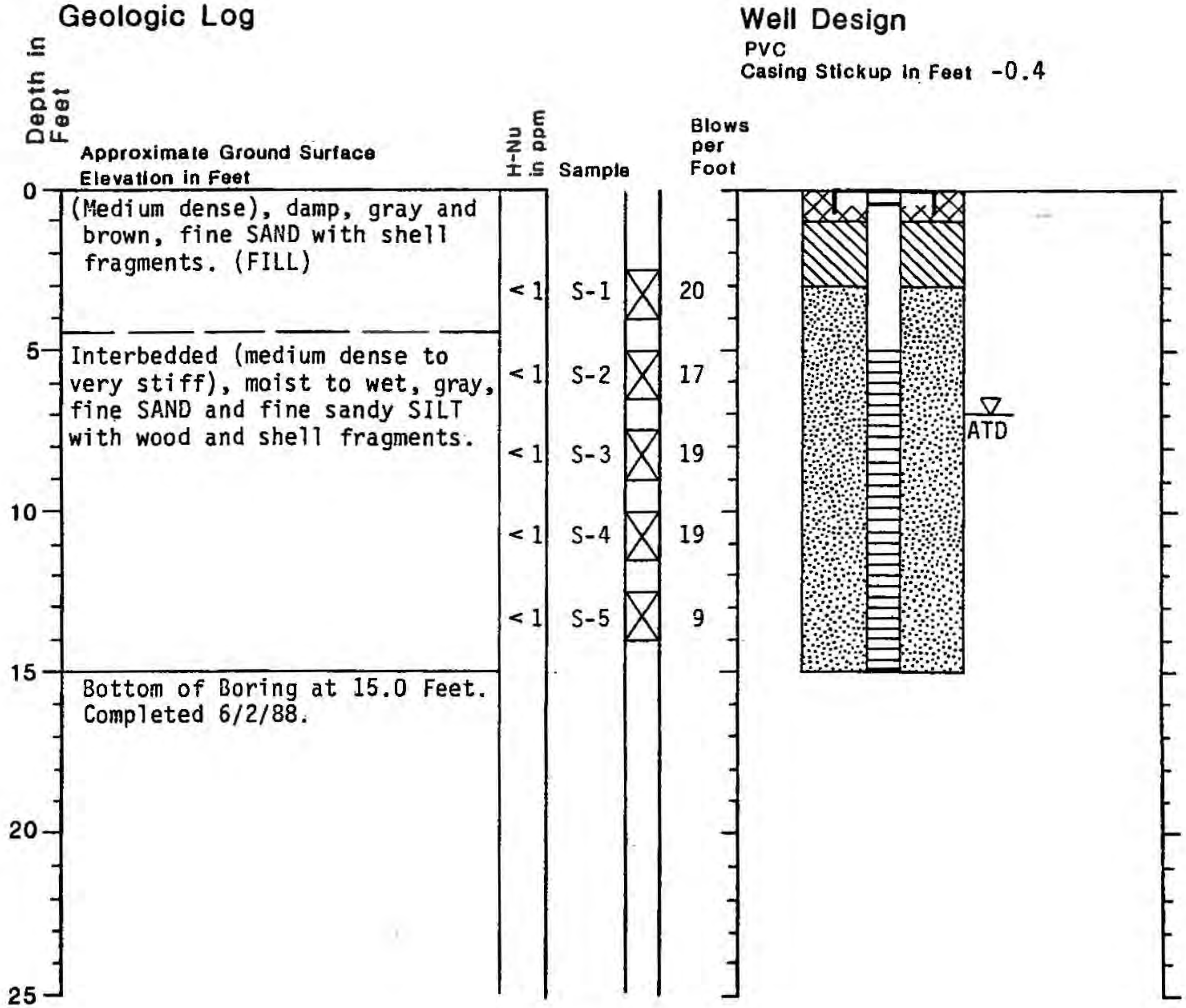
PVC
Casing Stickup in Feet 1.3



1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-01 6/88
Figure C-17

Boring Log and Construction Data for Monitoring Well MW-13



Geologic Log

Well Design

PVC
Casing Stickup in Feet -0.4

(Medium dense), damp, gray and brown, fine SAND with shell fragments. (FILL)

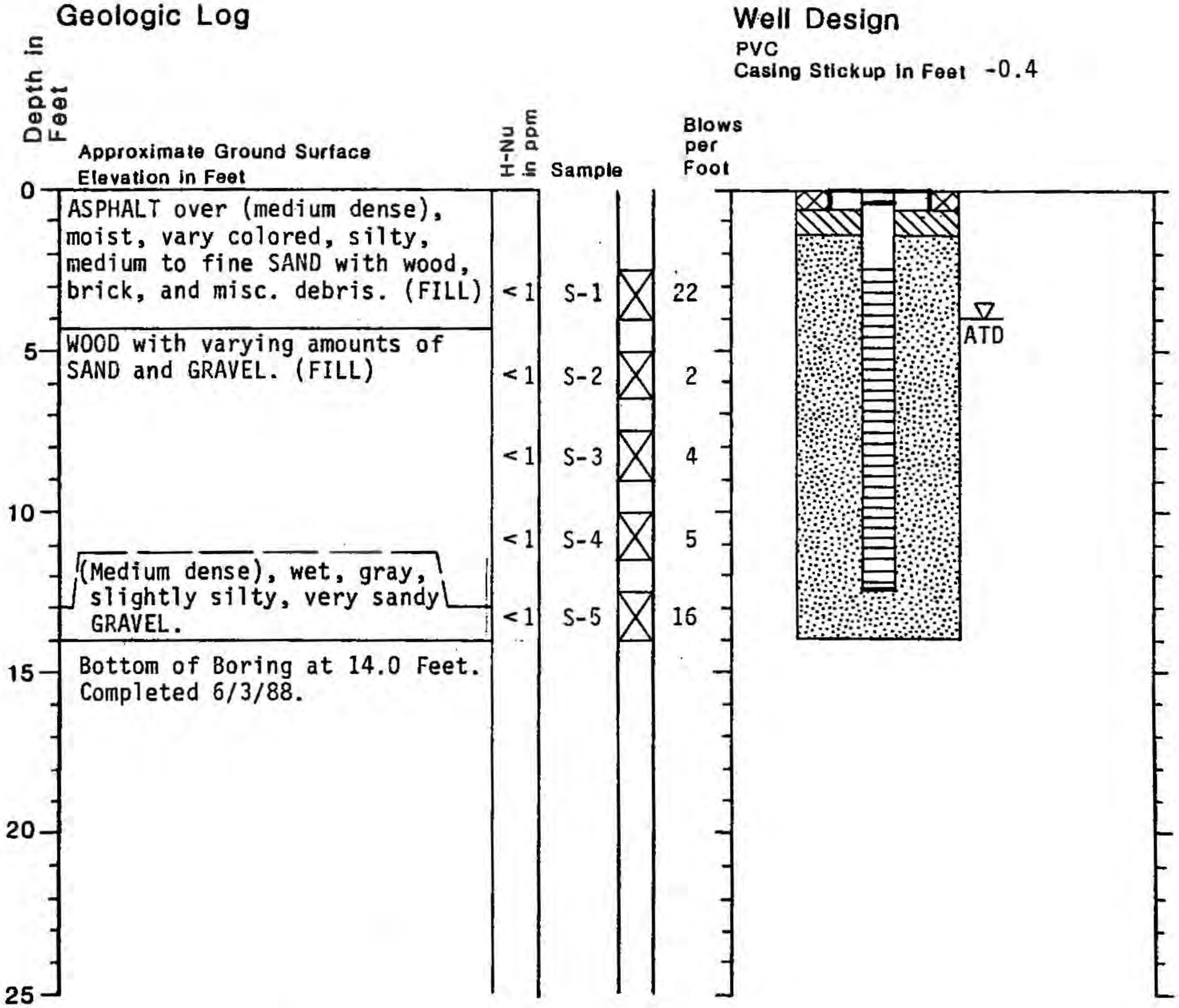
Interbedded (medium dense to very stiff), moist to wet, gray, fine SAND and fine sandy SILT with wood and shell fragments.

Bottom of Boring at 15.0 Feet. Completed 6/2/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-01 6/88
Figure C-18

Boring Log and Construction Data for Monitoring Well MW-14



ASPHALT over (medium dense), moist, vary colored, silty, medium to fine SAND with wood, brick, and misc. debris. (FILL)

WOOD with varying amounts of SAND and GRAVEL. (FILL)

(Medium dense), wet, gray, slightly silty, very sandy GRAVEL.

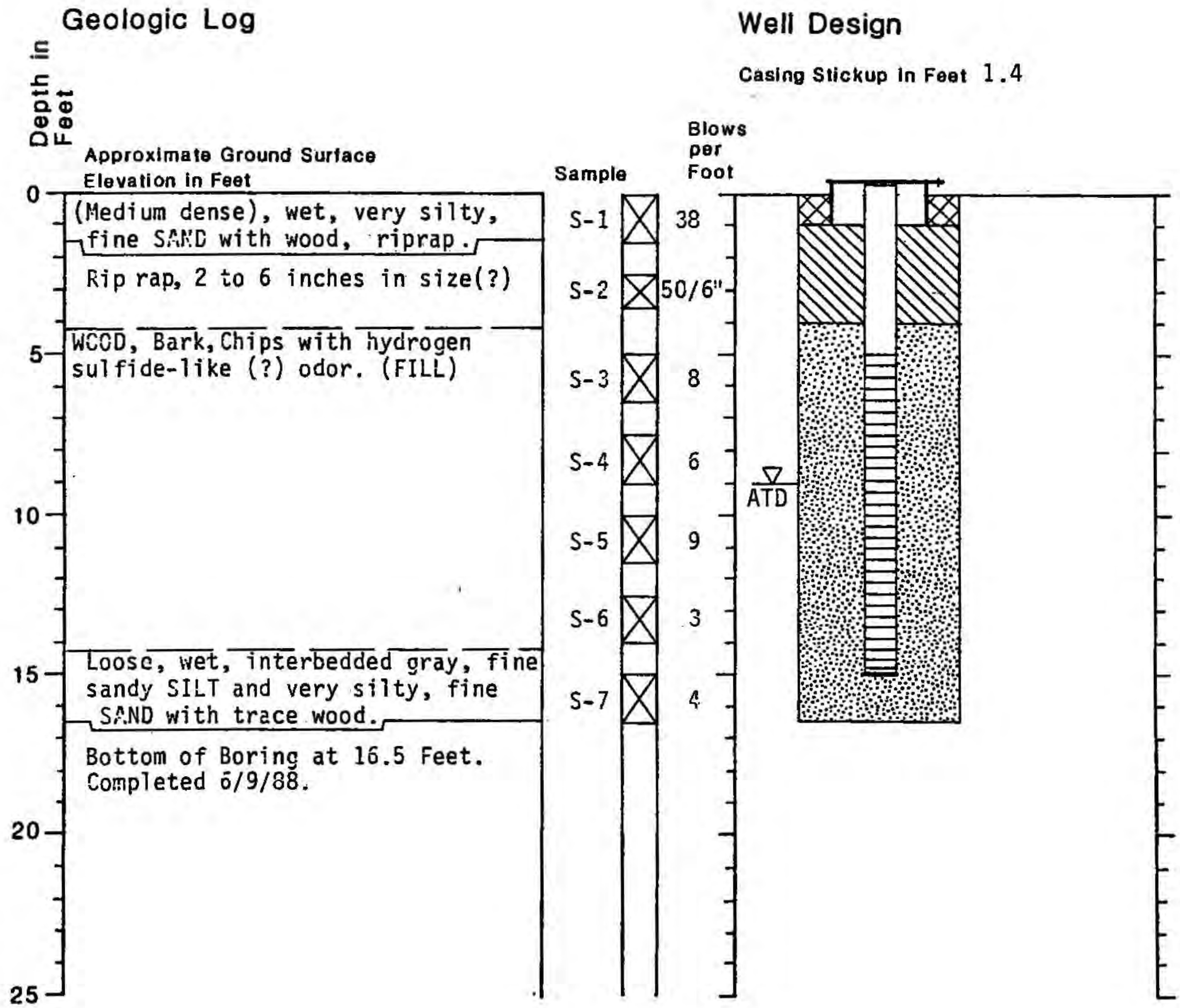
Bottom of Boring at 14.0 Feet. Completed 6/3/88.

H-Nu in ppm	Sample	Blows per Foot
< 1	S-1	22
< 1	S-2	2
< 1	S-3	4
< 1	S-4	5
< 1	S-5	16

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-01 6/88
Figure C-19

Boring Log and Construction Data for Monitoring Well MW-15



(Medium dense), wet, very silty, fine SAND with wood, riprap.

Rip rap, 2 to 6 inches in size(?)

WOOD, Bark, Chips with hydrogen sulfide-like (?) odor. (FILL)

Loose, wet, interbedded gray, fine sandy SILT and very silty, fine SAND with trace wood.

Bottom of Boring at 16.5 Feet. Completed 6/9/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.

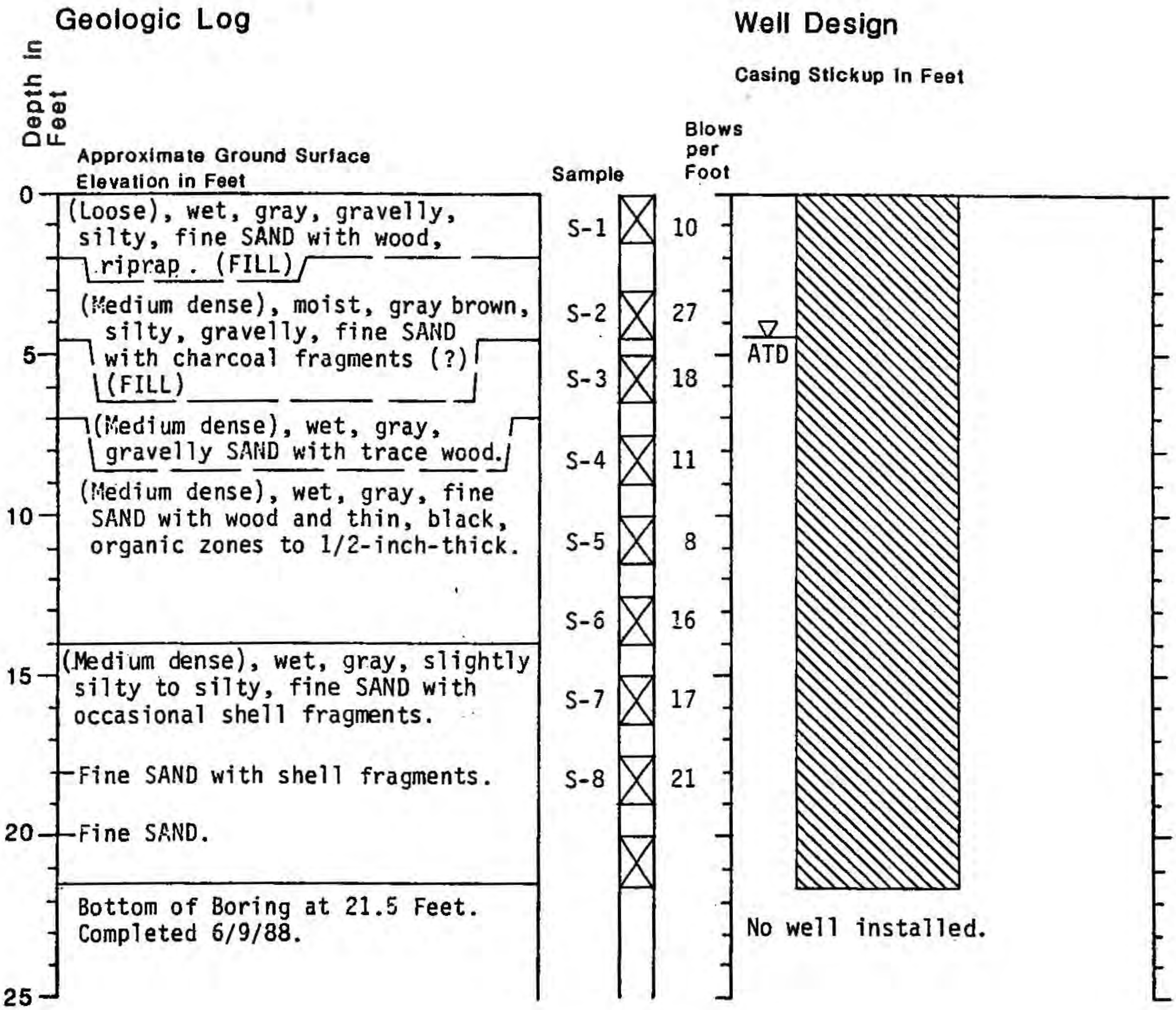
ATD: At Time of Drilling

HARTCROWSER

J-2159-02 6/88

Figure C-20

Boring Log and Construction Data for Boring B-16



(Loose), wet, gray, gravelly, silty, fine SAND with wood, riprap. (FILL)

(Medium dense), moist, gray brown, silty, gravelly, fine SAND with charcoal fragments (?) (FILL)

(Medium dense), wet, gray, gravelly SAND with trace wood.

(Medium dense), wet, gray, fine SAND with wood and thin, black, organic zones to 1/2-inch-thick.

(Medium dense), wet, gray, slightly silty to silty, fine SAND with occasional shell fragments.

Fine SAND with shell fragments.

Fine SAND.

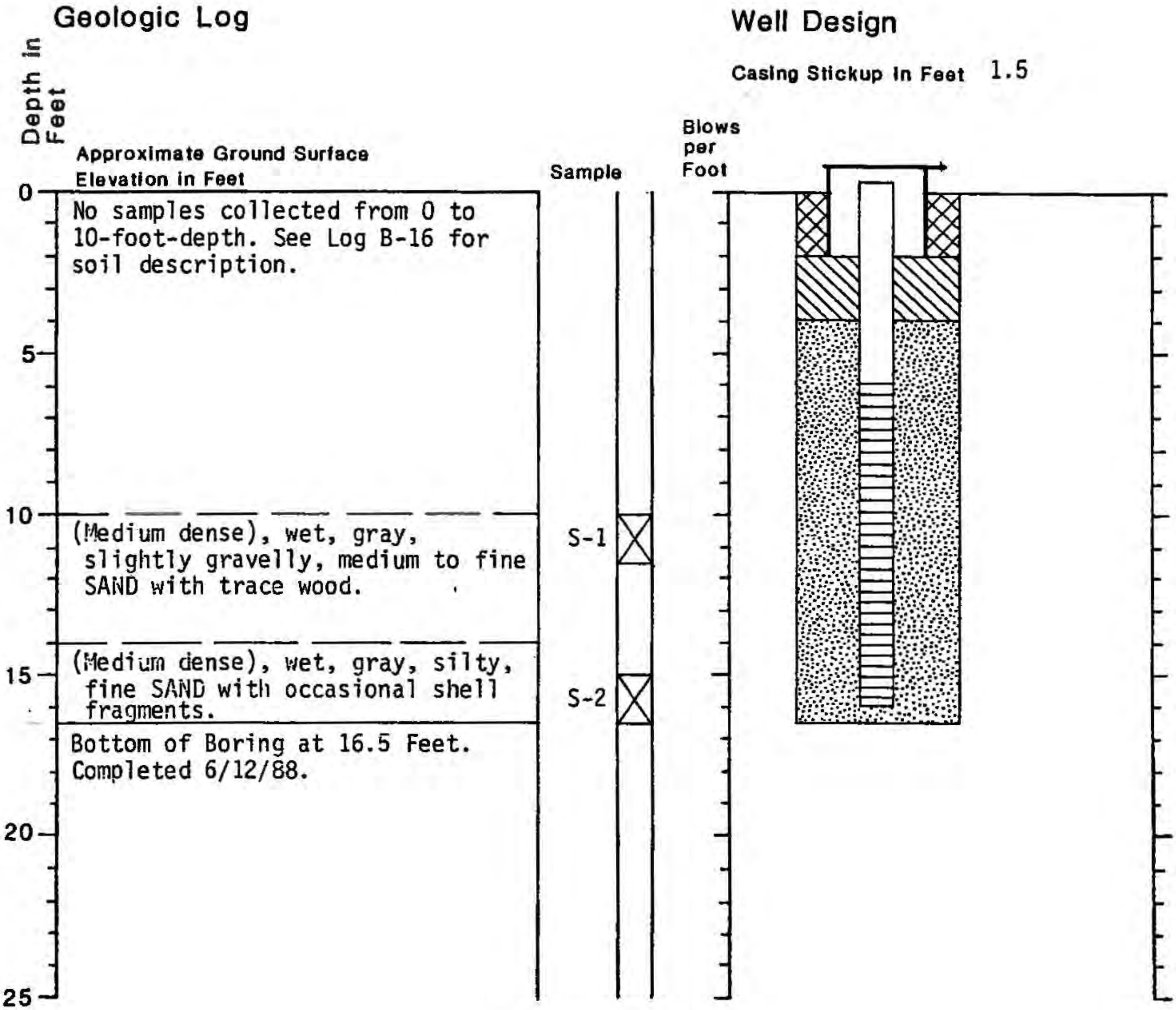
Bottom of Boring at 21.5 Feet.
Completed 6/9/88.

No well installed.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-02 6/88
Figure C-21

Boring Log and Construction Data for Monitoring Well MW-16A



No samples collected from 0 to 10-foot-depth. See Log B-16 for soil description.

(Medium dense), wet, gray, slightly gravelly, medium to fine SAND with trace wood.

(Medium dense), wet, gray, silty, fine SAND with occasional shell fragments.

Bottom of Boring at 16.5 Feet. Completed 6/12/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.

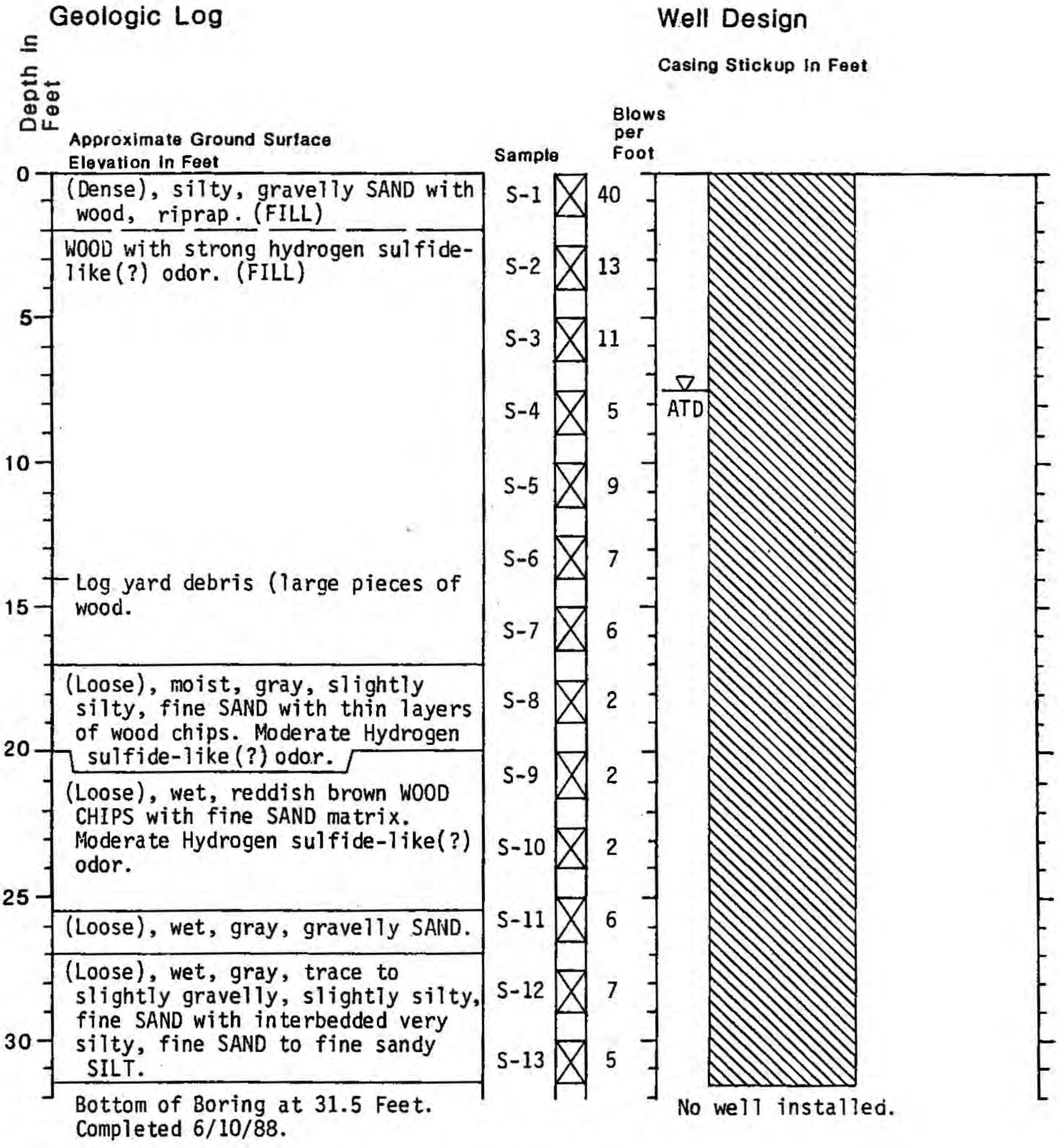
ATD: At Time of Drilling

HARTCROWSER

J-2159-02 6/88

Figure C-22

Boring Log and Construction Data for Boring B-17



(Dense), silty, gravelly SAND with wood, riprap. (FILL)

WOOD with strong hydrogen sulfide-like(?) odor. (FILL)

Log yard debris (large pieces of wood.

(Loose), moist, gray, slightly silty, fine SAND with thin layers of wood chips. Moderate Hydrogen sulfide-like(?) odor.

(Loose), wet, reddish brown WOOD CHIPS with fine SAND matrix. Moderate Hydrogen sulfide-like(?) odor.

(Loose), wet, gray, gravelly SAND.

(Loose), wet, gray, trace to slightly gravelly, slightly silty, fine SAND with interbedded very silty, fine SAND to fine sandy SILT.

Bottom of Boring at 31.5 Feet. Completed 6/10/88.

Sample	Blows per Foot
S-1	40
S-2	13
S-3	11
S-4	5
S-5	9
S-6	7
S-7	6
S-8	2
S-9	2
S-10	2
S-11	6
S-12	7
S-13	5

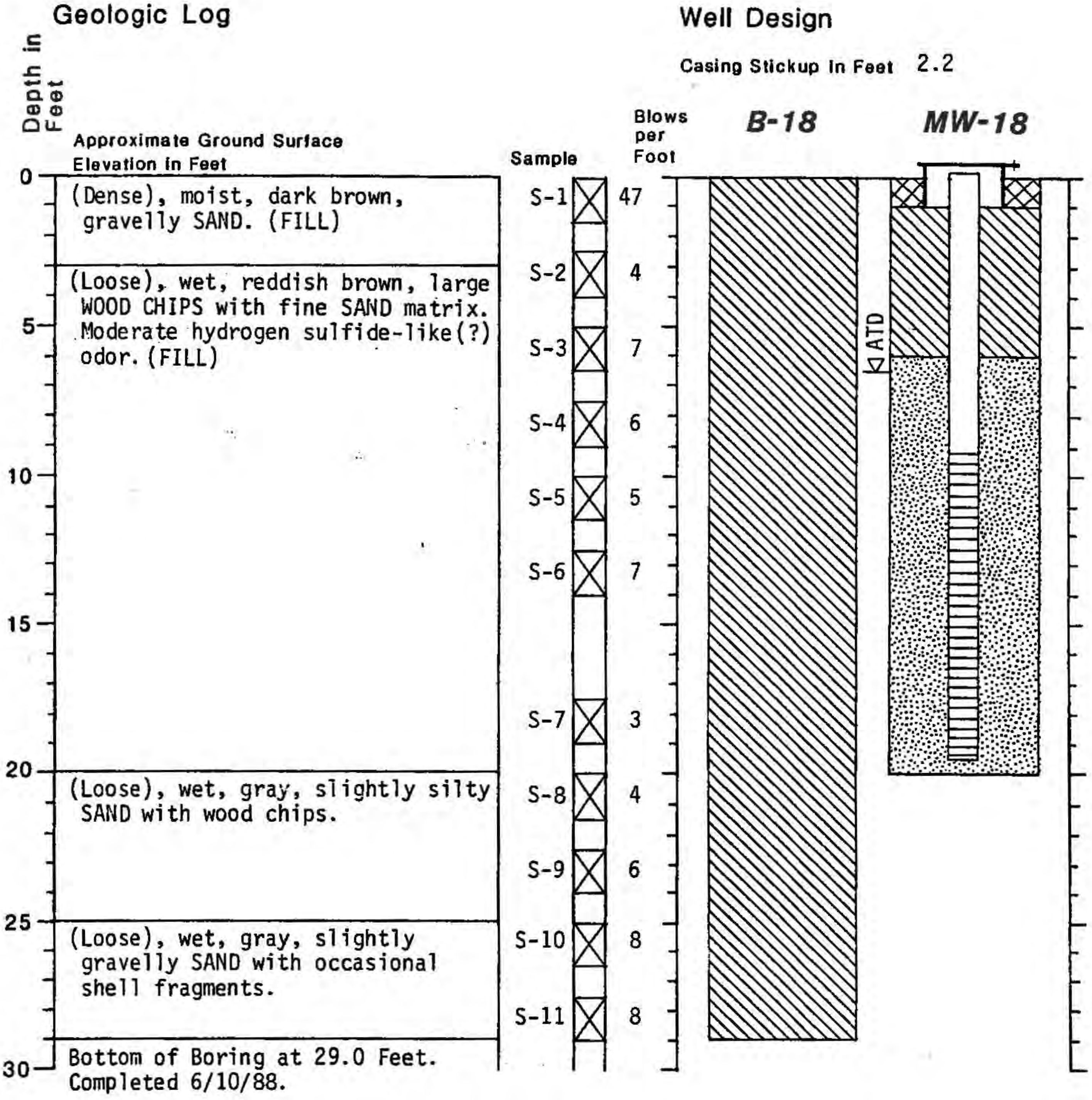
No well installed.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER

J-2159-02 6/88
Figure C-23

Boring Log and Construction Data for Monitoring Well MW-18



(Dense), moist, dark brown, gravelly SAND. (FILL)

(Loose), wet, reddish brown, large WOOD CHIPS with fine SAND matrix. Moderate hydrogen sulfide-like(?) odor. (FILL)

(Loose), wet, gray, slightly silty SAND with wood chips.

(Loose), wet, gray, slightly gravelly SAND with occasional shell fragments.

Bottom of Boring at 29.0 Feet. Completed 6/10/88.

Sample	Blows per Foot
S-1	47
S-2	4
S-3	7
S-4	6
S-5	5
S-6	7
S-7	3
S-8	4
S-9	6
S-10	8
S-11	8

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.

ATD: At Time of Drilling

HARTCROWSER
J-2159-02 6/88
Figure C-24

Boring Log and Construction Data for Monitoring Well MW-19

Geologic Log

Depth in Feet

Approximate Ground Surface Elevation in Feet

0

(Medium dense), damp, gray, sandy GRAVEL to reddish brown, large WOOD CHIPS. (FILL)

(Loose), moist, reddish brown to black, large WOOD CHIPS with fine SAND matrix and occasional gravel. (FILL)

5

10

Slight Hydrogen sulfide-like, (?) odor.

15

(Loose), wet, brown, fine WOOD CHIPS and fine to medium SAND. Slight hydrogen sulfide-like (?) odor.

20

(Loose), wet, gray, silty, fine SAND with occasional shell fragments.

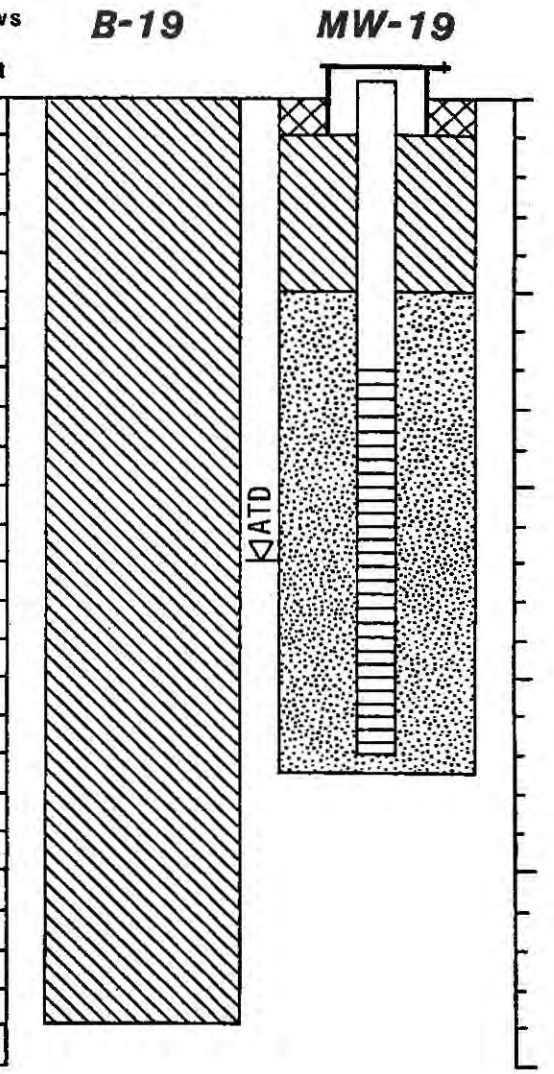
25

Bottom of Boring at 24.0 Feet. Completed 6/11/88.

Sample	Blows per Foot
S-1	19
S-2	13
S-3	3
S-4	5
S-5	8
S-6	15
S-7	4
S-8	2
S-9	6
S-10	5

Well Design

Casing Stickup in Feet 1.9



1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.

ATD: At Time of Drilling

HARTCROWSER
J-2159-02 6/88
Figure C-25

Boring Log and Construction Data for Monitoring Well MW-20

Geologic Log

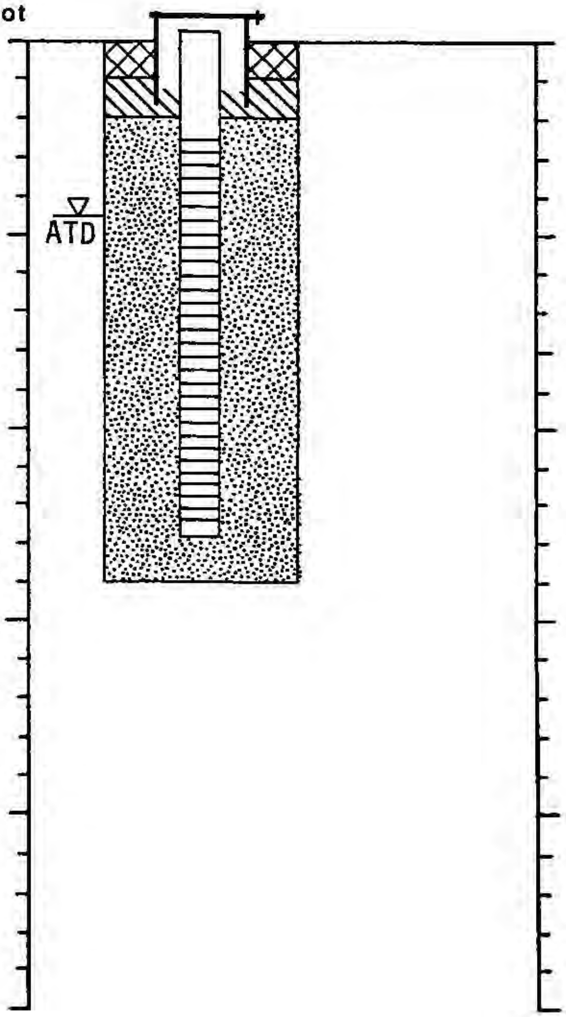
Depth in Feet

Approximate Ground Surface Elevation in Feet

Depth in Feet	Geologic Log	Sample	Blows per Foot
0	ASPHALT over (loose), damp, gray and black, slightly silty, very gravelly SAND. (FILL)	S-1 S-2	10 4
4	(Medium dense), wet, gray, slightly gravelly to gravelly, medium to fine SAND with occasional thin, gravelly interbeds.	S-3 S-4 S-5 S-6	14 16 28 20
14	Bottom of Boring at 14.0 Feet. Completed 6/11/88.		

Well Design

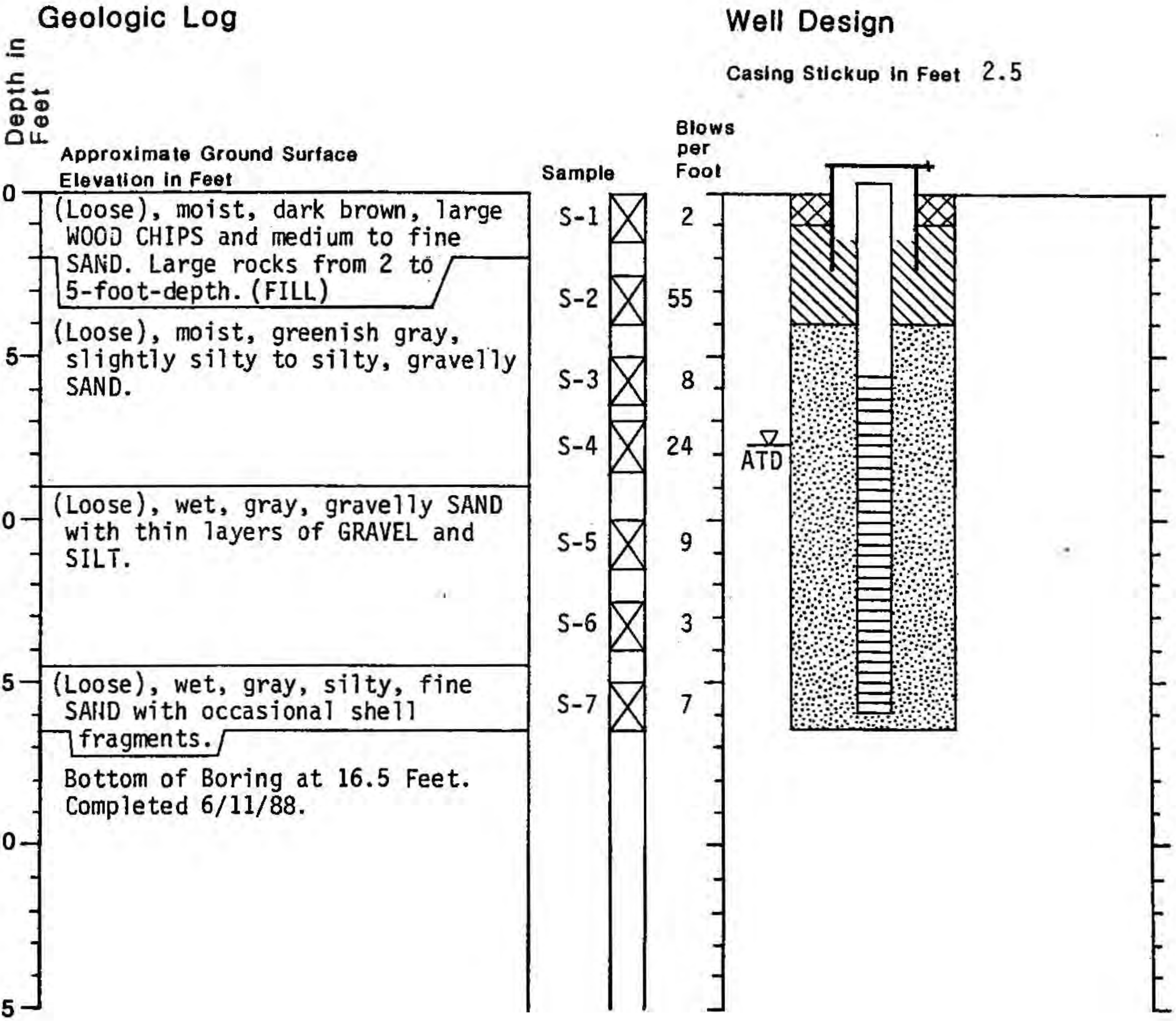
Casing Stickup in Feet 1.6



1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-02 6/88
Figure C-26

Boring Log and Construction Data for Monitoring Well MW-21



(Loose), moist, dark brown, large WOOD CHIPS and medium to fine SAND. Large rocks from 2 to 5-foot-depth. (FILL)

(Loose), moist, greenish gray, slightly silty to silty, gravelly SAND.

(Loose), wet, gray, gravelly SAND with thin layers of GRAVEL and SILT.

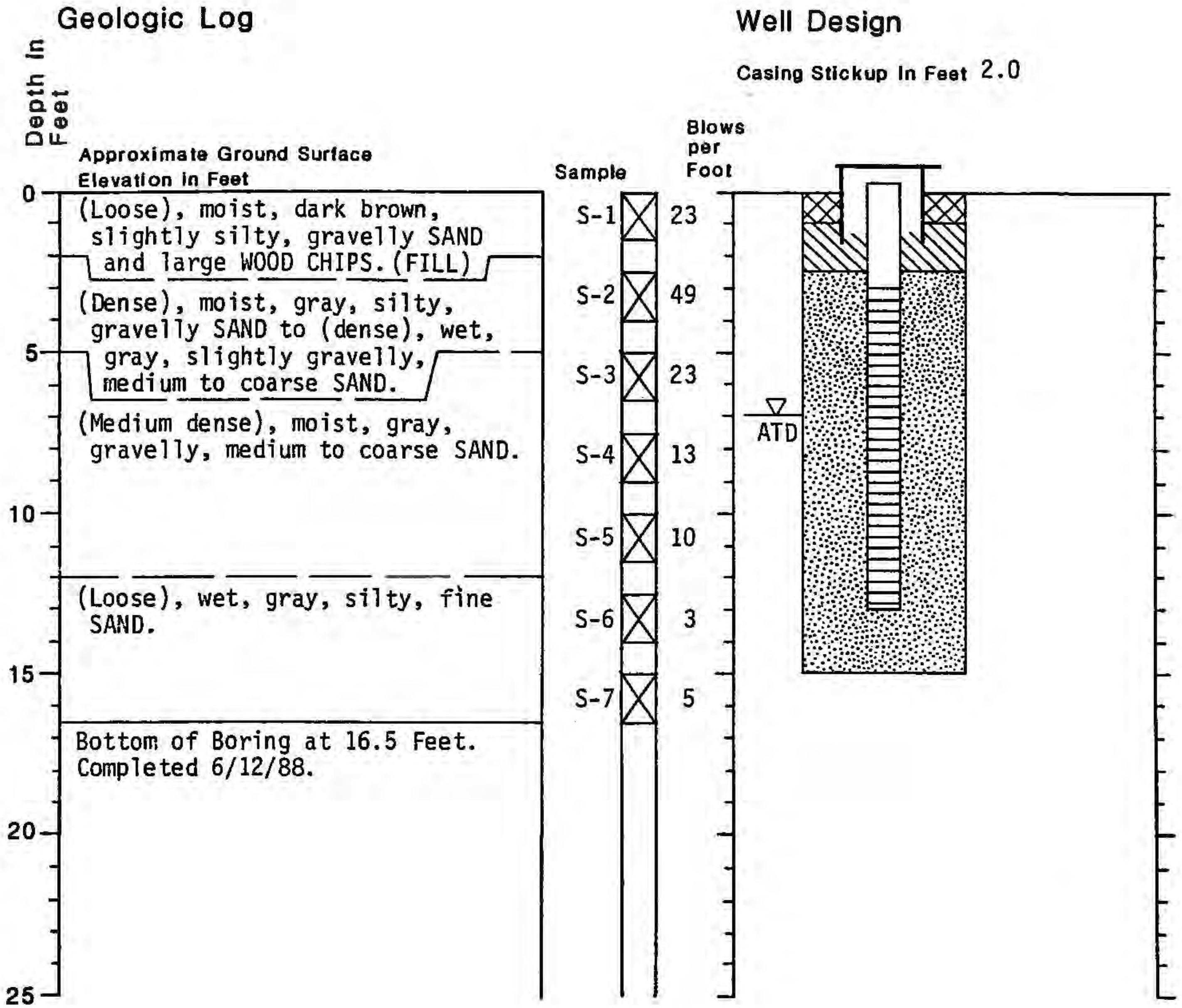
(Loose), wet, gray, silty, fine SAND with occasional shell fragments.

Bottom of Boring at 16.5 Feet.
Completed 6/11/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER
J-2159-02 6/88
Figure C-27

Boring Log and Construction Data for Monitoring Well MW-22



(Loose), moist, dark brown, slightly silty, gravelly SAND and large WOOD CHIPS. (FILL)

(Dense), moist, gray, silty, gravelly SAND to (dense), wet, gray, slightly gravelly, medium to coarse SAND.

(Medium dense), moist, gray, gravelly, medium to coarse SAND.

(Loose), wet, gray, silty, fine SAND.

Bottom of Boring at 16.5 Feet.
Completed 6/12/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions are interpretive and actual changes may be gradual.
3. Water level is for date indicated and may vary with the time of year.
   ATD: At Time of Drilling

HARTCROWSER

J-2159-02 6/88
Figure C-28

J-2159-03

APPENDIX C
FIELD INVESTIGATIVE METHODS

APPENDIX C
FIELD INVESTIGATIVE METHODS

The program of surface and subsurface explorations and sampling for this project was conducted in three phases over a five-week period in May and June of 1988. Descriptions of our observations and exploration activities are presented below for each phase. General information on activities and methods employed for all phases are presented at the end of this appendix.

The exploration logs are a representation of our interpretation of the drilling, sampling, and testing information. The depth where soils or soil characteristics changed is noted. The change may be gradual. Soil samples recovered in the subsurface explorations were visually classified in the field in general accordance with the method presented on Figure C-1. Field measurements of volatile organics compounds were conducted on subsurface samples during Phases I and II using a portable photoionization detector (H-Nu). A legend for the field exploration logs defining symbols and abbreviations utilized is also presented on Figure C-1.

Surface sampling and boring locations were located in the field by hand taping from existing physical features. Ground surface and monitoring well casing elevations are not currently available.

PHASE I

Phase I field activities included an environmental site reconnaissance, surface soil and transformer sampling, and subsurface explorations and monitoring well installation.

Surface Soil Sampling Methods

Surficial sampling locations were identified and sampled during the Phase I environmental site reconnaissance conducted by Hart Crowser personnel on May 9 and 10, 1988. Based on visual observations and historical information, five transformer sites and two soil sampling locations, were selected. Sampling locations are shown on Figures 8 and 9.

Surface Soil Sampling

One grab soil sample, SS-2, was collected and analyzed from the truck maintenance shop area at the east end of the property as well as one soil sample, SS-3, from the west side of the existing planer building. These soil samples were collected by compositing the upper two to three inches of soil from various locations in the area where visible staining or discoloration was observed. An attempt was made to select those places where discoloration or staining was heaviest or most visibly concentrated to obtain a "worst case" sample. Soils were retrieved with disposable plastic sampling scoops which were discarded after each use. Sample SS-1 was collected but not analyzed.

Transformer Sampling

Five transformer locations were sampled as shown on Figure 9. These samples were collected in visibly oil-stained soils in the vicinity of the transformers or oils on the pads or transformers themselves. It was difficult at the time of sample collection to determine whether the observed oils were due to transformer leakage or splashes from nearby barrels.

Sample TR-1 was collected from the three transformers located west of the existing planer building, and TR-2 from the three transformers west of the sawmill. Sample TR-3 was obtained from the transformer north of the kiln/boiler, while samples TR-4 and TR-5 were collected from transformers located near the older chipper and the chip pile/ship loading, respectively.

One sample was collected from each site from the upper two to three inches of oil-stained soils from the vicinity of the transformer, as well as oils scraped off the pad or transformer. The samples were retrieved with a disposable plastic sampling scoop into a laboratory prepared glass jar for PCB analysis.

Subsurface Explorations

A total of 6 hollow-stem auger borings, designated MW-3A, MW-4A, MW-5A, MW-6A, MW-7, and MW-8, were drilled from May 9 to May 17, 1988. The borings were advanced to depths ranging from 12.5 to 15.5 feet below the ground surface. Soil samples were collected using a split-spoon sampler and split into two equal portions. One portion was placed in a laboratory prepared glass jar and immediately stored in a chilled cooler. The other portion was placed in a plastic jar for headspace evaluation. For a more detailed description of drilling, sampling, and headspace evaluation procedures, refer to those sections later in this appendix.

The borings were completed as monitoring wells after the last soil sample had been retrieved. Well construction diagrams are shown on the boring logs in this appendix. Construction methods are described in the Monitoring Well Construction section later in this appendix.

In addition to the six borings drilled and converted to monitoring wells, eight hollow-stem auger borings, designated B-1 through B-6, B-9, and B-10, were drilled during the same period for a concurrent geotechnical study of the site for Daishowa. Boring logs of these explorations have been included in this report for completeness. Boring logs of these and the Phase I explorations are presented on Figures C-2 through C-15 this appendix.

Well Development

Monitoring wells completed during the Phase I field explorations were developed to remove accumulated sediment and to improve the flow of formation water into the well screen. A 3-foot-long teflon and stainless steel bailer was lowered by new polypropylene rope to the well bottom. The bailer was then worked up and down to "surge" and develop the well. Approximately 15 gallons of water was removed in this manner from each well.

Groundwater Sampling

Monitoring wells installed during the Phase I field exploration portion of the project were sampled on May 17, 1988. Samples were collected with bailers, and transported to a testing laboratory for analysis.

The depth to water in each monitoring well was measured with an electric well probe and the volume of water standing in the well bore was calculated. A 3-foot-long, stainless-steel and teflon bailer and new polypropylene rope were employed to remove a minimum of three casing volumes of water prior to sample collection. Water samples from each well were then collected with a bailer.

PHASE II

Phase II included conducting in situ integrity tests of two petroleum underground storage tanks located on-site, as well as advancing an additional four soil borings completed as monitoring wells.

Subsurface Explorations

A total of four hollow-stem auger borings, designated MW-11 through MW-14, were drilled on May 26, and 27, 1988. The borings were advanced to depths ranging from 12.5 to 16.5 feet below the ground surface. Soil samples were collected for chemical analysis. The borings were completed as monitoring wells. The wells were then developed and sampled as described in sections below. Boring logs of the Phase II explorations are presented on Figures C-16 through C-19 of this appendix.

Well Development

Monitoring wells completed during the Phase II field explorations were developed to remove accumulated sediment and to improve the flow of formation water into the well screen. A 3-foot-long teflon and stainless steel bailer was lowered by new polypropylene rope to the well bottom. The bailer was then worked up and down to "surge" and develop the well. Approximately 15 gallons of water was removed in this manner from each well.

Groundwater Sampling

Monitoring wells installed during the Phase II field exploration portion of the project were sampled on May 27, 1988. Samples were collected with bailers, placed into appropriate laboratory prepared glass jars, and transported to a testing laboratory for analysis.

The depth to water in each monitoring well was measured with an electric well probe and the volume of water standing in the well bore was calculated. A 3-foot-long, stainless-steel and teflon bailer and new polypropylene rope were employed to remove a minimum of three casing volumes of water prior to sample collection. Water samples from each well were then collected with a bailer.

PHASE III

Phase III work was conducted between June 8 and 12, 1988, after receipt and initial evaluation of chemical test data from Phase I. A total of 10 soil borings were advanced in the vicinity of the old planer building site (north of green chain). A total of six monitoring wells were installed. Off-shore sediment and water samples were collected along the shoreline. We obtained one off-shore sediment background sample from the shoreline along Ediz Hook. We collected one background soil sample from property adjacent to the Merrill and Ring site.

In addition, one soil boring was completed as a monitoring well and six shallow hand auger explorations were conducted north of the existing planer building.

Chemical analysis of soil and water samples were conducted on a Gas Chromatograph mobilized to the site for the Phase III work.

Mobil Gas Chromatograph

Soil and water samples obtained during Phase III field activities were submitted to a mobile Gas Chromatograph (GC) for analysis by Farr Friedman and Bruya (FF&B), a chemical testing laboratory under subcontract to Hart Crowser. The GC was mounted in a trailer and transported to the site to allow a rapid turnaround time for sample analysis. Samples were delivered to the GC as soon as was practicable (usually 15 minutes to one hour) after collection. FF&B's chemist took custody of the delivered samples and then proceeded with extraction and analysis. Results were provided to Hart Crowser generally within one to five hours after delivery of the sample, or for samples delivered late in the day, the following morning. Sample custody and handling procedures are discussed in the **FIELD QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC) PLAN** section of this appendix.

Surficial Soil Sampling

Eleven surficial soil samples, designated SS-1 through SS-11, were collected in the vicinity of the old planer building site. These samples were collected from the upper 2 or 3 inches of soil exposed at the surface; generally a moist to wet, black, dark brown and gray, slightly gravelly, silty to very silty, fine SAND with trace to substantial wood and bark fragments. Samples were obtained using a stainless-steel spoon, placed directly into laboratory prepared glass jars with teflon-lined lids, and submitted to the GC for analysis. Sampling locations shown on Figure 4 were hand taped from existing site features.

Off-shore Sampling

Samples of both bottom sediments off-shore along the shoreline, and water samples were collected and submitted to the on-site GC for analysis

Off-shore Sediment Sampling

Six off-shore sediment samples, designated OSS-1 through OSS-6, were obtained from bottom sediments along the shoreline north of the old planer building site on June 11 and 12, 1988. Sampled locations are shown on Figure 4. Samples OSS-1 through OSS-4 were collected June 11, 1988. Samples OSS-5 and OSS-6 were obtained June 12, 1988 to confirm analysis of samples OSS-1 and OSS-2. Sediment samples at the four locations consisted of a gray trace to slightly silty, very sandy GRAVEL, with varying amounts of shells, wood, and organics.

A 10-foot-long metal pole fitted with a stainless steel spoon was used to collect sediment samples from below the water. Soils were composited at each location in a stainless-steel pan. After thorough mixing in the pan, two samples were collected in laboratory-prepared glass jars with teflon lid inserts. One sample from each location was submitted to the on-site GC for analysis. The second sample from each location was held for possible future analysis.

Depths of samples collected were estimated by measuring the depth to sediment below water at each sampling location and correlation with local tide charts, rounded to nearest 1-foot interval. Sample depths recorded were 2, 3, 2 and 2 feet below MLLW for OSS-1 through OSS-4 respectively. Samples OSS-5 and OSS-6 were collected at the same locations and depths as OSS-1 and OSS-2.

Off-shore Water Sampling

A grab sample of surface water was obtained at each of the four off-shore sampling locations designated OSW-1 through OSW-4 by dipping a laboratory prepared glass jar below the water surface. Water samples were submitted to the on-site GC for analysis.

Background Sampling

Soil samples were collected from the vicinity of the Merrill and Ring property to obtain information about the levels of contaminants in the area in general.

Background Off-shore Sediment Sampling

The off-shore sediment sample designated OSSBG-1 was collected from the south side of Ediz Hook to provide information on the levels of pentachlorophenol and tetrachlorophenol present in soils in the Port Angeles Harbor. The sample location is shown on Figure 15, approximately 0.35 miles out from the base of Ediz Hook on the paved road. Sampling methods consisted of compositing soils collected from below water with a 10-foot metal pole and stainless-steel spoon in a mixing bowl. The mixed sample was split and placed into two jars, with one-half submitted to the on-site GC. The other half was held for possible further analysis.

Depth of sample OSS BG-1 collection estimated as described in the Off-shore Sediment Sampling section above was +4 feet above MLLW.

Background On-shore Soil Sampling

A background on-shore sediment sample, designated BG-1, was collected on June 11, 1988, at the public marina/dock located just east of the property, shown on Figure 15. The overlying inch or two of organic matter was removed, and the upper 4 or 5 inches of soil was collected from three locations using a stainless-steel spoon. These soils which consisted of a damp, brown and oxidized brown, slightly gravelly, silty, fine SAND were composited in a stainless-steel pan, and split into two halves; one-half was submitted to the on-site GC, the other half retained for further analysis.

Subsurface Explorations

Subsurface explorations conducted for Phase III included advancing soil borings in the vicinity of the old planer building site and north of the existing planer, as well as completing shallow excavations with a post-hole digger beneath the pavement just west of the existing planer.

Auger Borings

Ten hollow-stem auger borings were advanced to depths ranging from 12.5 to 31.5 feet below ground surface north of the old planer building site. Soil samples were collected during drilling, split into two halves, and the halves placed in two laboratory-prepared glass jars with teflon-lined lids. One-half of each sample was submitted to the on-site GC for analysis. The other half was retained for possible future analysis.

Borings B-15, B-21, and B-22 were finished as monitoring wells at the completion of drilling activities at each site, and designated MW-15, MW-21, and MW-22, respectively. Due to logistical problems and sample analysis turnaround time, borings B-16, B-18, and B-19 were grouted after total depths were reached. Monitoring wells were installed later (a day or two at most) in a second, unsampled boring adjacent to each site. Wells were labeled to correspond with each boring location, MW-16A, MW-18, and MW-19. The MW-16A designation was used to distinguish the first and second borings at the B-16 location as two additional soil samples were collected in the second boring (MW-16A).

Boring B-20 was drilled on June 11, 1988, approximately 40 feet north of the northwest corner of the existing planer building, and completed as a monitoring well, designated MW-20. Well construction information is provided in the Monitoring Well Construction section of this appendix. Boring logs and well construction data for the Phase III explorations are presented on Figures C-20 through C-28 of this appendix.

Hand Auger Explorations

Soil samples were collected from six explorations located just west of the existing planer building. Mobile drill B-61 on-site to conduct hollow-stem auger borings was utilized to core six holes through the asphalt at the locations shown on Figure 4. The asphalt rubble was removed by hand, and soil samples obtained on 0.5- to 1.0-foot-depth intervals with a post-hole digger. Exploration depths ranged from 1.0 to 2.5 feet. Soils were composited over the specified sampling interval in a stainless-steel pan. Samples were then split in half and placed in laboratory-prepared glass jars with teflon-lined lids. One-half of each sample was submitted to the on-site GC, while the second half was retained for possible further analysis. Boring logs of these hand auger borings are presented on Figures C-29 and C-30 of this appendix.

Well Development

Monitoring wells completed during the field explorations were developed to remove accumulated sediment and to improve the flow of formation water into the well screen. A 3-foot-long teflon and stainless steel bailer was lowered by new polypropylene rope to the well bottom. The bailer was then worked up and down to "surge" and develop the well. Approximately 20 gallons of water was removed in this manner from each well.

Groundwater Sampling

After development, the wells installed during Phase III were sampled. Due to the limited time frame during which Phase III work occurred, wells MW-15, MW-16A, MW-18, MW-19, MW-20, MW-21, and MW-22 were sampled immediately after well development was completed. Samples were collected as described previously for Phases I and II. One water sample collected in a laboratory-prepared glass jar was submitted to the on-site GC. No duplicate samples were collected.

In addition, wells installed during Phases I and II were resampled during Phase III. Approximately 5 gallons of water was removed from wells MW-3A, MW-4A, MW-5A, MW-6A, MW-7, MW-11, MW-12, MW-13, and MW-14. Water samples were collected and submitted to the on-site GC for analysis. An oversight resulted in well MW-8 being sampled and extracted, but not analyzed by the GC.

Field Water Quality Measurements

General water quality measurements were recorded for all wells installed for this project. However, field equipment failure prevented data collection for MW-16A and MW-22. Measurements were obtained after approximately 5 gallons of water had been purged, and prior to sample collection. In the case of Phase III wells, measurements were recorded after well development, but before sample collection. Table C-1 shows pH, specific conductivity, and temperature measurements for the wells.

Table C-1 - Monitoring Well Water Quality Data

Well Number	Phase Installed	Purge Volume in Gallons	pH	Specific Conductivity	Temperature in Degrees C
3A	1	5	6.91	320	11
4A	1	5	6.97	910	13
5A	1	5	6.37	710	13
6A	1	5	6.79	1,740	14
7	1	5	6.62	770	18
8	1	5	6.90	1,092	15
11	2	5	7.00	17,100	16
12	2	5	6.21	20	15
13	2	5	6.56	236	13
14	2	5	6.79	1,320	14
15	3	20	6.61	14,020	14
16A	3	20	N/A	N/A	N/A
18	3	20	6.38	40,000*	15
19	3	20	6.47	33,300*	14

Table C-1 - (continued)

Well Number	Phase Installed	Purge Volume in Gallons	pH	Specific Conductivity	Temperature in Degrees C
20	3	20	6.61	610	16
21	3	20	6.75	1,830	14
22	3	20	N/A	N/A	N/A

* May reflect some mixing of fresh and salt water along shoreline.

Waste Soils and Water

Based on results of chemical analysis of selected samples from Phase I, as well as additional historical information about the old planer building site, a Health and Safety Plan was implemented for Phase III field work. This plan is included in at the end of this appendix.

Precautions were undertaken to contain and control, as much as was practicable, soil and water generated during drilling and sampling activities. Plastic sheeting was placed on the ground and the drill rig moved into place on top of the plastic at each boring location. Soil cuttings generated during drilling generally were carried to the surface by the auger flights and were contained on the plastic. After the boring or monitoring well installation was completed, soils were shoveled directly into open-topped 55-gallon barrels. During site cleanup, the plastic ground cover was collected and transferred to barrels as well.

Decontamination fluid generated during auger and drill tool cleaning, sampling equipment cleaning and well purge water were also collected in 55-gallon drums. Drums were sprayed on one side with white spray paint. Labels were handwritten both on the side and on the top of each drum in waterproof pen recording the drum contents, date filled, approximate volume, job number, and the name of a local person should additional information be required. Table C-2 contains an inventory of waste soils and water stored in drums on-site at the completion of Phase III field activities.

Table C-2 - List of Wastes Generated during Exploration Activities, June 1988

	Drum Designation	Contents	Drum Location	Number of Drums	Approx. Volume	Date Filled	
1	B-15 Cuttings	Soils from Boring B-15 (MW-15)	MW-15	1	3.5 cu. ft.	6/9/88	1
2	MW-15 Purge and Rinse	Water from MW-15 and decontamination rinse water	MW-15	1	20 gallons	6/9/88	2
3	B-16 Cutings	Soils from Boring B-16	MW-16A	1	7 cu. ft	6/10/88	3
4	MW-16A Cuttings	Soils from Boring MW-16A	MW-16A	1	7 cu. ft	6/12/88	4
5	Protective Clothing, and Plastic	Protective clothing, gloves, and plastic ground cover	MW-16A	1	Full Drum	6/12/88	5
6	B-22, MW-16A Rinse	Steam clean water from auger decontamination	MW-16A	2	100 gallons	6/12/88	6
7	B-16 Cuttings	Soils from Boring B-16	MW-16A	1	7 cu. ft.	6/9/88	7
8	MW-3A,5A,7,11,12,13,14	Water from listed wells	Green Chain	1	35 gallons	6/9/88	8
9	MW-4A Purge and Rinse	Water from MW-4A and decontamination rinse water	MW-4A	1	5 gallons	6/9/88	9
10	B-17 Cuttings	Soils from Boring B-17	B-17	2	14 cu. ft.	6/10/88	10
11	B-15,-16 Rinse	Steam clean water from auger decontamination	Green Chain	1	50 gallons	6/10/88	11
12	B-17,-18 Rinse	Steam clean water from auger decontamination	MW-18	1	25 gallons	6/11/88	12
13	Protective clothing, and Plastic	Protective clothing, gloves, and plastic ground cover	MW-18	1	Full Drum	6/11/88	13
14	B-18 Cuttings	Soils from Boring B-18	MW-18	3	17.5 cu. ft.	6/11/88	14
15	MW-18 Purge	Water from MW-18 and decontamination rinse water	MW-18	1	15 gallons	6/12/88	15
16	MW-6A Purge	Water from MW-6A and decontamination rinse water	Green Chain	1	10 gallons	6/8/88	16
17	B-19 Cuttings	Soils from Boring B-19	MW-19	3	17.5 cu. ft.	6/12/88	17
18	B-20 Cuttings	Soils from Boring B-20	MW-20	1	3.5 cu. ft.	6/11/88	18
19	B-19,-20 Rinse	Steam clean water from auger decontamination	MW-20	1	50 gallons	6/11/88	19
20	B-21 Cuttings	Soils from Boring B-21	MW-21	1	3.5 cu. ft.	6/12/88	20
21	Protective Clothing, and Plastic	Protective clothing, gloves, and plastic ground cover	MW-16A	1	Full Drum	6/12/88	21
22	B-22 Cuttings	Soils from Boring B-22	MW-22	1	5 cu.ft.	6/12/88	22
23	MW-22 Purge	Water from MW-22 and decontamination rinse water	MW-22	1	20 gallons	6/12/88	23
24	Protective Clothing, and Plastic	Protective clothing, gloves, and plastic ground cover	Green Chain	1	Full Drum	6/12/88	24
25	HA-1 to HA-6	Soils from hand auger holes	Planer	1	7 cu. ft.	6/11/88	25

GENERAL FIELD METHODS

This section details field methods and activities which were used in all phases of the project, and includes descriptions of hollow-stem auger borings, monitoring well construction methods, decontamination procedures, and our field quality control plan.

Hollow-stem Auger Borings

The borings completed for this project were advanced with a truck-mounted drill rig under subcontract to Hart Crowser, using 4-inch inside diameter hollow-stem auger. The drilling was accomplished under the continuous observation of a geologist from our firm. Detailed field logs were prepared of each boring. Samples collected for environmental analysis were obtained on 2-1/2- to 5-foot-depth intervals using a 3-inch inside diameter split-spoon sampler. The sampler was driven into the soil approximately 18 inches ahead of the auger using a 300-pound hammer free-falling 30 inches to obtain soil samples. Soil samples retrieved from the split-spoon sampler were field classified, and divided into two equal portions. One portion was placed immediately into a chilled cooler for later transport to the testing laboratory. The other portion was retained for later organic vapor evaluation by H-Nu, or for submission to the on-site GC for analysis during Phase Three. H-Nu headspace evaluation methods are described below.

Samples collected for geotechnical and engineering purposes were collected on 2-1/2- to 5-foot-depth intervals using the Standard Penetration Test (SPT) procedure and thin-walled shelby tubes.

The standard Penetration Test procedure as described in ASTM D 1587, was used to obtain disturbed samples. A standard 2-inch outside diameter, split-spoon sampler is driven into the soil a distance of 18 inches using a 140-pound hammer, free-falling 30 inches. the number of blows required to drive the sampler the last 12 inches is the Standard Penetration Resistance. This resistance, or blow count, provides a measure of the relative density of granular soils and consistency of cohesive soils. The blow counts are plotted on the boring logs at the respective sample depths. Samples were recovered from the split-barrel sampler, field classified and placed in water-tight jars and taken to our laboratory for further testing. The Standard Penetration Test is a useful quatitative tool from which density/consistency is determined. The results must be used in conjunction with other tests and engineering judgment.

If the high penetration resistance encountered in very dense materials precluded driving the total 18-inch sample interval, the penetration resistance for the partial penetration is entered on logs as follows: if the total penetration is greater than 6 inches and less than 18 inches, then the noted blow count is the sum of the number of blows completed after the first 6 inches of penetration, over the number of inches driven in excess of the first 6 inches. For example, a blow count series of 12 for 6 inches, 30 for 6 inches, and 50 for 3 inches, would be recorded as 80/9 inches. A blow count series of 32 for 6 inches and 50 for 4 inches would be reported as 50/4 inches. In the case where total penetration is less than 6 inches, the total number of blows and penetration are indicated.

In fine-grained soils, a 3-inch-diameter thin-walled stell (Shelby) tube sampler was pushed hydraulically below the auger to obtain a relatively undisturbed sample for classification and testing. The tubes were sealed in the field and taken to our laboratory for extrusion and classification.

Soil borings and monitoring well installations for this project are in general accordance with the minimum standards for the construction and maintenance of wells adopted by the Washington State Department of Ecology (Ecology) in May of this year. Borings not completed as monitoring wells were grouted from the bottom to near ground surface with a bentonite/cement slurry installed through a tremie pipe. Hand auger explorations completed for Phase Three were also grouted with bentonite/cement. Grouted holes were capped with a premix concrete plug at ground surface.

Monitoring Well Construction

When groundwater was encountered in a boring, and after the last soil sample was collected, a 4-inch-diameter plug was used to remove any accumulated soil from the inside of the auger, to facilitate installation of the monitoring well. Two-inch inside diameter, schedule 40 PVC threaded riser pipe attached to a 2-inch-diameter 10-foot-long, 0.020 slot PVC well screen fitted with a threaded end cap was then placed through the auger to the bottom of the boring. Colorado 10/20 silica sand was installed in the annular space as filter material. The sand pack around the well screen was recorded by sounding inside the annular space with a weighted measuring tape. A bentonite seal was installed from the top of the sand pack to near ground surface.

Steel monuments were installed on all wells for security and protection. Wells MW-3A, MW-4A, MW-6A, MW-8, MW-11, MW-12, MW-15, MW-16A, MW-18, MW-19, MW-20, MW-21, and MW-22 were completed with either 4- or 6-inch-diameter locking steel well casing cemented around the PVC well casing and sticking up approximately 18 to 24 inches above ground surface. Wells MW-5A, MW-7, MW-13, and MW-14 were completed with flush mount cast iron monuments cemented level with the ground surface, and locking "thermos-type" gasket PVC well caps. All wells were secured with padlocks.

Field Decontamination Procedures

All non-disposable soil sampling and drilling equipment were routinely decontaminated after each use. The drill rig, auger, and sampling rods were washed thoroughly with a high pressure hot water washer ("steam cleaner") using soap and tap water, and rinsed with tap water. During Phase III operations, used auger and tooling was placed on a steel grating above an approximately 150-gallon holding tank. Rinse water and soil were collected in the holding tank during decontamination operations. The holding tank was drained periodically into 55-gallon barrels for storage on-site.

Split-spoon samplers were washed between each use during Phases I and II with a concentrated solution of laboratory grade soap and tap water, and rinsed with deionized water. For Phase III work, split-spoon samplers were "steam cleaned" as described above between each use.

Sampling equipment such as bailers, stainless steel spoons, pans, and the post-hole digger were washed thoroughly between each sample with a concentrated solution of trisodium phosphate soap (TSP) and tap water and a stiff-bristle brush, and rinsed with deionized water. Decontamination and rinse water was collected in 55-gallon drums.

Organic Vapor Detection (H-Nu Readings)

Organic vapors were detected during the Phases I and II field investigation using a model PI 101 H-Nu portable photoionization analyzer. The H-Nu consists of a sealed ultraviolet light source which emits photons which ionize trace organics but do not ionize the major components of air. Which organic vapors are detected, and to what degree of accuracy, depends on the photoionization potential at the particular compounds and the calibration and lamp voltage of the instrument. For instance, some organic vapors, such as methane, cannot be detected with the H-Nu.

The operational range of the H-Nu is from the detection limit, 0.1 to 2,000 ppm in air, however, the response is linear from 0.1 to 600 ppm. For the field investigation, the H-Nu was equipped with a 10.2 eV lamp and calibrated to benzene which has the lowest human exposure threshold in air of the volatile organic compounds commonly found in gasoline. The organic vapor concentrations measured by the H-Nu are not accurate but may correlate to the total volatile compounds in a given sample and is therefore a useful screening test. The H-Nu values are also used for environmental monitoring as a health and safety precaution.

To assess the organic vapor content in the soil samples, a portion of the sample is placed in a sealed jar immediately upon opening the sampler. After nominal standing time of approximately 10 minutes the jar lid is cracked and the H-Nu probe inserted in the sample jar headspace. The resultant readings are shown on the boring logs.

Field Screening for Underground Utilities

Subsurface exploration locations were checked with M&R personnel prior to drilling whenever possible to minimize the possibility of damaging buried utilities. Locations were also checked by our field representative using Metrotech utility locating equipment. A Metrotech 810 was used to detect buried metal piping by inducing a radio frequency in ductile material. A Metrotech 50/60 was employed to locate active sources of electricity.

FIELD QUALITY ASSURANCE (QA)/QUALITY CONTROL (QC) PLAN

Objectives

The primary objective of this Quality Assurance(QA)/Quality Control(QC) Plan was to assure that the accuracy, completeness, and representativeness of project data are known and documented. This plan also provided guidance for documentation of information collected in the field, sample custody, and field quality control samples. The following specific tasks are discussed:

- Sample Collection Quality Control
- Sample Documentation and Custody
- Field Data Quality Control Subsampling
- Field Equipment Specifications
- Laboratory Analytical Procedures

Sample Collection Quality Control

Field samples were collected according to methods discussed previously. To ensure accurate laboratory analysis of samples it was important that proper preservation and storage measures were performed. Table C-3 presents container type, preservation and storage parameters, and maximum holding times for various chemical analyses for water, and soils.

Table C-3 - Sample Handling Requirements

Analyses	Matrix	Container (a)	Preservation and Storage	Maximum Holding Time (b)
Volatile Organics	Water	Glass (G), teflon-lined caps	4°C	7 days until analysis
	Soil	G, teflon-lined caps	4°C	10 days until analysis
Semivolatile Organics	Water	Amber G, teflon-lined caps	4°C	5 days until extraction; 40 days until analysis
	Soil	G, teflon-lined caps	4°C	10 days until extraction; 40 days until analysis
Pesticides/ PCB	Soil	G, teflon-lined caps	4°C	7 days until analysis
Dioxin	Soil	G, teflon-lined caps	4°C	No time specified for extraction or analysis
	Water	G, teflon-lined caps	4°C	No time specified, recommended 7 days until analysis

---

(a) Appropriate containers will generally be obtained from the laboratory performing analyses and will conform to their specifications.

(b) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times samples may be held from date of collection until date of extraction or analysis as specified.

Note: These parameters are in accordance with USEPA CLP guidelines (1986).

Sample Documentation and Custody

The following subsections describe the protocol used for accurate recording of sample information and the use of proper forms of documentation to ensure legally binding chain of custody requirements.

Sample Labeling

Sample labels clearly indicated sampling location (boring, well, site), sample number and depth (for borings only), date, sampler's initials, and any pertinent comments such as specifics of filtration or preservation. Labels were filled out at the time of sampling.

Sample Custody

After recovery, samples were maintained in our custody until formally transferred to another party. For purposes of this work, custody was defined as follows:

- In plain view of our field representatives.
- Inside a cooler which was in plain view of our field representatives.
- Inside any locked space such as a motel room, trailer, car, or truck to which our field representative or chemist subconsultant had the only immediately available key(s).
- Inside our corporate offices in a secure space.

Custody Records

Custody records were maintained for all samples recovered. This record was signed by the sampler and others who subsequently held custody of the sample. Specifications for chemical analyses was usually recorded on the custody record under the header of Testing or was discussed in advance with the analytical laboratory.

Boring Sample Collection Documentation

As drilling progressed and subsurface soil samples were obtained, a qualified field representative described the drilling conditions and nature of the samples on a boring log. Soil samples were described in general accordance with the visual-manual description procedure (Method ASTM D 2488). Samples of other materials encountered such as shells or wood were described in similar terms but without field particle size assessment.

Field Data Quality Control Subsampling

Field blank samples were used for quality control. The purpose of the field blank samples is to assess the degree to which a parameter of interest is added or removed during field operations such as equipment decontamination. Reinseate blanks included samples from split-spoon sampler bailer and sampling spoon washing, and were obtained at the discretion of the field representative. At least one field blank per 10 samples was collected. In addition, samples of deionized water used as a final rinse during the decontamination process were collected on a daily basis. These samples were submitted to the on-site GC for analysis.

Field Equipment Specifications

To assure optimum performance of all field equipment, adequate calibration and routine maintenance procedures was followed. The field equipment included a PI-101 H-Nu photoionization detector and MSA Model 361. Manufacturer specifications for all equipment were used. Field water quality measurements were obtained using a hand held meter, model DSPH-3.

Laboratory Analytical Procedures

Once samples were properly collected and documented, they were submitted either to the on-site mobile GC for analysis, or at the completion of field work to a specific analytical laboratory. Field QA/QC for the mobile GC included continuing calibration (a minimum of daily) matrix spikes, daily laboratory blanks, and standard additions. For more information on mobile GC QA/QC as well as the specified analytical laboratory, refer to the laboratory QA/QC reports included in Appendix D.

Key to Exploration Logs

Sample Descriptions

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 in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance 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 perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible 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

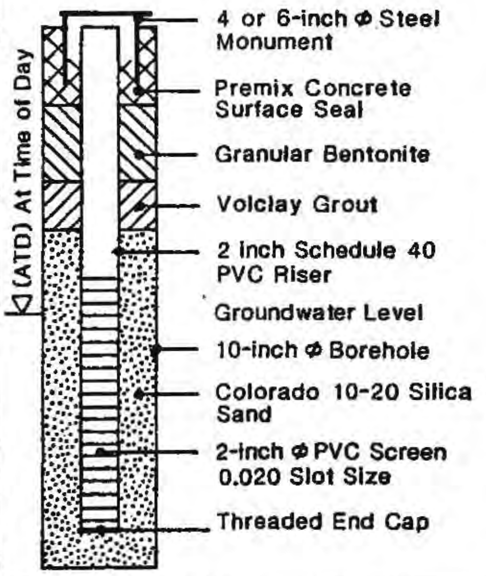
Legends

Sampling

BORING SAMPLES

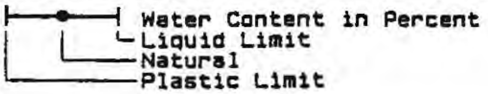
☒	Split Spoon
⧅	Shelby Tube
*	No Sample Recovery
P	Tube Pushed, Not Driven

Ground Water Observations



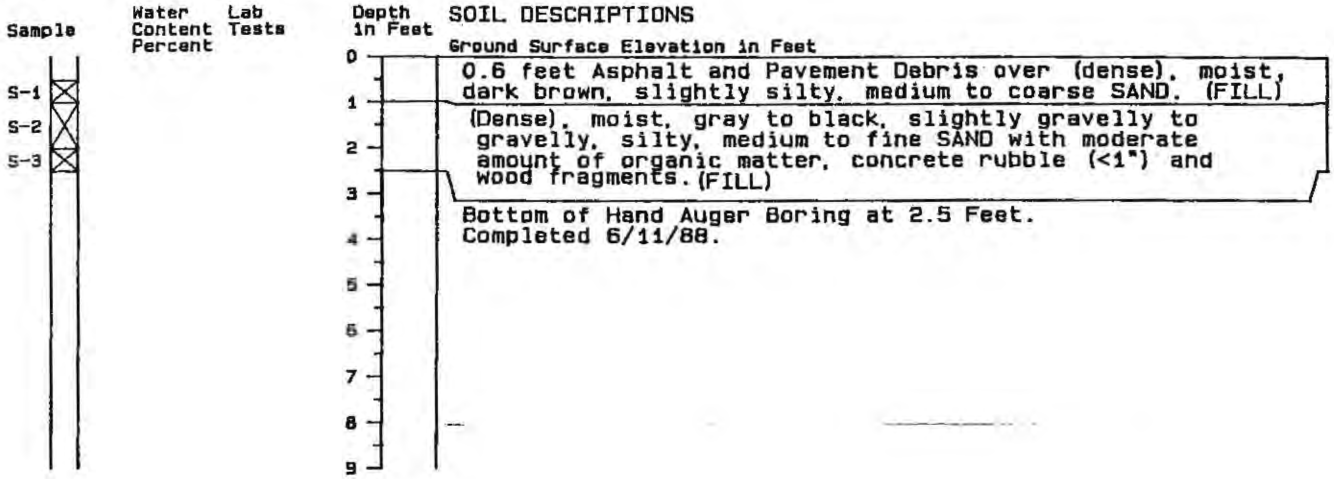
Test Symbols

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	Permeability
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



J-2159-03 June 1988
HART-CROWSER & associates, inc.
Figure C-1

Hand Auger Boring Log HA-1

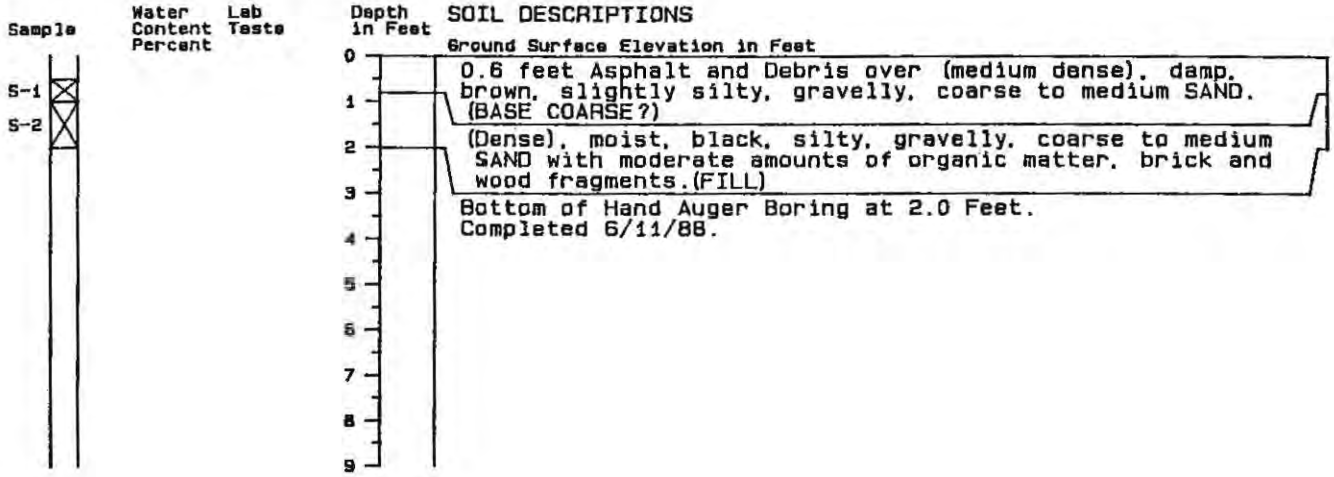


0.6 feet Asphalt and Pavement Debris over (dense), moist, dark brown, slightly silty, medium to coarse SAND. (FILL)

(Dense), moist, gray to black, slightly gravelly to gravelly, silty, medium to fine SAND with moderate amount of organic matter, concrete rubble (<1") and wood fragments. (FILL)

Bottom of Hand Auger Boring at 2.5 Feet.
Completed 6/11/88.

Hand Auger Boring Log HA-2

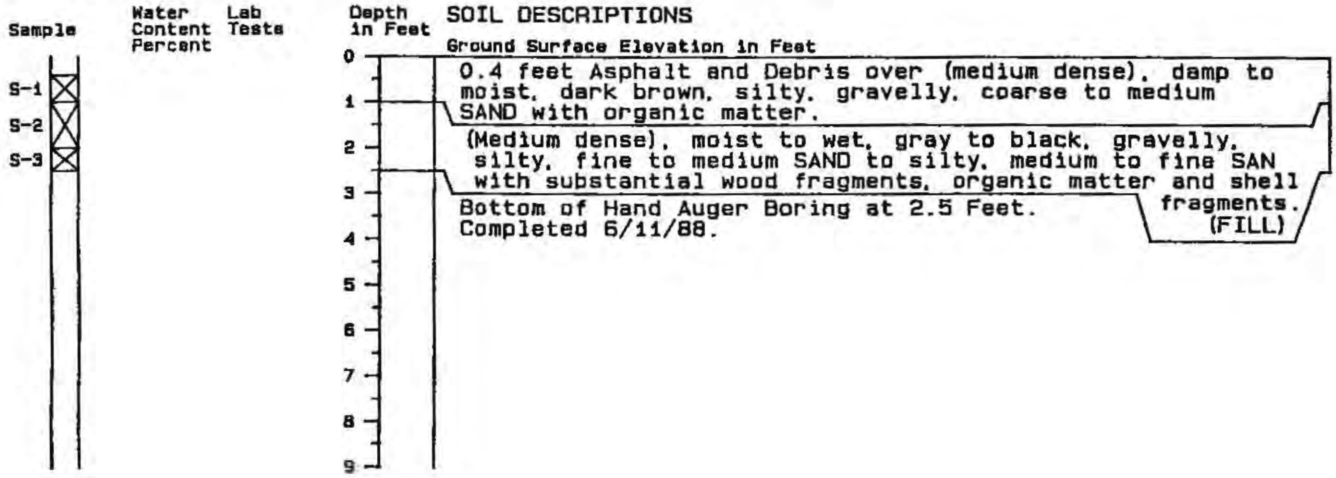


0.6 feet Asphalt and Debris over (medium dense), damp, brown, slightly silty, gravelly, coarse to medium SAND. (BASE COARSE?)

(Dense), moist, black, silty, gravelly, coarse to medium SAND with moderate amounts of organic matter, brick and wood fragments. (FILL)

Bottom of Hand Auger Boring at 2.0 Feet.
Completed 6/11/88.

Hand Auger Boring Log HA-3



0.4 feet Asphalt and Debris over (medium dense), damp to moist, dark brown, silty, gravelly, coarse to medium SAND with organic matter.

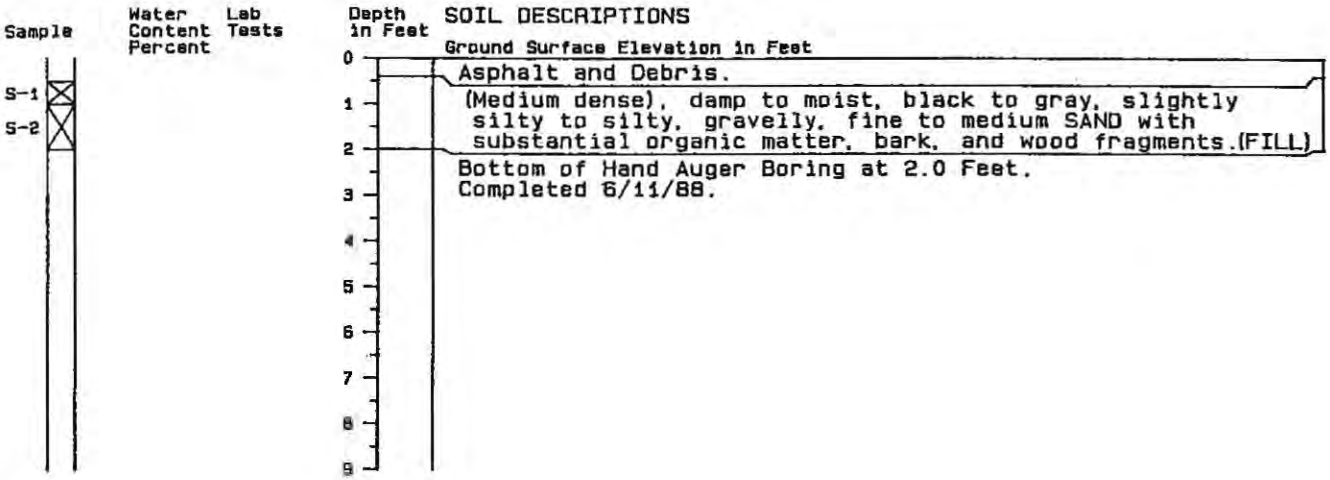
(Medium dense), moist to wet, gray to black, gravelly, silty, fine to medium SAND to silty, medium to fine SAN with substantial wood fragments, organic matter and shell fragments. (FILL)

Bottom of Hand Auger Boring at 2.5 Feet.
Completed 6/11/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

J-2159-02 June 1988
HART-CROWSER & associates, inc.
Figure C-29

Hand Auger Boring Log HA-4

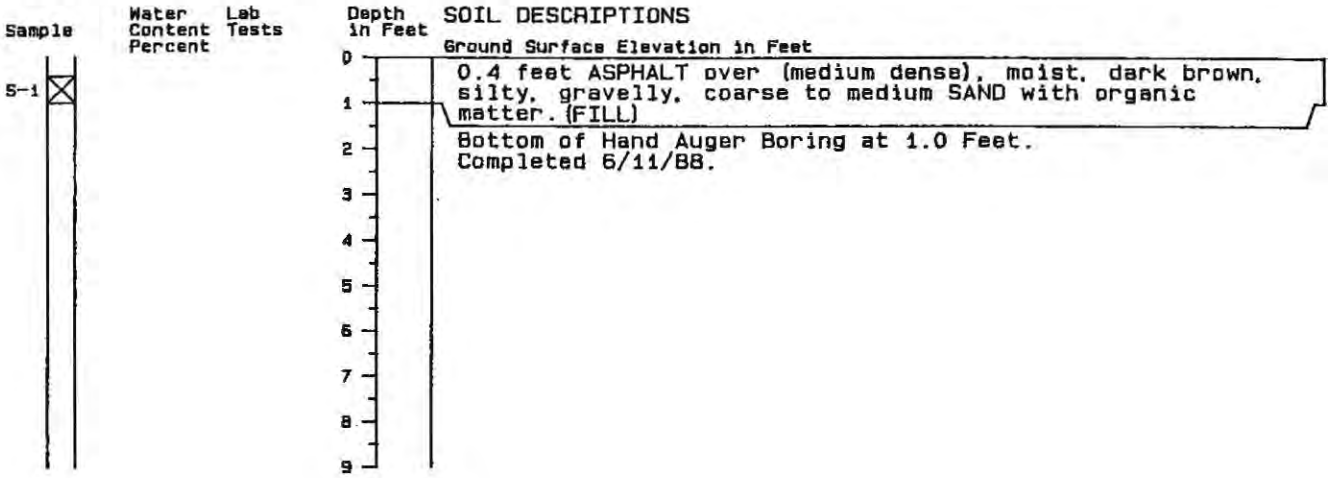


Asphalt and Debris.

(Medium dense), damp to moist, black to gray, slightly silty to silty, gravelly, fine to medium SAND with substantial organic matter, bark, and wood fragments.(FILL)

Bottom of Hand Auger Boring at 2.0 Feet.
Completed 6/11/88.

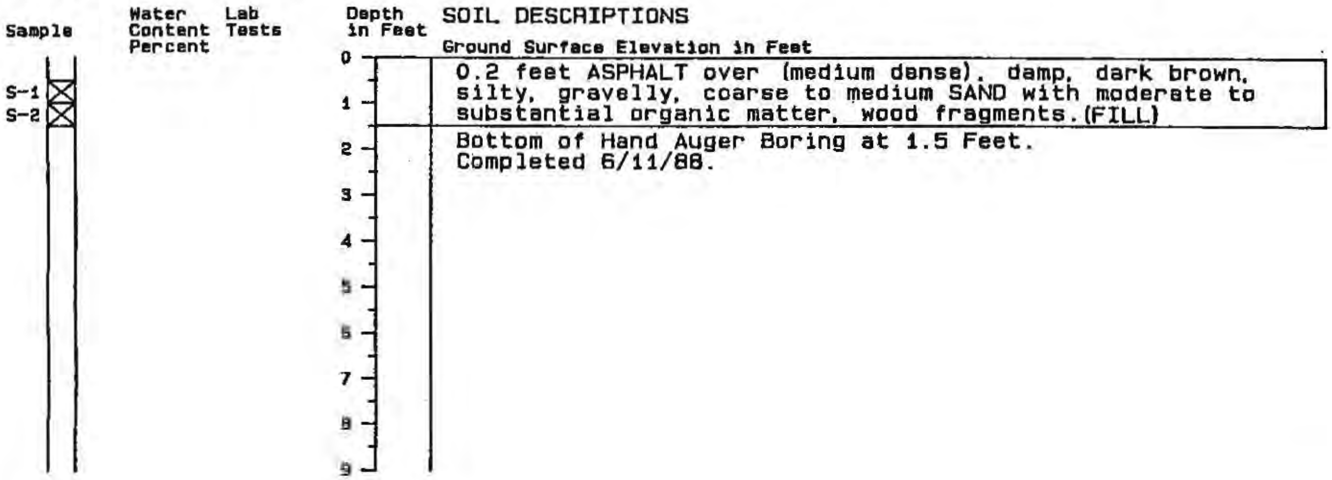
Hand Auger Boring Log HA-5



0.4 feet ASPHALT over (medium dense), moist, dark brown, silty, gravelly, coarse to medium SAND with organic matter. (FILL)

Bottom of Hand Auger Boring at 1.0 Feet.
Completed 6/11/88.

Hand Auger Boring Log HA-6



0.2 feet ASPHALT over (medium dense), damp, dark brown, silty, gravelly, coarse to medium SAND with moderate to substantial organic matter, wood fragments.(FILL)

Bottom of Hand Auger Boring at 1.5 Feet.
Completed 6/11/88.

1. Refer to Figure C-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water conditions, if indicated, are at time of excavation. Conditions may vary with time.

J-2159-02 June 1988
HART-CROWSER & associates, inc.
Figure C-30

J-2159-03

APPENDIX D

LABORATORY CERTIFICATION AND QUALITY ASSURANCE/QUALITY CONTROL

APPENDIX D
LABORATORY CERTIFICATION AND QUALITY ASSURANCE/QUALITY CONTROL

DATA QUALITY

Phase I

Data quality was good for analyses performed by Laucks Testing Laboratories for tests performed during Phase I field work. Surrogate recoveries for all analyses were within control limits. Laboratory method blanks did not detect any laboratory contamination.

Phase II

Data quality was good for analyses performed by Laucks Testing Laboratories for tests performed during Phase II field work. Surrogate recoveries for all analyses were within control limits. Field blanks did not detect any contamination from field operations. Laboratory method blanks were also clean. No replicate analyses were performed to assess the precision of the sampling and analyses.

Phase III

Pentachlorophenol (PCP) and tetrachlorophenol (TCP) analyses for Phase III work were performed in the field by Farr, Friedman & Bruya, Inc., using a mobile laboratory located on the site. Due to difficulties maintaining reliable calibration of the gas chromatograph they chose to use the method of standard additions on all samples run after June 10 which corrected the problem. Samples run prior to this change included soil samples from MW-15, B-16, B-17, and B-18 and surface soil samples SS-1 through SS-11. A number of these samples were re-analyzed later in the week and the results agreed well with earlier findings with the exception of one soil sample (S-6) from B-17. Routine duplicate analyses generally indicated good analytical precision. Method blanks did not detect any contamination from analytical procedures. Matrix spikes were routinely added to samples at both 0.1 mg/kg and at 1.0 mg/kg to evaluate percent recovery of PCP. Recoveries ranged from 70 to 200% with the exception of one recovery of 300% associated with a 0.1 mg/kg spike on SS-7 on June 10. Interpretation of analyses in terms of a high matrix spike recoveries are considered conservative.

DIOXIN ANALYSES

Dioxin analyses were performed by Triangle Laboratories, North Carolina. Laboratory blanks indicated no laboratory contamination. Surrogate recoveries were good for all samples and ranged from 70 to 100%. No field or laboratory duplicate samples were analyzed.

VERIFICATION ANALYSES

Five soil samples were submitted to Laucks Testing Laboratory for analysis of PCP and TCP to verify analyses performed in the field. Soxhlet extraction was utilized as a more vigorous method rather than sonication which was used in the field. Two of the samples represented a wood matrix (S-1 and S-2) and two represented a non-wood matrix (S-3 and S-4). It was thought that wood material was causing some sort of matrix interference during the extraction step. One sample (S-5) was spiked with 20 ul of PCP and submitted as a blind sample to evaluate method recovery.

Results from Laucks for samples S-1, S-3, and S-5 did not agree with field values obtained by FFB (Table D-1). Also, no PCP was detected at 25 ug/kg in sample S-5, which had been spiked at a level of approximately 300 ug/kg prior to submittal to the lab. Results from sample S-2 agreed well with field data, though this sample had a high degree of wood material.

Overall, the results of the comparative analyses are inconclusive as to matrix interferences due to the presence of wood. It does indicate, however, that significant matrix interferences are probably associated with many of the soil samples collected at the site.

Table D-1 - Comparative PCP Analyses

Laucks Sample Number	Hart Crowser Sample	Concentration in ppb Laucks	 FFB
S-1 (wood)	B-17; S-6	43	6,800
S-2 (wood)	B-19; S-6	37	60
S-3	B-16; S-7	19,000	6,300
S-4	B-22; S-7	11,000	< 50
*S-5 (wood)	B-23; S-6	< 25	300* (spike)

OVERALL DATA QUALITY

Overall the quality of the data presented here is adequate for the purpose of this report. Some discrepancies occur in the results of PCP analyses run at both Laucks and on-site by FFB.

PHASE I ANALYTICAL DATA

Laucks
Testing Laboratories, Inc.
940 South Harney St., Seattle, Washington 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

Certificate

CLIENT: Hart Crowser & Associates
1910 Fairview Ave. E.
Seattle, WA 98102
ATTN: Will Abercrombie

LABORATORY NO. 9834

DATE: June 3, 1988

Job No. 2159

REPORT ON: SOIL AND WATER

SAMPLE IDENTIFICATION: Submitted 05/13/88, 05/16/88, 05/20/88 and identified as shown below:

SOIL:

1)	TR-1	West Planer		05/10/88	8:30
2)	TR-2	West Sawmill		05/10/88	9:25
3)	SS-2	West Planer		05/10/88	8:45
4)	TR-3	NW Kiln		05/10/88	9:50
5)	TR-4	Alder Chipper		05/10/88	10:10
6)	SS-3	Truck Maint.		05/10/88	10:20
7)	TR-5	Chip Yard		05/10/88	11:40
8)	S-1	B-3	2.5-4.0	05/09/88	15:00
9)	S-2	B-3	5-6.5	05/09/88	13:30
10)	S-3	B-3	7.5-9	05/09/88	13:35
11)	S-4	B-3	10-11.5	05/09/88	13:45
12)	S-5	B-3	12.5-13.5	05/09/88	13:55
13)	S-6	B-3	15-16.5	05/09/88	14:05
14)	S-4	B-4A		05/11/88	13:55
15)	S-5	B-4A		05/11/88	14:00
16)	S-6	B-4A		05/11/88	14:00
17)	S-3	B-5		05/12/88	8:15
18)	S-4	B-5		05/12/88	07:30
19)	S-1	B-6A		05/13/88	13:10
20)	S-2	B-6A		05/13/88	13:20
21)	S-3	B-6A		05/13/88	13:30
22)	S-4	B-6A		05/13/88	13:40
23)	S-5	B-6A		05/13/88	13:50
24)	S-1	B-7		05/16/88	11:10
25)	S-2	B-7		05/16/88	11:15

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SAMPLE
IDENTIFICATION: (Cont.)

26)	S-3	B-7	05/16/88	11:20
27)	S-4	B-7	05/16/88	11:25
28)	S-5	B-7	05/16/88	11:30
29)	S-1	B-8	05/16/88	14:00
30)	S-2	B-8	05/16/88	14:05
31)	S-3	B-8	05/16/88	14:15
32)	S-4	B-8	05/16/88	14:25
33)	S-5	B-8	05/16/88	14:35

WATER:

34)	3A	05/17/88	13:10
35)	4A	05/17/88	13:40
36)	5A	05/17/88	10:56
37)	6A	05/17/88	09:50
38)	7	05/17/88	12:35
39)	MW8	05/17/88	10:45
40)	FB		

Selected soil samples were composited on an equal weight basis according to the following scheme:

Composite 1000 = Samples 8 - 12
Composite 1001 = Samples 14 - 16
Composite 1002 = Samples 17 - 18
Composite 1003 = Samples 19 - 23
Composite 1004 = Samples 24 - 28
Composite 1005 = Samples 29 - 33

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LABORATORY NO. 9834

TESTS PERFORMED
AND RESULTS:

Soil samples were passed through a No. 10 sieve, with percent retained and description of retained matter shown below. Only material passing the sieve was further analyzed.

Sample No.	% Retained	Major Description	Minor Description
1	<2.	---	---
2	<2.	---	---
3	45.	Bark	---
4	<2.	---	---
5	<2.	---	---
6	55.	Rock	---
7	<2.	---	---
13	64.	Rock	---
1000	34.	Rock	---
1001	43.	Rock	---
1002	42.	Rock	---
1003	39.	Rock	---
1004	<2.	---	---
1005	40.	Rock	---

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LABORATORY NO. 9834

A total solids analysis was performed on all soil samples, following method 209F, Standard Methods, 16th edition.

	1	2	3	4	5
Total Solids, %	41.4	68.5	50.6	74.1	47.1

	6	7	13	1000	1001
Total Solids, %	66.0	90.2	83.0	84.2	84.1

	1002	1003	1004	1005
Total Solids, %	85.1	83.7	86.0	82.4

Hart Crowser & Associates

LABORATORY NO. 9834

parts per billion (ug/kg), dry basis

	1	2	4	5	7
PCBs	**	<2,400.	<2,400.	<2,400.	4,800.
*Aroclor					C

*Aroclor Quantitated
C: Aroclor 1260

**Sample exhausted in initial low level extraction. No data available from that analysis. No sample remaining for medium level extraction.

Selected samples were analyzed by gas chromatography following Method 8020, Test Methods for Evaluating Solid Waste (SW-846), U.S.E.P.A., 1986, with results as shown below:

parts per billion (ug/kg), dry basis

	1001	1002	1004	Method Blank
Benzene	<12.	<12.	<12.	<10.
Ethylbenzene	<12.	<12.	<12.	<10.
Toluene	<12.	<12.	<12.	<10.
Xylenes	24.	34.	<12.	<10.

parts per billion (ug/L)

	35	36	38
Benzene	<1.	<1.	<1.
Ethylbenzene	<1.	<1.	<1.
Toluene	<1.	<1.	<1.
Xylenes	5.	2.	2.

Hart Crowser & Associates

LABORATORY NO. 9834

Selected samples were analyzed by gas chromatography employing a modified Method 8150, Test Methods for Evaluating Solid Waste (SW-846), U.S.E.P.A., 1986, with results as shown below:

	parts per billion (ug/kg), dry basis					
	3	13	1000	1003	1005	Method Blank
Tetrachlorophenol	40,000.	<25.	<25.	3,600.	<25.	<25.
Pentachlorophenol	270,000.	<25.	<25.	11,000.	<25.	<25.
Sodium Tetrachlorophenate	4,000.	<25.	<25.	25.	<25.	<25.
Sodium Pentachlorophenate	17,000.	<25.	<25.	47.	<25.	<25.

	parts per billion (ug/L)		
	34	37	39
Pentachlorophenol	<1.	5,700.	<1.
Tetrachlorophenol	<1.	7,400.	<1.

Comments on analysis

To attempt to distinguish between the free phenol and acid forms of tetrachlorophenol and pentachlorophenol in the soil samples, the extraction method was slightly modified. The samples were initially extracted at a neutral pH. The results of analyzing this extract are reported as the free phenol. The sample was then re-extracted after adjusting to an acidic pH. The results of analyzing this extract are reported as the sodium salts of the two phenols.

The results for the sodium salts should be regarded as estimates since the free phenol could be present in both the ionized and un-ionized forms. In other words, the presence of free phenol could contribute to the determination of the sodium salt and as a result, the value reported for the sodium salt should be considered a maximum concentration.

PAGE NO. 7

Hart Crowser & Associates

LABORATORY NO. 9834

A screen for base/acid/neutral components was performed by gas chromatography (GC) with flame ionization detector (FID) on selected samples. All peaks within the retention time window of 6-48 minutes were summed and calculated on the response of Phenanthrene. Copies of chromatograms are attached.

parts per billion (ug/kg), dry basis

	6	1001	1002
GC/FID BAN Screen, calculated on the response of Phenanthrene	2,400,000.	9,700.	4,700.

	Method Blank 1	Method Blank 2	Method Blank 3
GC/FID BAN Screen, calculated on the response of Phenanthrene	<3,500.	<200,000.	<200,000.

parts per billion (ug/L)

	35	36	Method Blank
GC/FID BAN Screen, calculated on the response of Phenanthrene	280.	<200.	<200.

Hart Crowser & Associates

LABORATORY NO. 9834

Key

< indicates "less than"

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J M. Owens

J. M. Owens

JMO:emt

Laucks
Testing Laboratories, Inc.
940 South Harney St., Seattle, Washington 98108 (206) 767-5060 FAX 767-5063

Chemistry, Microbiology, and Technical Services

Certificate

APPENDIX A

Surrogate Recovery Quality Control Report

Attached are surrogate (chemically similar) compounds utilized in the analysis of organic compounds. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

JOB No 9834 DATE: 06/01/88

Sample No. 80531GPXSMG Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	84		20 - 156
Isodrin	66		20 - 112

Sample No. 2 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	57		20 - 156
Isodrin	61		20 - 112

Sample No. 4 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	97		20 - 156
Isodrin	82		20 - 112

Sample No. 5 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	54		20 - 156
Isodrin	57		20 - 112

Sample No. 7 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	56		20 - 156
Isodrin	70		20 - 112

JOB No. 9834 DATE: 06/01/88

Sample No. B0531GPXSMG Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	84		20 - 156
Isodrin	66		20 - 112

Sample No. 2 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	57		20 - 156
Isodrin	61		20 - 112

Sample No. 4 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	97		20 - 156
Isodrin	82		20 - 112

Sample No. 5 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	54		20 - 156
Isodrin	57		20 - 112

Sample No. 7 Matrix: Soil Analysis: PEST

Surrogate Compound	Percent Recovery	Comment	Control Limits
Dibutylchlorendate	56		20 - 156
Isodrin	70		20 - 112

JOB No. 9834 DATE: 05/17/88

Sample No. B0517GV0.SA1 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	97		87 - 113

Sample No. 1001 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	104		87 - 113

Sample No. 1002 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	105		87 - 113

JOB No. 9834   DATE: 05/27/88

Sample No. B0526GV0.WA1   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	100		87 - 113

Sample No. 35   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	95		87 - 113

Sample No. 36   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	100		87 - 113

Sample No. 38   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	101		87 - 113

Sample No. 38MS   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	103		87 - 113

Sample No. 38MSD   Matrix: Water   Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	100		87 - 113

Sample No. 1004 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	100		87 - 113

JOB No. 9834 DATE: 06/01/88

Sample No. B0523GSC.SMI Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	81		18 - 154
2-Fluorobiphenyl	82		39 - 146
Azobenzene	89		40 - 133

Sample No. 6 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	84		18 - 154
2-Fluorobiphenyl	75		39 - 146
Azobenzene	54		40 - 133

JOB No. 9834   DATE: 06/01/88

Sample No. B0519GSC.SMI   Matrix: Soil   Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	72		18 - 154
2-Fluorobiphenyl	69		39 - 146
Azobenzene	71		40 - 133

Sample No. 1001 (MED)   Matrix: Soil   Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	64		18 - 154
2-Fluorobiphenyl	64		39 - 146
Azobenzene	73		40 - 133

JOB No. 9834 DATE: 06/01/88

Sample No. B0529GSC.SLI Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	85		18 - 154
2-Fluorobiphenyl	95		39 - 146
Azobenzene	91		40 - 133

Sample No. 1002 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	73		18 - 154
2-Fluorobiphenyl	73		39 - 146
Azobenzene	77		40 - 133

JOB No. 9834   DATE: 06/01/88

Sample No. B0525GSC.WLI   Matrix: Water   Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	81		28 - 150
2-Fluorobiphenyl	81		41 - 129
Azobenzene	85		50 - 128

Sample No. 35   Matrix: Water   Analysis: GC-ABN

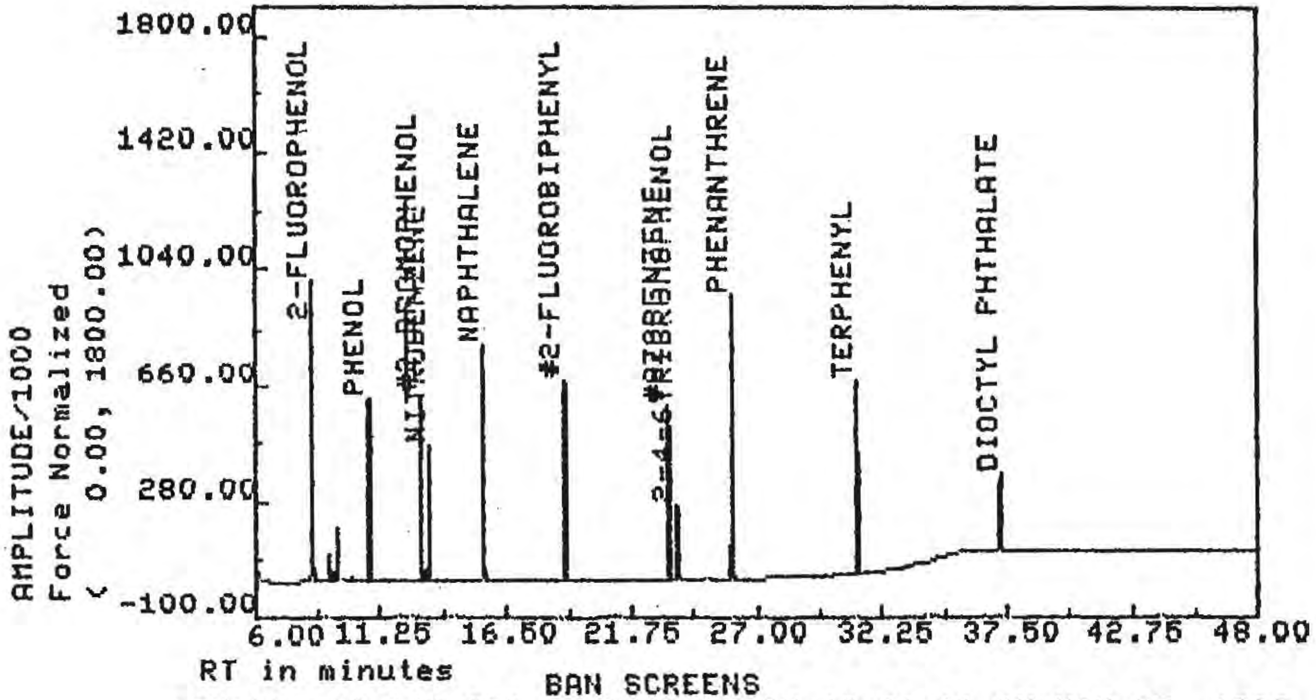
Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	70		28 - 150
2-Fluorobiphenyl	77		41 - 129
Azobenzene	80		50 - 128

Sample No. 36   Matrix: Water   Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	51		28 - 150
2-Fluorobiphenyl	51		41 - 129
Azobenzene	54		50 - 128

APPENDIX B

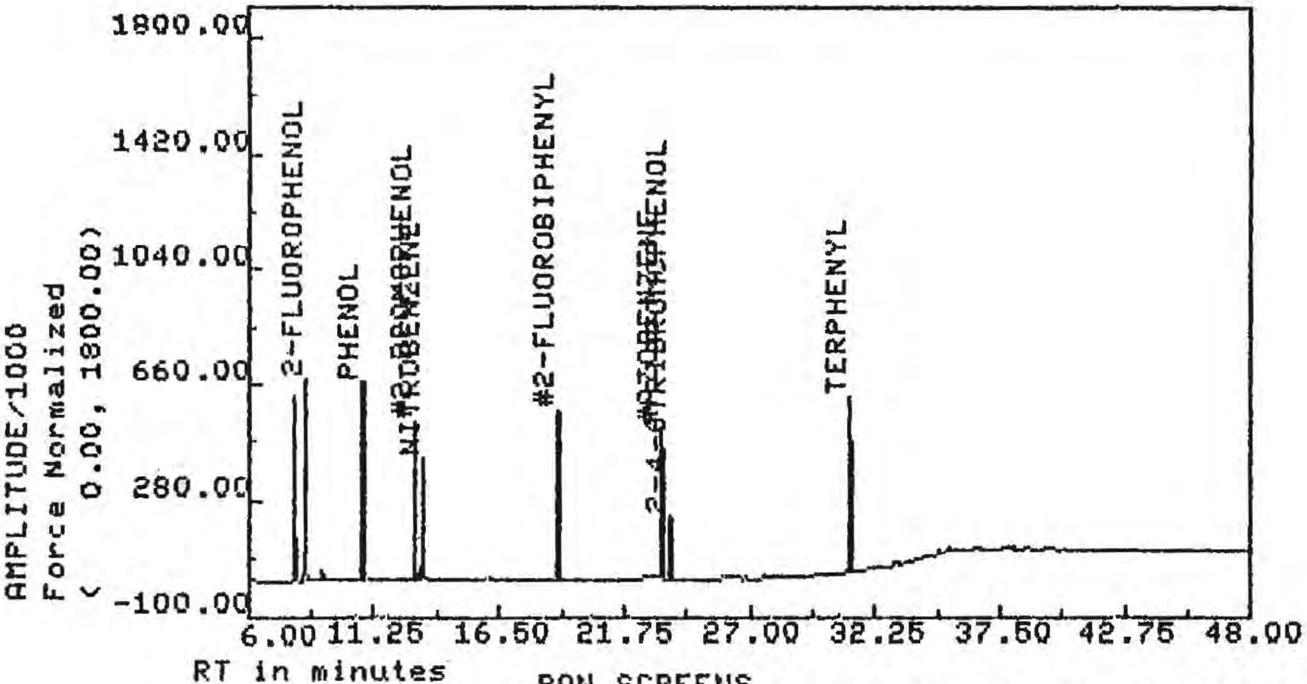
Copies of chromatograms from the GC/FID BAN Screen are attached



BAN SCREENS

SAMPLE: BA 167 STD   INJECTED AT 19:06:11 ON MAY 27, 1988
Meth: MHSCRN   Raw: RH2708   Proc: PH2708

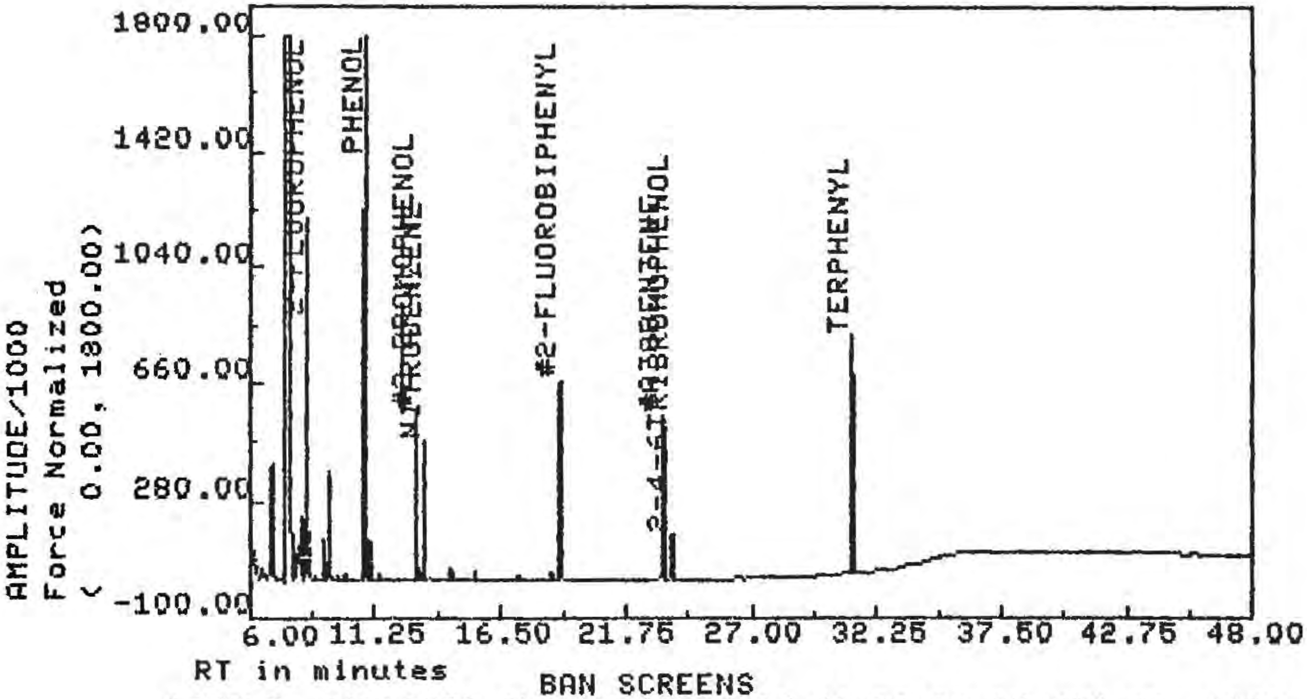
Standard



BAN SCREENS

SAMPLE: B0515GMS.SLI INJECTED AT 20:07:07 ON MAY 27, 1988
Meth: MHSCRN Raw: RH2709 Proc: PH2709

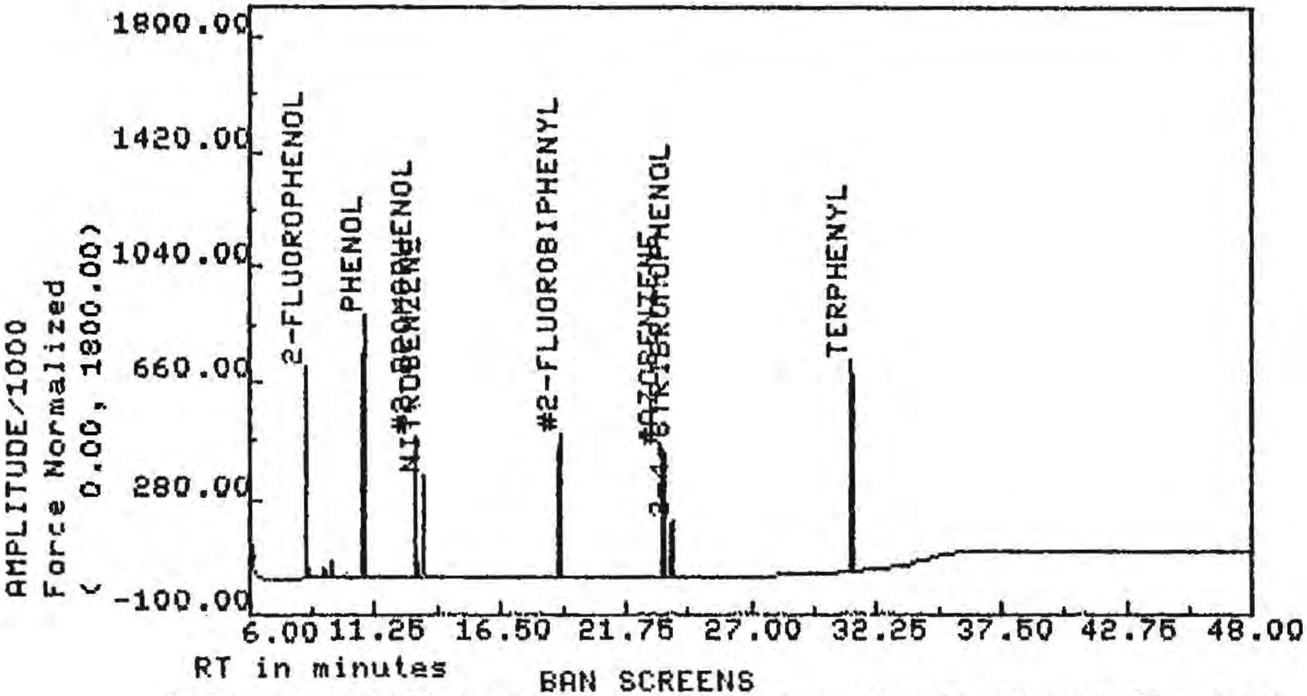
Blank low soil



BAN SCREENS

SAMPLE: B0519GSC.SLI INJECTED AT 21:08:03 ON MAY 27, 1988
Meth: MHSCRN Raw: RH2710 Proc: PH2710

Blank low soil

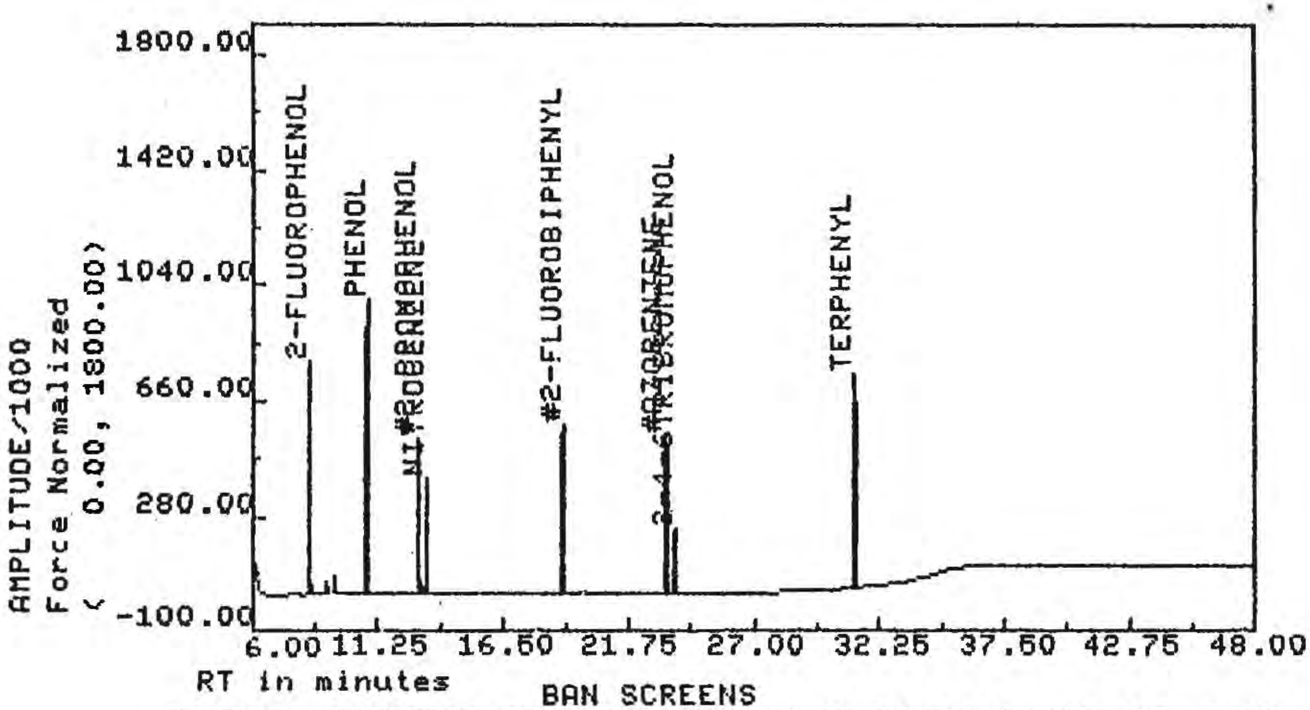


BAN SCREENS

SAMPLE: B05196SC.SMI INJECTED AT 22:08:59 ON MAY 27, 1988

Meth: MHSCRN Raw: RH2711 Proc: PH2711

Blank medium - soil

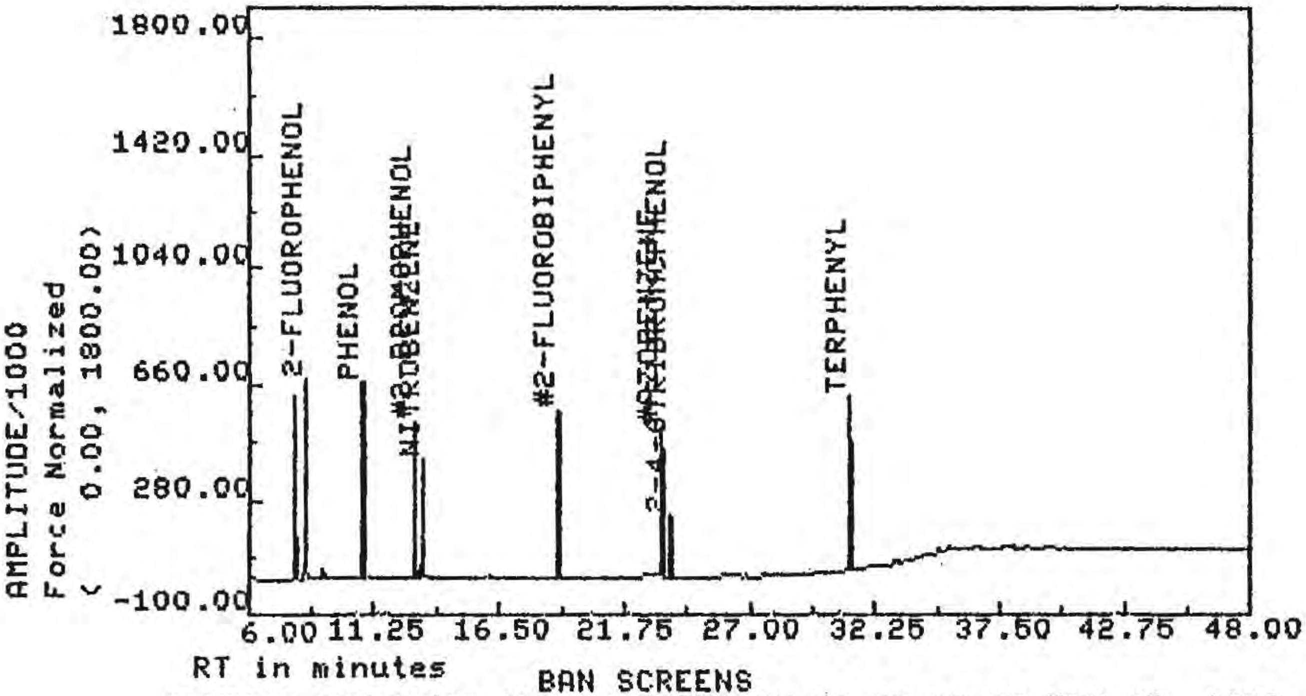


BAN SCREENS

SAMPLE: B0523GSC.SMI INJECTED AT 23:09:55 ON MAY 27, 1988

Meth: MHSCRN Raw: RH2712 Proc: PH2712

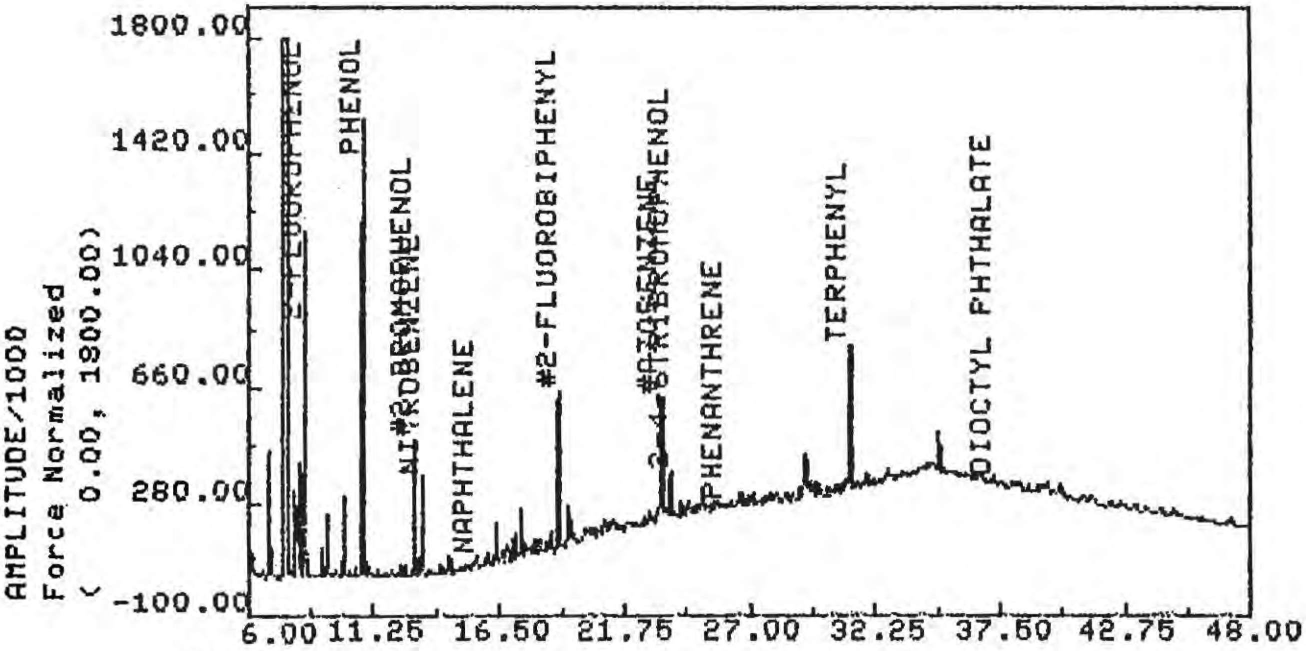
Blank medium soil



BAN SCREENS

SAMPLE: B0525GSC.VLI INJECTED AT 20:07:07 ON MAY 27, 1988
Meth: MHSCRN Raw: RH2709 Proc: PH2709

Blank Water - low

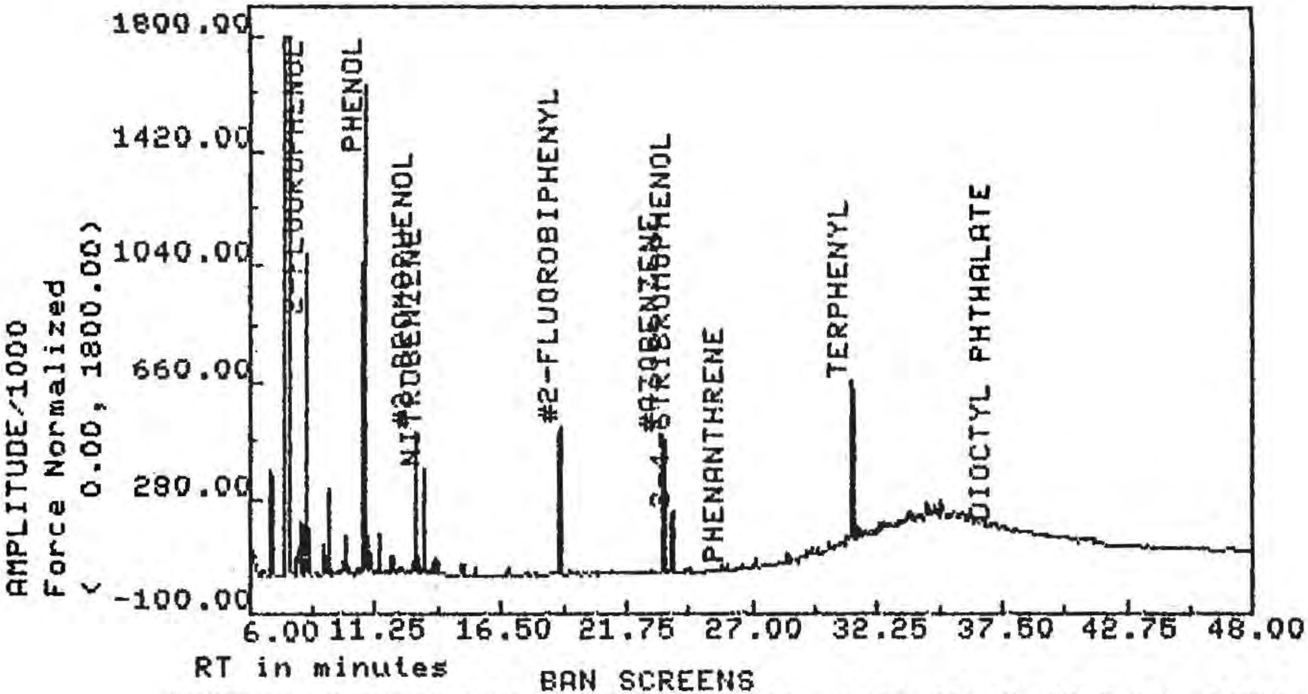


BAN SCREENS

SAMPLE: S 9834-1001 INJECTED AT 11:54:43 ON MAY 28, 1988

Meth: MHSCRN Raw: RH2721 Proc: PH2721

#1001 25.2 gms/1.0 ml

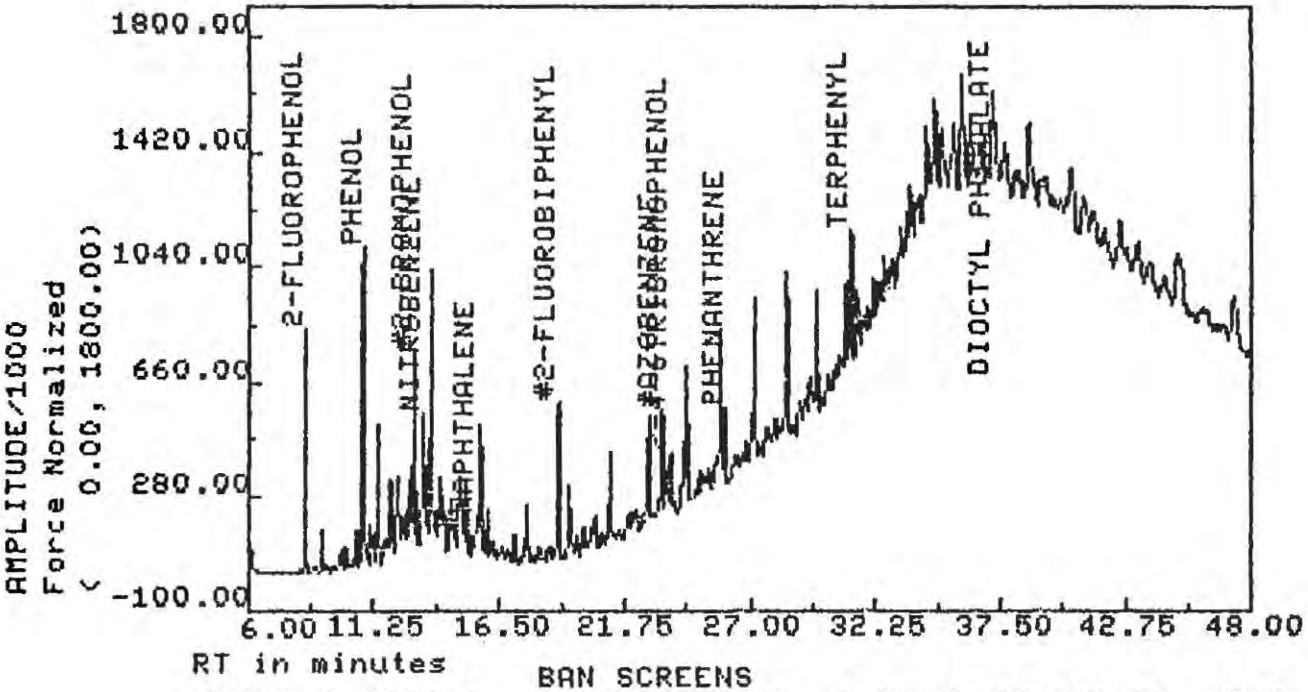


BAN SCREENS

SAMPLE: S 9834-1002 INJECTED AT 1:11:47 ON MAY 28, 1988

Meth: MHSCRN Raw: RH2714 Proc: PH2714

#1002 25.56 g/1.0ml

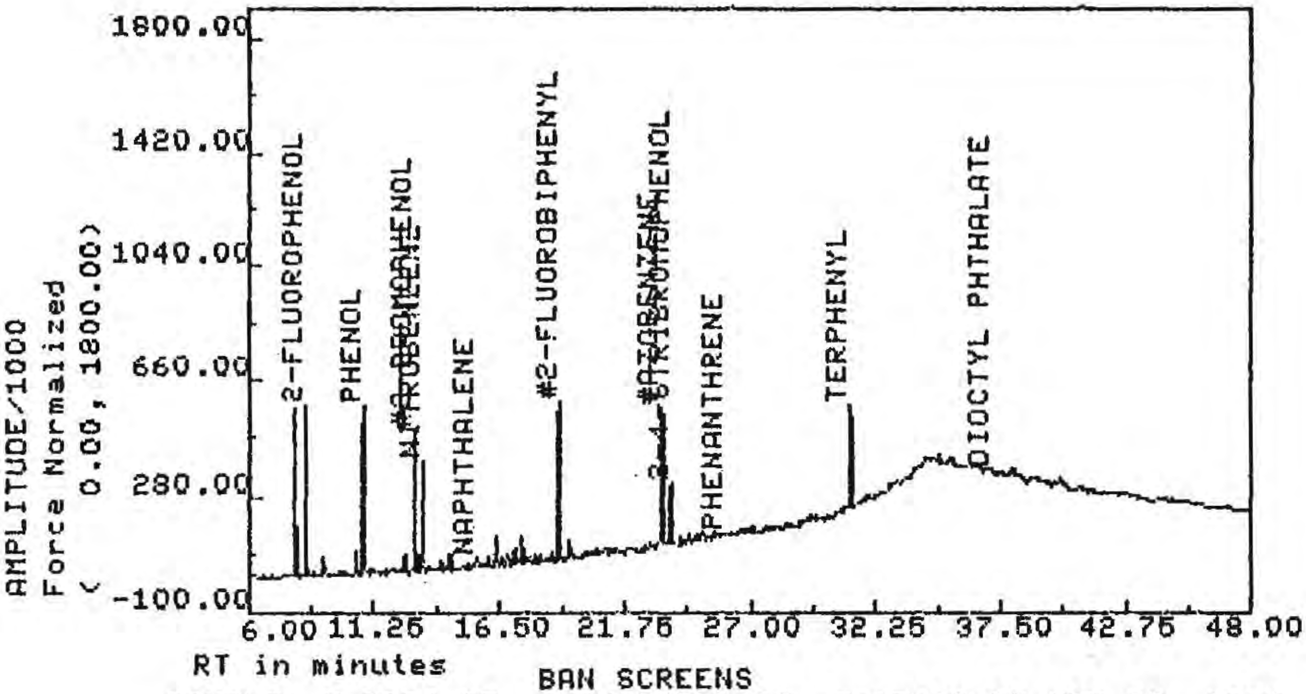


BAN SCREENS

SAMPLE: S 9834-6 INJECTED AT 5:15:31 ON MAY 28, 1988

Meth: MHSCRN Raw: RH2718 Proc: PH2718

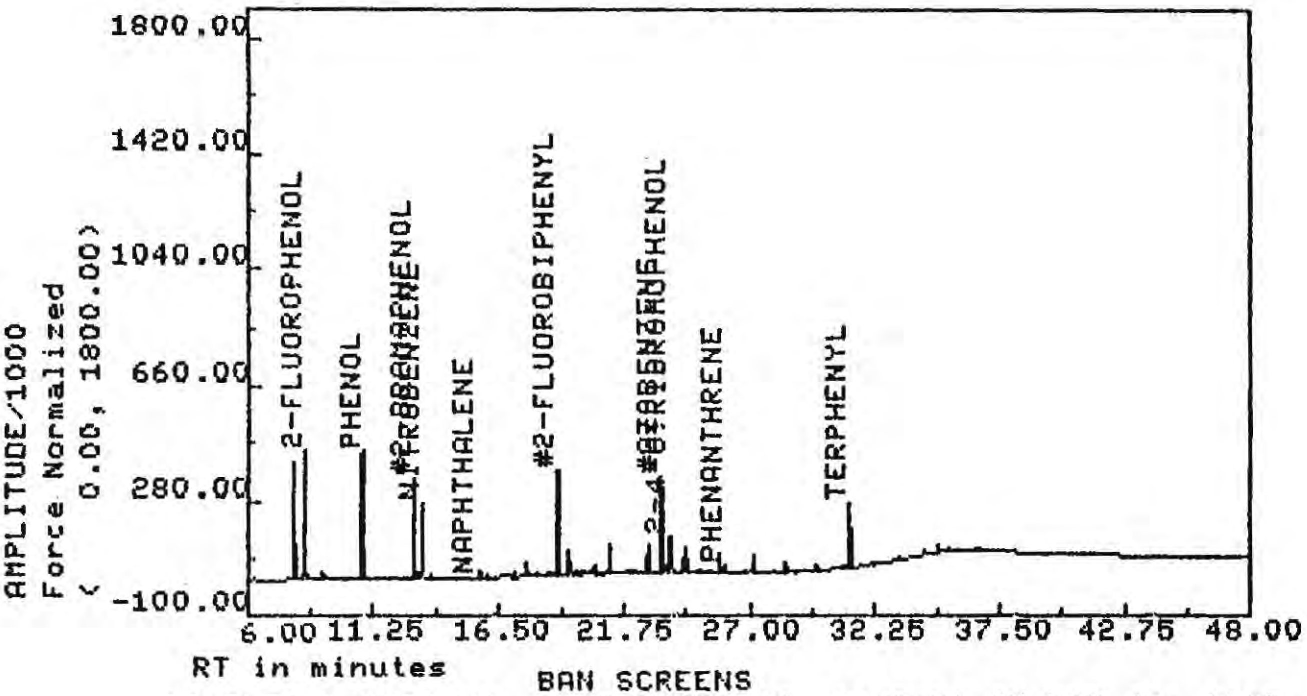
#6 0.7 gms/1.0 ml



BAN SCREENS

SAMPLE: W 9834-35 INJECTED AT 7:17:23 ON MAY 28, 1988
Meth: MHSCRN Raw: RH2720 Proc: PH2720

#35 500mls/1.0ml



BAN SCREENS
SAMPLE: W 9834-36 INJECTED AT 0:10:51 ON MAY 28, 1988
Meth: MHSCRN Raw: RH2713 Proc: PH2713

#36 500 ml /1.0ml

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Testing Laboratories, Inc.
940 South Harney St., Seattle, Washington 98108 (206) 767-5060 FAX 767-5063
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APPENDIX C

Copies of Chain-of-Custody are Attached

Sample Custody Record

DATE 5/10/88 PAGE 1 OF 2

HARTCROWSER

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

JOB NUMBER 2159 **LAB NUMBER**

PROJECT MANAGER JR Funderburk III

PROJECT NAME Merril & Ring

SAMPLED BY: Lynn Bruner / Will Abercombie

LAB NO.	SAMPLE	TIME	STATION	MATRIX	● PCB (Total)	* Phenols 8040	▼ BAN Screen	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
9834-1	TR-1	8:30	West planer	Soil	X			1	* Sample may contain
2	TR-2	9:25	West Sawmill	"	X			1	Sodium Salts of tetra
~~3~~	~~SS-1~~	~~8:45~~	~~West Planer~~	~~Soil~~	—	NOT Analyzing	W/A	~~1~~	& Pentachlorophenate.
3	SS-2	8:46	" "	"		X		1	
4	TR-3	9:50	Boiler/Kiln	"	X			1	▼ GC/FID Screen –
5	TR-4	10:10	Alder Chipper	"	X			1	Need copies of chromatogram
6	SS-3	10:20	Truck Maint.	"			X	1	
7	TR-5	11:40	Chip Yard	"	X			1	● Total PCB value only.
									Do not need to
									Speciate

RELINQUISHED BY Lynn Bruner
Signature
LYNN BRUNER
Printed Name
HART CROWSER
Company
DATE 5/10/88 **TIME** 1630

RECEIVED BY William Abercombie
Signature
William Abercrombie
Printed Name
Hart Crowser
Company
DATE 5/10/88 **TIME** 1630

RELINQUISHED BY William Abercombie
Signature
William Abercrombie
Printed Name
Hart Crowser
Company
DATE 5/13/88 **TIME** 1511

RECEIVED BY Ross D. Potter
Signature
Ross D. Potter
Printed Name
Hart Crowser
Company
DATE 5/13/88 **TIME** 1515

TOTAL NUMBER OF CONTAINERS 7

METHOD OF SHIPMENT Cooler & ice

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS
Keep Cool

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

WBH

Sample Custody Record

DATE 5/9/88 PAGE 1 OF ~~1~~ 2

HARTCROWSER

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

JOB NUMBER 2159 **LAB NUMBER**

PROJECT MANAGER JOHN R. FUNDERBURK III

PROJECT NAME M&R ENVIRONMENTAL ASSESSMENT

SAMPLED BY: HW Small

TESTING

LAB NO.	SAMPLE	TIME	STATION	MATRIX	Phenols 8040	NO. OF CONTAINERS
9834-8	S-1	1300	B-3 2.5'-4.0'	SOIL		1
9	S-2	1330	B-3 5.0'-6.5'	"		1
10	S-3	1335	B-3 7.5'-9.0'	"	X - Run S-1 thru S-5 as one composite sample. Composite in lab.	1
11	S-4	1345	B-3 10.0'-11.5'	"		1
12	S-5	1355	B-3 12.5'-14.0'	"		1
13	S-6	1405	B-3 15.0'-16.5'	"	X	1

Composite

OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS

Composite samples S-1 through S-5 in lab by taking equal aliquots from each container - run as 1 sample. Run S-6 by itself.

* Note: samples may contain Sodium salts of tetra & pentachlorophenate,

RELINQUISHED BY	DATE	RECEIVED BY	DATE
HW Small Signature	5/10/88	William Abercrombie Signature	5/10/88
H W SMALL Printed Name	TIME 0824	William Abercrombie Printed Name	TIME 0824
HART CROWSER INC Company		Hart Crowser, Inc Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
William Abercrombie Signature	5/13/88	Ross D. Potter Signature	5/13/88
William Abercrombie Printed Name	TIME 1511	ROSS D. Potter Printed Name	TIME 1515
Hart Crowser Company		Hart Crowser Company	

TOTAL NUMBER OF CONTAINERS 6

METHOD OF SHIPMENT Ice chest w/Ice

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep Cool

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

→ continued on page 2

Samples Taken on 5/11/88 Note: 7 day Holding Time on BTEX

S-3 ; S-4 Taken 5/12

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

Sample Custody Record

DATE 5-16-88 NOT on SCAN PAGE 1 OF 1

JOB NUMBER 2159 LAB NUMBER

PROJECT MANAGER John Funderburk III

PROJECT NAME M & R Environmental Assessment

SAMPLED BY: H-W. Small

LAB NO.	SAMPLE	TIME	STATION	MATRIX	BAN Screen	BTEX	• phenol 8040							NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
14	S-4	1355	B-4A 10.0'-11.5	Soil } *										2	* Composite in Lab
15	S-5	1400	" 12.5-14.0	"	X	X	(Composite)							2	by mixing equal aloquots
16	S-6	1400	" Cutting Grab	"										2	of each subsample –
															Run as 1 composite Sample
17	S-3 WAH ~~S-2~~	0900 WBA ~~1650~~	B-5 Cuttings ~~7.5-4.0~~	WBA Soil } *	X	X	(Composite)							2	
18	S-4	0730	B-5~~A~~ WBA 7.5-9.0'	"										2	• Sample for phenol may
															contain sodium tetra and
19	S-1	1310	B-6A 2.5-4.0'	Soil } *										1	pentachlorophenates
20	S-2	1320	" 5.0-6.5'	"										1	
21	S-3	1330	" 7.5-9.0'	"			X (Composite)							1	
22	S-4	1340	" 10.0-11.5'	"										1	Need Chromatograph on
23	S-5	1350	" 12.5-14.0'	"										1	BAN Screen

RELINQUISHED BY	DATE	RECEIVED BY	DATE
William Abercrombie Signature	5/16/88	Toni A Carmichael Signature	5/16/88
William Abercrombie Printed Name	TIME	TONI A. CARMICHAEL Printed Name	TIME
Hart Crowser Company	1453	Hart Crowser Company	1503
RELINQUISHED BY	**DATE**	**RECEIVED BY**	**DATE**
Signature		F Collins Signature	5/16
Printed Name	TIME	F Collins Printed Name	TIME
Company		Company	3:00

TOTAL NUMBER OF CONTAINERS 15

METHOD OF SHIPMENT Ice

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS
Keep Cool (≈ 4°C)

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 5/16/88 PAGE 1 OF ~~7~~ 2 WBA

HARTCROWSER

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

JOB NUMBER 2159 LAB NUMBER

PROJECT MANAGER John FunderBurk III

PROJECT NAME M&R Environmental Assessment

SAMPLED BY: Howard Small

LAB NO.	SAMPLE	TIME	STATION	MATRIX	BTEX	Phenols 8040	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
983424	S-1	1110	B-7 2.5-4.0'	SOIL			1	* Composite in lab by
25	S-2	1115	" 5.0'-6.5'	"			1	taking equal aliquots
26	S-3	1120	" 7.5'-9.0'	" composite *	X		1	from each container. Run
27	S-4	1125	" 10.0'-11.5'	"			1	as 1 sample
28	S-5	1130	" 12.5'-14.0'	"			1	
					X			
29	S-1	1400	B-8 2.5'-4.0'	SOIL			1	Phenol sample may
30	S-2	1405	" 5.0-6.5'	"			1	contain Sodium salt
31	S-3	1415	" 7.5'-9.0'	" composite *		X	1	of Tetra & pentachlorophenate.
32	S-4	1425	" 10.0'-11.5'	"			1	
33	S-5	1435	" 12.5'-14.0'	"			1	
			"					

NOTE: Samples from B-7 were not placed in BTEX container - Take sample from pint jar

RELINQUISHED BY	DATE	RECEIVED BY	DATE
H W Small Signature H W SMALL Printed Name HART CROWSER Company	5/17/88 TIME 0915	Signature Neil Shaw Printed Name Hart Crowser inc Company	5/17/88 TIME 915

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature Neil Shaw Printed Name Hart Crowser Inc. Company	5/18/88 TIME 1550	Signature C ALBer H. Trott Printed Name H.C. Company	5/19/88 TIME 10:00

TOTAL NUMBER OF CONTAINERS 10

METHOD OF SHIPMENT hand delivery

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep Cool

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 5/17/88 PAGE 1 OF 1

HARTCROWSER

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

JOB NUMBER 2159 **LAB NUMBER**

PROJECT MANAGER John Funderburke III

PROJECT NAME Merril & Ring Environmental Assessment

SAMPLED BY: Neil Shaw

LAB NO.	SAMPLE	TIME	STATION	MATRIX	* Phenols 8040	BAN Screen	BTEX								NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
																WBA
634 34	MW-3A	1256	MW-3A	water	X										1~~2~~	* Phenol samples may
35	MW-4A	1326	MW-4A	water		X	X								3	Contain tetra &
36	MW-5A	1046	MW-5A	water		X	X								3	pentachlorophenate —
37	MW-6A	0950	MW-6A	water	X									WBA	1~~2~~	sodium salts.
38	MW-7	1227	MW-7	water			X								2	
39	MW-8	1020	MW-8	water	X									WBA	1~~2~~	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature	5/18/88	Signature	5/20/88
Neil Shaw Printed Name	TIME	John H. Tritt Printed Name	TIME
Hart Crowser Company	1550	H.C. Company	10:00

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature	5/20	Judy Ecklund Signature	5/20
GALBERT Tritt Printed Name	TIME	Judy Ecklund Printed Name	TIME
H.C. Company	1024	Laucks Company	1024

TOTAL NUMBER OF CONTAINERS 11 WBA 14

METHOD OF SHIPMENT hand delivery

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep cold

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

PHASE II ANALYTICAL DATA

Laucks
Testing Laboratories, Inc.
940 South Harney St., Seattle, Washington 98108 (206) 767-5060 FAX 767-5063
Chemistry, Microbiology, and Technical Services

RECEIVED
JUN 15 1988
HART CROWSER, INC.

Certificate

CLIENT: Hart Crowser, Inc.
1910 Fairview Ave. E.
Seattle, WA 98102-3699
ATTN: Will Abercrombie

LABORATORY NO. 10227

DATE: June 14, 1988

JOB #2159-01

REPORT ON: SOIL & WATER

SAMPLE IDENTIFICATION: Submitted 6/6/88 and identified as shown:

1)	B-11	S-1	06/02/88	11:25	2.5 - 4.0
2)	B-11	S-2	06/02/88	11:30	5. - 6.5
3)	B-11	S-3	06/02/88	11:35	7.5 - 9.
4)	B-12	S-1	06/02/88	14:15	2.5 - 4.0
5)	B-12	S-2	06/02/88	14:20	5. - 6.5
6)	B-12	S-3	06/02/88	14:25	7.5 - 9.
7)	B-12	S-4	06/02/88	14:30	10. - 11.5
8)	B-12	S-5	06/02/88	14:35	12.5 - 14.
9)	B-13	S-1	06/02/88	16:30	2.5 - 4.
10)	B-13	S-2	06/02/88	16:35	5. - 6.5
11)	B-13	S-3	06/02/88	16:40	7.5 - 9.
12)	B-13	S-4	06/02/88	16:45	10. -11.5
13)	B-13	S-5	06/02/88	16:50	12.5 -14.
14)	B-14	S-1	06/03/88	10:00	2.5 - 4.
15)	B-14	S-2	06/03/88	10:05	5. - 6.5
16)	B-14	S-3	06/03/88	10:10	7.5 - 9.
17)	B-14	S-4	06/03/88	10:15	10. -11.5
18)	B-14	S-5	06/03/88	10:20	12.5 -14.
19)	MW-11	S-1	06/03/88	14:00	
20)	MW-12	S-1	06/03/88	15:30	
21)	MW-13	S-1	06/03/88	16:00	
22)	MW-14	S-1	06/03/88	16:30	

Selected samples were composited on an equal weight basis according to the following scheme:

Composite 1000 = Samples 1 through 3
Composite 1001 = Samples 4 through 8
Composite 1002 = Samples 9 through 13
Composite 1003 = Samples 14 through 18

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PAGE NO. 2

Hart Crowser & Associates

LABORATORY NO. 9834

TESTS PERFORMED
AND RESULTS:

Composite samples were passed through a No. 10 sieve prior to analysis. Only material passing the sieve was further analyzed. Percentages retained were as follow:

Sample Number	% Retained	Major Constituent
1000	57.	Rock
1001	33.	Rock
1002	39.	Rock
1003	<2.	----

	parts per million (mg/L)			
	20	21	22	Method Blank
Total Organic Halogens as Cl	<0.02	<0.02	0.03	<0.02
Sulfites	--	--	<0.5	--

	parts per million (mg/kg), dry basis
	1003
Water Soluble Sulfite	30.

Hart Crowser & Associates

LABORATORY NO. 10227

All samples except for sample 22 were analyzed by gas chromatography following Method 8020, Test Methods for Evaluating Solid Waste (SW 846), U.S.E.P.A., 1986, with results as shown below:

parts per billion (ug/kg), dry basis

	1000	1001	1002	Method Blank1
Benzene	<1.	<1.	<1.	<1.
Ethylbenzene	<1.	<1.	<1.	<1.
Toluene	<1.	<1.	<1.	<1.
Xylene	<1.	<1.	<1.	<1.

parts per billion (ug/L)

	19	20	21	Field Blank	Method Blank2
Benzene	<1.	<1.	<1.	<1.	<1.
Ethylbenzene	<1.	<1.	<1.	<1.	<1.
Toluene	<1.	<1.	<1.	<1.	<1.
Xylene	<1.	<1.	<1.	<1.	<1.

BETX Method Blank 1 was analyzed with composite samples 1000 through 1003
BETX Method Blank 2 was analyzed with samples 19 through 21.

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LABORATORY NO. 10227

	parts per billion (ug/kg), dry basis				
	1001	1002	1003	Method Blank1	Method Blank2
trans-1,3-Dichloropropene	<12.	<12.	<9.	<3.	<10.
cis-1,3-Dichloropropene	<12.	<12.	<9.	<3.	<10.
1,1,2-Trichloroethane	<12.	<12.	<3.	<1.	<10.
1,1,2,2-Tetrachloroethene	<12.	<12.	<3.	<1.	<10.
Dibromochloromethane	<12.	<12.	<9.	<3.	<10.
Chlorobenzene	<12.	<12.	<9.	<3.	<10.
Bromoform	<58.	<58.	<3.	<1.	<50.
1,1,2,2-Tetrachloroethane	<12.	<12.	<9.	<3.	<10.
1,3-Dichlorobenzene	<12.	<12.	<3.	<1.	<10.
1,4-Dichlorobenzene	<12.	<12.	<3.	<1.	<10.
1,2-Dichlorobenzene	<12.	<12.	<3.	<1.	<10.

Hart Crowser & Associates LABORATORY NO. 10227

A screen for base/acid/neutral components was performed by gas chromatography (GC) with flame ionization detector (FID) on selected samples. All peaks within the retention time window of 6-48 minutes were summed and calculated on the response of Phenanthrene. Copies of chromatograms are attached.

	parts per billion (ug/kg), dry basis				
	1000	1001	1002	1003	Method Blank1
GC/FID Screen, as phenanthrene	16,000.	<3,000.	4,500.	46,000.	<3,000.

	parts per billion (ug/L)				
	19	20	21	22	Method Blank2
GC/FID Screen, as phenanthrene	<200.	<200.	420.	240.	<200.

GC/FID Method Blank 1 was analyzed with composite samples 1000 through 1003.
GC/FID Method Blank 2 was analyzed with samples 19 through 22.

Key

< indicates "less than"

Respectfully submitted,

Laucks Testing Laboratories, Inc.

J.M. Owens

J. M. Owens

JMO:laj

Hart Crowser & Associates

LABORATORY NO. 10227

APPENDIX A

Surrogate Recovery Quality Control Report

Attached are results of surrogate (chemically similar) compound analysis. The surrogates are added to every sample prior to extraction and analysis to monitor for matrix effects, purging efficiency, and sample processing errors. The control limits represent the 95% confidence interval established in our laboratory through repetitive analysis of these sample types.

JOB No. 10227 DATE: 06/10/88

Sample No. B0608GVD.WA1 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	96		87 - 113

Sample No. FB Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	94		87 - 113

Sample No. 19 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	92		87 - 113

Sample No. 20 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	92		87 - 113

Sample No. 21 Matrix: Water Analysis: GC-PID

Surrogate Compound	Percent Recovery	Comment	Control Limits
n-propylbenzene	96		87 - 113

JOB No. 10227 DATE: 06/10/88

Sample No. B0609GV0.SA1 Matrix: Soil Analysis: GC-FID

Surrogate Compound	Percent Recovery	Comment	Control Limits
4-Bromofluorobenzene	95		75 - 118

Sample No. 1000 Matrix: Soil Analysis: GC-FID

Surrogate Compound	Percent Recovery	Comment	Control Limits
4-Bromofluorobenzene	93		75 - 118

Sample No. 1001 Matrix: Soil Analysis: GC-FID

Surrogate Compound	Percent Recovery	Comment	Control Limits
4-Bromofluorobenzene	89		75 - 118

Sample No. 1002 Matrix: Soil Analysis: GC-FID

Surrogate Compound	Percent Recovery	Comment	Control Limits
4-Bromofluorobenzene	93		75 - 118

JOB No. 10227 DATE: 06/13/88

Sample No. B0610MVOSJ1 Matrix: Soil Analysis: MS-VOA

Surrogate Compound	Percent Recovery	Comment	Control Limits
d4-1.2-Dichloroethene	96		74 - 125
d8-Toluene	98		77 - 121
p-Bromofluorobenzene	95		75 - 115

Sample No. 1003 Matrix: Soil Analysis: MS-VOA

Surrogate Compound	Percent Recovery	Comment	Control Limits
d4-1.2-Dichloroethene	104		74 - 125
d8-Toluene	109		77 - 121
p-Bromofluorobenzene	83		75 - 115

JOB No. 10227 DATE: 06/13/88

Sample No. B0607GSV.WLI Matrix: Water Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	76		28 - 150
2-Fluorobiphenyl	86		41 - 129
Azobenzene	84		50 - 128

Sample No. 19 Matrix: Water Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	62		28 - 150
2-Fluorobiphenyl	86		41 - 129
Azobenzene	68		50 - 128

Sample No. 20 Matrix: Water Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	67		28 - 150
2-Fluorobiphenyl	85		41 - 129
Azobenzene	63		50 - 128

Sample No. 21 Matrix: Water Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	72		28 - 150
2-Fluorobiphenyl	80		41 - 129
Azobenzene	63		50 - 128

Sample No. 22 Matrix: Water Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	72		28 - 150
2-Fluorobiphenyl	85		41 - 129
Azobenzene	73		50 - 128

JOB No. 10227 DATE: 06/13/88

Sample No. 80608GSC.SLE Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	100		18 - 154
2-Fluorobiphenyl	86		39 - 146
Azobenzene	77		40 - 133

Sample No. 1000 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	79		18 - 154
2-Fluorobiphenyl	82		39 - 146
Azobenzene	55		40 - 133

Sample No. 1001 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	92		18 - 154
2-Fluorobiphenyl	89		39 - 146
Azobenzene	75		40 - 133

Sample No. 1002 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	74		18 - 154
2-Fluorobiphenyl	79		39 - 146
Azobenzene	63		40 - 133

Sample No. 1003 Matrix: Soil Analysis: GC-ABN

Surrogate Compound	Percent Recovery	Comment	Control Limits
2-Bromophenol	91		18 - 154
2-Fluorobiphenyl	91		39 - 146
Azobenzene	59		40 - 133

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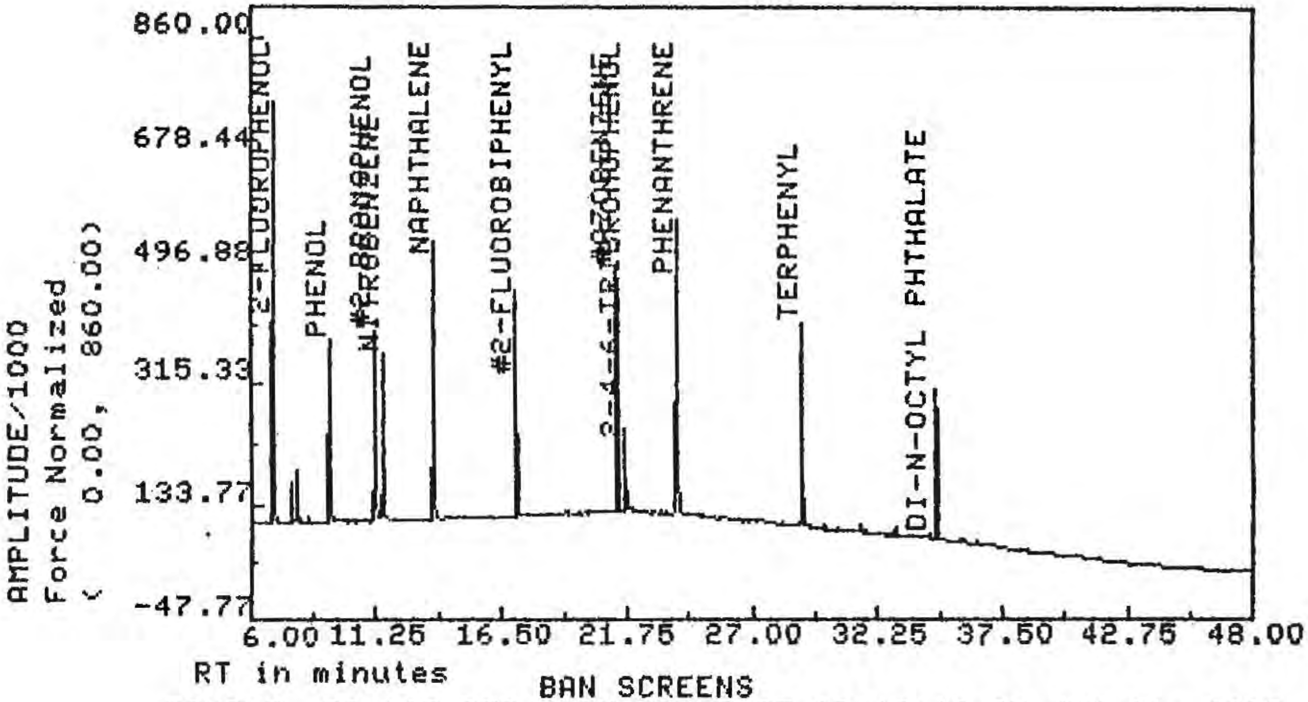
Hart Crowser & Associates

LABORATORY NO. 10227

APPENDIX B

Copies of GC/FID Screen chromatograms are attached.

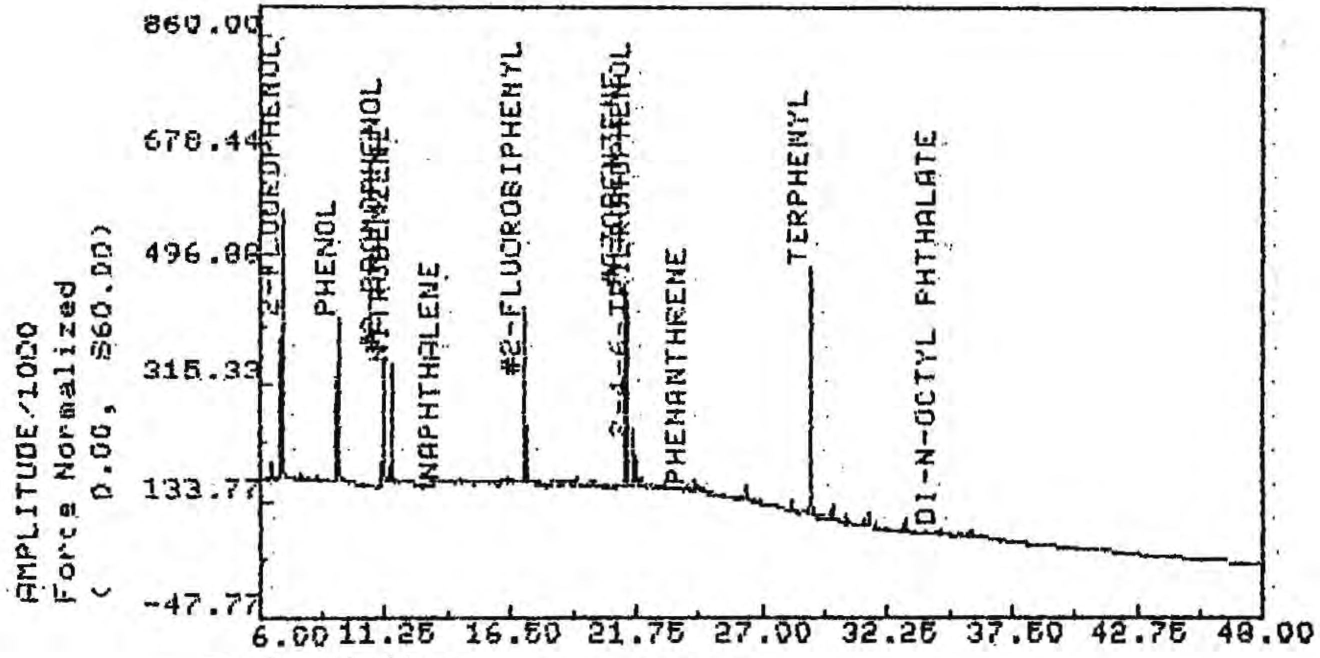


BAN SCREENS

SAMPLE: BA 167 STD INJECTED AT 19:15:46 ON JUN 11, 1988

Meth: MISCRN Raw: RI1108 Proc: PI1108

Standard

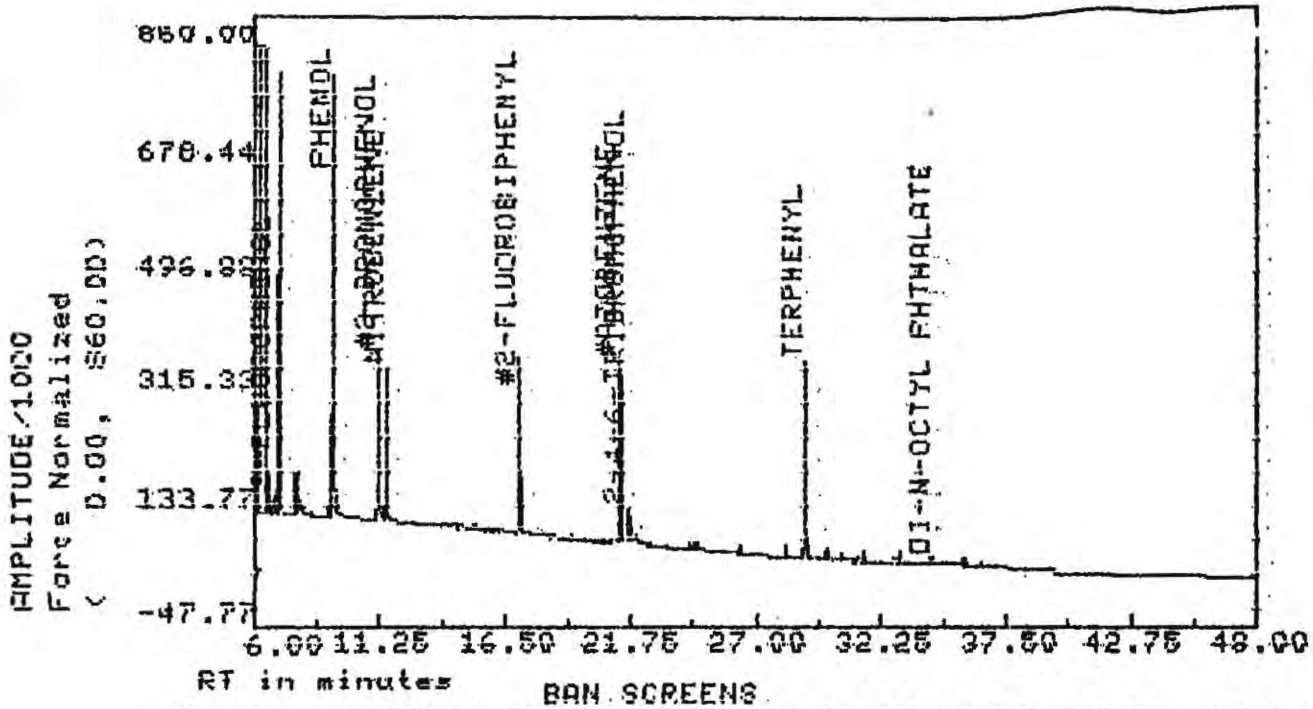


BAN SCREENS

SAMPLE: B0607GSV.WL1 INJECTED AT 14:18:11 ON JUN 11, 1988

Meth: MISCRN Raw: RI1103 Proc: PI1103

Blank (water)

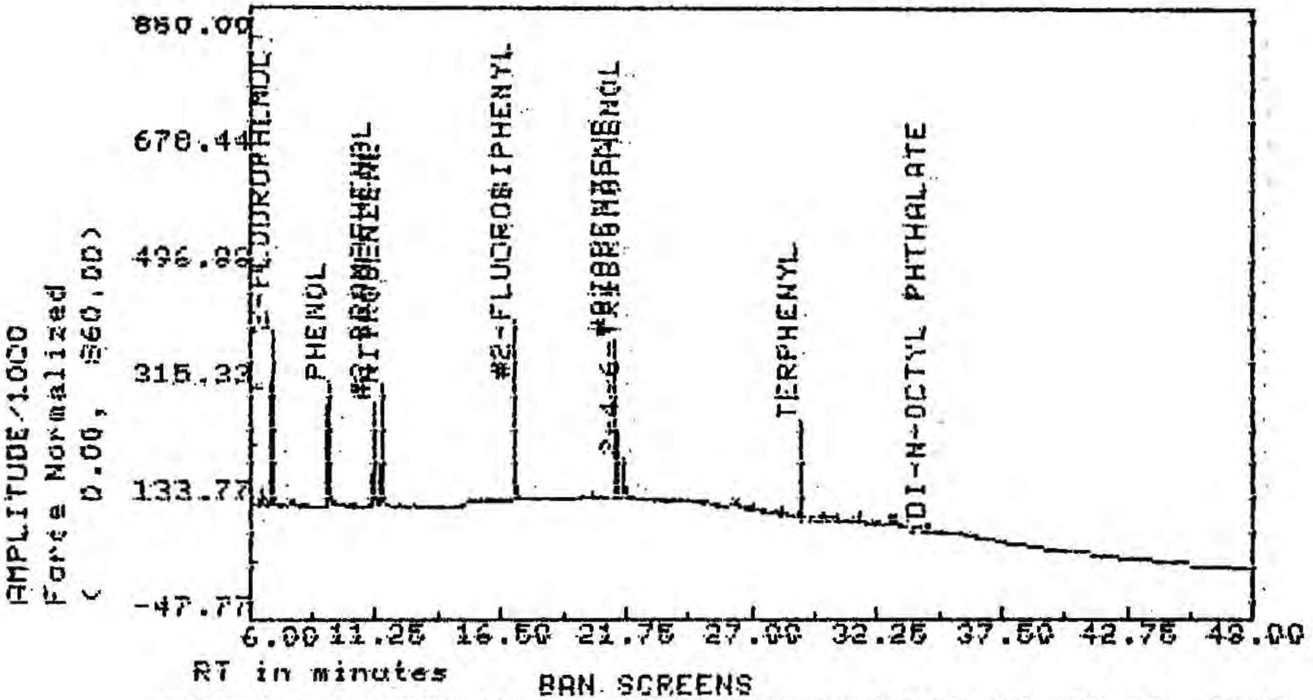


BAN SCREENS

SAMPLE: 0060800C.BLE INJECTED AT 19:10:00 ON JUN 11, 1988

Meth: MISCRN Raw: RI1104 Proc: PI1104

Blank (soil)

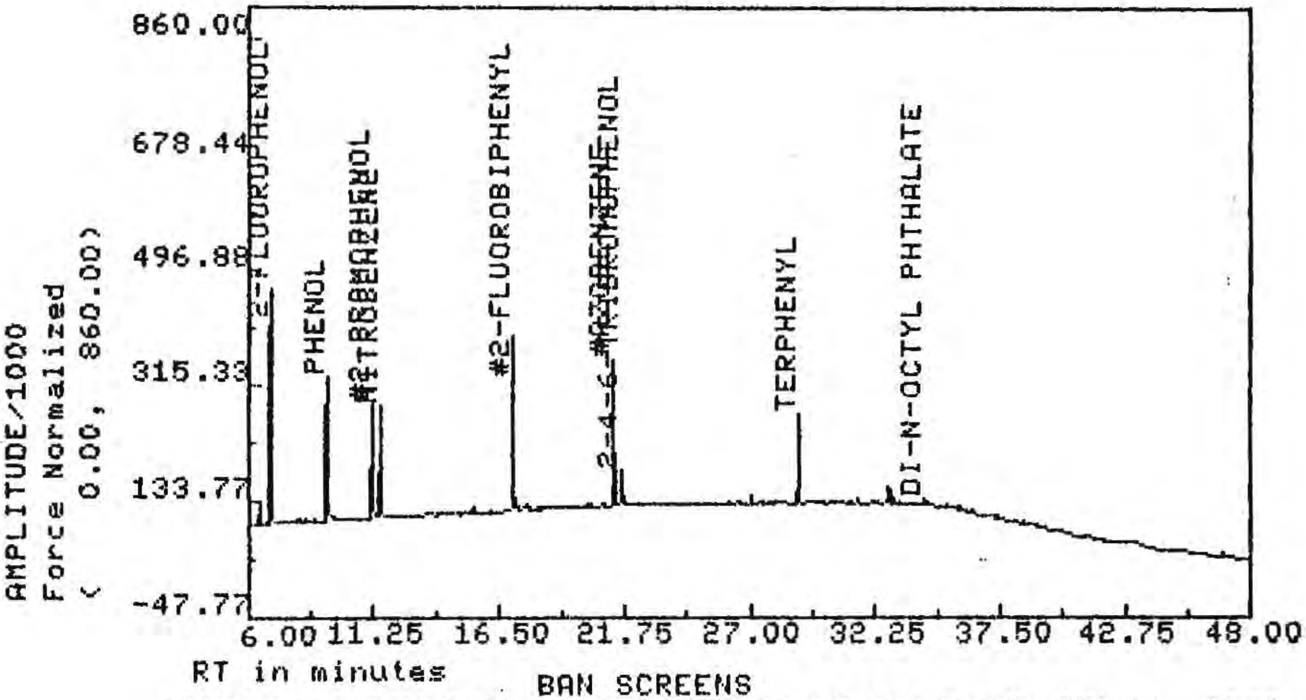


BAN SCREENS

SAMPLE: W 10227-19 INJECTED AT 16:17:25 ON JUN 11, 1988

Meth: MISCRN Raw: RI1105 Proc: PI1105

#19 500 ml/1.0 ml

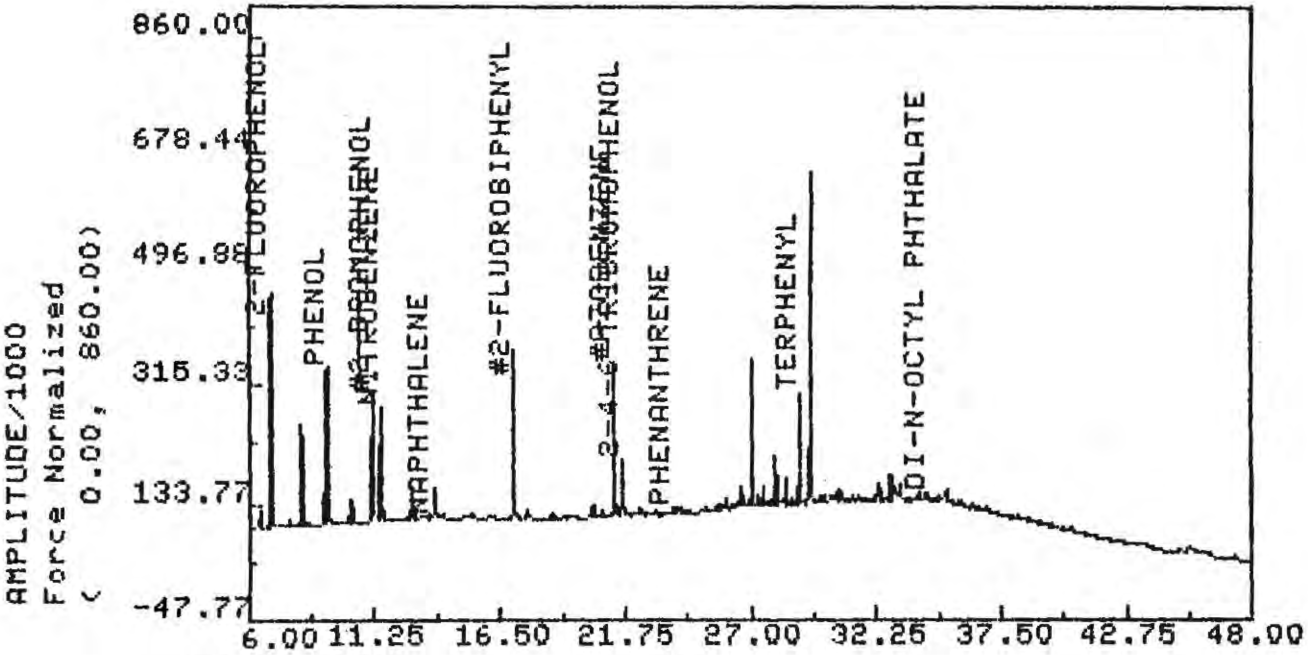


BAN SCREENS

SAMPLE: W 10227-20 INJECTED AT 23:13:20 ON JUN 11, 1988

Meth: MISCRN Raw: RI1112 Proc: PI1112

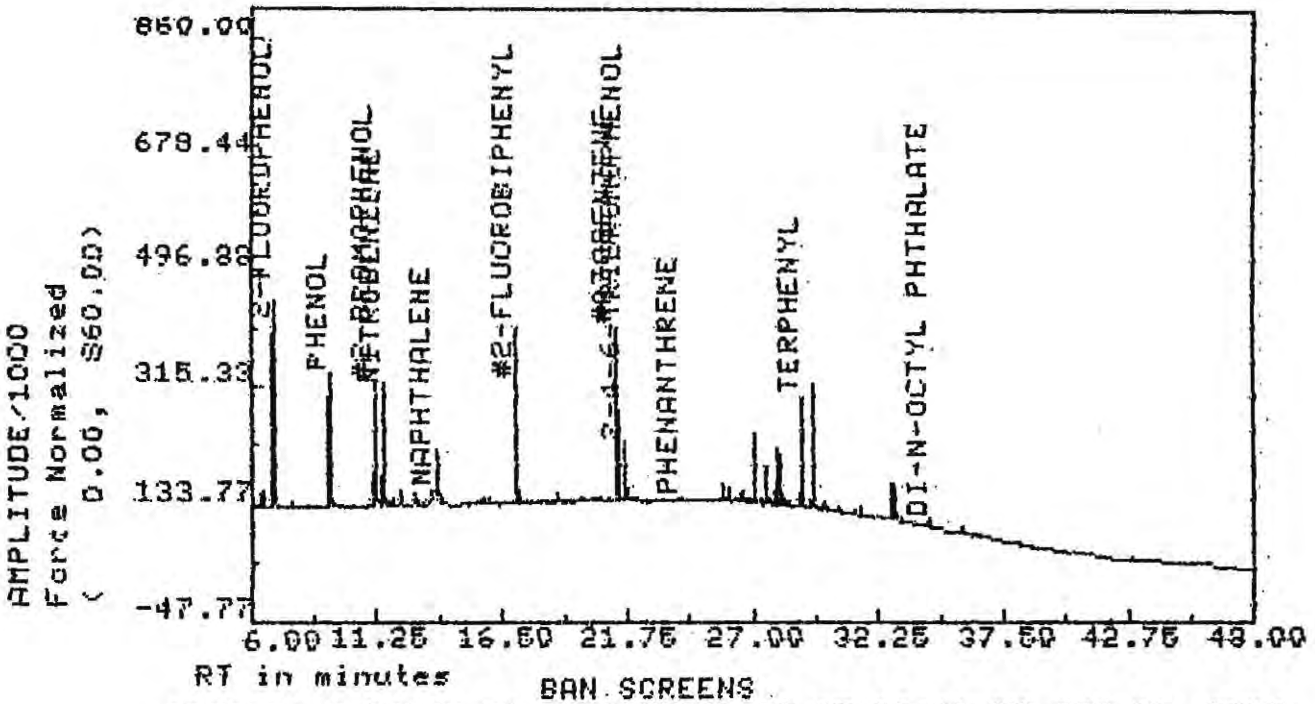
#20 500 ml/1.0 ml



BAN SCREENS

SAMPLE: W 10227-21 INJECTED AT 22:13:57 ON JUN 11, 1988
Meth: MISCRN Raw: RI1111 Proc: PI1111

#21 500 ml/1.0ml

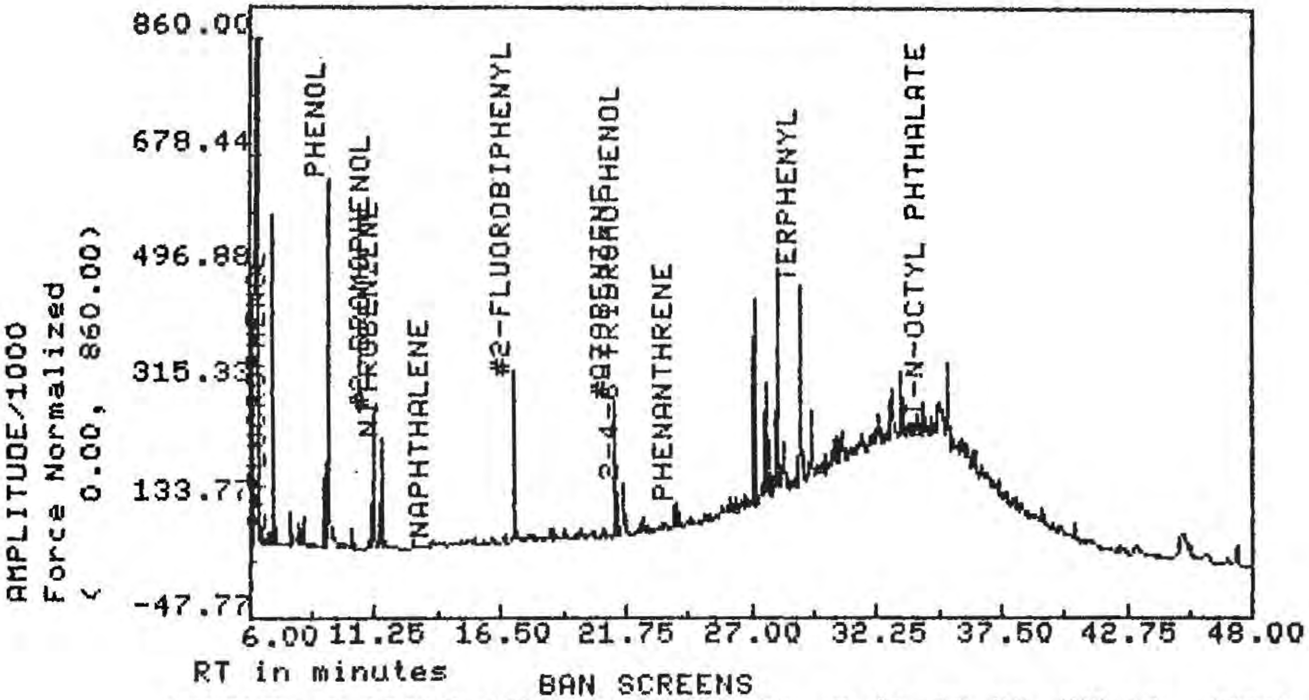


BAN SCREENS

SAMPLE: W 10227-22   INJECTED AT 17:16:48 ON JUN 11, 1988

Meth: MISCRN   Raw: RI1106   Proc: PI1106

#20   500 ml/1.0ml

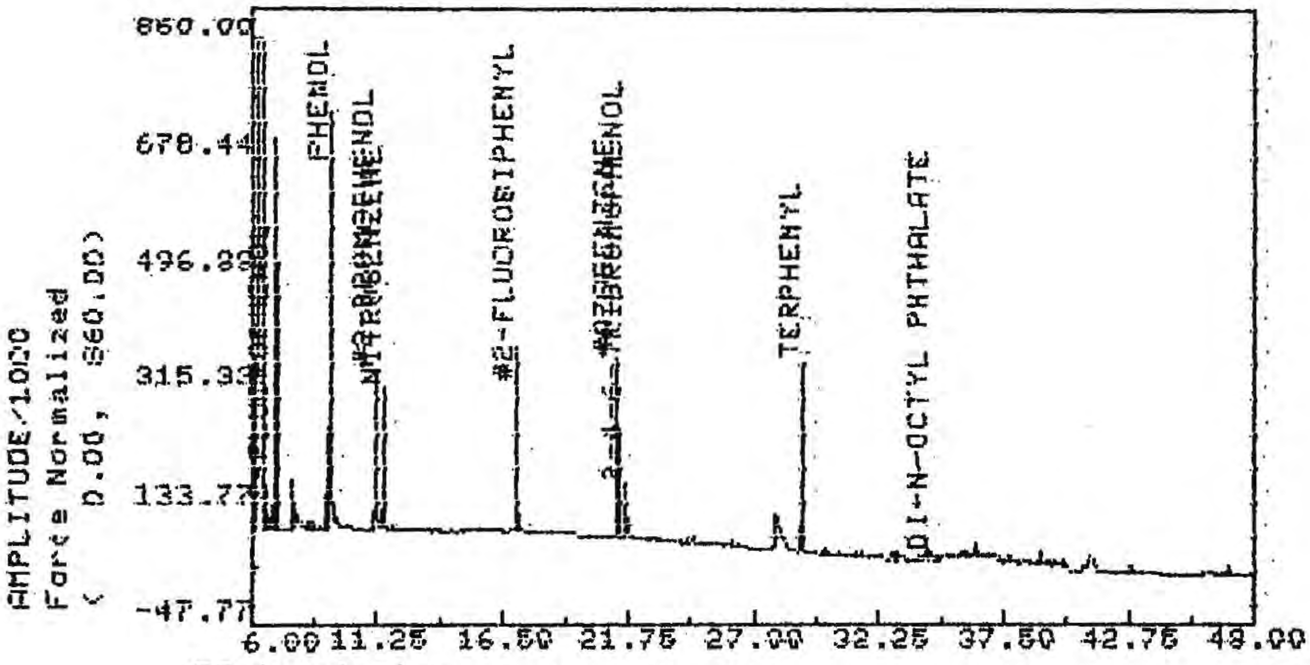


BAN SCREENS

SAMPLE: S 10227-1000 INJECTED AT 3:11:33 ON JUN 12, 1988
Meth: MISCRN Raw: RI1116 Proc: PI1116

#1000

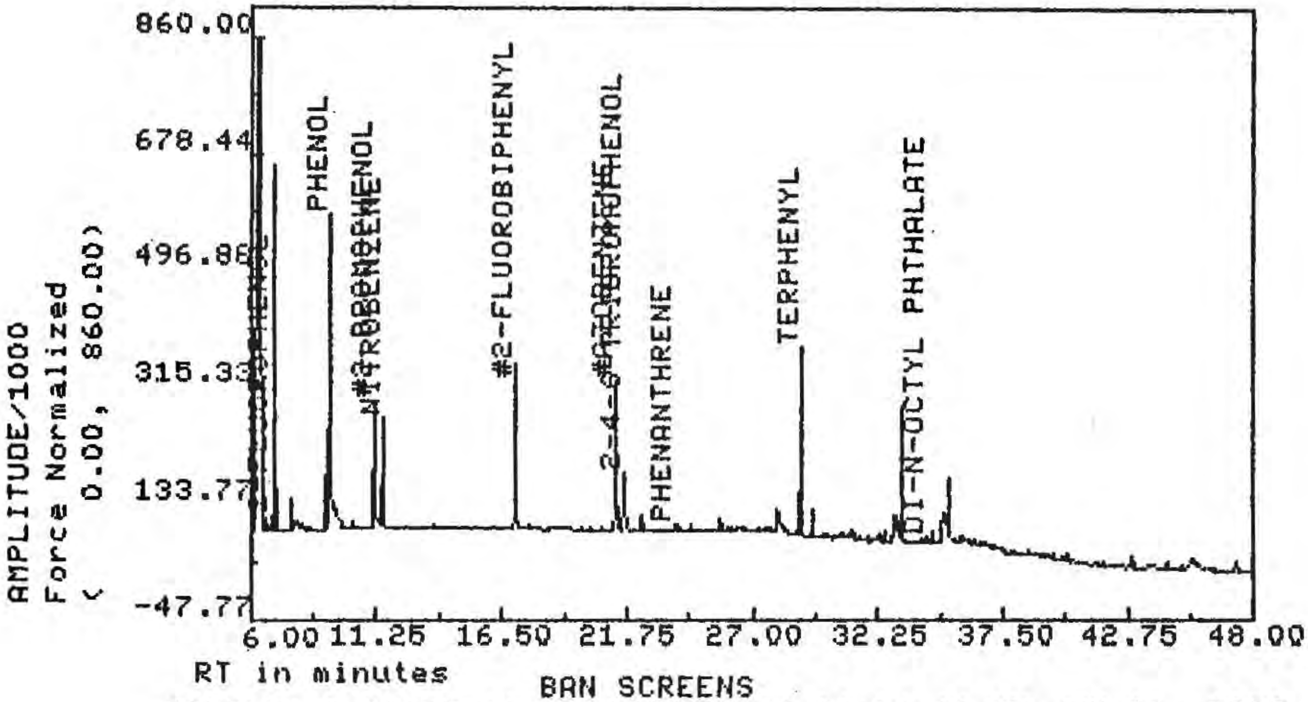
25.0 g/1.0mL



BAN SCREENS

SAMPLE: S 10227-1001 INJECTED AT 18:16:14 ON JUN 11, 1988
Meth: MISCRN Raw: RI1107 Proc: PI1107

#1001 25.9 g/1.0ml

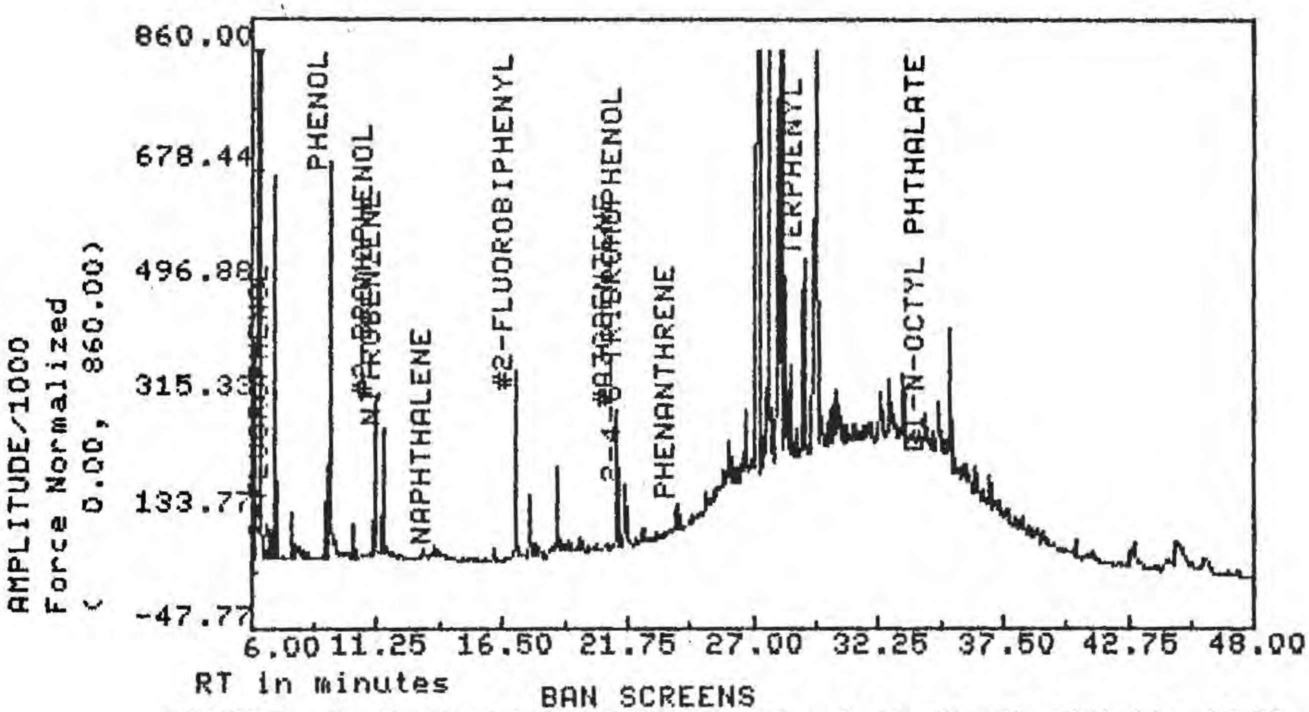


BAN SCREENS

SAMPLE: S 10227-1002 INJECTED AT 21:14:34 ON JUN 11, 1988

Meth: MISCRN Raw: RI1110 Proc: PI1110

#1002 25.5 g/1.0 ml



BAN SCREENS

SAMPLE: S 10227-1003 INJECTED AT 4:10:58 ON JUN 12, 1988

Meth: MISCRN Raw: RI1117 Proc: PI1117

#1003 18.0 g/1.0 ml

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Hart Crowser & Associates

LABORATORY NO. 10227

APPENDIX C

Copies of Chain-of-Custodies Attached

[redacted]

Sample Custody Record

DATE 6/3/88 PAGE 1 OF ~~2~~ 1

HARTCROWSER

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

JOB NUMBER 2159-01 LAB NUMBER

PROJECT MANAGER John FunderBurk

PROJECT NAME M&R Environmental Assessment

SAMPLED BY: HW Small

LAB NO.	SAMPLE	TIME	STATION	MATRIX	GC/FID BAN SCREEN ①	HALOGENATED VOL. ORGANICS (8010)	TOT. ORGANIC HALOGEN (TOX)	SULFITES	BTEX						NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
10227-14	S-1	1000	B-14	SOIL											2	* Composite by taking
15	S-2	1005	"	" * Composite											2	equal aliquots from
16	S-3	1010	"	"	X	X		X							2	each container & run
17	S-4	1015	"	"											2	as 1 sample.
18	S-5	1020	"	"											2	
							w/ NO TOX on This sample									① Need chromatograph
19	S-1	1400	MW-11	WATER	X		~~X~~		X						5	on BAN Screen.
20	S-1	1530	MW-12	"	X		X		X						5	
21	S-1	1600	MW-13	"	X		X		X						4	
22	S-1	1630	MW-14	"	X		X	X							5	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
HW Small Signature	~~6/4/88~~ HWS 6/3/88	Signature	
HW SMALL Printed Name	TIME	Printed Name	TIME
Hart Crowser Company	~~1200~~ ~~2:14~~ 9:30	Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature		F. Collins Signature	6/6
Printed Name	TIME	F. Collins Printed Name	TIME
Company		Company	9:30

TOTAL NUMBER OF CONTAINERS 29

METHOD OF SHIPMENT Ice in Cooler

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep Cool

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 6/2/88 PAGE 2 OF 2

HARTCROWSER

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

JOB NUMBER 2159-01 LAB NUMBER

PROJECT MANAGER John Funderburk III

PROJECT NAME M&R Environmental Assessment

SAMPLED BY: HW Small

LAB NO.	SAMPLE	TIME	STATION	MATRIX	BTEX	① GC/FID BAN SCREEN	8010 Halo. Vol. Org.	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	~~SW-1~~	~~1530~~	~~Water Tank~~	~~Water~~				~~3~~	* Composite by taking
10227-9	S-1	1630	B-13	SOIL				2	equal aliquots from each
10	S-2	1635	"	"				2	container & run as
11	S-3	1640	"	"	X	X	X	2	one sample.
12	S-4	1645	"	"				2	
13	S-5	1650	"	"				2	
									① Need chromatograph on BAN Screen

Composite *

RELINQUISHED BY	DATE	RECEIVED BY	DATE
HW Small Signature	~~6/3/88~~ HWS 6/1/88	Signature	
HW Small Printed Name	TIME	Printed Name	TIME
Hart Crowser Company	~~1800~~ 930 AM	Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature		F. Collins Signature	6/6
Printed Name	TIME	F. Collins Printed Name	TIME
Company		Company	9:30

TOTAL NUMBER OF CONTAINERS ~~13~~ 10

METHOD OF SHIPMENT Ice in cooler

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep Cool

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

/ work [illegible]

Sample Custody Record

DATE 6/2/88 PAGE 1 OF ~~1~~ 2 wa

HARTCROWSER

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

JOB NUMBER 2159-01 **LAB NUMBER**

PROJECT MANAGER JOHN FUNDERBURK III

PROJECT NAME MERRILL & RING, ENVIRONMENTAL ASSESS.

SAMPLED BY: HW Small

LAB NO.	SAMPLE	TIME	STATION	MATRIX	BTEX	GC/FID BAN SCREEN ①	Halog. Vol. Org. 8010	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
10227-1	S-1	1125	B-11	SOIL }				2	* Composite in lab by
2	S-2	1130	"	" } * Composite	X	X		2	taking equal aliquots from
3	S-3	1135	"	" }				2	each container and run as
	~~S-4~~	~~1140~~	~~"~~	~~"~~ wa				~~2~~ wa	one sample.
	~~S-5~~	~~1145~~	~~"~~	~~"~~ wa				~~2~~ wa	
	~~S-6~~	~~1150~~	~~"~~	~~"~~ wa				~~2~~ wa	
4	S-1	1415	B-12	" }				2	
5	S 2	1420	"	" }				2	① Need chromatograph
6	S-3	1425	"	" } * Composite	X	X	X	2	on BAN Screen
7	S-4	1430	"	" }				2	
8	S-5	1435	"	" }				2	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
HW Small Signature	~~6/2/88~~ HWS 6/3/88	Signature	
HW SMALL Printed Name	TIME	Printed Name	TIME
Hart Crowser Company	~~1200 AM~~ 930	Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature		F. Collins Signature	6/6
Printed Name	TIME	F. Collins Printed Name	TIME
Company		Company	9:30

TOTAL NUMBER OF CONTAINERS 16 wa ~~22~~

METHOD OF SHIPMENT Ice in cooler

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep Cool

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

PHASE III ANALYTICAL DATA

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D.
Andrew John Friedman
James E. Bruya, Ph.D.

3008 B - 16th West
Seattle, WA 98119
(206) 285-8282

June 24, 1988

William B. Abercrombie, Project Manager
Hart Crowser and Associates, Inc.
1910 Fairview Avenue East
Seattle, WA 98102-3699

Dear Mr. Abercrombie:

Enclosed are the results of the analyses of samples submitted on June 8 to June 12, 1988 from Project 2159-02.

As you are aware, we encountered more difficulty in analyzing the pentachlorophenol in these samples than we had anticipated prior to arriving at the sight. This was due to the nature of the matrix, mostly wood chips, and the resultant difficulties in maintaining reliable calibrations. This problem resulted in our finally going to the method of standard additions for all samples on June 11. The change allowed us to generate reliable quantitations at a rate that could support the field work effectively. Review of the previous analyses and their quality assurance indicates that the quantitations are reliable, but the level of effort that was required to generate them was extreme.

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this material, or if you just want to discuss any aspect of your projects, please do not hesitate to contact me.

Sincerely,

Andrew John Friedman, Chemist

AJF/cag

Enclosures

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1988
Date: June 8, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
MW-6	0.10	<0.1

Quality Assurance

Method Blank	<0.01	<0.01
Initial Calibration	r = 1.00 ,n = 4	

a - The analysis was done by the method of standard additions

Date of Report: June 24, 1988
Date: June 9, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
B-15		
S-1 0-1.5′	0.25	0.75
S-3 5-6.5′	0.23	<0.05
S-4 7.5-9′	0.18	<0.05
S-5 10-11.5′	0.15	0.19
S-6 12.5-14′	0.12	<0.05
S-7 15-16.5′	0.20	<0.05
B-16		
S-1 0-1.5′	2.7	2.7
S-2 2.5-4′	0.48	0.18
S-3 5-6.5′	3.0	1.9
S-4 7.5-9′	1.8	2.1
S-5 10-11.5′	34	4.5
S-6 12.5-14′	3.1	0.41
S-7 15-16.5′ (run 6-10)	6.3	<0.1
S-8 17.5-19′ (run 6-10)	4.8	<0.1
S-9 20-21.5′	1.6	0.13
B-17		
S-6 12.5-14′	6.8	0.45
Water Samples		
MW-5A	<0.01	<0.01
MW-12	<0.01	<0.01
MW-15	<0.01	<0.01
DI0 (6-8-88)	<0.01	<0.01
RW0, MW-6A	<0.01	<0.01

Date of Report: June 24, 1988
Date: June 9, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
Quality Assurance		
Method Blank	<0.01	<0.01
Method Blank	<0.01	<0.01
Method Blank	<0.01	<0.01
MW-5A (Replicate)	<0.01	<0.01
MW-5A (Matrix Spike) Spiked @ 0.10 ppm Percent Recovery	250%	
B-16 S-6 (Duplicate, run 6-10)	3.8	<0.1
B-17 S-6 (Duplicate)	1.9	0.33
Initial Calibration	r = 0.994, n = 4	

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1988
Date: June 10, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
B-17		
S-1 0-1.5′	0.12	<0.05
S-2 2.5-4′	0.28	<0.05
S-3 5-6.5′	0.33	<0.05
S-4 7.5-9′	0.18	0.08
S-5 10-11.5′	0.12	<0.05
S-6 12.5-14′ (run 6-9)	6.8	0.45
S-7 15-17.5′	<0.05	<0.05
S-8 17.5-19′	<0.05	<0.05
S-9 20-21.5′	<0.05	<0.05
S-10 22.5-24	<0.05	<0.05
S-11 25-26.5′	0.09	0.13
S-12 27.5-29	0.08	<0.05
S-13 30-31.5′	0.11	<0.05
RW0 B-17 S-10	<0.01	<0.01
B-18		
S-1 0-1.5′	0.23	<0.05
S-2 2.5-4′	0.18	<0.05
S-3 5-6.5′	0.09	<0.05
S-4 4.5-9′	0.11	<0.05
S-5 10-11.5′	0.07	<0.05
S-6 12.5-14′	0.62	0.06
S-7 17.5-19′	0.27	<0.05
S-8 20-21.5′	0.10	<0.05
S-9 22.5-24′	0.12	<0.05
S-10 25-26.5′	0.05	<0.05
S-11 27.5-29′	0.05	<0.05

Date of Report: June 24, 1988
Date: June 10, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
Surface Samples		
SS-1	0.64	0.44
SS-2	0.35	0.62
SS-3	0.09	0.10
SS-4	0.67	0.09
SS-5	0.18 a	<0.05
SS-6	<0.05	<0.05
SS-7	<0.05	<0.05
SS-8	0.06	<0.05
SS-9	<0.05	<0.05
SS-10	<0.05	<0.05
SS-11	<0.05	<0.05

a - This value is probably carry-over from the previous injection. The replicate analysis gave a value of 0.06.

Date of Report: June 24, 1988
Date: June 10, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
Quality Assurance		
Method Blank	<0.01	<0.01
B-17 S-1 (Replicate)	0.13	<0.05
B-17 S-4 (Replicate)	0.16	<0.05
B-17 S-13 (Replicate)	0.10	<0.05
B-17 S-1 (Duplicate)	<0.05	<0.05
B-17 S-10 (Duplicate)	0.09	0.09
B-17 S-13 (Matrix Spike)		
Spiked @ 0.10 ppm		
Percent Recovery	200%	
B-18 S-1 (Replicate)	0.17	<0.05
B-18 S-11		
(Matrix Spike)		
Spiked @ 0.10 ppm		
Percent Recovery	120%	
SS-3 (Replicate)	0.88	0.62
SS-5 (Replicate)	0.06	<0.05
SS-10 (Duplicate)	<0.05	<0.05
SS-1 (Matrix Spike)		
Spiked @ 1.0 ppm		
Percent Recovery	160%	
SS-7 (Matrix Spike)		
Spiked @ 0.10 ppm		
Percent Recovery	300%	

Date of Report: June 24, 1988
Date: June 10, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD

Sample #	PCP (ppm)	TCP (ppm)
Quality Assurance		
SS-10 (Matrix Spike)		
Spiked @ 0.10 ppm		
Percent Recovery	92%	
Initial Calibration	r = 0.964,n = 6	
Second Calibration	r = 0.947,n = 3	
Final Calibration	r = 0.995,n = 4	

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: June 24, 1988
Date: June 11, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
B-19		
S-1 0-1.5′	<0.05	<0.05
S-2 2.5-4′	<0.05	<0.05
S-3 5-6.5′	0.06	<0.05
S-4 7.5-9′	<0.05	<0.05
S-5 10-11.5′	0.09	<0.05
S-6 12.5-14	0.06	<0.05
S-7 15-16.5′	<0.05	<0.05
S-8 17.5-19′	0.11	<0.05
S-9 20-21.5′	<0.05	<0.05
S-10 22.5-24′	<0.05	<0.05
RW0 B-19 S-5(run 6-12)	<0.01	<0.01
HA-1		
S-1 0.5-1′	0.25	0.6
S-2 1-2′	0.10	<0.05
S-3 2-2.5′	0.06	<0.05
HA-2		
S-1 0.5-1′	<0.05	<0.05
S-2 1-2′	<0.05	<0.05
OSS-1	0.30	0.09
OSS-2	0.08	<0.05
Water Samples		
OSW-1	<0.01	<0.01
OSW-2	<0.01	<0.01
MW-3A	<0.01	<0.01
MW-4A	<0.01	<0.01
MW-7	<0.01	<0.01
MW-11	<0.01	<0.01
MW-13	<0.01	<0.01
MW-14	<0.01	<0.01

a - All analyses were done by the method of standard additions

Date of Report: June 24, 1988
Date: June 11, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
Quality Assurance		
Method Blank	<0.05	<0.05
OSS-2 (Replicate)	0.08	<0.05
B-19 S-7 (Duplicate)	<0.05	<0.05
B-19 S-8 (Duplicate)	<0.05	<0.05
B-19 S-8 (Duplicate)	<0.05	<0.05
MW-4A RWO (Matrix Spike) Spiked @ 0.05 ppm Percent Recovery	70%	
OSW-1 (Matrix Spike) Spiked @ 0.01 ppm Percent Recovery	<100%	
OSW-2 (Matrix Spike) Spiked @ 0.10 ppm Percent Recovery	200%	

a - All analyses were done by the method of standard additions

Date of Report: June 24, 1988
Date: June 12, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
B-21		
S-1 0-1.5′	<0.05	<0.05
S-2 2.5-4′	<0.05	<0.05
S-3 5-6.5′	<0.2 b	
S-4 7.5-9′	0.10	<0.05
S-5 10-11.5′	0.20	<0.05
S-6 12.5-14′	0.10	<0.05
S-7 15-16.5′	<0.05	<0.05
B-22		
S-1 0-1.5′	<0.05	<0.05
S-2 2.5-4′	<0.05	<0.05
S-3 5-6.5′	<0.05	<0.05
S-4 7.5-9′	<0.05	<0.05
S-5 10-11.5′	<0.05	<0.05
S-6 12.5-14′	<0.05	<0.05
S-7 15-16.5′	<0.05	<0.05
RW0 B-22	<0.01	<0.01
HA-3		
S-1 4"-1′	<0.05	<0.05
S-2 1-2′	<0.05	<0.05
S-3 2-2.5′	<0.05	<0.05
HA-4		
S-1 0.5-1′	<0.05	<0.05
S-2 1-2′	<0.05	<0.05
HA-5		
S-1	<0.05	<0.05
HA-6		
S-1	<0.05	<0.05
S-2	<0.05	<0.05

a - All analyses were done by the method of standard additions
b - Matrix effects prevented lower level quantitation.

Date of Report: June 24, 1988
Date: June 12, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
MW-16 (soils)		
S-1 10-11.5′	36	<0.1
S-2 15-16.5′	3.2	<0.1
B-17 (reruns)		
S-11 25-26.5′	0.05	<0.05
S-12 27.5-29′	<0.05	<0.05
S-13 30-31.5′	0.05	<0.05
PLSSCOMP-2	2.2	0.66
BG-1	<0.05	<0.05
OSSBG-1	<0.05	<0.05
OSS-3	<0.05	<0.05
OSS-4	<0.05	<0.05
OSS-5	<0.05	<0.05
OSS-6	<0.05	<0.05
Water Samples		
OSW-3	<0.01	<0.01
OSW-4	<0.01	<0.01
MW-6A	0.09	0.01
MW-16	0.59	<0.01
MW-18	<0.01	<0.01
MW-19	<0.01	<0.01
MW-20	<0.01	<0.01
MW-21	<0.01	<0.01
MW-22	0.01	<0.01

a - All analyses were done by the method of standard additions

Date of Report: June 24, 1988
Date: June 12, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
Water Samples		
D.I.0 6-12	<0.01	<0.01
HA0 M.B.	<0.01	<0.01
RW0MW19	<0.01	<0.01
Quality Assurance		
Method Blank	<0.05	<0.05
B-22 S-6 (Duplicate)	<0.05	<0.05
OSS-1 (Duplicate)	<0.05	<0.05
OSS-2 (Duplicate)	0.08	<0.05
MW-19 (Matrix Spike) Spiked @ 0.01 ppm Percent Recovery	143%	
B-17 S-6 (Duplicate)	0.62	
B-17 S-6 (Duplicate)	0.85	
B-17 S-6 (Matrix Spike) Spiked @ 1.0 ppm Percent Recovery	130%	
B-17 S-6 (Matrix Spike) Spiked @ 1.0 ppm Percent Recovery	190%	

[a] - All analyses were done by the method of standard additions

Date of Report: June 24, 1988
Date: June 16, 1988
Project: 2159-02

RESULTS OF ANALYSES OF ENVIRONMENTAL SAMPLES FOR PENTACHLOROPHENOL AND TETRACLOROPHENOLS BY GC/ECD[a]

Sample #	PCP (ppm)	TCP (ppm)
B-20		
S-1 1-2.5'	<0.05	<0.05
S-2 2.5-4'	<0.05	<0.05
S-3 5-6.5'	<0.05	<0.05
S-4 7.5-9'	<0.05	<0.05
S-5 10-11.5'	<0.05	<0.05
S-6 12.5-14'	<0.05	<0.05
Quality Assurance		
Method Blank	<0.05	<0.05
B-20 S-6 (Duplicate)	<0.05	<0.05

a - All analyses were done by the method of standard additions

Date of Report: June 24, 1988
Date: June 16, 1988
Project: 2159-02

RESULTS OF ANALYSES OF WATER SAMPLES FOR TOTAL HYDROCARBONS AND TOTAL PHENOLS BY TLC

Sample #	Total Hydrocarbons (ppm)	Phenols (ppm)
MW-16	4	<1
Quality Assurance		
Method Blank	<1	<1

FARR, FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James K. Farr, Ph.D.
Andrew John Friedman
James E. Bruya, Ph.D.

3008 B - 16th West
Seattle, WA 98119
(206) 285-8282

INVOICE #88HCI0624-1

June 24, 1988

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

Re: Billing for the on-site analyses of environmental samples from June 8 to June 12, 1988 from Project 2159-02.

Mobilization to Port Angeles, WA, June 8, 1988	$ 1000.00
On-site sample analyses for petachlorophenol:	
June 9, 1988	1400.00
June 10, 1988	1400.00
June 11, 1988	1400.00
June 12, 1988	1400.00
Demobilization June 13, 1988	
Amount Due	$ 6600.00

DIOXIN ANALYTICAL DATA

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST: EW FILE NAME: M882107 CONCAL: M882100
DATE: 06/23/88 SAMPLE ID: TLI WATER BLANK
SAMPLEWT: 500.00 CASE NO: ATI
PROJ NO: 12456R

NAME	CONC(ppt)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	ND		0.028			
12378-PCDD	ND		0.037			
123478-HxCDD	ND		0.048			
123678-HxCDD	ND		0.043			
123789-HxCDD	ND		0.060			
1234678-HpCDD	ND		0.145			
OCDD	ND		0.752			
2378-TCDF	ND		0.022			
12378-PCDF	ND		0.030			
23478-PCDF	ND		0.030			
123478-HxCDF	ND		0.028			
123678-HxCDF	ND		0.022			
234678-HxCDF	ND		0.035			
123789-HxCDF	ND		0.048			
1234678-HpCDF	ND		0.060			
1234789-HpCDF	ND		0.088			
OCDF	ND		0.440			
TOTAL TCDD	ND		0.028			
TOTAL PCDD	ND			2.101	0.78	
TOTAL HxCDD	ND			1.026	4.17	
TOTAL HpCDD	ND		0.145			
TOTAL TCDF	ND		0.022			
TOTAL PCDF	ND		0.030			
TOTAL HxCDF	ND		0.030			
TOTAL HpCDF	ND		0.073			

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppt)	% REC.	RATIO	RT
37CL-TCDD	18.44	92.20		31.24
13C12-HxCDF 789	13.52	67.60	0.54	42.33

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppt)	% REC.	RATIO	RT
13C12-TCDF	7.81	39.05	0.81	30.36
2378-13C12-TCDD	11.24	56.20	0.81	31.24
13C12-PCDF	8.22	41.10	1.48	35.21
13C12-PCDD	11.97	59.85	1.64	36.48
13C12-HxCDF 478	9.28	46.40	0.55	40.25
13C12-HxCDD 678	11.30	56.50	1.26	41.41
13C12-HpCDF	4.64	23.20	0.41	45.00
13C12-HpCDD	4.47	22.35	1.15	46.32
13C12-OCDD	2.68	6.70	0.82	51.51

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST: EW
DATE: 06/23/88
SAMPLEWT: 1.00
FILE NAME: M882106
SAMPLE ID: TLI SOIL BLANK
CASE NO: ATI
PROJ NO: 12456R
CONCAL: M882100

NAME	CONC(ppb)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	ND		0.177			
12378-PCDD	ND		0.288			
123478-HxCDD	ND		0.220			
123678-HxCDD	ND		0.200			
123789-HxCDD	ND		0.283			
1234678-HpCDD	ND		0.320			
OCDD	ND		1.067			
2378-TCDF	ND		0.128			
12378-PCDF	ND		0.175			
23478-PCDF	ND		0.180			
123478-HxCDF	ND		0.105			
123678-HxCDF	ND		0.083			
234678-HxCDF	ND		0.128			
123789-HxCDF	ND		0.177			
1234678-HpCDF	ND		0.145			
1234789-HpCDF	ND		0.210			
OCDF	ND		0.623			
TOTAL TCDD	ND		0.177			
TOTAL PCDD	ND		0.288			
TOTAL HxCDD	ND		0.230			
TOTAL HpCDD	ND		0.320			
TOTAL TCDF	ND		0.128			
TOTAL PCDF	ND		0.177			
TOTAL HxCDF	ND		0.115			
TOTAL HpCDF	ND		0.173			

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
37CL-TCDD	9.03	90.30		31.22
13C12-HxCDF 789	8.33	83.30	0.50	42.31

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
13C12-TCDF	6.50	65.00	0.76	30.34
2378-13C12-TCDD	8.05	80.50	0.87	31.22
13C12-PCDF	6.51	65.10	1.58	35.19
13C12-PCDD	7.43	74.30	1.74	36.45
13C12-HxCDF 478	7.40	74.00	0.53	40.24
13C12-HxCDD 678	7.21	72.10	1.19	41.38
13C12-HpCDF	5.74	57.40	0.49	44.58
13C12-HpCDD	6.02	60.20	0.98	46.30
13C12-OCDD	5.60	28.00	0.77	51.51

HC # B-15 0-1.5' Soil

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST:	EW	FILE NAME:	M882108	CONCAL:	M882100
DATE:	06/23/88	SAMPLE ID:	8806-D10-1		
SAMPLEWT:	1.26	CASE NO:	ATI		
		PROJ NO:	12456R		

NAME	CONC(ppb)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	ND		0.005			
12378-PCDD	ND		0.008			
123478-HxCDD	ND			0.061	0.98	
123678-HxCDD	0.149				1.26	41.43
123789-HxCDD	ND			0.188	1.46	
1234678-HpCDD	4.994				1.01	46.34
OCDD	63.506				0.89	51.55
2378-TCDF	ND		0.003			
12378-PCDF	ND		0.005			
23478-PCDF	ND		0.005			
123478-HxCDF	0.018				1.19	40.26
123678-HxCDF	0.012				1.18	40.37
234678-HxCDF	ND			0.024	0.39	
123789-HxCDF	ND		0.005			
1234678-HpCDF	1.181				1.02	45.02
1234789-HpCDF	0.036				1.03	47.16
OCDF	2.740				0.91	52.11
TOTAL TCDD	ND		0.005			
TOTAL PCDD	ND			0.023	2.18	
TOTAL HxCDD	0.728	3			1.21	
TOTAL HpCDD	8.861	2			1.07	
TOTAL TCDF	ND		0.003			
TOTAL PCDF	ND		0.005			
TOTAL HxCDF	0.825	5			1.19	
TOTAL HpCDF	3.333	3			1.01	

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
37CL-TCDD	7.58	95.51		31.23
13C12-HxCDF 789	6.13	77.24	0.53	42.32

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
13C12-TCDF	4.69	59.09	0.81	30.34
2378-13C12-TCDD	6.66	83.92	0.81	31.22
13C12-PCDF	4.76	59.98	1.56	35.20
13C12-PCDD	5.99	75.47	1.54	36.46
13C12-HxCDF 478	5.19	65.39	0.55	40.25
13C12-HxCDD 678	5.49	69.17	1.28	41.41
13C12-HpCDF	3.27	41.20	0.47	45.01
13C12-HpCDD	3.31	41.71	1.07	46.33
13C12-OCDD	2.86	18.02	0.93	51.54

HC# B-16 0-1.5' Soil

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST: EW
DATE: 06/24/88
SAMPLEWT: 1.08
FILE NAME: M882110
SAMPLE ID: 8806-D10-2
CASE NO: ATI
PROJ NO: 12456R
CONCAL: M882100

NAME	CONC(ppb)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	0.030				0.86	31.23
12378-PCDD	ND		0.008			
123478-HxCDD	ND		0.008			
123678-HxCDD	ND			0.014	0.82	
123789-HxCDD	ND		0.010			
1234678-HpCDD	ND			0.156	1.55	
OCDD	ND			1.251	1.10	
2378-TCDF	ND		0.003			
12378-PCDF	ND		0.005			
23478-PCDF	ND		0.005			
123478-HxCDF	ND		0.005			
123678-HxCDF	ND		0.003			
234678-HxCDF	ND		0.005			
123789-HxCDF	ND		0.008			
1234678-HpCDF	0.174				1.03	44.59
1234789-HpCDF	ND		0.010			
OCDF	ND			0.166	0.58	
TOTAL TCDD	0.030	1			0.86	
TOTAL PCDD	ND			0.018	0.61	
TOTAL HxCDD	ND			0.382	2.28	
TOTAL HpCDD	ND			0.273	1.40	
TOTAL TCDF	ND		0.003			
TOTAL PCDF	ND		0.005			
TOTAL HxCDF	0.196	2			1.28	
TOTAL HpCDF	0.563	2			1.02	

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
37CL-TCDD	8.65	93.42		31.22
13C12-HxCDF 789	7.55	81.54	0.53	42.30

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
13C12-TCDF	6.35	68.58	0.78	30.33
2378-13C12-TCDD	8.47	91.48	0.82	31.20
13C12-PCDF	5.58	60.26	1.56	35.19
13C12-PCDD	7.19	77.65	1.57	36.45
13C12-HxCDF 478	6.54	70.63	0.54	40.23
13C12-HxCDD 678	7.52	81.22	1.26	41.39
13C12-HpCDF	4.56	49.25	0.46	44.58
13C12-HpCDD	4.68	50.54	1.09	46.30
13C12-OCDD	4.29	23.17	0.90	51.51

HC # MW-16 10'-11.5'
Soil

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST: MC
DATE: 06/24/88
SAMPLEWT: 1.24
FILE NAME: M882113
SAMPLE ID: 8806-D10-3
CASE NO: ATI
PROJ NO: 12456R
CONCAL: M882112

NAME	CONC(ppb)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	0.273				0.70	31.19
12378-PCDD	ND		0.020			
123478-HxCDD	ND		0.028			
123678-HxCDD	ND		0.025			
123789-HxCDD	ND		0.033			
1234678-HpCDD	ND		0.045			
OCDD	0.430				0.76	51.46
2378-TCDF	ND		0.013			
12378-PCDF	ND		0.015			
23478-PCDF	ND		0.015			
123478-HxCDF	ND		0.015			
123678-HxCDF	ND		0.013			
234678-HxCDF	ND		0.020			
123789-HxCDF	ND		0.025			
1234678-HpCDF	ND		0.028			
1234789-HpCDF	ND		0.037			
OCDF	ND		0.073			
TOTAL TCDD	0.273	1			0.70	
TOTAL PCDD	ND			0.051	0.30	
TOTAL HxCDD	ND			0.377	5.05	
TOTAL HpCDD	ND		0.045			
TOTAL TCDF	ND		0.013			
TOTAL PCDF	ND		0.015			
TOTAL HxCDF	ND		0.018			
TOTAL HpCDF	ND		0.030			

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
37CL-TCDD	7.96	98.70		31.19
13C12-HxCDF 789	5.66	70.18	0.53	42.27

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
13C12-TCDF	3.92	48.61	0.79	30.31
2378-13C12-TCDD	4.97	61.63	0.80	31.18
13C12-PCDF	3.95	48.98	1.56	35.16
13C12-PCDD	4.95	61.38	1.58	36.42
13C12-HxCDF 478	6.12	75.89	0.57	40.21
13C12-HxCDD 678	6.65	82.46	1.26	41.36
13C12-HpCDF	4.14	51.34	0.49	44.55
13C12-HpCDD	5.25	65.10	1.06	46.27
13C12-OCDD	7.89	48.92	0.91	51.46

HC # BG-1 Soil
Background

TRIANGLE LABORATORIES, INC.
PCDD/PCDF ANALYSIS (8290)

ANALYST:	DH	FILE NAME:	M882114	CONCAL:	M882112
DATE:	06/24/88	SAMPLE ID:	8806-D10-4		
SAMPLEWT:	1.18	CASE NO:	ATI		
		PROJ NO:	12456R		

NAME	CONC(ppb)	NUMBER	DL	EMPC	RATIO	RT
2378-TCDD	ND		0.008			
12378-PCDD	ND		0.010			
123478-HxCDD	ND			0.030	1.94	
123678-HxCDD	0.282				1.13	41.42
123789-HxCDD	0.104				1.42	42.10
1234678-HpCDD	12.265				1.08	46.32
OCDD	81.462				0.90	51.52
2378-TCDF	0.013				0.67	30.37
12378-PCDF	ND		0.008			
23478-PCDF	0.019				1.61	36.19
123478-HxCDF	0.098				1.28	40.25
123678-HxCDF	0.066				1.19	40.35
234678-HxCDF	0.116				1.32	41.18
123789-HxCDF	ND		0.010			
1234678-HpCDF	2.738				1.07	45.00
1234789-HpCDF	ND			0.192	1.28	
OCDF	6.375				0.95	52.08
TOTAL TCDD	ND		0.008			
TOTAL PCDD	0.031	1			1.41	
TOTAL HxCDD	1.375	4			1.27	
TOTAL HpCDD	20.881	2			1.05	
TOTAL TCDF	0.234	4			0.70	
TOTAL PCDF	0.284	4			1.58	
TOTAL HxCDF	2.098	6			1.20	
TOTAL HpCDF	7.485	2			1.03	

SURROGATE RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
37CL-TCDD	8.25	97.35		31.23
13C12-HxCDF 789	6.46	76.23	0.51	42.32

INTERNAL STANDARDS RECOVERY SUMMARY

NAME	CONC (ppb)	% REC.	RATIO	RT
13C12-TCDF	6.01	70.92	0.80	30.34
2378-13C12-TCDD	6.64	78.35	0.83	31.22
13C12-PCDF	5.12	60.42	1.59	35.20
13C12-PCDD	5.59	65.96	1.59	36.46
13C12-HxCDF 478	6.96	82.13	0.54	40.24
13C12-HxCDD 678	7.21	85.08	1.29	41.40
13C12-HpCDF	4.26	50.27	0.45	44.59
13C12-HpCDD	4.70	55.46	1.05	46.31
13C12-OCDD	5.17	30.50	0.96	51.51

HC # MW-16 Water

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                      TRIANGLE LABORATORIES, INC.
                        PCDD/PCDF ANALYSIS (8290)

ANALYST:      DH          FILE NAME: M882115      CONCAL: M882112
DATE:         06/24/88    SAMPLE ID: 8806-D10-5
SAMPLEWT:      500.00     CASE NO:   ATI
                          PROJ NO:   12456
===========================================================================
     NAME           CONC(ppt)    NUMBER       DL      EMPC      RATIO      RT
---------------------------------------------------------------------------
2378-TCDD             ND                    0.048
12378-PCDD            ND                    0.060
123478-HxCDD          ND                    0.075
123678-HxCDD          ND                    0.070
123789-HxCDD          ND                    0.092
1234678-HpCDD         ND                    0.205
OCDD                  ND                    0.960
2378-TCDF             ND                    0.030
12378-PCDF            ND                    0.040
23478-PCDF            ND                    0.043
123478-HxCDF          ND                    0.037
123678-HxCDF          ND                    0.033
234678-HxCDF          ND                    0.048
123789-HxCDF          ND                    0.060
1234678-HpCDF         ND                    0.088
1234789-HpCDF         ND                    0.123
OCDF                  ND                    0.638
TOTAL TCDD            ND                    0.048
TOTAL PCDD            ND                    0.060
TOTAL HxCDD           ND                             0.675     4.57
TOTAL HpCDD           ND                    0.205
TOTAL TCDF            ND                    0.030
TOTAL PCDF            ND                    0.043
TOTAL HxCDF           ND                    0.043
TOTAL HpCDF           ND                    0.103


SURROGATE RECOVERY SUMMARY
==========================================================================
NAME                CONC (ppt)          % REC.       RATIO            RT
--------------------------------------------------------------------------
37CL-TCDD                20.32          101.60                     31.22
13C12-HxCDF 789          12.29           61.45        0.51         42.29


INTERNAL STANDARDS RECOVERY SUMMARY
===========================================================================
NAME                CONC (ppt)          % REC.       RATIO             RT
--------------------------------------------------------------------------
13C12-TCDF                6.31           31.55        0.78          30.33
2378-13C12-TCDD           7.07           35.35        0.77          31.20
13C12-PCDF                5.57           27.85        1.55          35.19
13C12-PCDD                6.46           32.30        1.53          36.45
13C12-HxCDF 478          11.44           57.20        0.52          40.22
13C12-HxCDD 678          11.09           55.45        1.28          41.37
13C12-HpCDF               5.92           29.60        0.43          44.56
13C12-HpCDD               5.44           27.20        0.99          46.28
13C12-OCDD                4.19           10.48        0.96          51.47
```

VERIFICATION ANALYTICAL DATA

Laucks
Testing Laboratories, Inc.
940 South Harney St. Seattle, Washington 98108 (206)767-5060
Chemistry, Microbiology, and Technical Services

FAX TRANSMISSION COVER SHEET

To the attention of Will Abercrombie

From Lisa Johnson

Date June 27, 1988

Re: Your file Project Name: M&R

Our file Laboratory No: 10382

Please regard this information as ________ preliminary.

X final.

For the transmission to be complete, you should have received ______ pages, including this cover page.

If you wish to respond by FAX, our number is 1-206-767-5063.

Charter Member American Council of Independent Laboratories

Sample Custody Record

DATE 6/14/88 PAGE 1 OF 1

HARTCROWSER

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

JOB NUMBER 2159-02 **LAB NUMBER**

PROJECT MANAGER WILL ABERCROMBIE

PROJECT NAME M & R

SAMPLED BY:

LAB NO.	SAMPLE	TIME	STATION	MATRIX	PENTACHLOROPHENOL	TETRACHLOROPHENOL	SOXLET EXTRACT. METHOD 8040	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
10382-1	S-6		B-17	Soil	X	X		1	
2	S-6		B-19	″	X	X		1	
3	S-7		B-16	″	X	X		1	
4	S-7		B-22	″	X	X		1	
5	S-6		B-23	″	X	X		1	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Toni A. Carmichael Signature	6/14/88	Signature	
Toni A. Carmichael Printed Name	TIME 4:25 p.m.	Printed Name	TIME
Hart Crowser Company		Company	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
Signature		Lisa Johnson Signature	6/14/88
Printed Name	TIME	Lisa Johnson Printed Name	TIME 4:25
Company		Laucks Company	

TOTAL NUMBER OF CONTAINERS 5

METHOD OF SHIPMENT Hand Carry

SPECIAL SHIPMENT/HANDLING OR STORAGE REQUIREMENTS Keep in dark, Cool.

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

		Tetrachlorophenol
10382-1	43 ug/kg	30 ug/kg
" -2	37 "	53 "
" -3	19,000 "	42,000 "
" -4	11,000 "	88 "
" -5	<25	<25
" -Blk	<25	<25

LLD 25 ug/kg

	TCP	PCP
10382-5 MS	105%	84%

J-2159-03

APPENDIX B

TRANSFORMER OIL TEST RESULTS

Acts 4:12

DIVISION OF SD Myers

TRANSFORMER CONSULTANTS

Suite 10, 26062 Eden Landing Rd
Hayward, California
Phone: (415) 783-7744
Toll Free: (800) 972-5940
Outside Calif. (800) 227-0637

July 21, 1982

M & R Timber, Inc.
P. O. Box 1058
Port Angeles, Washington 98362

Attn: Mr. Dennis Dille

RE: Your PO# 610MR82
Tested: July 1982

Gentlemen:

Here are the results on the transformer oils recently tested at your plant.

FURTHER WORK IS REQUIRED on some of these transformers. A complete listing of these transformers will be found under the SERVICING REQUIRED tab.

A formal quotation is included with your test results and can be found under the Reclaimer Quotation Tab.

If you have any questions on this or any related matter, do not hesitate to contact us.

Sincerely,

Fred Shephard

Fred Shephard
Regional MTL Supervisor

FS/dr
Test No: 10805-12

Acts 4:12

DIVISION OF SDMyers TRANSFORMER CONSULTANTS

P.O. BOX 3575, AKRON, OHIO 44310, PHONE (216) 929-2847
Out of State Call Toll-Free 800-321-9580

SO # 82-4-0617

DATE 6/8/82

Client M & R Timber, Inc.

Contact Dennis Dille

reet P.O. Box 1058

Phone 206/452-2368

City Port Angeles State WA Zip 98362

NO. SAMPLES 4

DATE RECEIVED 7/16/82

POLYCHLOROBIPHENYL (PCB) ANALYSIS
STATEMENT OF CERTIFICATION

Equipment Manufacturer Serial Number	Assigned Label Color	Parts Per Million of Arochlor				
		1242	1254	1260	Other	Total
TC# 2 Chip & Saw Sub Esco 5811668	Green	Trace		Trace		Trace
TC# 3 Left Unit Spokane S740422N	Green					ND
TC# 5 Right Unit Spokane S740420N	Green					ND
TC# 10 Planer Sub Left West 73AE6223	Green					ND

omments: N.D. - NONE DETECTED

B. Colvin 7/19/82
Lab Technician / Date Tested

R. E. Moon 7/20/82
Quality Control Engineer / Date Approved

Acts 4:12
DIVISION OF SD Myers TRANSFORMER CONSULTANTS

P.O. Box 3575
Akron, Ohio 44310
Phone: (216) 929-2847
Outside Ohio (800) 321-958

July 21, 1982

RE: PCB CONTENT RESULTS

Gentlemen:

Enclosed with this letter are the results of your PCB tests.

Please note that the Federal Register (Vol. 44, No. 106, May 31, 1979, p. 31537) defines these three classes of transformers: (1) PCB transformers (those units containing 500 ppm or greater PCB's); (2) PCB - contaminated transformers (those units containing 50 to 500 ppm PCB) and (3) Non-PCB transformers (those units containing less than 50 ppm PCB).

We have provided as an additional service to you color-coded labels for your transformers. These colors are: 1) YELLOW for PCB equipment; 2) ORANGE for PCB contaminated equipment, and 3) GREEN for non-PCB equipment. Only those units in category (1) PCB equipment are required by EPA to have labels.

The same Federal Register (page 31538) states: "EPA will not consider it to be good judgement to assume that the sample has less than 50 ppm PCB because the experimental error of the procedure overlaps the cut-off point. Through experimental data and by cross-checking with other laboratories, we have determined a deviation of ± 10%. For this reason we have established our limits as below 45 ppm for non-PCB's, 45-450 ppm for PCB contaminated oil and 450+ for PCB transformer oil.

A point to remember is that all samples other than transformer oil are classified as PCB's at 50 ppm or more.

A few of your test results may be reported using the following terms or abbreviation:

ND - None Detected
Trace - Less than 1 ppm
UP - Unidentified Peaks - The result from the Chromatogram displayed major peaks NOT ASSOCIATED with PCB's normally found in electrical transformer fluid.

Very truly yours,

RE Moon

R. E. Moon
Chief Chemist

REM/maf
Enclosures

J-2159-03

APPENDIX F

PETRO-TITE TANK TESTING METHOD AND RESULTS

APPENDIX F

PETRO-TITE TANK TESTING METHOD* AND RESULTS

Manufacturer's Description of Method

This test is essentially a fluid-static (standpipe) test. The tank and standpipe (installed in the tank opening) are completely filled. A loss can be observed and measured to 0.01 gallon. A one-gallon graduate is used to measure the exact amount of gasoline added to or drained from the standpipe to maintain a constant level. The constant level results in a uniform tank pressure.

A circulating pump draws gasoline from at least 6 inches below the tank top through a suction tube; if necessary, the tube is lengthened by a hose extension. The gasoline is discharged under approximately 25 pounds per square inch pressure through a discharge hose into sections of tubing which have been coupled together to form an outlet jet at the bottom of the tank. This jet is adjusted to be above any water in the tank bottom and is adjusted to be below any drop tube. The jet is directed 45 degrees upward from the center line of the long tank axis. These suction and jet systems create a vortex-like swirling motion in the tank and attempt to produce a uniform temperature throughout the tank.

The uniform temperature obtained by circulation is electrically measured by a thermistor in the bottom of the suction tube. The thermistor is located approximately 6 inches below the top of the tank. Temperature changes are constantly measured. Volume changes are calculated from the temperature changes. The calculated volumes are subtracted from the volume change measured by the graduate. Measured volume changes are due to tank end

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* From publication EPA/600/2-86/001: Underground Tank Leak Detection Methods: A State of the Art Review, United States Environmental Protection Agency.

deflection or leakage. Any difference between the calculated and measured volumes in the 15 to 30 minutes after tank end deflections cease, (approximately two hours), is considered to be leakage if it is equal to or more than 0.05 gallon per hour.

The minimum time to perform the test is 2.5 hours. The entire test can usually be completed in one working day.

Manufacturer's Techniques to Compensate for Effects of Variables

In the Petro-Tite testing method, the following effects of variables are compensated as described below:

- Temperature - This is done by using a thermal sensor and a temperature monitoring system. During the test, the product is constantly circulated to attain an average temperature. Circulation time is five to eight minutes per 1,000 gallons; five minutes for lighter liquids (gasoline) and eight minutes for heavier liquids (fuel oil). The thermal sensor is attached to a semiconductor thermistor probe in the tank and is capable of discerning 0.003 degree Fahrenheit changes. By passing a small electric current through the thermistor, the average temperature is measured at the point of widthdrawal 6 inches or more below the tank top. However, due to the overall accuracy and repeatability of the thermal system, the exact fraction of a degree Fahrenheit (i.e., 0.003 degree Fahrenheit) varies slightly at different temperatures, which may cause some inaccuracy in the measurement of actual temperature changes. A chart gives the fraction for any temperature. Because the test takes several hours, accurate temperature monitoring can be accomplished.

- Water Table - The leak meashing effect due to a water table is eliminated by inducing a constant pressure gradient on a leak. In addition, in areas with a water table and when there are no data available on the water level, the data should be obtained by drilling a monitoring well, prior to a test. The water level is used to determine the product level in the standpipe for testing.

- Tank Deformation - Apparent volume changes are compared with a chart to recognize the occurrence of tank end deflection. Volume changes are observed in equal time intervals and recorded on the Tank Test Data Chart. The manufacturer reports diminishing apparent losses in equal time intervals as end deflection occurs.

  A technique has been developed to quickly eliminate these apparent losses due to tank end deflection. A high level, and therefore a greater pressure, is maintained at the beginning of the test in the standpipe. When recorded data indicate steadily decreasing losses, the product level, and therefore the pressure, is lowered, and tank end deflection usually disappears within two hours.

- Vapor Pockets - The presence of vapor pockets in the tank is recognized by direct observation of the bubbles in the standpipe. This is due to product circulation for temperature monitoring which carries some of the air to the fill pipe.

- Evaporation - Product loss by evaporation is minimized by using a cap to cover the graduate's top.

- Piping Leaks - For storage systems with submerged pumping, separate tests must be run on the tank and piping by the tank tester and line tester units. On suction delivery tank systems, the test checks the entire system simultaneously.

- Equipment Accuracy - The product volume change in the standpipe (tank) can be measured by using a one-gallon graduated cylinder. Volumes less than 0.01 gallon can be read on this cylinder. The temperature changes are constantly measured with 0.003 degree Fahrenheit accuracy.

- Operator Error - This is minimized by using a skilled technician.

- Type of Product - As long as the product is of low enough viscosity to be free flowing, the method can be used to detect small leaks.

- Tank geometry, wind, vibration, noise, power variation, and instrumentation limitation do not appear to have significant effects on the applicability and accuracy of the detection method.

Data Chart for Tank System Tightness Test

PL SE PRINT

1. OWNER Property ☒ Tank(s) ☒

MERRILL & Ring Inc PORTANGELES WA
Name Address Representative Telephone

Name Address Representative Telephone

2. OPERATOR

SAME
Name Address Telephone

3. REASON FOR TEST (Explain Fully)

SALE OF PROPERTY

4. WHO REQUESTED TEST AND WHEN

HOWARD SMALL ENGR HART CROWSER 5-31-88
Name Title Company or Affiliation Date

Address Telephone

5. TANK INVOLVED

Use additional lines for manifolded tanks

Identify by Direction	Capacity	Brand/Supplier	Grade	Approx. Age	Steel/Fiberglass
NORTH OF SCALING SHED	2000	N/A	DIESEL	UNKNOWN	STL

6. INSTALLATION DATA

Location	Cover	Fills	Vents	Siphones	Pumps
NORTH OF SCALING SHED NEXT TO DRINK	CONCRETE	1- 3"	1- 1¼"	NONE	SUCTION TOKHEIM
North inside driveway, Rear of station, etc.	Concrete, Black Top, Earth, etc.	Size, Titefill make, Drop tubes, Remote Fills	Size, Manifolded	Which tanks?	Suction, Remote, Make if known

7. UNDERGROUND WATER

Depth to the Water table 81"

Is the water over the tank? ☐ Yes ☒ No

8. FILL-UP ARRANGEMENTS

Tanks to be filled ______ hr. ______ Date Arranged by ______
Name Telephone

Extra product to "top off" and run tank tester. How and who to provide? Consider NO Lead.

Terminal or other contact for notice or inquiry ______
Company Name Telephone

9. CONTRACTOR, MECHANICS, any other contractor involved

10. OTHER INFORMATION OR REMARKS

Additional information on any items above. Officials or others to be advised when testing is in progress or completed. Visitors or observers present during test, etc.

11. TEST RESULTS

Tests were made on the above tank systems in accordance with test procedures prescribed for as detailed on attached test charts with results as follows:

Tank Identification	Tight	Leakage Indicated	Date Tested
2000 gal DIESEL	NO	-.080 gal./hr	6-3-88

12. SENSOR CERTIFICATION

2-4-87
Date

1991
Serial No. of Thermal Sensor

13. This is to certify that these tank systems were tested on the date(s) shown. Those indicated as "Tight" meet the criteria established by the National Fire Protection Association Pamphlet 329.

Technicians

1. JOHN D. COX

Certification # 414512754

Testing Contractor or Company. By: Signature

Address

2. ______

Certification # ______

PN6827

P-T Tank Test Data Chart
Additional Info

1. Net Volume Change at Conclusion of Precision Test -.080 gph

Signature of Tester: JOHN D. COX

Date: 6-3-88

2. Statement:

☐ Tank and product handling system has been tested tight according to the Precision Test Criteria as established by N.F.P.A. publication 329. This is not intended to indicate permission of a leak.

OR

☒ Tank and product handling system BELOW GRADE has failed the tank tightness test according to the Precision Test Criteria as established by N.F.P.A. publication 329.

It is the responsibility of the owner and/or operator of this system to immediately advise state and local authorities of any implied hazard and the possibility of any reportable pollution to the environment as a result of the indicated failure of this system. Heath Consultants Incorporated does not assume any responsibility or liability for any loss of product to the environment.

Tank Owner/Operator ____________________

Date ____________________

27\. Sensor Calibration 16541 / 16544

LOG OF TEST PROCEDURES

28. DATE 6-3-88 TIME (24 hr.)	Record details of setting up and running test. (Use full length of line if needed.)	29. Reading No.	30. HYDROSTATIC PRESSURE CONTROL Standpipe Level in inches Beginning of Reading	Level to which Restored	31. VOLUME MEASUREMENTS (V) RECORD TO .001 GAL. 32. Product in Graduate Before Reading	After Reading	33. Product Replaced (-) Product Recovered (+)	34. TEMPERATURE COMPENSATION USE FACTOR (a) 35. Thermal Sensor Reading	36. Change Higher + Lower - (c)	37. Computation (c) × (a) = Expansion + Contraction -	38. NET VOLUME CHANGING EACH READING Temperature Adjustment Volume Minus Expansion (+) or Contraction (-) #33(V) — #37(T)	39. ACCUMULATED CHANGE At Low Level compute Change per Hour (NFPA criteria)
	DURING TOP OFF FOUND LEAK IN SUCTION LINE TO PUMP (ABOVE GROUND) REMOVED EXPOSED LINE											
	AND PLUGGED LINE FROM TANK. RE-STARTED TEST BLED AIR FROM CAPPED OFF PRODUCT LINE											
15:40	START CIRCULATION											
:50	TOOK 1ST API SAMPLE											
:55	TOOK 2ND API SAMPLE											
16:00	TOOK THERMAL SENSOR READING							10319				A = .0029
:15	START HIGH LEVEL TEST	1	41.2	42	.590	.530	-.060	336	+17	+.049	-.109	
:30		2	41.4	42	.530	.495	-.035	358	+22	+.064	-.099	
:45		3	41.7	42	.495	.470	-.015	374	+16	+.046	-.061	
17:00		4	41.5	42	.470	.445	-.025	385	+11	+.032	-.057	
:01	DROP TO LOW LEVEL											
:15	START LOW LEVEL TEST	5		12		.455		400	+15			
:30	CLOUDS MOVED IN AND	6	12.3	12	.455	.475	+.020	412	+12	+.035	-.015	-.015
:45	AMBIENT IS COOLING OFF FAST	7	12.3	12	.475	.490	+.015	422	+10	+.029	-.014	-.029
18:00		8	12.2	12	.490	.500	+.010	432	+10	+.029	-.019	-.048
:15		9	12.4	12	.500	.520	+.020	450	+18	+.052	-.032	-.080
	STOPPED TEST TANK IS NOT TIGHT									RATE	-.080 GAL/HR	

14. RRILL + RING INC — Name of Supplier, Owner or Dealer

Address No. and Street(s)

PORT Angeles — City

WA — State

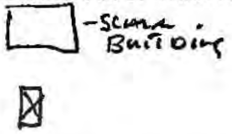
6-3-88 — Date of Test

15. TANK TO TEST

NORTH OF SCALE — Identity by position

DIESEL — Brand and Grade

15a. BRIEF DIAGRAM OF TANK FIELD



16. CAPACITY

Nominal Capacity 2000 Gallons

By most accurate capacity chart available 2005 Gallons

From
☐ Station Chart
☒ Tank Manufacturer's Chart
☐ Company Engineering Data
☐ Charts supplied with
☐ Other

17. FILL-UP FOR TEST

Stick Water Bottom before Fill-up 0 in. to ⅛"

0 Gallons

64 in. Tank Diameter

		Gallons	Total Gallons ea. Reading
Inventory			2005
		+ Fill	+ 5
			2010

Transfer total to line 25a

18. SPECIAL CONDITIONS AND PROCEDURES TO TEST THIS TANK

☐ Water in tank ☐ Line(s) being tested with LVLLT

☒ High water table in tank excavation

See manual sections applicable. Check below and record procedure in log (27).

Use maximum allowable test pressure for all tests.
Four pound rule does not apply to doublewalled tanks.

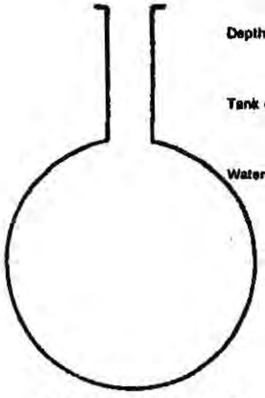
Complete section below:

1. Is four pound rule required? Yes ☒ No ☐

2. Height to 12" mark from bottom of tank 146 in.

3. Pressure at bottom of tank 4.916 P.S.I.

4. Pressure at top of tank 3.472 P.S.I.



Depth of burial 32 in.

Tank dia. 64 in.

Water table 15 in.

NOTES:

The above calculations are to be used for dry soil conditions to establish a positive pressure advantage, or when using the four pound rule to compensate for the presence of subsurface water in the tank area.

Refer to N.F.P.A. 30, Sections 2-3.2.4 and 2-7.2 and the tank manufacturer regarding allowable system test pressures.

19. TANK MEASUREMENTS FOR TSTT ASSEMBLY

Bottom of tank to grade* 96 in.

Add 30" for "T" probe assy. 30 in.

Total tubing to assemble — approximate 144 in.

20. EXTENSION HOSE SETTING

Tank top to grade* 32 in.

Extend hose on suction tube 6" or more below tank top in.

*If Fill pipe extends above grade, use top of fill.

21. VAPOR RECOVERY SYSTEM

☐ Stage I ☐ Stage II NONE

22. Thermal-Sensor reading after circulation 10319 digits

53/54 °F Between

23. Digits per °F in range of expected change 308 digits

COEFFICIENT OF EXPANSION (Complete after circulation)

24a. Corrected A.P.I. Gravity

Observed A.P.I. Gravity

Hydrometer employed H

Observed Sample Temperature °F

Corrected A.P.I. Gravity @ 60°F, From Table A

Coefficient of Expansion for Involved Product From Table B

Transfer COE to Line 25b.

24b. COEFFICIENT OF EXPANSION RECIPROCAL METHOD

Type of Product DIESEL

Hydrometer Employed 4 H

Temperature in Tank After Circulation 53.2 °F

Temperature of Sample 58 °F

50

Difference (+/-) + 4.8 °F

Observed A.P.I. Gravity 32.5

Reciprocal 2213 Page # 36

2010 Total quantity in full tank (16 or 17) ÷ 2213 Reciprocal = .9082693 Volume change in this tank per °F

Transfer to Line 26a.

24c. FOR TESTING WITH WATER

see Table C & D

Water Temperature after Circulation Table C °F

Coefficient of Water Table D

Added Surfactant? ☐ Yes ☐ No Transfer COE to Line 25b.

25. (a) Total quantity in full tank (16 or 17) × (b) Coefficient of expansion for involved product = (c) Volume change in this tank per °F gallons

26. (a) .9082693 Volume change per °F (25 or 24b) ÷ 308 Digits per °F in test Range (23) = .0029489 Volume change per digit Compute to 4 decimal places. This is test factor (u)

.0029

Data Chart for Tank System Tightness Test

P SE PRINT

1. OWNER Property ☒ Tank(s) ☒

MARRILL + RING PORT ANGRLES WA

Name / Address / Representative / Telephone

Name / Address / Representative / Telephone

2. OPERATOR

SAWLR

Name / Address / Telephone

3. REASON FOR TEST (Explain Fully)

SALA OF PROPERTY

4. WHO REQUESTED TEST AND WHEN

Name	Title	Company or Affiliation	Date
HOWARD SMALL	ENGR.	HART CROWSER	5-31-88

Address / Telephone

5. TANK INVOLVED

Use additional lines for manifolded tanks

Identify by Direction	Capacity	Brand/Supplier	Grade	Approx. Age	Steel/Fiberglass
SOUTH OF KILN SHED	1000	N/A	Regular	NA	STL

6. INSTALLATION DATA

Location	Cover	Fills	Vents	Siphones	Pumps
	CONCRATE	1-4"	1-2"	NONE	SUCTION WAYNE
North inside driveway, Rear of station, etc.	Concrete, Black Top, Earth, etc.	Size, Titefill make, Drop tubes, Remote Fills	Size, Manifolded	Which tanks?	Suction, Remote, Make if known

7. UNDERGROUND WATER

Depth to the Water table 48"

Is the water over the tank? ☐ Yes ☒ No

8. FILL-UP ARRANGEMENTS

Tanks to be filled ______ hr. ______ Date Arranged by ______ Name ______ Telephone

Extra product to "top off" and run tank tester. How and who to provide? Consider NO Lead.

Terminal or other contact for notice or inquiry ______ Company ______ Name ______ Telephone

9. CONTRACTOR, MECHANICS, any other contractor involved

10. OTHER INFORMATION OR REMARKS

Additional information on any items above. Officials or others to be advised when testing is in progress or completed. Visitors or observers present during test, etc.

11. TEST RESULTS

Tests were made on the above tank systems in accordance with test procedures prescribed for as detailed on attached test charts with results as follows:

Tank Identification	Tight	Leakage Indicated	Date Tested
1- 1000 gas	YES	-.027 GAL/HR	6-3-88

12. SENSOR CERTIFICATION

(-24-87
Date

1991
Serial No. of Thermal Sensor

13. This is to certify that these tank systems were tested on the date(s) shown. Those indicated as "Tight" meet the criteria established by the National Fire Protection Association Pamphlet 329.

Technicians

1. JOHN A. COX

Certification # 414 512 754

2. ______

Certification # ______

Testing Contractor or Company. By: Signature

Address

PN6827

P-T Tank Test Data Chart
Additional Info

1. Net Volume Change at Conclusion of Precision Test -.027 gph

Signature of Tester: JOHN D. COX

Date: 6/3/88

2. Statement: plus vent below grade

☒ Tank and product handling system has been tested tight according to the Precision Test Criteria as established by N.F.P.A. publication 329. This is not intended to indicate permission of a leak.

OR

☐ Tank and product handling system has failed the tank tightness test according to the Precision Test Criteria as established by N.F.P.A. publication 329.

It is the responsibility of the owner and/or operator of this system to immediately advise state and local authorities of any implied hazard and the possibility of any reportable pollution to the environment as a result of the indicated failure of this system. Heath Consultants Incorporated does not assume any responsibility or liability for any loss of product to the environment.

Tank Owner/Operator ______________________

Date ______________________

27. Sensor Calibration 16541, 16544

LOG OF TEST PROCEDURES

28. DATE 8-3-88 TIME (24 hr.)	Record details of setting up and running test. (Use full length of line if needed.)	29. Reading No.	30. HYDROSTATIC PRESSURE CONTROL Standpipe Level in Inches: Beginning of Reading	Level to which Restored	31. VOLUME MEASUREMENTS (V) RECORD TO .001 GAL. 32. Product in Graduate: Before Reading	After Reading	33. Product Replaced (−) Product Recovered (+)	34. TEMPERATURE COMPENSATION USE FACTOR (a) 35. Thermal Sensor Reading	36. Change Higher + Lower − (c)	37. Computation (c) × (a) = Expansion + Contraction −	38. NET VOLUME CHANGING EACH READING Temperature Adjustment Volume Minus Expansion (+) or Contraction (−) #33(V) — #37(T)	39. ACCUMULATED CHANGE At Low Level compute Change per Hour (NFPA criteria)
	1ST ATTAMPT TO START TEST FOUND LEAK IN COUPLING ABOVE GROUND IN VENT LINE/REMOVED VENT RISER											
	AND PLUGGED WITH BLEEDER VALVE/BLED AIR FROM VALVE AND PUMP RE-STARTED TEST											
10:30	START CIRCULATION											
10:40	TOOK 1ST API SAMPLE											
:45	TOOK 2ND API SAMPLE											
:50	TOOK THERMAL SENSOR READING							11850				A =.0022
11:05	START HIGH LEVEL TEST	1	41.8	42	.460	.450	−.010	885	+35	+.077	−.087	
:20		2	42.6	42	.450	.475	+.025	918	+33	+.073	−.048	
:35		3	43.2	42	.475	.525	+.050	949	+31	+.068	−.018	
:50		4	43.2	42	.525	.575	+.050	978	+29	+.064	−.014	
:51	DROP TO LOW LEVEL											
12:05	START LOW LEVEL TAST	5		12				12010				
:20		6	13.5	12	.630	.685	+.055	036	+26	+.057	−.002	−.002
:35	SUNNY, BUT, PARTLY CLOUDY	7	13.5	12	.685	.740	+.055	065	+29	+.064	−.009	−.011
:50		8	13.4	12	.740	.790	+.050	093	+.28	+.062	−.012	−.023
13:05		9	13.4	12	.790	.845	+.055	120	+.27	+.059	−.004	−.027
										RATE −	.027 GAL/	HR

A=.0022

14. MERRILL & RING INC — PORT ANGELES — WA — 6-3-88
Name of Supplier, Owner or Dealer — Address No. and Street(s) — City — State — Date of Test

15. TANK TO TEST

N.XT KILN SHED
Identity by position

Regular UNLEADED
Brand and Grade

15a. BRIEF DIAGRAM OF TANK FIELD

16. CAPACITY

Nominal Capacity 1000 Gallons

By most accurate capacity chart available 1036 Gallons

From
☐ Station Chart
☒ Tank Manufacturer's Chart
☐ Company Engineering Data
☐ Charts supplied with
☐ Other

17. FILL-UP FOR TEST

Stick Water Bottom before Fill-up 0 in. to ¼" — 0 Gallons — 46 in. Tank Diameter

		Gallons	Total Gallons ea. Reading
Inventory			1036
		+ Fill	+ 5
			1041

Transfer total to line 25a

18. SPECIAL CONDITIONS AND PROCEDURES TO TEST THIS TANK

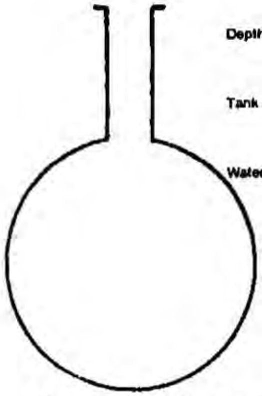
☐ Water in tank ☐ Line(s) being tested with LVLLT
☒ High water table in tank excavation

See manual sections applicable. Check below and record procedure in log (27).

Use maximum allowable test pressure for all tests.
Four pound rule does not apply to doublewalled tanks.

Complete section below:

1. Is four pound rule required? Yes ☒ No ☐
2. Height to 12" mark from bottom of tank 182 in.
3. Pressure at bottom of tank 4.792 P.S.I.
4. Pressure at top of tank 4.316 P.S.I.



Depth of burial 22 in.
Tank dia. 46 in.
Water table 20 in.

NOTES:

The above calculations are to be used for dry soil conditions to establish a positive pressure advantage, or when using the four pound rule to compensate for the presence of subsurface water in the tank area.

Refer to N.F.P.A. 30, Sections 2-3.2.4 and 2-7.2 and the tank manufacturer regarding allowable system test pressures.

19. TANK MEASUREMENTS FOR TSTT ASSEMBLY

Bottom of tank to grade* 68" in.
Add 30" for "T" probe assy. 30 in.
Total tubing to assemble — approximate 96 in.

20. EXTENSION HOSE SETTING

Tank top to grade* 22 in.
Extend hose on suction tube 6" or more below tank top ______ in.

*If Fill pipe extends above grade, use top of fill.

21. VAPOR RECOVERY SYSTEM

☐ Stage I ☐ Stage II NONE

22. Thermal-Sensor reading after circulation 11850 digits
58/59 °F Between

23. Digits per °F in range of expected change 318 digits

COEFFICIENT OF EXPANSION (Complete after circulation)

24a. Corrected A.P.I. Gravity

Observed A.P.I. Gravity ______
Hydrometer employed ______ H
Observed Sample Temperature ______ °F
Corrected A.P.I. Gravity @ 60°F, From Table A ______
Coefficient of Expansion for Involved Product From Table B ______

Transfer COE to Line 25b.

24b. COEFFICIENT OF EXPANSION RECIPROCAL METHOD

Type of Product GAS Reg. UNLEADED
Hydrometer Employed 6 H
Temperature in Tank After Circulation 58.2 °F
Temperature of Sample 60 °F
Difference (+/-) +1.8 °F
Observed A.P.I. Gravity 58.5
Reciprocal 1484 Page # 62

1041 ÷ 1484 = .7014824
Total quantity in full tank (16 or 17) — Reciprocal — Volume change in this tank per °F

Transfer to Line 26a.

24c. FOR TESTING WITH WATER

see Table C & D

Water Temperature after Circulation Table C ______ °F
Coefficient of Water Table D ______
Added Surfactant? ☐ Yes ☐ No Transfer COE to Line 25b.

25. (a) ______ × (b) ______ = (c) ______ gallons
Total quantity in full tank (16 or 17) — Coefficient of expansion for involved product — Volume change in this tank per °F

26. (a) .7014824 ÷ 318 = .0022059 This is test factor (a) .0022
Volume change per °F (25 or 24b) — Digits per °F in test Range (23) — Volume change per digit Compute to 4 decimal places.

APPENDIX G

MATERIAL SAFETY DATA SHEETS

MATERIAL
SAFETY
DATA
SHEET

KOPPERS

MEDICAL EMERGENCIES: 1 800-553-5631

IN PENNSYLVANIA: 1 800-323-6571

KOPPERS COMPANY, INC.
436 SEVENTH AVENUE
PITTSBURGH, PA. 15219

CHEMTREC ASSISTANCE: 1 800-424-9300

CUSTOMER SERVICE: 1 800-556-7737

SECTION I - PRODUCT IDENTIFICATION

PRODUCT NAME: Sapstain Control Chemical NP-1

COMMODITY NUMBER: 38012463

SYNONYM: none

CHEMICAL FAMILY: wood preservative

FORMULA: mixture

CAS NUMBER: none

DOT PROPER SHIPPING NAME: Corrosive liquid NOS

DOT HAZARD CLASS: Corrosive material

UN/NA NUMBER: UN 1760

SECTION II - HEALTH/SAFETY ALERT

DANGER
CORROSIVE TO THE EYES
CAUSES SEVERE BURNS
MAY BE FATAL IF INHALED
MAY BE FATAL IF ABSORBED THROUGH SKIN
MAY BE FATAL IF SWALLOWED
AVOID CONTACT WITH SKIN, EYES AND CLOTHING
DO NOT USE THIS PRODUCT UNTIL MSDS HAS BEEN READ AND UNDERSTOOD

SECTION III - HEALTH HAZARD INFORMATION

EYE: Corrosive. Causes irreversible damage.

SKIN: Corrosive. Causes skin burns. Can penetrate the skin to cause internal organ damage which may be fatal.

INHALATION: May produce irritation of the airways. Prolonged inhalation of concentrated vapors may be fatal.

INGESTION: May be fatal if swallowed.

REVISION DATE: 06/87
SPECIFICATION SHEET NUMBER: CFR(7/84)
COMMODITY NUMBER: 38012463

CODE NUMBER: WPR00A25JU8703
REPLACES SHEET: WPR00A25AU8602

SECTION IV - EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: Immediately flush with large amounts of water for 15 minutes. Immediately seek medical aid.

SKIN CONTACT: Wash thoroughly with soap and water. Remove contaminated clothing.

INHALATION: Remove from exposure. If breathing has stopped or is difficult, administer artificial respiration or oxygen as indicated. Seek medical aid.

INGESTION: Induce vomiting. Give water. Call a physician. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTE TO PHYSICIAN: Mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be required. Although carbamates are known to cause cholinesterase inhibition, iodopropynl carbamate did not inhibit cholinesterase in animal tests.

SECTION V - FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT & METHOD: 40 C (104 F) TCC **AUTOIGNITION TEMP:** ND

FLAMMABLE LIMITS (% BY VOLUME/AIR): **LOWER:** ND **UPPER:** ND

EXTINGUISHING MEDIA: Use dry chemical, carbon dioxide, foam or water spray. Use water spray (fog).

FIRE-FIGHTING PROCEDURES: Wear complete fire service protective equipment, including full-face MSHA/NIOSH approved self-contained breathing apparatus. Use water to cool fire-exposed container/structure/protect personnel. Toxic vapors may be given off in a fire.

FIRE AND EXPLOSION HAZARDS: When heated (fire conditions), vapors/decomposition products may be released forming flammable/explosive mixtures in air. Closed containers may explode when exposed to extreme heat(fire).

SECTION VI - SPILL, LEAK AND DISPOSAL INFORMATION

SPILL OR LEAK PROCEDURES: Stop leak if no risk involved. Stay upwind. Solidified spills: Shovel into dry containers and cover. Flush area with water. Small wet spills: Take up with sand or other noncombustible absorbent material. Flush area with water. Dike large spills for later disposal. Contain runoff from fire control and dilution water.

WASTE DISPOSAL: This product is a US EPA defined ignitable hazardous waste. Dispose of as an ignitable waste in accordance with local, state and federal regulations. Place in tightly sealed labeled containers. This product released into the environment must be reported to the National Response Center (1 800-424-8802). The reportable quantity (RQ) for this product is 7,700 pounds.

SECTION IV - EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: Immediately flush with large amounts of water for 15 minutes. Immediately seek medical aid.

SKIN CONTACT: Wash thoroughly with soap and water. Remove contaminated clothing.

INHALATION: Remove from exposure. If breathing has stopped or is difficult, administer artificial respiration or oxygen as indicated. Seek medical aid.

INGESTION: Induce vomiting. Give water. Call a physician. DO NOT ATTEMPT TO GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

NOTE TO PHYSICIAN: Mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be required. Although carbamates are known to cause cholinesterase inhibition, iodopropynl carbamate did not inhibit cholinesterase in animal tests.

SECTION V - FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT & METHOD: 40 C (104 F) TCC AUTOIGNITION TEMP: ND

FLAMMABLE LIMITS (% BY VOLUME/AIR): LOWER: ND UPPER: ND

EXTINGUISHING MEDIA: Use dry chemical, carbon dioxide, foam or water spray. Use water spray (fog).

FIRE-FIGHTING PROCEDURES: Wear complete fire service protective equipment, including full-face MSHA/NIOSH approved self-contained breathing apparatus. Use water to cool fire-exposed container/structure/protect personnel. Toxic vapors may be given off in a fire.

FIRE AND EXPLOSION HAZARDS: When heated (fire conditions), vapors/decomposition products may be released forming flammable/explosive mixtures in air. Closed containers may explode when exposed to extreme heat(fire).

SECTION VI - SPILL, LEAK AND DISPOSAL INFORMATION

SPILL OR LEAK PROCEDURES: Stop leak if no risk involved. Stay upwind. Solidified spills: Shovel into dry containers and cover. Flush area with water. Small wet spills: Take up with sand or other noncombustible absorbent material. Flush area with water. Dike large spills for later disposal. Contain runoff from fire control and dilution water.

WASTE DISPOSAL: This product is a US EPA defined ignitable hazardous waste. Dispose of as an ignitable waste in accordance with local, state and federal regulations. Place in tightly sealed labeled containers. This product released into the environment must be reported to the National Response Center (1 800-424-8802). The reportable quantity (RQ) for this product is 7,700 pounds.

SECTION VII - RECOMMENDED EXPOSURE LIMIT/HAZARDOUS INGREDIENTS

EXPOSURE LIMIT (PRODUCT): None established.

HAZARDOUS INGREDIENTS	CAS NUMBER	PERCENT	EXPOSURE LIMIT (PPM;MG/M3)		
Didecyl dimethyl ammonium chlorid		65	none		
Iodopropanyl butyl carbamate	55406-53-6	20	none		
Petroleum naphtha	64742-88-7	5	ACGIH-TLV		5
			OSHA-PEL		5
✓ Ethanol NIOSH	64-17-5	10	ACGIH-TLV	1000	1900
			OSHA-PEL	1000	1900
✓ Dimethyl sulfoxide	67-68-5	5	none		

SECTION VIII - PERSONAL PROTECTION INFORMATION

EYE PROTECTION: Industrial safety glasses, minimum. As necessary to comply with 29 CFR 1910.133 and work area conditions: use side shields, goggles or face shield. Chemical goggles; face shield (if splashing is possible).

SKIN PROTECTION: As required, industrial resistant flexible-type gloves (nitrile, neoprene or equal). Wear industrial type work clothing and safety footwear. Depending on working conditions, i.e., contact potential, wear impervious protective garments such as head/neck cover, aprons, jackets, pants, coveralls, boots, etc.

RESPIRATORY PROTECTION: If ventilation does not maintain inhalation exposures below TLV(PEL), Use MSHA/NIOSH approved units as per current 29 CFR1910.134 and manufacturers' "Instructions" and "Warnings". combination filter/organic vapor cartridges or canisters may be used.

VENTILATION: Provide sufficient general/local exhaust ventilation in pattern/volume to control inhalation exposures below current exposure limits and areas below flammable vapor concentrations. Local exhaust is necessary for use in enclosed or confined spaces. See OSHA Requirement/NIOSH Pub. 80-106 "Working in a Confined Space".

SECTION IX - PERSONAL HANDLING INSTRUCTIONS

HANDLING: Avoid prolonged or repeated breathing of vapors, mists or fumes. Avoid prolonged or repeated contact with skin or eyes. Observe good personal hygiene practices and recommended procedures. Handle and use in accordance with OSHA 29CFR1910.106/local codes.

STORAGE: Store in areas/buildings designed to comply with OSHA 1910.106. Keep in a closed, labeled container within a cool (well shaded), dry -ventilated area. Protect from physical damage. Keep containers closed when material is not in use. Maintain good housekeeping.

OTHER: Not for use or storage in or around the home. DO NOT TAKE INTERNALLY. Do not use until manufacturer's precautions have been read/understood. Wash exposed areas promptly and thoroughly after skin contact and before eating, drinking, using tobacco products or rest rooms.

SECTION X - REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY: none

INCOMPATABILITY: none known

HAZARDOUS REACTIONS/DECOMPOSITION PRODUCTS: Carbon dioxide; carbon monoxide; ammonia; nitrous oxide; ammonium chloride

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION: none

SECTION XI - PHYSICAL DATA

BOILING POINT: ND	SPECIFIC GRAVITY: 0.9314 at 25 C
MELTING POINT: NA	% VOLATILE BY VOL: 25%
VAPOR PRESSURE: 1 mm	EVAPORATION RATE(ETHER=1): slower than ether
VAPOR DENSITY(AIR=1): 1	VISCOSITY: ND
SOLUBILITY (WATER): soluble	PH: ND
	VOC: Na

FREEZING POINT: -20 C (-4 F)

APPEARANCE/ODOR: Amber colored liquid with a weak fatty amine odor

SECTION XII - COMMENTS

EPA REGISTRATION NUMBER: 453-297

Individuals with pre-existing disease in or a history of ailments involving the eyes, skin, nervous system, liver, kidney are at a greater than normal risk of developing adverse health effects when working with this material.

No known ingredients which occur at greater than 0.1% are listed as a carcinogen in the IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, the NTP Annual Report on Carcinogens or OSHA 29 CFR 1910.1001-1047 subpart Z Toxic and Hazardous Substances (Specifically Regulated Substances).

SKIN PROTECTION (protective material): Permeation/degradation values of chemical mixtures cannot be predicted from pure components or chemical classes. Thus, these materials are normally best estimates based on available pure component data.

Do not use until manufacturer's precautions have been read/understood. Wash exposed areas promptly and thoroughly after skin contact and before eating, drinking, using tobacco products or rest rooms.

Do not wear contact lens without proper eye protection when using this product.

NOTICE: While the information and recommendations set forth herein are believed to be accurate as of the date hereof, Koppers Company makes no warranty with respect thereto and disclaims all liability from reliance thereon.

[illegible]
Memphis, TN 38109-0158 BUSINESS PHONE: (901) 396-5151

DATA SHEET

Chapman Product Code: 41584

CHAPMAN PRODUCT NAME: MILLBRITE 50 BROWN 583

Date of Issue: 03/22/88
Date of Last Revision: 06/09/86

Mailed To:

MERRILL & RING INC
P O BOX 1058
PORT ANGELES WASH
98362-0000

Attn: Bob Crouse

SECTION 1 – PHYSICAL AND CHEMICAL CHARACTERISTICS

Boiling Point or Range (deg. F): >212
Vapor Pressure (mm Hg): Unknown
Vapor Density (Air=1): >1
Solubility in Water: Disperses
Appearance and Odor: Liquid with faint amine odor. Color as indicated.
Specific Gravity (Water=1): N/A
% Volatile by Volume: 55
Evaporation Rate (n-BuAc=1): <1

DOT Hazardous Material Name: N/A

SECTION 2 – HAZARDOUS INGREDIENTS

COMMON NAME	CHEMICAL NAME	C.A.S. #	%	OSHA PEL	ACGIH TLV
AMP-95	Amino-2 Meth-2 Propanol-1	124-68-5	1-10	N/A	N/A
Nonionic surfactant	Proprietary		1-10	N/A	N/A
Aqueous pigment dispersion	Proprietary		15-25	N/A	N/A
Aqueous pigment dispersion	Proprietary		1-10	N/A	N/A
Solubilizing agent	Alkanolamine		1-10	N/A	N/A

SECTION 3 – FIRE AND EXPLOSION HAZARD DATA

Flash Point (deg. F, Method): N/A
Flammable Limits in Air (LEL/UEL, % by Volume): N/A
Extinguisher Media: foam, carbon dioxide, water spray, dry chemical
Special Fire Fighting Procedures: Wear MSHA/NIOSH-approved, self-contained breathing apparatus and full protective clothing.
Unusual Fire and Explosion Hazards: None known.

SECTION 4 – HEALTH HAZARD DATA (See Section 9 also)

Signs and Symptoms of Exposure:
Inhalation: Negligible hazard at ambient temperatures.
Eyes: Can cause severe irritation, redness, tearing, blurred vision.
Skin: May cause skin irritation or rash on prolonged or repeated contact.
Ingestion: Gastrointestinal irritation, nausea, vomiting and diarrhea.

Medical Conditions Generally Aggravated by Exposure: None known.

Listed as a Carcinogen or Potential Carcinogen by: None

Emergency First Aid:
Inhalation: This product is not usually hazardous by inhalation. However, if any unusual symptoms develop following exposure by inhalation, contact a physician or Poison Control Center immediately.
Eyes: Hold eyelids open and flush with a steady, gentle stream of water for 15 minutes.
Skin: Wash exposed area of skin with plenty of soap and water. Get medical attention if irritation persists.
Ingestion: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger, or, if available, by administering syrup of ipecac. Do not induce vomiting or give anything by mouth to an unconscious person.

Primary Routes of Entry: Inhalation Eyes Skin Ingestion

SECTION 5 – REACTIVITY DATA

Stability: Stable Conditions to Avoid: None
Incompatability: Acids, strong oxidants
Hazardous Decomposition Products: Oxides of carbon and nitrogen
Hazardous Polymerization: Will not occur Conditions to Avoid: None known.

SECTION 6 – SPILL OR LEAK PROCEDURES

Steps to be taken if material is released or spilled:
Small Spill: Wear appropriate protective clothing (see Section 7). Absorb with sand or clay and place in waste receptacle.
Large Spill: Wear appropriate protective clothing (see Section 7) Absorb with sand or clay and place in waste receptacle.

Waste Disposal Methods: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility Do not reuse container. Rinse thoroughly before discarding in trash.

SECTION 7 – PROTECTIVE EQUIPMENT

Respiratory Protection: If TLV for product or any component is exceeded, use MSHA/NIOSH-approved air supplied respirator.
Ventilation: Ventilate via mechanical methods (general or local exhaust) to maintain exposure below TLV(s).
Protective Gloves: Wear rubber gloves if prolonged contact is expected.
Eye Protection: Wear chemical splash goggles and/or face shield during mixing and when exposed to mist.
Other Protective Equipment: Impervious (nitrile rubber) apron, boots, and hat as necessary to prevent exposure.

SECTION 8 – SPECIAL PRECAUTIONS

Precautions for Handling and Storage: Store away from food or feed in a secure, well-ventilated area protected from extreme temperatures. Keep container closed when not in use.

Other Precautions: Do not allow to freeze.

SECTION 9 – NOTES

* Ingredients marked with an asterisk (*) are hazardous as nuisance dusts in dry or granular products. These ingredients may not present a hazard in liquid products.

NOTICT:

OSHA'S Hazard Com
cation Standard, 29
1910.1200, may require y
distribute this informat
your employees and/or
mers. If this product is u
locations other than the m
address shown above, it i
responsibility to prompt
tribute this information
location.
Additional copies of
Material Safety Data She
available on request.

RECEIVED
APR 6 1988
MERRILL & RING, INC.

APPENDIX H

WASTE DESIGNATION OF NP-1 WORKING SOLUTION

Memorandum

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
206.324-9530

To Will Abercrombie
Page 1 of
From Ross Potter
Date 6/24/88
Project M+R
Job Number 2159-03
Subject Designation

conclusions regarding potential for designation (Work shown on attached sheets):

Concentrations in Solution and Toxic Category

.325%	Didecyl dimethyl ammonium chloride	-- "C"; Oral LD50
.1%	Iodopropanyl butyl carbamate	-- NL
.025%	Petroleum Naphtha[1]	-- "D"; Inh LC50
.05%	Ethanol	-- "D"; Inh LC50
.025%	Dimethyl sulfoxide	-- NT
.133%	Amino-2 Meth-2 Propanol-1	-- "D"; Oral LD50
.133%	Alkanolamine	-- NL

NL = Not listed in NIOSH or spill Table. Review for synonyms and by CAS # revealed no viable alternatives.

NT = Not toxic by available data.

[1] Found in NIOSH as "Benzin", but different CAS # from that on MSDS. Benzin synonym is Petroleum Naphtha.

HARTCROWSER

Memorandum

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
206.324-9530

To

From

Project

Subject

Page 2 of

Date 6/24

Job Number 2159-03

None of these were identified as halogenated hydrocarbons or 4,5,6-ring PAHs. None were identified as IARC carcinogens. None are on EPA's 302.4 Spill Table.

Equivalent Concentration Calculation

$$EC\% = [X\%] + \frac{[A\%]}{10} + \frac{[B\%]}{100} + \frac{[C\%]}{1000} + \frac{[D\%]}{10{,}000}$$

$$= 0\% + 0\% + 0\% + \frac{.325\%}{1000} + \frac{[.025\% + .05\% + .133\%]}{10{,}000}$$

$$= .000325\% + .0000208\% = \underline{\underline{0.0003458\%}}$$

Since the EC% cutoff on the graph is .001%, this calculated EC% for the M+R mixture would not be designated for toxicity. Since HH, PAH and IARC don't apply, based on available information, the mixture is not dangerous waste under WAC 173-303-084

M+R
2159-03

$$75\left[H_2O + \frac{1}{200}(NP\text{-}1)\right] + 1\left[MB\right] = \text{Final Solution}$$

$$75(H_2O) + \frac{75}{200}(NP\text{-}1) + 1(MB)$$

$$1 : H_2O + \frac{1}{200} : (NP\text{-}1) + \frac{1}{75} : (MB) = \text{Final Solutio}$$

Thus, for every part of water, $\frac{1}{200}$ is NP-1 and $\frac{1}{75}$ is MB

Thus, in a given volume of water; there will be:

$$\frac{65\%\ \text{Didec} + 20\%\ \text{Iodo} + 5\%\ \text{PetNap} + 10\%\ \text{Eth} + 5\%\ \text{Din}}{200}$$

$$+$$

$$\frac{10\%\ \text{Amino} + 10\%\ \text{Alkan.}}{75} \quad + \approx 99\%\ H_2O$$

Note; doesn't account for molecular weights, etc., so not totally accurate. But good enough to use for toxicity calcutations

M+R
2159-03

②

which works out to :

.325% Didec + .1% Iodo + .025% Pet Nap + .05% Eth
+ .025% Dimeth + .133% Amino + .133% Alka
+ ≈ 99.2% H_2O

J-2159-03

APPENDIX I
EXPLORATION RATIONALE

APPENDIX I
EXPLORATION RATIONALE

Subsurface Soil Explorations

The purpose of the focused subsurface investigations was to establish a rough outline, both horizontally and vertically of the contaminated soil and groundwater in the vicinity of the old planer building site, as well as some indications of the concentrations of contaminants involved. Additional historical information came to light after contaminants were detected during the preliminary investigation in monitoring well MW-6A, which indicated the old planer building was the site of PCP use up until the early 1970s.

We were also asked to evaluate the extent of possible shallow subsurface soil and groundwater contamination in the area of the existing planer building. Surface soil samples collected along the west side of the building during the preliminary assessment (Phase I) activities indicated the presence of significant levels of PCP and TCP.

Due to time constraints imposed by the pending sale of the property, field work would take place over a 5-day period in early June, with a 2-day lead time before work was to commence. We elected to utilize a mobile, on-site testing laboratory to reduce sample transport and analysis time. Analysis of soil samples from completed borings and monitoring wells would provide information for locating additional borings to help define the magnitude and extent of contamination. Farr, Friedmann, and Bruya was selected to provide on-site testing and analysis of soil and groundwater samples. A portable laboratory equipped to provide gas chromatography analysis was mobilized to the site and set up in the vicinity of MW-6A.

Old Planer Building Site

Utilizing rapid turnaround analysis for PCP and TCP provided by a gas chromatograph (GC), we planned to drill and sample auger borings to a maximum depth of 15 feet in the vicinity of MW-6A. Groundwater monitoring wells would next be developed and sampled to obtain water quality data. Chemical test results from borings would be used to determine the appropriateness of well installation, as well as to locate additional borings to better define the contaminant extent. Drilling and sampling would continue until the contaminated area was more or less "bracketed".

The first boring to be drilled on June 8, 1988, B-15, was located north of MW-6A as close to the shoreline as possible. Log stacks in the area and riprap fill behind the timber seawall prevented locating B-15 closer than about 45 feet from the water. We elected to drill, sample, and install a well, MW-15, at this location to determine the likelihood of contamination reaching the harbor.

Boring B-15 and the exploration area in general contains significant amounts of bark and wood debris in the near-surface soils, and areas of buried sawdust, bark, and timber. It was assumed that naturally occurring phenols in the wood and subsequently in the groundwater significantly affected the operation of the GC. The GC-ECD column became unusable and required replacement after as few as three samples. Instrument sensitivities, as shown by QA-QC methods, dropped off significantly. Normally, a GC-ECD column is replaced after days or weeks of operation. Because of this problem, our sample analysis turnaround time would be longer than estimated.

As a result of this situation, field operations were modified. Borings would need to be drilled, completed, and new locations chosen and drilled before chemical data would be available, thus impacting our sampling location selection. An additional driller's helper was enlisted to improve the efficiency of the drill crew. Health and Safety precautions were performed, and included drumming waste soils, water, and "steam cleaning" drilling equipment. The Health and Safety Plan developed for the focused investigations and decontamination procedures is included in Appendix K.

A second lead section of hollow-stem auger was used to gain more flexibility in drilling and installing monitoring wells. This allowed a boring to be advanced and sampled to a specified depth, and left temporarily in the ground. The drill rig was then able to move to another location and drill and sample a second boring while analysis was conducted on samples collected from the first boring. Based on the analysis, the first boring could either be terminated and grouted, completed as a monitoring well, or advanced deeper if necessary, to move through the contaminant plume.

A site was chosen approximately half way between MW-15 and MW-6A, and designated B-16. Drilling and sampling was conducted to a depth of 12.5 feet. Soil samples were submitted to the GC for analysis. During the drilling of B-16, test results indicated detectable levels of PCP and TCP in soils from B-15. The auger was left in the ground at B-16 and the second lead auger section used to begin drilling B-17 to determine the extent of contaminated soils to the west of B-15.

Our drilling and analysis limits were strained when B-17 was extended to a depth of 12.5 feet and samples were submitted to the GC. Analysis of soils from B-16 indicated detectable levels of PCP and TCP. The auger was left in the ground at the B-17 location while soils analysis was performed, and boring B-16 was extended to a depth of 21.5 feet. Samples were collected for analysis. Test results of the bottom sample from B-17 (S-6 at 12.5 feet) indicated detectable levels of PCP. B-17 was then sampled to a depth of 21.5 feet. This utilized all the hollow-stem auger sections available on site. Deeper drilling at B-16 or B-17 would require either additional auger be mobilized to the site, or one boring be completed and the auger used to extend the other boring.

We elected to grout boring B-16 without installing a well and to extend B-17 deeper to determine local soil stratigraphy and to assess soil quality at depth. B-17 was advanced and sampled to a total depth of 31.5 feet where a slightly silty to silty fine sand with fine sandy silt interbeds was encountered. Our preliminary geotechnical investigation of site soils completed for Daishowa, under separate contract, indicated this material may be continuous in the investigation area, representing a significant change in soil permeability. Borings were terminated in this material to minimize the potential for vertical migration of contaminants.

Soil quality data from GC analysis indicated that contaminants extended deeper than the anticipated 15-foot depth in B-15, B-16, and B-17. Additional auger sections were mobilized to the site on June 9 to allow explorations to extend deeper.

Review of the stratigraphy and soils analysis disclosed in B-17 indicated low levels of PCP and TCP contamination in samples collected at or near the 30-foot-depth interval. The slightly silty fine sand unit was encountered at about 27 feet below ground surface. In order to increase drilling efficiency and reduce the amount of drill rig move and setup time, we elected to advance future borings until the slightly silty, fine sand unit was encountered, or to approximately 30 feet, whichever came first. The borings would then be grouted from bottom to ground surface. Monitoring wells would be located later at selected boring sites and placed in un-sampled borings after soil analysis was available. This would allow placement of the screen adjacent to the highest detected levels of PCP.

A location approximately 125 feet west of B-17 was chosen for the next exploration and designated B-18. B-18 was drilled and sampled to a depth of 29 feet, and grouted. Samples were submitted to the GC, and a location approximately 125 feet east of B-15 was selected for the next exploration, designated B-19. Silty, fine sand was encountered at about 20 feet below ground surface and the boring was terminated at 24 feet and grouted.

After drilling, sampling, and installing a monitoring well north of the existing planar building (MW-20), explorations resumed in the vicinity of MW-6A mid-morning on June 11, 1988. Contaminant levels in soils from B-18 and B-19 indicated low levels of PCP; 0.05 to 0.62 mg/kg, and < 0.05 to

0.11 mg/kg (unverified data), respectively. Although PCP was present in both borings at detectable levels, we felt additional soils test data were critical inland in the vicinity of B-16, where the highest PCP concentration to date (34 ppm) was recorded at the 10- to 15-foot-depth interval. Boring B-18 and B-19 sites were selected for monitoring well installations based on these data, providing a total of three wells along the shoreline for groundwater quality monitoring purposes. Project time contraints at this point allowed for the drilling of these two wells plus a possible two additional borings.

The locations of borings B-21 and B-22 were chosen approximately 100 feet east and west of B-16, with the intent of defining contaminant levels in soils inland of the shoreline borings. Silty, fine sand was encountered at about 12 to 15 feet below ground surface in both borings. Due to groundwater levels at 7 to 8 feet below the surface and the silty fine sand unit at 15 feet precluding deeper drilling, monitoring wells were installed in both borings, and designated MW-21 and MW-22.

Monitoring wells were drilled and installed with no soil samples collected adjacent to B-18 and B-19 and designated MW-18 and MW-19. Screen tips were placed at approximately 20 and 17 feet below ground, respectively.

We elected to install a well at the B-16 location in the limited time remaining during the early evening of June 12, 1988. Samples S-5 and s07 from boring B-16 indicated PCP levels of 34 and 6.3 mg/kg, respectively, but sample recoveries from the split-spoon sampler were poor. MW-16A was drilled and installed to 15 feet below the ground surface adjacent to B-16. Soil samples were obtained at the 10-foot- and 15-foot-depth intervals to provide additional material for analysis and soils classification. Chemical analysis by GC of these two samples indicated PCP levels of 36 mg/kg and 3.2 mg/kg, respectively.

Monitoring well construction diagrams are presented in Appendix C, along with a description of boring, sampling, and well construction methods.

Existing Planer Building

Six shallow hand auger explorations as shown on Figure 4, were advanced west of the new planer building on June 11, 1988. Results of chemical analysis for surface soil sample SS-2 collected during the Phase I investigation indicated PCP levels of greater the 250,000 ug/kg along the western edge of the building. This area consisted of asphalt and concrete paving overlain by several inches of soil.

Hand auger explorations were placed in two rows west of the planer building wall to depths between 1 and 2.5 feet below the pavement. Exploration logs are included on Figures C-29 and C-30 in Appendix C.

Groundwater Sampling

Monitoring wells installed and sampled during the preliminary investigations were re-sampled during the focused investigation. Samples were submitted to the on-site GC-ECD for analysis in order to investigate potential PCP-related groundwater contamination at other locations in the M&R site, if present. In addition, wells installed during the focused exploration were developed and sampled. MW-6A was sampled twice during the focused exploration for PCP and TCP. Well development and sampling procedures are described in Appendix C.

Surface Exploration and Soil Sampling

Surface soil sampling was conducted for the focused investigation in the vicinity of the old planer building. Preliminary investigation in the area consisted of two soil borings and monitoring wells, MW-6A and MW-8, installed during the preliminary investigation. Little data were available on the exact location of the old planer building or where any PCP drums may have been stored. M&R provided a front-end loader and operator to move logs, clear access roads, and establish drill pads.

Based on information provided by M&R, several shallow cuts were made with the loader in the vicinity of MW-6A to try and establish the boundaries of the demolished planer building. Cuts were made to the approximate elevation of the concrete slab exposed adjacent to MW-6A, assumed to be parts of the old planer building. Two cuts made east-west between MW-6A and MW-8 and one north-south cut was made east of MW-6A. However, it became clear that it would not be possible to determine the old building edges without clearing the entire area. Some areas adjacent to the old building had been paved with asphalt, some with concrete, and the floor of the building also contained concrete and asphalt. Subsequent years of log-loading and storage operations had cracked much of the concrete slabs in the area making determination of edges difficult. However, a zone of brick rubble approximately 50 feet south of MW-6A was interpreted to be the location of the old boiler stack.

Sampling of surface soils was conducted in the vicinity of MW-6A in the fresh cuts described above, and in the access roads and drill pads cleared for the drilling rig. Contouring of the surface contaminant levels would be used as additional information in determining the approximate PCP source area. Thus, eleven surface samples were collected randomly as described in Appendix C, and submitted for GC-ECD for analysis. The data would also provide information to assess the adequacy of the Health and Safety Plan (Appendix K).

Test results indicated that the highest PCP and TCP levels were west and south of MW-6A in samples SS-1 through SS-4 and ranged from 0.35 mg/kg at SS-2 to 0.9 mg/kg at SS-3. Sample SS-8 in the vicinity of MW-21 showed PCP at 0.06 mg/kg. All other surface samples were below the detection limit for PCP and TCP. Sampled locations are shown on Figure 4.

Off-shore Sediment and Water Sampling

Off-shore sediment and water samples were collected when low levels of contaminants were detected in soils adjacent to the shoreline. Four sediment samples were obtained on June 11, 1988 during low tide, as described in Appendix C. GC-ECD analysis indicated low but detectable levels of PCP in samples OSS-1 and OSS-2 (0.3 and 0.08 mg/kg, respectively). These locations were resampled on June 12, to verify the initial analysis under sample numbers OSS-5 (OSS-1 location) and OSS-6 (OSS-2 location).

Four off-shore water samples were collected on June 11 at the locations shown on Figure 4. Sampling methods are described in Appendix C. PCP and TCP were below the detection limit for all four samples.

One off-shore sediment background sample was obtained, designated OSSBG-1, from off the project site to gain information about PCP and TCP levels in Port Angeles Harbor sediments. The sample was obtained as described in Appendix C, from sediments collected along the shoreline on the south side of Ediz Hook (Figure 15). PCP and TCP were not detected in this sample.

On-shore Sediment Background Sampling

One on-shore sediment background sample, designated BG-1, was collected, as described in Appendix C, from the public marina and boat launch area (Figure 15) located just east of the M&R property. The soil sample was collected to provide information for the dioxin sampling program. A split of this sample was also submitted to the on-site GC for analysis. PCP and TCP levels were below the detection limit of 0.05 mg/kg.

J-2159-03

APPENDIX J

OTHER DUE DILIGENCE

APPENDIX J
OTHER DUE DILIGENCE

On May 9 and 10, 1988, Lynn Bruner and William Abercrombie, both of Hart Crowser, Inc., conducted a site visit of M&R in Port Angeles, Washington.

The purpose of the visit was to gain insight into the facilities waste handling practices. A visual reconnaissance of the site and its buildings was performed to identify signs of potential soil and groundwater contamination problems resulting from current or past practices. The presence of drums, above-ground tanks, spills, vegetation distress, or stained soils was noted. Field notes and photographs (Appendix B) were taken to document observations.

Information was gathered from personal interviews with Jim Hendrickson, Jim Critchfield, and others at M&R.

Due to the size of the facility, the site reconnaissance findings and conclusions are divided into seventeen unique areas. Each area will be discussed individually, noting any regulatory conformance problems with respect to hazardous waste, water quality, or other concerns. The seventeen areas include:

- Drum/Machinery Boneyard;
- Sawmill;
- Machine Shop;
- Old Planer Building;
- Length Sorter;
- Log Scale Yard;
- Dry Kiln;
- Boiler Room;
- Old Alder Mill/Old Truck Maintenance Shop;

- New Planer and Wood Treatment Area;
- Paint Spray Booth;
- Finished Lumber Shed;
- Alder Chip Yard;
- New Truck Maintenance Shop;
- Chip Pile/Ship Loading;
- Historical Bulk Petroleum Storage Area; and
- Old Fiber Board Mill.

Boneyard

The boneyard area is covered with heavy vegetation and small trees (Appendix B). Rusted machinery, scrap metal, wood debris, and miscellaneous 55-gallon drums were observed at the site. Corroded, rusted, and dented drums were scattered around the area. Several drums labeled Permatox 180 were found and contained unknown liquid material. Drums marked with oil and kerosene labels were located on the site, some contained unknown material. It is likely that some of the container with unknown content have filled with rainwater. However, other drums contained materials that were obviously not rainwater alone based on the color of the materials.

Sawmill

The sawmill is located at the northwestern end of the property (Figure 3). A product storage area and a transformer vault are located west of the sawmill. A cherry picker used to lift logs onto the sawmill conveyor, miscellaneous 55-gallon product drums, and a transformer are located south of the sawmill.

Jim Hendrickson explained that the sawmill is predominantly operated by electrical and compressed air power, keeping hydraulic usage to a minimum. If a hydraulic line were to break, the runoff probably discharges to the harbor via one of the NPDES permitted discharges.

The lower level floor of the sawmill was wet from the cooling water for the saws. Several 55-gallon drums of what appeared to be lubricating oil were located in the area. The ponded water on the concrete floor did not show evidence of oil spillage.

A product storage area containing miscellaneous 55-gallon drums is located at the western end of the sawmill near a paved driveway. Drums labeled Frosto anti-freeze, which contained methanol and miscellaneous lubricating oils, and mineral spirits were stored on the bare soil, pallets, asphalt, or on a concrete pad. A drum of the anti-freeze was lying on the soil, but it did not appear to have leaked. Across the driveway were 55-gallon drums labeled lubricating oils lying prone on a wooden tip rack. Jim Hendrickson explained that for easier handling purposes, employees would pour smaller containers of product from the drums.

South of the sawmill, near the cherry picker, were five 55-gallon drums, wood debris, and oily rags scattered around the area. The drums appeared to contain lubricating oils and the surrounding soil was stained with an oil-like material.

Machine Shop

The machine shop is located just north of the sawmill. The shop appeared to be relatively inactive which was supported by Jim Hendrickson who stated that they do some welding in the shop but that most machinery work including electric motor repair is done off-site. The shop contained small amounts of paint, aerosol lubricating oils, a drill press, welding equipment, HandiKleen parts washer, several drums of unknown liquid material, and a parts room.

Jim Hendrickson did not know if the HandiKleen parts washer was still utilized or how the waste was disposed. However, the parts washer did not appear to have been used for some time due to evidence of dust, sawdust, and other debris in the parts cleaning tray.

When asked about the paints, Jim Hendrickson stated that they were used mainly to mark machinery and that "some of the paints had probably been there for ten years". He also stated that any major paint projects were contracted out.

A 55-gallon drum, with unknown contents, labeled Permatox 180 was observed in the machine shop. Jim Hendrickson stated that he doubted that the drum contained Permatox because they have not used it for at least 3 years. A 20-gallon drum labeled SPR-50 liquid steam cleaner was found in the machine shop. The label stated the material is non-flammable, biodegradable, and contained liquid potassium hydroxide.

Old Planer Building

The area is presently used as a log sort yard and access to the site was very limited due to heavy machinery activity during the site tour. No standing structures were observed, but a concrete slab was located during drilling activities at boring B-6 which was later completed as a well, MW-6A.

Length Sorter

The length sorter, located south of the sawmill, is no longer in use. It was used in the past to automatically sort lumber by length. A structure with various equipment remains at the site. Jim Hendrickson explained that an electric compressor had been located inside the building. We did not observe evidence of potential environmental concern while touring the length sorter.

Log Scale Yard

An underground storage tank is located at the log scale house (Figure 3). Further information concerning the UST is located in section 2.4.2.

The Washington State Department of Ecology (Ecology) was contacted to determine if M&R had notified for the two underground storage tanks known to be located on site. According to Jean Witt of Ecology, M&R submitted notification in April 1986 for two underground storage tanks. Both tanks are reported on the notification form to be between 1,000 and 5,000 gallons in size. One tank is listed as being 20 to 30 years old and contained leaded gasoline, as reported in 1986. The other tank is listed as being 3 to 5 years old and contained diesel at the time of notification. Both tanks are single wall, carbon steel with galvanized steel piping. The tanks and piping lack cathodic protection and are unlined. Daily inventory is taken as a means of detecting leakage.

We understand that the tank near the scale house if a 5,000-gallon diesel tank.

Dry Kiln

A trap water catch basin is located on the south side of the kiln. Two sections of corrugated piping are situated over a grated basin. Various debris was scattered around the basin. When asked where the catch basin flows to, Jim Hendrickson stated it probably flows to the sewer. We assume that this means the trap water flows to the harbor via one of the four NPDES permitted discharges.

An underground storage tank is located south of the kiln. This tank reportedly contains unleaded gasoline and holds 1,000 gallons.

Boiler Room

The boiler room is north of the dry kiln. According to information from M&R employees, water softeners and descalers were mixed in the boiler to be used for the kiln process. The pH of the raw chemical additives range from 9.6 to 12.4 as verified in their chemical data sheets.

The boiler is hog fuel fed with shavings from the planer according to M&R employees. The boiler plant operator could not recall having used NP-1, PCP treated shavings, treatment system sludges or residue in the boiler.

The boiler operator stated that boiler blowdown is discharged to the harbor through one of the NPDES permitted discharges. Boiler soot was being temporarily collected in two bunkers located northeast of the boiler room. The employees thought the soot was disposed of at the local dump or at M&R's landfill. The soot bunker is three-sided, concrete walled, with open tops on a concrete pad. We observed miscellaneous paper debris thrown in the bunker, along with the soot. We did not sample the soot.

Old Alder Mill/Old Truck Maintenance Shop

The area is the previous location of Nelson Hardware and M&R's truck maintenance shop (Figure 3). The site is situated northwest of the boiler building. It was noted during the site tour that the area was scattered with wood debris, broken concrete, sawdust piles, and assumed waste oil drums. A transformer was also located in the vicinity of the drums.

The western portion of the area contained approximately twenty drums of what appeared to be waste oils. Some of the drums were labeled hydraulic or lubricating oils. The drums were individually stacked on soil. In a later conversation with Dick Stroble, we were informed that up to a year ago, M&R had used this area as a truck maintenance shop, which included a pressure wash area (see **SURFACE STAIN** section).

Across the road to the south were four spent batteries lying in a sawdust pile. Some of the battery caps were off, but no visible signs of leakage were noted.

New Planer and Wood Treatment Area

The new planer building is located east of the boiler/dry kiln (Figure 3). At the west end of the building is the NP-1/Millbrite 50 treatment area.

The treatment system consists of an enclosed spray booth which receives individual pieces of lumber immediately after each board leaves the planer. Overspray is collected in a holding tank and is recirculated through the treatment process.

A brown puddle was observed on the concrete floor under the treatment area. We observed the puddle of what appeared to be NP-1 and Millbrite 50 being pumped from the concrete floor and recycled back into the product holding tank. Two above-ground tanks were observed under the spray room area. As stated by the employees, approximately five gallons of sludge from the treatment area are generated per month. The sludges are then sent to the boiler to be burned as hog fuel.

Areas of potential concern noted during the tour of the new planer building are:

- Three 55-gallon drums of NP-1 raw product were placed outdoors on a sloped concrete pad without containment, in the event of a leak. The three drums were marked with corrosive labels. One drum appeared empty and the other two appeared to contain product. The NP-1 label states the contents of the drums as 65 percent didecyldimethyl ammonium chloride, 8 percent 3-iodo, 2-propynyl butyl carbamate, and 28 percent inert ingredients.

- Empty Millbrite containers were stacked outdoors by the NP-1 storage area, subject to rainfall and without containment for runoff.

- Two above-ground tanks reportedly containing diesel fuel were observed adjacent to the west end of the planer building. The tank volumes are estimated to be 8,000 gallons and 1,000 gallons (Figure 3). The surrounding soil and vegetation showed evidence of minor staining with an oil-like material.

The finished lumber grading area is located at the east end of the new planer. The NP-1 and/or Millbrite treated wood being graded in this area appeared to be dry. No visible signs of treatment residue were observed.

Paint Spray Booth

The paint spray booth is a three-sided building surrounded by asphalt. The ends of the planed lumber are painted on a metal grate suspended over an asphalt floor that appeared to be continuous under the spray booth area. The M&R logo is then painted on the strapped bundle of lumber.

The area was heavily coated with the paint overspray during the site tour. Several 55-gallon drums of paint were stored on a pad in the area. According to an M&R employee at the paint booth, the dried paint residue is occasionally shoveled out and disposed of in a dumpster.

Finished Lumber Shed

After painting and strapping, the finished product is stacked in an open-sided building underlain by asphalt while awaiting shipment to the customer. The area appeared to be free of debris and no visible stains were observed on the surrounding asphalt.

Alder Chip Yard

Jim Hendrickson explained this area was the location of the former Fiber Board Mill. Presently, the site is covered with asphalt, chip piles, and an alder chipping operation. Concrete foundations reported to be remnants of the pulp mill that was located on site are visible to the north of the alder chipper. The area adjacent to and under the alder chipper appeared to be covered with asphalt.

See Old Fiber Board Mill section on Page J-11.

New Truck Maintenance Shop

According to M&R personnel the truck maintenance building has been used for storage until about a year ago when M&R started using it for performing maintenance on trucks and equipment.

To the west of the building is a dirt and concrete parking lot and a boneyard containing various machinery, scrap metal, 5-gallon pails, wood debris, 55-gallon drums, batteries, tires, and dry wall debris. Several drums contained an unknown material, some of which appeared to have leaked onto the soil. Several drums contained what appeared to be waste paint material.

The truck maintenance shop contained three above-ground oil product tanks with approximately 500-gallon capacities each. 55-gallon drums labeled lube oils and various containers of oils and lubricants were observed in the shop. A 5-gallon bucket labeled Novasol 300 solvent degreaser was noted along with an AstroPneumatic parts washer. Jim Hendrickson did not know how the degreasers were used or the disposal practices for spent solvent or accumulated sludges from the parts washer.

Fifteen waste oil drums, two above-ground tanks, tires, and metal debris were observed in an area north of the truck shop. One tank, estimated 5,000-gallon capacity, was dented, stained with an oil-like material, and appeared empty. Jim Hendrickson stated the tank was no longer used to store waste oil, but instead M&R used the 55-gallon drums for recycling the waste oil. The second tank (approximately 500 gallons) would eventually be used for waste oil instead of the drums.

We walked the waterfront portion of the property to in an attempt to observe discharge areas from M&R and to identify potential areas of environmental concern, if present.

A corrugated pipe was observed coming out of a wooden bulkhead northwest of the sawmill, but no flow was observed. North of the log sort yard and dry kiln an apparent discharge line into the harbor was observed based on the amount of steam rising off the water where it entered the bay. Due to the heavy machinery traffic, we were unable to gain access to the area. This discharge is thought to contain boiler blowdown and trap water based on its proximity to the dry kiln and boiler house.

A strip of property reportedly leased by Port Angeles Shake from the Port of Port Angeles is located west of the new planer building. The property was beyond our scope of work, but we observed the adjacent property for signs of visual contamination. There was an area on the property that contained a large amount of drums, which could present a potential source of concern.

SAMPLE EVALUATION

Historic Bulk Petroleum Area

Based on our historical review and conversations with M&R employees it appears that the old above-ground fuel storage tanks, estimated at 1,000,000 and 270,000-gallon capacity, were located north of the new planer building. Employees stated that the associated underground piping may still exist and possibly may contain small amounts of product. The rationale behind this statement is not known. A tour of the area where the tanks are thought to have been located revealed nothing unusual. No visible tank structures exist and the area is now used for log storage.

After identification of an area that had been the location of several above-ground bulk petroleum storage tanks, during our historic research of the site, MW-4A was installed to investigate potential concerns. Our Phase II work involved installation of an additional groundwater monitoring well, MW-11, located as indicated on Figure 4. This well is in a presumed downgradient position of identified surface stain sources of contamination.

Five soil samples from each well boring, obtained during drilling of these wells, were composited into a single sample for each location and analyzed for benzene, toluene, ehtylbenzene, and xylenes (BTEX) and other selected volatile organic compounds using GC/FID technique. Groundwater samples from the two monitoring wells were analyzed for BTEX, solvent extractable compounds and total organic halogens (as chlorine).

A GC/FID screen of the composite soil samples detected 10,000 ug/kg in MW-11. No volatile organic compounds were detected in groundwater samples from MW-11.

The concentration of solvent extractable organic compounds detected in the composite soil sample is typical of industrial property around Puget Sound and would be considered relatively low for an historic area of petroleum storage.

Old Fiber Board Mill

After identification of an area that had been the location of an old Fiber Board Mill, during our historic research of the site, MW-14 was installed to investigate potential concerns, as indicated on Figure 4. Our concerns centered around compounds associated with the pulping process (sulfites, bleaches, and acids). Our analysis was a screen that took into account historic and current concerns.

Five soil samples from this well boring, obtained during drilling was composited into a single sample and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and other selected volatile organic compounds using GC/FID technique. A groundwater sample from the monitoring well was analyzed for BTEX, solvent extractable compounds and total organic halogens (as chlorine).

The only volatile compound detected in soil samples was methylene chloride. MW-14 detected 5 ug/kg. Methylene chloride is a common laboratory solvent. Contamination from laboratory procedures is possible but two method blanks run at the same time as the soils did not detect any contamination from this source. A GC/FID screen of the composited soil samples detected 46,000 ug/kg in MW-14. Water soluble sulfite was detected at 30 mg/kg in soil from MW-14.

No volatile organic compounds were detected in groundwater sampled from MW-14. Solvent extractable compounds were measured at 240 ug/L in MW-14. Total organic halogens, measured as chlorine, were detected in groundwater from MW-14 at .03 mg/L. Sulfites were not detected in water from MW-14.

At this time, we have no basis on which to interpret the concentration of water soluble sulfite present in the composite soil sample tested. Likewise, the concentration of total organic halogens present in the groundwater at MW-14 could be more or less important depending on the specific compound or compounds present. The concentrations of solvent extractable organic compounds detected are typical of industrial property around Puget Sound.

RECOMMENDATIONS

The following represents recommendations based on the due diligence reconnaissance:

- If operations are to continue, all product drums on-site should be individually stacked on wooden pallets and stored under cover on an impermeable base so that the integrity of the container is not damaged from corrosion and rust. Spigot pumps should be placed on in-service product drums for easier transfer of product to smaller containers. These small containers should have a closed lid during product transportation to eliminate any further spillage. These housekeeping measures are recommended to reduce the potential for product spills to the environment.

- The old drums found at various locations throughout the property, and in particular those in the drum/machinery boneyard should be individually stacked on pallets, covered with plastic tarps, and weighed with drum lids for protection from the elements. Corroded and leaking drums should be placed in drum overpacks and stacked on pallets. The contents of the drums should be identified through a sampling and analysis program and/or in consultation with M&R employees that may have knowledge of drum contents. The drums, including empty drums, should be properly disposed of based on their contents.

- Material Safety Data Sheets (MSDS) should be obtained for all of the products used by M&R. Copies were not available for review during our site visit, therefore it was unknown if the products could be hazardous or incompatible based upon available information.

- The drums of known waste oils should be disposed of through a waste recycler. If the contents of the drums are unknown, a sampling and analysis program should be implemented to verify their contents. Visually stained soils should be properly disposed of according to Clallam County Health Department requirements.

- Burning of suspected hazardous substances, such as NP-1 or solvent sludges, should be discontinued until the regulatory implications have been fully evaluated.

- Degreasing part cleaners were located in the machine shop and the truck shop. If the use of these parts cleaners will continue any waste sludges or solvents should be evaluated against the state and federal hazardous waste regulations. The parts cleaners may contain regulated solvents requiring proper designation and disposal. At a minimum, M&R may be considered a small quantity hazardous waste generator and could be regulated under State regulations.

FOLLOW-UP ACTIONS

According to M&R all drums, batteries, and waste oils have been removed from the site. M&R does not plan to continue operations at the facility.

J-2159-03

APPENDIX K
HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN

FOR

MERRILL AND RING SITE
PORT ANGELES, WASHINGTON

SITE INVESTIGATION

J-2159-03
June 1988

Emergency Notification Information

	On-site	Off-site
AMBULANCE	9-911	911
FIRE		
Port Angeles Fire Department	9-911	911
HOSPITAL		
Olympic Memorial Hospital Washington & Caroline St., Port Angeles		457-8513
FOR ALL EMERGENCIES, NOTIFY:		
Hart Crowser Corporate Health and Safety Manager David Chawes		1-324-9530
Hart Crowser Project Manager Will Abercrombie		1-324-9530
Field Health and Safety Manager Howard Small		1-324-9530

HEALTH AND SAFETY PLAN

CONSENT FORM

FOR

MERRILL AND RING
SITE INVESTIGATION

I have read the Health and Safety Plan pertaining to work to be performed by Hart Crowser, Inc. at the Merrill and Ring Site. I understand the contents of this Health and Safety Plan and agree to abide by its provisions. Any questions I had regarding the plan have been satisfactorily answered.

Name (print)	Signature	Date

CONTENTS

1.0 INTRODUCTION

This Health and Safety Plan (H&SP) provides guidance to Hart Crowser, Inc. personnel conducting work at the Merrill and Ring Site in Port Angeles, Washington. This plan discusses potential chemical and physical hazards anticipated on site and details control measures to assure individual safety. All Hart Crowser staff expected to work on this site will read this H&SP and will sign the consent form prior to site entry.

2.0 SITE DESCRIPTION

2.1 Proposed Work Activities

The purpose of this study is to assess site contaminant concentration and distribution. Planned site activities include drilling borings for soil samples and completion of groundwater monitoring wells. Work will be conducted in June 1988.

Soil Sampling and Analysis: We will drill test borings with a hollow-stem auger drilling rig.

Well Installation: Hart Crowser will install monitoring wells on site.

Groundwater Sampling and Analyses: Upon well completion and development, we will collect groundwater samples for chemical analysis.

2.2 Site Characterization

Current Status of Wastes

Soil: Prior investigations conducted at the site have indicated elevated soil concentrations of pentachlorophenol and tetrachlorophenol. Maximum soil concentrations of pentachlorophenol in the first 15 feet of soil are on the order of 270 ppm.

Groundwater: Groundwater samples indicate that pentachlorophenol concentrations range from 6 to 8 ppm.

Legal Status

This is a voluntary investigation.

3.0 HAZARD EVALUATION

3.1 Toxicity of Contaminants of Concern

Pentachlorophenol (PCP or "Penta")

In very high concentrations, pentachlorophenol can induce short-term toxic effects on humans, such as irritation of the eyes and upper respiratory tract, as well as an acne-like skin rash called chloracne. Other symptoms of exposure include weakness, loss of appetite, nausea, vomiting, shortness of breath, chest pain, excessive sweating, headache and dizziness. PCP is suspected to be teratogenic, meaning it is toxic to developing fetuses.

Animal studies of this effect have demonstrated lower birth weights, birth defects, and decreased survival for newborn animals. Current evidence does not indicate that PCP is carcinogenic. However, some forms of PCP contain highly toxic dibenzo-p-dioxins and dibenzo-p-furans, which are suspect human carcinogens. Pregnant women, children, and individuals with liver or kidney disease should make the greatest efforts to minimize exposure to pentachlorophenol.

Tetrachlorophenol

Little information is available on this compound, except that it may cause birth defects in rats whose mothers were exposed to the substance.

Evaluation of Exposure Routes

Inhalation: Airborne dust containing pentachlorophenol may be created during drilling and sampling activities. Pentachlorophenol itself is not a very volatile substance, and therefore the principal route of entry would be inhalation of dust.

Skin Contact: If airborne dust is generated, it may settle on nearby workers. Also, handling of the excavated soils which contain high concentrations of pentachlorophenol could lead to direct skin absorbtion of the material. Protective clothing and washing will prevent skin contact with the material.

Ingestion: This route is unlikely, as no eating or other hand-to-mouth contact will be permitted in the exclusion zones. Also, decontamination procedures established in this plan will ensure that virtually no contaminants are ingested inadvertently.

Evaluation of Hazard Potential

In a worst case situation, if dust from locations where pentachlorophenol concentrations equal 270 mg/kg became airborne, an atmospheric concentration of 1,851 mg/m^3 airborne dust would be necessary to achieve the TLV for pentachlorophenol (0.5 mg/m^3). Even under extremely dusty conditions, airborne dust levels rarely exceed 30 mg/m^3, so therefore there is little likelihood of exceeding the TLV solely by inhalation of contaminated dust. There is a contribution to exposure, however, from the skin absorption route of entry, so inhalation of dusts should be maintained as low as possible.

3.2 Physical Hazard Evaluation

The plant presents a number of routine hazards, including vehicular traffic, powered industrial trucks, overhead and underground utilities, noise, tripping and puncture hazards from scrap materials. In order to minimize these hazards, site workers must obey all plant safety rules, keep a high degree of vigilance while moving about the site, and only drill or dig in previously designated locations.

Heat Stress

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

4.0 PROTECTION MEASURES

4.1 Site Work Zones

Exclusion Zones

Only persons authorized by the Field Health and Safety Manager will enter each zone while work is being conducted there. We will use barrier tape, and warning signs as necessary to establish the zone boundaries. Dust suppression measures may be necessary in the Exclusion Zone.

Contamination Reduction Zone (CRZ)

We will establish a contamination reduction zone just outside each exclusion zone in order minimize the spread of contamination. In the CRZ, we will decontaminate equipment and personnel. Care will be taken to prevent the spread of contamination from this area.

Support Zone

Outside of the contamination reduction areas, the support zone will be used to stage clean equipment, don protective clothing, take rest breaks, etc.

4.2 Protection Levels for Specific Activities

Level C Activities: General site drilling and soil sampling, where inhalation of dust, or skin contact with contaminated material is possible: Wear air-purifying respirators, full-face, equipped with GMC-H combination cartridges (High Efficiency Particulate Air (HEPA) filters/ organic vapor). Polyethylene-coated tyvek coveralls, safety glasses, hardhat, disposable latex or PVC inner gloves, nitrile outer gloves, and chemically-resistant safety boots.

Level D Activities: Well Development, Purging, or Sampling: Wear polyethylene-coated tyvek coveralls, safety glasses, hardhat, disposable latex or PVC inner gloves, nitrile outer gloves, and chemically-resistant safety boots, with the addition of faceshields or goggles during activities involving high potential for liquid splashes to the eyes or face.

Exclusion zone activities with little possibility of inhalation of dust or skin contact with contaminated material: Wear tyvek coveralls, safety glasses, hardhat, disposable latex or PVC inner gloves, nitrile outer gloves, and chemically-resistant safety boots.

The Site Health and Safety Manager may make additional decisions about the appropriate level of protection. He/she will communicate this information to workers in the Daily Safety Briefing or whenever necessary during the work day.

4.3 Work Limitations

Minimization of Contamination

Minimize personnel and equipment used in the contaminated area. Send only the required amounts of soil or water to laboratories for analysis. Do not kneel on contaminated ground, stir up unnecessary dust, or perform any practice that increases the probability of hand-to-mouth transfer of contaminated materials (eating, drinking, chewing gum, smoking or chewing tobacco). Use water sprayers to reduce dust generation. Use plastic drop cloths and equipment covers to protect non-disposable equipment.

Safety Equipment

Sampling teams must have a portable first aid kit, eyewash, and fire extinguisher nearby at all times.

Overhead Power Lines

A minimum distance of 20 feet will be maintained between overhead electric power lines and equipment such as drill rigs.

Smoking

Hart Crowser employees will not smoke on site, as a precaution against hazardous material ingestion and fire.

4.4 Documentation

To assure H&SP implementation, Hart Crowser staff expected to work on this site will sign the Health and Safety Plan Consent Form, which will be kept on site during work activities. They will also sign a Field Health and Safety Report daily to indicate participation in a Daily Safety Briefing. The entire Field Health and Safety Report will be completed daily by the Field Health and Safety Manager. This individual will route this form to the Project Files.

5.0 DECONTAMINATION

5.1 Equipment Decontamination

All non-disposable equipment will be decontaminated upon leaving the exclusion zones. Prior to demobilization, all heavy equipment should be thoroughly decontaminated before leaving the contamination reduction zone. This should occur in a location suitable for capturing runoff. Soil and water sampling instruments should be cleaned in portable buckets.

5.2 Personnel Decontamination

All personnel with known or suspected contamination will perform a mini-decontamination between sampling locations, and to change respirator cartridges (if worn). They will decontaminate fully before going to eating lunch or leaving the site.

Mini-decon consists of the following steps:

a. TSP wash and clean water rinse of boots and outer gloves.

b. Inspection of protective outer suit, if worn, for severe contamination, rips or tears.

c. If suit appears contaminated or damaged, full decontamination as outlined below will be performed.

d. Remove outer gloves. Discard if damaged or heavily contaminated.

e. Remove respirator (if worn) and deposit cartridges in labeled drum. Refresh inside of respirator with pre-moistened towelettes.

f. Replace respirator cartridges and outer gloves, and return to the exclusion zone.

Full decontamination consists of the following steps:

a. TSP wash and clean water rinse of boots and outer gloves.

b. Remove outer gloves and protective suit and deposit in labeled drum.
c. Remove respirator cartridges and discard in drum.

d. Remove respirator, clean off in specially designated respirator wash/rinse bucket.

e. Remove inner gloves and discard into drum.

f. Remove safety boots and put on street shoes.

g. Wash hands and face.

h. Shower as soon after work shift as possible.

5.3 Disposal of Contaminated Materials

Pump all decon solutions and rinse water into labeled drums, which will be stored in a designated site location pending testing and disposition per state Dangerous Waste rules. Drums filled with used protective clothing will be labeled and closed. Store drums under securely fastened plastic sheeting.

6.0 EMERGENCY PROCEDURES

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

6.1 Emergency Telephone Numbers

Emergency phone numbers are on page H&S - i.

6.2 Immediate Response

In the event of a site emergency, cease all work at the site immediately. Offer whatever assistance is required. Those not needed for immediate assistance will decontaminate per normal procedures and leave the immediate area, pending re-start of work.

6.3 Emergency Decontamination

In the event that a seriously injured person is also contaminated, the other site workers will wrap the injured individual in impervious materials (e.g., plastic sheeting) to prevent contamination of the vehicle transporting to the hospital. Less severely injured individuals will have their protective clothing decontaminated and carefully cut off before transport to the hospital.

6.4 Route to Nearest Hospital

Olympic Memorial Hospital, Washington and Caroline St., Port Angeles, 457-8513.

6.5 Follow-up and Evaluation

The Field Health and Safety Manager will notify the Hart Crowser Project Manager and the Corporate Health and Safety Manager as soon as possible after an emergency situation has been stabilized. The Project Manager will notify the appropriate agencies and client contacts. If an individual is injured, the Field Health and Safety Manager will file an Accident Report with the Corporate Health and Safety Manager within 24 hours.

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October 25, 2002

Washington State Department of Transportation
c/o Mr. Tony Allen, P.E.
Material Laboratory
P.O. Box 47365
Olympia, Washington 98504

Re: Environmental Investigation Results
Port of Port Angeles Graving Yard
Agreement No. Y-7672, Task 4
7794

Dear Mr. Allen:

This letter report presents the preliminary results of our environmental investigation at the subject property located in Port Angeles, Washington (Figure 1). The project work scope was completed in general accordance with our proposal (03-5-1100-033), dated August 28, 2002, and your scope of work and assumptions presented in a request for proposal dated August 22, 2002. Soil boring locations are shown on Figure 2. Field methods and boring logs are presented in Appendix A, and laboratory reports are included in Appendix B.

The purpose of the investigation was to evaluate the potential impacts from the past use of the subject property as a wood processing facility. The boring locations were selected by Washington State Department of Transportation (WSDOT). The five borings were converted to permanent groundwater monitoring wells.

PROJECT BACKGROUND

The subject property is located near the north shoreline of Port of Port Angeles property in Port Angeles, Washington. The subject property is a portion of a former wood processing facility. Previous investigations conducted on the entire former wood processing facility property indicated soils and groundwater at the site had been impacted by pentachlorophenol and tetrachlorophenol. Petroleum hydrocarbons and other metals in the soil and/or groundwater are also other potential concerns.

1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

WSDOT is considering this site as a possible graving yard for the construction of concrete pontoons used for the SR 520 bridge on Lake Washington. Therefore, WSDOT has requested the environmental investigation to evaluate the subject property and the potential impacts that might affect the construction of the graving yard.

SUBSURFACE CONDITIONS

We based this environmental assessment of site soils from five borings (HC-NE-PA, HC-SE-PA, HC-C-PA, HC-NW-PA, and HC-SW-PA) advanced by Hart Crowser. The borings were drilled to a maximum depth of 51.5 feet below the ground surface. Five groundwater monitoring wells were also installed to a depth of 25 feet at these same locations. Soil samples were collected for screening and selected analysis from each of these borings. One groundwater sample was collected from each of the wells and submitted for chemical analysis.

Geologic Conditions

Based on our understanding of the site from current and previous explorations, the site is situated on filled ground. A 150- to 200-foot-high bluff, located just south of the property, forms the boundary of the uplands to the south. The site area was part of the intertidal zone prior to being filled. In general, the site stratigraphy from the current ground surface downward includes recent fills consisting of probable dredged silts, sands, and gravel as well as localized area of wood chips overlying natural beach deposits consisting of interbedded silts, sands, and gravel overlying glacially overridden and consolidated sediments. Our current explorations, as shown on the boring logs in Appendix A, apparently were not deep enough to reach these consolidated sediments. Materials encountered in our explorations were near-surface fill material including wood debris over intertidal and beach deposits of sand and gravel with interbed of cleaner sand as well as silt layers. These intertidal and beach deposits generally contain shell fragments but are difficult to distinguish from the overlying dredged fill, which may also contain shell fragments.

The bluff and the soils underlying the original beach deposits consist of an interlayered and very dense sequence of glacially derived sediments ranging from relatively permeable sands and gravels to silts of very low permeability.

Much of the fill was placed over the original beach deposits prior to the 1920s. Much of the fill is reported to be dredge material, and at the site, consists of sandy gravel and gravelly sand. Based upon the explorations at the site, the upper portions of the fill (generally above

5 feet in depth) consist of a loose to medium dense mixture of sand with silt and gravel, and containing varying amounts of bark and wood debris, coarse gravel, and angular riprap used as ballast on the dirt log haul roads.

Hydrogeologic Conditions

Regional maps indicate that the fresh groundwater system is largely contained within confined and semi-confined aquifers distributed within the glacial sediments forming the bluffs and underlying the fill and beach deposits beneath the site. Regionally, flow of the upland groundwater system is north toward the harbor.

The groundwater flow system at the site has two major components, fresh water flowing from within the glacial sediments, and tidal waters from the harbor. Within the shallow flow system, these waters mix beneath the property.

The shallow groundwater system was encountered in borings on the site at depths of from between 5 and 9 feet. The direction of flow within the shallow system is likely to be relatively complex, with flow reversals, depending upon the tidal conditions and other factors such as existing drain lines or other buried features that can act as conduits.

FIELD ACTIVITIES

From September 9 to 12, 2002, five hollow-stem auger borings (HC-NE-PA, HC-SE-PA, HC-C-PA, HC-NW-PA, and HC-SW-PA) were advanced on the subject property. Soil samples were collected and screened primarily at 5.0-foot-depth intervals to a depth of 51.5 feet. Approximately two soil samples from each boring were selected for chemical analysis except for HC-SE-PA. Five soil samples were selected from this boring for chemical analysis based on visual observations and screening.

Approximate boring locations are shown on Figure 2. Groundwater was generally encountered at approximately 9.0 feet at the time of drilling.

Field Screening

Soil samples were field screened using a portable photo-ionization detector (PID). Only soil samples from HC-SE-PA exhibited detectable organic vapors as indicated by the PID readings as displayed on the boring logs in Appendix A. These readings were detected in several soil samples between 2.5 and 10 feet below grade with vapors declining below 10 feet. The field observations indicated a petroleum odor in three of these samples and wood pieces were noted at the 7.5- to 10-foot sample. No other petroleum or volatile odors were noted in the other borings. Other odors noted during drilling and sampling were hydrogen sulfide and "burnt" odors.

Laboratory Analysis

Based on field observations and sampling depths, thirteen soil samples and five groundwater sample were selected for chemical analysis. Select samples were submitted to the Environmental Services Network (ESN) Northwest laboratory (Redmond, Washington), for the following tests as appropriate:

- Diesel- and oil-range hydrocarbons by Ecology Method NWTPH-D extended;
- RCRA (As, Cd, Cr, Ag, Pb, Hg, Ba, Se); and
- Semivolatile Organic Compounds by EPA Method 8270.

Analytical Results

The chemical results for the samples analyzed did not indicate any significant contamination in the soil on the subject property (Table 1). A concentration of 37 mg/kg of petroleum hydrocarbons in the diesel-range, was detected in the soil sample (S-2) from HC-SE-PA at a depth of 5 to 7.5 feet. The S-1 sample (0 to 1.0 foot), above S-2, and the S-3 sample (7.5 to 9.0 feet), below S-2, had no detectable concentrations of petroleum hydrocarbons or semivolatiles organic compounds. Therefore, the sample with detected concentration of petroleum hydrocarbons appears to represent a limited depth range of petroleum-impacted soils. The groundwater sample collected at this location as well as the other four locations did not have any detectable concentrations of petroleum hydrocarbons.

In addition, the other soil and groundwater samples had non-detectable concentrations for petroleum hydrocarbons (NWTPH-D extended) and semivolatile organic compounds (8270) and most of the metals. Low concentrations of chromium were detected in the soil samples collected and analyzed. The soil samples contained non-detectable concentrations of lead except for HC-SE-PA (S-1). This soil sample had a concentration of 55 mg/kg. The detected concentrations of the metals were below the MTCA Method A unrestricted cleanup levels.

Conclusions

Based on the chemical results, there does not appear to be widespread soil or groundwater contamination on the subject property. However, based on our field observations during drilling, knowledge of the past use of the property, and noted fill material in the upper soils, there is still a possibility of hot spot contamination on the subject property.

Recommendations

A construction contingency plan should be developed and used during future excavations at the property. The contingency plan would layout common-sense criteria for recognizing USTs, suspect soils, or wood debris based on appearance, odor, etc., and would identify chain of command links for notification during construction.

Further groundwater investigation may be required prior to developing dewatering plans, if needed, for the site.

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 Washington State Department of Transportation, for specific application to the subject property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

All MTCA cleanup levels included in this report are provided for comparison purposes only and are based on our understanding of cleanup levels required by Ecology for similar projects. They do not represent MTCA interpretations. By using them for comparison purposes, we are not implying that remedial actions at this site are required under MTCA. Specific MTCA interpretations may involve separate calculations and determinations upon which a range of cleanup standards may be established by Ecology.

Any questions regarding our work and this letter 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.

JULIE K. W. WUKELIC
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BARRY S. CHEN, P.E.
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Attachments:
Table 1 - Analytical Results for Soil Samples
Table 2 - Analytical Results for Groundwater Sample
Figure 1 – Vicinity Map
Figure 2 - Site and Exploration Plan
Appendix A - Field Methods and Boring Logs
Appendix B - Laboratory Report
Environmental Services Network Northwest

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Table 1 - Analytical Results for Soil Samples

Sample ID:	MTCA		HC-SE-PA	HC-SE-PA	HC-SE-PA	HC-SE-PA	HC-SE-PA	HC-NE-PA	HC-NE-PA	HC-C-PA	HC-C-PA	HC-SW-PA	HC-SW-PA	HC-NW-PA	HC-NW-PA
Sample Interval			S-1	S-2	S-3	S-4	S-6	S-3	S-5	S-2	S-6	S-2	S-4	S-3	S-6
PID Reading			0	50	10	0	0	0	0	0	0	0.0	0.0	0.0	0
Sample Depth (in Feet)	Method A Unrestricted	Puget Sound Background	0-1	5-6.5	7.5-9	10-11.5	20-21.5	10-11.5	20-21.5	5-6.5	25-26.5	5-6.5	15-16.5	10-11.5	25-26.5
NWTPH-Dx in mg/kg															
Kerosene/Jet fuel	2000		20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Diesel/Fuel oil	2000		20 U	**37**	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Heavy oil	2000		50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Semivolatiles in ug/kg (EPA Method 8270)															
No constituents detected			-	-	-	-	-	-	-	-	-	-	-	-	-
Metals in mg/kg															
Arsenic	20	7	5 U	5 U	na	5 U	na	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Cadmium	2	1	1 U	1 U	na	1 U	na	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Chromium (c)	19(a)/2000(b)	48	**30**	**10**	na	**5**	na	**10**	**8**	5 U	**5**	**6**	**6**	**6**	**5**
Silver	–	–	20 U	20 U	na	20 U	na	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Lead	250	24	5 U	**55**	na	5 U	na	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Mercury	2.0	0.07	0.5 U	0.5 U	na	0.5 U	na	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Selenium	–	–	50 U	50 U	na	50 U	na	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Barium	–	–	20 U	20 U	na	20 U	na	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U

U = Not detected at indicated detection limit.

Detected results presented in bold

(a) Based on hexavalent chromium

(b) Based on trivalent chromium

(c) Hexavalent chromium is not available. Total chromium results do not exceed Puget Sound background of 48 mg/kg.

na = sample not analyzed for specific analyte

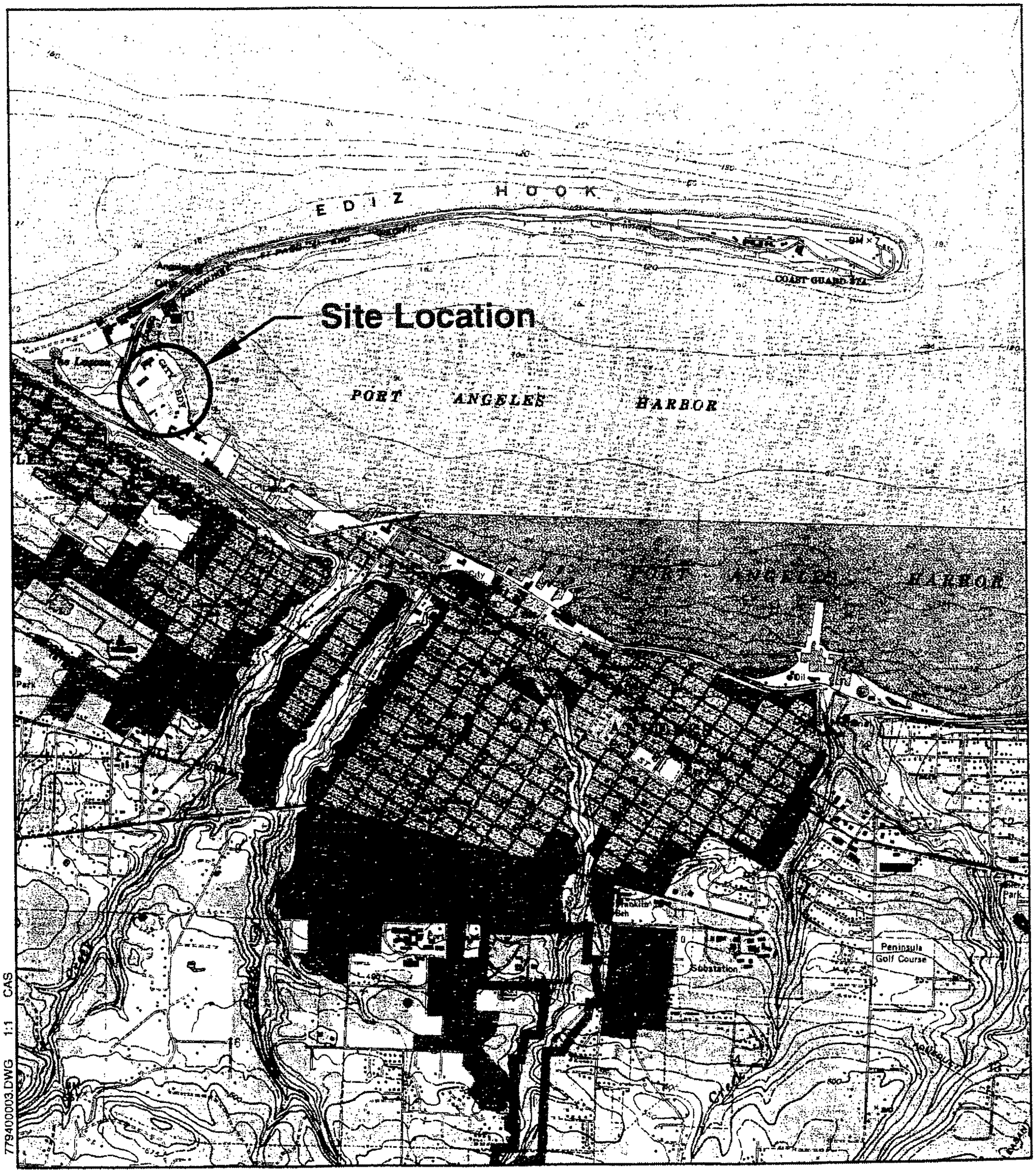
– = not criteria specified for specific analyte

Table 2 - Analytical Results for Water Samples

Sample ID: Sample Date:	MTCA Method A	MTCA Method B Surface Water*	MW-SE-PA 9/11/2002	MW-SW-PA 9/11/2002	MW-NW-PA 9/11/2002	MW-C-PA 9/11/2002	MW-NE-PA 9/11/2002
Total Suspended Solids in mg/L			59	1100	103	187	245
Total Metals in ug/L							
Arsenic	5	36	**10.4**	**31.2**	2.5 U	**9.91**	2.5 U
Cadmium	5	9.3	5 U	5 U	5 U	5 U	5 U
Chromium (Total)	50	50	10 U	**22.6**	10 U	10 U	**10.6**
Barium	–	–	**22.7**	**27.4**	**11.5**	**13.6**	**21.2**
Lead	15	8.1	5 U	5 U	5 U	5 U	5 U
Mercury	2	0.025	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Selenium		71	50 U	50 U	50 U	50 U	50 U
Silver		1.9	10 U	10 U	10 U	10 U	10 U
NWTPH-Dx in mg/L							
Kerosene/Jet fuel	0.5		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Diesel/Fuel oil	0.5		0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Heavy oil	0.5		0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Semivolatiles (EPA Method 8270) in ug/L							
No constituents detected			-	-	-	-	-

* Surface Water Quality Criteria for Protection of Aquatic Marine Life (WAC 173-201A-040). These criteria are based on dissolved concentrations, while reported concentrations are for total metals.

Vicinity Map



779400003.DWG 1:1 CAS

Note: Base map prepared from USGS 7.5-minute quadrangle maps Port Angeles, and Ediz Hook, Washington.

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Figure 1

Site and Exploration Plan

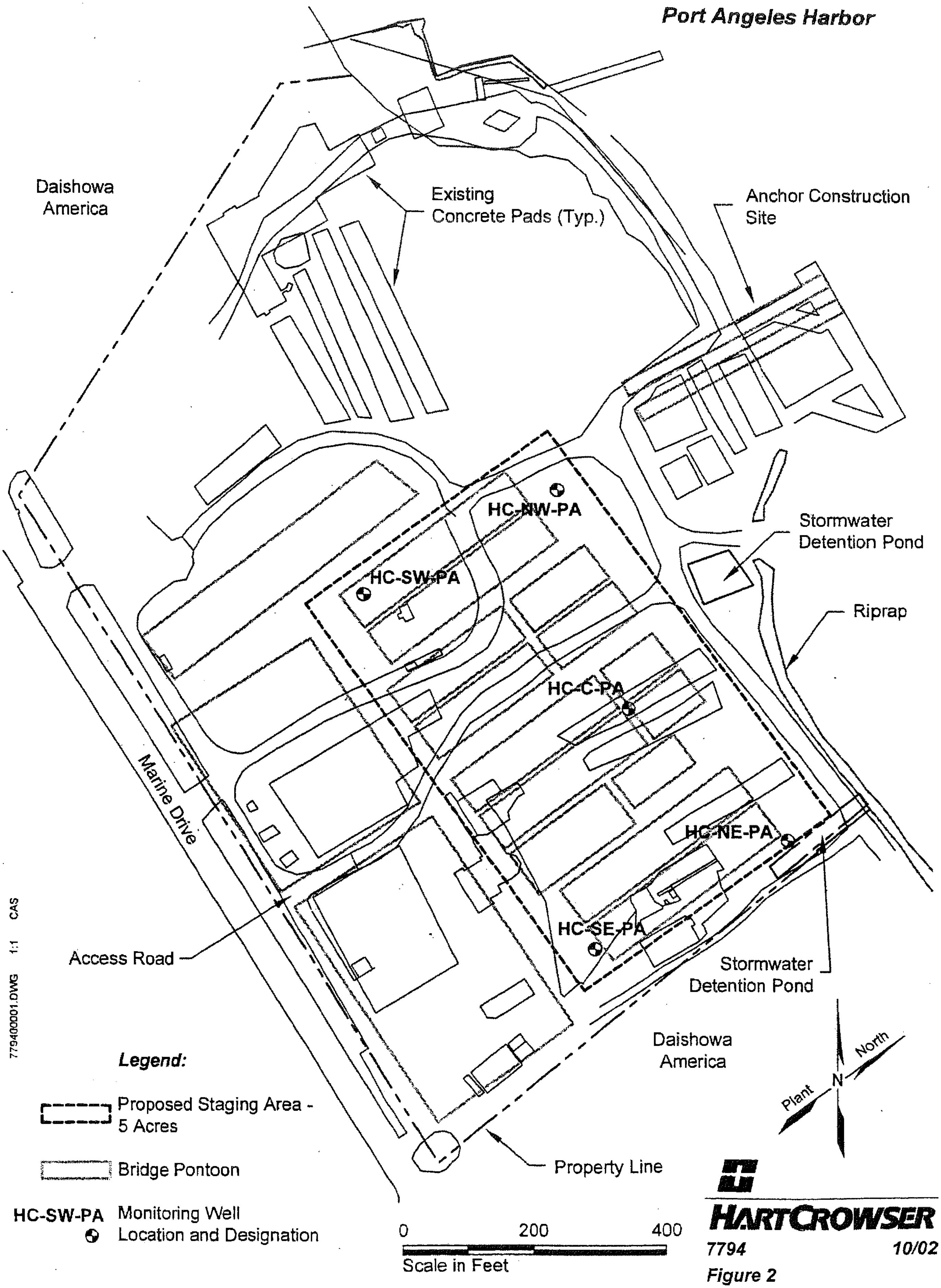

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Figure 2

APPENDIX A
FIELD METHODS AND BORING LOGS

APPENDIX A
FIELD METHODS AND BORING LOGS

Subsurface explorations were completed via the hollow-stem auger method to a maximum of 51.5 feet below grade. Figure 2 shows the locations of these explorations. Boring logs for the explorations are presented on Figures A-2 through A-6 at the end of this appendix. The exploration logs show our interpretation of conditions encountered in the explorations. They indicate the depth where the soils change. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1—Key to Explorations Logs. Figure A-1 also provides a legend explaining the symbols and abbreviations in the logs.

The following sections describe the specific exploration and sample collection methods used, and sample handling and transfer, organic vapor detection, and decontamination procedures used.

Explorations and Sampling

Under subcontract to Hart Crowser, Holt Drilling of Auburn, Washington, used hollow-stem auger drilling rig to advance five borings and collect soil samples at the subject property.

With depths to 51.5 feet below the ground surface, five hollow-stem auger borings, designated HC-NE-PA, HC-SE-PA, HC-C-PA, HC-NW-PA, and HC-SW-PA, were drilled from September 9 to 12, 2002. The borings used a 3-3/8-inch inside diameter hollow-stem auger and were advanced with a truck-mounted drill rig subcontracted by Hart Crowser. An engineering geologist from Hart Crowser continuously observed the drilling. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT), we obtained samples at 2.5- to 5-foot-depth intervals.

The borings logs are presented on Figures A-2 through A-6 at the end of this appendix.

Standard Penetration Test (SPT) Procedures

This test is an approximate measure of soil density and consistency. To be useful, the results must be used with engineering judgment in conjunction with other tests. The SPT (as described in ASTM D 1586) was used to obtain disturbed samples. This test employs a standard 2-inch outside diameter split-spoon sampler. Using a 140-pound hammer, free-falling 30 inches, the sampler is driven into the soil for 18 inches. The number of blows required to drive the sampler the last 12 inches only is the Standard Penetration Resistance. This resistance, or blow count, measures the relative density of granular soils and the consistency of cohesive soils. The blow counts are plotted on the boring logs at their respective sample depths.

Soil samples are recovered from the split-barrel sampler, field classified, and placed into watertight jars. They are then taken to Hart Crowser's laboratory for further testing.

Groundwater Sampling

Monitoring wells were installed adjacent to each boring. Following installation and development, one grab groundwater sample was collected from each well on September 11 or 12, 2002. The groundwater samples were submitted for chemical analysis.

Soil Sample Handling and Transfer

Soil samples from the explorations were transferred to pre-cleaned, labeled sample jars for laboratory analyses. Each jar was wiped clean and capped with a Teflon-lined lid, and then placed in an insulated ice chest with ice for transfer to Hart Crowser's refrigerated storage locker and to the ESN Northwest laboratory in Redmond, Washington. Sample custody forms accompanied the samples to the laboratory. The samples were transported with blue ice and were received at the laboratory in good condition.

The remaining portion of each soil sample collected from the split-spoon sampler was placed in a clean glass sample jar, covered with tin foil, and capped for sample jar organic vapor headspace measurements, as discussed below.

Organic Vapor Detection

Organic vapors were measured from the headspace in glass jars covered with foil during the field investigation using a portable HNU photoionization detector (PID). PID measurements were made by inserting the PID probe through the foil into headspace of the jar full of soil. These organic vapor readings are presented on the exploration logs on Figures A-2 through A-6.

The PID has sealed ultraviolet light sources, which emit photons that ionize trace organics, but does not ionize the major components of air. Which organic vapors are detected depends on the photoionization potential of the particular compounds, and the calibration and lamp voltage of the instrument. For instance, the PID cannot detect some organic vapors, such as methane.

For the field observation, the PID was equipped with a 10.2 eV lamp. The instrument was calibrated to a benzene equivalent which has a relatively low human exposure threshold in air. The organic vapor concentrations measured by the PID can be correlated to the total volatile compounds in a given sample and are, therefore, a useful screening test. The PID values are also used for environmental monitoring as a health and safety measure.

Decontamination

Boring equipment were cleaned prior to and between each exploration. The drilling rods and stainless steel samplers were cleaned using a high-pressure hot water washer. Stainless steel spoons, bowls, and other hand sampling equipment were brush-scrubbed using an Alconox detergent solution followed by successive rinses of tap and deionized water.

Attachments:

Figure A-1	Key to Explorations Logs
Figures A-2 through A-6	Boring Log and Construction Data for Monitoring Well HC-NE-PA, HC-SE-PA, HC-C-PA, HC-NW-PA, and HC-SW-PA

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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 perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

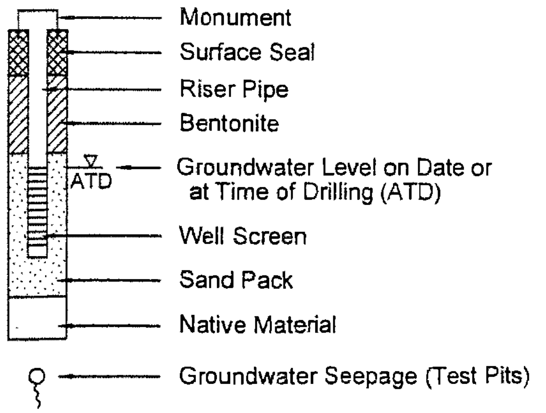
Minor Constituents	Estimated Percentage
Not identified in description	0 - 5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Legends

Sampling Test Symbols

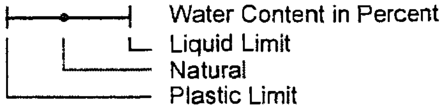
Boring Samples		Test Pit Samples	
☒	Split Spoon	☒	Grab (Jar)
⧅	Shelby Tube	⧄	Bag
▥	Cuttings	⧅	Shelby Tube
◫	Core Run		
*	No Sample Recovery		
P	Tube Pushed, Not Driven		

Groundwater Observation Wells



Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
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 Detector Reading
CA	Chemical Analysis
DT	*In Situ* Density Test



HC Standards\Standard Report Figures\A-1's\A-1 Standard

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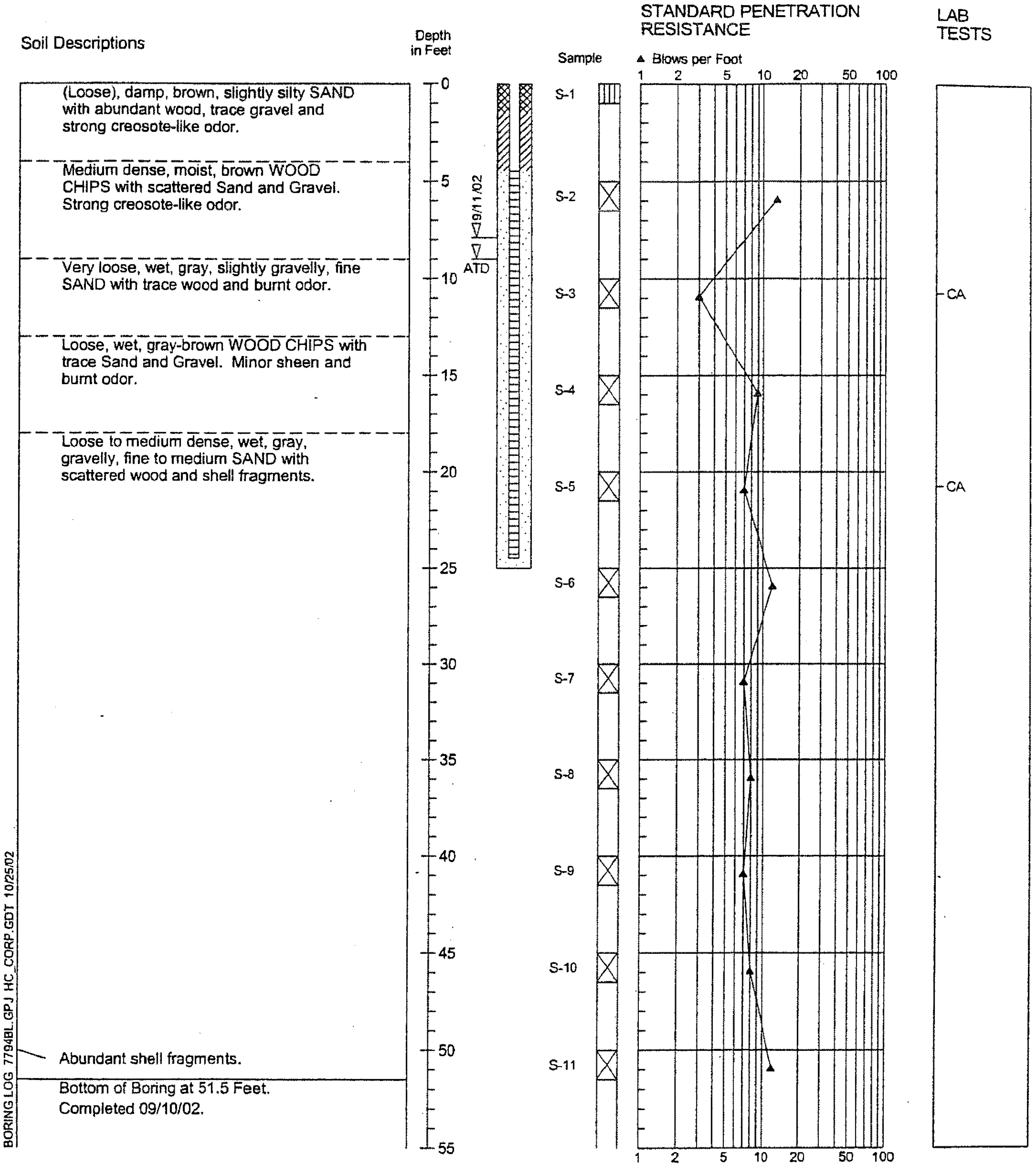
Figure A-1

Boring Log & Construction Data for Monitoring Well HC-NE-PA



(Loose), damp, brown, slightly silty SAND with abundant wood, trace gravel and strong creosote-like odor.

Medium dense, moist, brown WOOD CHIPS with scattered Sand and Gravel. Strong creosote-like odor.

Very loose, wet, gray, slightly gravelly, fine SAND with trace wood and burnt odor.

Loose, wet, gray-brown WOOD CHIPS with trace Sand and Gravel. Minor sheen and burnt odor.

Loose to medium dense, wet, gray, gravelly, fine to medium SAND with scattered wood and shell fragments.

Abundant shell fragments.

Bottom of Boring at 51.5 Feet.
Completed 09/10/02.

Groundwater sample collected for chemical analysis.

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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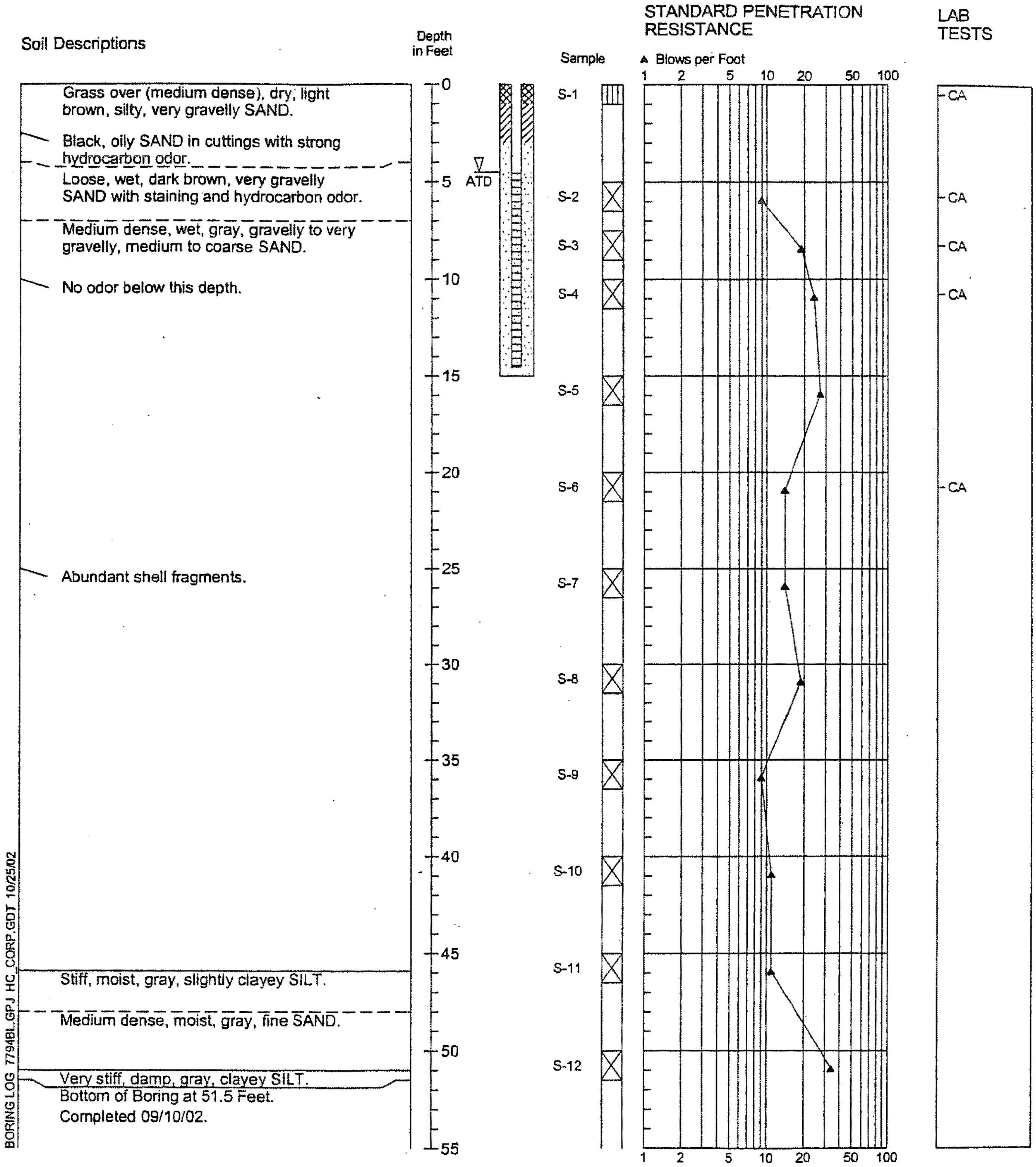
Figure A-2

Boring Log & Construction Data for Monitoring Well HC-SE-PA



Grass over (medium dense), dry, light brown, silty, very gravelly SAND.

Black, oily SAND in cuttings with strong hydrocarbon odor.

Loose, wet, dark brown, very gravelly SAND with staining and hydrocarbon odor.

Medium dense, wet, gray, gravelly to very gravelly, medium to coarse SAND.

No odor below this depth.

Abundant shell fragments.

Stiff, moist, gray, slightly clayey SILT.

Medium dense, moist, gray, fine SAND.

Very stiff, damp, gray, clayey SILT.

Bottom of Boring at 51.5 Feet.

Completed 09/10/02.

Groundwater sample collected for chemical analysis.

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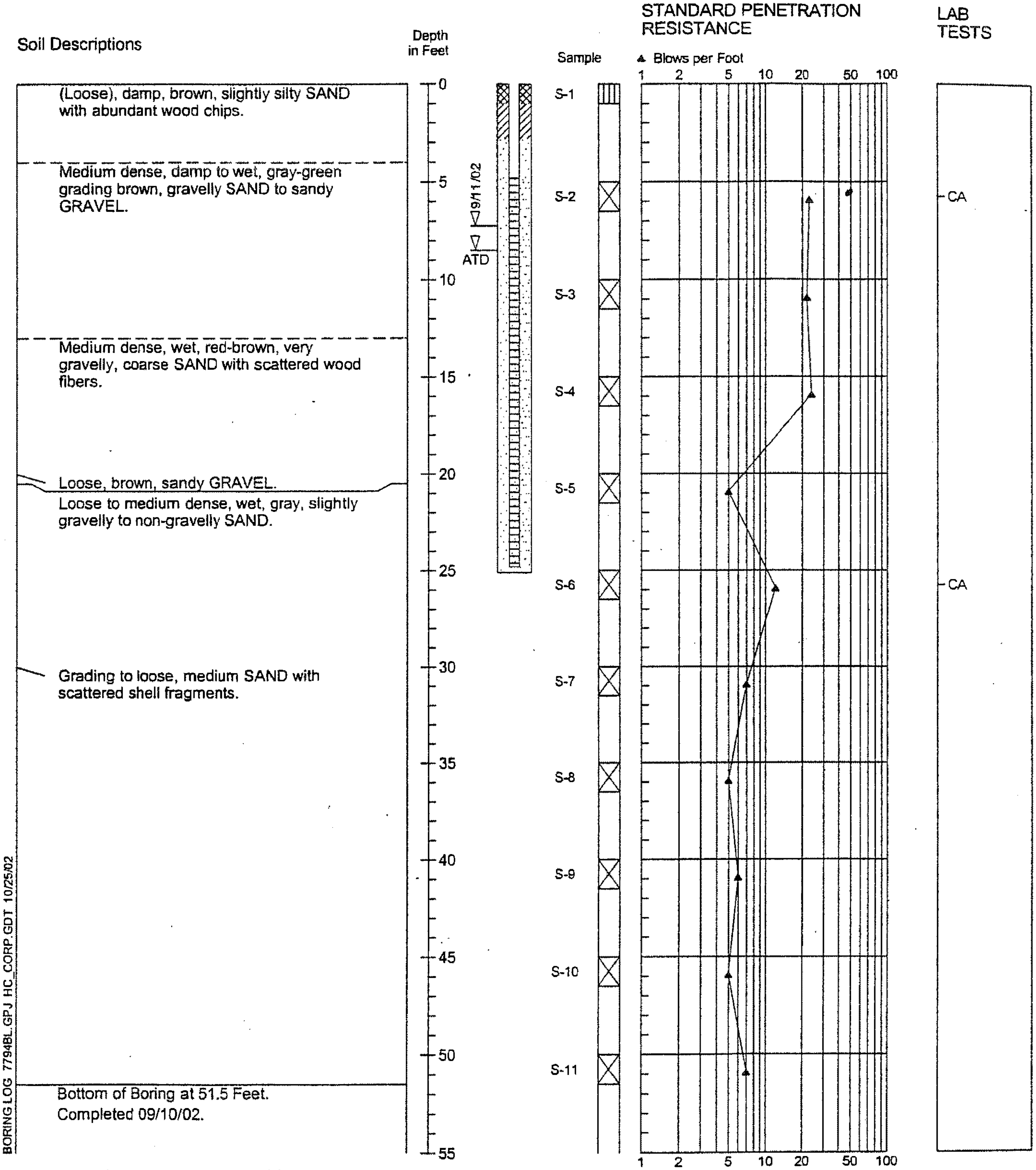
Figure A-3

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

Boring Log & Construction Data for Monitoring Well HC-C-PA



(Loose), damp, brown, slightly silty SAND with abundant wood chips.

Medium dense, damp to wet, gray-green grading brown, gravelly SAND to sandy GRAVEL.

Medium dense, wet, red-brown, very gravelly, coarse SAND with scattered wood fibers.

Loose, brown, sandy GRAVEL.

Loose to medium dense, wet, gray, slightly gravelly to non-gravelly SAND.

Grading to loose, medium SAND with scattered shell fragments.

Bottom of Boring at 51.5 Feet.

Completed 09/10/02.

Groundwater sample collected for chemical analysis.

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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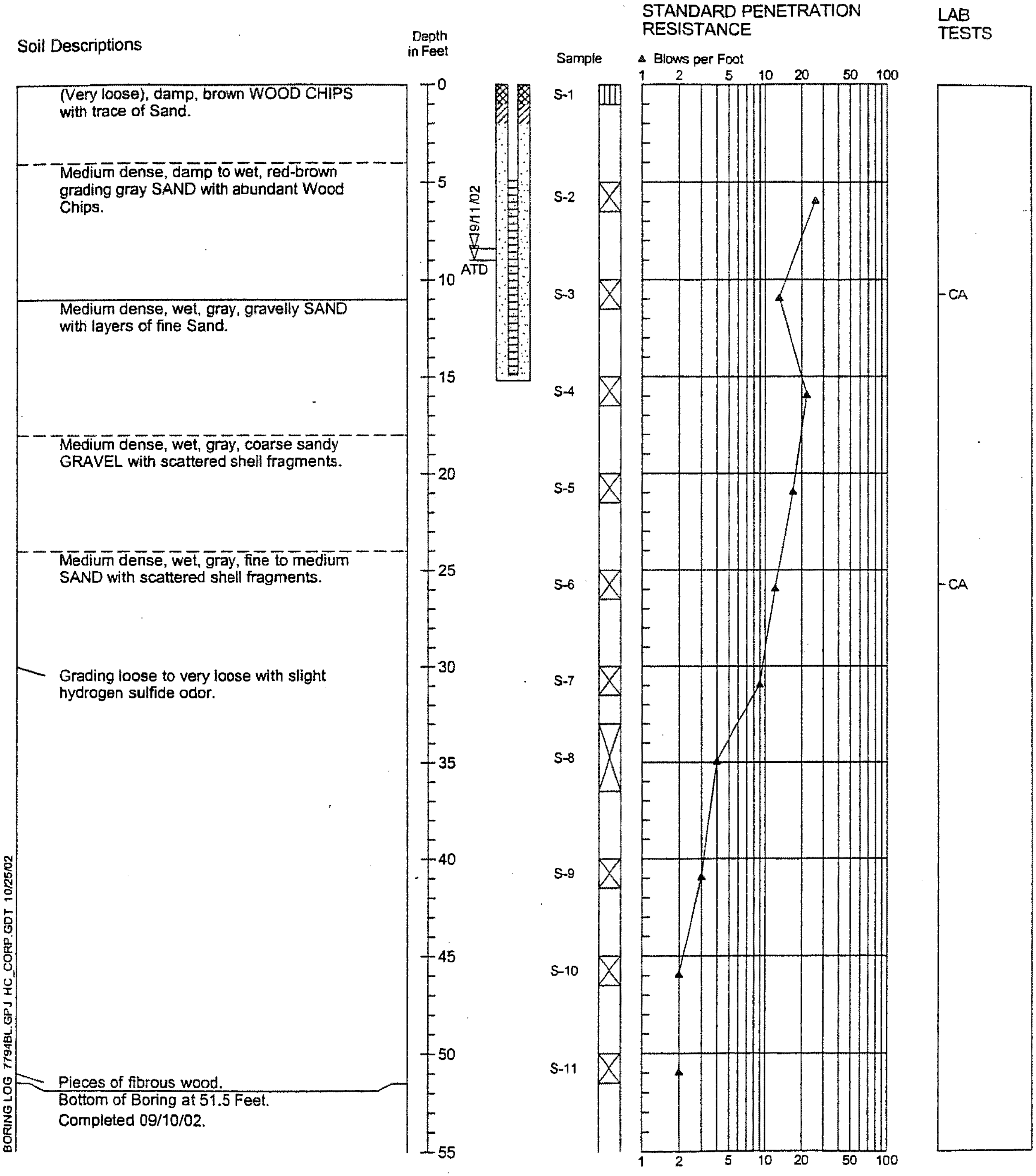
Figure A-4

Boring Log & Construction Data for Monitoring Well HC-NW-PA



(Very loose), damp, brown WOOD CHIPS with trace of Sand.

Medium dense, damp to wet, red-brown grading gray SAND with abundant Wood Chips.

Medium dense, wet, gray, gravelly SAND with layers of fine Sand.

Medium dense, wet, gray, coarse sandy GRAVEL with scattered shell fragments.

Medium dense, wet, gray, fine to medium SAND with scattered shell fragments.

Grading loose to very loose with slight hydrogen sulfide odor.

Pieces of fibrous wood.

Bottom of Boring at 51.5 Feet.

Completed 09/10/02.

Groundwater sample collected for chemical analysis.

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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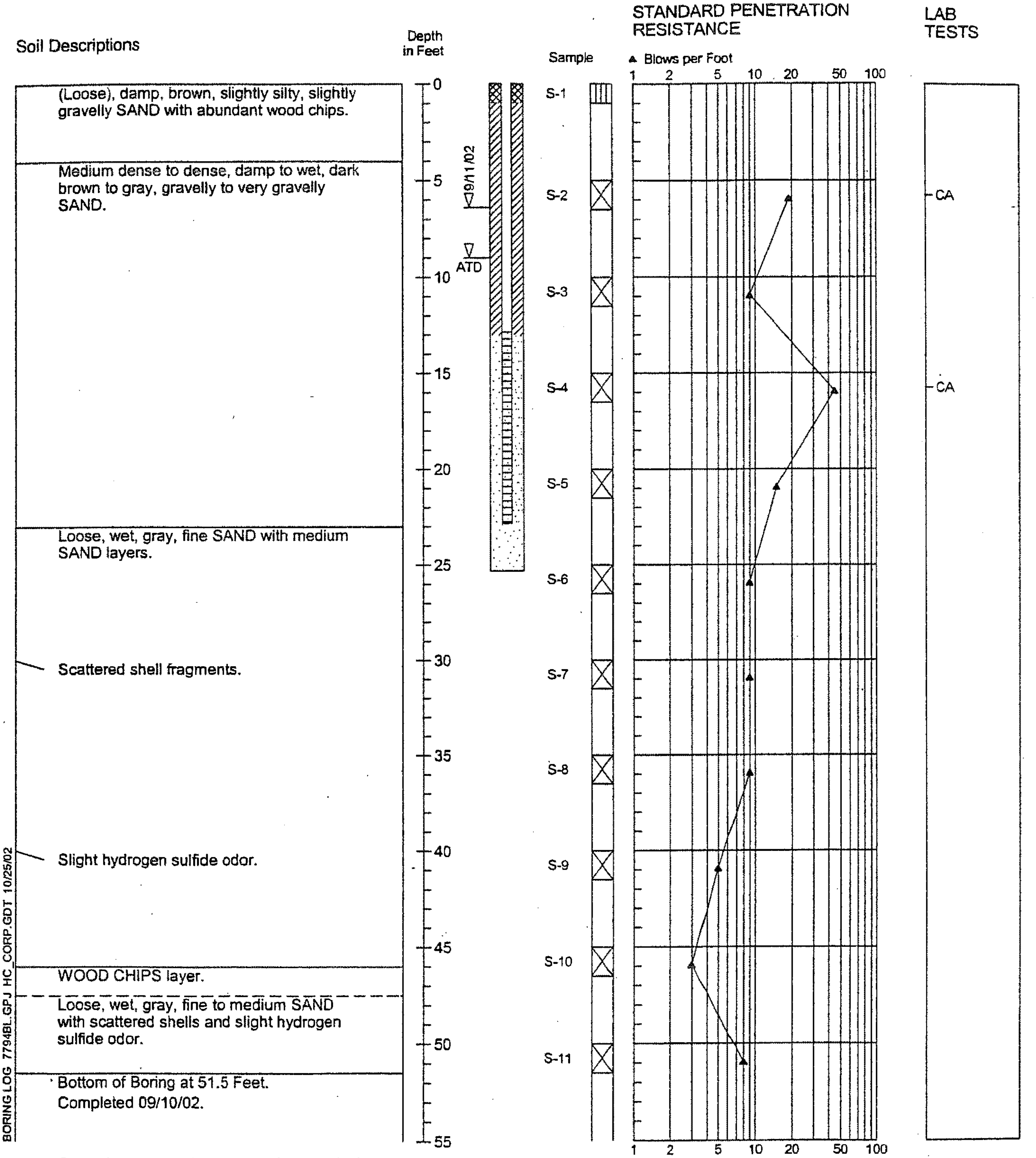
Figure A-5

Boring Log & Construction Data for Monitoring Well HC-SW-PA



Groundwater sample collected for chemical analysis.

BORING LOG 7794BL.GPJ HC_CORP.GDT 10/25/02

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-6

APPENDIX B
CHEMICAL DATA QUALITY REVIEW AND LABORATORY REPORT
ENVIRONMENTAL SERVICES NETWORK NORTHWEST

APPENDIX B
CHEMICAL DATA QUALITY REVIEW

Soil and groundwater samples were collected between September 9 and 11, 2002. Thirteen selected soil samples and five groundwater samples were submitted to ESN, Northwest of Lacey, Washington, for analysis of at least one of the following:

- Diesel- and oil-range petroleum hydrocarbons (NWTPH-Dx);
- Semivolatile Organic Compounds (EPA Method 8270);
- Total metals (EPA Method 6010, 6020, and 7470); and
- Total Suspended Solids (EPA Method 160.2).

Hart Crowser performed a summary data review (raw data were not evaluated) to assess whether analytical results met project and method data quality objectives. Data review followed the format outlined in the National Functional Guidelines for Inorganic and Organic Data Review (EPA 1994) modified to include specific criteria of the individual analytical methods. The following criteria were evaluated in the data quality review process upon receipt of final laboratory certificates:

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory control sample (LCS) recoveries;
- Matrix spike and matrix spike duplicate (MS/MSD) recoveries; and
- Laboratory duplicate and MS/MSD relative percent difference values (RPD).

Holding Times

Samples were analyzed within method specified holding times.

Laboratory Method Blanks

Target analytes were not detected in laboratory method blanks.

Surrogate Compound Recovery

Surrogate compound recoveries for TPH and semivolatile organic compound analysis were within laboratory specified quality control limits.

LCS Recovery

LCS (blank spike) recoveries were within laboratory specified quality control limits.

MS/MSD Recovery

MS and MSD recoveries were within laboratory specified quality control limits.

Laboratory Duplicate and MS/MSD RPD

The RPD between duplicate measurements were within laboratory specified quality control limits.

Overall Data Assessment

Data accurately reflect sample concentrations. No corrective actions or data qualification were required. Data completeness is 100 percent.

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ESN
NORTHWEST
Environmental
Services Network

September 26, 2002

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

Dear Ms. Wukelic:

Please find enclosed the analytical data report for the Port Angeles Project in Washington. Soil and water samples were analyzed for Diesel by NWTPH-Dx, Semi volatile Compound by EPA Method 8270, Total Suspended Solids by EPA Method 160.2, and Metals by EPA Method 6000 Series on September 17, 2002.

The results of these analyses are summarized in the attached tables. All soil values are reported on a dry weight basis. Applicable detection limits and QA/QC data are included. An invoice for this work has been sent to your accounting department.

ESN Northwest appreciates the opportunity to have provided analytical services to Hart Crowser for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you, and we are looking forward to the next opportunity to work together.

Sincerely,

Michael A Ko

Michael A. Korosec
President

677 Woodland Square Lp. SE, Suite D ■ Lacey, Washington 98503 ■ 360.459.4670 ■ FAX 360.459.3432
Web Site: *www.ESN-USA.com* E-Mail: *esnnw@aol.com*

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELES
Client Job Number:	7794

Analytical Results			HC-SE-PA	HC-SE-PA	HC-NE-PA	HC-NE-PA	HC-C-PA
NWTPH-Dx, mg/kg		**MTH BLK**	**S-2**	**S-3**	**S-3**	**S-5**	**S-2**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Date analyzed	Limits	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Kerosene/Jet fuel	20	nd	nd	nd	nd	nd	nd
Diesel/Fuel oil	20	nd	37	nd	nd	nd	nd
Heavy oil	50	nd	nd	nd	nd	nd	nd
Surrogate recoveries:							
Fluorobiphenyl		113%	124%	118%	119%	120%	118%
o-Terphenyl		105%	110%	108%	108%	108%	109%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
na - not analyzed
C - coelution with sample peaks
M - matrix interference
J - estimated value
Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
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ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

Analytical Results		HC-C-PA	HC-NW-PA	HC-NW-PA	HC-SW-PA	HC-SW-PA	DUPL HC-SW-PA
NWTPH-Dx, mg/kg		S-6	S-3	S-6	S-2	S-4	S-4
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Date analyzed	Limits	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Kerosene/Jet fuel	20	nd	nd	nd	nd	nd	nd
Diesel/Fuel oil	20	nd	nd	nd	nd	nd	nd
Heavy oil	50	nd	nd	nd	nd	nd	nd
Surrogate recoveries:							
Fluorobiphenyl		117%	118%	119%	119%	118%	119%
o-Terphenyl		108%	107%	109%	108%	109%	110%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
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J - estimated value
Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

Analytical Results

NWTPH-Dx, mg/kg		**MTH BLK**	**HC-SE-PA S-1**	**HC-SE-PA S-4**	**HC-NE-PA S-6**
Matrix	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02
Kerosene/Jet fuel	20	nd	nd	nd	nd
Diesel/Fuel oil	20	nd	nd	nd	nd
Heavy oil	50	nd	nd	nd	nd

Surrogate recoveries:

Fluorobiphenyl		122%	125%	122%	121%
o-Terphenyl		122%	113%	110%	109%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
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Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
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ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELES
Client Job Number:	7794

Analytical Results

NWTPH-Dx, mg/l		MTH BLK	MW-SE-PA	MW-SW-PA	MW-NW-PA	MW-C-PA
Matrix	Water	Water	Water	Water	Water	Water
Date extracted	Reporting	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Date analyzed	Limits	09/17/02	09/17/02	09/17/02	09/17/02	09/17/02
Kerosene/Jet fuel	0.20	nd	nd	nd	nd	nd
Diesel/Fuel oil	0.20	nd	nd	nd	nd	nd
Heavy oil	0.50	nd	nd	nd	nd	nd

Surrogate recoveries:

Fluorobiphenyl	109%	117%	116%	115%	116%
o-Terphenyl	101%	108%	107%	116%	106%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
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M - matrix interference
J - estimated value
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

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ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

Analytical Results		DUPL	
NWTPH-Dx, mg/l		**MW-C-PA**	**MW-NE-PA**
Matrix	Water	Water	Water
Date extracted	Reporting	09/17/02	09/17/02
Date analyzed	Limits	09/17/02	09/17/02
Kerosene/Jet fuel	0.20	nd	nd
Diesel/Fuel oil	0.20	nd	nd
Heavy oil	0.50	nd	nd
Surrogate recoveries:			
Fluorobiphenyl		116%	115%
o-Terphenyl		111%	106%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
na - not analyzed
C - coelution with sample peaks
M - matrix interference
J - estimated value
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number: S20917-3
Client: HART CROWSER
Client Job Name: PORT OF ANGELES
Client Job Number: 7794

Analytical Results				HC-SE-PA	HC-SE-PA	HC-SE-PA	HC-NE-PA
8270, mg/kg		**MTH BLK**	**LCS**	**S1**	**S2**	**S4**	**S3**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Penatchloroethane	0.10	nd		nd	nd	nd	nd
Phenol	0.10	nd		nd	nd	nd	nd
2-Chlorophenol	0.10	nd		nd	nd	nd	nd
Bis (2-chloroethyl) ether	0.10	nd		nd	nd	nd	nd
1,3-Dichlorobenzene	0.10	nd		nd	nd	nd	nd
1,4-Dichlorobenzene	0.10	nd	114%	nd	nd	nd	nd
1,2-Dichlorobenzene	0.10	nd		nd	nd	nd	nd
2-Methylphenol (o-cresol)	0.10	nd		nd	nd	nd	nd
Bis (2-chloroisopropyl) ether	0.10	nd		nd	nd	nd	nd
3,4-Methylphenol (m,p-cresol)	0.10	nd		nd	nd	nd	nd
2-Nitrophenol	0.50	nd		nd	nd	nd	nd
2,4-Dimethylphenol	0.50	nd		nd	nd	nd	nd
Bis (2-chloroethoxy) methane	0.10	nd		nd	nd	nd	nd
2,4-Dichlorophenol	0.50	nd		nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.10	nd	124%	nd	nd	nd	nd
Naphthalene	0.10	nd		nd	nd	nd	nd
2,6-Dichlorophenol	0.50	nd		nd	nd	nd	nd
Hexachloropropylene	0.50	nd		nd	nd	nd	nd
Hexachlorobutadiene	0.50	nd		nd	nd	nd	nd
4-Chloro-3-methylphenol	0.50	nd		nd	nd	nd	nd
1,2,4,5-Tetrachlorobenzene	0.10	nd		nd	nd	nd	nd
Hexachlorocyclopentadiene	0.10	nd		nd	nd	nd	nd
2,4,6-Trichlorophenol	0.50	nd		nd	nd	nd	nd
2,4,5-Trichlorophenol	0.50	nd		nd	nd	nd	nd
2-Chloronaphthalene	0.10	nd		nd	nd	nd	nd
Dimethylphthalate	0.10	nd		nd	nd	nd	nd
Acenaphthylene	0.10	nd		nd	nd	nd	nd
Acenaphthene	0.10	nd	104%	nd	nd	nd	nd
2,4-Dinitrophenol	0.50	nd		nd	nd	nd	nd
4-Nitrophenol	0.50	nd		nd	nd	nd	nd
Pentachlorobenzene	0.10	nd		nd	nd	nd	nd
2,3,4,6-Tetrachlorophenol	0.10	nd		nd	nd	nd	nd
Fluorene	0.10	nd		nd	nd	nd	nd
Diethylphthalate	0.50	nd		nd	nd	nd	nd
4-Chlorophenylphenylether	0.10	nd		nd	nd	nd	nd
N-Nitrosodiphenylamine	0.10	nd		nd	nd	nd	nd
4-Bromophenylphenylether	0.10	nd		nd	nd	nd	nd
Hexachlorobenzene	0.10	nd		nd	nd	nd	nd
Pentachlorophenol	0.50	nd		nd	nd	nd	nd
Phenanthrene	0.10	nd		nd	nd	nd	nd
Anthracene	0.10	nd		nd	nd	nd	nd
2-sec-Butyl-4,6-dinitrophenol (Di	0.50	nd		nd	nd	nd	nd
Di-n-butylphthalate	0.10	nd		nd	nd	nd	nd
Fluoranthene	0.10	nd		nd	nd	nd	nd
Pyrene	0.10	nd	98%	nd	nd	nd	nd
Butylbenzylphthalate	0.50	nd		nd	nd	nd	nd
Benzo(a)anthracene	0.10	nd		nd	nd	nd	nd
Chrysene	0.10	nd		nd	nd	nd	nd
Bis (2-ethylhexyl) ether	0.10	nd		nd	nd	nd	nd

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ESN Job Number:	S20917-3
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Client Job Name:	PORT OF ANGELES
Client Job Number:	7794

Analytical Results				HC-SE-PA	HC-SE-PA	HC-SE-PA	HC-NE-PA
8270, mg/kg		**MTH BLK**	**LCS**	**S1**	**S2**	**S4**	**S3**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Di-n-octylphthalate	0.50	nd		nd	nd	nd	nd
Benzo(b)fluoranthene	0.10	nd		nd	nd	nd	nd
Benzo(k)fluoranthene	0.10	nd		nd	nd	nd	nd
Benzo(a)pyrene	0.10	nd		nd	nd	nd	nd
Dibenzo(a,h)anthracene	0.10	nd		nd	nd	nd	nd
Benzo(ghi)perylene	0.10	nd		nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	0.10	nd		nd	nd	nd	nd
Surrogate recoveries							
Nitrobenzene-d5		102%	93%	95%	99%	101%	104%
2-Fluorobiphenyl		105%	101%	101%	103%	101%	100%
4-Terphenyl-d14		94%	98%	98%	99%	95%	99%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

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ESN Job Number:	S20917-3
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Client Job Number:	7794

Analytical Results		HC-NE-PA	HC-C-PA	HC-C-PA	HC-NW-PA	HC-NW-PA	HC-SW-PA
8270, mg/kg		S5	S2	S6	S3	S6	S2
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Penatchloroethane	0.10	nd	nd	nd	nd	nd	nd
Phenol	0.10	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.10	nd	nd	nd	nd	nd	nd
Bis (2-chloroethyl) ether	0.10	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.10	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.10	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.10	nd	nd	nd	nd	nd	nd
2-Methylphenol (o-cresol)	0.10	nd	nd	nd	nd	nd	nd
Bis (2-chloroisopropyl) ether	0.10	nd	nd	nd	nd	nd	nd
3,4-Methylphenol (m,p-cresol)	0.10	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.50	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.50	nd	nd	nd	nd	nd	nd
Bis (2-chloroethoxy) methane	0.10	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.50	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.10	nd	nd	nd	nd	nd	nd
Naphthalene	0.10	nd	nd	nd	nd	nd	nd
2,6-Dichlorophenol	0.50	nd	nd	nd	nd	nd	nd
Hexachloropropylene	0.50	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.50	nd	nd	nd	nd	nd	nd
4-Chloro-3-methylphenol	0.50	nd	nd	nd	nd	nd	nd
1,2,4,5-Tetrachlorobenzene	0.10	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.10	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.50	nd	nd	nd	nd	nd	nd
2,4,5-Trichlorophenol	0.50	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.10	nd	nd	nd	nd	nd	nd
Dimethylphthalate	0.10	nd	nd	nd	nd	nd	nd
Acenaphthylene	0.10	nd	nd	nd	nd	nd	nd
Acenaphthene	0.10	nd	nd	nd	nd	nd	nd
2,4-Dinitrophenol	0.50	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.50	nd	nd	nd	nd	nd	nd
Pentachlorobenzene	0.10	nd	nd	nd	nd	nd	nd
2,3,4,6-Tetrachlorophenol	0.10	nd	nd	nd	nd	nd	nd
Fluorene	0.10	nd	nd	nd	nd	nd	nd
Diethylphthalate	0.50	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.10	nd	nd	nd	nd	nd	nd
N-Nitrosodiphenylamine	0.10	nd	nd	nd	nd	nd	nd
4-Bromophenylphenylether	0.10	nd	nd	nd	nd	nd	nd
Hexachlorobenzene	0.10	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.50	nd	nd	nd	nd	nd	nd
Phenanthrene	0.10	nd	nd	nd	nd	nd	nd
Anthracene	0.10	nd	nd	nd	nd	nd	nd
2-sec-Butyl-4,6-dinitrophenol (Di	0.50	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.10	nd	nd	nd	nd	nd	nd
Fluoranthene	0.10	nd	nd	nd	nd	nd	nd
Pyrene	0.10	nd	nd	nd	nd	nd	nd
Butylbenzylphthalate	0.50	nd	nd	nd	nd	nd	nd
Benzo(a)anthracene	0.10	nd	nd	nd	nd	nd	nd
Chrysene	0.10	nd	nd	nd	nd	nd	nd
Bis (2-ethylhexyl) ether	0.10	nd	nd	nd	nd	nd	nd

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ESN Job Number:	S20917-3
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Client Job Number:	7794

Analytical Results		HC-NE-PA	HC-C-PA	HC-C-PA	HC-NW-PA	HC-NW-PA	HC-SW-PA
8270, mg/kg		**S5**	**S2**	**S6**	**S3**	**S6**	**S2**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Di-n-octylphthalate	0.50	nd	nd	nd	nd	nd	nd
Benzo(b)fluoranthene	0.10	nd	nd	nd	nd	nd	nd
Benzo(k)fluoranthene	0.10	nd	nd	nd	nd	nd	nd
Benzo(a)pyrene	0.10	nd	nd	nd	nd	nd	nd
Dibenzo(a,h)anthracene	0.10	nd	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.10	nd	nd	nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	0.10	nd	nd	nd	nd	nd	nd
Surrogate recoveries							
Nitrobenzene-d5		97%	102%	103%	99%	106%	106%
2-Fluorobiphenyl		99%	100%	101%	98%	102%	102%
4-Terphenyl-d14		93%	96%	98%	94%	96%	98%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits

Acceptable Recovery limits: 65% TO 135%

Acceptable RPD limit: 35%

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ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

			MS	MSD	RPD
Analytical Results		HC-SW-PA	HC-SW-PA	HC-SW-PA	HC-SW-PA
8270, mg/kg		**S4**	**S4**	**S4**	**S4**
Matrix	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02
Penatchloroethane	0.10	nd			
Phenol	0.10	nd			
2-Chlorophenol	0.10	nd			
Bis (2-chloroethyl) ether	0.10	nd			
1,3-Dichlorobenzene	0.10	nd			
1,4-Dichlorobenzene	0.10	nd	114%	114%	0%
1,2-Dichlorobenzene	0.10	nd			
2-Methylphenol (o-cresol)	0.10	nd			
Bis (2-chloroisopropyl) ether	0.10	nd			
3,4-Methylphenol (m,p-cresol)	0.10	nd			
2-Nitrophenol	0.50	nd			
2,4-Dimethylphenol	0.50	nd			
Bis (2-chloroethoxy) methane	0.10	nd			
2,4-Dichlorophenol	0.50	nd			
1,2,4-Trichlorobenzene	0.10	nd	120%	124%	3%
Naphthalene	0.10	nd			
2,6-Dichlorophenol	0.50	nd			
Hexachloropropylene	0.50	nd			
Hexachlorobutadiene	0.50	nd			
4-Chloro-3-methylphenol	0.50	nd			
1,2,4,5-Tetrachlorobenzene	0.10	nd			
Hexachlorocyclopentadiene	0.10	nd			
2,4,6-Trichlorophenol	0.50	nd			
2,4,5-Trichlorophenol	0.50	nd			
2-Chloronaphthalene	0.10	nd			
Dimethylphthalate	0.10	nd			
Acenaphthylene	0.10	nd			
Acenaphthene	0.10	nd	104%	104%	0%
2,4-Dinitrophenol	0.50	nd			
4-Nitrophenol	0.50	nd			
Pentachlorobenzene	0.10	nd			
2,3,4,6-Tetrachlorophenol	0.10	nd			
Fluorene	0.10	nd			
Diethylphthalate	0.50	nd			
4-Chlorophenylphenylether	0.10	nd			
N-Nitrosodiphenylamine	0.10	nd			
4-Bromophenylphenylether	0.10	nd			
Hexachlorobenzene	0.10	nd			
Pentachlorophenol	0.50	nd			
Phenanthrene	0.10	nd			
Anthracene	0.10	nd			
2-sec-Butyl-4,6-dinitrophenol (Di	0.50	nd			
Di-n-butylphthalate	0.10	nd			
Fluoranthene	0.10	nd			
Pyrene	0.10	nd	98%	98%	0%
Butylbenzylphthalate	0.50	nd			
Benzo(a)anthracene	0.10	nd			
Chrysene	0.10	nd			
Bis (2-ethylhexyl) ether	0.10	nd			

ESN Job Number:	S20917-3
Client:	HART CROWSER
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Analytical Results		HC-SW-PA	MS HC-SW-PA	MSD HC-SW-PA	RPD HC-SW-PA
8270, mg/kg		**S4**	**S4**	**S4**	**S4**
Matrix	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02
Di-n-octylphthalate	0.50	nd			
Benzo(b)fluoranthene	0.10	nd			
Benzo(k)fluoranthene	0.10	nd			
Benzo(a)pyrene	0.10	nd			
Dibenzo(a,h)anthracene	0.10	nd			
Benzo(ghi)perylene	0.10	nd			
Indeno(1,2,3-cd)pyrene	0.10	nd			
Surrogate recoveries					
Nitrobenzene-d5		98%	90%	96%	
2-Fluorobiphenyl		97%	98%	102%	
4-Terphenyl-d14		92%	93%	96%	

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

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ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELES
Client Job Number:	7794

Analytical Results

8270, µg/L		MTH BLK	LCS	MW-SE-PA	MW-SW-PA	MW-NW-PA	MW-C-PA
Matrix	Water	Water	Water	Water	Water	Water	Water
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Penatchloroethane	2.0	nd		nd	nd	nd	nd
Phenol	2.0	nd		nd	nd	nd	nd
2-Chlorophenol	2.0	nd		nd	nd	nd	nd
Bis (2-chloroethyl) ether	2.0	nd		nd	nd	nd	nd
1,3-Dichlorobenzene	2.0	nd		nd	nd	nd	nd
1,4-Dichlorobenzene	2.0	nd	116%	nd	nd	nd	nd
1,2-Dichlorobenzene	2.0	nd		nd	nd	nd	nd
2-Methylphenol (o-cresol)	2.0	nd		nd	nd	nd	nd
Bis (2-chloroisopropyl) ether	2.0	nd		nd	nd	nd	nd
3,4-Methylphenol (m,p-cresol)	2.0	nd		nd	nd	nd	nd
2-Nitrophenol	10	nd		nd	nd	nd	nd
2,4-Dimethylphenol	10	nd		nd	nd	nd	nd
Bis (2-chloroethoxy) methane	2.0	nd		nd	nd	nd	nd
2,4-Dichlorophenol	10	nd		nd	nd	nd	nd
1,2,4-Trichlorobenzene	2.0	nd	122%	nd	nd	nd	nd
Naphthalene	0.1	nd		nd	nd	nd	nd
2,6-Dichlorophenol	10	nd		nd	nd	nd	nd
Hexachloropropylene	10	nd		nd	nd	nd	nd
Hexachlorobutadiene	10	nd		nd	nd	nd	nd
4-Chloro-3-methylphenol	10	nd		nd	nd	nd	nd
1,2,4,5-Tetrachlorobenzene	2.0	nd		nd	nd	nd	nd
Hexachlorocyclopentadiene	2.0	nd		nd	nd	nd	nd
2,4,6-Trichlorophenol	10	nd		nd	nd	nd	nd
2,4,5-Trichlorophenol	10	nd		nd	nd	nd	nd
2-Chloronaphthalene	2.0	nd		nd	nd	nd	nd
Dimethylphthalate	2.0	nd		nd	nd	nd	nd
Acenaphthylene	0.1	nd		nd	nd	nd	nd
Acenaphthene	0.1	nd	102%	nd	nd	nd	nd
2,4-Dinitrophenol	10	nd		nd	nd	nd	nd
4-Nitrophenol	10	nd		nd	nd	nd	nd
Pentachlorobenzene	2.0	nd		nd	nd	nd	nd
2,3,4,6-Tetrachlorophenol	2.0	nd		nd	nd	nd	nd
Fluorene	0.1	nd		nd	nd	nd	nd
Diethylphthalate	10	nd		nd	nd	nd	nd
4-Chlorophenylphenylether	2.0	nd		nd	nd	nd	nd
N-Nitrosodiphenylamine	2.0	nd		nd	nd	nd	nd
4-Bromophenylphenylether	2.0	nd		nd	nd	nd	nd
Hexachlorobenzene	2.0	nd		nd	nd	nd	nd
Pentachlorophenol	10	nd		nd	nd	nd	nd
Phenanthrene	0.1	nd		nd	nd	nd	nd
Anthracene	0.1	nd		nd	nd	nd	nd
2-sec-Butyl-4,6-dinitrophenol (Di	10	nd		nd	nd	nd	nd
Di-n-butylphthalate	2.0	nd		nd	nd	nd	nd
Fluoranthene	0.1	nd		nd	nd	nd	nd
Pyrene	0.1	nd	102%	nd	nd	nd	nd
Butylbenzylphthalate	10	nd		nd	nd	nd	nd
Benzo(a)anthracene	2.0	nd		nd	nd	nd	nd
Chrysene	0.1	nd		nd	nd	nd	nd
Bis (2-ethylhexyl) ether	2.0	nd		nd	nd	nd	nd

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number: S20917-3
Client: HART CROWSER
Client Job Name: PORT OF ANGELES
Client Job Number: 7794

Analytical Results

8270, µg/L		MTH BLK	LCS	MW-SE-PA	MW-SW-PA	MW-NW-PA	MW-C-PA
Matrix	Water	Water	Water	Water	Water	Water	Water
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Di-n-octylphthalate	10	nd		nd	nd	nd	nd
Benzo(b)fluoranthene	0.1	nd		nd	nd	nd	nd
Benzo(k)fluoranthene	0.1	nd		nd	nd	nd	nd
Benzo(a)pyrene	0.1	nd		nd	nd	nd	nd
Dibenzo(a,h)anthracene	0.1	nd		nd	nd	nd	nd
Benzo(ghi)perylene	0.1	nd		nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	0.1	nd		nd	nd	nd	nd

Surrogate recoveries

2-Fluorobiphenyl		89%	101%	102%	101%	101%	101%
4-Terphenyl-d14		85%	99%	91%	90%	95%	92%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

Analytical Results				MS	MSD	RPD
8270, µg/L		**MW-C-PA**	**MW-NE-PA**	**MW-NE-PA**	**MW-NE-PA**	**MW-NE-PA**
Matrix	Water	Water	Water	Water	Water	Water
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Penatchloroethane	2.0	nd	nd			
Phenol	2.0	nd	nd			
2-Chlorophenol	2.0	nd	nd			
Bis (2-chloroethyl) ether	2.0	nd	nd			
1,3-Dichlorobenzene	2.0	nd	nd			
1,4-Dichlorobenzene	2.0	nd	nd	114%	114%	0%
1,2-Dichlorobenzene	2.0	nd	nd			
2-Methylphenol (o-cresol)	2.0	nd	nd			
Bis (2-chloroisopropyl) ether	2.0	nd	nd			
3,4-Methylphenol (m,p-cresol)	2.0	nd	nd			
2-Nitrophenol	10	nd	nd			
2,4-Dimethylphenol	10	nd	nd			
Bis (2-chloroethoxy) methane	2.0	nd	nd			
2,4-Dichlorophenol	10	nd	nd			
1,2,4-Trichlorobenzene	2.0	nd	nd	118%	122%	3%
Naphthalene	0.1	nd	nd			
2,6-Dichlorophenol	10	nd	nd			
Hexachloropropylene	10	nd	nd			
Hexachlorobutadiene	10	nd	nd			
4-Chloro-3-methylphenol	10	nd	nd			
1,2,4,5-Tetrachlorobenzene	2.0	nd	nd			
Hexachlorocyclopentadiene	2.0	nd	nd			
2,4,6-Trichlorophenol	10	nd	nd			
2,4,5-Trichlorophenol	10	nd	nd			
2-Chloronaphthalene	2.0	nd	nd			
Dimethylphthalate	2.0	nd	nd			
Acenaphthylene	0.1	nd	nd			
Acenaphthene	0.1	nd	nd	104%	102%	2%
2,4-Dinitrophenol	10	nd	nd			
4-Nitrophenol	10	nd	nd			
Pentachlorobenzene	2.0	nd	nd			
2,3,4,6-Tetrachlorophenol	2.0	nd	nd			
Fluorene	0.1	nd	nd			
Diethylphthalate	10	nd	nd			
4-Chlorophenylphenylether	2.0	nd	nd			
N-Nitrosodiphenylamine	2.0	nd	nd			
4-Bromophenylphenylether	2.0	nd	nd			
Hexachlorobenzene	2.0	nd	nd			
Pentachlorophenol	10	nd	nd			
Phenanthrene	0.1	nd	nd			
Anthracene	0.1	nd	nd			
2-sec-Butyl-4,6-dinitrophenol (Di	10	nd	nd			
Di-n-butylphthalate	2.0	nd	nd			
Fluoranthene	0.1	nd	nd			
Pyrene	0.1	nd	nd	100%	98%	2%
Butylbenzylphthalate	10	nd	nd			
Benzo(a)anthracene	2.0	nd	nd			
Chrysene	0.1	nd	nd			
Bis (2-ethylhexyl) ether	2.0	nd	nd			

ESN Job Number:	S20917-3
Client:	HART CROWSER
Client Job Name:	PORT OF ANGELE
Client Job Number:	7794

Analytical Results				MS	MSD	RPD
8270, µg/L		**MW-C-PA**	**MW-NE-PA**	**MW-NE-PA**	**MW-NE-PA**	**MW-NE-PA**
Matrix	Water	Water	Water	Water	Water	Water
Date extracted	Reporting	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Date analyzed	Limits	09/19/02	09/19/02	09/19/02	09/19/02	09/19/02
Di-n-octylphthalate	10	nd	nd			
Benzo(b)fluoranthene	0.1	nd	nd			
Benzo(k)fluoranthene	0.1	nd	nd			
Benzo(a)pyrene	0.1	nd	nd			
Dibenzo(a,h)anthracene	0.1	nd	nd			
Benzo(ghi)perylene	0.1	nd	nd			
Indeno(1,2,3-cd)pyrene	0.1	nd	nd			
Surrogate recoveries						
2-Fluorobiphenyl		102%	0%	97%	100%	
4-Terphenyl-d14		93%	0%	93%	97%	

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits

Acceptable Recovery limits: 65% TO 135%

Acceptable RPD limit: 35%

S2D917-3

Sample Custody Record

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

Samples Shipped to: ______

JOB 7794 LAB NUMBER ______

PROJECT NAME Port of Port Angeles / Graving Dock

HART CROWSER CONTACT Julie Wukelic

SAMPLED BY: William Damow

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	8270 (+TCP/PCP)/(FULL)	RCRA 8 METALS	TPH-NWDX	TSS	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	MW-SE-PA	500mL poly 500mL glass			H2O	X	X	X	X	3	
	MW-SW-PA	↓			↓	X	X	X	X		
	MW-NW-PA					X	X	X	X		NOTE: METALS
	MW-C-PA					X	X	X	X		SAMPLES HAVE
	MW-NE-PA					X	X	X	X		HNO3, BUT NOT
											FILTERED.

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/13/02	SIGNATURE	9/17/2
PRINT NAME William Damow	TIME	PRINT NAME VAL F[illegible]	TIME 1100
COMPANY Hart Crowser		COMPANY CSN	

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

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

TOTAL NUMBER OF CONTAINERS

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

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ______
for Other Contract Requirements

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER ______

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

Sample Custody Record

S20917-3

Samples Shipped to:

HARTCROWSER

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

JOB 7794 LAB NUMBER
PROJECT NAME Port of Port Angeles / Graving Dock
HART CROWSER CONTACT Julie Wukelic
SAMPLED BY: WILLIAM DAMON

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	FULL 8270	TOTAL RCRA 9 METALS	TPH-NWDX	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	HC-SW-PA S-2	4oz Glass JARS			SOIL	X	X	X		
	S-4	" "			SOIL	X	X	X		

OK to run by J Wukelic 09/19/02 14:00
VFI

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/16/02	Val Ivanov SIGNATURE	9/17/02
Julie Wukelic PRINT NAME	TIME	Val Ivanov PRINT NAME	TIME
Hart Crowser COMPANY		ESN NW COMPANY	11:00

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

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No.
for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER

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

Sample Custody Record

S20917-3

Samples Shipped to: ____________________

HARTCROWSER

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

JOB 7794 LAB NUMBER ____________

PROJECT NAME Port of Port Angeles / Graving Dock

HART CROWSER CONTACT Julie Wukelic

SAMPLED BY: William Damon

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	8270 + (TCLP/PCP) (Full)	RCRA 8 Metals	TPH-NWDx											NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	HC-SL-PA S-1	4oz. Glass Jars			SOIL	X	X	⊗												
	S-2					X	X	X												~~Hold these samples~~
	S-3							X												~~until authorized~~
	S-4					X	X	⊗												
	S-6							⊗												OK to run
	HC-NE-PA S-3					X	X	X												by J Wukelic
	S-5					X	X	X												09/19/02 14:00
	HC-C-PA S-2					X	X	X												VOZ
	S-6					X	X	X												
	HC-NW-PA S-3					X	X	X												
	S-6					X	X	X												

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/13/02	SIGNATURE	9/17/2
PRINT NAME William Damon	TIME	PRINT NAME W Damon	TIME
COMPANY Hart Crowser		COMPANY ESN	9/17 11:00

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

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ____________ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:

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

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

Sample Custody Record

S017-3

Samples Shipped to:

HARTCROWSER

Hart Crowser, In
1910 Fairview Avenue Ea
Seattle, Washington 98102-36
Phone: 206-324-9530 FAX: 206-328-55

JOB 7794 LAB NUMBER

PROJECT NAME Port of Port Angeles / Graving Dock

HART CROWSER CONTACT Julie Wukelic

SAMPLED BY: William Damon

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	8021 (TCE) (PCE)	RCRA 8 Metals	TPH-NWDx	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	11C-WPT S-1	4 Glass Jars			Soil	X	X	X		
	S-2					X	X	X		HOLD This sample
	S-3							X		
	S-4					X	X	X		
	S-5							X		
	11-NE PA S-2					X	X	X		
	S-5					X	X	X		Run RCRA 8 only
	11-C PA S-2					X	X	X		
	S-6					X	X	X		VF
	11-NW PA S-3					X	X	X		
	S-6	▽			▽	X	X	X		

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/17/12	SIGNATURE	9/17/12
William Damon PRINT NAME	TIME	PRINT NAME	TIME
Hart Crowser COMPANY		COMPANY	11:00

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/18/12	SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work ~~Order No.~~ ____________ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER

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

Sample Custody Record

320917-3

Samples Shipped to: ______

HARTCROWSER

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

JOB 7774 LAB NUMBER ______

PROJECT NAME [illegible]

HART CROWSER CONTACT [illegible]

SAMPLED BY: WILLIAM SAMON

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	~~[illegible]~~	RCRA 8 METAL	~~[illegible]~~												NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	[illegible] S-2	[illegible]			SOIL	X	X	X													
	S-4	" "			SOIL	X	X	X													

Run RCRA8 only!

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/1/12	SIGNATURE	9/17/1
PRINT NAME [illegible]	TIME	PRINT NAME [illegible]	TIME
COMPANY Hart Crowser		COMPANY	1100

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/18/12	SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ______ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER ______

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

STL Seattle

Sample Identification:

Lab. No.	Client ID	Date/Time Sampled	Matrix
108706-1	MW-SE-PA	09-13-02 *	Liquid
108706-2	MW-SW-PA	09-13-02 *	Liquid
108706-3	MW-NW-PA	09-13-02 *	Liquid
108706-4	MW-C-PA	09-13-02 *	Liquid
108706-5	MW-NE-PA	09-13-02 *	Liquid

* - Sampling time not specified for this sample

STL Seattle

Client Name	ESN Northwest, Inc.
Project Name	Port of Angeles
Date Received	09-18-02

General Chemistry Parameters

Client Sample ID MW-SE-PA
Lab ID 108706-01

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Suspended Solids	EPA 160.2	09-19-02	mg/L	59	5

Client Sample ID MW-SW-PA
Lab ID 108706-02

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Suspended Solids	EPA 160.2	09-19-02	mg/L	1,100	20

Client Sample ID MW-NW-PA
Lab ID 108706-03

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Suspended Solids	EPA 160.2	09-19-02	mg/L	103	10

Client Sample ID MW-C-PA
Lab ID 108706-04

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Suspended Solids	EPA 160.2	09-19-02	mg/L	187	10

Client Sample ID MW-NE-PA
Lab ID 108706-05

Parameter	Method	Date Analyzed	Units	Result	PQL
Total Suspended Solids	EPA 160.2	09-19-02	mg/L	245	10

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SE-PA
Lab ID:	108706-01
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Barium	0.0227	0.005	
Cadmium	ND	0.005	
Chromium	ND	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SE-PA
Lab ID:	108706-01
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	5

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.0104	0.0025	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SE-PA
Lab ID:	108706-01
Date Received:	9/18/02
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SW-PA
Lab ID:	108706-02
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Barium	0.0274	0.005	
Cadmium	ND	0.005	
Chromium	0.0226	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SW-PA
Lab ID:	108706-02
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	5

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.0312	0.0025	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-SW-PA
Lab ID:	108706-02
Date Received:	9/18/02
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	0.000263	0.0002	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NW-PA
Lab ID:	108706-03
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	Result (mg/L)	PQL	Flags
Barium	0.0115	0.005	
Cadmium	ND	0.005	
Chromium	ND	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

10

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NW-PA
Lab ID:	108706-03
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	5

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	Flags
Arsenic	ND	0.0025	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NW-PA
Lab ID:	108706-03
Date Received:	9/18/02
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-C-PA
Lab ID:	108706-04
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Barium	0.0136	0.005	
Cadmium	ND	0.005	
Chromium	ND	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-C-PA
Lab ID:	108706-04
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	5

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	0.00991	0.0025	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-C-PA
Lab ID:	108706-04
Date Received:	9/18/02
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	PQL	Flags
Mercury	ND	0.0002	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NE-PA
Lab ID:	108706-05
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Barium	0.0212	0.005	
Cadmium	ND	0.005	
Chromium	0.0106	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NE-PA
Lab ID:	108706-05
Date Received:	9/18/02
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	5

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	PQL	Flags
Arsenic	ND	0.0025	

STL Seattle

Client Name	ESN Northwest, Inc.
Client ID:	MW-NE-PA
Lab ID:	108706-05
Date Received:	9/18/02
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

QUALITY CONTROL REPORT

Client Sample ID: MW-NW-PA
Lab ID: 108706-03
QC Batch Number: 1114-50

Method Blank

Parameter	Result (mg/L)	PQL
Total Suspended Solids	ND	2

Duplicate

Parameter	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD (%)	Flag
Total Suspended Solids	103	103	0.0	

STL Seattle

Lab ID:	Method Blank - TP935
Date Received:	-
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
Dilution Factor	1

Metals by ICP - USEPA Method 6010

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Barium	ND	0.005	
Cadmium	ND	0.005	
Chromium	ND	0.01	
Lead	ND	0.01	
Selenium	ND	0.05	
Silver	ND	0.01	

STL Seattle

Matrix Spike Report

Client Sample ID:	SW-1
Lab ID:	108690-01
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
QC Batch ID:	TP935

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Spike Amount (mg/L)	MS Result (mg/L)	MS % Rec.	Flag
Barium	0.073	4	3.66	90	
Cadmium	0	0.1	0.0921	92	
Chromium	0.022	0.4	0.416	98	
Lead	0	1	0.928	93	
Selenium	0	4	3.9	98	
Silver	0	0.6	0.588	98	

STL Seattle

Duplicate Report

Client Sample ID:	SW-1
Lab ID:	108690-01
Date Prepared:	9/19/02
Date Analyzed:	9/19/02
QC Batch ID:	TP935

Metals by ICP - USEPA Method 6010

Parameter Name	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD %	Flag
Barium	0.073	0.072	1.4	
Cadmium	0	0	NC	
Chromium	0.022	0.022	0.0	
Lead	0	0	NC	
Selenium	0	0	NC	
Silver	0	0	NC	

22

STL Seattle

Lab ID:	Method Blank - TP935
Date Received:	-
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
Dilution Factor	1

Metals by ICP-MS - USEPA Method 6020

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Arsenic	ND	0.0005	

STL Seattle

Matrix Spike Report

Client Sample ID:	SW-1
Lab ID:	108690-01
Date Prepared:	9/19/02
Date Analyzed:	9/20/02
QC Batch ID:	TP935

Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Arsenic	0.0064	4	3.87	97	

24

STL Seattle

Duplicate Report

Client Sample ID: SW-1
Lab ID: 108690-01
Date Prepared: 9/19/02
Date Analyzed: 9/20/02
QC Batch ID: TP935

Metals by ICP-MS - USEPA Method 6020

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Arsenic	0.0064	0.0068	-6.1	

STL Seattle

Lab ID:	Method Blank - ZT1117
Date Received:	-
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
Dilution Factor	1

Mercury by CVAA - USEPA Method 7470

Analyte	**Result (mg/L)**	**PQL**	**Flags**
Mercury	ND	0.0002	

STL Seattle

Blank Spike/Blank Spike Duplicate Report

Lab ID:	ZT1117
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
QC Batch ID:	ZT1117

Mercury by CVAA - USEPA Method 7470

Compound Name	**Blank Result (mg/L)**	**Spike Amount (mg/L)**	**BS Result (mg/L)**	**BS % Rec.**	**BSD Result (mg/L)**	**BSD % Rec.**	**RPD**	**Flag**
Mercury	0	0.002	0.00188	93.8	0.00188	94.2	0.43	

STL Seattle

Matrix Spike Report

Client Sample ID:	MW-SE-PA
Lab ID:	108706-01
Date Prepared:	9/23/02
Date Analyzed:	9/23/02
QC Batch ID:	ZT1117

Mercury by CVAA - USEPA Method 7470

Parameter Name	**Sample Result (mg/L)**	**Spike Amount (mg/L)**	**MS Result (mg/L)**	**MS % Rec.**	**Flag**
Mercury	0	0.002	0.00161	81	

STL Seattle

Duplicate Report

Client Sample ID: MW-SE-PA
Lab ID: 108706-01
Date Prepared: 9/23/02
Date Analyzed: 9/23/02
QC Batch ID: ZT1117

Mercury by CVAA - USEPA Method 7470

Parameter Name	**Sample Result (mg/L)**	**Duplicate Result (mg/L)**	**RPD %**	**Flag**
Mercury	0	0	NC	

ESN
NORTHWEST
Environmental
Services Network

September 26, 2002

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

Dear Ms. Wukelic:

Please find enclosed the analytical data report for the Port Angeles Project in Washington. Soil samples were analyzed for Metals by EPA Method 7000 Series on September 20, 2002.

The results of these analyses are summarized in the attached tables. All soil values are reported on a dry weight basis. Applicable detection limits and QA/QC data are included. An invoice for this work has been sent to your accounting department.

ESN Northwest appreciates the opportunity to have provided analytical services to Hart Crowser for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you, and we are looking forward to the next opportunity to work together.

Sincerely,

Michael A

Michael A. Korosec
President

677 Woodland Square Lp. SE, Suite D ■ Lacey, Washington 98503 ■ 360.459.4670 ■ FAX 360.459.3432
Web Site: *www.ESN-USA.com* E-Mail: *esnnw@aol.com*

ESN NORTHWEST CHEMISTRY LABORATORY

PORT OF PORT ANGELES PROJECT
Port Angeles, Washington
Hart Crowser, Inc.
Client Project #7794

Heavy Metals in Soil by EPA-7000 Series

Sample Number	Date Analyzed	Lead (Pb) EPA 7420 (mg/kg)	Cadmium (Cd) EPA 7130 (mg/kg)	Chromium (Cr) EPA 7190 (mg/kg)	Arsenic (As) EPA 7061 (mg/kg)	Silver (Ag) EPA 7760 (mg/kg)	Barium (Ba) EPA 7080 (mg/kg)	Selenium (Se) EPA 7741 (mg/kg)	Mercury (Hg) EPA 7471 (mg/kg)
Method Blank	9/20/02	nd	nd	nd	nd	nd	nd	nd	nd
HC-SE-PA-S-1	9/20/02	55	nd	30	nd	nd	nd	nd	nd
HC-SE-PA-S-2	9/20/02	nd	nd	10	nd	nd	nd	nd	nd
HC-SE-PA-S-4	9/20/02	nd	nd	5	nd	nd	nd	nd	nd
HC-NE-PA-S-3	9/20/02	nd	nd	10	nd	nd	nd	nd	nd
HC-NE-PA-S-5	9/20/02	nd	nd	8	nd	nd	nd	nd	nd
HC-C-PA-S-2	9/20/02	nd	nd	nd	nd	nd	nd	nd	nd
HC-C-PA-S-6	9/20/02	nd	nd	5	nd	nd	nd	nd	nd
HC-NW-PA-S-3	9/20/02	nd	nd	5	nd	nd	nd	nd	nd
HC-NW-PA-S-6	9/20/02	nd	nd	6	nd	nd	nd	nd	nd
HC-NW-PA-S-6 Dup	9/20/02	nd	nd	5	nd	nd	nd	nd	nd
HC-SW-PA-S-2	9/20/02	nd	nd	6	nd	nd	nd	nd	nd
HC-SW-PA-S-4	9/20/02	nd	nd	5	nd	nd	nd	nd	nd
Method Detection Limits		5	1	5	5	20	20	50	0.5

"nd" Indicates not detected at listed detection limits.

ANALYSES PERFORMED BY: Dean Phillips

ESN NORTHWEST CHEMISTRY LABORATORY

PORT OF PORT ANGELES PROJECT
Port Angeles, Washington
Hart Crowser, Inc.
Client Project #7794

QA/QC Data - Total Metals EPA-7000 Series Analyses

Sample Number: HC-NW-PA-S-6

	Matrix Spike			Matrix Spike Duplicate			RPD
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	(%)
Lead	125	115	92	125	120	96	4.26
Cadmium	12.5	12.5	100	12.5	12.2	98	2.43
Chromium	125	120	96	125	120	96	0.00
Arsenic	125	121	97	125	121	97	0.00

	Laboratory Control Sample		
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)
Lead	125	124	99
Cadmium	12.5	12.7	102
Chromium	125	132	106
Arsenic	125	115	92

ACCEPTABLE RECOVERY LIMITS FOR MATRIX SPIKES: 65%-135%
ACCEPTABLE RPD IS 35%

ANALYSES PERFORMED BY: Dean Phillips

Sample Custody Record

20917-3

Samples Shipped to: ____________

HARTCROWSER

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

JOB 7714 LAB NUMBER ____________

PROJECT NAME [illegible] / [illegible]

HART CROWSER CONTACT John [illegible]

SAMPLED BY: William Damon

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	8270 (TCLP)	RCRA 8 Metals	TPH-[illegible]	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	HC-[illegible] S-1	4 [illegible]			SOIL	X	X	X		
	S-2					X	⊗	X		HOLD This sample
	S-3							X		
	S-4					X	X	X		
	S-5							X		
	H-NE PA S-2					X	X	X		Run RCRA 8 only
	S-5					X	X	X		
	H-C-PA S-[illegible]					X	X	X		
	S-6					X	X	X		VH
	H-NW PA S-3					X	X	X		
	S-6					X	X	X		

REQUESTED ANALYSIS

HCSE PA S-2
TAKE OFF
HOLD
AS PER MO
9/20/02

RELINQUISHED BY
SIGNATURE
PRINT NAME William Damon
COMPANY Hart Crowser
DATE 9/17/02
TIME

RECEIVED BY
SIGNATURE
PRINT NAME [illegible] Vargu
COMPANY [illegible]
DATE 9/17/02
TIME 11:00

RELINQUISHED BY
SIGNATURE V. Olver
PRINT NAME
COMPANY
DATE 9/18/02
TIME

RECEIVED BY
SIGNATURE
PRINT NAME Sherry Chilcutt
COMPANY ESN NW
DATE 9-19-02
TIME

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ____________ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER ____________

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

Sample Custody Record

20917-3

Samples Shipped to: ______________________

HARTCROWSER

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

JOB 7794 LAB NUMBER ______

PROJECT NAME [illegible]

HART CROWSER CONTACT Julie Wukelic

SAMPLED BY: William Samon

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	REQUESTED ANALYSIS [illegible]	 8 METAL	 [illegible]	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	[illegible] 2	[illegible]			SOIL	X	X	X		
	[illegible] 4	"			SOIL	X	X	X		

Run RCRA8 only!
V

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE PRINT NAME Julie Wukelic COMPANY Hart Crowser	9/1?/02 TIME	SIGNATURE PRINT NAME [illegible] COMPANY [illegible]	9/17/2 TIME 11:00
SIGNATURE PRINT NAME COMPANY	9/18/2 TIME	SIGNATURE Sherry Chilcutt PRINT NAME Sherry Chilcutt COMPANY ESNW	9-18-02 TIME

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. ______________________ for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☐ STANDARD
☐ 72 HOURS OTHER ____________

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Anchorage
Boston
Denver
Edmonds
Eureka
Jersey City
Juneau
Long Beach
Portland
Seattle

December 6, 2002

Washington State Department of Transportation
c/o Mr. Tony Allen, P.E.
Material Laboratory
P.O. Box 47365
Olympia, Washington 98504

Re: Supplemental Environmental Investigation Results
Port of Port Angeles Graving Yard
Agreement No. Y-7672, Task 4
7794

Dear Mr. Allen:

This letter report presents the results of our supplemental environmental investigation at the subject property located in Port Angeles, Washington (Figure 1). This letter is an addendum to our earlier letter report presenting our environmental investigation results dated October 25, 2002. Please refer to that report for information concerning the project background and subsurface conditions (not repeated herein). This report presents additional supplemental environmental data generated from soil samples collected from the geotechnical borings conducted and reported previously in our draft geotechnical report dated November 18, 2002. Soil boring locations from our various studies are shown on Figure 2. We have modified the existing geotechnical boring logs to indicate the environmental data as presented in Appendix A, and laboratory reports are included in Appendix B.

The purpose of this supplemental investigation was to assess the soil quality in the upper 10 feet for potential environmental impacts.

SUPPLEMENTAL ENVIRONMENTAL FINDINGS

Based on your request, we selected and chemically analyzed nine soil samples from our seven geotechnical borings (HC-1 through HC-7) advanced on the subject property. One or two soil samples from each boring were selected for chemical analysis.

1910 Fairview Avenue East
Seattle, Washington 98102-3699
Fax 206.328.5581
Tel 206.324.9530

Approximate boring locations are shown on Figure 2. Groundwater was generally encountered at a depth of approximately 4.5 to 12.5 feet at the time of drilling, as shown on the boring logs in Appendix A.

Field Screening

The near-surface soil samples from these borings were field screened using a portable photo-ionization detector (PID). The PID readings were generally non-detect in these samples except for low level organic vapors as indicated by the PID readings as displayed on the boring logs in Appendix A. These readings were detected in several near-surface soil samples.

Laboratory Analysis

Based on field observations and sampling depths, nine soil samples were selected for chemical analysis. Select samples were submitted to the Environmental Services Network (ESN) Northwest laboratory (Redmond, Washington), for the following tests, as appropriate:

- Diesel- and oil-range hydrocarbons by Ecology Method NWTPH-D extended;
- RCRA metals (As, Cd, Cr, Ag, Pb, Hg, Ba, Se); and
- Semivolatile Organic Compounds by EPA Method 8270.

Analytical Results

The chemical results for the samples analyzed did not indicate any significant contamination in the soil on the subject property (Table 1). Concentrations of 73 and 54 mg/kg of petroleum hydrocarbons in the diesel-range were detected in the soil samples S-1 and S-2 from HC-3 at depths of 3 to 4 and 8 to 9 feet. Sample S-1 from HC-4 had a heavy oil concentration of 640 mg/kg. Those samples with detected concentration of petroleum hydrocarbons are well below the MTCA Method A cleanup level of 2,000 mg/kg and appear to represent a limited depth range of petroleum-impacted soils at the site.The other soil samples analyzed were non-detect for petroleum hydrocarbons (NWTPH-D extended).

All samples analyzed were non-detect for semivolatile organic compounds (EPA Method 8270) and most of the metals. Low concentrations of chromium were detected in soil sample S-1 collected and analyzed from HC-3, sample S-2 from HC-6, and sample S-1 from

HC-7. These total chromium concentrations are below the Puget Sound background level of 48 mg/kg.

The soil samples analyzed also were non-detect for lead except for soil samples S-1 and S-3 from HC-4, which had concentrations of 140 and 29 mg/kg lead, respectively. The detected concentrations of lead were below the MTCA Method A unrestricted cleanup levels and slightly above the Puget Sound background level.

Conclusions

These chemical results confirm our earlier conclusion that there does not appear to be widespread soil contamination on the subject property. However, as indicated in our earlier report, there is still a possibility of hot spot contamination on the subject property in areas as yet unexplored. These supplemental data from other areas of the site tend to indicate the presence of adverse widespread contamination at the site is unlikely.

Recommendations

As indicated in our earlier report, we still think it prudent to develop a construction contingency plan to be used during future excavations at the property. The contingency plan would layout common-sense criteria for recognizing USTs, suspect soils, or wood debris based on appearance, odor, etc., and would identify chain of command links for notification during construction.

Based on the data results from the soil samples analyzed, the soils with detectable concentrations below MTCA cleanup levels are not required to be disposed of at a licensed solid waste landfill. These soils, therefore, could be reused on-site. However, based on the noted petroleum odor from these areas, we recommend that these soils be reused under asphalt pavement and not reused where there would be contact with the groundwater.

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 Washington State Department of Transportation, for specific application to the subject property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

All MTCA cleanup levels included in this report are provided for comparison purposes only and are based on our understanding of cleanup levels required by Ecology for similar projects. They do not represent MTCA interpretations. By using them for comparison purposes, we are not implying that remedial actions at this site are required under MTCA. Specific MTCA interpretations may involve separate calculations and determinations upon which a range of cleanup standards may be established by Ecology.

Any questions regarding our work and this letter 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.

Julie K W Wukelic

JULIE K. W. WUKELIC
Principal
jkw@hartcrowser.com

BARRY S. CHEN, P.E.
Principal
bsc@hartcrowser.com

Attachments:
Table 1 - Analytical Results for Soil Samples
Figure 1 – Vicinity Map
Figure 2 - Site and Exploration Plan
Appendix A - Supplemental Boring Logs
Appendix B - Laboratory Report
Environmental Services Network Northwest

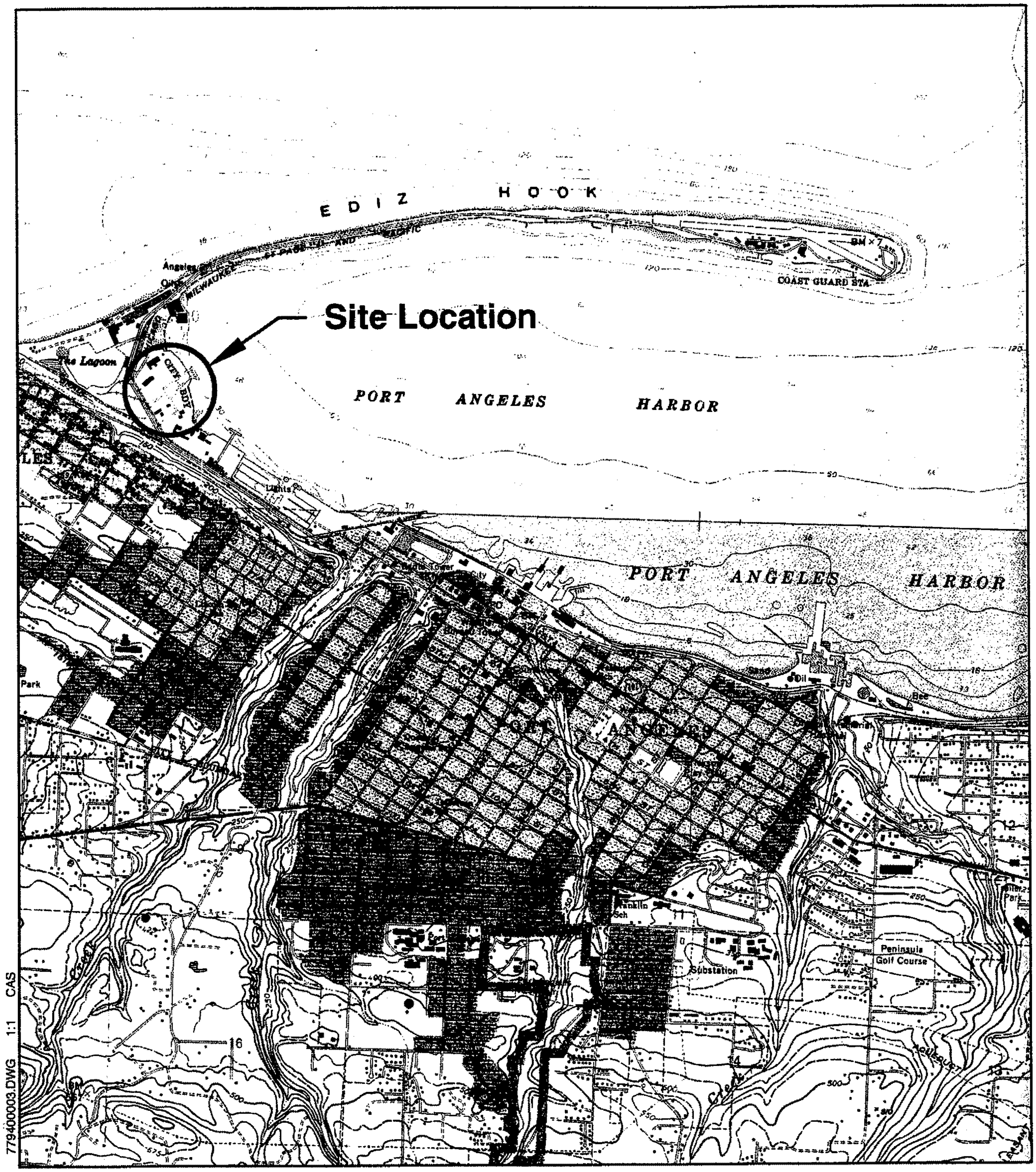
F:\Docs\Jobs\7794\Add.Env.Invest.Rslts.doc

Table 1 - Analytical Results for Soil Samples

Sample ID: Sample Interval PID Reading Sample Depth in Feet	MTCA Method A Unrestricted	Puget Sound Background	HC-1 S-2 0.0 9-10	HC-2 S-2 0.0 9-10	HC-3 S-1 0.0 3-4	HC-3 S-2 0 8-9	HC-4 S-1 0.0 3-4	HC-4 S-3 0.0 13-14	HC-5 S-2 0 5-6	HC-6 S-2 0 9-10	HC-7 S-1 0 3-4
NWTPH-Dx in mg/kg											
Kerosene/Jet fuel	2000	-	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Diesel/Fuel oil	2000	-	20 U	20 U	**73**	**54**	20 U	20 U	20 U	20 U	20 U
Heavy oil	2000	-	50 U	50 U	50 U	50 U	**640**	50 U	50 U	50 U	50 U
Semivolatiles in ug/kg (EPA Method 8270)											
No constituents detected				na		na			na		
Metals in mg/kg											
Arsenic	20	7	5 U	na	5 U	na	5 U	5 U	na	5 U	5 U
Cadmium	2	1	1 U	na	1 U	na	1 U	1 U	na	1 U	1 U
Chromium (c)	19(a)/2000(b)	48	5 U	na	**6**	na	5 U	5 U	na	**7**	**7**
Silver	–	–	20 U	na	20 U	na	20 U	20 U	na	20 U	20 U
Lead	250	24	5 U	na	5 U	na	**140**	**29**	na	5 U	5 U
Mercury	2.0	0.07	0.5 U	na	0.5 U	na	0.5 U	0.5 U	na	0.5 U	0.5 U
Selenium	–	–	50 U	na	50 U	na	50 U	50 U	na	50 U	50 U
Barium	–	–	20 U	na	20 U	na	20 U	20 U	na	20 U	20 U

U = Not detected at indicated detection limit.
(a) Based on hexavalent chromium
(b) Based on trivalent chromium
(c) Hexavalent chromium is not available. Total chromium results do not exceed Puget Sound background of 48 mg/kg.
na = sample not analyzed for specific analyte
– = not criteria specified for specific analyte
Blank indicate analyte not detected in specific sample.

Vicinity Map



Note: Base map prepared from USGS 7.5-minute quadrangle maps Port Angeles, and Ediz Hook, Washington.

0 3,000 4,000

Scale in Feet

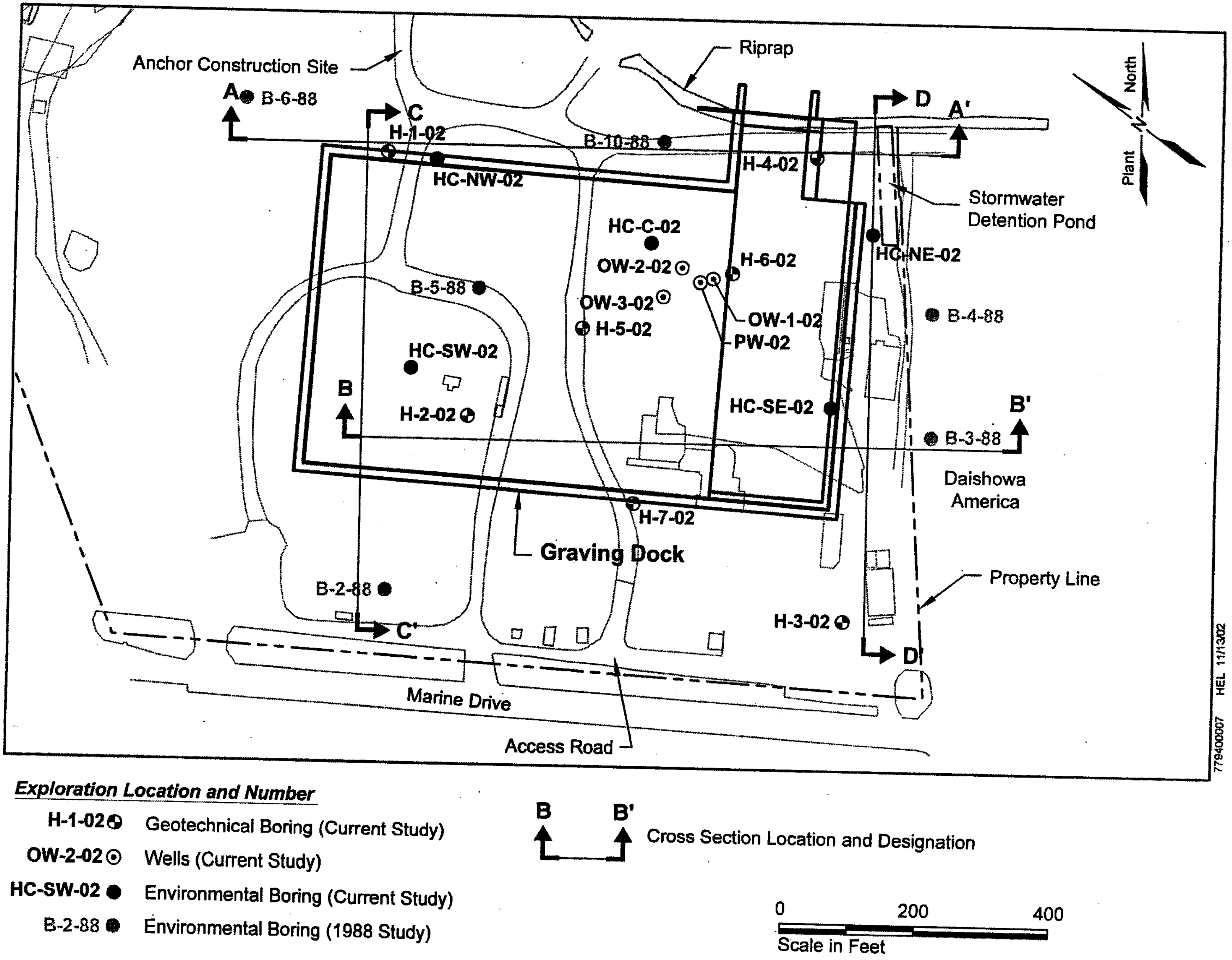
N

HARTCROWSER

7794 **10/02**

Figure 1

Site and Exploration Plan



HARTCROWSER

7794 11/02

Figure 2

APPENDIX A
SUPPLEMENTAL BORING LOGS

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 perceptible moisture
Damp	Some perceptible moisture, probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible 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

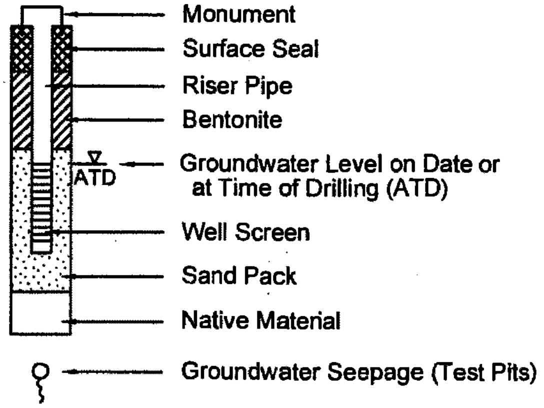
Boring Samples

- ☒ Split Spoon
- ⧅ Shelby Tube
- ▥ Cuttings
- ◫ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

Test Pit Samples

- ☒ Grab (Jar)
- ⧄ Bag
- ⧅ Shelby Tube

Groundwater Observation Wells



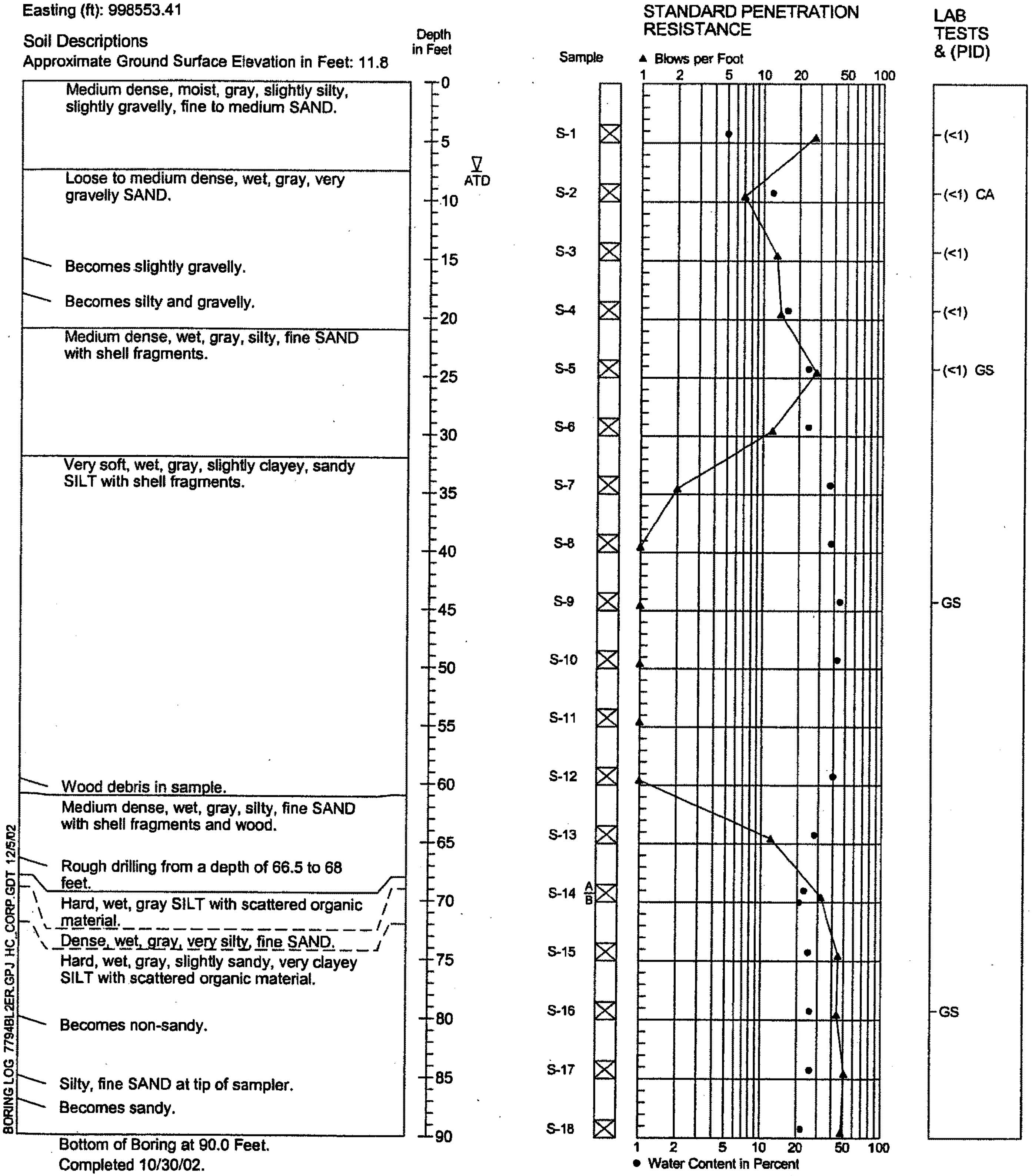
Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
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 Detector Reading
CA	Chemical Analysis
DT	*In Situ* Density Test

HARTCROWSER
7794 12/02
Figure A-1

Boring Log H-1-02

Northing (ft): 423863.51
Easting (ft): 998553.41



Soil Descriptions
Approximate Ground Surface Elevation in Feet: 11.8

Medium dense, moist, gray, slightly silty, slightly gravelly, fine to medium SAND.

Loose to medium dense, wet, gray, very gravelly SAND.

Becomes slightly gravelly.

Becomes silty and gravelly.

Medium dense, wet, gray, silty, fine SAND with shell fragments.

Very soft, wet, gray, slightly clayey, sandy SILT with shell fragments.

Wood debris in sample.

Medium dense, wet, gray, silty, fine SAND with shell fragments and wood.

Rough drilling from a depth of 66.5 to 68 feet.

Hard, wet, gray SILT with scattered organic material.

Dense, wet, gray, very silty, fine SAND.

Hard, wet, gray, slightly sandy, very clayey SILT with scattered organic material.

Becomes non-sandy.

Silty, fine SAND at tip of sampler.

Becomes sandy.

Bottom of Boring at 90.0 Feet.
Completed 10/30/02.

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-2

Boring Log H-2-02

Northing (ft): 423531.11
Easting (ft): 998308.07

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 12.9

Medium dense, moist, gray, slightly silty, slightly gravelly, fine to medium SAND.

Medium dense, wet, gray, slightly silty, very gravelly SAND.

Very dense, wet, gray, gravelly SAND.

Dense, wet, gray, slightly silty, very sandy GRAVEL.

Loose to medium dense, wet, gray, silty, fine SAND, with shell fragments.

Very dense, wet, gray, gravelly, silty, fine SAND.

Hard, moist, gray, slightly sandy, clayey SILT.

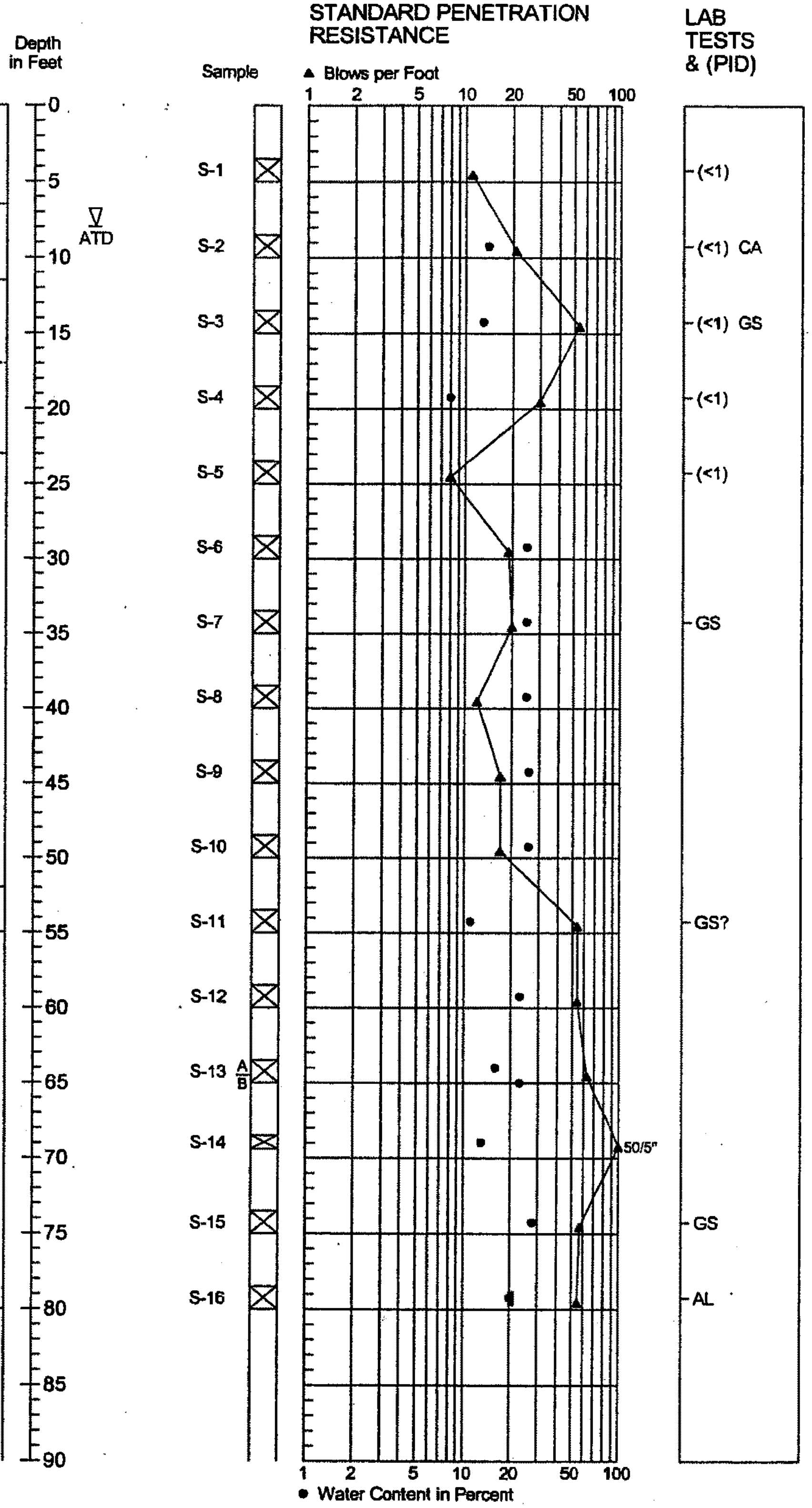
Interbedded layer of very dense, wet, dark gray, silty, fine to medium SAND.

Interbedded layer of very dense, wet, dark gray, slightly silty, gravelly SAND.

Interbedded layers of organic material.

Interbedded layers of silty, fine SAND.

Bottom of Boring at 80.0 Feet.
Completed 10/30/02.



BORING LOG 7794BL2ER.GPJ HC_CORP.GDT 12/5/02

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-3

Boring Log H-3-02

Northing (ft): 422897.63
Easting (ft): 998401.54

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 9.7

Depth in Feet

4 inches of Asphalt over damp, gray, silty, fine to medium SAND.

Very stiff, moist to wet, gray, very silty, fine SAND with trace gravels and wood debris.

Water added at a depth of 5 feet.

Medium dense, wet, gray, silty, very sandy GRAVEL with scattered root fragments.

Very dense, wet, gray, slightly silty, very sandy GRAVEL.

12 inches of heave at S-3.

6 inches of heave at S-4. Mud added to hole.

Dense, wet, gray, very silty, fine SAND.

Scattered gravels at a depth of 31 feet.

Hard, moist, gray, sandy SILT with scattered shell fragments.

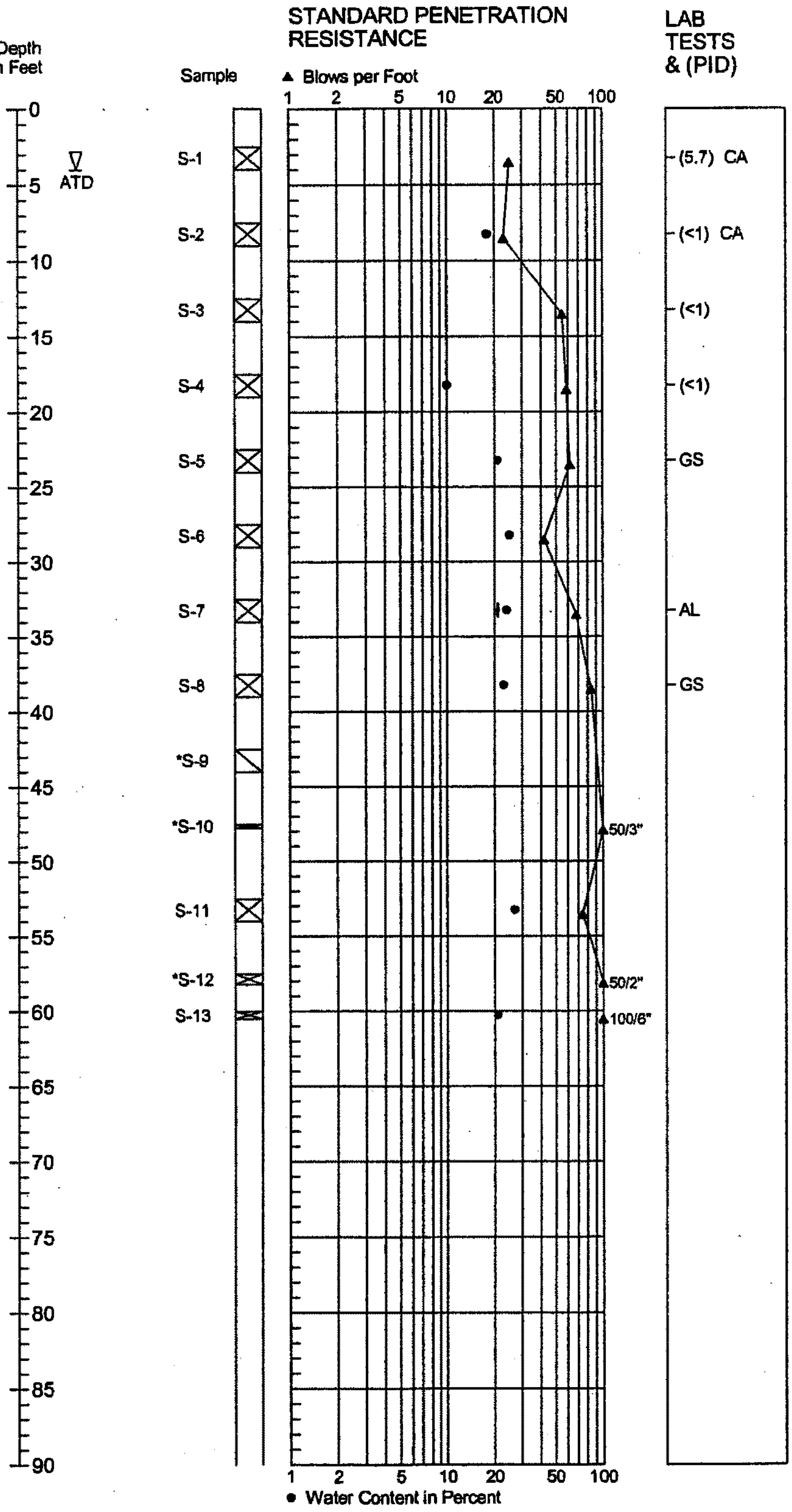
Scattered gravels at a depth of 34 feet.

Becomes slightly sandy.

Becomes sandy.

Bottom of Boring at 60.5 Feet.
Completed 10/28/02.

BORING LOG 7794BL2ER.GPJ HC_CORP.GDT 12/5/02



HARTCROWSER
7794 *10/02*
Figure A-4

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

Boring Log H-4-02

Northing (ft): 423342.8
Easting (ft): 998932.95

Soil Descriptions
Approximate Ground Surface Elevation in Feet: 15.2

Damp, brown, slightly gravelly, sandy SILT over medium dense, damp, dark gray, gravelly, silty SAND with shell fragments.

SILT with organic material.

Very dense, wet, dark gray, silty, very sandy GRAVEL with scattered wood fragments.

Loose, wet, dark gray, very silty, fine SAND.

Brief gravelly drill action at 18 feet.

Dense to medium dense, wet, gray, very silty, fine SAND with shell fragments.

Medium stiff, wet, gray, slightly clayey, very sandy SILT with shell fragments and trace organic material.

Becomes very soft and sandy.

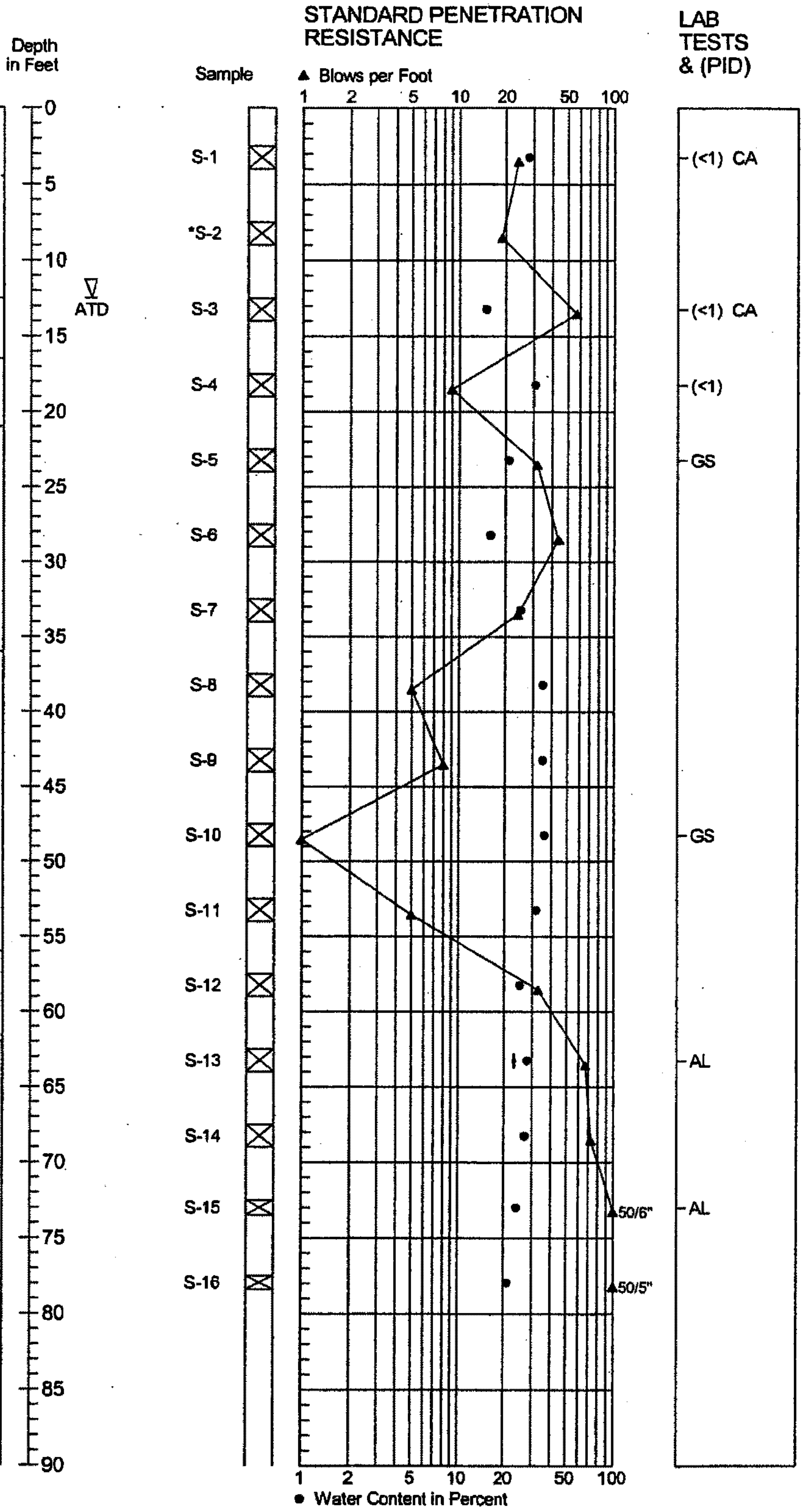
Becomes medium stiff.

Dense, wet, gray, very silty, fine SAND with shell fragments and trace gravels.

Hard, moist, gray, sandy SILT with shell fragments.

Very dense, moist, gray, very silty, fine SAND.

Bottom of Boring at 78.4 Feet.
Completed 10/31/02.



BORING LOG 7794BL2ER.GPJ HC_CORP.GDT 12/5/02

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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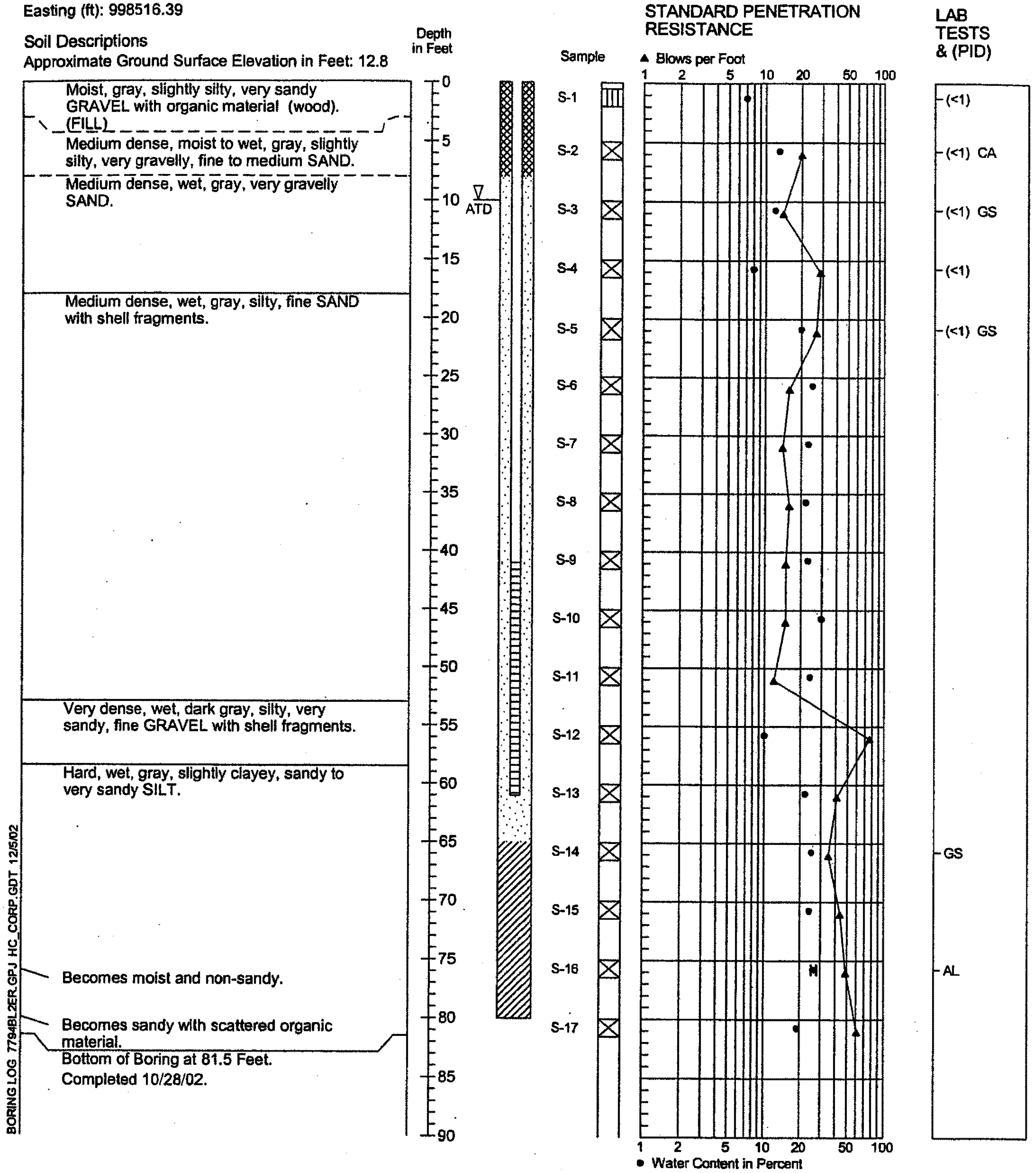
Figure A-5

Monitoring Well Log H-5-02

Northing (ft): 423471.57
Easting (ft): 998516.39



Soil Descriptions
Approximate Ground Surface Elevation in Feet: 12.8

Moist, gray, slightly silty, very sandy GRAVEL with organic material (wood). (FILL)

Medium dense, moist to wet, gray, slightly silty, very gravelly, fine to medium SAND.

Medium dense, wet, gray, very gravelly SAND.

Medium dense, wet, gray, silty, fine SAND with shell fragments.

Very dense, wet, dark gray, silty, very sandy, fine GRAVEL with shell fragments.

Hard, wet, gray, slightly clayey, sandy to very sandy SILT.

Becomes moist and non-sandy.

Becomes sandy with scattered organic material.

Bottom of Boring at 81.5 Feet.
Completed 10/28/02.

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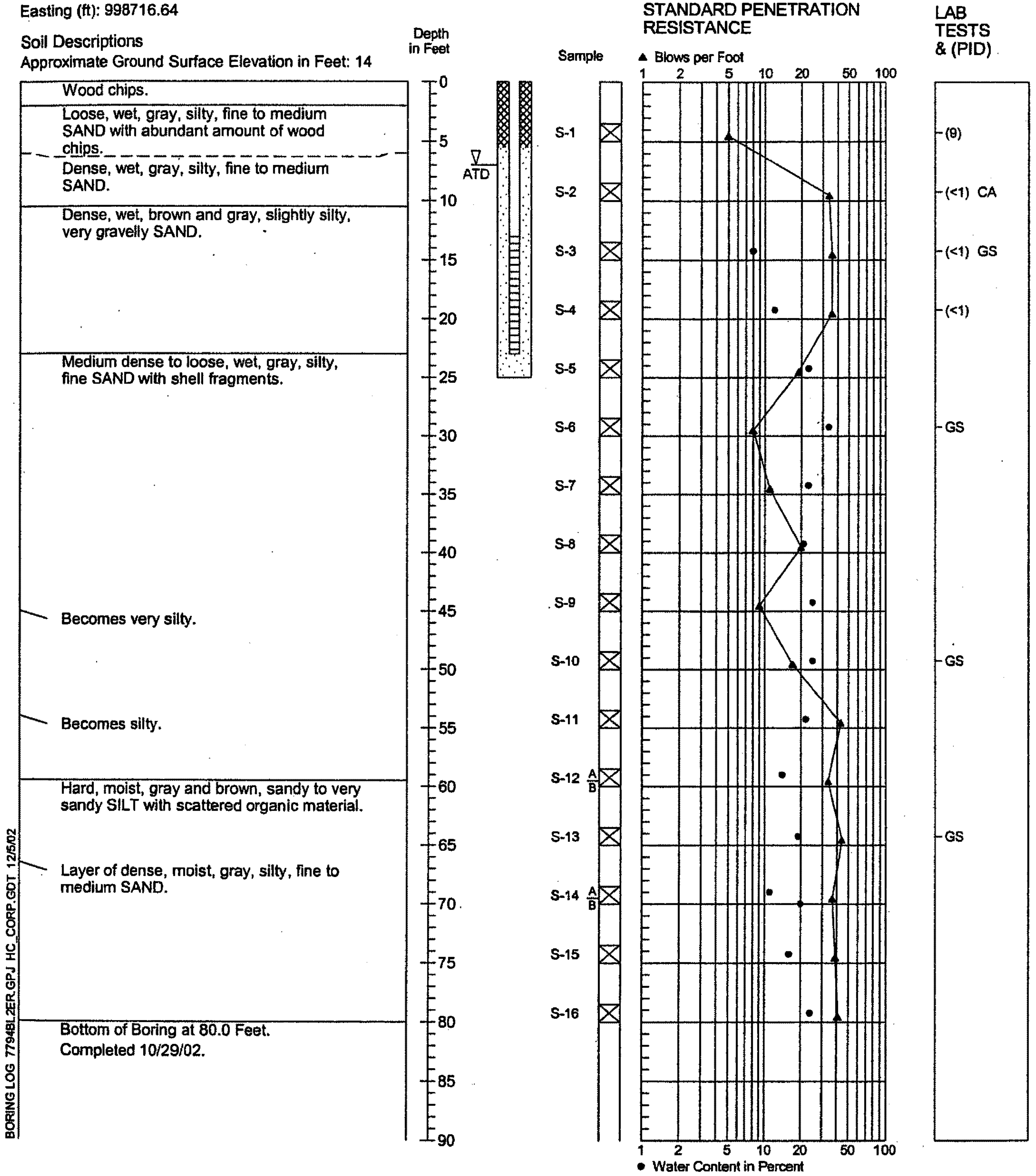
7794 *10/02*

Figure A-6

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

Monitoring Well Log H-6-02

Northing (ft): 423339.67
Easting (ft): 998716.64



Soil Descriptions
Approximate Ground Surface Elevation in Feet: 14

Wood chips.

Loose, wet, gray, silty, fine to medium SAND with abundant amount of wood chips.

Dense, wet, gray, silty, fine to medium SAND.

Dense, wet, brown and gray, slightly silty, very gravelly SAND.

Medium dense to loose, wet, gray, silty, fine SAND with shell fragments.

Becomes very silty.

Becomes silty.

Hard, moist, gray and brown, sandy to very sandy SILT with scattered organic material.

Layer of dense, moist, gray, silty, fine to medium SAND.

Bottom of Boring at 80.0 Feet.
Completed 10/29/02.

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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

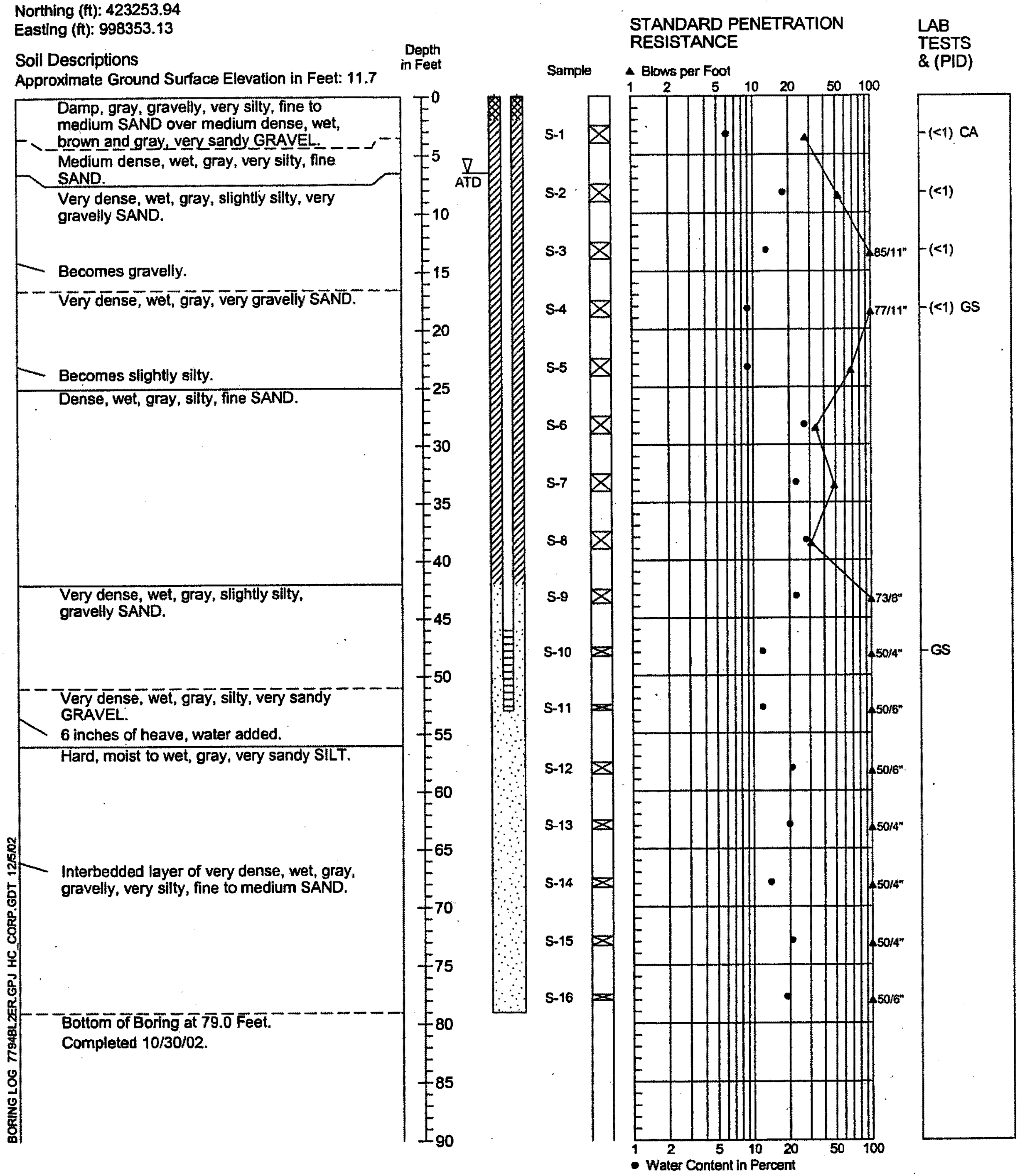
HARTCROWSER

7794 **10/02**

Figure A-7

Monitoring Well Log H-7-02

Northing (ft): 423253.94
Easting (ft): 998353.13



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. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

7794 *10/02*

Figure A-8

APPENDIX B
CHEMICAL DATA QUALITY REVIEW AND LABORATORY REPORT

APPENDIX B
CHEMICAL DATA QUALITY REVIEW AND LABORATORY REPORT

Chemical Data Quality Review

Nine soil samples were collected between October 29 and 31, 2002. Samples were submitted to ESN Northwest of Bellevue, Washington, for analysis of at least two of the following:

- Diesel- and oil-range petroleum hydrocarbons (NWTPH-Dx);
- Semivolatile organic compounds (EPA Method 8270);
- RCRA 8 metals (EPA 7000 Series); and
- Salinity (AOAC 935.47).

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

- Holding times;
- Method blanks;
- Surrogate recoveries;
- Laboratory control sample (LCS) recoveries;
- Matrix spike and matrix spike duplicate (MS/MSD) recoveries; and
- Laboratory duplicate and MS/MSD relative percent difference values (RPD).

All required holding times were met. No method blank contamination was detected. Surrogate recoveries were within laboratory control limits. LCS and MS recoveries were within laboratory control limits. Laboratory duplicate and MS/MSD RPDs were acceptable. The data are acceptable for use.

CERTIFICATES OF ANALYSIS
ENVIRONMENTAL SERVICES NETWORK NORTHWEST

ESN
NORTHWEST
Environmental
Services Network

November 14, 2002

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

Dear Ms. Wukelic:

Please find enclosed the analytical data report for the Port of Port Angeles Project in Port Angeles, Washington. Soil samples were analyzed for Diesel and Oil by NWTPH-Dx/Dx Extended, Semi-VOC's by Method 8270, RCRA 8 Metals by Method 7000 series, and Salinity by AOAC 935.47 on November 5 – 11, 2002.

The results of these analyses are summarized in the attached tables. All soil values are reported on a dry weight basis. Applicable detection limits and QA/QC data are included. An invoice for this work has been sent to your accounting department.

ESN Northwest appreciates the opportunity to have provided analytical services to Hart Crowser for this project. If you have any further questions about the data report, please give me a call. It was a pleasure working with you, and we are looking forward to the next opportunity to work together.

Sincerely,

Michael A

Michael A. Korosec
President

677 Woodland Square Lp. SE, Suite D ◆ Lacey, Washington 98503 ◆ 360.459.4670 ◆ FAX 360.459.3432
Web Site: *www.ESN-USA.com* E-Mail: *esnnw@aol.com*

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S21105-1
Client:	HART CROWSER
Client Job Name:	PORT OF PORT ANGELES
Client Job Number:	7794

Analytical Results

NWTPH-Dx, mg/kg		MTH BLK	HC1-S2	HC2-S2	HC3-S1	HC3-S2
Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	11/05/02	11/05/02	11/05/02	11/05/02	11/05/02
Date analyzed	Limits	11/05/02	11/05/02	11/05/02	11/05/02	11/05/02
Kerosene/Jet fuel	20	nd	nd	nd	nd	nd
Diesel/Fuel oil	20	nd	nd	nd	73	54
Heavy oil	50	nd	nd	nd	nd	nd
Surrogate recoveries:						
Fluorobiphenyl		107%	104%	111%	110%	111%
o-Terphenyl		107%	114%	124%	120%	122%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
na - not analyzed
C - coelution with sample peaks
M - matrix interference
J - estimated value
Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S21105-1
Client:	HART CROWSER
Client Job Name:	PORT OF PORT ANGELES
Client Job Number:	7794

Analytical Results			DUPL	RPD		
NWTPH-Dx, mg/kg		**HC4-S1**	**HC4-S1**	**HC4-S1**	**HC4-S3**	**HC5-S2**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	11/05/02	11/05/02	11/05/02	11/05/02	11/05/02
Date analyzed	Limits	11/05/02	11/05/02	11/05/02	11/05/02	11/05/02
Kerosene/Jet fuel	20	nd	nd		nd	nd
Diesel/Fuel oil	20	nd	nd		nd	nd
Heavy oil	50	640	660	3%	nd	nd
Surrogate recoveries:						
Fluorobiphenyl		107%	115%		113%	111%
o-Terphenyl		113%	118%		128%	126%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
na - not analyzed
C - coelution with sample peaks
M - matrix interference
J - estimated value
Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number: S21105-1
Client: HART CROWSER
Client Job Name: PORT OF PORT ANGELES
Client Job Number: 7794

Analytical Results

NWTPH-Dx, mg/kg		HC6-S2	HC7-S1
Matrix	Soil	Soil	Soil
Date extracted	Reporting	11/05/02	11/05/02
Date analyzed	Limits	11/05/02	11/05/02
Kerosene/Jet fuel	20	nd	nd
Diesel/Fuel oil	20	nd	nd
Heavy oil	50	nd	nd
Surrogate recoveries:			
Fluorobiphenyl		112%	107%
o-Terphenyl		127%	125%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
na - not analyzed
C - coelution with sample peaks
M - matrix interference
J - estimated value
Results reported on dry-weight basis
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number: S21105-1
Client: HART CROWSER
Client Job Name: PORT OF PORT ANGELES
Client Job Number: 7794

Analytical Results

8270, mg/kg		MTH BLK	LCS	HC-1 S-2	HC-3 S-1	HC-3 S-1 (2)	HC-4 S-1
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Date analyzed	Limits	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Penatchloroethane	0.10	nd		nd	nd	nd	nd
Phenol	0.10	nd		nd	nd	nd	nd
2-Chlorophenol	0.10	nd		nd	nd	nd	nd
Bis (2-chloroethyl) ether	0.10	nd		nd	nd	nd	nd
1,3-Dichlorobenzene	0.10	nd		nd	nd	nd	nd
1,4-Dichlorobenzene	0.10	nd	115%	nd	nd	nd	nd
1,2-Dichlorobenzene	0.10	nd		nd	nd	nd	nd
2-Methylphenol (o-cresol)	0.10	nd		nd	nd	nd	nd
Bis (2-chloroisopropyl) ether	0.10	nd		nd	nd	nd	nd
3,4-Methylphenol (m,p-cresol)	0.10	nd		nd	nd	nd	nd
2-Nitrophenol	0.50	nd		nd	nd	nd	nd
2,4-Dimethylphenol	0.50	nd		nd	nd	nd	nd
Bis (2-chloroethoxy) methane	0.10	nd		nd	nd	nd	nd
2,4-Dichlorophenol	0.50	nd		nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.10	nd	123%	nd	nd	nd	nd
Naphthalene	0.10	nd		nd	nd	nd	nd
2,6-Dichlorophenol	0.50	nd		nd	nd	nd	nd
Hexachloropropylene	0.50	nd		nd	nd	nd	nd
Hexachlorobutadiene	0.50	nd		nd	nd	nd	nd
4-Chloro-3-methylphenol	0.50	nd		nd	nd	nd	nd
1,2,4,5-Tetrachlorobenzene	0.10	nd		nd	nd	nd	nd
Hexachlorocyclopentadiene	0.10	nd		nd	nd	nd	nd
2,4,6-Trichlorophenol	0.50	nd		nd	nd	nd	nd
2,4,5-Trichlorophenol	0.50	nd		nd	nd	nd	nd
2-Chloronaphthalene	0.10	nd		nd	nd	nd	nd
Dimethylphthalate	0.10	nd		nd	nd	nd	nd
Acenaphthylene	0.10	nd		nd	nd	nd	nd
Acenaphthene	0.10	nd	104%	nd	nd	nd	nd
2,4-Dinitrophenol	0.50	nd		nd	nd	nd	nd
4-Nitrophenol	0.50	nd		nd	nd	nd	nd
Pentachlorobenzene	0.10	nd		nd	nd	nd	nd
2,3,4,6-Tetrachlorophenol	0.10	nd		nd	nd	nd	nd
Fluorene	0.10	nd		nd	nd	nd	nd
Diethylphthalate	0.50	nd		nd	nd	nd	nd
4-Chlorophenylphenylether	0.10	nd		nd	nd	nd	nd
N-Nitrosodiphenylamine	0.10	nd		nd	nd	nd	nd
4-Bromophenylphenylether	0.10	nd		nd	nd	nd	nd
Hexachlorobenzene	0.10	nd		nd	nd	nd	nd
Pentachlorophenol	0.50	nd		nd	nd	nd	nd
Phenanthrene	0.10	nd		nd	nd	nd	nd
Anthracene	0.10	nd		nd	nd	nd	nd
2-sec-Butyl-4,6-dinitrophenol (D	0.50	nd		nd	nd	nd	nd
Di-n-butylphthalate	0.10	nd		nd	nd	nd	nd
Fluoranthene	0.10	nd		nd	nd	nd	nd
Pyrene	0.10	nd	102%	nd	nd	nd	nd
Butylbenzylphthalate	0.50	nd		nd	nd	nd	nd
Benzo(a)anthracene	0.10	nd		nd	nd	nd	nd
Chrysene	0.10	nd		nd	nd	nd	nd
Bis (2-ethylhexyl) ether	0.10	nd		nd	nd	nd	nd
Di-n-octylphthalate	0.50	nd		nd	nd	nd	nd
Benzo(b)fluoranthene	0.10	nd		nd	nd	nd	nd
Benzo(k)fluoranthene	0.10	nd		nd	nd	nd	nd
Benzo(a)pyrene	0.10	nd		nd	nd	nd	nd
Dibenzo(a,h)anthracene	0.10	nd		nd	nd	nd	nd
Benzo(ghi)perylene	0.10	nd		nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	0.10	nd		nd	nd	nd	nd

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S21105-1
Client:	HART CROWSER
Client Job Name:	PORT OF PORT ANGELES
Client Job Number:	7794

Analytical Results

8270, mg/kg		**MTH BLK**	**LCS**	**HC-1 S-2**	**HC-3 S-1**	**HC-3 S-1 (2)**	**HC-4 S-1**
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date extracted	Reporting	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Date analyzed	Limits	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Surrogate recoveries							
Phenol-d6		118%	96%	100%	112%	88%	78%
Nitrobenzene-d5		121%	100%	112%	105%	111%	112%
2-Fluorobiphenyl		114%	101%	131%	117%	110%	115%
2,4,6-Tribromophenol		95%	70%	79%	88%	114%	129%
4-Terphenyl-d14		96%	79%	95%	87%	93%	97%

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S21105-1
Client:	HART CROWSER
Client Job Name:	PORT OF PORT ANGELE
Client Job Number:	7794

Analytical Results

8270, mg/kg		HC-4 S-3	HC-6 S-2	HC-7 S-1	MS HC-7 S-1	MSD HC-7 S-1	RPD
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	%
Date extracted	Reporting	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Date analyzed	Limits	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Penatchloroethane	0.10	nd	nd	nd			
Phenol	0.10	nd	nd	nd			
2-Chlorophenol	0.10	nd	nd	nd			
Bis (2-chloroethyl) ether	0.10	nd	nd	nd			
1,3-Dichlorobenzene	0.10	nd	nd	nd			
1,4-Dichlorobenzene	0.10	nd	nd	nd	116%	115%	1%
1,2-Dichlorobenzene	0.10	nd	nd	nd			
2-Methylphenol (o-cresol)	0.10	nd	nd	nd			
Bis (2-chloroisopropyl) ether	0.10	nd	nd	nd			
3,4-Methylphenol (m,p-cresol)	0.10	nd	nd	nd			
2-Nitrophenol	0.50	nd	nd	nd			
2,4-Dimethylphenol	0.50	nd	nd	nd			
Bis (2-chloroethoxy) methane	0.10	nd	nd	nd			
2,4-Dichlorophenol	0.50	nd	nd	nd			
1,2,4-Trichlorobenzene	0.10	nd	nd	nd	123%	123%	0%
Naphthalene	0.10	nd	nd	nd			
2,6-Dichlorophenol	0.50	nd	nd	nd			
Hexachloropropylene	0.50	nd	nd	nd			
Hexachlorobutadiene	0.50	nd	nd	nd			
4-Chloro-3-methylphenol	0.50	nd	nd	nd			
1,2,4,5-Tetrachlorobenzene	0.10	nd	nd	nd			
Hexachlorocyclopentadiene	0.10	nd	nd	nd			
2,4,6-Trichlorophenol	0.50	nd	nd	nd			
2,4,5-Trichlorophenol	0.50	nd	nd	nd			
2-Chloronaphthalene	0.10	nd	nd	nd			
Dimethylphthalate	0.10	nd	nd	nd			
Acenaphthylene	0.10	nd	nd	nd			
Acenaphthene	0.10	nd	nd	nd	102%	105%	3%
2,4-Dinitrophenol	0.50	nd	nd	nd			
4-Nitrophenol	0.50	nd	nd	nd			
Pentachlorobenzene	0.10	nd	nd	nd			
2,3,4,6-Tetrachlorophenol	0.10	nd	nd	nd			
Fluorene	0.10	nd	nd	nd			
Diethylphthalate	0.50	nd	nd	nd			
4-Chlorophenylphenylether	0.10	nd	nd	nd			
N-Nitrosodiphenylamine	0.10	nd	nd	nd			
4-Bromophenylphenylether	0.10	nd	nd	nd			
Hexachlorobenzene	0.10	nd	nd	nd			
Pentachlorophenol	0.50	nd	nd	nd			
Phenanthrene	0.10	nd	nd	nd			
Anthracene	0.10	nd	nd	nd			
2-sec-Butyl-4,6-dinitrophenol (D	0.50	nd	nd	nd			
Di-n-butylphthalate	0.10	nd	nd	nd			
Fluoranthene	0.10	nd	nd	nd			
Pyrene	0.10	nd	nd	nd	103%	102%	1%
Butylbenzylphthalate	0.50	nd	nd	nd			
Benzo(a)anthracene	0.10	nd	nd	nd			
Chrysene	0.10	nd	nd	nd			
Bis (2-ethylhexyl) ether	0.10	nd	nd	nd			
Di-n-octylphthalate	0.50	nd	nd	nd			
Benzo(b)fluoranthene	0.10	nd	nd	nd			
Benzo(k)fluoranthene	0.10	nd	nd	nd			
Benzo(a)pyrene	0.10	nd	nd	nd			
Dibenzo(a,h)anthracene	0.10	nd	nd	nd			
Benzo(ghi)perylene	0.10	nd	nd	nd			
Indeno(1,2,3-cd)pyrene	0.10	nd	nd	nd			

ESN SEATTLE CHEMISTRY LABORATORY
(425) 957-9872, fax (425) 957-9904

ESN Job Number:	S21105-1
Client:	HART CROWSER
Client Job Name:	PORT OF PORT ANGELE
Client Job Number:	7794

Analytical Results

8270, mg/kg		HC-4 S-3	HC-6 S-2	HC-7 S-1	MS HC-7 S-1	MSD HC-7 S-1	RPD
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	%
Date extracted	Reporting	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Date analyzed	Limits	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02	11/06/02
Surrogate recoveries							
Phenol-d6		90%	112%	93%	110%	108%	
Nitrobenzene-d5		107%	122%	117%	101%	101%	
2-Fluorobiphenyl		115%	110%	106%	101%	99%	
2,4,6-Tribromophenol		68%	129%	114%	88%	89%	
4-Terphenyl-d14		92%	101%	97%	93%	94%	

Data Qualifiers and Analytical Comments

nd - not detected at listed reporting limits
Acceptable Recovery limits: 65% TO 135%
Acceptable RPD limit: 35%

ESN NORTHWEST CHEMISTRY LABORATORY

PORT OF PORT ANGELES PROJECT
Port Angeles, Washington
Hart Crowser, Inc.
Client Project #7794

Heavy Metals in Soil by EPA-7000 Series

Sample Number	Date Analyzed	Lead (Pb) EPA 7420 (mg/kg)	Cadmium (Cd) EPA 7130 (mg/kg)	Chromium (Cr) EPA 7190 (mg/kg)	Arsenic (As) EPA 7061 (mg/kg)	Silver (Ag) EPA 7760 (mg/kg)	Barium (Ba) EPA 7080 (mg/kg)	Selenium (Se) EPA 7741 (mg/kg)	Mercury (Hg) EPA 7471 (mg/kg)
Method Blank	11/6/02	nd	nd	nd	nd	nd	nd	nd	nd
HC-1 S-2	11/6/02	nd	nd	6	nd	nd	nd	nd	nd
HC-3 S-1	11/6/02	nd	nd	nd	nd	nd	nd	nd	nd
HC-4 S-1	11/6/02	140	nd	nd	nd	nd	nd	nd	nd
HC-6 S-2	11/6/02	nd	nd	7	nd	nd	nd	nd	nd
HC-7 S-1	11/6/02	nd	nd	7	nd	nd	nd	nd	nd
HC-7 S-1 Dup.	11/6/02	nd	nd	7	nd	nd	nd	nd	nd
HC-4 S-3	11/6/02	29	nd	nd	nd	nd	nd	nd	nd
Method Detection Limits		5	1	5	5	20	50	50	0.5

"nd" Indicates not detected at listed detection limits.

ANALYSES PERFORMED BY: Marilyn Farmer

ESN NORTHWEST CHEMISTRY LABORATORY

PORT OF PORT ANGELES PROJECT
Port Angeles, Washington
Hart Crowser, Inc.
Client Project #7794

QA/QC Data - Total Metals EPA-7000 Series Analyses

Sample Number: HC-5 S-2

	Matrix Spike			Matrix Spike Duplicate			RPD
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)	(%)
Lead	125	138	110	125	142	114	2.86
Cadmium	12.5	11.6	93	12.5	12.5	100	7.47
Chromium	125	123	98	125	132	106	7.06

	Laboratory Control Sample		
	Spiked Conc. (mg/kg)	Measured Conc. (mg/kg)	Spike Recovery (%)
Lead	125	129	103
Cadmium	12.5	10.6	85
Chromium	125	122	98

ACCEPTABLE RECOVERY LIMITS FOR MATRIX SPIKES: 65%-135%
ACCEPTABLE RPD IS 35%

ANALYSES PERFORMED BY: Marilyn Farmer

STL Seattle

Sample Identification:

Lab. No.	Client ID	Date/Time Sampled	Matrix
109779-1	HC-1 S-2	10-28-02 *	solid
109779-2	HC-2 S-2	10-28-02 *	solid
109779-3	HC-3 S-1	10-28-02 *	solid
109779-4	HC-3 S-1(2)	10-28-02 *	solid
109779-5	HC-4 S-1	10-28-02 *	solid
109779-6	HC-4 S-3	10-28-02 *	solid
109779-7	HC-5 S-2	10-28-02 *	solid
109779-8	HC-6 S-2	10-28-02 *	solid
109779-9	HC-7 S-1	10-28-02 *	solid

* - Sampling time not specified for this sample

STL Seattle

Client Name	ESN Northwest, Inc.
Project Name	Port of Port Angeles
Date Received	11-06-02

General Chemistry Parameters

Client Sample ID HC-1 S-2
Lab ID 109779-01

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.01	0.005

Client Sample ID HC-2 S-2
Lab ID 109779-02

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	ND	0.005

Client Sample ID HC-3 S-1
Lab ID 109779-03

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.05	0.005

Client Sample ID HC-3 S-1 (2)
Lab ID 109779-04

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.50	0.005

Client Sample ID HC-4 S-1
Lab ID 109779-05

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.03	0.005

STL Seattle

Client Sample ID HC-4 S-3
Lab ID 109779-06

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.005	0.005

Client Sample ID HC-5 S-2
Lab ID 109779-07

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.02	0.005

Client Sample ID HC-6 S-2
Lab ID 109779-08

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.005	0.005

Client Sample ID HC-7 S-1
Lab ID 109779-09

Parameter	Method	Date Analyzed	Units	Result	PQL
Salt	AOAC 935.47	11-11-02	%	0.02	0.005

SEVERN TRENT STL

STL Seattle
5755 8th Street East
Tacoma, WA 98424

Tel: 253 922 2310
Fax: 253 922 5047
www.stl-inc.com

DATA QUALIFIERS AND ABBREVIATIONS

B1:	This analyte was detected in the associated method blank. The analyte concentration was determined not to be significantly higher than the associated method blank (less than ten times the concentration reported in the blank).
B2:	This analyte was detected in the associated method blank. The analyte concentration in the sample was determined to be significantly higher than the method blank (greater than ten times the concentration reported in the blank).
C1:	Second column confirmation was performed. The relative percent difference value (RPD) between the results on the two columns was evaluated and determined to be ≤ 40%.
C2:	Second column confirmation was performed. The RPD between the results on the two columns was evaluated and determined to be > 40%. The higher result was reported unless anomalies were noted.
M:	GC/MS confirmation was performed. The result derived from the original analysis was reported.
D:	The reported result for this analyte was calculated based on a secondary dilution factor.
E:	The concentration of this analyte exceeded the instrument calibration range and should be considered an estimated quantity.
J:	The analyte was analyzed for and positively identified, but the associated numerical value is an estimated quantity.
MCL:	Maximum Contaminant Level
MDL:	Method Detection Limit
N:	See analytical narrative.
ND:	Not Detected
PQL:	Practical Quantitation Limit
X1:	Contaminant does not appear to be "typical" product. Elution pattern suggests it may be __________ .
X2:	Contaminant does not appear to be "typical" product.
X3:	Identification and quantitation of the analyte or surrogate was complicated by matrix interference.
X4:	RPD for duplicates was outside advisory QC limits. The sample was re-analyzed with similar results. The sample matrix may be nonhomogeneous.
X4a:	RPD for duplicates outside advisory QC limits due to analyte concentration near the method practical quantitation limit/detection limit.
X5:	Matrix spike recovery was not determined due to the required dilution.
X6:	Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Sample was re-analyzed with similar results.
X7:	Recovery and/or RPD values for matrix spike(/matrix spike duplicate) outside advisory QC limits. Matrix interference may be indicated based on acceptable blank spike recovery and/or RPD.
X7a:	Recovery and/or RPD values for this spiked analyte outside advisory QC limits due to high concentration of the analyte in the original sample.
X8:	Surrogate recovery was not determined due to the required dilution.
X9:	Surrogate recovery outside advisory QC limits due to matrix interference.

SR 1103-1

ample Custody Record

HARTCROWSER

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

ples Shipped to:

OB 7794 LAB NUMBER

ROJECT NAME Port of Port Angeles

ART CROWSER CONTACT Julie Wukelic

AMPLED BY: Fred Tuttle

REQUESTED ANALYSIS

AB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	TPH D-EXT	Salinity?	8270 + ~~[illegible]~~ (FULL)	RCRA 8 Metals	NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
+	HC-1	S-2	10/30		SOIL	X	X	X	X		
✓	HC-2	S-1	10/30		SOIL	X	X				- IF NOT ENOUGH – RUN S-2
+	HC-3	S-1	10/30		SOIL	X	X	X	X		
+✓	HC-3	S-2	10/30		SOIL	X	X				
+	HC-4	S-1	10/30		SOIL	X	X	X	X		
	HC-5	S-2	10/30		SOIL	X	X				
	HC-6	S-2	10/30		SOIL	X	X	X	X		
	HC-7	S-1	10/30		SOIL	X	X	X	X		
+	HC-4	S-3	10/31		SOIL	X	X	X	X		

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	[illegible]	SIGNATURE	11/05/02
PRINT NAME Julie Wukelic	TIME	PRINT NAME Val Ivanov	TIME
COMPANY Hart Crowser		COMPANY ESN	800

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

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No.
for Other Contract Requirements

TOTAL NUMBER OF CONTAINERS

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

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☒ STANDARD 5 DAY TURNAROUND
☐ 72 HOURS OTHER

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