Rec'd 6/18/96 J.C.

HARTCROWSER

Earth and Environmental Technologies

Geotechnical Feasibility Study for the Proposed Uplands Development and Environmental Assessment of the Central Waterfront Project

Prepared for
Port of Seattle

March 26, 1992
J-3447

N24936

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Recorder: G. Colburn	Report Type (Check box): ☑ Initial ☐ Secondary ☐ Followup
Date Received: 6/20/96	☐ Check if Incident is URGENT!
Time Received:	☐ Check if Caller Wants to Be Anonymous

✱ Reporter's Name: Hart Crowser | Return Call Time:
✱ Address 1: | ☐ AM ☐ PM
Address 2:
✱ City: Seattle | State: Wa. | Zip Code:
Phone/Home: | Phone/Work: | Phone Type (*List):
Business Name:
Alternate Contact: | Phone: | Phone Type (*List):

✱ County (*List): King | Closest City: Seattle
Waterway: | WRIA#:
Waterway Type (*List): | Segment#:
Additional Location Information:

Weather (*List): | Tide (*List):
Latitude: | Longitude:
Township: | Range: | Section:

☐ Check if Hazardous Material or Situation

✱ Medium (*List): soil, GW, sediments	✱ Material (*List): petroleum
Other Material: PAHs, VOH's, Metals	Oil/Petroleum Type (*List): gas, heating oil
Source (*List): various (spills, USTs, impr handl.)	Quantity: unknown
Vessel (*List):	Unit of Measure (*List):
Vessel Name:	Activity (*List):
Cause (*List):	Impact (*List):
Human Factor (*List):	

OVER

DEPARTMENT OF ECOLOGY
ENVIRONMENTAL REPORTS TRACKING SYSTEM INPUT FORM

WASHINGTON STATE DEPARTMENT OF ECOLOGY

ALLEGED VIOLATOR INFORMATION

* Alleged Violator Name: Port of Seattle / Central Waterfront Project

* Business: Port of Seattle

* Address 1: 2000 — 2200 block of Alaskan Way

Address 2: (between Bell and Virginia Streets

* City: Seattle | State: Wa. | Zip: 98121

Contact:

Home Phone:

Work Phone: | Phone Type (*List):

Additional Comments:
The proposed development site contains several parcels with various historic businesses, all of which are contaminated to some degree with TPH, PAHs, metals, and solvents. There are also UST decommissioning issues (heating oil & gas), asbestos demolition issues, PCBs in light ballasts (demo issue), PCB transformers, print shop chemicals and drums of oil and refrigerants, suspect fill material under Pier 66. The parcels are known as Pier 66, the "Triangle Parcel", Auto Freight Warehouse Parcel, Pacific Coast Feather Warehouse Parcel.

If multiple contacts, phone numbers, violators, etc., are involved use separate forms and staple together.
If more space is needed for comments, check box and use back of form. ☐ See Back of Form

OVER

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Internal Referral Information:

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ident:              N24936
Referred to program: TCP          Section Head: Gallagher
Investigation Completed? (Y/N) : -   Date Inv. -0-
Staff Person: Maule/Turvey            Date Comp:-0-
Action Taken: sediment site file      Cause:    -0-
Impact:        -0-          External Referral? (Y/N): -
Nonpoint:      -0-                    Point:    -0-
Enforcement Sensitive? (Y/N) :                  -
Cross-Reference To Other Systems:               -0-
Reference to (Put tag on this field) :          -0-
mark:                                           -0-
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Form: work_frm Table: inref Field: ext_ref Page: 2

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Alleged contaminant:
 ident: N24936  Medium: water          Quantity: -0-
 Material: chemical               Other Material: metals-LEAD
 Comments:                             Source: -0-
 DNR, AG Lands Div, PO Box 47027, Olympia, WA 98504-7027            P
 ort of Seattle, Pier 66, 2201 Alaskan Way, Seatlle 98121. Sediment sitePa
 per file, ERTS being processed by Martha Turvey as of 9/9/96.
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Actual Contaminant:
 ident: N24936  Medium: -0-            Transfer: -0
 Materilal:-0-                 Quantity: -0-
 Source: -0-                           Other mat:-0-
 Narrative:
 3/26/92 "Geotechnical Feasibility Study..." found in Colburn's mail-box, R
 egistered by Bardy 7/96, IITS entered and given to Turvey by Maule 9/17/96
  to include with file.
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Form: work_frm Table: contaminant Field: ident Page: 3

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GEOTECHNICAL FEASIBILITY STUDY FOR THE PROPOSED UPLANDS DEVELOPMENT AND ENVIRONMENTAL ASSESSMENT OF THE CENTRAL WATERFRONT PROJECT

INTRODUCTION

This report presents the results of our preliminary geotechnical engineering feasibility study and our environmental investigations and recommendations for the proposed Central Waterfront project. The geotechnical work addresses issues to the east of Alaskan Way while the environmental and assessment is intended to address the site as a whole. This report presents the following:

- Site and project description;
- Purpose, scope, and limitations of our work;
- Summary and recommendations of our work;
- Environmental assessment;
- Preliminary geotechnical engineering recommendations; and
- Appendices addressing field explorations and laboratory tests.

SITE AND PROJECT DESCRIPTION

Site Description

The Central Waterfront site is located in the 2000 through 2200 blocks of Alaskan Way between Bell and Virginia Streets as shown on Figure 1 - Vicinity Map.

Figure 2 is a Site and Geotechnical Exploration Plan which shows the locations of explorations advanced for this and previous studies. Figure 2 also shows the location of existing and proposed structures on the east side of Alaskan Way. Figure 3 is an environmental assessment site plan which shows the locations of the various existing facilities discussed in the environmental portions of this report. The uplands, east of Alaskan Way, were originally part of the Seattle tide flats and are therefore fairly level with the exception of a 40- to 55-foot slope along the northeast edge of the properties. A triangular vacant lot, a 16,000-square-foot Auto Freight Warehouse with an asphalt area for truck loading and unloading, and a 37,000-square-foot Pacific Coast Feather Warehouse currently occupy this portion of the site. These parcels are referred to in subsequent sections as the "Triangle Parcel", the "Auto Freight Warehouse Parcel", and the "Pacific Coast Feather Warehouse Parcel or Parcel 1". Burlington Northern Railroad (BNRR) runs in a general north-south direction adjacent on the east side of the parcels.

Portions of the site west of Alaskan Way on Elliott Bay include Pier 66 and the pre-existing Piers 64 and 65. Pier 66 is currently occupied by the Port of Seattle main office building, a Transit Shed, and an asphalt concrete parking lot.

Project Description

A combination of commercial and residential development is proposed at the uplands portion of the site as seen on Figure 2. The development is part of a large Central Waterfront project which includes a proposed rebuilt and redeveloped Pier 66, a new transient boat moorage south of Pier 66, and the aforementioned uplands development. To accomplish this, the Port of Seattle intends to demolish existing structures within the project area and excavate site soils to prepare for future site development.

The proposed uplands structures will include an 8-story Trade Center Office building with 4 levels of parking below the structure, a 12-story hotel east of the BNRR, and an 8-story hotel west of the BNRR. Further south, a 5-story hotel and 4-story housing unit are proposed with 4 levels of on-grade parking below the structures. An inn and additional housing units on top of a 2-story parking structure are also proposed. In addition to these structures, two pedestrian bridges at Bell and Lenora Streets, and a 450-foot-long tunnel over the BNRR tracks between Bell and Blanchard Streets will be constructed. Directly above the railroad tunnel will be a pedestrian plaza which will connect to the Trade Center and adjacent hotels.

PURPOSE, SCOPE, AND LIMITATIONS OF OUR WORK

Purpose of Our Work

The purpose of our work was to provide preliminary geotechnical engineering recommendations for the commercial and residential development of the uplands portion of the Central Waterfront project. Environmentally we were tasked with updating and expanding our previous work at the site (including those portions of the site east and west of Alaskan Way). Specific goals of this work included:

- Assessing subsurface site conditions at the uplands;
- Determining preliminary foundation, pavement, and retaining structure design criteria at the uplands;
- Identifying environmental considerations that might affect the cost of construction across the site;
- Updating Pier 64/65 Sediment Quality Assessment; and
- Providing preliminary geotechnical engineering and environmental design recommendations for initial construction cost estimations.

Scope of Our Work

Our scope of work for this project included:

- Reviewing past Hart Crowser reports relevant to this project;
- Updating site-specific historical information as part of our environmental assessment;
- Performing a site reconnaissance;
- Drilling 4 borings at the uplands site to depths of 25 feet and installing monitoring wells in 2 of the borings;
- Performing geotechnical and chemical laboratory tests on selected soil and groundwater samples;
- Developing preliminary geotechnical engineering and environmental recommendations for the proposed development; and
- Preparing this summary report.

It is important to note that the scope of environmental explorations and chemical analyses on soil and groundwater was not intended to be comprehensive. Our scope of work in this area was intended to take advantage of explorations advanced for geotechnical purposes as well as previously installed wells to gain a further understanding of potential site contamination issues. Additional explorations and analyses will likely be necessary to fully assess the site environmentally.

Limitations of Our Work

Hart Crowser completed this portion of our work in general accordance with our December 19, 1991, Contract No. P-046404. We performed this work for the exclusive use of the Port of Seattle and their design consultants for specific application to this project. We performed this work in accordance with generally accepted professional practices in the same or similar localities, related to the nature of the work accomplished at the time the services were performed. 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. In particular, the levels presented for the MTCA Level B residential standards are based only on direct contact standards. They do not provide a comparison standard for groundwater quality. Such information is site specific and specific MTCA interpretations may involve separate calculations and determinations upon which a range of cleanup standards may be established by Ecology.

EXECUTIVE SUMMARY OF FINDINGS AND RECOMMENDATIONS

The following is a summary of the principal conclusions and recommendations contained herein. Information presented in this summary is subject to conditions stated elsewhere in this report. The subsequent sections of the report should be consulted for expanded discussion of each point as well as further recommendations.

Environmental Findings and Recommendations

The following section provides a summary of environmental issues identified for each project parcel, the environmental testing performed to investigate the identified issues, and an overall summary of chemical results for the environmental explorations performed.

Environmental Issues. Our review of historical records and our site reconnaissance observations identified several environmental issues at the Central Waterfront site which were previously identified in our January 15, and February 6, 1992, letters. The following section states the environmental issues identified.

Pier 66 - Environmental Issues

- As discussed in our meeting with Port representatives, in order to avoid a spill situation several items located within the warehouse and office areas should be removed prior to building demolition. These included fluorescent PCB-containing light ballasts, potential PCB transformers, paints, adhesives, solvents, print shop chemicals, and 55-gallon drums of oils and refrigerants.

- Historically, the office building area and the warehouse storage area have been used as a cold storage facility. Oil was often used to lubricate gears associated with operating the freezer equipment. Undocumented spills and leaks of oil occurred on the parcel.

- The paint on the buildings should be tested for lead content prior to building demolition to avoid possible dispersion of lead to surrounding soils during demolition.

- The two USTs located on site should be removed in accordance with UST removal regulations.

- Pilings which are to be removed for construction purposes will have to be chemically characterized in a representative fashion (coring) and disposed of appropriately according to results of testing.

- Pier 66 is constructed on fill material. Fill material from undocumented sources have been known to contain elevated concentrations of metals.

__Triangle Parcel - Environmental Issues__

- Historically, the adjacent auto freight warehouse stored automobile engines, parts, trailers, and miscellaneous containers on the exposed soils of the site. Consequently, construction activities may encounter associated contamination.

- Heavy oil staining was observed on the site, in particular around 55-gallon drums, empty storage tanks, and automobile parts stored on the parcel. Soils which have been adversely impacted from auto repair activities may exist on site. Excavated soils from the site will most likely have to be chemically characterized for disposal.

- It is likely that treated pilings from buried piers/wharfs and railroad trestles will be encountered during excavation activities. Such materials should be representatively sampled by coring to characterize the materials for disposal. In addition, soils which are associated with the pilings should also be chemically characterized for proper disposal.

__Auto Freight Warehouse Parcel - Environmental Issues__

- The parcel has an extended history of use as an automotive shipping freight center. Aerial photographs and our site reconnaissance indicated the company performs their own auto repairs on site. Poor housekeeping practices may have potentially exposed subsurface soils and groundwater to automotive oils and greases, as well as solvents.

- Gasoline service stations were located upgradient of the site along Western Avenue from about 1916 to about 1969. There is a limited potential for off-site sources of petroleum hydrocarbon contamination to be impacting the project site through groundwater migration.

- Several potentially environmentally hazardous materials are located inside the building. These include paints, solvents, oil containers, and PCB-containing light ballasts. They should be removed prior to building demolition in order to prevent spill.

- A 10,000-gallon fuel underground storage tank (UST) was recently removed from the parcel. Impacted soils and groundwater from the former leaking UST remain on the site. In addition, Port of Seattle information indicated that hydrocarbon contamination from another source is present in the soils and groundwater of the parcel. A construction contingency plan should be developed to address removal and disposal of potentially impacted soils encountered during site development.

- A 600-gallon UST is located underneath the building. A construction contingency plan should be developed for the tank removal according to UST removal guidelines and for possible remediation of impacted soils during site development.

Pacific Coast Feather Warehouse Parcel - Environmental Issues

- Historical evidence indicates an oil burner was previously used to heat the building. Although evidence of a UST was not observed during our site reconnaissance, such information suggests the presence of a heating oil UST. A construction contingency plan should be developed in the potential event a UST and contaminated soils are encountered during demolition activities.

- Stained soils were observed adjacent north of the parcel beneath the Lenora Street Viaduct. Soils may potentially be contaminated with oil and metal constituents.

- To avoid a potential spill situation, all hazardous materials located within the building should be removed prior to building demolition. These include paints, solvents, cleaning supplies, and print chemicals from a silk screen operation.

- Fluorescent light ballasts not labeled as "non-PCB" are considered to contain PCB oils. All PCB-containing fluorescent light ballasts should be removed prior to building demolition and disposed of in accordance with appropriate regulations.

- Gasoline service stations were located upgradient of the site along Western Avenue from about 1916 to about 1969. Based on this, a limited potential exists for off-site source migration of petroleum contamination to the parcel.

- Undocumented spills from train derailments as well as spillage from product tanks may have occurred in the railroad corridor east of and adjacent to the parcel.

- The facility is adjacent a warehouse that has two out-of-service heating oil USTs. In addition, this adjacent building housed a chemical manufacturer from at least 1948 to about 1958. "Back Door" dumping of chemicals may have occurred.

- A concrete batch plant was located east of the building in the railroad corridor. Construction activities may encounter concrete debris. In addition, oil-powered cement kilns may have operated in the area near the buildings and undocumented releases of petroleum fuel sources may have occurred.

Environmental Testing

Based on the above environmental issues, two borings and monitoring wells (HC-7 and HC-9) were developed to address potential environmental concerns associated with soil and groundwater. The recommended environmental testing was presented as a series of tasks to be accomplished to address the identified issues. Of the nine previously recommended tasks, five (Tasks 1, 2, 3, 6, and 7) were authorized by Ms. Elizabeth Stetz and Mr. Duncan Kelso of the Port of Seattle.

The tasks were as follows:

- **Task 1 - Pier 66.** We were to collect soil samples from geotechnical borings drilled at Pier 66 (HC-1, HC-2, and HC-3). The samples were screened in the field both visually for evidence of petroleum sheening and with an HNU Photoionization Detector (PID) for the presence of volatile organic compounds. A laboratory total metals analysis was performed on two composite samples (HC-2 and HC-3).

- **Task 2 and 6 - Triangle Parcel and Pacific Coast Feather Warehouse Parcel.** We were to collect soil samples from geotechnical borings (HC-7 and HC-9), screen the samples visually for petroleum sheening and for volatile organic compounds using a PID meter, and analyze selected samples for the following: volatile organic compounds (VOCs), petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and total metals.

- **Task 3 and 7 - Triangle Parcel and Pacific Coast Feather Warehouse Parcel.** We were to develop monitoring wells from borings HC-7 and HC-9 and analyze groundwater samples for the following parameters: VOCs, petroleum hydrocarbons, PAHs, PCBs, total suspended solids, total metals, and dissolved metals.

A combined overview of the results of these tasks is as follows.

Summary of Chemical Testing

Soil Samples

Two soil samples were collected from each boring (total of four) and analyzed for a number of constituents. The results are as follows:

- **Total Metals.** All heavy metals detected in HC-7 and HC-9 were below MTCA Method A cleanup levels used in our comparison.

- **PCBs.** PCBs were not detected in the four soil samples collected as part of this investigation.

- **PAHs.** Carcinogenic PAHs (cPAHs) were detected in borings HC-7 and HC-9 at levels which slightly exceed the MTCA Method A cleanup level of 1.0 mg/kg.

- **Volatile Organic Compounds.** Tetrachloroethane (PCE) was detected in samples collected at 7.5 to 9 feet below ground surface in borings HC-7 (4.4 mg/kg) and HC-9 (0.19 mg/kg). The MTCA Method A cleanup level for PCE is 0.5 mg/kg. 1,1,1-trichloroethane was also detected in boring HC-7 at a concentration of 0.14 mg/kg.

- **Petroleum Hydrocarbons.** Petroleum hydrocarbons were not detected in boring HC-7. However, both gasoline and diesel range hydrocarbons were detected in HC-9 at levels below MTCA Method A cleanup levels. The chromatogram results indicated that compounds heavier than diesel were likely present in the soils.

Recommendations: Available data indicate there could potentially be soils contaminated with PCE or cPAHs at concentrations which exceed MTCA Method A cleanup levels for the site. There is a potential that these soils, if present, may require special handling if they are excavated during construction. We recommend that a contingency plan be developed prior to construction to address such issues as soil stockpiling, verification analysis, soil disposal, and cleanup verification analysis. This approach will help keep disruption of construction to a minimum.

Groundwater Samples

Groundwater samples were collected from HC-7 and HC-9 (renamed B-11 and B-12) and analyzed for a number of constituents. The results are as follows:

- **Total and Dissolved Metals.** Total metal concentrations for arsenic, chromium, and lead exceed MTCA Method A and B cleanup levels in wells HC-7 (B-11) and HC-9 (B-12). However, extremely high turbidity present in groundwater in these wells is the likely cause for the elevated total metals concentrations. No dissolved metals concentrations exceed MTCA Method A or B cleanup levels.

- **PCBs.** PCBs were not detected in groundwater sample collected from either of the two wells.

- **PAHs.** cPAHs were detected in wells B-11 (0.17 μg/L) and B-12 (2.3 μg/L) at levels which exceed the MTCA Method A cleanup level of 0.1 μg/L.

- **Volatile Organic Compounds.** No volatile organic compounds were detected in groundwater samples collected from the two wells.

Recommendations: Based on the chemical results from the groundwater analysis, it is likely that contaminated groundwater will be encountered during construction activities. In the event of dewatering activities, water collected will have to be chemically characterized for proper disposal.

Sediment Quality Summary Pier 64/65

Sediment quality conditions in the Pier 64/65 area were evaluated in 1990 by the Port of Seattle (Hart Crowser, 1990; Beak Consultants, 1990). A summary of these studies is provided below:

- Nearshore sediments throughout the Pier 64/65 area within approximately 200 feet from the seawall contain concentrations of metals (esp. lead, mercury, and zinc), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organic contaminants which exceed potentially applicable cleanup levels established under the State Sediment Management Standards (Chapter 173-204 WAC);

- While some of these contaminant accumulations (e.g., PCBs) occur primarily in deeper sediments and appear to be the result of historical releases, other contaminants (e.g., PAHs) are currently being released to the site vicinity, apparently from relatively widespread, regional sources such as treated pilings. PAH concentrations are highest within the top one foot of sediments and in materials periodically resuspended and transported through the area;

- Biological testing performed by Beak Consultants (1990) suggested that a smaller number of benthic infaunal species inhabit the Pier 64/65 area as compared with similar habitats elsewhere in Elliott Bay. This condition was thought to reflect the degraded quality of sediments in the Pier 64/65 area. Since sediment toxicity was also observed in limited bioassays previously performed by EPA in the area, exceedence of the WAC 173-204 standards is indicated;

- Based on the available data, the Pier 64/65 area has been identified by EPA and Ecology as priority problem area for sediment cleanup;

- Because of the apparently ongoing inputs of contaminants such as PAHs to the site vicinity, initial source control efforts are required to achieve sediment cleanup. Following a demonstration of effective source controls, it may be appropriate to cap some of the more contaminated sediment areas;

- Dredging of sediments within approximately 200 feet from shoreline in the Pier 64, 65, and 66 areas will likely encounter contaminated sediments which will not be suitable for open-water disposal.

Results of Geotechnical Field Explorations at the Uplands

The Vicinity Map and Site and Exploration Plan are shown on Figures 1 and 2, respectively.

- Subsurface soils at the uplands generally consist of 10 to 23 feet plus of loose to medium dense, uncontrolled granular fill over very dense, gravelly sand.

- The top of the dense gravelly sand bearing layer slopes from the east near the base of the slope, to the west near Alaskan Way.

- Groundwater exists at an average depth of 11 feet below the ground surface in the flat low-lying area of the site, and was not encountered on the hill slope.

Preliminary Geotechnical Engineering Recommendations

- The proposed Trade Center Office Building and adjacent 12-story hotel may be supported on a combination of shallow footings and end bearing piles.

- The remainder of the proposed structures should be supported on end bearing piles embedded about 10 feet into the dense, gravelly sand bearing layer.

- Pile capacities may be expected to range between 40 to 80 tons for 10- to 18-inch-diameter augercast piles; 80 to 120 tons for steel pipe piles; and 40 to 120 tons for steel H piles.

Excavations may be supported using a conventional tied-back soldier pile wall, either temporary or permanent.

ENVIRONMENTAL ASSESSMENT

This section presents our level of effort and findings from our environmental assessment of the Central Waterfront Project. The environmental assessment update was to review past environmental work which had been performed by Hart Crowser on portions of the project area in 1986, 1987, and 1989; to update this information with a historical review and site reconnaissance for each project parcel; and to summarize the findings of the environmental testing. The purpose of this work was to help identify the potential for encountering contaminated soil and groundwater at the project site during site development activities.

Work involved in this effort included:

- Review of previous work (Hart Crowser Reports J-2626, J-1799, J-3245, and J-2854). To assess site conditions relative to soil and groundwater contamination, Hart Crowser installed ten monitoring wells in and around the project area in 1986. Monitoring wells B-1 through B-3, and B-8 through B-10 were installed in the project area. B-4 through B-7 were installed south of the current project boundary.

- Researching and reviewing available historical background records for the property and the immediate adjacent areas to identify former operations or activities that may have contributed to soil or groundwater contamination. The following sources were reviewed:

  - Sanborn Fire Insurance Maps (1888, 1893, 1905, 1923, and 1950)

  - City Street Directories (Seattle: 1938, 1940, 1948/1949, 1951, 1958/1959, 1960, 1968/1969, 1970, 1978/1979, 1980, and 1989/1990)

  - Sunset Archives - Seattle Tidelands

  - Aerial Photographs - (Walker Photographs: 1936, 1946, 1956, 1960, 1969, 1974, and 1977)

  - Title Report as provided by Port of Seattle (Lots 30 and 31 of CWF)

- Conducting a site reconnaissance of buildings in the Central Waterfront Project area.

The following sections are organized by parcel and contain ***Summary of Previous Work***, ***Site Historical Review***, ***Site Reconnaissance Observations***, and ***Potential for Contamination*** sections for each parcel. Figure 3 is a Environmental Assessment Site Plan showing past and present uses of the project area and our site reconnaissance observations and photograph locations. Site reconnaissance photographs are provided in Appendix C. Appendix E presents the historical land use summary for the project area.

Summary

Low levels of contaminants were identified on the property in 1986. Screening conducted at that time was very limited and did not address current regulatory concerns. Our current environmental review identified issues which required a more detailed level of chemical analyses in order to identify chemical constituents of concern and to screen to a level of detection to provide an indication of potential regulatory concerns.

Pier 66 Parcel

Summary of Previous Work

Our report (J-2891) on sediment quality for Piers 64/65 was reviewed in order to evaluate the potential for encountering contaminated sediments during demolition and construction activities at Pier 66.

Site Historical Review

The Pier 66 building was first constructed in 1915 on treated pilings on top of imported fill material. The building was first constructed for use as an Oriental warehouse dock and was known as the Bell Street Terminal. The warehouse and what are currently the office areas were used as cold storage warehouses in which large ammonia compressors were used to chill cold storage rooms. Later, the central office building on the pier was used for the Port of Seattle's administration offices, with portions of the building and the transient shed being leased to various tenants over the years.

Site Reconnaissance Observations

On November 22, 1991, Julie Sowa of Hart Crowser conducted a site reconnaissance of the Pier 66 parcel transient shed and office buildings. The following observations were recorded.

Transit Shed

- Potential PCB-containing fluorescent light fixtures were observed inside the building. Many ballasts manufactured before 1978 contain polychlorinated biphenyl (PCB) oils. Unless labeled "No PCBs" or tested to indicate otherwise, a light ballast is considered to be a PCB item. No leaking ballasts from existing light fixtures were observed during our site reconnaissance. Although non-leaking ballasts are unregulated items under the Toxic Substances Control Act (TSCA 40 CFR Part 762), we recommend when ballasts, which are not labeled as non-PCB containing, are replaced they be collected in a drum and disposed of appropriately using a TSCA-approved hazardous waste contractor.

- Three transformers, potentially containing PCBs, were observed in the warehouse. Two were in the northern portion of the warehouse and were apparently used to power chiller units. The third was observed on the second floor in the south portion of the warehouse (Photograph 2, Appendix C as located on Figure 3). Relative to the location of transformers we could not determine potential PCB content. The content of the transformers should be determined prior to site demolition.

- An empty ammonia tank used to cool a chiller unit was observed in the north portion of the warehouse. The refrigerated storage area was not accessible for observations.

- Paints, adhesives, solvents, and 55-gallon drums of oils and refrigerants were observed stored in various areas of the warehouse (Photograph 1 and Figure 3).

- The first floor northernmost office areas, the second floor northern transient shed areas, and the second floor northeast portion of the transient shed were inaccessible for observation purposes.

- Full oil containers, old boiler units, and water treatment chemicals were observed in the Dressel Collins leased space of the warehouse. The tenant states that all materials will be removed at the time of their vacating.

Office Building

- Three large Seattle City Light transformers were observed in a vault underneath the building. According to Seattle City Light officials, the transformers have been tested and contain less than 50 ppm PCB oils.

- A print shop is located on the second floor. Many chemicals used in print shop operations were observed stored in the area. No spills or stains were observed about the containers.

- Individual transformer units were observed in utility closets on the third and fourth floors. The PCB content of the transformers should be determined prior to building demolition. Transformers containing PCB oils should be disposed of according to appropriate regulations.

- Potential PCB-containing fluorescent light fixtures were observed in many areas. Ballasts not labeled as "PCB-free" are considered to contain PCB oils. PCB-containing ballasts should be removed and appropriately disposed of as previously discussed.

- Various cleaning supplies, paints, and solvents were observed in supply closets and utility closets. To avoid a possible spill situation such items should be removed prior to building demolition.

- Automotive batteries, paints, and thinners were observed stored in the Sea Floor Surveys leased space of the Pier 66 office building. Such materials should be removed prior to building demolition.

- A small oil/fuel above-ground storage tank was observed in the boiler room. The tank should be emptied and removed prior to building demolition.

Outdoors

- Two fuel USTs (one 20-year-old, 560-gallon leaded gasoline, one 9-year-old, 1,000-gallon unleaded gasoline) are located on the parcel. Prior to site development the tanks should be removed in accordance with UST regulations.

- At times, ship repairs have occurred along the south side of the pier. Ship repairs often involved sandblasting, paint stripping, and painting. Such activities suggest the potential for metals in the sediments.

Potential for Contamination Based on Site History and Site Reconnaissance

Materials such as oil, refrigerants, paints, and solvents have the potential to cause a spill situation if they are not removed prior to building demolition.

The gasoline USTs located on site are nine years old and twenty years old. There is a potential the tanks may have eroded and leaked petroleum product into the soils. Petroleum hydrocarbons were not encountered in a soil boring (HC-1) placed near the USTs based on field soil headspace screening and laboratory TPH (8015 modified) analysis. Although contamination was not encountered during our exploration near the tanks, the age of the tank suggests that leakage may have occurred. We recommend that a contingency plan for construction be developed in order to properly manage petroleum hydrocarbon soil and/or groundwater contamination that may be encountered during construction. Alternatively, the tanks could be removed as a special construction operation as part of demolition of the site.

Oils used to lubricate gears associated with ammonia compressor units may have the potential to adversely impact site soils. However, as the units were constructed on fill material and it was greater than 60 years ago that the oil compressors were in operation, it is unlikely that such contamination remains.

To avoid the potential for lead dispersion to the surrounding areas during building demolition, the paint on the buildings should be tested for lead content prior to demolition.

Triangle Parcel

Summary of Previous Work

In September 1989, Hart Crowser performed a preliminary environmental assessment on the Triangle Parcel. Environmental issues identified at that time included oily stains observed on the soils, 55-gallon drums of unknown substances, and trucks stored on the parcel. Many of the concerns identified were the results of practices performed by the adjacent automotive freight warehouse.

Site Historical Review

The first major development on the Triangle parcel was part of the Seattle Lakeshore and Eastern Railway (S.L. & E.). The mainline for this railroad was built on piled trestles over the tidelands in 1887. Trackage entered Seattle paralleling the S.L. & E. in 1891. The land between the railroad tracks and Elliott Avenue was filled around 1900 prior to realignment of the GN tracks.

Between 1902 and 1905, the Great Northern constructed a tunnel under the city leading to its terminal in the Pioneer Square area. The triangle of land formed by the project parcel resulted from the double-track line switch following Elliott Avenue to the north portal of the tunnel several blocks south. Subsequent to the time of this transition in use, the parcel has remained essentially undeveloped except as noted below. The railroad maintained a small office, storage house, and switchman's house on the property into the 1950s. Since the 1960s, the property has been used as a parking lot for a motor freight terminal to the immediate south.

Site Reconnaissance Observations

On November 21, 1991, Julie Sowa and John Funderburk of Hart Crowser visited the Triangle parcel. No site escorts were available for the site reconnaissance. The following observations were recorded.

- Oily stains were observed on the soils at the time of our reconnaissance. In particular, dark staining was observe around two above-ground storage tanks stored along the western border and around four 55-gallon drums stored along the southern border adjacent the auto freight building (Photographs 3 and 4 and Figure 3).

- Additional automotive parts and equipment were observed stored on the property. Small oil stains on soils associated with this equipment were observed.

- Four treated telephone poles were observed on the property. The treated telephone poles stored on the parcel are potentially a dangerous waste. The poles should be reused or representatively sampled by coring to dispose of appropriately.

Potential for Contamination Based on Site History and Site Reconnaissance

Historical and current practices by the adjacent automotive freight building have potentially exposed site soils and groundwater to greases, oils, metals, solvents, and other chemicals associated with automotive engine maintenance and repair activities. Such impacted soils will have to be chemically characterized for proper disposal.

Auto Freight Warehouse Parcel

Summary of Previous Work

Three soil borings and monitoring wells were developed on the site (B-8, B-9, and B-10). Soil samples were screened in the field using a PID. Field screening results indicated VOCs present in the soils. Samples were then submitted for analyses for a base/acid/neutral (BAN) screening analysis. The BAN screen is intended to screen for the presence of semivolatile organic compounds ranging from gasoline compounds to heavier oil compounds. Results of the soil analysis for B-8 indicated light end BAN compounds to be present, indicating a gasoline or organic solvent source. No detectable BAN compounds were identified in the soils of B-9 and B-10.

Groundwater samples were also analyzed for BAN compounds and results indicated BAN compounds slightly above detection limits in B-9 and B-10. In B-8, results indicated light end BAN compounds to be present, indicative of gasoline compounds.

Site Historical Review

The Auto Freight Warehouse at 2100 Elliott Avenue was developed around 1900 by the United Warehouse Company to store cement and salt and serve their "Oriental Dock" on the west side of Alaskan Way. This dock was the forerunner of the Port of Seattle's Pier 66. The warehouse and parcel subsequently served, in the 1930s, as the facilities for three fish by-product companies including the: 1) Marine By-Products Fertilizer Company; 2) Salmon By-products Inc.; and 3) W.R. Lebo Fertilizer company. The facility burned down right after World War II. It was reconstructed in 1946 and became the Seattle Auto Freight Depot. It since has served as a transhipment point for a number of small freight companies. The majority of activities consisted of freight transfer, although some refueling of trucks occurred. Two fuel tanks associated with recent operations have been identified on the property. According to Port of Seattle information, a 10,000-gallon UST has recently been removed and contaminated soils and groundwater are known to remain on the site.

Site Reconnaissance Observation

On November 22, 1992, Julie Sowa of Hart Crowser performed a site reconnaissance of the Auto Freight Warehouse parcel. There were no escorts available for the site reconnaissance. The following observations were recorded.

- Numerous oil spills were observed on the paved portion of the property, and substantial spills were observed near storm water catch basins (Photograph 5 and Figure 3).

- Significant oil staining was observed on exposed soils adjacent the north and south side of the building.

- Four 55-gallon drums of unidentified substances were observed stored on soils on the north side of the building. In addition, two full 55-gallon drums of oil were observed on the south side of the building. An oily diesel engine was observed on the exposed soils adjacent the south side of the building. Oil stains were observed on soils around the diesel engine.

- Paint fumes from a painting booth (Omni Design) operation were detected during our site reconnaissance. No spills of unusual substances were observed inside this shop area.

- At the time of our site reconnaissance, auto repair activities were occurring inside the freighthouse. Large oil stains were observed on the concrete area surrounding these autos. A few oily diesel engines were observed inside the building. One of the site occupants states that when it rains, the roof leaks like a 'sieve'. It is suspected that runoff from inside the building is directed to the storm drains outdoors.

- Many hazardous substances are stored within the building including paints, solvents, and automobile batteries (Photograph 6, Figure 3). Such materials should be removed prior to building demolition and disposed of accordingly.

Potential for Contamination Based on Site History and Site Reconnaissance

Large volumes of spilled oils were observed on the project property and around and in storm water catch basins. Soils and groundwater on the site may potentially be adversely impacted by metals associated with auto repair activities, petroleum constituents associated with automotive fluids and spills of such fluids, and solvents associated with automotive and paint booth activities.

Gasoline service stations were located upgradient of the site from at least 1916 to about 1969. In addition, undocumented spills from product rail cars may have occurred in the railway adjacent the site. There is a limited potential for off-site sources of contamination to impact site soil and groundwater quality.

The UST located underneath the building may have been either a heating oil UST or a waste oil UST. The tank may have eroded, adversely impacting surrounding soils and groundwater. A construction contingency plan should be developed to address potentially contaminated soils during site development.

According to information available from the Port of Seattle, a 10,000-gallon UST was recently removed. Petroleum contamination is known to exist in the site soils and groundwater. In addition, information provided by the Port of Seattle indicates contamination in the soils and groundwater are present in the form of heavy end oils.

Pacific Coast Feather Warehouse Parcel

Summary of Previous Work

Five borings and monitoring wells were placed in and around the Pacific Coast Feather warehouse (B-1, B-2, and B-3). Soil samples were screened in the field for volatile organic compounds using a PID. As there were no VOCs detected by the PID screening, no soil samples were submitted for chemical analyses.

Groundwater samples were analyzed for dissolved metals (As, Cd, Cr, and Pb) and BAN compounds. Dissolved arsenic was detected in well B-3 at a low concentration of 0.007 ppm. Dissolved lead was detected in wells B-1 through B-5 at concentrations ranging from 0.01 to 0.02 ppm. No BAN compounds were detected in B-1 or B-2. Minor BAN compounds were detected in B-3.

Site Historical Review

The subject building on the site was first constructed in about 1900 as the United Warehouse Company's merchants warehouse. A cold storage warehouse which housed two ammonia compressors was attached on the south side of the merchant warehouse. By about 1960, the attached cold storage building had been demolished and a parking lot constructed on the site. The main warehouse has continuously been utilized as a storage warehouse.

Site Reconnaissance Observations

On November 21, 1991, Julie Sowa of Hart Crowser performed a site reconnaissance of the Pacific Coast Feather Warehouse parcel. The following observations were recorded.

- Dark stains were observed on exposed soils adjacent on the north side of the building beneath the Lenora Street Viaduct. Additional miscellaneous empty containers were observed stored along the north side of the building. A few stains were observed about the containers.

- Drain pipes from the overhead Lenora Street Viaduct drain directly to soils on the north side of the building. Dark stains were observed about the drains. Such staining indicates the potential for the presence of metals from street dust.

- Miscellaneous debris was observed in the back of the building (east side). These materials included discarded empty containers and drums. No stains were observed about these containers.

- Cleaning supplies, paints, and solvents were observed inside the building. Such items should be removed prior to demolition.

- Potential PCB-containing fluorescent light fixtures were observed in many areas. Ballasts not labeled as "PCB-free" are considered to contain PCB oils. PCB-containing ballasts should be removed and appropriately disposed of as previously discussed.

- A small silk-screening shop was observed inside the office area of the building (Photograph 8, Figure 3). No spills were observed about the chemicals used in the operation. Such equipment and chemicals should be removed prior to building demolition.

Potential for Contamination Based on Site History and Site Reconnaissance

Historical evidence suggests the building was heated by an oil burner. Although evidence of a UST was not observed during our site reconnaissance, this suggests the presence of an UST. If an UST is located under the building, the tank may have eroded and adversely impacted site subsurface soils and groundwater. A construction contingency plan for tank removal and possible soil remediation should be developed in the event an UST is encountered during site development.

Soil staining observed adjacent north of the parcel underneath the Lenora Street Viaduct suggests surficial soil contamination and potential subsurface soil and groundwater contamination. Such soils should be chemically characterized for proper disposal prior to site development.

The warehouse adjacent to the south of the parcel has two aged heating oil USTs on site. Former work performed on this parcel indicated heavy end BAN compounds in water collected from B-7, indicating a potential waste or heating oil source. In addition, a chemical manufacturer also operated in this warehouse from at least 1948 to prior to 1958. Chemicals associated with petroleum compounds and chemicals associated with the former chemical manufacturer have the potential to adversely impact the site through groundwater migration.

Gasoline automotive service station were located upgradient of the site along Western Avenue from at least 1916 to about 1969. In addition, undocumented spills from product tank rail cars may have occurred in the railway corridor adjacent cast. A limited potential for off-site source migration of contaminants to impact the project area exists.

RESULTS OF ENVIRONMENTAL EXPLORATIONS AND ANALYSES

This section presents potential site environmental issues based on field and laboratory screening performed on selected soil and groundwater samples collected in the field. As discussed previously the amount of information generated from the field and analytical work is limited because our scope was limited to taking advantage of the geotechnical engineering explorations proposed as part of our preliminary engineering study. Two of the four geotechnical borings were utilized for environmental purposes (HC-7 and HC-9) and completed as monitoring wells.

Based on the results of our field and laboratory screening analyses (the laboratory certificates of analysis are presented in Appendix D), we have generated Tables 1 and 2 (presented at the end of the text) to present only those compounds detected in our chemical analyses. Also presented in these tables are MTCA Method A and Method B cleanup levels for comparison purposes only. The Method B levels for soils are based on direct contact concerns only and not groundwater protection or other potential exposures pathways.

Discussion of Data and Recommendations

Pier 66 - Task 1 Results

To identify the potential for encountering elevated total metals concentrations and the presence of petroleum hydrocarbons in the Pier 66 fill material, the following were accomplished:

- Soil samples from borings HC-1, HC-2, and HC-3 drilled along the eastern side of the Pier 66 Parcel were screened in the field with a PID. No VOCs were detected in this screening procedure.

- Two composite samples from borings HC-2 and HC-3 are currently being tested for total metals. Results from the analysis will be sent as a letter of addendum to the Port of Seattle.

Triangle Parcel - Task 2 and 3 Results

To assess potential chemical impacts to soil and groundwater quality (based on historical site use and visible soil staining), two soil samples from HC-9 were collected and chemically analyzed.

Soil. Sample S-1 was collected at the 2.5- to 4.0-foot-depth interval and S-3 was collected at the 7.5- to 9.0-foot-depth interval. Each sample was analyzed for PAHs, PCB, VOCs, petroleum hydrocarbon, and total metals. The following soil quality information was obtained:

- Elevated concentrations of polynuclear aromatic hydrocarbons (PAHs), petroleum hydrocarbons, tetrachloroethene (PCE), and several metals (including lead and zinc) were encountered in soil samples collected from boring HC-9 (Table 1). Boring HC-9 (renamed B-12 on Site Plan 3) was installed in an area containing visibly stained soils. However, cPAHs are the only constituents which exceed MTCA Method A cleanup levels. Total cPAH concentrations detected in boring HC-9 (1.4 and 2.0 mg/kg) only slightly exceed the MTCA Method A cleanup level of 1.0 mg/kg. These detections do not exceed the Method B direct contact cleanup level of 3.4 mg/kg.

Recommendation: Exceedence of the MTCA Method A cleanup levels presented in Table 1 does not indicate that soil remediation is required but this approach helps to identify areas and constituents which may require further evaluation. A site-specific evaluation of MTCA cleanup levels should be undertaken before site remediation is initiated.

Groundwater. One groundwater sample was collected from monitoring well B-12 (HC-9) and analyzed for VOCs, PAHs, PCBs, petroleum hydrocarbons, total and dissolved metals, and total suspended solids. The following information was obtained:

- Groundwater collected from the monitoring well (B-12) installed in boring HC-9 contained elevated levels of PAHs and total (unfiltered) metals. Concentrations of cPAHs, total arsenic, total chromium, and total lead detected in HC-9 groundwater exceed MTCA Method A cleanup levels (Table 2). The elevated total metal and cPAH concentrations observed in groundwater sampled from well HC-9, which was screened in a very silty sand unit, are likely due to the presence of suspended solids. Although we attempted to minimize the turbidity in the well by employing aggressive well development procedures, the amount of suspended solids present in the groundwater remained high as illustrated by its high total suspended solids (TSS) content (1,400 mg/L). No dissolved (filtered) metals concentrations exceed MTCA Method A cleanup levels.

Recommendations: Based on the chemical results from the groundwater analysis, it is likely that contaminated groundwater will be encountered during construction activities. In the event of dewatering, water collected will have to be chemically characterized for proper disposal.

In addition to the sampling and analysis program that we performed, we recommend collecting and analyzing a surface composite sample of the stained soils to characterize the contaminants of concern and identify the concentrations of these contaminants present in the soil. Such an analysis would assist in characterizing the waste designation of the stacked soils for proper disposal.

Auto Freight Warehouse Parcel

- No subsurface environmental sampling and analyses were conducted at this parcel under the present scope of work.

Recommendations: To further characterize the contaminants of concern, we recommend sampling monitoring wells which exist on site (B-8, B-9, and B-10; 1986 Study) and analyzing the samples for PAHs, PCBs, petroleum hydrocarbons, volatile organic compounds, total and dissolved metals, and TSS.

We recommend a construction contingency plan be prepared to address issues in the event contaminated soils are encountered during site development activities.

Test pits should be installed in planned excavation areas in order to assist in determining the contamination present. Estimates could then be developed as to the amount of contaminated soil for disposal.

Pacific Coast Feather Warehouse Parcel - Task 6 and 7 Results

To assess potential chemical impacts to soil and groundwater quality, two soil samples were collected and a monitoring well developed from HC-7 on the east side of the Pacific Coast Feather warehouse.

Soil. Sample S-1 was collected at the 2.5- to 4.0-foot-depth interval and sample S-3 was collected at the 7.5- to 9.0-foot-depth interval. Each sample was analyzed for the following: VOCs, PAHs, PCB, petroleum hydrocarbons, and total metals. The following information was obtained:

- Elevated concentrations of tetrachloroethene (PCE), 1,1,1-trichloroethane, and PAHs were encountered in one of the two soil samples collected from boring HC-7 (S-3, Table 1). Tetrachloroethene, which is commonly used as an industrial solvent for dry cleaning and metal degreasing operations, was detected at a concentration of 4.4 mg/kg in a soil sample collected 7.5 to 9 feet below ground surface. The MTCA Method A cleanup level for PCE is 0.5 mg/kg. PCE was not detected in the sample collected at the 2.5- to 4-foot-depth interval.

- Total cPAH concentrations ranged from not detected in the shallow soil sample to 1.2 mg/kg in the sample collected at the 7.5- to 9-foot-depth interval. This concentration slightly exceeds the MTCA Method A cleanup level.

Groundwater. One groundwater sample was collected from monitoring well B-11 (HC-7) and analyzed for VOCs, PAHs, PCBs, petroleum hydrocarbons, total and dissolved metals, and TSS. The following information was obtained:

- Groundwater sampled from the monitoring well installed in boring HC-7 (renamed B-11 on Site Plan 3) contained elevated concentrations of PAHs and total metals. PCE was not detected. Concentrations of total cPAHs (0.17 μg/L), total arsenic (10 μg/L), total chromium (370 μg/L), and total lead (120 μg/L) exceed MTCA Method A and B cleanup levels. High turbidity (TSS of 3,600 mg/L) in groundwater sampled from well HC-7 is likely to be the primary cause of these elevated cPAHs and total metal levels. No dissolved metals concentrations exceed MTCA Method A or B cleanup levels.

Recommendations: Based on the chemical results from the groundwater analysis, it is likely that contaminated groundwater will be encountered during construction activities. In the event of dewatering, water collected will have to be chemically characterized for proper disposal.

To screen for potential off-site sources of contamination, we recommend sampling monitoring wells which exist on the *west* side of the parcel. Samples should be analyzed for the same parameters examined as part of this investigation.

Test pits should be installed in planned excavation areas in order to assist in determining the contamination present. Estimates could then be developed as to the amount of contaminated soil for disposal.

Also, we recommend collecting a composite soil sample from the northwest side of the parcel to chemically characterize the stained surface soils in this area. Such an analysis would assist in characterizing the waste designation of the stained soils for proper disposal.

ADDITIONAL ENVIRONMENTAL RECOMMENDATIONS

It is believed the groundwater in the area is tidally influenced. To better assess groundwater fluctuations and flow direction, water level measurements should be collected from selected wells during a tidal period.

All monitoring wells (B-1 through B-10) should be resampled and the groundwater analyzed using methods employed in this study to better assess groundwater quality in the project area.

PRELIMINARY GEOTECHNICAL ENGINEERING CONSIDERATIONS

This section of the report presents our conclusions and recommendations regarding the preliminary geotechnical aspects of design and construction on the subject property. We include a discussion of the following topics:

- Subsurface conditions;
- General considerations;
- Preliminary foundation design;
- Preliminary excavation retention and support;
- Preliminary pavement design and construction; and
- Other design criteria.

We have developed our recommendations based on our current understanding of the project. If the nature or location of the facilities is different than we have assumed, Hart Crowser should be notified so we can change or confirm our recommendations.

Physical Subsurface Conditions at the Uplands Site

In August, October, and November of 1986 Hart Crowser drilled a series of borings and installed monitoring wells as part of a preliminary site contamination assessment and soils investigation of five properties along Alaskan Way. The results of this work were presented to the Port in four reports dated October 3, November 24, and December 4, 1986 and January 6, 1987. More recently, in January 1991, we drilled 2 borings at the top of the slope along Elliott Avenue as part of a subsurface investigation to address slope stability and excavation retention as input to the project Environmental Impact Statement. This work was presented to you in a report dated March 1991.

As part of the current study, in February 1992, we drilled 4 additional borings (HC-7, HC-8, HC-9, and HC-10) at the site to depths of about 25 feet. The additional borings were drilled in order to get a more comprehensive understanding of the subsurface conditions, establish contouring of the firm bearing layer where possible, and to identify suspected contaminants in the soil and groundwater. We installed monitoring wells in borings HC-7 and HC-9 for our site subsurface contamination investigation. The monitoring wells are renamed B-11 and B-12.

Soils information from the 1986, 1991, and 1992 explorations have been incorporated into the current study. Figure 2 shows the approximate locations of the explorations. The exploration procedures and logs are presented in Appendix A. Laboratory test results are presented in Appendix B.

We based our interpretation of subsurface conditions on materials encountered in our borings. The nature and extent of variations between borings may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.

The general subsurface conditions consist of (in descending order from the ground surface downward):

Uncontrolled Fill. This variable material lies in some areas of the site beneath 6 inches of asphalt (B-6, B-7, B-8, B-9, B-10A, and B-10B; 1986 Study), in other areas of the site beneath about 3 inches of asphalt and about a foot of concrete (B-1, and B-2; 1991 Study), and in the remaining areas of the site beneath sod and loose gravel. The uncontrolled fill is primarily a loose to medium dense, silty, gravelly sand with occasional layers of silt and brick and wood fragments. In borings B-3 and HC-10 the fill is soft to stiff, sandy silt and clayey silt with occasional organics and wood fragments.

This upper soil unit varies in thickness across the site from about 10 to 14 feet on the northeast edge of the site, near the base and top of the slope, to about 23 feet and thicker on the southwest edge of the site, along the Alaskan Way right-of-way. The fill encountered in boring B-2 which was advanced from the top of the slope on Elliott Avenue(1991 Study), extended to about 25 feet below grade most likely because this boring was located directly behind a retaining wall that had been backfilled during construction. Based on interpolation between 0 feet of fill at the base of the slope, and the depth of soft fill material over the dense sand encountered in HC-1, HC-2, and HC-3 on the west side of Alaskan Way, the likely maximum depth of fill at the uplands site is about 30 feet.

Gravelly Sand. The lower soil unit is a very dense, natural, gravelly sand with varying amounts of silt and gravel. This very dense soil was encountered below the fill in 6 out of the 14 borings drilled at the site. The approximate depths at which this material was encountered is listed below:

Study	Boring	Depth to Gravelly Sand in Feet
1991	B-1	14
1986	B-3	12
1992	HC-7	10
1992	HC-8	10
1992	HC-9	12
1986	B-10B	23

In the other seven borings, drilled to depths of approximately 20 to 25 feet, this unit was not encountered.

This dense gravelly sand zone is a high strength, low compressibility material which will exhibit excellent foundation support characteristics both for shallow footings (where the dense material is near the ground surface) and for pile foundations (in deeper areas).

Groundwater. Groundwater was encountered in a majority of the borings between depths of 7 and 15 feet below the ground surface with an average depth of about 11 feet. No groundwater was encountered in borings B-1 and B-2 (1991 study) drilled at the top of the slope along Elliott Avenue. These groundwater levels, indicated on the boring logs as ATD, were measured at the time of drilling. Actual groundwater levels may fluctuate due to tidal influence, variations in rainfall, temperature, and other factors. Also, soil conditions may influence the rate at which groundwater seeps into a boring or monitoring well during the time that the excavation remains open.

General Considerations

The Port of Seattle will be contracting with a private developer to develop the uplands portion of the project. The preliminary recommendations we are providing herein are intended to help the developer to formulate a reasonable construction cost estimate. Our geotechnical engineering recommendations are intended specifically to identify foundation, earthwork, and retaining structure issues that would impact construction costs.

Hart Crowser has already accomplished work toward this end. We have conducted a subsurface soils exploration and installed monitoring wells as part of a detailed environmental assessment for the three blocks along Alaskan Way from Blanchard south to Stewart Street. We have previously advanced a deep boring (B-10B) to a depth of about 48 feet in order to determine the thickness of fill material and the top elevation of dense bearing soil. In addition, we have completed borings at the top of the slope along Elliott Avenue and performed preliminary engineering design for slope stability and retaining structures in this area. References to these previous Hart Crowser projects will be made in this section of the report. A summary of the findings will be included herein but the reader is asked to also refer to the original reports for more detail.

Preliminary Foundation Design

The type of foundation support system needed beneath a structure is influenced by subsurface conditions, the magnitude of the structural loads, and the sensitivity of the structure to settlement. Although the layout of the building support systems and the building loads have not yet been established we anticipate that the structures will be supported primarily on a series of heavily loaded columns spaced reasonably close as well as perimeter walls.

The surficial uncontrolled fill soils, present at varying thicknesses across the site, are unsuitable for direct support of the planned structures. As an alternative, the uncontrolled fill could be overexcavated and replaced with good quality structural fill and the structures could be supported on shallow foundations within the structural fill. More likely, footings could be deepened to bear on the dense soils at depth. Shallow footings bearing on structural fill should be designed using a bearing pressure of 2 kips per square foot. Shallow footings bearing on dense natural soils should be designed using a bearing pressure of 6 to 7 kips per square foot.

Shallow foundation support alternatives would be unsuitable, however (from a geotechnical engineering prospective), for a majority of the structures proposed at the site because they would involve a 10-foot to 30-foot excavation well below the water table. From our experience, the practical limit for shallow footing support would be those areas of the site where the depth to the firm bearing zone is less than about 8 to 10 feet below the proposed finished floor elevation. Such options might be viable for structures proposed near the base of the existing slope (i.e., the proposed Trade Center Office Building and the adjacent 12-story hotel) where dense soils exist nearer to the ground surface and excavations into the slope are proposed. Such options might also be viable for buildings with basements; however, as we understand first floor elevations of all proposed structures are designed at existing low grade level or perhaps one half level below existing low grade.

As has been discussed, the potential for soil and groundwater contamination at the site is significant. As a result, deeper excavations to extend footings or provide subgrade basements may not be appropriate from an environmental prospective considering the potential costs associated with removal and disposal of contaminated material.

Trade Center Office Building and Hotel

Significant cuts made into the existing slope could be required in order to construct the proposed Trade Center Office Building and adjacent hotel in the vicinity of the existing Art Institute. Such excavations will most likely expose dense natural soils in the northeast portions of the building pads that would be suitable for direct support of the structures. Explorations at the top of the slope showed firm and relatively incompressible soils near the planned foundation level (about 35 to 40 feet below the elevation of Elliott Avenue). In such areas where the firm soil is exposed by excavations, the structures may be supported on shallow footings and a slab-on-grade. The firm incompressible bearing layer dips downward in a south and westerly direction however (away from the slope), rather dramatically. The bearing layer may be as low as 10 or more feet below existing grade on the southwest side of the proposed structures. Consequently, the southwest portions of the Trade Center and hotel may need to be supported on pile foundations.

Remaining Structures

We recommend supporting the remaining proposed structures solely on pile foundations. The primary consideration for pile design beneath the proposed structures is embedment into the dense bearing layer as predominantly end bearing piles. Pile types that would be technically feasible to use include augercast piles, steel pipe piles, steel H-piles, precast concrete piles, and timber piles. In our opinion, the most appropriate pile types for this project would be augercast piles, steel pipe piles, and steel H-piles. Timber piles would be less suitable because of their relatively low structural capacities (about 25 to 30 tons) and the difficulty they have penetrating dense bearing soils. Precast concrete piles would also be less suitable because precast concrete is difficult to cut and splice in the field and consequently requires a better than normal up front estimate of required lengths. The surface of the bearing layer at the upland site is erratic which means that the length of the pile could differ from pile cap to pile cap. Steel piles and augercast piles have the advantage that their lengths can be more easily controlled in the field during construction.

Augercast piles have an advantage in that the noise and vibrations associated with installation is minimal as opposed to driven piles. Their main disadvantage at this site, due to potential soil contamination, is that the cuttings from the pile may be contaminated. This potential will likely result in a need for the pile cuttings to be chemically analyzed as part of waste designation for proper landfill disposal.

Drilled shafts would also be feasible at the site but would likely not be cost-effective. Because of the high groundwater level, the shafts would likely require casing and possibly dewatering or use of drilling mud which would increase the costs. The same disadvantages as augercast piles apply to drilled shafts due to potential soil contamination and additionally groundwater contamination.

Vertical Compressive Pile Capacity

All piles will derive the majority of their capacity from embedment into the underlying dense, gravelly sand bearing layer. Top elevations of the bearing layer are indicated parenthetically at a number of the boring locations on Figure 2 the Site and Geotechnical Exploration Plan. This bearing layer lies about 10 to 12 feet below the ground surface (elevation 8 to 6 feet) along the northeastern edge of the site at the base of the slope and dips down to the west to about 23 feet and possibly deeper (elevation -5 feet) near the Alaskan Way right-of-way.

We expect about 10 feet of penetration into the bearing layer to achieve full compressive pile capacity. Pile lengths will therefore be between about 20 to 35 feet or more.

Vertical compressive capacities of end bearing piles would be governed primarily by the structural capacity of the pile. We estimate that augercast piles at this site would have allowable vertical compressive capacities of about 40, 50, 60, and 80 tons each for 12-, 14-, 16-, and 18-inch-diameter piles, respectively. Steel pipe piles in the range of 10 to 16 inches in diameter would have compressive capacities in the range of 80 to 120 tons depending on the diameter and wall thickness. Minimum wall thicknesses of 3/8- to 1/2-inch should be assumed. Pipe piles should be driven closed end to achieve full compressive capacity with the minimum amount of embedment. Steel H-piles would have compressive capacities in the range of 40 to 120 tons depending on the size of section.

Vertical Uplift Pile Capacity

Uplift capacities would be equal to the circumferential area or equivalent circumferential area in the case of Steel H-piles, multiplied by an adhesion value of about 300 psf above the bearing layer and 2,000 psf below the top of the bearing layer. Under seismic conditions there may be negative skin friction acting on the piles. This is discussed further in a subsequent section.

Lateral Pile Capacity

Lateral forces develop on a structure and its foundation during an earthquake or as a result of wind or other forces. The resultant lateral resistance and deflections of pile foundations are governed primarily by the lateral capacity of near-surface soils and the strength of the pile itself. The design lateral capacity of the vertical piles will depend, to a large extent, on the allowable lateral deflections of the piles.

Lateral pile capacity may become a governing factor for foundation design of the proposed Trade Center Office and Hotel in their current configuration. If these structures are constructed integrally with the shoring system adjacent to Elliott Avenue then the lateral soil pressures from the shoring system would be transferred into the structures. If the structures, in turn, are situated at existing grade then the piles and pile caps will be required to support most of this lateral load.

Use of the procedure discussed below, incorporating the design charts on Figures 4 and 5 will allow the structural engineer to estimate the pile deflection and moments within the pile at any point at or below the pile cap for a given loading.

Development of lateral pile criteria requires an assumption of the degree of fixity at the pile head by the structural engineer. A pile is considered free-headed if the top is free to rotate. If the top of the pile is fixed against rotation by embedment in a pile cap that is sufficient to develop a fixed-end moment, the pile is considered restrained and fixed-headed. We expect that the piling would be structurally connected to the pile cap and therefore fixed to a great degree against rotation. We recommend that the structural engineer evaluate the degree of fixity and then linearly interpolate between results outlined from Figure 4 (true fixity at head) and from Figure 5 (true free-headed condition).

In addition to the pile head fixity condition, the following information is required to determine lateral pile deflections and moments:

Moment and Deflection Equations:

Free-Headed Condition

$$Y = \frac{A_y P_{xx} T^3}{EI} + \frac{B_y M_{xx} T^2}{EI}$$

$$M = A_m P_{xx} T + B_m M_{xx}$$

Fixed-Headed Condition

$$Y = \frac{A_y P_{xx} T^3}{EI}$$

$$M = A_m P_{xx} T$$

Where:

Y = Deflection at any point at or below the pile cap,

M = Moment at any point at or below the pile cap,

P_{xx} = Shear applied to the pile at pile cap (x-x plane),

M_{xx} = Moment applied to the pile at pile cap (x-x plane),

A_y,B_y = Deflection coefficients from Figure 4 or 5,

A_m,B_m = Moment coefficients from Figure 4 or 5,

EI = Flexural stiffness of the pile,

T = Relative stiffness factor =

$$\left(\frac{EI}{n_h}\right)^{1/5}$$

n_h = Coefficient of variation of horizontal subgrade reaction, in pounds per cubic inch,

2T = Assumed depth to point of zero deflection.

The rate of increase of horizontal subgrade reaction, n_h, is related to the stiffness and density of the soil. The soil above a depth of about 2T (2 times the relative stiffness factor) usually controls the lateral capacity of the pile. For loose to medium dense sand fill encountered in this zone, an appropriate value of n_h is estimated to be 15 pounds per cubic inch for piles installed on level ground. The horizontal subgrade reaction is affected by pile spacing. For piles spaced 3, 4, and 6 times the diameter of the pile (pile spacing in the direction of loading), the subgrade reduction factors are 0.25, 0.4 and 0.7.

The moment and deflection of the pile at any depth may be determined by the above equations. This procedure is appropriate for piles driven or augered the entire depth of embedment. The moment formulations calculated using the procedures do not contain a factor of safety. The structural engineer should incorporate a suitable factor of safety in the lateral load design, and should verify the strength of the pile to resist the applied loads.

Pile Installation

Spacing of individual piles or piles within groups should be no closer than three pile diameters center to center for both driven and auger-cast piles. All pile installations should be observed by a geotechnical engineer or experienced technician.

General Driven Pile Installation. The size of the pile hammer required for installation will be a function of the size and required capacities of the piles. Because the dense bearing layer should be penetrated at least 5 to 10 feet in order to achieve adequate pile capacities, the hammer should be of sufficient energy to achieve this penetration. We anticipate that minimum hammer energies of 35,000 foot pounds will be required for steel pipe or H-piles.

Drilled Augercast Piles. Augercast piles are constructed by drilling to a predetermined depth with a hollow-stem auger followed by pumping grout through the hollow stem as the auger is withdrawn. Reinforcing steel may then be installed in the fresh grout column as necessary.

Slab Support

The lower floors of the buildings could be supported as slab-on-grade either over 1) a minimum of 18 inches of densely compacted structural fill or densely compacted *in situ* material as described in the ***Structural Fill Selection, Placement, and Compaction*** section of this report, or 2) over dense natural soils that are exposed after slope excavation in the vicinity of the Proposed Trade Center and adjacent hotel. As an alternative, lower floors of the buildings could be supported by a structurally supported slab instead of a slab-on-grade. It is likely that grade beams will be used to connect the pile caps supporting the columns in the case of pile-supported structures. Structural slabs may be more suitable in these instances because the pile caps and grade beams tend to act as "hard spots" in the floor increasing the likelihood of differential movement and cracking of the slab.

For proposed structures built at grade, we recommend placing a minimum of 6 inches of free-draining material and perimeter drains directly below the floor slabs as described in the subsequent ***Site Drainage*** section. For proposed structures constructed below grade we recommend 10 inches of drainage material with perimeter drains and cross drains spaced on 40-foot centers.

Preliminary Pavement Design and Construction

Pavements proposed at the uplands site will most likely include temporary parking spaces, driveways, and an expansion of Alaskan Way. We recommend in areas of heavy traffic such as roadways, truck access, or main parking lot drives, pavement sections consisting of 3 to 4 inches of asphalt concrete over 6 inches of crushed rock base course. General parking or light traffic areas would require 2 inches of asphalt concrete over 4 to 6 inches of crushed rock. These are only estimates to be used for general guidance. Both pavement sections should be supported on a minimum thickness of 12 to 18 inches of well compacted subgrades as discussed in the ***Site Preparation*** section. This subgrade may consist of compacted structural fill, natural soils that have been compacted in place, or dense natural soil.

Site Preparation

We anticipate that site preparation would generally consist of the removal of existing pavements and structures which would likely interfere with new construction. Site preparation may also involve the removal of underground storage tanks as discussed in previous sections. In the case of the proposed building areas, site preparation will include grading as necessary to meet finished floor elevations and provide minimum thicknesses of structural fill (including the drainage layer) directly beneath the slab-on-grade or structural slab. In the case of the proposed pavement areas, site preparation will include grading to provide the necessary pavement section.

In addition to site grading and demolition, site preparation activities will also include proper subgrade preparation beneath proposed structures and pavement sections. Unsuitable surficial organic soils (where present) should be stripped from the area under the footprint of the proposed structures or pavement areas. The areas should be proofrolled and soft areas should be recompacted, if possible or overexcavated and replaced with structural fill so that a nonyielding subgrade is obtained. The subgrade in the areas of the proposed structures and pavement sections should be compacted to a density equivalent to at least 95 percent of the maximum dry density, as determined by the modified Proctor test, ASTM D 1557.

There will be a significant advantage to conducting site preparation activities during the dry season in order to maximize the potential for drying and recompacting the *in situ* soils so that overexcavation of site soils can be avoided. Otherwise site grading operations may include the costly removal and disposal of contaminated material.

Site Drainage

The following section includes a discussion of permanent subsurface drainage and drainage during construction.

Permanent Subsurface Drainage. Permanent drainage systems beneath the proposed structures built at grade should include a minimum of 6 inches of free-draining (fines content of less than 3 percent passing the U.S. No. 200 sieve based on the minus 3/4-inch fraction), sand or sand and gravel and perimeter drains directly below the floor slabs. For proposed structures constructed below grade we recommend 10 inches of drainage material with perimeter drains and cross drains spaced on 30- to 40-foot centers.

Drainage during Construction. Groundwater was encountered during the time of drilling, at an average depth of 11 feet below the ground surface in the low lying areas of the site. No groundwater was encountered in borings drilled at the top of the existing slope. Due to the nature of the proposed on-grade structures, we would anticipate that water encountered during construction would be minimal and that this water could be controlled by conventional construction practices such as surface diversion, ditching, and sump pumping. It is important to note that our chemical analysis of groundwater samples taken from monitoring wells (B-11 and B-12) in borings HC-7 and HC-9 showed signs of contamination as described in previous sections. Water collected during construction will therefore have to be sampled and chemically characterized for proper disposal.

Structural Fill Selection, Placement, and Compaction

Structural fill is recommended beneath slab-on-grades and pavement sections. We recommend using a clean, well-graded sand and gravel with less than 5 percent by weight passing the No. 200 mesh sieve (based on the 3/4-inch fraction) or suitable on-site soil as described in the following section. Fill that is to serve as a leveling course and drainage layer beneath floor slabs should be a clean sand or sand and gravel with less than 3 percent by weight passing the No. 200 mesh sieve (based on the 3/4-inch fraction) as described in the ***Slab Support*** section of this report.

Structural fill should be placed in 10 inch lifts and compacted to a minimum density equal to 95 percent of the modified Proctor maximum dry density as determined by ASTM D 1557 test procedure.

Use of excavated soil at the site for structural fill is a function of the gradation and moisture content of the soil. Soil with more than about 5 percent fines cannot be consistently compacted to a dense and non-yielding condition when the moisture content is significantly above or below the optimum. Structural fill must also be free of organic matter and other debris. Surficial on-site soils at the uplands site are silty, gravelly sands with layers of silt and brick and wood fragments. This material, classified in this report as uncontrolled fill, would not be suitable for use as structural fill beneath the proposed structures due to the moderate to high silt content and presence of brick and wood fragments. The uncontrolled fill may however, be suitable as structural fill beneath pavement areas provided the exposed surface is proof rolled with heavy compaction equipment and any visible debris is removed and replaced with good quality structural fill as per the criteria discussed in the previous paragraph.

Preliminary Excavation Retention and Support

Construction of the proposed Trade Center Office Building and adjacent hotel will require significant cuts into the steep slope that exists along the northwest edge of the properties. Elliott Avenue runs along the top of the slope and an existing Art Institute abuts the slope just north of the proposed Trade Center. A well-designed shoring system will therefore be required to provide temporary and possibly permanent lateral support for the required slope excavations. The continued stability of the adjacent street and facilities, and maintenance of a safe work area are important.

Hart Crowser has already completed preliminary engineering design for slope excavation and retaining structures in this area. The engineering design is presented in our report titled "Preliminary Geotechnical Engineering Study, Elliott Avenue Retaining Wall," dated March 27, 1991. The following discussion is intended to address only key issues regarding excavation and retaining structures. We urge the reader to refer to our 1991 report for additional design level details.

Excavation and Slope Stability

Subsurface soils in the vicinity of the slope generally consist of surficial fill over stiff silt and hard gravelly sand. As discussed in our March 1991 report, such soils can be excavated with conventional heavy equipment such as large bulldozers, backhoes, and front end loaders.

The existing slope currently shows no obvious signs of instability. Things that would indicate instability include surface scarping or distorted vegetative growth. Instability would most likely arise, however, as a result of significant open cutting of the slope. We recommend therefore shoring all excavations made into the existing slope.

Any excavations made within a 1 Horizontal to 1 Vertical (1H:1V) angle projected from the edge of the City right-of-way will require special permits and detailed review by the Seattle Engineering Department.

Retaining Structures

In our 1991 report we recommended supporting the excavation with a conventional tied-back soldier pile wall. A tied-back soldier pile wall may be used as either a temporary or a permanent shoring system. In order to construct a permanent shoring system heavier structural sections and corrosion protection would be necessary. In addition, the factor of safety on a permanent shoring system would be increased to account for long-term load transfer of the anchors and the resultant creep.

Soil nailing was also mentioned in our report as an alternative support system. Soil nailing design recommendations could be made at a later date after additional subsurface excavations are made on the slope. Additional soils explorations would be necessary to determine soil caving conditions and ultimately the conduciveness of the slope to a shotcrete/soil nailing reinforcement system.

Vibrations Associated with the Burlington Northern Railroad

The Burlington Northern Railroad runs in a general north-south direction through the uplands site. All of the proposed structures are either immediately adjacent to or are within the railroad right-of-way. A 450-foot-long tunnel is proposed over a section of the tracks that will connect to the Trade Center Office Building and adjacent hotel. We would anticipate that the vibrations associated with the passing trains would be felt at the proposed structures. Although the vibration level at the site could be significant, we would not anticipate that vibrations associated with train movements would be of structural significance. We would not anticipate any significant loss of strength of soil surrounding the pile foundations.

The magnitude of vibration is not known and cannot be realistically assessed using analytical techniques. If desired, vibration levels at the site could be relatively easily monitored using an S-meter. The vibrations which are usually assessed in the form of peak particle velocity, could then be compared to various criteria for generally acceptable vibration levels.

Given the proximity of the tracks to the proposed structures, it is likely that some form of foundation damping will be required.

Seismic Design Criteria

We recommend using a Site Coefficient of S3 as indicated in table 23-j of the 1988 Uniform Building Code. Soil Type 2 should be used on Figure No. 3 (page 23-3) of the U.B.C.

RECOMMENDED ADDITIONAL GEOTECHNICAL SERVICES

We make the following recommendations for the final design phase of the project:

- Drill additional deep exploratory borings and collect soil samples. Deeper borings are required to better assess the depth to the firm bearing zone as well as to obtain information within the bearing zone as to strength and compressibility of this material;

- Perform laboratory tests on selected soil samples to provide information on soil gradation, plasticity, and consolidation;

- Conduct a geotechnical engineering analysis which would include foundation design recommendations, settlement analysis, pavement design recommendations, and recommendations for detailed design of permanent or temporary shoring systems;

- Provide input to the selected design team with regard to selection and design of appropriate shoring systems for the cuts along Elliott Avenue;

- Prepare a final geotechnical engineering design study report; and

- Review the final plans and specifications in order to see that the geotechnical engineering recommendations are properly interpreted and implemented into the design before construction begins.

During the construction phase of the project, we recommend that Hart Crowser observe the following activities:

- Site grading and subgrade preparation;

- Excavations and construction of shoring systems (refer to our March 1991 report for a more specific list of construction observations);

- Placement and compaction of structural fill;

- Installation of footings and or piles; and

- Other geotechnical considerations which may arise during the course of construction.

Sincerely,

HART CROWSER, INC.

GARRY E. HORVITZ, P.E.
Principal Geotechnical Engineer

PAULA M. ESTORNELL
Staff Geotechnical Engineer

JULIE A. SOWA
Industrial Hygn. Technician

GEH/PME/JAS:sde
CENTWATE.fr

Table 1 - Soil Analyses Results - Detected Compounds Only

Sample Location: Sample Number: Sample Depth in Feet:	HC-7 S-1 2.5-4.0	HC-7 S-3 7.5-9.0	HC-9 S-1 2.5-4.0	HC-9 S-3 7.5-9.0	MTCA Method A Residential/ Industrial Cleanup Level	MTCA Method B Direct Contact Cleanup Level(1)	Method Blank
Volatile Organic Compounds (EPA Method 8240) in mg/kg (ppm)							
Tetrachloroethene	ND	4.4	ND	0.19	0.5/2.5	20	ND
1,1,1-Trichloroethane	ND	0.14	ND	ND	20.0/20.0		ND
Hexane	0.66 UB	0.76 UB	0.56 UB	0.63 UB	-	4800	0.45
Polynuclear Aromatic Hydrocarbons (EPA Method 8310) in mg/kg (ppm)							
Fluorene	ND	0.13	0.12	0.077	-	3200	ND
Phenanthrene	ND	0.65	0.82	0.45	-	-	ND
Anthracene	ND	0.12	0.12	0.067	-	24000	ND
Fluoranthene	ND	0.86	1.4	0.86	-	3200	ND
Pyrene	ND	0.75	1.2	0.72	-	2400	ND
Benzo(a)Anthracene	ND	0.22	0.40	0.26	-	-	ND
Chrysene	ND	0.24	0.40	0.27	-	-	ND
Benzo(B)Fluoranthene	ND	0.19	0.29	0.20	-	-	ND
Benzo(K)Fluoranthene	ND	0.099	0.17	0.12	-	-	ND
Benzo(A)Pyrene	ND	0.24	0.41	0.32	-	0.34	ND
Dibenzo(A,H)Anthracene	ND	ND	0.047	0.043	-	-	ND
Benzo(G,H,I)Perylene	ND	0.23	0.30	0.22	-	-	ND
Indeno (1,2,3-CD)Pyrene	ND	0.16	0.25	0.19	-	-	ND
Total cPAHs (2)	ND	1.2	2.0	1.4	1.0 (3)/20.0	3.4	ND
Fuel Hydrocarbons (EPA Method 8015 Modified) in mg/kg (ppm)							
Range: C7-C12							
Quantitation: Gasoline	ND	ND	9	ND		-	ND
					100.0/100.0		
Range: C12-C24							
Quantitation: Diesel	ND	ND	75*	ND*		-	ND
					200.0/200.0		
Metals Analysis in mg/kg (ppm)							
Arsenic	3.3	3.0	3.8	2.1	20.0/20.0	20	ND
Chromium	58	42	25	25		400(4)	ND
Copper	52	37	47	30	100.0/500.0	3000	ND
Lead	10	26	93	120	-	500	ND
Mercury	ND	ND	ND	0.14		24	ND
Nickel	75	52	34	27	250.0/1000.0	1600	ND
Zinc	87	86	110	180	1.0/1.0	16000	0.57
					-		
					-		

ND - Not detected
UB - Analyte is considered to be not detected based on its presence in the associated method blank.
(1) - MTCA Method B cleanup levels presented in this table are based on direct contact exposures and were calculated in March of 1992
(2) - Total cPAH concentrations were calculated using one-half the detection limit for nondetected values
(3) - Cleanup level based on 10^{-6} cancer risk for benzo(a)pyrene
(4) - Direct contact cleanup level based on hexavalent chromium; cleanup level for trivalent chromium is 80,000 mg/kg

Table 1 - Soil Analyses Results - Detected Compounds Only

Sample Location: Sample Number: Sample Depth in Feet:	HC-7 S-1 2.5-4.0	HC-7 S-3 7.5-9.0	HC-9 S-1 2.5-4.0	HC-9 S-3 7.5-9.0	MTCA Method A Cleanup Level	MTCA Method B Direct Contact Cleanup Level(1)	Method Blank
Volatile Organic Compounds (EPA Method 8240) in mg/kg (ppm)							
Tetrachloroethene	ND	4.4	ND	0.19	0.5	20	ND
1,1,1-Trichloroethane	ND	0.14	ND	ND	20.0		ND
Hexane	0.66 UB	0.76 UB	0.56 UB	0.63 UB	-	4800	0.45
Polynuclear Aromatic Hydrocarbons (EPA Method 8310) in mg/kg (ppm)							
Fluorene	ND	0.13	0.12	0.077	-	3200	ND
Phenanthrene	ND	0.65	0.82	0.45	-	-	ND
Anthracene	ND	0.12	0.12	0.067	-	24000	ND
Fluoranthene	ND	0.86	1.4	0.86	-	3200	ND
Pyrene	ND	0.75	1.2	0.72	-	2400	ND
Benzo(a)Anthracene	ND	0.22	0.40	0.26	-	-	ND
Chrysene	ND	0.24	0.40	0.27	-	-	ND
Benzo(B)Fluoranthene	ND	0.19	0.29	0.20	-	-	ND
Benzo(K)Fluoranthene	ND	0.099	0.17	0.12	-	-	ND
Benzo(A)Pyrene	ND	0.24	0.41	0.32	-	0.34	ND
Dibenzo(A,H)Anthracene	ND	ND	0.047	0.043	-	-	ND
Benzo(G,H,I)Perylene	ND	0.23	0.30	0.22	-	-	ND
Indeno (1,2,3-CD)Pyrene	ND	0.16	0.25	0.19	-	-	ND
Total cPAHs (2)	ND	1.2	2.0	1.4	1.0 (3)	3.4	ND
Fuel Hydrocarbons (EPA Method 8015 Modified) in mg/kg (ppm)							
Range: C7-C12 Quantitation: Gasoline	ND	ND	9	ND	100.0	-	ND
Range: C12-C24 Quantitation: Diesel	ND	ND	75*	ND*	200.0	-	ND
Metals Analysis in mg/kg (ppm)							
Arsenic	3.3	3.0	3.8	2.1	20.0	20	ND
Chromium	58	42	25	25	100.0	400(4)	ND
Copper	52	37	47	30	-	3000	ND
Lead	10	26	93	120	250.0	500	ND
Mercury	ND	ND	ND	0.14	1.0	24	ND
Nickel	75	52	34	27	-	1600	ND
Zinc	87	86	110	180	-	16000	0.57

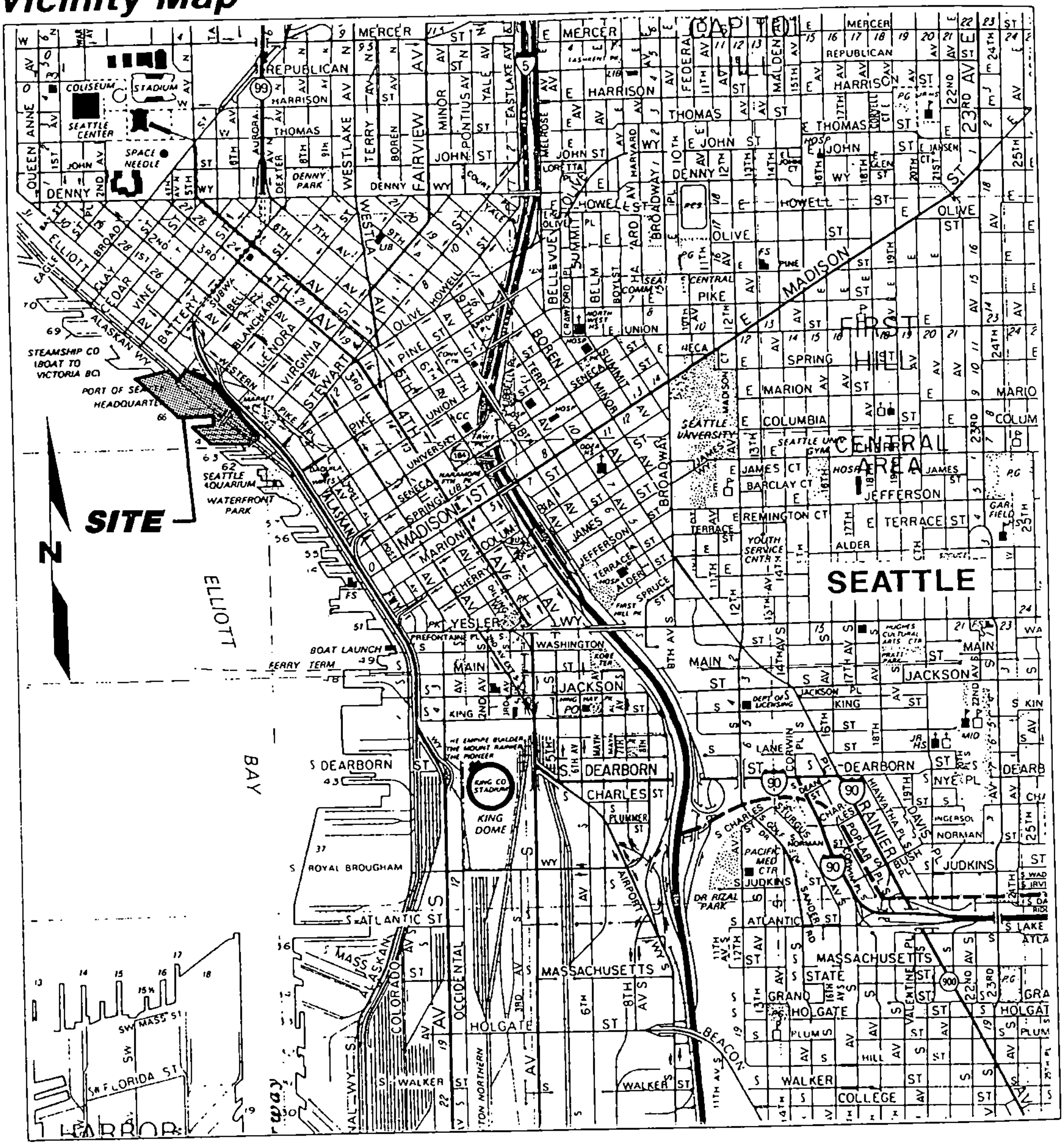
ND - Not detected
UB - Analyte is considered to be not detected based on its presence in the associated method blank.
(1) - MTCA Method B cleanup levels presented in this table are based on direct contact exposures and were calculated in March of 1992
(2) - Total cPAH concentrations were calculated using one-half the detection limit for nondetected values
(3) - Cleanup level based on 10^{-6} cancer risk for benzo(a)pyrene
(4) - Direct contact cleanup level based on hexavalent chromium; cleanup level for trivalent chromium is 80,000 mg/kg

Table 2 - Groundwater Analyses Results - Detected Compounds Only

Sample Location: Sample Number Date Sampled:	B-12 HC-9 2/24/92	B-11 HC-7 2/24/92	MTCA Method A Cleanup Levels in ug/L (ppb)	MTCA Method B Cleanup Levels in ug/L (ppb) (1)	Method Blank
Volatile Organics Analysis in ug/L (ppb)					
Hexane	11 UB	11 UB	-	960	10
Polynuclear Aromatic Hydrocarbons (EPA Method 8310) in ug/L (ppb)					
Naphthalene	0.14	0.12	-	64.0	ND
Acenaphthene	0.10	0.28	-	960.0	ND
Fluorene	0.090	0.099	-	640.0	ND
Phenanthrene	0.88	0.24	-	-	ND
Anthracene	0.15 B	0.069 B	-	4800	0.010
Fluoranthene	1.2	0.25	-	640	0.010
Pyrene	1.2	0.23	-	480	ND
Benzo(A)Anthracene	0.45	0.064	-	-	ND
Chrysene	0.50	0.043	-	-	ND
Benzo(B)Fluoranthene	0.32	ND	-	-	ND
Benzo(K)Fluoranthene	0.19	ND	-	-	ND
Benzo(A)Pyrene	0.46	0.038	-	0.01	ND
Dibenzo(A,H)Anthracene	0.065	ND	-	-	ND
Benzo(G,H,I)Perylene	0.36	ND	-	-	ND
Indeno(1,2,3-CD)Pyrene	0.32	ND	-	-	ND
Total cPAHs (2)	2.3	0.17	0.1	0.1	ND
Total PCBs in μg/L (ppb)	ND	ND	0.1	0.1	ND
Total Metals in μg/L (ppb)					
Arsenic	26	10	5.0	5.0	ND
Cadmium	1.2	1.5	5.0	5.0	ND
Chromium	270	370	50.0	100 (4)	ND
Copper	210	300	-	590	ND
Lead	280	120	5.0	15 (5)	ND
Mercury	1.4	0.66	2.0	2.0	ND
Nickel	250	510	-	100	ND
Zinc	510	540	-	3200	ND
Dissolved Metals in μg/L (ppb)					
Arsenic	ND	ND	5.0	-	ND
Cadmium	ND	ND	5.0	-	ND
Chromium	ND	ND	50.0	-	ND
Copper	ND	ND	-	-	ND
Lead	ND	ND	5.0	-	ND
Mercury	ND	ND	2.0	-	ND
Nickel	ND	ND	-	-	ND
Zinc	21	25	-	3200	ND
Total Suspended Solids in mg/L (ppm)	1400	3600	-	-	ND

ND - Not detected
UB - Analyte is considered to be not detected based on its presence in the associated method blank
B - Analyte is found in the associated blank as well as the sample
(1) - MTCA Method B cleanup levels calculated March 1992
(2) - Total cPAH concentrations were calculated using one-half the detection limit for nondetected values
(3) - Cleanup level based on 10^{-6} cancer risk for benzo(a)pyrene
(4) - Cleanup level based on hexavalent chromium; cleanup level for trivalent chromium is 100 μg/L
(5) - Office of Solid Waste and Emergency Response (OSWER) final cleanup for lead in groundwater

Vicinity Map



0 2000 4000

Scale in Feet

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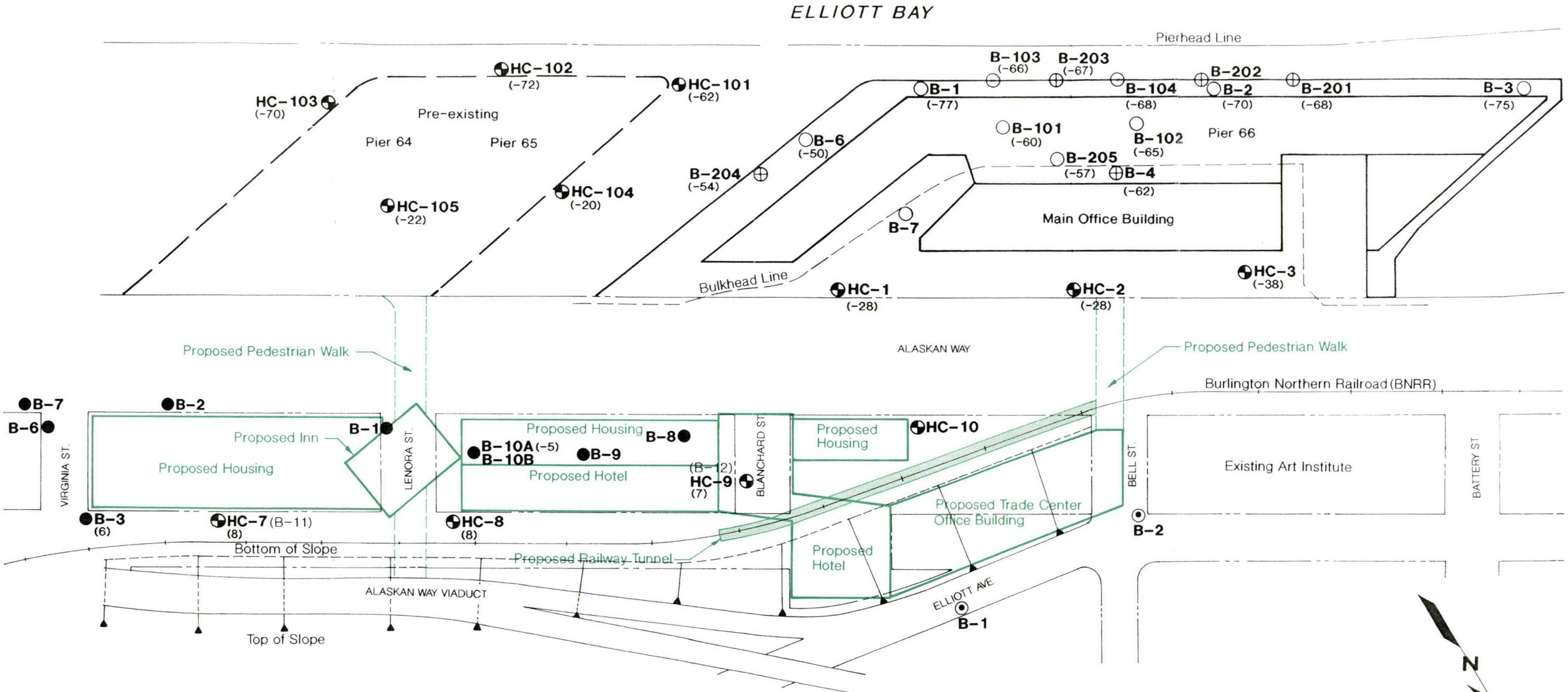
Figure 1

Site and Geotechnical Exploration Plan



○B-1 Boring Location and Number, by Shannon and Wilson, Inc. (1974, 1975, and 1988 Studies)

●B-8 Monitoring Well Location and Number, Hart Crowser, (1986 Study)

⊕B-201 Boring Location and Number, AGS, (1988 Study)

⊙B-1 Boring Location and Number, Hart Crowser, (1991 Study)

◐HC-101 Boring Location and Number, Hart Crowser, (Current Study)

(-70) Elevation in Feet of Top of Dense Soil Bearing Layer

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Figure 2

Environmental Assessment Site Plan

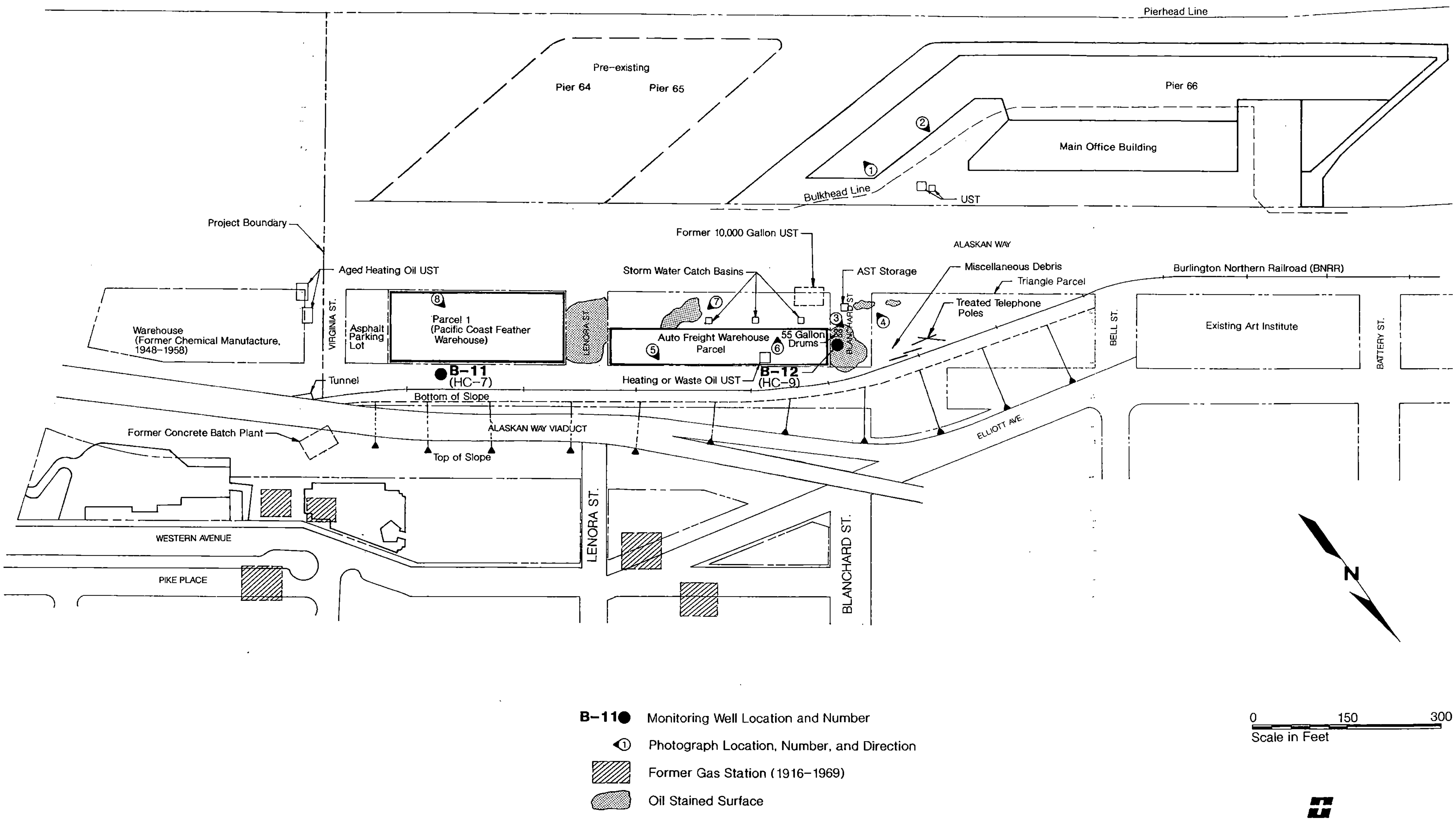

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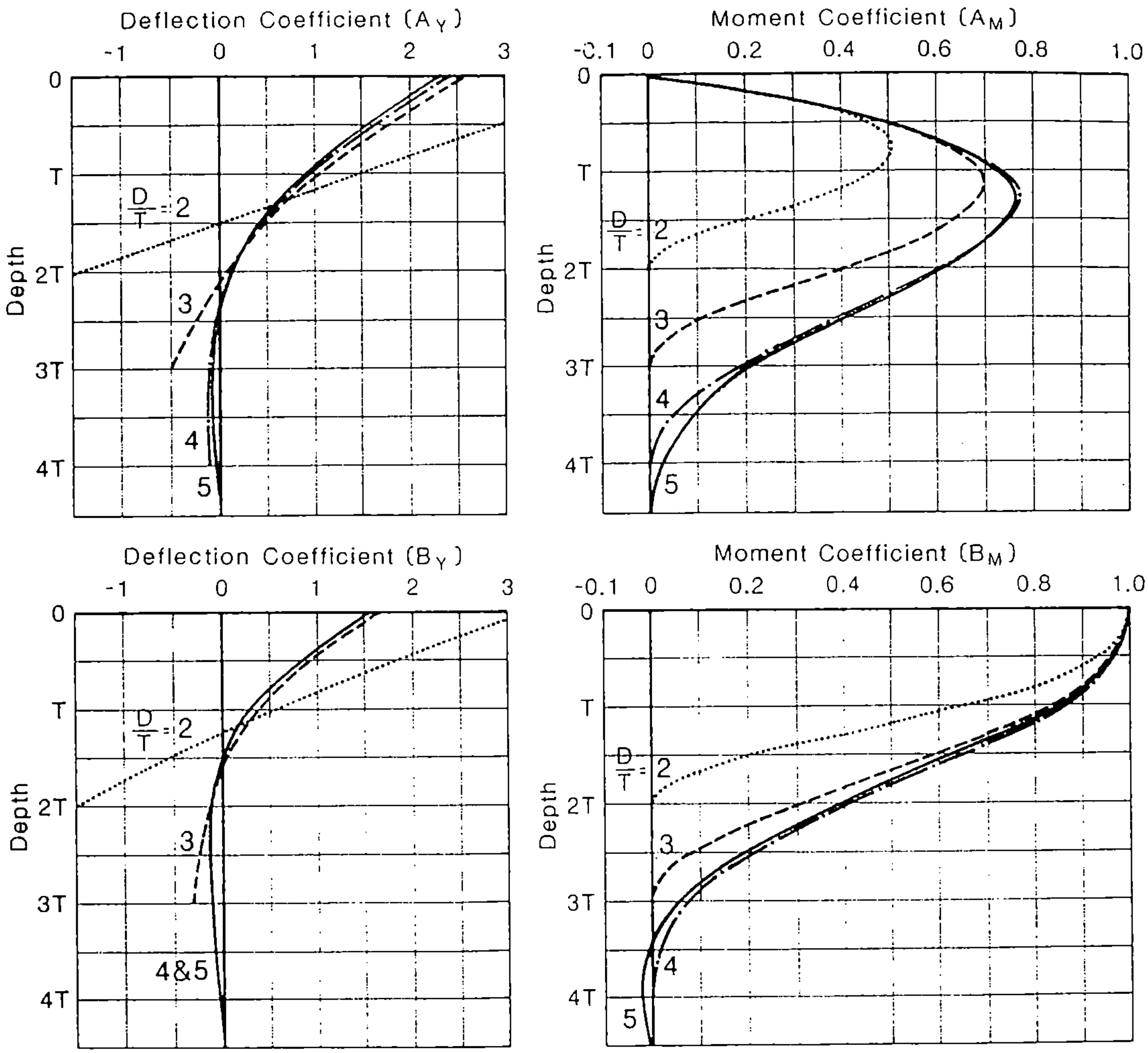
Figure 3

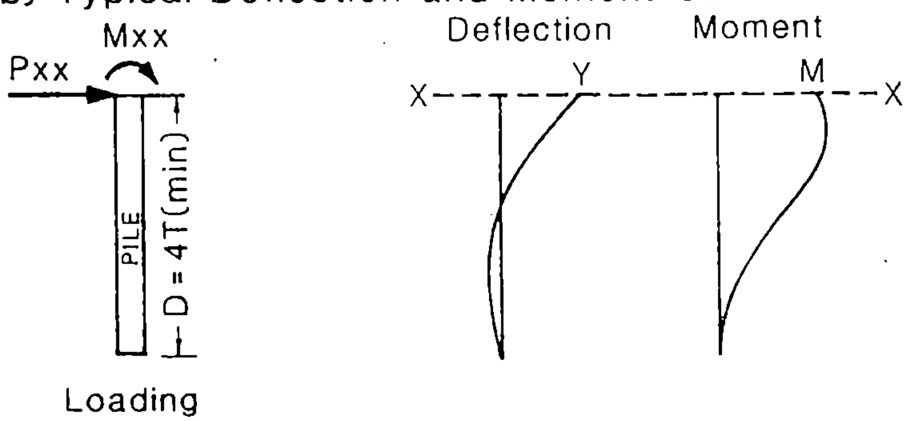
Laterally Loaded Piles in Elastic Subgrade Deflection and Moment Criteria

Free-Headed Pile Condition

(a) Deflection and Moment Coefficients



(b) Typical Deflection and Moment Curves



Pxx — Pile Shear at Ground Surface

Mxx — Pile Moment at Ground Surface

T — Relative Stiffness Factor

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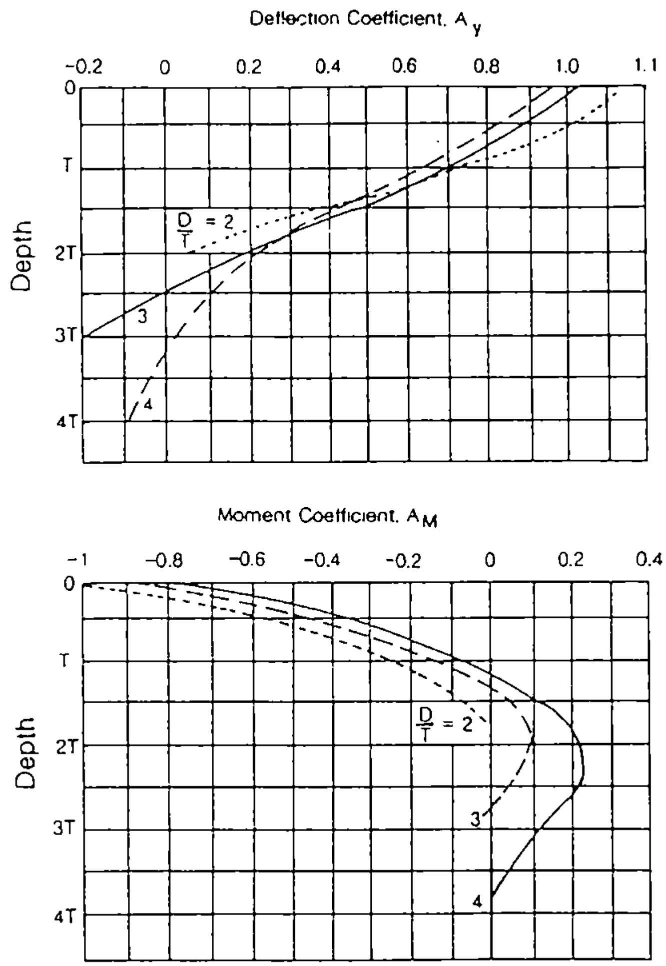
Figure 4

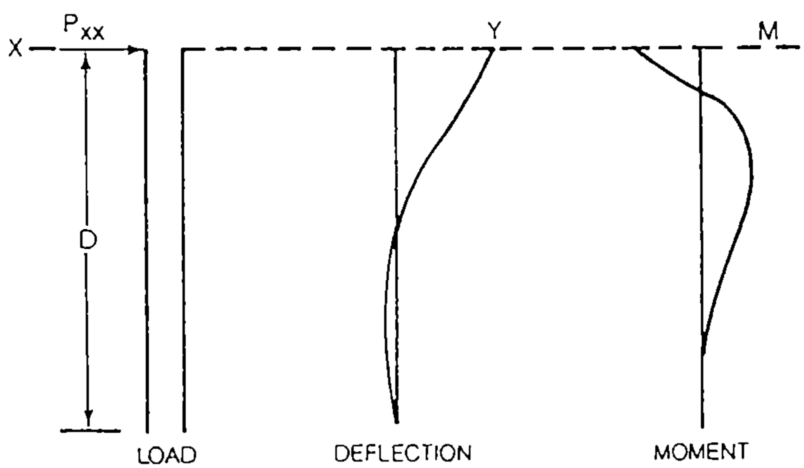
Laterally Loaded Piles in Elastic Subgrade Deflection and Moment Criteria

Fixed–Headed Pile Condition

(a) Deflection and Moment Coefficients



(b) Typical Deflection and Moment Curves



P_{xx} Pile Shear at Ground Surface

T Relative Stiffness Factor

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Figure 5

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

APPENDIX A
FIELD EXPLORATIONS METHODS AND ANALYSIS

This appendix documents the processes Hart Crowser used to determine subsurface conditions at the project site. The discussion includes information on the following subjects:

- Explorations and Their Location
- The Use of Auger Borings
- Standard Penetration Test (SPT) Procedures
- Environmental Soil Sampling
- Environmental Soil Analysis
- Monitoring Well Installation and Development
- Groundwater Level Measurements
- Groundwater Sampling
- Groundwater Analyses
- Equipment Decontamination
- Sample Custody

Geotechnical Explorations and Their Location

Subsurface explorations for this project include borings HC-7, HC-8, HC-9, and HC-10. The exploration logs within this appendix show our interpretation of the drilling, sampling, and testing data. They indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 - Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Exploration logs from seven borings drilled by Hart Crowser in 1986 and two borings drilled by Hart Crowser in 1991 have also been included in this appendix.

Location of Explorations. Figure 2 shows the location of explorations, located by hand taping or pacing from existing physical features. The ground surface elevations at these locations were interpreted from elevations shown on the 1986 Port of Seattle Marine Facilities Topographic Survey by Degross Areal Mapping. The method used determines the accuracy of the location and elevation of the explorations.

The Use of Auger Borings

With depths ranging from 23 to 25 feet below the ground surface, 4 hollow-stem auger borings, designated HC-7 through HC-10, were drilled from February 5 to February 6, 1992. 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. The drilling was continuously observed by an engineering geologist from Hart Crowser. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT) and thin-walled Shelby tubes, we obtained samples at 2-1/2- to 5-foot-depth intervals.

The borings logs are presented on Figures A-2 through A-5 at the end of this appendix.

Similar methods were used to drill the nine hollow-stem auger borings drilled for our previous 1986 and 1991 studies.

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 1587) 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 <u>the last 12 inches only</u> 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 water tight jars. They are then taken to Hart Crowser's laboratory for further testing.

In the Event of Hard Driving

Occasionally very dense materials preclude driving the total 18-inch sample. When this happens, the penetration resistance is entered on logs as follows:

Penetration less than six inches. The log indicates the total number of blows over the number of inches of penetration.

Penetration greater than six inches. The blow count noted on the log is the sum of the total number of blows completed after the first six inches of penetration. This sum is expressed over the number of inches driven that exceed the first 6 inches. The number of blows needed to drive the first six inches are not reported. For example, a blow count series of 12 blows for 6 inches, 30 blows for 6 inches, and 50 (the maximum number of blows counted within a 6-inch increment for SPT) for 3 inches would be recorded as 80/9.

Environmental Soil Sampling

Soil samples were collected at 2.5-foot-depth intervals. At each sampling interval, a clean 1.5-inch ID split-spoon sampler was driven 18 inches ahead of the auger by a 140-pound hammer falling 30 inches. Soil samples were visually classified using ASTM D 2488.

Environmental Soil Analysis

Organic vapor levels were measured in the field within each 8-oz. headspace sample container using an HNU Photoionization Detector (PID). Headspace sample jars were filled half way, covered with aluminum foil, sealed with the screw cap, and allowed to equilibrate for several hours before measuring the vapor concentrations with a 10.2 eV probe. Headspace readings were recorded on the boring logs. No positive readings were encountered in this study.

Two soil samples from borings HC-7 and HC-9 were submitted for chemical analysis. Since there was no visible staining on the soils or positive headspace readings, samples were selected for analysis based on sample depth, lithology, and proximity to the water table.

Selected soil samples were submitted for analysis for petroleum hydrocarbons quantified as gasoline and diesel, volatile organic compounds, polynuclear aromatic hydrocarbons, polychlorinated biphenyl, and total metals (As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn). Analyses were performed by Analytical Technologies, Inc. (ATI). Analytical results are summarized in Tables 1 and 2, and laboratory certificates of analysis are provided in Appendix D.

Monitoring Well Installation and Development

Monitoring wells HC-7 and HC-9 will be identified as B-11 and B-12, respectively, at the request of the client. The monitoring wells were constructed of 2-inch-diameter PVC casing and screen. Ten-foot lengths of 0.020-inch machine-slotted screen were installed, with the top of each screen section approximately three feet above the water table level encountered at the time of drilling. A 10-20 sand was placed in the annular space surrounding the well screen to approximately five feet above the top of the screen. The remaining annular space was sealed with hydrated bentonite chips. Each well was completed with a 1.5-foot-thick concrete surface seal and a flush-mounted, tamper-proof steel monument.

Each monitoring well was developed on February 18, 1992, by surging and bailing five casing volumes of groundwater to remove fine sediment and establish good hydraulic connection with the surrounding formation. Due to heavy sediment in the groundwater, the wells were again surged on February 22, 1992. Ten additional casing volumes were removed from the wells. Development water was stored on site near each of the wells for appropriate disposal by the Port of Seattle.

Groundwater Level Measurements

Groundwater levels were measured before and after well development, and prior to collecting groundwater samples. Depth to groundwater measurements collected during drilling are shown on the boring logs located at the end of this appendix.

Groundwater Sampling

Hart Crowser collected groundwater samples from monitoring wells B-11 and B-12 on February 24, 1992. Due to the high turbidity in the wells, samples were recollected on February 28, 1992, for PCB analysis.

Prior to sampling on February 24, 1992, three casing volumes of water were purged from the wells using a stainless steel bailer. The purge water was also stored in the 55-gallon drums adjacent to the wells. On February 28, 1992, the wells were purged and groundwater sampled using a peristaltic pump in an effort to reduce the total suspended solids content of the samples.

Groundwater Analyses

Groundwater samples collected from each monitoring well were submitted for analyses for petroleum hydrocarbons, polychlorinated biphenyls, polynuclear aromatic hydrocarbons, volatile organic compounds, and total metals, dissolved metals (As, Cd, Cu, Cr, Pb, Hg, Ni, and Zn), and total suspended solids.

Equipment Decontamination

Drilling, and soil and groundwater sampling equipment was thoroughly cleaned before each boring or monitoring well installation and sampling event to minimize the potential for cross contamination. The hollow-stem auger drill rig was steam cleaned before each exploration. All stainless steel sampling equipment was thoroughly decontaminated with an Alconox detergent wash, tap water rinse, and de-ionized water rinse before each sample event.

Sample Custody

A sample custody form was completed and transmitted with each release and receipt of samples collected in this investigation. Original custody documents are retained by Hart Crowser. Copies are provided in Appendix C.

Key to Exploration Logs

Sample Description

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

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

Density/Consistency

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

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

Moisture

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

Minor Constituents

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

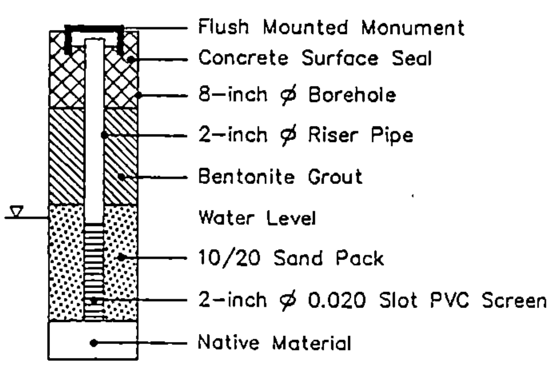
Legends

Sampling Test Symbols

BORING SAMPLES
- ☒ Split Spoon
- ⧅ Shelby Tube
- ▥ Cuttings
- ◫ Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

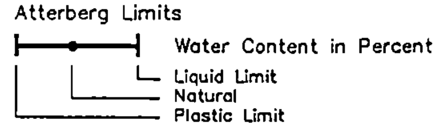
TEST PIT SAMPLES
- ☒ Grab (Jar)
- ⧄ Bag
- ⧅ Shelby Tube

Groundwater Observations



Test Symbols

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



HNU	Photoionization Reading

HARTCROWSER

J-3447 3/92

Figure A-1

Boring Log and Monitoring Well HC-7 (B-11)

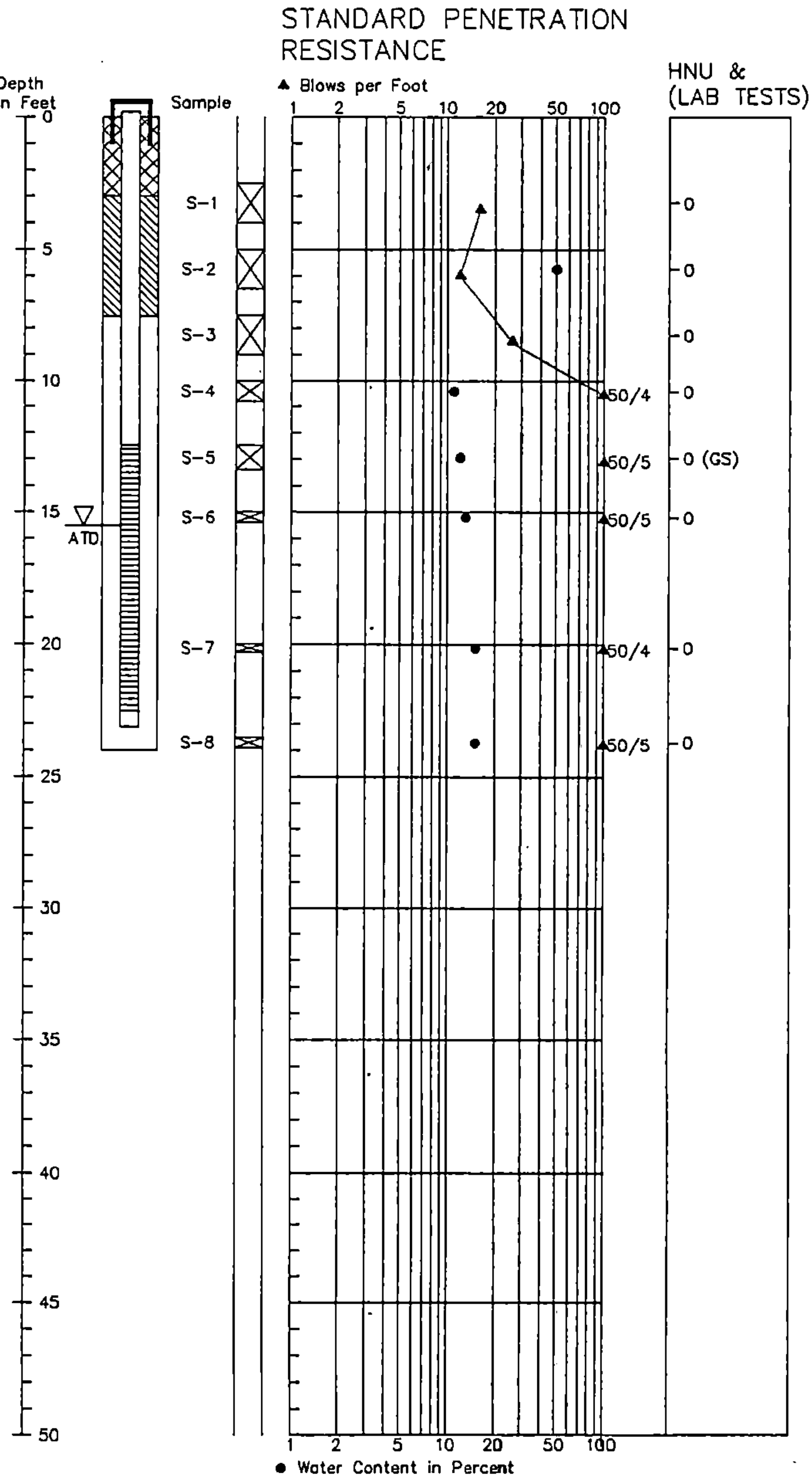
Soil Descriptions

Ground Surface Elevation in Feet 18.5
Casing Stickup in Feet 0.7

1 inch of gravel over loose to medium dense, brown, silty, sandy GRAVEL with layers of stiff, moist, gray, clayey SILT and scattered wood fragments. (FILL)

Very dense, wet, brown, slightly silty, very gravelly SAND with scattered roots at 10.5- and 13-foot depths.

Bottom of Boring at 24.0 Feet.
Completed 2/6/92.



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 1/1

Boring Log HC-8

Soil Descriptions

Ground Surface Elevation in Feet 18.5

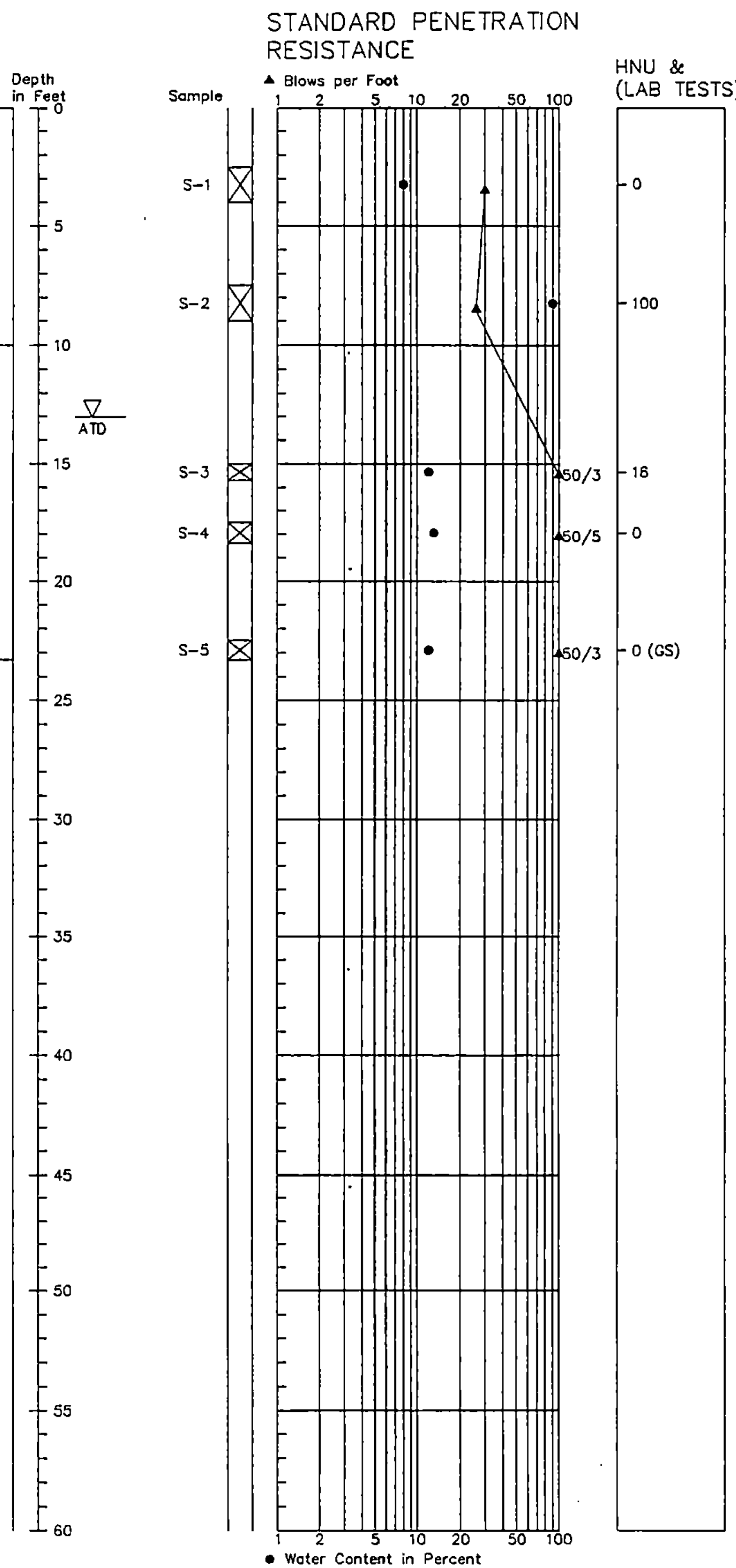
1 inch of gravel over medium dense, moist, dark brown, silty, very sandy GRAVEL with abundant wood fragments. (FILL)

Very dense, wet, brown, slightly silty, very gravelly SAND.

— Scattered roots.

— Scattered roots.

Bottom of Boring at 23.3 Feet. Completed 2/5/92.



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 1/1

Boring Log and Monitoring Well HC-9 (B-12)

Soil Descriptions

Ground Surface Elevation in Feet 19.0
Casing Stickup in Feet 1.5

1 inch of gravel over medium dense, moist, brown, silty SAND becoming gravelly with depth. (FILL)

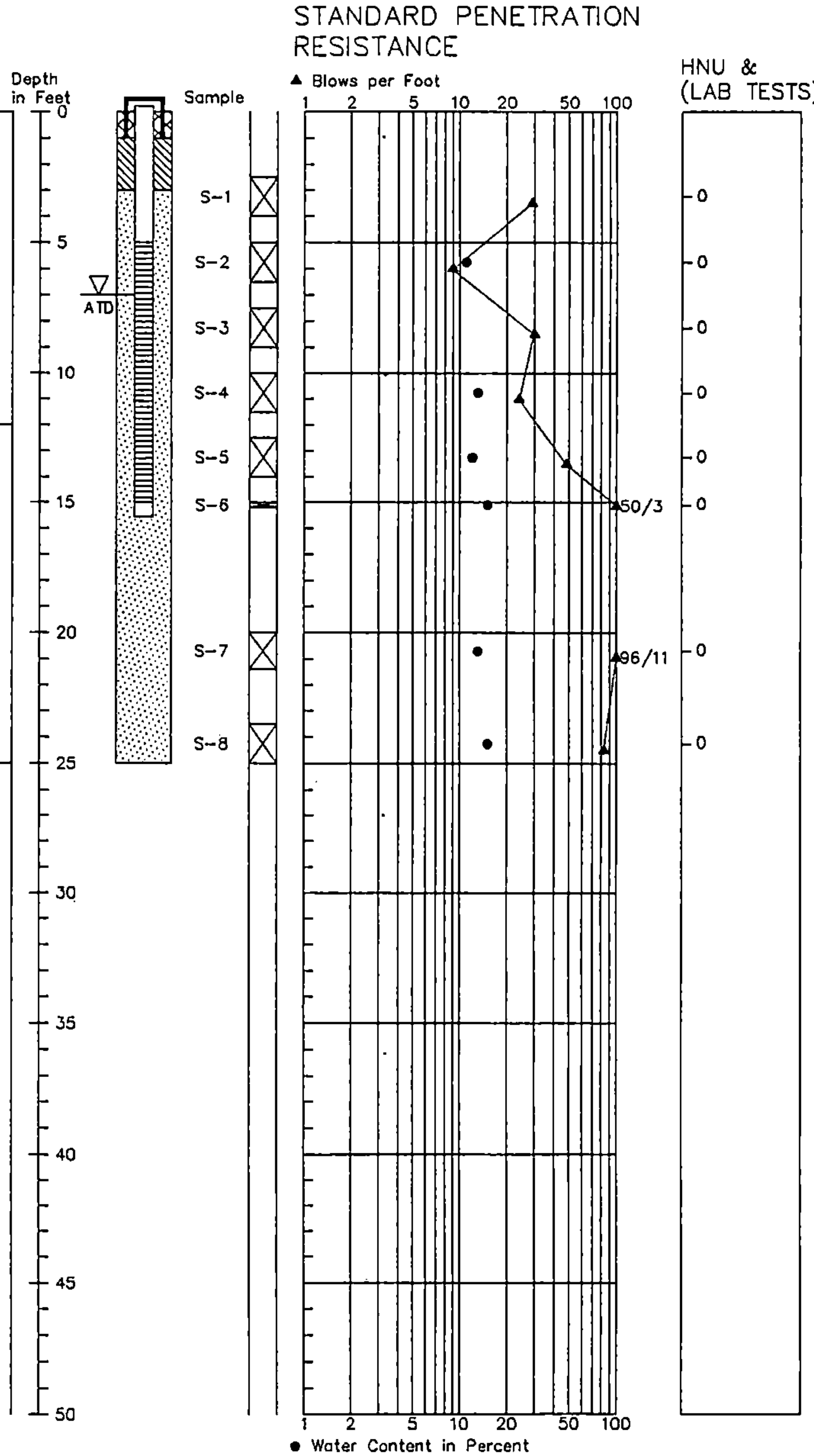
— Scattered organics.

— Grading gravelly, very silty.

— Grading very gravelly.

Medium dense to very dense, brown, silty, very gravelly SAND.

Bottom of Boring at 25.0 Feet.
Completed 2/6/92.



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 1/1

Boring Log HC-10

Soil Descriptions

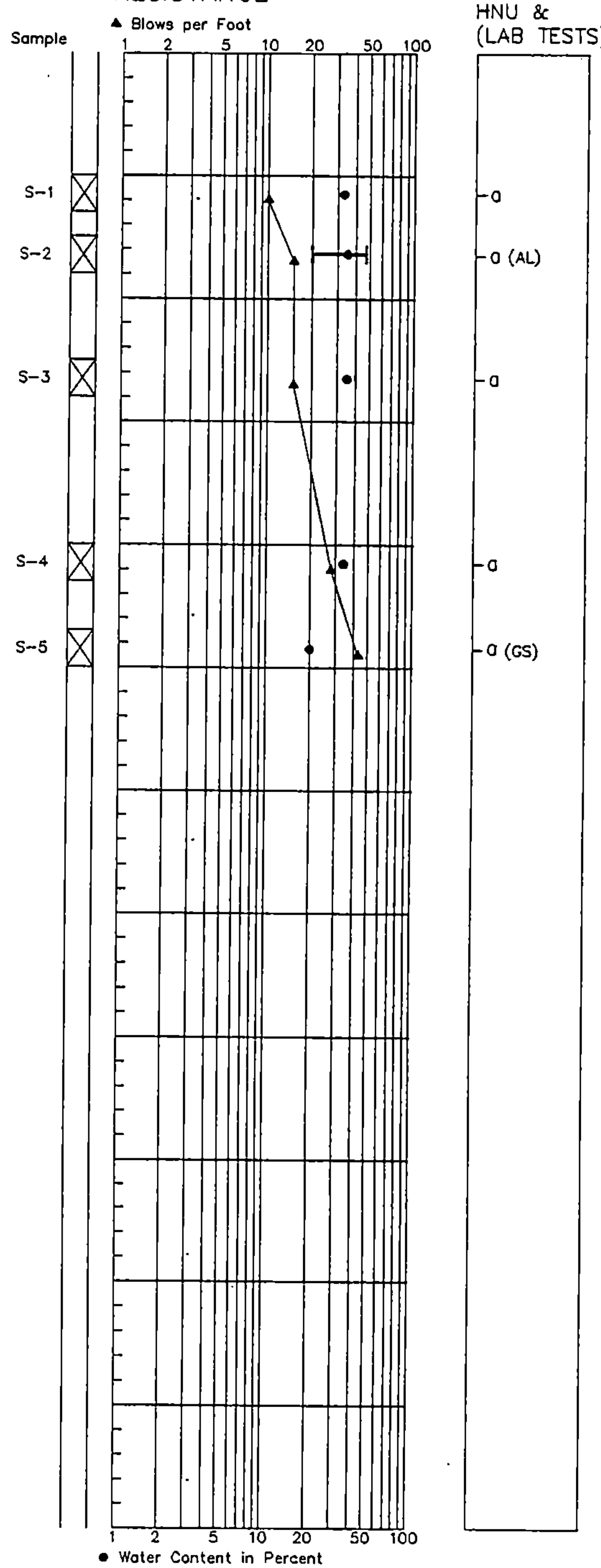
Ground Surface Elevation in Feet 18.5

Depth in Feet

- 0 — 1 inch of gravel over stiff to very stiff, moist, gray, clayey SILT. (FILL)
- Grading slightly sandy.
- Loose, moist, brown, silty, sandy GRAVEL with scattered roots.
- No retrieval.
- Medium dense to dense, wet, brown, slightly silty, gravelly to very gravelly SAND. (FILL)
- Large wood piece.
- Scattered organics.
- 25 — Bottom of Boring at 25.0 Feet. Completed 2/5/92.

Groundwater: ATD

STANDARD PENETRATION RESISTANCE



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 1/1

Boring Log and Construction Data for Well B-1

Geologic Log

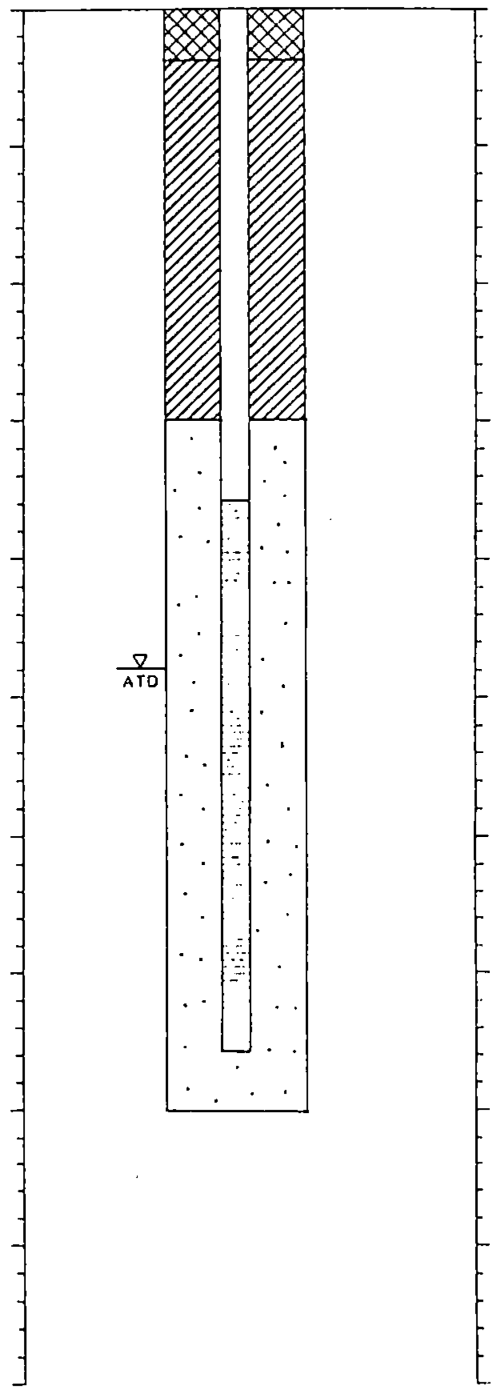
Depth in Feet	Description
0 – 6.5	Loose, moist, black, gravelly SAND with brick fragments. (FILL)
6.5 – 17.5	Medium dense, moist, gray-brown, silty, gravelly SAND to medium stiff, wet, gray, very sandy SILT with occasional wood fragments. (FILL)
17.5 – 20	Medium dense, wet, gray, sandy, fine GRAVEL (FILL)
20	Bottom of Boring at 20.0 Feet. Completed 8/20/86.

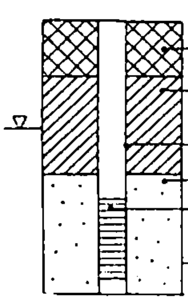
Sample	N
S-1	6
S-2	9
S-3	12
S-4	16
S-5	10
S-6	7
S-7	29

Well Design

Top Casing Elevation in Feet

Casing Stickup in Feet





- Concrete Surface Seal
- Bentonite/Cement Grout
- Water Level
- 2-Inch ⌀ PVC Riser Pipe
- Aqua ♯ 8 Sand Pack
- 2-Inch ⌀ PVC Screen (0.020 Slot Size)
- 6-inch ⌀ Borehole

☒ 2-Inch O.D. Split Spoon Sample

N Standard Penetration Resistence, Blows per foot

NOTES:

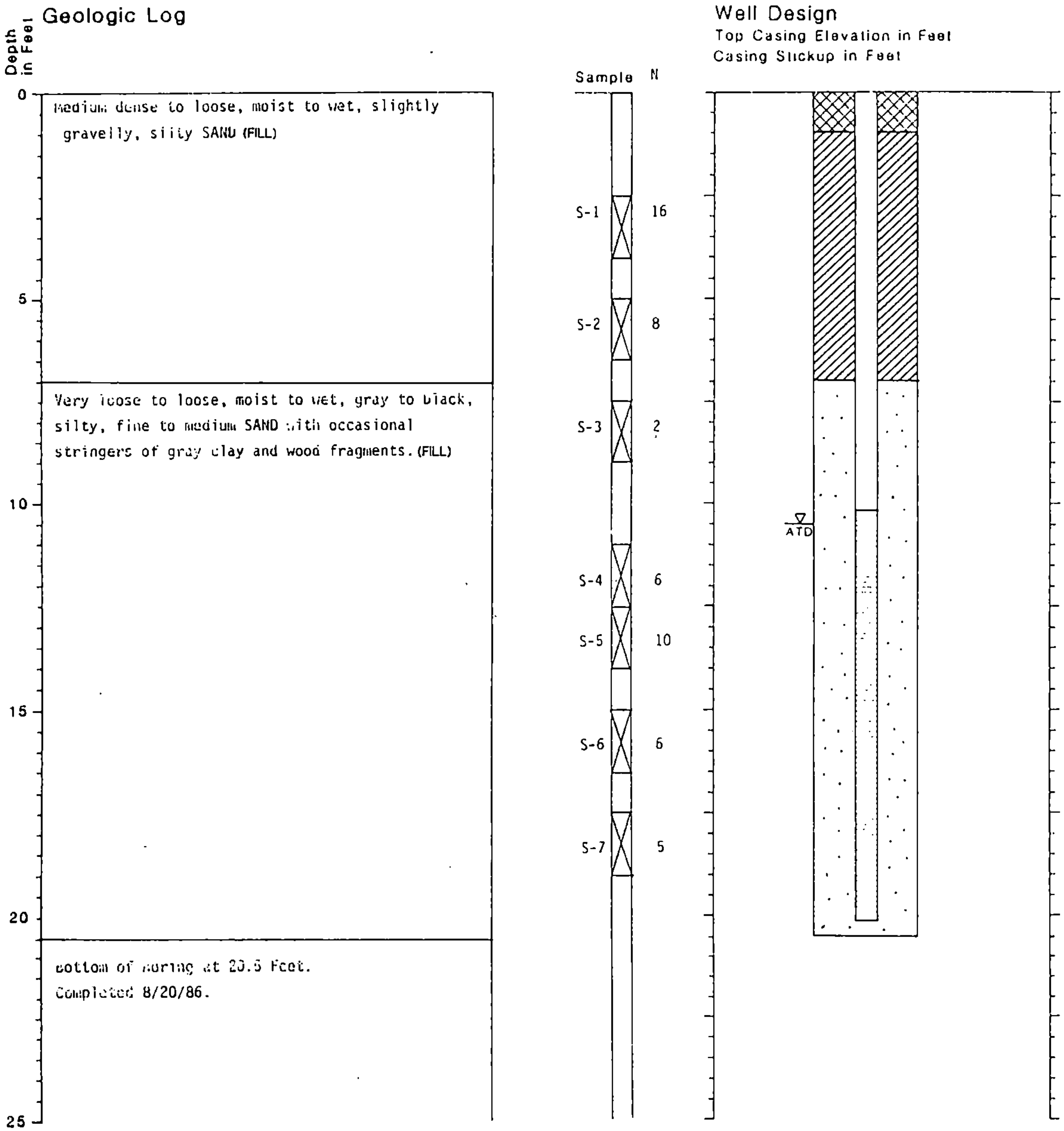
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

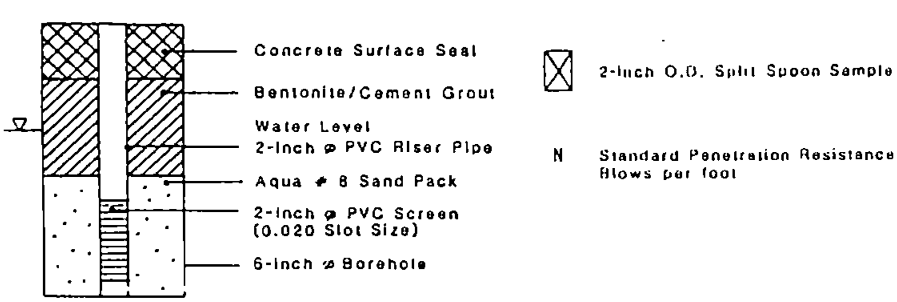
J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

HART-CROWSER & associates inc.

Figure A-6

Boring Log and Construction Data for Well B-2





NOTES:

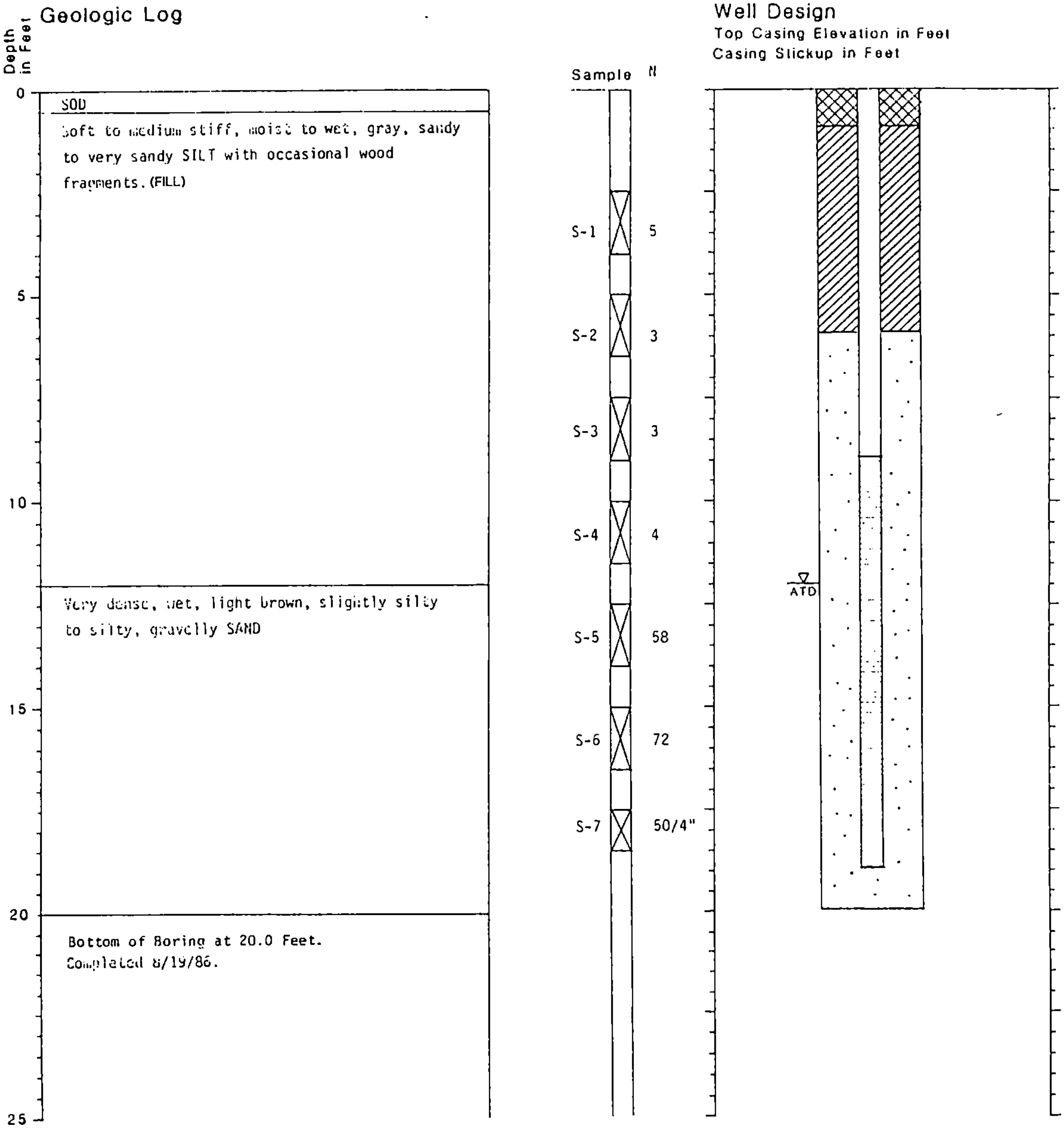
1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD:At Time of Drilling

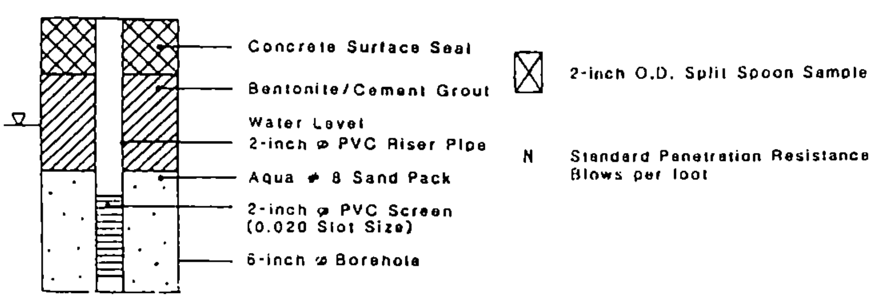
J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

HART-CROWSER & associates inc.

Figure A-7

Boring Log and Construction Data for Well B-3





NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water Level is for date indicated and may vary with time of year. ATD: At Time of Drilling

J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

HART-CROWSER & associates inc.

Figure A-8

Boring Log B-6

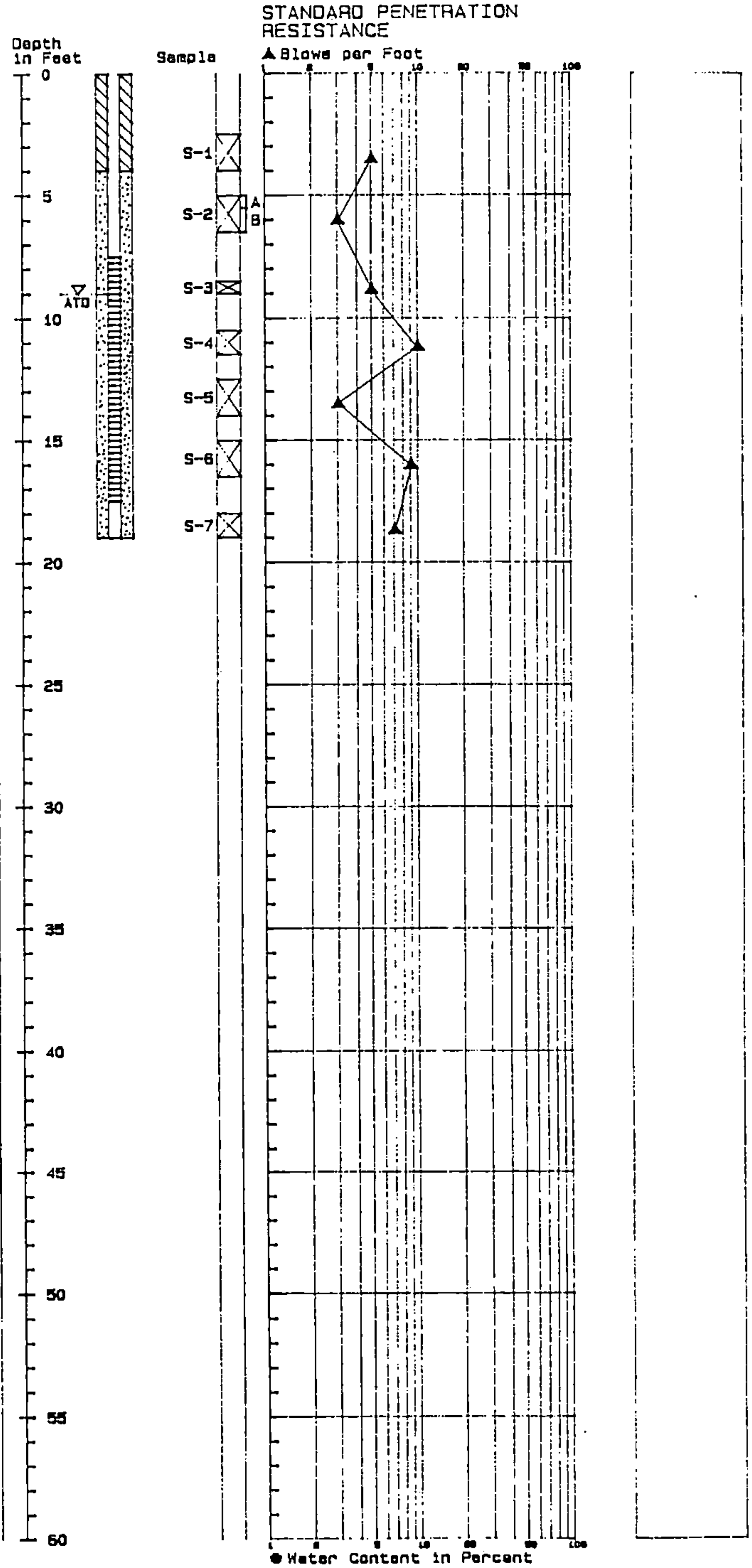
SOIL DESCRIPTIONS

ASPHALT over loose, moist, gray, silty to gravelly SAND with brick and cinder fragments. (FILL)

Soft to medium stiff, moist, gray SILT. (FILL)

Loose, moist to wet, gray, silty SAND to silty, gravelly SAND with occasional wood fragments. (FILL)

Bottom of Boring at 19.0 Feet.
Completed 10/28/86.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

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Figure A-9

Boring Log B-7

SOIL DESCRIPTIONS

ASPHALT.

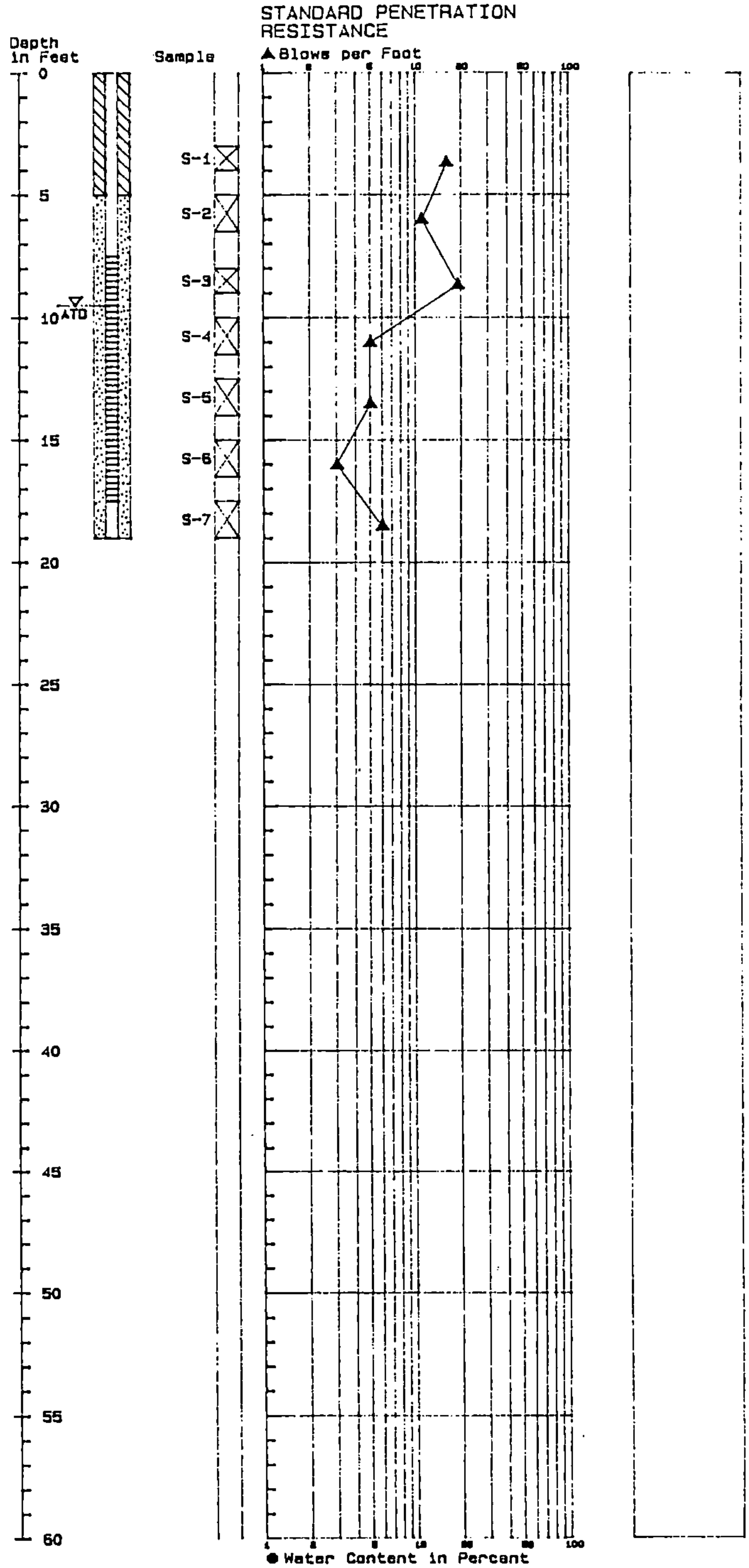
CRUSHED ROCK (RAILROAD BALLAST).

Loose to medium dense, moist, gray, slightly silty, gravelly SAND. (FILL)

Black SAND with glass and brick fragments. (FILL)

Loose, wet, gray SAND to slightly gravelly SAND with stringers of gray SILT and occasional wood fragments. (FILL)

Bottom of Boring at 19.0 Feet.
Completed 10/28/86.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447 March 1992
87-02-1014 January 1987
J-1799 August 1986

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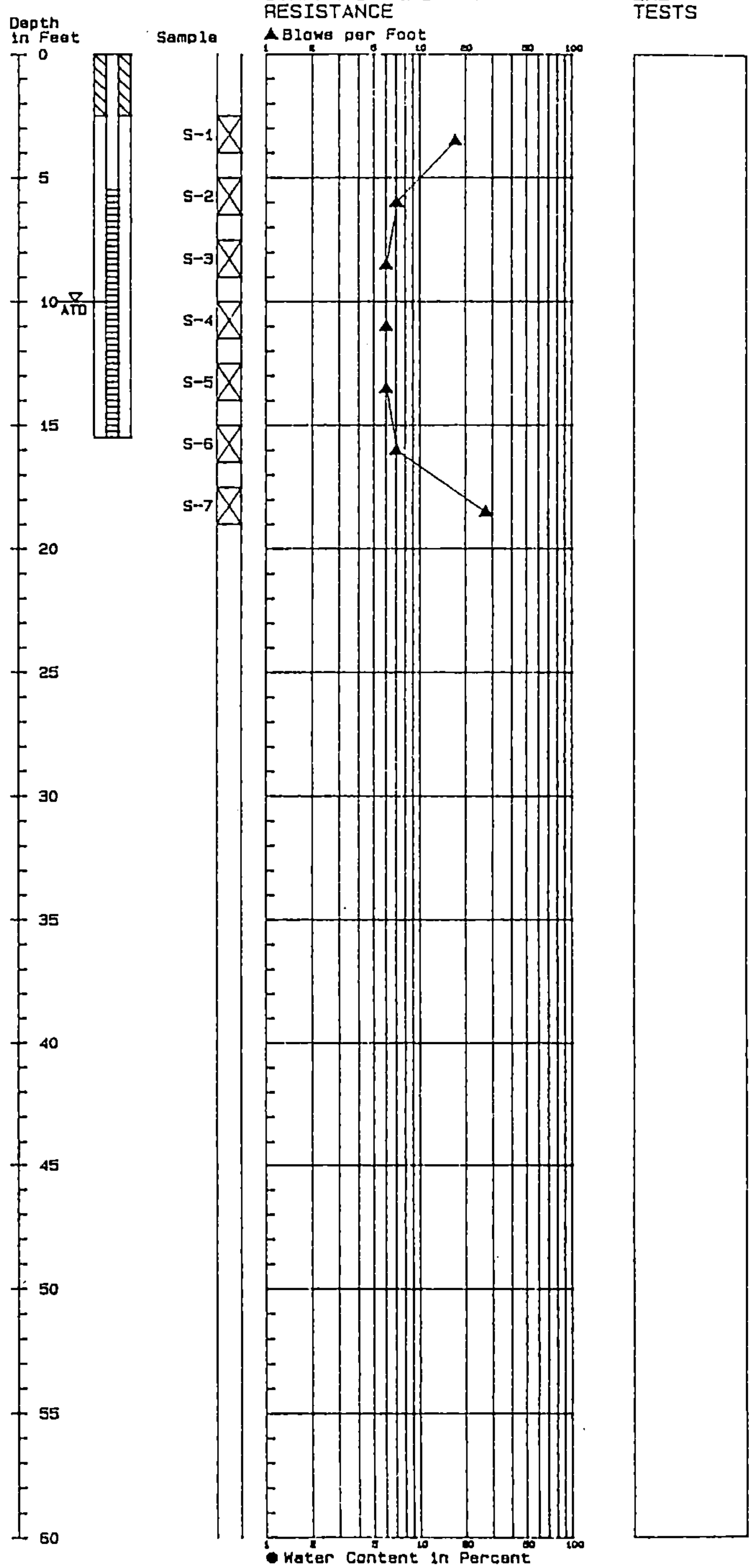
Figure A-10

Boring Log B-8

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

6 inches ASPHALT over medium dense, moist, black, very gravelly, silty SAND with gasoline-like odor.(FILL)
Loose, moist, gray, very silty SAND with gasoline-like odor.(FILL)
Medium stiff, moist, gray, sandy SILT with gasoline-like odor.(FILL)
Loose, wet, gray, silty, gravelly SAND with stringers of gray, very sandy SILT with occasional brick and wood fragments.(FILL)
Bottom of Boring at 19.0 Feet. Completed 11/22/86.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

HART-CROWSER & associates inc.

Figure A-11

Boring Log B-9

SOIL DESCRIPTIONS

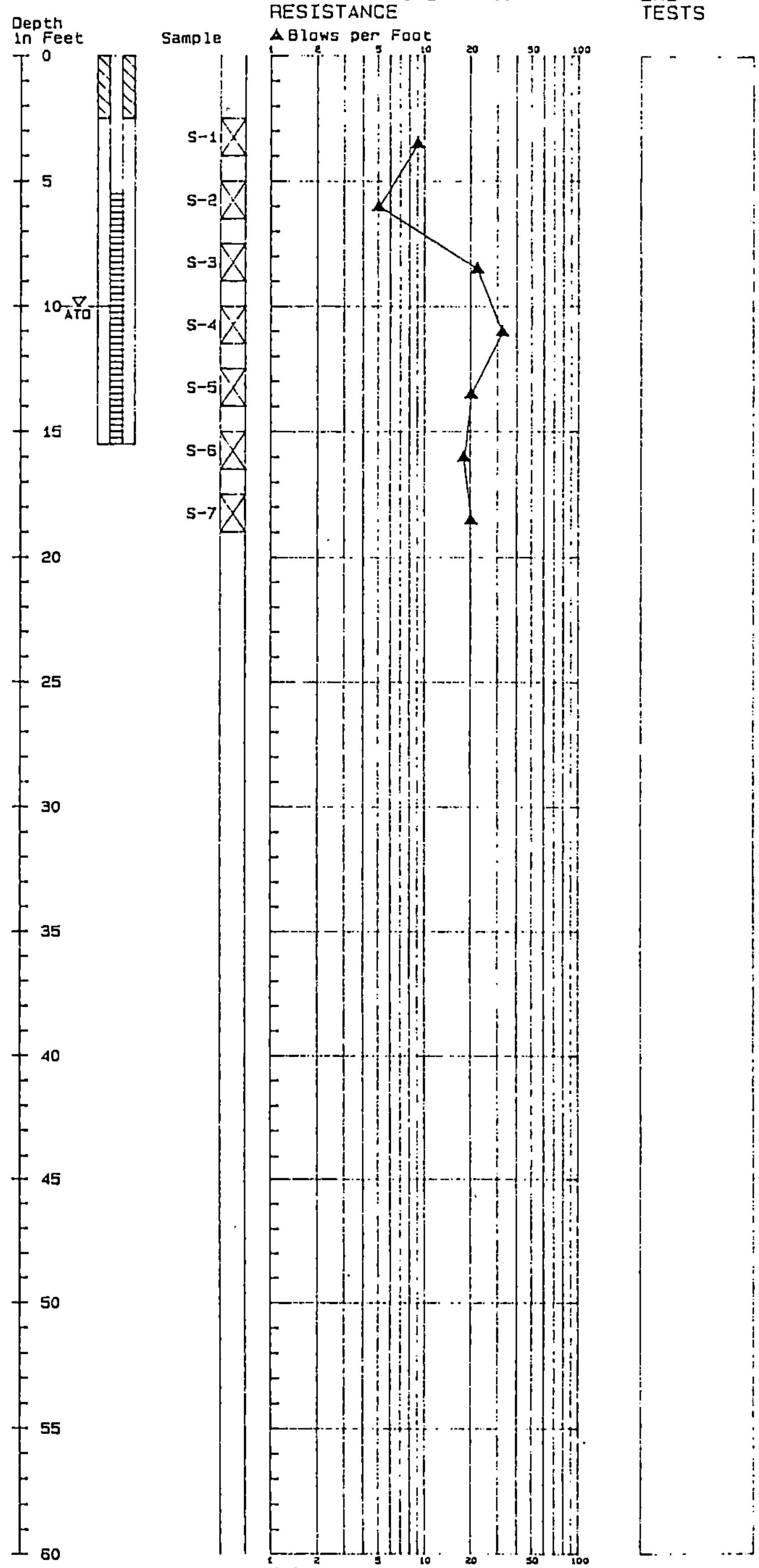
Ground Surface Elevation in Feet

6 inches ASPHALT over loose, moist, gray, very silty SAND with brick fragments. (FILL)

Loose, moist, gray, very sandy, silty GRAVEL with brick fragments. (FILL)

Medium dense to dense, moist to wet, gray and brown, very gravelly, slightly silty SAND to slightly gravelly, very silty SAND with occasional wood fragments. (FILL)

Bottom of Boring at 19.0 Feet.
Completed 11/21/86.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447	March	1992
87-02-1014	January	1987
J-1799	~~August~~ Nov	1986

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Figure A-12

Boring Log B-10A

SOIL DESCRIPTIONS

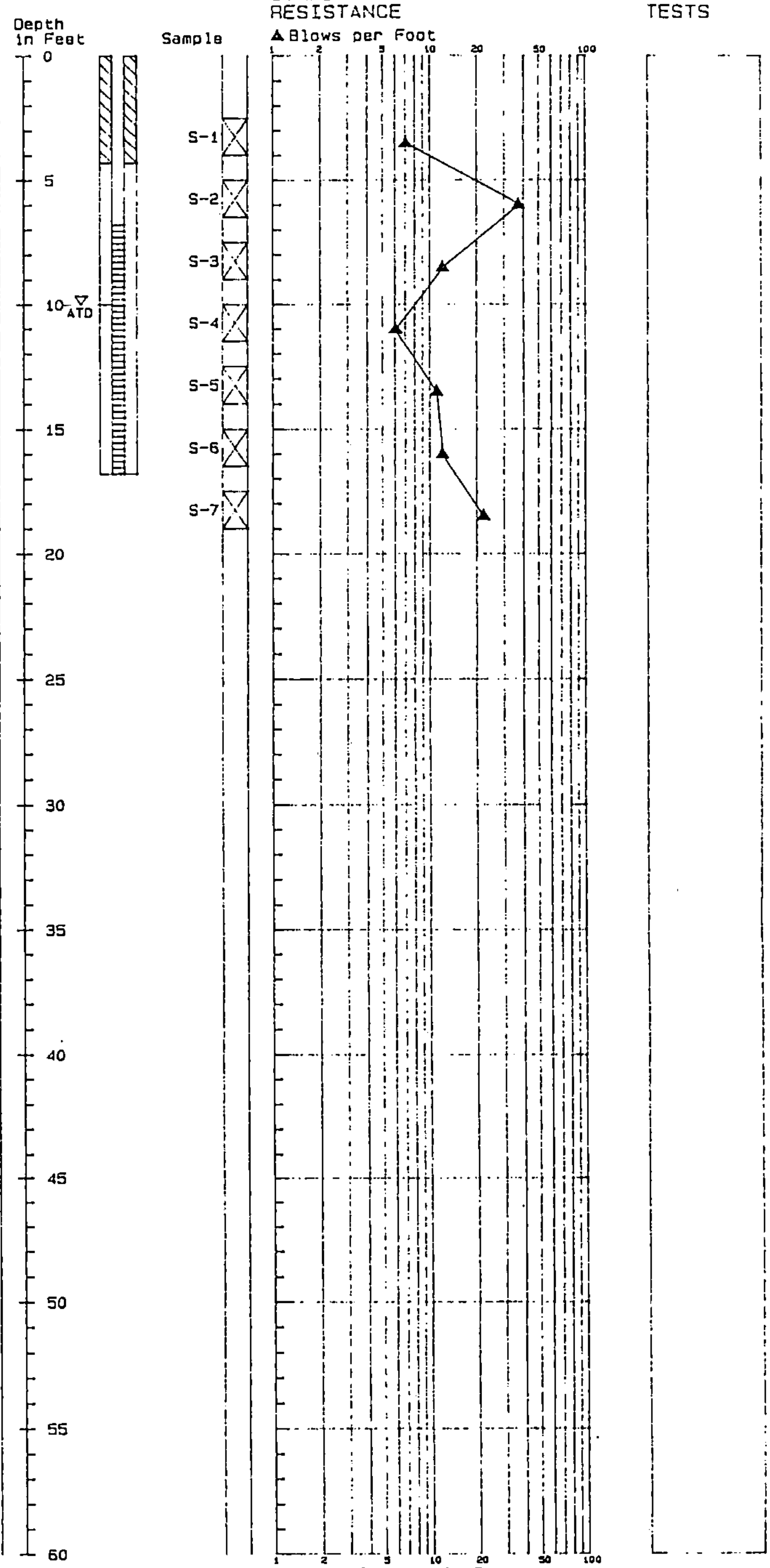
Ground Surface Elevation in Feet

6 inches ASPHALT over medium stiff, moist, gray SILT with occasional wood fragments. (FILL)

Medium dense to dense, moist, gray, silty, sandy GRAVEL to very silty, very sandy GRAVEL. (FILL)

Loose to medium dense, gray, moist to wet, very gravelly, silty SAND to silty SAND with stringers of gray SILT. (FILL)

Bottom of Boring at 19.0 Feet.
Completed 11/21/86.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447	March	1992
87-02-1014	January	1987
J-1799	August	1986

HART-CROWSER & associates inc.

Figure A-13

Boring Log B-10B

SOIL DESCRIPTIONS

Ground Surface Elevation in Feet

6 inches ASPHALT over medium stiff, moist, gray SILT with occasional wood fragments. (FILL)

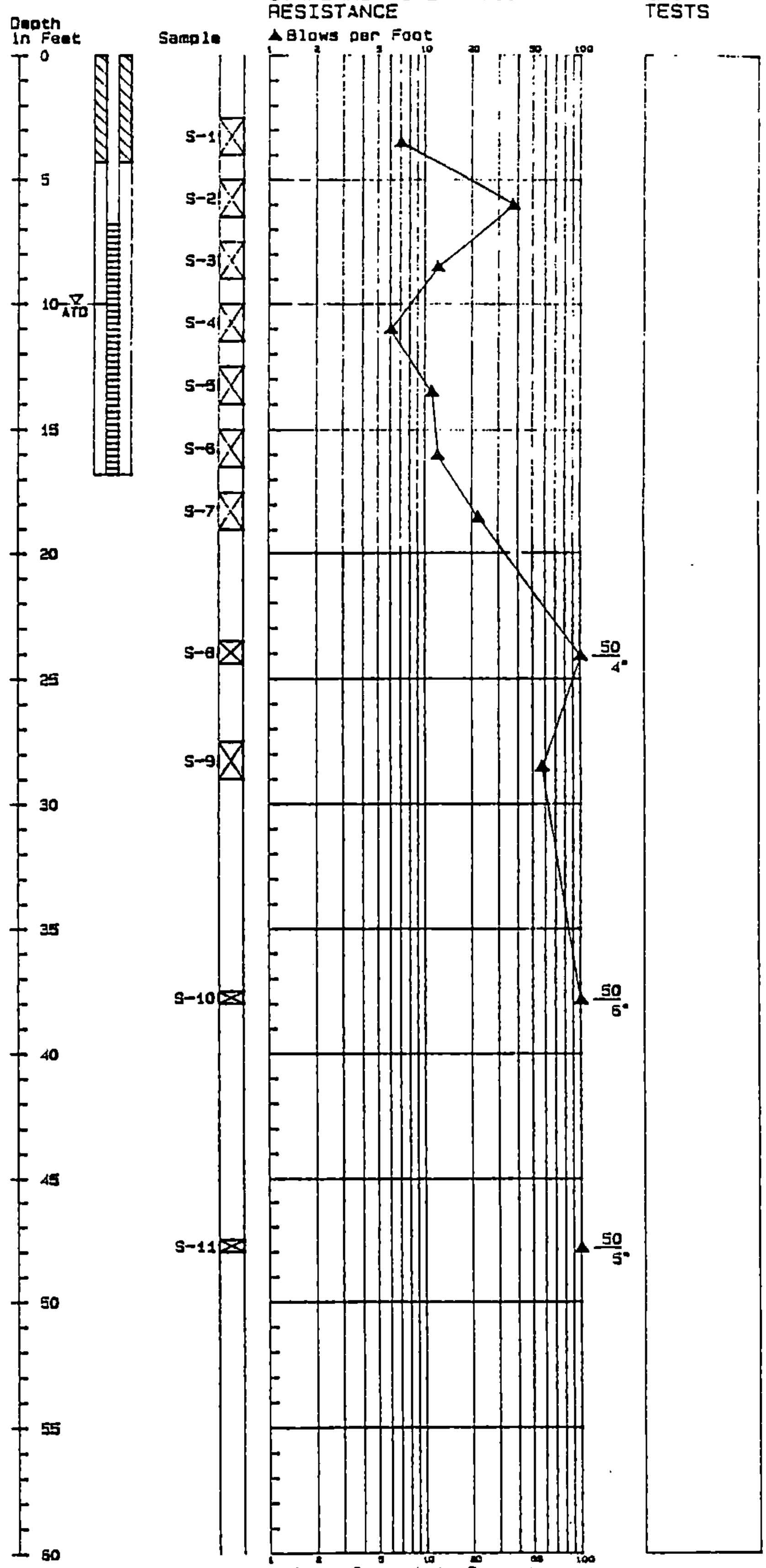
Medium dense to dense, moist, gray, silty, sandy GRAVEL to very silty, very sandy GRAVEL. (FILL)

Loose to medium dense, gray, moist to wet, very gravelly, silty SAND to silty SAND with stringers of gray SILT. (FILL)

Very dense, saturated, brown, slightly gravelly to gravelly, fine to medium SAND.

Bottom of Boring at 48.0 Feet.
Completed 11/25/86.

Note: Upper 19 feet of boring information represent conditions encountered in Boring B-10A, located 6 feet northeast.



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

J-3447	March	1992
87-02-1014	January	1987

HART-CROWSER & associates inc.

Figure A-14

Boring Log B-1

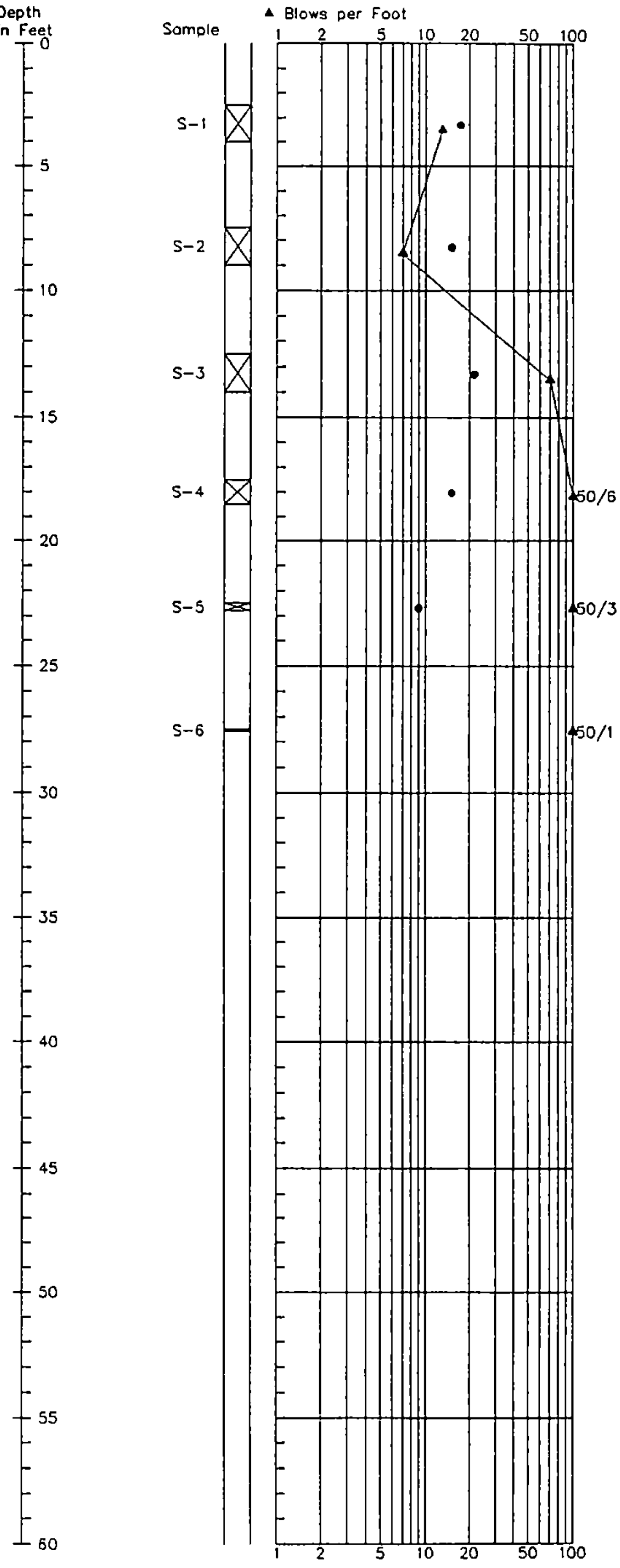
Soil Descriptions

Ground Surface Elevation in Feet 0.0

Soil Descriptions	Depth in Feet
3 inches of asphalt over 4 inches brick over 6 inches concrete.	0
Medium dense, damp, brown, gravelly, very silty SAND with brick fragments. (FILL)	
Grading loose with wood fragments.	
Hard, damp, brown, very sandy SILT.	
Very dense, damp, brown, silty, gravelly SAND.	
Bottom of Boring at 27.6 Feet. Completed 2/18/91.	

STANDARD PENETRATION RESISTANCE

LAB TESTS



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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J-3447 3/92

J-3245 2/91

Figure A-15

Boring Log B-2

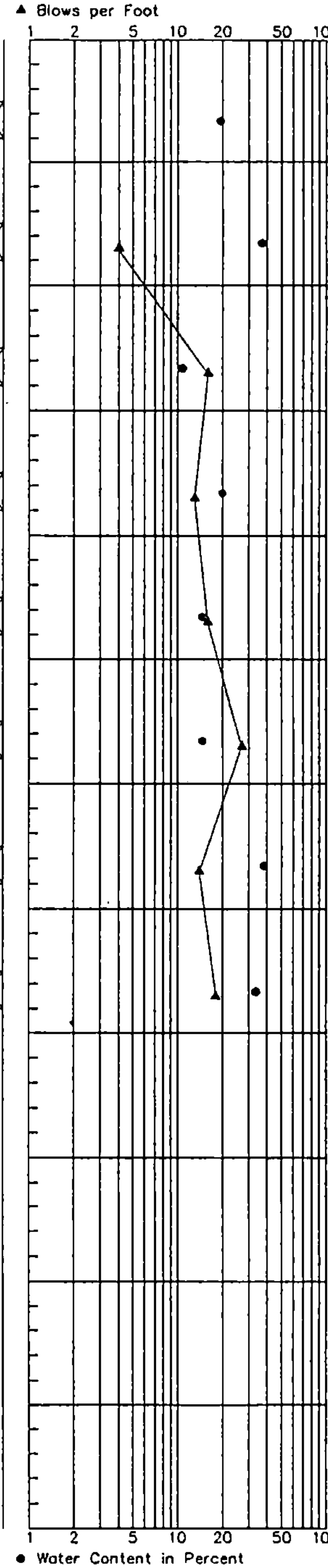
Soil Descriptions

Ground Surface Elevation in Feet 0.0

Soil Description	Depth in Feet	Sample
2 inches asphalt concrete over 12 inches concrete reinforced with steel.	0	
Very loose, moist, brown, very silty SAND. (FILL)		S-1
Soft, moist, green-brown, sandy SILT with trace wood fragments. (FILL)	5	S-2
Medium dense, moist, brown, slightly gravelly, silty SAND with trace brick fragments. (FILL)	10	S-3
Grading green and brown with trace wood fragments.	15	S-4, S-5
Medium dense, damp, blue-gray, silty SAND.	25	S-6
Stiff, damp, blue-gray, slightly sandy SILT.	30	S-7
Grading very stiff.	35	S-8
Bottom of Boring at 39.0 Feet. Completed 2/18/91.	40	

STANDARD PENETRATION RESISTANCE

LAB TESTS



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

J-3447 3/92

J-3245 2/91

Figure A-16

APPENDIX B
LABORATORY TESTING PROGRAM

APPENDIX B
LABORATORY TESTING PROGRAM

A laboratory testing program was performed for this study to evaluate the basic index and geotechnical engineering properties of the site soils. Both disturbed and relatively undisturbed samples were tested. The tests performed and the procedures followed are outlined below.

Soil Classification

Field Observation and Laboratory Analysis. Soil samples from the explorations were visually classified in the field and then taken to our laboratory where the classifications were verified in a relatively controlled laboratory environment. Field and laboratory observations include density/consistency, moisture condition, and grain size and plasticity estimates.

The classifications of selected samples were checked by laboratory tests such as Atterberg limits determinations and grain size analyses. Classifications were made in general accordance with the Unified Soil Classification (USC) System, ASTM D 2487, as presented on Figure B-1.

Water Content Determinations

As soon as possible following their arrival in our laboratory, water contents were determined for most samples recovered in the explorations in general accordance with ASTM D 2216. Water contents were not determined for very small samples nor samples where large gravel contents would result in values considered unrepresentative. The results of these tests are plotted at the respective sample depth on the exploration logs. In addition, water contents are routinely determined for samples subjected to other testing. These are also presented on the exploration logs.

Atterberg Limits (AL)

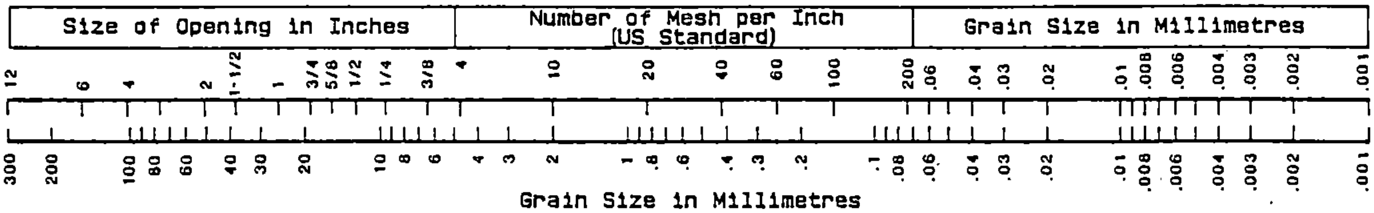
We determined Atterberg limits for a selected fine-grained soil sample. The liquid limit and plastic limit were determined in general accordance with ASTM D 4318-84. The results of the Atterberg limits analysis and the plasticity characteristics are summarized in the Liquid and Plastic Limits Test Report, Figure B-2. This relates the plasticity index (liquid limit minus the plastic limit) to the liquid limit. The results of the Atterberg limits test is shown graphically on the boring logs.

Grain Size Analysis (GS)

Grain size distribution was analyzed on representative samples in general accordance with ASTM D 422. Wet sieve analysis was used to determine the size distribution greater than the U.S. No. 200 mesh sieve. The results of the tests are presented as curves on Figure B-3 plotting percent finer by weight versus grain size.

Unified Soil Classification (USC) System

Soil Grain Size



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

Coarse-Grained Soils

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

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

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

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

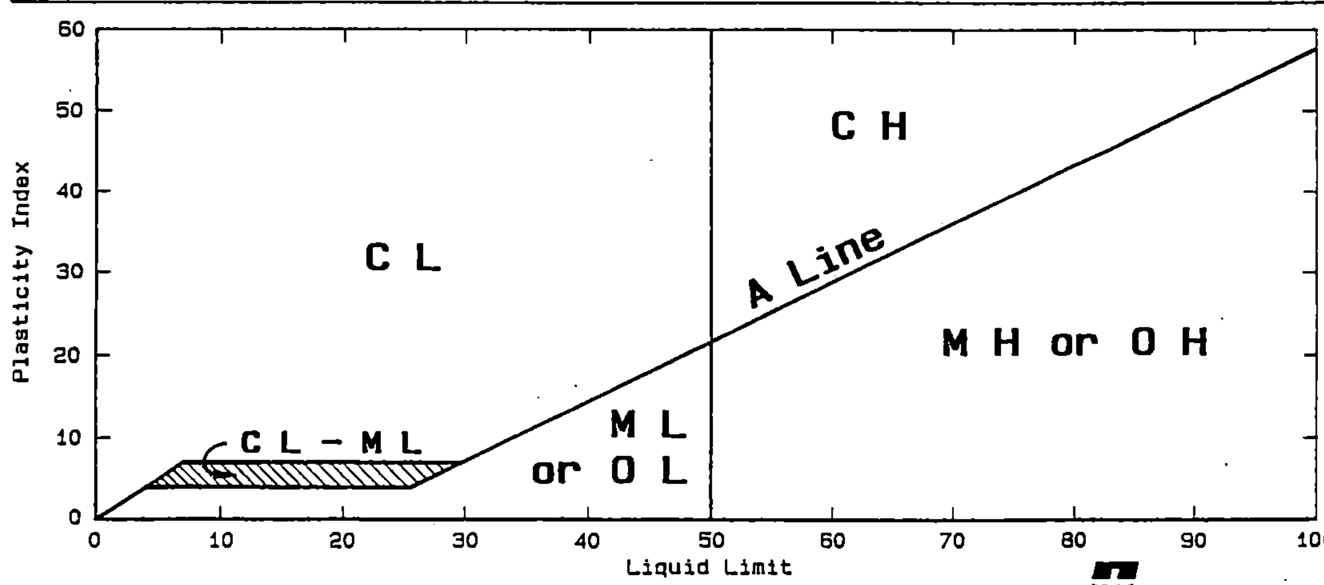
G C and S C Atterberg limits above A Line with PI >7

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

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

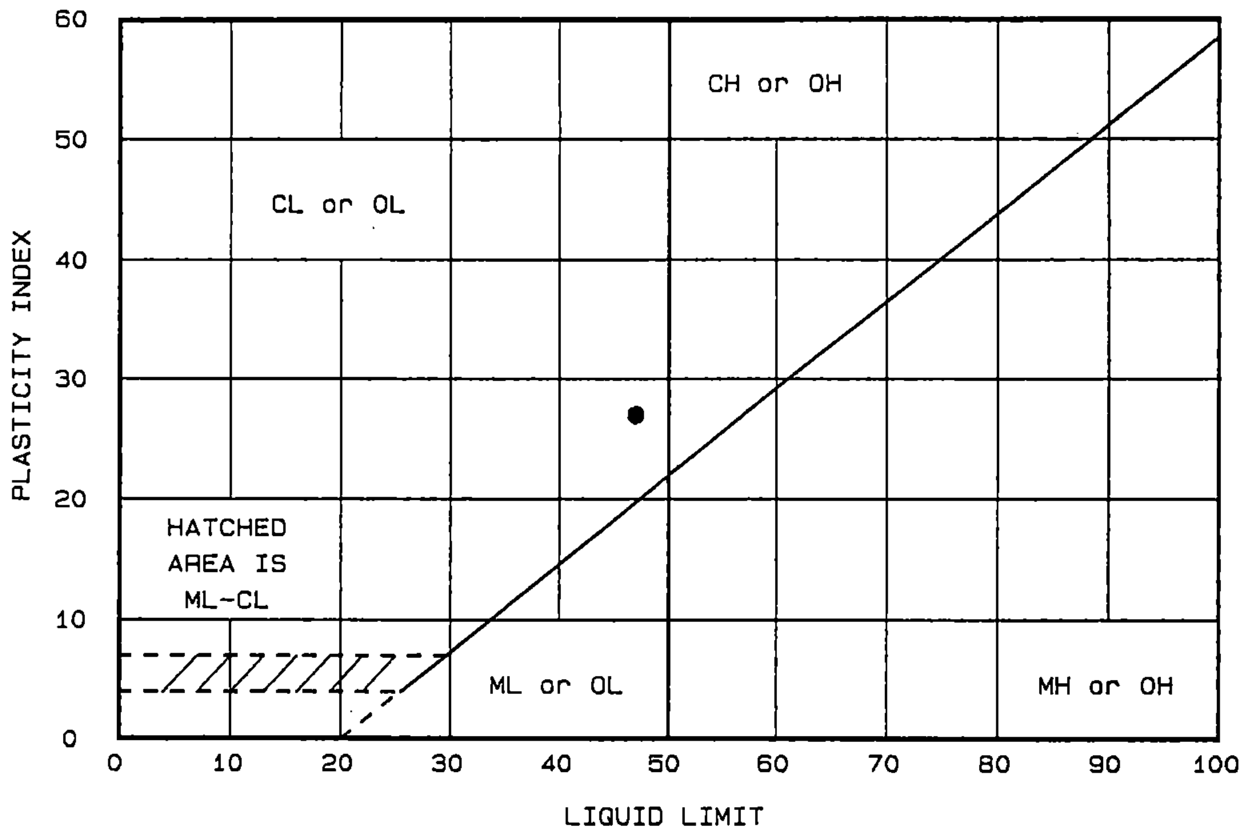
Fine-Grained Soils

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



HARTCROWSER
J-3447 3/92
Figure B-1

LIQUID AND PLASTIC LIMITS TEST REPORT



	Location + Description	LL	PL	PI	-200	ASTM D 2487-85
●	H-10, S-2 Depth: 7.5'-9' Nat. W.C. = 35%	47	20	27	100	CL, Lean clay

Remarks:

Project: Central Waterfront

Client:

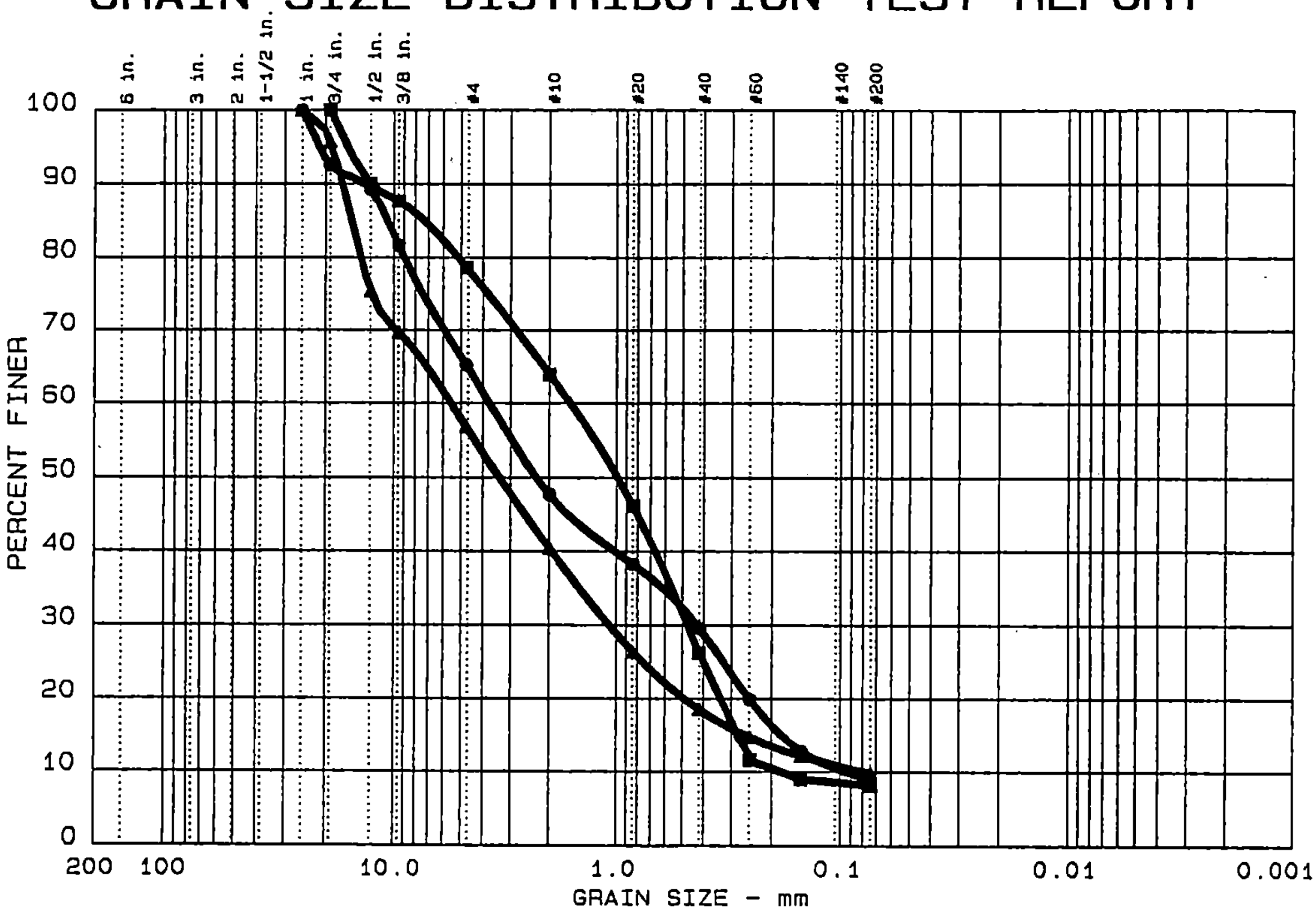
Location:

HART CROWSER

J-3447 2/11/92

Figure B-2

GRAIN SIZE DISTRIBUTION TEST REPORT



	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	0.0	34.7	56.3	9.0	
▲	0.0	43.2	47.0	9.8	
■	0.0	21.4	70.5	8.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			10.59	3.72	2.26	0.427	0.1799	0.0933	0.52	39.8
▲			15.36	5.51	3.36	1.063	0.2639	0.0797	2.57	69.2
■			7.33	1.60	0.99	0.472	0.2812	0.1837	0.76	8.7

MATERIAL DESCRIPTION	USCS	NAT. MOIST.
● Slightly sitly, very gravelly SAND	SP-SM	12%
▲ Slightly silty, very gravelly SAND	SW-SM	12%
■ Slightly silty, gravelly SAND	SP-SM	20%

Remarks:

Project: Central Waterfront

● Location: HC-7, S-5 @13'

▲ Location: HC-8, S-5 @23'

■ Location: HC-10, S-5 @24'

HART CROWSER

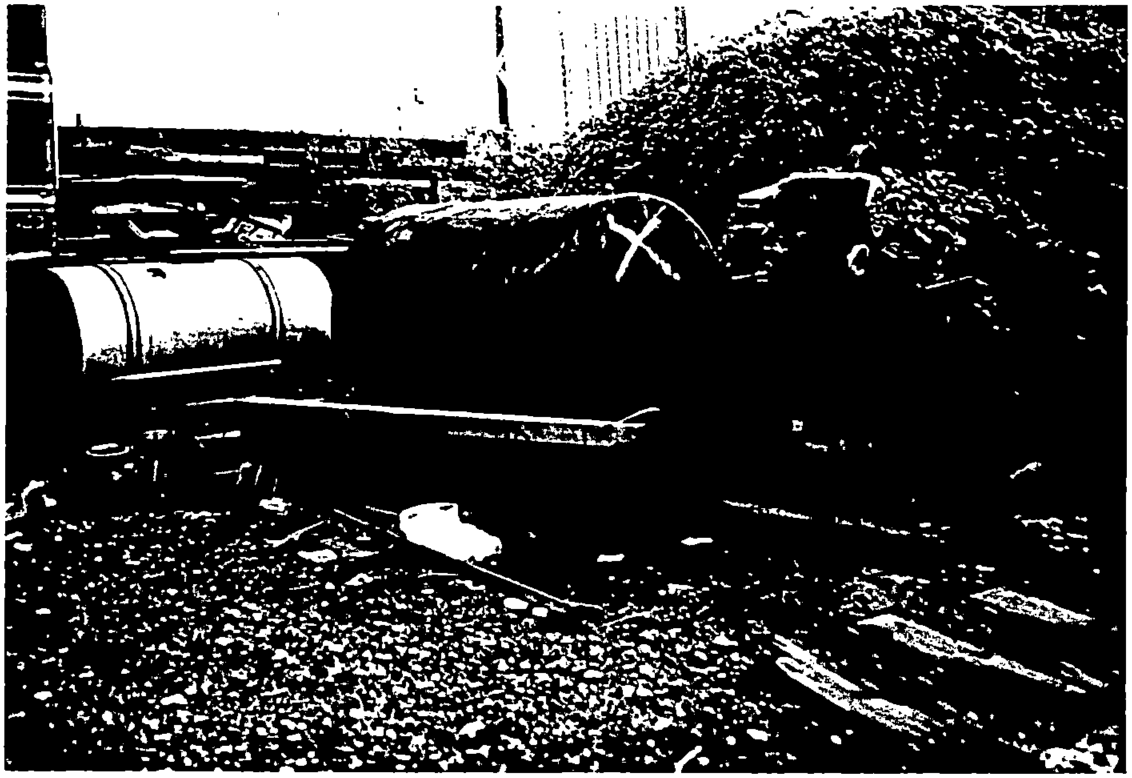
J-3447 3/2/92

Figure B-3

APPENDIX C
SITE RECONNAISSANCE PHOTOGRAPHS

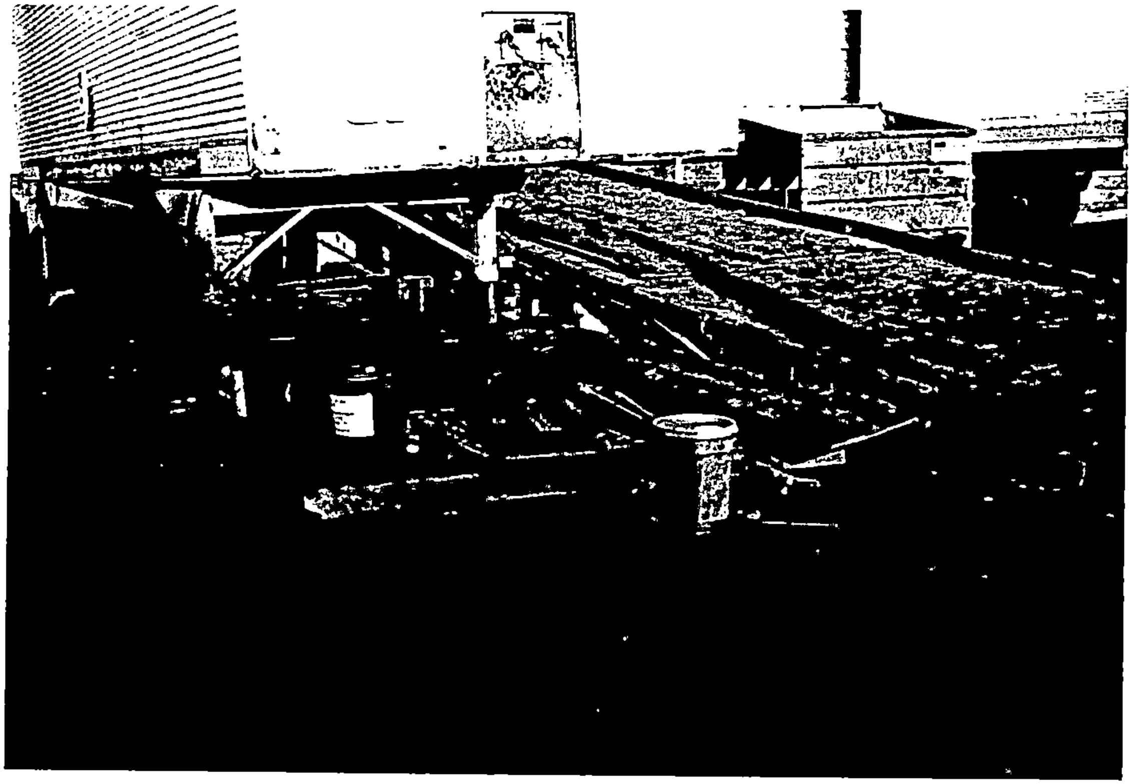
Photograph 1 Pier 66 - 55-gallon drums of oil and refrigerants.

Photograph 2 Pier 66 - Second floor warehouse area - electric transformer.

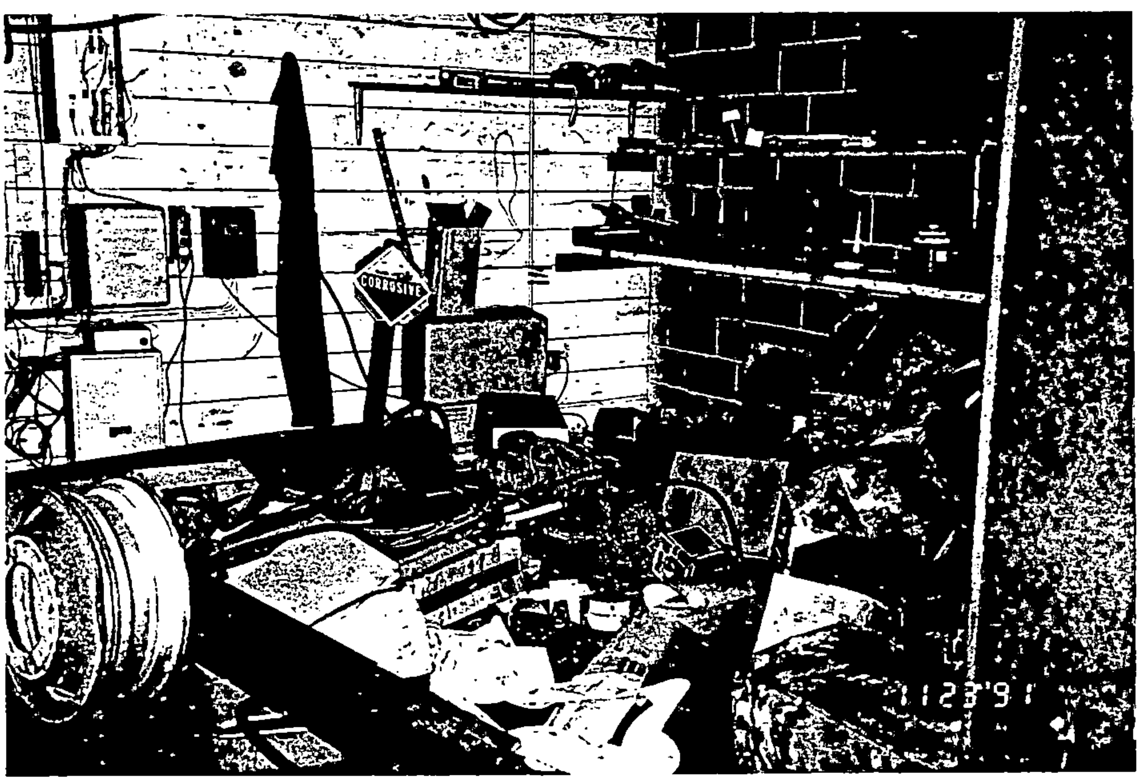


Photograph 3 Triangle Parcel - Empty storage tanks. Note surface soil stains.

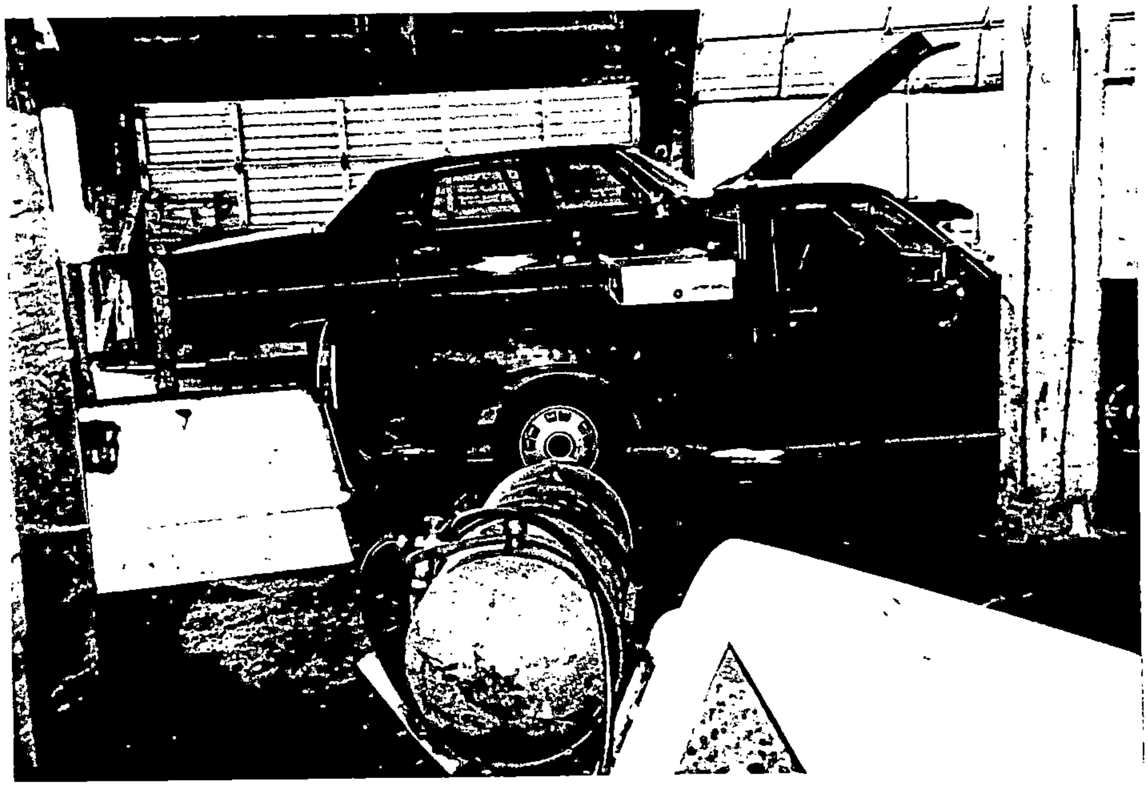
Photograph 4 Triangle Parcel - 55-gallon drum of soil. Note surface soil stains.



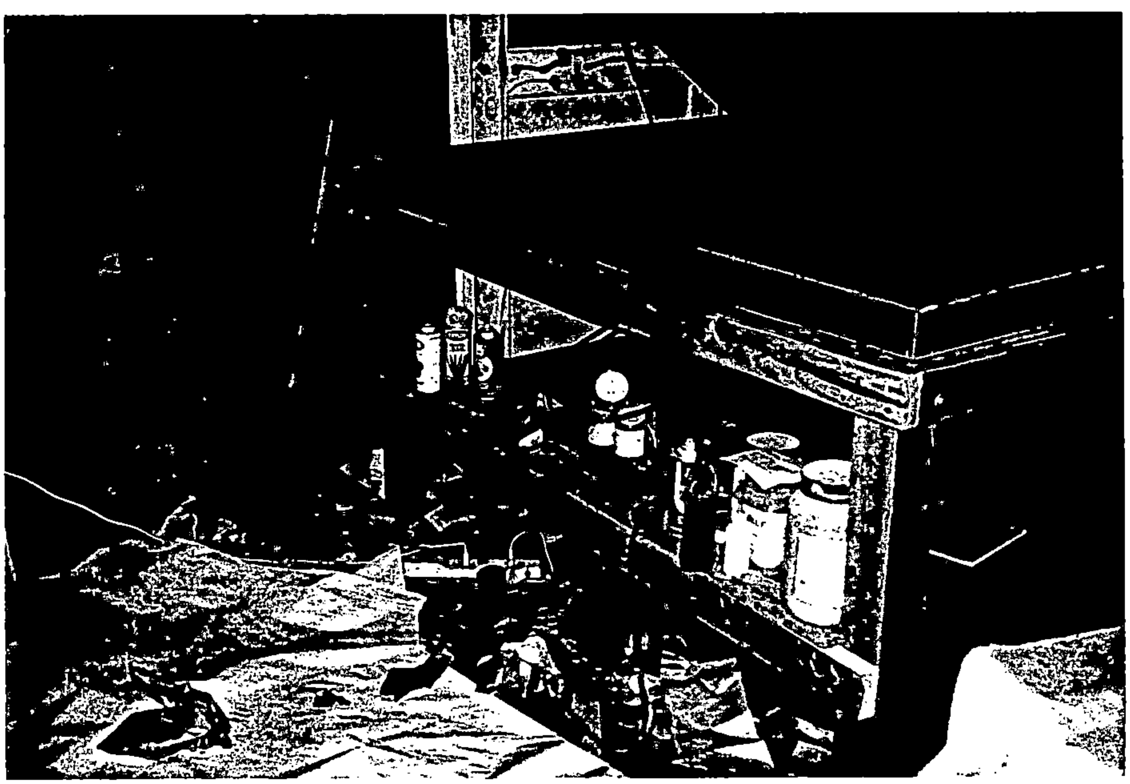
Photograph 5 Auto Freight Warehouse - Oil spills and stains on front lot.



Photograph 6 Auto Freight Warehouse - Storage room of miscellaneous materials including batteries, paint, and wire.



Photograph 7 Auto Freight Warehouse - Automotive repair inside building. Note oil spills.



Photograph 8 Parcel 1 (Pacific Coast Feather) - Silk screen chemicals - front office area.

APPENDIX D
CERTIFICATES OF ANALYSIS
ANALYTICAL TECHNOLOGIES, INC.

Analytical**Technologies,**Inc. 560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9202-061

March 2, 1992

Hart Crowser, Inc.
1910 Fairview Ave. E.
Seattle, WA 98102-3699

Attention : Julie Sowa

Project Number : 3447

Project Name : Port of Seattle

On February 7, 1992, Analytical Technologies, Inc., received four soil samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed. Soil method detection limits are corrected for moisture content of the sample where noted.

Emily C. Carfioli
Senior Project Manager

Frederick W. Grothkopp
Laboratory Manager

FWG/hal/ew

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9202-061-1	HC-7,S-1	02/06/92	SOIL
9202-061-2	HC-7,S-3	02/06/92	SOIL
9202-061-3	HC-9,S-1	02/06/92	SOIL
9202-061-4	HC-9,S-3	02/06/92	SOIL

----- TOTALS -----

MATRIX	# SAMPLES
SOIL	4

ATI STANDARD DISPOSAL PRACTICE

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

ANALYSIS	TECHNIQUE	REFERENCE	LAB
VOLATILE ORGANIC COMPOUNDS	GCMS	EPA 8240	R
POLYCHLORINATED BIPHENYLS (PCBs)	GC/ECD	EPA 8080	R
POLYNUCLEAR AROMATIC HYDROCARBONS	HPLC/UV/FLUOR	EPA 8310	R
FUEL HYDROCARBONS	GC/FID	EPA 8015 MODIFIED	R
ARSENIC	AA/GF	EPA 7060	R
CADMIUM	ICAP	EPA 6010	R
CHROMIUM	ICAP	EPA 6010	R
COPPER	ICAP	EPA 6010	R
LEAD	ICAP	EPA 6010	R
MERCURY	AA/COLD VAPOR	EPA 7471	R
NICKEL	ICAP	EPA 6010	R
ZINC	ICAP	EPA 6010	R
MOISTURE	GRAVIMETRIC	CLP SOW ILMO1.0	R

R = ATI - Renton
SD = ATI - San Diego
PHX = ATI - Phoenix
PNR = ATI - Pensacola
FC = ATI - Fort Collins
SUB = Subcontract

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
ACETONE	<1.0
BENZENE	<0.050
BROMODICHLOROMETHANE	<0.050
BROMOFORM	<0.25
BROMOMETHANE	<0.50
2-BUTANONE (MEK)	<0.50
CARBON DISULFIDE	<0.050
CARBON TETRACHLORIDE	<0.050
CHLOROBENZENE	<0.050
CHLOROETHANE	<0.050
CHLOROFORM	<0.050
CHLOROMETHANE	<0.50
DIBROMOCHLOROMETHANE	<0.050
1,1-DICHLOROETHANE	<0.050
1,2-DICHLOROETHANE	<0.050
1,1-DICHLOROETHENE	<0.050
1,2-DICHLOROETHENE (TOTAL)	<0.050
1,2-DICHLOROPROPANE	<0.050
CIS-1,3-DICHLOROPROPENE	<0.050
TRANS-1,3-DICHLOROPROPENE	<0.050
ETHYLBENZENE	<0.050
2-HEXANONE (MBK)	<0.50
4-METHYL-2-PENTANONE (MIBK)	<0.50
METHYLENE CHLORIDE	<0.25
STYRENE	<0.050
1,1,2,2-TETRACHLOROETHANE	<0.050
TETRACHLOROETHENE	<0.050
TOLUENE	<0.050
1,1,1-TRICHLOROETHANE	<0.050
1,1,2-TRICHLOROETHANE	<0.050
TRICHLOROETHENE	<0.050
VINYL ACETATE	<0.50
VINYL CHLORIDE	<0.050
TOTAL XYLENES	<0.050

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	93
TOLUENE-D8	94
BROMOFLUOROBENZENE	101

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUND	FLAG	SCAN	RESULTS
HEXANE		247	0.45

Analytical Technologies, Inc.

ATI I.D. # 9202-061-1

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-7,S-1	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
ACETONE	<1.3
BENZENE	<0.066
BROMODICHLOROMETHANE	<0.066
BROMOFORM	<0.33
BROMOMETHANE	<0.66
2-BUTANONE (MEK)	<0.66
CARBON DISULFIDE	<0.066
CARBON TETRACHLORIDE	<0.066
CHLOROBENZENE	<0.066
CHLOROETHANE	<0.066
CHLOROFORM	<0.066
CHLOROMETHANE	<0.66
DIBROMOCHLOROMETHANE	<0.066
1,1-DICHLOROETHANE	<0.066
1,2-DICHLOROETHANE	<0.066
1,1-DICHLOROETHENE	<0.066
1,2-DICHLOROETHENE (TOTAL)	<0.066
1,2-DICHLOROPROPANE	<0.066
CIS-1,3-DICHLOROPROPENE	<0.066
TRANS-1,3-DICHLOROPROPENE	<0.066
ETHYLBENZENE	<0.066
2-HEXANONE (MBK)	<0.66
4-METHYL-2-PENTANONE (MIBK)	<0.66
METHYLENE CHLORIDE	<0.33
STYRENE	<0.066
1,1,2,2-TETRACHLOROETHANE	<0.066
TETRACHLOROETHENE	<0.066
TOLUENE	<0.066
1,1,1-TRICHLOROETHANE	<0.066
1,1,2-TRICHLOROETHANE	<0.066
TRICHLOROETHENE	<0.066
VINYL ACETATE	<0.66
VINYL CHLORIDE	<0.066
TOTAL XYLENES	<0.066

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	74
TOLUENE-D8	77
BROMOFLUOROBENZENE	85

Analytical**Technologies,**Inc.

ATI I.D. # 9202-061-1

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
CLIENT I.D. : HC-7,S-1
SAMPLE MATRIX : SOIL
EPA METHOD : 8240
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

DATE SAMPLED : 02/06/92
DATE RECEIVED : 02/07/92
DATE EXTRACTED : 02/10/92
DATE ANALYZED : 02/12/92
UNITS : mg/Kg
DILUTION FACTOR : 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	248	0.66

B = Analyte is found in the associated blank as well as the sample.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-2

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-7,S-3	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
ACETONE	<1.5
BENZENE	<0.076
BROMODICHLOROMETHANE	<0.076
BROMOFORM	<0.38
BROMOMETHANE	<0.76
2-BUTANONE (MEK)	<0.76
CARBON DISULFIDE	<0.076
CARBON TETRACHLORIDE	<0.076
CHLOROBENZENE	<0.076
CHLOROETHANE	<0.076
CHLOROFORM	<0.076
CHLOROMETHANE	<0.76
DIBROMOCHLOROMETHANE	<0.076
1,1-DICHLOROETHANE	<0.076
1,2-DICHLOROETHANE	<0.076
1,1-DICHLOROETHENE	<0.076
1,2-DICHLOROETHENE (TOTAL)	<0.076
1,2-DICHLOROPROPANE	<0.076
CIS-1,3-DICHLOROPROPENE	<0.076
TRANS-1,3-DICHLOROPROPENE	<0.076
ETHYLBENZENE	<0.076
2-HEXANONE (MBK)	<0.76
4-METHYL-2-PENTANONE (MIBK)	<0.76
METHYLENE CHLORIDE	<0.38
STYRENE	<0.076
1,1,2,2-TETRACHLOROETHANE	<0.076
TETRACHLOROETHENE	4.4
TOLUENE	<0.076
1,1,1-TRICHLOROETHANE	0.14
1,1,2-TRICHLOROETHANE	<0.076
TRICHLOROETHENE	<0.076
VINYL ACETATE	<0.76
VINYL CHLORIDE	<0.076
TOTAL XYLENES	<0.076

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	74
TOLUENE-D8	76
BROMOFLUOROBENZENE	83

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-2

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
CLIENT I.D. : HC-7,S-3
SAMPLE MATRIX : SOIL
EPA METHOD : 8240
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

DATE SAMPLED : 02/06/92
DATE RECEIVED : 02/07/92
DATE EXTRACTED : 02/10/92
DATE ANALYZED : 02/12/92
UNITS : mg/Kg
DILUTION FACTOR : 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	248	0.76

B = Analyte is found in the associated blank as well as the sample.

Analytical Technologies, Inc.

ATI I.D. # 9202-061-3

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-1	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
ACETONE	<1.1
BENZENE	<0.056
BROMODICHLOROMETHANE	<0.056
BROMOFORM	<0.28
BROMOMETHANE	<0.56
2-BUTANONE (MEK)	<0.56
CARBON DISULFIDE	<0.056
CARBON TETRACHLORIDE	<0.056
CHLOROBENZENE	<0.056
CHLOROETHANE	<0.056
CHLOROFORM	<0.056
CHLOROMETHANE	<0.56
DIBROMOCHLOROMETHANE	<0.056
1,1-DICHLOROETHANE	<0.056
1,2-DICHLOROETHANE	<0.056
1,1-DICHLOROETHENE	<0.056
1,2-DICHLOROETHENE (TOTAL)	<0.056
1,2-DICHLOROPROPANE	<0.056
CIS-1,3-DICHLOROPROPENE	<0.056
TRANS-1,3-DICHLOROPROPENE	<0.056
ETHYLBENZENE	<0.056
2-HEXANONE (MBK)	<0.56
4-METHYL-2-PENTANONE (MIBK)	<0.56
METHYLENE CHLORIDE	<0.28
STYRENE	<0.056
1,1,2,2-TETRACHLOROETHANE	<0.056
TETRACHLOROETHENE	<0.056
TOLUENE	<0.056
1,1,1-TRICHLOROETHANE	<0.056
1,1,2-TRICHLOROETHANE	<0.056
TRICHLOROETHENE	<0.056
VINYL ACETATE	<0.56
VINYL CHLORIDE	<0.056
TOTAL XYLENES	<0.056

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	84
TOLUENE-D8	87
BROMOFLUOROBENZENE	94

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-3

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-1	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	248	0.56

B = Analyte is found in the associated blank as well as the sample.

Analytical**Technologies**,Inc.

ATI I.D. # 9202-061-4

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-3	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
ACETONE	<1.1
BENZENE	<0.057
BROMODICHLOROMETHANE	<0.057
BROMOFORM	<0.28
BROMOMETHANE	<0.57
2-BUTANONE (MEK)	<0.57
CARBON DISULFIDE	<0.057
CARBON TETRACHLORIDE	<0.057
CHLOROBENZENE	<0.057
CHLOROETHANE	<0.057
CHLOROFORM	<0.057
CHLOROMETHANE	<0.57
DIBROMOCHLOROMETHANE	<0.057
1,1-DICHLOROETHANE	<0.057
1,2-DICHLOROETHANE	<0.057
1,1-DICHLOROETHENE	<0.057
1,2-DICHLOROETHENE (TOTAL)	<0.057
1,2-DICHLOROPROPANE	<0.057
CIS-1,3-DICHLOROPROPENE	<0.057
TRANS-1,3-DICHLOROPROPENE	<0.057
ETHYLBENZENE	<0.057
2-HEXANONE (MBK)	<0.57
4-METHYL-2-PENTANONE (MIBK)	<0.57
METHYLENE CHLORIDE	<0.28
STYRENE	<0.057
1,1,2,2-TETRACHLOROETHANE	<0.057
TETRACHLOROETHENE	0.19
TOLUENE	<0.057
1,1,1-TRICHLOROETHANE	<0.057
1,1,2-TRICHLOROETHANE	<0.057
TRICHLOROETHENE	<0.057
VINYL ACETATE	<0.57
VINYL CHLORIDE	<0.057
TOTAL XYLENES	<0.057

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	81
TOLUENE-D8	82
BROMOFLUOROBENZENE	91

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-4

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-3	DATE ANALYZED	: 02/12/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8240	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	247	0.63

B = Analyte is found in the associated blank as well as the sample.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.	SAMPLE I.D. #	: 9202-003-6
PROJECT #	: 3447	DATE EXTRACTED	: 02/03/92
PROJECT NAME	: PORT OF SEATTLE	DATE ANALYZED	: 02/05/92
EPA METHOD	: 8240	UNITS	: mg/Kg
SAMPLE MATRIX	: SOIL		

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,1-DICHLOROETHENE	<0.050	2.50	2.26	90	2.14	86	5
TRICHLOROETHENE	<0.050	2.50	2.41	96	2.35	94	3
BENZENE	<0.050	2.50	2.34	94	2.35	94	0
TOLUENE	<0.050	2.50	2.58	103	2.42	97	6
CHLOROBENZENE	<0.050	2.50	2.56	102	2.40	96	6

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

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

Analytical Technologies, Inc.

ATI I.D. # 9202-061

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
EPA METHOD : 8240
SAMPLE MATRIX : SOIL

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : 02/10/92
DATE ANALYZED : 02/11/92
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,1-DICHLOROETHENE	<0.050	2.50	2.60	104	N/A	N/A	N/A
TRICHLOROETHENE	<0.050	2.50	2.50	100	N/A	N/A	N/A
BENZENE	<0.050	2.50	2.52	101	N/A	N/A	N/A
TOLUENE	<0.050	2.50	2.71	108	N/A	N/A	N/A
CHLOROBENZENE	<0.050	2.50	2.61	104	N/A	N/A	N/A

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

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

Analytical**Technologies,**Inc.

ATI I.D. # 9202-061

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/17/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8080	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
PCB 1016	<0.033
PCB 1221	<0.033
PCB 1232	<0.033
PCB 1242	<0.033
PCB 1248	<0.033
PCB 1254	<0.033
PCB 1260	<0.033

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	96
DIBUTYLCHORENDATE	72

Note: Sulfur cleanup procedure performed.

Analytical Technologies, Inc.

ATI I.D. # 9202-061-1

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-7,S-1	DATE ANALYZED	: 02/16/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8080	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
PCB 1016	<0.044
PCB 1221	<0.044
PCB 1232	<0.044
PCB 1242	<0.044
PCB 1248	<0.044
PCB 1254	<0.044
PCB 1260	<0.044

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	78
DIBUTYLCHORENDATE	73

Analytical Technologies, Inc.

ATI I.D. # 9202-061-2

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-7,S-3	DATE ANALYZED	: 02/17/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8080	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
PCB 1016	<0.098
PCB 1221	<0.098
PCB 1232	<0.098
PCB 1242	<0.098
PCB 1248	<0.098
PCB 1254	<0.098
PCB 1260	<0.098

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	84
DIBUTYLCHORENDATE	67

Note: Sulfur cleanup procedure performed.

Analytical Technologies, Inc.

ATI I.D. # 9202-061-3

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-9,S-1	DATE ANALYZED	: 02/16/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8080	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
PCB 1016	<0.037
PCB 1221	<0.037
PCB 1232	<0.037
PCB 1242	<0.037
PCB 1248	<0.037
PCB 1254	<0.037
PCB 1260	<0.037

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	96
DIBUTYLCHORENDATE	85

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-4

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-9,S-3	DATE ANALYZED	: 02/16/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8080	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
PCB 1016	<0.038
PCB 1221	<0.038
PCB 1232	<0.038
PCB 1242	<0.038
PCB 1248	<0.038
PCB 1254	<0.038
PCB 1260	<0.038

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	89
DIBUTYLCHORENDATE	70

Analytical**Technologies**,Inc.

ATI I.D. # 9202-061

PCB ANALYSIS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.		SAMPLE I.D. #	: 9202-022-3
PROJECT #	: 3447		DATE EXTRACTED	: 02/12/92
PROJECT NAME	: PORT OF SEATTLE		DATE ANALYZED	: 02/14/92
EPA METHOD	: 8080		UNITS	: mg/Kg
SAMPLE MATRIX	: SOIL			

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
PCB 1260	<0.033	0.333	0.305	92	0.310	93	2

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

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

Analytical**Technologies**,Inc.

ATI I.D. # 9202-061

PCB ANALYSIS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.		SAMPLE I.D. #	: BLANK SPIKE
PROJECT #	: 3447		DATE EXTRACTED	: 02/12/92
PROJECT NAME	: PORT OF SEATTLE		DATE ANALYZED	: 02/17/92
EPA METHOD	: 8080		UNITS	: mg/Kg
SAMPLE MATRIX	: SOIL			

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
PCB 1260	<0.033	0.333	0.309	93	N/A	N/A	N/A

Note: Sulfur cleanup procedure performed.

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

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

Analytical Technologies, Inc.

ATI I.D. # 9202-061

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8310	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
NAPHTHALENE	<0.083
ACENAPHTHYLENE	<0.17
ACENAPHTHENE	<0.17
FLUORENE	<0.017
PHENANTHRENE	<0.0083
ANTHRACENE	<0.0083
FLUORANTHENE	<0.017
PYRENE	<0.017
BENZO(A)ANTHRACENE	<0.017
CHRYSENE	<0.017
BENZO(B)FLUORANTHENE	<0.017
BENZO(K)FLUORANTHENE	<0.017
BENZO(A)PYRENE	<0.017
DIBENZO(A,H)ANTHRACENE	<0.034
BENZO(G,H,I)PERYLENE	<0.017
INDENO(1,2,3-CD)PYRENE	<0.017

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	96

Analytical Technologies, Inc.

ATI I.D. # 9202-061-1

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-7,S-1	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8310	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
NAPHTHALENE	<0.11
ACENAPHTHYLENE	<0.22
ACENAPHTHENE	<0.22
FLUORENE	<0.022
PHENANTHRENE	<0.011
ANTHRACENE	<0.011
FLUORANTHENE	<0.022
PYRENE	<0.022
BENZO(A)ANTHRACENE	<0.022
CHRYSENE	<0.022
BENZO(B)FLUORANTHENE	<0.022
BENZO(K)FLUORANTHENE	<0.022
BENZO(A)PYRENE	<0.022
DIBENZO(A,H)ANTHRACENE	<0.045
BENZO(G,H,I)PERYLENE	<0.022
INDENO(1,2,3-CD)PYRENE	<0.022

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	82

Analytical Technologies, Inc.

ATI I.D. # 9202-061-2

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-7,S-3	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8310	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
NAPHTHALENE	<0.13
ACENAPHTHYLENE	<0.26
ACENAPHTHENE	<0.26
FLUORENE	0.13
PHENANTHRENE	0.65
ANTHRACENE	0.12
FLUORANTHENE	0.86
PYRENE	0.75
BENZO(A)ANTHRACENE	0.22
CHRYSENE	0.24
BENZO(B)FLUORANTHENE	0.19
BENZO(K)FLUORANTHENE	0.099
BENZO(A)PYRENE	0.24
DIBENZO(A,H)ANTHRACENE	<0.052
BENZO(G,H,I)PERYLENE	0.23
INDENO(1,2,3-CD)PYRENE	0.16

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	92

Analytical**Technologies,**Inc.

ATI I.D. # 9202-061-3

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-9,S-1	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8310	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
NAPHTHALENE	<0.092
ACENAPHTHYLENE	<0.19
ACENAPHTHENE	<0.19
FLUORENE	0.12
PHENANTHRENE	0.82
ANTHRACENE	0.12
FLUORANTHENE	1.4
PYRENE	1.2
BENZO(A)ANTHRACENE	0.40
CHRYSENE	0.40
BENZO(B)FLUORANTHENE	0.29
BENZO(K)FLUORANTHENE	0.17
BENZO(A)PYRENE	0.41
DIBENZO(A,H)ANTHRACENE	0.047
BENZO(G,H,I)PERYLENE	0.30
INDENO(1,2,3-CD)PYRENE	0.25

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	105

Analytical Technologies, Inc.

ATI I.D. # 9202-061-4

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/12/92
CLIENT I.D.	: HC-9,S-3	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
EPA METHOD	: 8310	DILUTION FACTOR	: 1

RESULTS ARE CORRECTED FOR MOISTURE CONTENT

COMPOUNDS	RESULTS
NAPHTHALENE	<0.094
ACENAPHTHYLENE	<0.19
ACENAPHTHENE	<0.19
FLUORENE	0.077
PHENANTHRENE	0.45
ANTHRACENE	0.067
FLUORANTHENE	0.86
PYRENE	0.72
BENZO(A)ANTHRACENE	0.26
CHRYSENE	0.27
BENZO(B)FLUORANTHENE	0.20
BENZO(K)FLUORANTHENE	0.12
BENZO(A)PYRENE	0.32
DIBENZO(A,H)ANTHRACENE	0.043
BENZO(G,H,I)PERYLENE	0.22
INDENO(1,2,3-CD)PYRENE	0.19

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	130

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

POLYNUCLEAR AROMATICS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
EPA METHOD : 8310
SAMPLE MATRIX : SOIL

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : 02/12/92
DATE ANALYZED : 02/25/92
UNITS : mg/Kg

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
ACENAPHTHYLENE	<0.17	3.33	2.76	83	2.61	78	6
PHENANTHRENE	<0.0083	0.333	0.328	98	0.299	90	9
PYRENE	<0.017	0.333	0.346	104	0.318	95	8
BENZO(K)FLUORANTHENE	<0.017	0.333	0.336	101	0.315	95	6
DIBENZO(A,H)ANTHRACENE	<0.034	0.333	0.285	86	0.268	80	6

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

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

Analytical**Technologies,**Inc.

ATI I.D. # 9202-061

FUEL HYDROCARBON ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/10/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

RESULTS ARE NOT CORRECTED FOR MOISTURE CONTENT

COMPOUND	RESULT
FUEL HYDROCARBONS	<5
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<25
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	88

Analytical Technologies, Inc.

ATI I.D. # 9202-061-1

FUEL HYDROCARBON ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-7,S-1	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

RESULTS ARE NOT CORRECTED FOR MOISTURE CONTENT

COMPOUND	RESULT
FUEL HYDROCARBONS	<5
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<25
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	70

Analytical Technologies, Inc.

ATI I.D. # 9202-061-2

FUEL HYDROCARBON ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-7,S-3	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

RESULTS ARE NOT CORRECTED FOR MOISTURE CONTENT

COMPOUND	RESULT
FUEL HYDROCARBONS	<5
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<25
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	84

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-3

FUEL HYDROCARBON ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-1	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

RESULTS ARE NOT CORRECTED FOR MOISTURE CONTENT

COMPOUND	RESULT
FUEL HYDROCARBONS	9
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	75 *
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	85

* Chromatogram indicates petroleum hydrocarbons heavier than diesel.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061-4

FUEL HYDROCARBON ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/06/92
PROJECT #	: 3447	DATE RECEIVED	: 02/07/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 02/10/92
CLIENT I.D.	: HC-9,S-3	DATE ANALYZED	: 02/11/92
SAMPLE MATRIX	: SOIL	UNITS	: mg/Kg
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

RESULTS ARE NOT CORRECTED FOR MOISTURE CONTENT

COMPOUND	RESULT
FUEL HYDROCARBONS	<5
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<25 *
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	80

* Chromatogram indicates petroleum hydrocarbons heavier than diesel.

Analytical**Technologies,**Inc.

ATI I.D. # 9202-061

FUEL HYDROCARBON ANALYSIS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.		SAMPLE I.D. #	: 9202-068-7
PROJECT #	: 3447		DATE EXTRACTED	: 02/10/92
PROJECT NAME	: PORT OF SEATTLE		DATE ANALYZED	: 02/11/92
METHOD	: 8015 (MODIFIED)		UNITS	: mg/Kg
SAMPLE MATRIX	: SOIL			

COMPOUND	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
FUEL HYDROCARBONS (DIESEL)	252	500	638	77	663	82	4

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

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Spike Result} - \text{Dup. Spike Result})|}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

ATI I.D. # 9202-061

FUEL HYDROCARBON ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
METHOD : 8015 (MODIFIED)
SAMPLE MATRIX : SOIL

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : 02/10/92
DATE ANALYZED : 02/10/92
UNITS : mg/Kg

COMPOUND	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED RESULT	DUP. % REC.	RPD
FUEL HYDROCARBONS (DIESEL)	<25	500	479	96	469	94	2

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

$$\text{RPD (Relative \% Difference)} = \frac{|(\text{Spike Result} - \text{Dup. Spike Result})|}{\text{Average Result}} \times 100$$

Analytical Technologies, Inc.

ATI I.D. # 9202-061

METALS ANALYSIS

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

MATRIX : SOIL

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	02/11/92	02/11/92
CADMIUM	02/11/92	02/12/92
CHROMIUM	02/11/92	02/12/92
COPPER	02/11/92	02/12/92
LEAD	02/11/92	02/12/92
MERCURY	02/10/92	02/11/92
NICKEL	02/11/92	02/12/92
ZINC	02/11/92	02/12/92

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE
RESULTS ARE CORRECTED FOR MOISTURE CONTENT

MATRIX : SOIL
UNITS : mg/Kg

ELEMENT	HC-7,S-1 -1	HC-7,S-3 -2	HC-9,S-1 -3	HC-9,S-3 -4	REAGENT BLANK
ARSENIC	3.3	3.0	3.8	2.1	<0.25
CADMIUM	<0.13	<0.14	<0.17	<0.11	<0.10
CHROMIUM	58	42	25	25	<0.50
COPPER	52	37	47	30	<0.25
LEAD	10	26	93	120	<1.5
MERCURY	<0.10	<0.10	<0.093	0.14	<0.10
NICKEL	75	52	34	27	<0.50
ZINC	87	86	110	180	0.57

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

MATRIX : SOIL

UNITS : mg/Kg

ELEMENT	ATI I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
ARSENIC	9202-061-3	3.8	3.7	3	4.34	1.45	37
ARSENIC	BLANK SPIKE	<0.25	N/A	N/A	1.15	1.25	92
CADMIUM	9202-061-3	<0.17	<0.10	NC	43.7	53.4	82
CADMIUM	BLANK SPIKE	<0.10	N/A	N/A	44.3	50.0	87
CHROMIUM	9202-061-3	25	23	8	70.7	53.4	86
CHROMIUM	BLANK SPIKE	<0.50	N/A	N/A	48.0	50.0	96
COPPER	9202-061-3	47	51	8	102	53.4	103
COPPER	BLANK SPIKE	<0.25	N/A	N/A	49.2	50.0	98
LEAD	9202-061-3	93	85	9	143	53.4	94
LEAD	BLANK SPIKE	<1.5	N/A	N/A	48.6	50.0	97
MERCURY	9202-061-4	0.14	0.26	60 F	0.75	0.45	136
MERCURY	BLANK SPIKE	<0.10	N/A	N/A	0.46	0.50	92
NICKEL	9202-061-3	34	30	12	75.7	53.4	78
NICKEL	BLANK SPIKE	<0.50	N/A	N/A	46.6	50.0	93
ZINC	9202-061-3	110	90	20	142	53.4	60
ZINC	BLANK SPIKE	0.57	N/A	N/A	47.1	50.0	93

F = Out of limits due to matrix interference.

NC = Not Calculable.

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

MATRIX : SOIL

PARAMETER	DATE ANALYZED
MOISTURE	02/10/92

Analytical Technologies, Inc.

ATI I.D. # 9202-061

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

MATRIX : SOIL

UNITS : %

ATI I.D. #	CLIENT I.D.	MOISTURE
9202-061-1	HC-7,S-1	24
9202-061-2	HC-7,S-3	34
9202-061-3	HC-9,S-1	10
9202-061-4	HC-9,S-3	12

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-061

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

MATRIX : SOIL
UNITS : %

PARAMETER	ATI I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
MOISTURE	9202-061-4	12	15	22	N/A	N/A	N/A

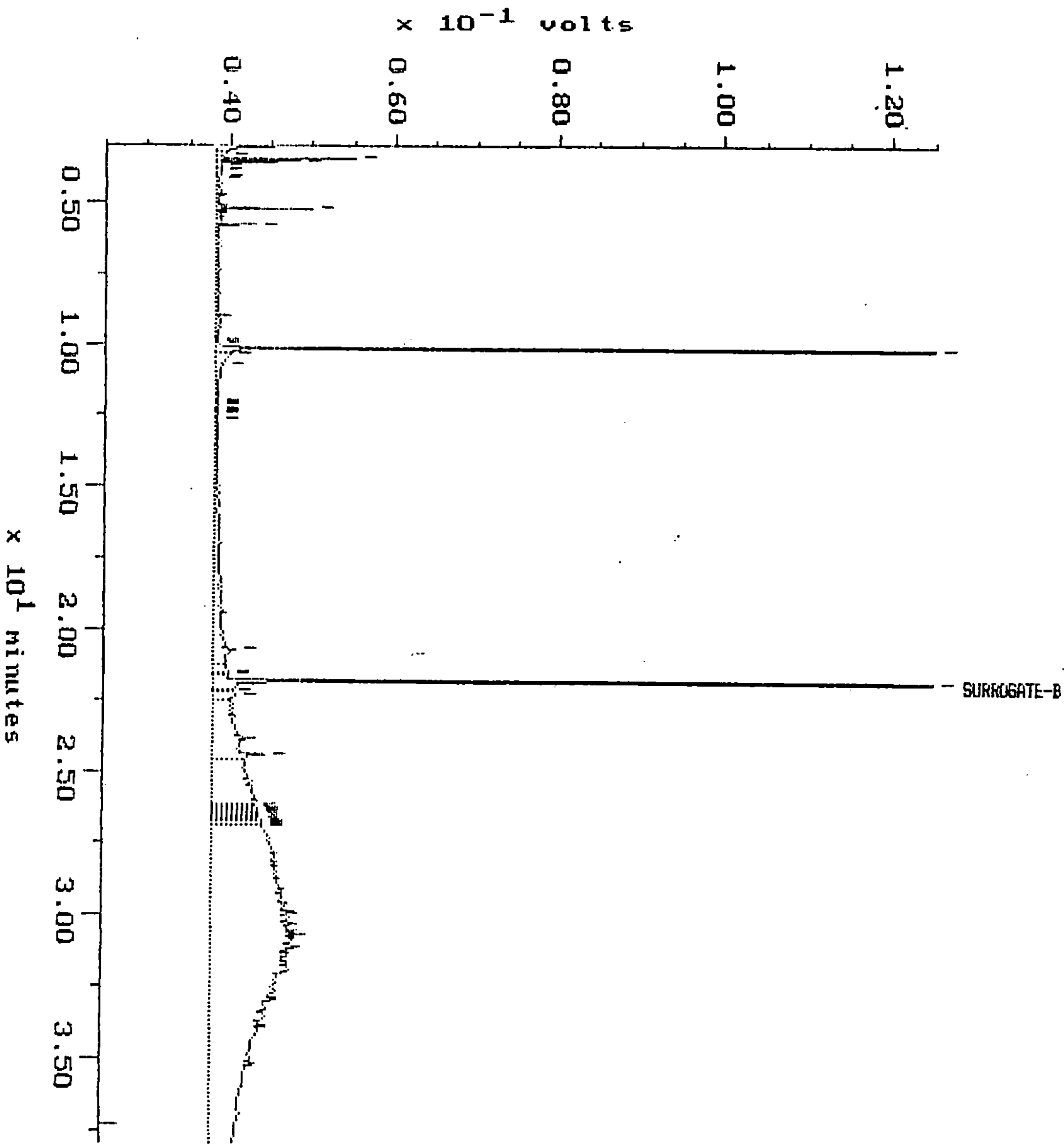
$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

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

Sample: 9202-061-3
Acquired: 11-FEB-92 9:24
Inj Vol: 1.00

Channel: FRED
Method: M:\BRO2\MAXDATA\FRED\FUEL0210

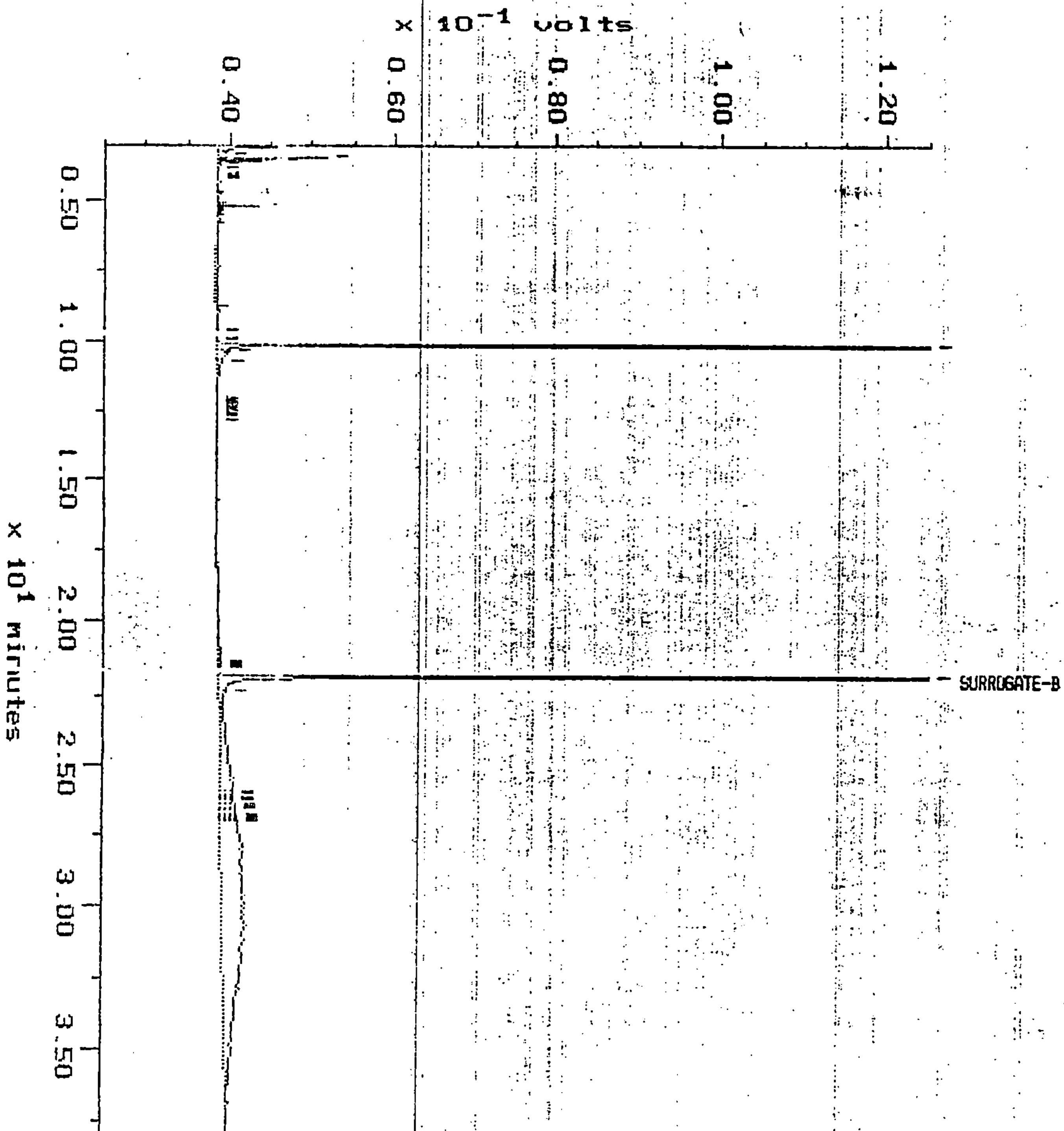
Filename: 0210FR19
Operator: ACE



Sample: 5202-261-4
Acquired: 11-FEB-92 10:11
Inj Vol: 1.00

Channel: FRED
Method: M:\BRO2\MAXDATA\FRED\FUEL0210

Filename: 0210FR20
Operator: ACE



AnalyticalTechnologies,Inc.
560 Naches Avenue SW, Suite 101 Renton,WA 98055 (206)228-8335

Chain of Custody

DATE 2/7/92 PAGE 1 OF 1

LABORATORY NUMBER: 9202-061

PROJECT MANAGER: Gary Horvitz
COMPANY: Hart Crowser
ADDRESS: 1910 Fairview Ave E
PHONE: 324-9530 SAMPLED BY: C. Wolfe

SAMPLE DISPOSAL INSTRUCTIONS

☐ ATI Disposal @ $5.00 each ☒ Return

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	8010 Halogenated Volatiles	8020 Aromatic Volatiles	8020 BETX ONLY	8240 GCMS Volatiles	8270 GCMS BNA	8310 HPLC PNA	8080 Pesticides & PCB's	8080 PCB's ONLY	8140 Phosphate Pesticides	8150 Herbicides	WDOE PAH/HH (WAC 173)	418.1 (TPH)	413.2 Grease & Oil	8015 (Modified)	TOC 9060	TOX 9020	% Moisture	EP TOX Metals (8) EP EXT	Priority Pollutant Metals (13)	TCLP ONLY: 8080 Pesticide (4)	TCLP ONLY: 8240 ZH-EXT	TCLP ONLY: 8270	TCLP ONLY: 8150 Herbicides (2)	TCLP ONLY: ~~Metals (8)~~	Metals *	3/10 [illegible]	NUMBER OF CONTAINERS
HC-7, S-1	2/6		SOIL	1				X		X		X						X										X	✓		2
HC-7, S-3	2/6		SOIL	2				X		X		X						X										X	✓		2
HC-9, S-1	2/6		SOIL	3				X		X		X						X										X	✓		2
HC-9, S-3	2/6		SOIL	4				X		X		X						X										X	✓		2
																													*As Cd Cr	Hg Pb Ni Zn	8

PROJECT INFORMATION

PROJECT NUMBER: 3447
PROJECT NAME: Port of Seattle
PURCHASE ORDER NUMBER:
ONGOING PROJECT? YES ☒ NO ☐

SAMPLE RECEIPT

TOTAL NUMBER OF CONTAINERS: 8
COC SEALS/INTACT? Y/N/NA: N/NA
RECEIVED GOOD COND./COLD: 4/4
RECEIVED VIA: Hand del

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS

TAT: (NORMAL) ☒ 2WKS (RUSH) ☐ 24HR ☐ 48 HRS ☐ 72 HRS ☐ 1 WK

GREATER THAN 24 HR. NOTICE? YES ☐ NO ☐ (LAB USE ONLY)

SPECIAL INSTRUCTIONS:
4-2 oz jars - VOA
4-8 oz jars

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: [signature] Time: 1100	Signature: Time:	Signature: Time:
Printed Name: Julio Sowa Date: 2/7/92	Printed Name: Date:	Printed Name: Date:
Company: HC	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: [signature] Time: 1430	Signature: Time:	Signature: Time:
Printed Name: Roger Fuller Date: 2/7/92	Printed Name: Date:	Printed Name: Date:
Company: ATI-WA	Company:	Analytical Technologies, Inc.

Analytical**Technologies,**Inc. 560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9202-188

March 16, 1992

Hart Crowser, Inc.
1910 Fairview Ave. E.
Seattle, WA 98102-3699

Attention : Julie Sowa

Project Number : J-3447

Project Name : P.O.S. C.W.F.

On February 24, 1992, Analytical Technologies, Inc., received three water samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Emily C. Carfioli
Senior Project Manager

Frederick W. Grothkopp
Laboratory Manager

FWG/hal/elf/ew

Analytical Technologies, Inc.

ATI I.D. # 9202-188

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9202-188-1	HC-9	02/24/92	WATER
9202-188-2	HC-7	02/24/92	WATER
9202-188-3	TRIP	N/A	WATER

----- TOTALS -----

MATRIX	# SAMPLES
WATER	3

ATI STANDARD DISPOSAL PRACTICE

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

Analytical Technologies, Inc.

ATI I.D. # 9202-188

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

ANALYSIS	TECHNIQUE	REFERENCE	LAB
VOLATILE ORGANIC COMPOUNDS	GCMS	EPA 8240	R
POLYNUCLEAR AROMATIC HYDROCARBONS	HPLC/UV/FLUOR	EPA 8310	R
FUEL HYDROCARBONS	GC/FID	EPA 8015 MODIFIED	R
ARSENIC	AA/GF	EPA 7060	R
CADMIUM	AA/GF	EPA 7131	R
CHROMIUM	ICAP	EPA 6010	R
COPPER	ICAP	EPA 6010	R
LEAD	AA/GF	EPA 7421	R
MERCURY	AA/COLD VAPOR	EPA 7470	R
NICKEL	ICAP	EPA 6010	R
ZINC	ICAP	EPA 6010	R
TOTAL SUSPENDED SOLIDS	GRAVIMETRIC	EPA 160.2	R

R = ATI - Renton
SD = ATI - San Diego
PHX = ATI - Phoenix
PNR = ATI - Pensacola
FC = ATI - Fort Collins
SUB = Subcontract

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: J-3447	DATE RECEIVED	: N/A
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/24/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
ACETONE	<10
BENZENE	<1
BROMODICHLOROMETHANE	<1
BROMOFORM	<5
BROMOMETHANE	<10
2-BUTANONE (MEK)	<10
CARBON DISULFIDE	<1
CARBON TETRACHLORIDE	<1
CHLOROBENZENE	<1
CHLOROETHANE	<1
CHLOROFORM	<1
CHLOROMETHANE	<10
DIBROMOCHLOROMETHANE	<1
1,1-DICHLOROETHANE	<1
1,2-DICHLOROETHANE	<1
1,1-DICHLOROETHENE	<1
1,2-DICHLOROETHENE (TOTAL)	<1
1,2-DICHLOROPROPANE	<1
CIS-1,3-DICHLOROPROPENE	<1
TRANS-1,3-DICHLOROPROPENE	<1
ETHYLBENZENE	<1
2-HEXANONE (MBK)	<10
4-METHYL-2-PENTANONE (MIBK)	<10
METHYLENE CHLORIDE	<5
STYRENE	<1
1,1,2,2-TETRACHLOROETHANE	<1
TETRACHLOROETHENE	<1
TOLUENE	<1
1,1,1-TRICHLOROETHANE	<1
1,1,2-TRICHLOROETHANE	<1
TRICHLOROETHENE	<1
VINYL ACETATE	<10
VINYL CHLORIDE	<1
TOTAL XYLENES	<1

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	99
TOLUENE-D8	99
BROMOFLUOROBENZENE	95

Analytical Technologies, Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: J-3447	DATE RECEIVED	: N/A
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/24/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE		272	10

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
CLIENT I.D. : REAGENT BLANK
SAMPLE MATRIX : WATER
EPA METHOD : 8240

DATE SAMPLED : N/A
DATE RECEIVED : N/A
DATE EXTRACTED : N/A
DATE ANALYZED : 02/25/92
UNITS : ug/L
DILUTION FACTOR : 1

COMPOUNDS	RESULTS
ACETONE	<10
BENZENE	<1
BROMODICHLOROMETHANE	<1
BROMOFORM	<5
BROMOMETHANE	<10
2-BUTANONE (MEK)	<10
CARBON DISULFIDE	<1
CARBON TETRACHLORIDE	<1
CHLOROBENZENE	<1
CHLOROETHANE	<1
CHLOROFORM	<1
CHLOROMETHANE	<10
DIBROMOCHLOROMETHANE	<1
1,1-DICHLOROETHANE	<1
1,2-DICHLOROETHANE	<1
1,1-DICHLOROETHENE	<1
1,2-DICHLOROETHENE (TOTAL)	<1
1,2-DICHLOROPROPANE	<1
CIS-1,3-DICHLOROPROPENE	<1
TRANS-1,3-DICHLOROPROPENE	<1
ETHYLBENZENE	<1
2-HEXANONE (MBK)	<10
4-METHYL-2-PENTANONE (MIBK)	<10
METHYLENE CHLORIDE	8
STYRENE	<1
1,1,2,2-TETRACHLOROETHANE	<1
TETRACHLOROETHENE	<1
TOLUENE	<1
1,1,1-TRICHLOROETHANE	<1
1,1,2-TRICHLOROETHANE	<1
TRICHLOROETHENE	<1
VINYL ACETATE	<10
VINYL CHLORIDE	<1
TOTAL XYLENES	<1

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	100
TOLUENE-D8	99
BROMOFLUOROBENZENE	99

Analytical Technologies, Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
CLIENT I.D. : REAGENT BLANK
SAMPLE MATRIX : WATER
EPA METHOD : 8240

DATE SAMPLED : N/A
DATE RECEIVED : N/A
DATE EXTRACTED : N/A
DATE ANALYZED : 02/25/92
UNITS : ug/L
DILUTION FACTOR : 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE		273	12

Analytical Technologies, Inc.

ATI I.D. # 9202-188-1

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: HC-9	DATE ANALYZED	: 02/24/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
ACETONE	<10
BENZENE	<1
BROMODICHLOROMETHANE	<1
BROMOFORM	<5
BROMOMETHANE	<10
2-BUTANONE (MEK)	<10
CARBON DISULFIDE	<1
CARBON TETRACHLORIDE	<1
CHLOROBENZENE	<1
CHLOROETHANE	<1
CHLOROFORM	<1
CHLOROMETHANE	<10
DIBROMOCHLOROMETHANE	<1
1,1-DICHLOROETHANE	<1
1,2-DICHLOROETHANE	<1
1,1-DICHLOROETHENE	<1
1,2-DICHLOROETHENE (TOTAL)	<1
1,2-DICHLOROPROPANE	<1
CIS-1,3-DICHLOROPROPENE	<1
TRANS-1,3-DICHLOROPROPENE	<1
ETHYLBENZENE	<1
2-HEXANONE (MBK)	<10
4-METHYL-2-PENTANONE (MIBK)	<10
METHYLENE CHLORIDE	<5
STYRENE	<1
1,1,2,2-TETRACHLOROETHANE	<1
TETRACHLOROETHENE	<1
TOLUENE	<1
1,1,1-TRICHLOROETHANE	<1
1,1,2-TRICHLOROETHANE	<1
TRICHLOROETHENE	<1
VINYL ACETATE	<10
VINYL CHLORIDE	<1
TOTAL XYLENES	<1

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	97
TOLUENE-D8	96
BROMOFLUOROBENZENE	93

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188-1

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: HC-9	DATE ANALYZED	: 02/24/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	271	11

B = Analyte is found in the associated blank as well as the sample.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188-2

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: HC-7	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
ACETONE	<10
BENZENE	<1
BROMODICHLOROMETHANE	<1
BROMOFORM	<5
BROMOMETHANE	<10
2-BUTANONE (MEK)	<10
CARBON DISULFIDE	<1
CARBON TETRACHLORIDE	<1
CHLOROBENZENE	<1
CHLOROETHANE	<1
CHLOROFORM	<1
CHLOROMETHANE	<10
DIBROMOCHLOROMETHANE	<1
1,1-DICHLOROETHANE	<1
1,2-DICHLOROETHANE	<1
1,1-DICHLOROETHENE	<1
1,2-DICHLOROETHENE (TOTAL)	<1
1,2-DICHLOROPROPANE	<1
CIS-1,3-DICHLOROPROPENE	<1
TRANS-1,3-DICHLOROPROPENE	<1
ETHYLBENZENE	<1
2-HEXANONE (MBK)	<10
4-METHYL-2-PENTANONE (MIBK)	<10
METHYLENE CHLORIDE	<5
STYRENE	<1
1,1,2,2-TETRACHLOROETHANE	<1
TETRACHLOROETHENE	<1
TOLUENE	<1
1,1,1-TRICHLOROETHANE	<1
1,1,2-TRICHLOROETHANE	<1
TRICHLOROETHENE	<1
VINYL ACETATE	<10
VINYL CHLORIDE	<1
TOTAL XYLENES	<1

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	97
TOLUENE-D8	99
BROMOFLUOROBENZENE	101

Analytical Technologies, Inc.

ATI I.D. # 9202-188-2

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: HC-7	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	272	11

B = Analyte is found in the associated blank as well as the sample.

Analytical Technologies, Inc.

ATI I.D. # 9202-188-3

VOLATILE ORGANICS ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: TRIP	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
ACETONE	<10
BENZENE	<1
BROMODICHLOROMETHANE	<1
BROMOFORM	<5
BROMOMETHANE	<10
2-BUTANONE (MEK)	<10
CARBON DISULFIDE	<1
CARBON TETRACHLORIDE	<1
CHLOROBENZENE	<1
CHLOROETHANE	<1
CHLOROFORM	<1
CHLOROMETHANE	<10
DIBROMOCHLOROMETHANE	<1
1,1-DICHLOROETHANE	<1
1,2-DICHLOROETHANE	<1
1,1-DICHLOROETHENE	<1
1,2-DICHLOROETHENE (TOTAL)	<1
1,2-DICHLOROPROPANE	<1
CIS-1,3-DICHLOROPROPENE	<1
TRANS-1,3-DICHLOROPROPENE	<1
ETHYLBENZENE	<1
2-HEXANONE (MBK)	<10
4-METHYL-2-PENTANONE (MIBK)	<10
METHYLENE CHLORIDE	<5
STYRENE	<1
1,1,2,2-TETRACHLOROETHANE	<1
TETRACHLOROETHENE	<1
TOLUENE	<1
1,1,1-TRICHLOROETHANE	<1
1,1,2-TRICHLOROETHANE	<1
TRICHLOROETHENE	<1
VINYL ACETATE	<10
VINYL CHLORIDE	<1
TOTAL XYLENES	<1

SURROGATE PERCENT RECOVERIES

1,2-DICHLOROETHANE-D4	101
TOLUENE-D8	100
BROMOFLUOROBENZENE	97

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188-3

VOLATILE ORGANICS ANALYSIS
TENTATIVELY IDENTIFIED COMPOUNDS

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: N/A
CLIENT I.D.	: TRIP	DATE ANALYZED	: 02/25/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8240	DILUTION FACTOR	: 1

COMPOUND	FLAG	SCAN	RESULTS
HEXANE	B	273	11

B = Analyte is found in the associated blank as well as the sample.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8240
SAMPLE MATRIX : WATER

SAMPLE I.D. # : 9202-188-1
DATE EXTRACTED : N/A
DATE ANALYZED : 02/24/92
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,1-DICHLOROETHENE	<1.0	50.0	39.7	79	39.1	78	2
TRICHLOROETHENE	<1.0	50.0	49.9	100	49.9	100	0
BENZENE	<1.0	50.0	51.0	102	50.6	101	1
TOLUENE	<1.0	50.0	52.9	106	54.7	109	3
CHLOROBENZENE	<1.0	50.0	52.9	106	54.3	109	3

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8240
SAMPLE MATRIX : WATER

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : N/A
DATE ANALYZED : 02/24/92
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,1-DICHLOROETHENE	<1.0	50.0	38.4	77	N/A	N/A	N/A
TRICHLOROETHENE	<1.0	50.0	49.9	100	N/A	N/A	N/A
BENZENE	<1.0	50.0	50.4	101	N/A	N/A	N/A
TOLUENE	<1.0	50.0	51.1	102	N/A	N/A	N/A
CHLOROBENZENE	<1.0	50.0	52.0	104	N/A	N/A	N/A

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

VOLATILE ORGANICS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8240
SAMPLE MATRIX : WATER

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : N/A
DATE ANALYZED : 02/25/92
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
1,1-DICHLOROETHENE	<1.0	50.0	39.4	79	N/A	N/A	N/A
TRICHLOROETHENE	<1.0	50.0	51.4	103	N/A	N/A	N/A
BENZENE	<1.0	50.0	51.4	103	N/A	N/A	N/A
TOLUENE	<1.0	50.0	56.5	113	N/A	N/A	N/A
CHLOROBENZENE	<1.0	50.0	56.2	112	N/A	N/A	N/A

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: J-3447	DATE RECEIVED	: N/A
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/25/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 03/02/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8310	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
NAPHTHALENE	<0.050
ACENAPHTHYLENE	<0.20
ACENAPHTHENE	<0.050
FLUORENE	<0.020
PHENANTHRENE	<0.010
ANTHRACENE	0.010
FLUORANTHENE	<0.010
PYRENE	<0.010
BENZO(A)ANTHRACENE	<0.010
CHRYSENE	<0.010
BENZO(B)FLUORANTHENE	<0.010
BENZO(K)FLUORANTHENE	<0.010
BENZO(A)PYRENE	<0.010
DIBENZO(A,H)ANTHRACENE	<0.010
BENZO(G,H,I)PERYLENE	<0.020
INDENO(1,2,3-CD)PYRENE	<0.020

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	71

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188-1

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/25/92
CLIENT I.D.	: HC-9	DATE ANALYZED	: 03/02/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8310	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS	
NAPHTHALENE	0.14	
ACENAPHTHYLENE	<0.20	
ACENAPHTHENE	0.10	
FLUORENE	0.090	
PHENANTHRENE	0.88	
ANTHRACENE	0.15	B
FLUORANTHENE	1.2	
PYRENE	1.2	
BENZO(A)ANTHRACENE	0.45	
CHRYSENE	0.50	
BENZO(B)FLUORANTHENE	0.32	
BENZO(K)FLUORANTHENE	0.19	
BENZO(A)PYRENE	0.46	
DIBENZO(A,H)ANTHRACENE	0.065	
BENZO(G,H,I)PERYLENE	0.36	
INDENO(1,2,3-CD)PYRENE	0.32	

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	65

B = Analyte is found in the associated blank as well as the sample.

Analytical Technologies, Inc.

ATI I.D. # 9202-188-2

POLYNUCLEAR AROMATICS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/25/92
CLIENT I.D.	: HC-7	DATE ANALYZED	: 03/02/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8310	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
NAPHTHALENE	0.12
ACENAPHTHYLENE	<0.20
ACENAPHTHENE	0.28
FLUORENE	0.099
PHENANTHRENE	0.24
ANTHRACENE	0.069 B
FLUORANTHENE	0.25
PYRENE	0.23
BENZO(A)ANTHRACENE	0.064
CHRYSENE	0.043
BENZO(B)FLUORANTHENE	<0.010
BENZO(K)FLUORANTHENE	<0.010
BENZO(A)PYRENE	0.038
DIBENZO(A,H)ANTHRACENE	<0.010
BENZO(G,H,I)PERYLENE	<0.020
INDENO(1,2,3-CD)PYRENE	<0.020

SURROGATE PERCENT RECOVERIES

2-CHLOROANTHRACENE	62

B = Analyte is found in the associated blank as well as the sample.

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

POLYNUCLEAR AROMATICS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8310
SAMPLE MATRIX : WATER

SAMPLE I.D. # : 9202-188-2
DATE EXTRACTED : 02/25/92
DATE ANALYZED : 03/02/92
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
ACENAPHTHYLENE	<0.20	20.0	13.0	65	12.4	62	5
PHENANTHRENE	0.245	2.00	1.81	78	1.82	79	1
PYRENE	0.231	2.00	1.54	65	1.59	68	3
BENZO(K)FLUORANTHENE	<0.010	2.00	0.675	34	0.679	34	1
DIBENZO(A,H)ANTHRACENE	<0.010	2.00	0.522	26	0.463	23	12

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

POLYNUCLEAR AROMATICS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8310
SAMPLE MATRIX : WATER

SAMPLE I.D. # : BLANK SPIKE
DATE EXTRACTED : 02/25/92
DATE ANALYZED : 03/02/92
UNITS : ug/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
ACENAPHTHYLENE	<0.20	20.0	13.4	67	N/A	N/A	N/A
PHENANTHRENE	<0.010	2.00	1.73	87	N/A	N/A	N/A
PYRENE	<0.010	2.00	1.78	89	N/A	N/A	N/A
BENZO(K)FLUORANTHENE	<0.010	2.00	1.74	87	N/A	N/A	N/A
DIBENZO(A,H)ANTHRACENE	<0.010	2.00	1.56	78	N/A	N/A	N/A

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

FUEL HYDROCARBONS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: J-3447	DATE RECEIVED	: N/A
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/26/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 02/26/92
SAMPLE MATRIX	: WATER	UNITS	: mg/L
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	118

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188-1

FUEL HYDROCARBONS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/26/92
CLIENT I.D.	: HC-9	DATE ANALYZED	: 02/26/92
SAMPLE MATRIX	: WATER	UNITS	: mg/L
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	103

Analytical Technologies, Inc.

ATI I.D. # 9202-188-2

FUEL HYDROCARBONS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/24/92
PROJECT #	: J-3447	DATE RECEIVED	: 02/24/92
PROJECT NAME	: P.O.S. C.W.F.	DATE EXTRACTED	: 02/26/92
CLIENT I.D.	: HC-7	DATE ANALYZED	: 02/26/92
SAMPLE MATRIX	: WATER	UNITS	: mg/L
METHOD	: 8015 (MODIFIED)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C7 - C12
HYDROCARBON QUANTITATION USING	GASOLINE
FUEL HYDROCARBONS	<1
HYDROCARBON RANGE	C12 - C24
HYDROCARBON QUANTITATION USING	DIESEL

SURROGATE PERCENT RECOVERIES

O-TERPHENYL	102

Analytical Technologies, Inc.

ATI I.D. # 9202-188

FUEL HYDROCARBONS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.
EPA METHOD : 8015 (MODIFIED)
SAMPLE MATRIX : WATER

SAMPLE I.D. # : 9202-188-1
DATE EXTRACTED : 02/26/92
DATE ANALYZED : 02/26/92
UNITS : mg/L

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
FUEL HYDROCARBONS (GASOLINE)	<1.0	50.0	51.4	103	50.2	100	2

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

FUEL HYDROCARBONS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.	SAMPLE I.D. #	: BLANK SPIKE
PROJECT #	: J-3447	DATE EXTRACTED	: 02/26/92
PROJECT NAME	: P.O.S. C.W.F.	DATE ANALYZED	: 02/26/92
EPA METHOD	: 8015 (MODIFIED)	UNITS	: mg/L
SAMPLE MATRIX	: WATER		

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
FUELS HYDROCARBONS (GASOLINE)	<1.0	50.0	47.8	96	48.4	97	1

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

METALS ANALYSIS

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER

ELEMENT	DATE PREPARED	DATE ANALYZED
ARSENIC	02/26/92	02/27/92
CADMIUM	02/26/92	03/07/92
CHROMIUM	02/26/92	02/28/92
COPPER	02/26/92	02/28/92
LEAD	02/26/92	02/27/92
MERCURY	02/28/92	03/01/92
NICKEL	02/26/92	02/28/92
ZINC	02/26/92	02/28/92

Analytical Technologies, Inc.

ATI I.D. # 9202-188

TOTAL METALS ANALYSIS DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER
UNITS : mg/L

ELEMENT	HC-9 -1	HC-7 -2	REAGENT BLANK
ARSENIC	0.026	0.010	<0.0050
CADMIUM	0.0012	0.0015	<0.00020
CHROMIUM	0.27	0.37	<0.010
COPPER	0.21	0.30	<0.0050
LEAD	0.28	0.12	<0.0030
MERCURY	0.0014	0.00066	<0.00020
NICKEL	0.25	0.51	<0.010
ZINC	0.51	0.54	<0.010

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

DISSOLVED
METALS ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER

UNITS : mg/L

ELEMENT	HC-9 -1	HC-7 -2	REAGENT BLANK
ARSENIC	<0.0050	<0.0050	<0.0050
CADMIUM	<0.00020	<0.00020	<0.00020
CHROMIUM	<0.010	<0.010	<0.010
COPPER	<0.0050	<0.0050	<0.0050
LEAD	<0.0030	<0.0030	<0.0030
MERCURY	<0.00040	<0.00040	<0.00020
NICKEL	<0.010	<0.010	<0.010
ZINC	0.021	0.025	<0.010

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

METALS ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER
UNITS : mg/L

ELEMENT	ATI I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
ARSENIC	9202-188-2	<0.0050	<0.0050	NC	0.0235	0.0250	94
ARSENIC	BLANK SPIKE	<0.0050	N/A	N/A	0.0220	0.0250	88
CADMIUM	9202-184-6	0.00032	<0.00020	NC	0.00077	0.00050	90
CADMIUM	BLANK SPIKE	<0.00020	N/A	N/A	0.00058	0.00050	116
CHROMIUM	9202-187-1	0.047	0.046	2	1.06	1.00	101
CHROMIUM	BLANK SPIKE	<0.010	N/A	N/A	1.03	1.00	103
COPPER	9202-187-1	0.66	0.66	0	1.55	1.00	89
COPPER	BLANK SPIKE	<0.0050	N/A	N/A	1.02	1.00	102
LEAD	9202-184-6	<0.0030	<0.0030	NC	0.0236	0.0250	94
LEAD	BLANK SPIKE	<0.0030	N/A	N/A	0.0226	0.0250	90
MERCURY	9202-203-2	<0.00020	<0.00020	NC	0.00094	0.00100	94
MERCURY	BLANK SPIKE	<0.00020	N/A	N/A	0.00094	0.00100	94
NICKEL	9202-187-1	<0.010	<0.010	NC	1.00	1.00	100
NICKEL	BLANK SPIKE	<0.010	N/A	N/A	1.01	1.00	101
ZINC	9202-187-1	0.19	0.14	30F	1.12	1.00	93
ZINC	BLANK SPIKE	<0.010	N/A	N/A	0.966	1.00	97

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

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

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

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

GENERAL CHEMISTRY ANALYSIS

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER

PARAMETER	DATE ANALYZED
TOTAL SUSPENDED SOLIDS	02/27/92

Analytical Technologies, Inc.

ATI I.D. # 9202-188

GENERAL CHEMISTRY ANALYSIS
DATA SUMMARY

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER
UNITS : mg/L

ATI I.D. #	CLIENT I.D.	TOTAL SUSPENDED SOLIDS
9202-188-1	HC-9	1,400
9202-188-2	HC-7	3,600
REAGENT BLANK	-	<20

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-188

GENERAL CHEMISTRY ANALYSIS
QUALITY CONTROL DATA

CLIENT : HART CROWSER, INC.
PROJECT # : J-3447
PROJECT NAME : P.O.S. C.W.F.

MATRIX : WATER
UNITS : mg/L

PARAMETER	ATI I.D.	SAMPLE RESULT	DUP RESULT	RPD	SPIKED RESULT	SPIKE ADDED	% REC
TOTAL SUSPENDED SOLIDS	9202-188-2	3,600	4,000	11	N/A	N/A	N/A

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

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

AnalyticalTechnologies,Inc.
560 Naches Avenue SW, Suite 101 Renton,WA 98055 (206)228-8335

Chain of Custody

DATE 2/24/92 PAGE 1 OF 1

LABORATORY NUMBER: 9202-188

PROJECT MANAGER: Julie Sowa
COMPANY: HART CROWSER (HC)
ADDRESS: 1910 FAIRVIEW AVE E.
Seattle WA
PHONE: 324-9530 SAMPLED BY: Lightner

SAMPLE DISPOSAL INSTRUCTIONS
☒ ATI Disposal @ $5.00 each ☐ Return

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	8010 Halogenated Volatiles	8020 Aromatic Volatiles	8020 BETX ONLY	8240 GCMS Volatiles	8270 GCMS BNA	8310 HPLC PNA LL	8080 Pesticides & PCB's	8080 PCB's ONLY LL	8140 Phosphate Pesticides	8150 Herbicides	WDOE PAH/HH (WAC 173)	418.1 (TPH)	413.2 Grease & Oil	8015 (Modified)	TOC 9060	~~TOX 9020~~ TSS	~~% Moisture~~ FILTER Ag	EP TOX Metals (8) EP EXT	Priority Pollutant Metals (13)	TCLP ONLY 8080 Pesticide (4)	TCLP ONLY 8240 ZH-EXT	TCLP ONLY 8270	TCLP ONLY 8150 Herbicides (2)	TCLP ONLY Metals (8)	Total Metals*	Dis. Metals*	NUMBER OF CONTAINERS
HC-9	2/24/92	1145	water	-1				✓		2		6						✓		✓	✓								✓	✓	18 (16)
HC-7	1/24/92	1045	water	2				✓		3		6						✓		✓	✓								.	✓	18 (16)
Trip			"	3				✓																							2

PROJECT INFORMATION
PROJECT NUMBER: 3447
PROJECT NAME: P.O.S. C.W.F.
PURCHASE ORDER NUMBER:
ONGOING PROJECT? YES ☒ NO ☐

SAMPLE RECEIPT
TOTAL NUMBER OF CONTAINERS: 32
COC SEALS/INTACT? Y/N/NA: NA
RECEIVED GOOD COND./COLD: Y/N
RECEIVED VIA: HAND DLVR ✓

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS
TAT: (NORMAL) ☐ 2WKS (RUSH) ☐ 24HR ☐ 48 HRS ☐ 72 HRS ☐ 1 WK
GREATER THAN 24 HR. NOTICE? YES ☐ NO ☐ (LAB USE ONLY)

SPECIAL INSTRUCTIONS:
Call project manager for analysis - Sampled on 2/24/92

RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature: [illegible] Time: 1820	Signature: Time:	Signature: Time:
Printed Name: Lightner Date: 2/24/92	Printed Name: Date:	Printed Name: Date:
Company: HC	Company:	Company:

RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature: Roberta Saturday Time: 1821	Signature: Time:	Signature: Time:
Printed Name: ROBERTA SATURDAY Date: 2/24/92	Printed Name: Date:	Printed Name: Date:
Company: ATI WA	Company:	Analytical Technologies, Inc.

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* As, Cd, Cu, Cr, Hg, Pb, Ni, Zn

Analytical Technologies, Inc. 560 Naches Avenue, S.W., Suite 101, Renton, WA 98055, (206) 228-8335

ATI I.D. # 9202-227

March 19, 1992

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

Attention : Julie Sowa

Project Number : 3447

Project Name : Port of Seattle

On February 28, 1992, Analytical Technologies, Inc., received two water samples for analysis. The samples were analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The results, sample cross reference, and quality control data are enclosed.

Emily C. Carfioli
Senior Project Manager

Mary C. Silva for:
Frederick W. Grothkopp
Laboratory Manager

FWG/hal/ff

Analytical Technologies, Inc.

ATI I.D. # 9202-227

SAMPLE CROSS REFERENCE SHEET

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

ATI #	CLIENT DESCRIPTION	DATE SAMPLED	MATRIX
9202-227-1	HC-7	02/28/92	WATER
9202-227-2	HC-9	02/28/92	WATER

----- TOTALS -----

MATRIX	# SAMPLES
WATER	2

ATI STANDARD DISPOSAL PRACTICE

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

Analytical**Technologies,**Inc.

ATI I.D. # 9202-227

ANALYTICAL SCHEDULE

CLIENT : HART CROWSER, INC.
PROJECT # : 3447
PROJECT NAME : PORT OF SEATTLE

ANALYSIS	TECHNIQUE	REFERENCE	LAB
POLYCHLORINATED BIPHENYLS	GC/ECD	EPA 8080 MODIFIED	R

R = ATI - Renton
SD = ATI - San Diego
PHX = ATI - Phoenix
PNR = ATI - Pensacola
FC = ATI - Fort Collins
SUB = Subcontract

Analytical**Technologies**,Inc.

ATI I.D. # 9202-227

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: N/A
PROJECT #	: 3447	DATE RECEIVED	: N/A
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 03/03/92
CLIENT I.D.	: REAGENT BLANK	DATE ANALYZED	: 03/11/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8080 (LOW LEVEL)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
PCB 1016	<0.020
PCB 1221	<0.050
PCB 1232	<0.050
PCB 1242	<0.020
PCB 1248	<0.020
PCB 1254	<0.020
PCB 1260	<0.020

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	100
DIBUTYLCHORENDATE	105

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-227-1

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/28/92
PROJECT #	: 3447	DATE RECEIVED	: 02/28/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 03/03/92
CLIENT I.D.	: HC-7	DATE ANALYZED	: 03/12/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8080 (LOW LEVEL)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
PCB 1016	<0.020
PCB 1221	<0.050
PCB 1232	<0.050
PCB 1242	<0.020
PCB 1248	<0.020
PCB 1254	<0.020
PCB 1260	<0.020

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	76
DIBUTYLCHORENDATE	73

Analytical Technologies, Inc.

ATI I.D. # 9202-227-2

PCB ANALYSIS
DATA SUMMARY

CLIENT	: HART CROWSER, INC.	DATE SAMPLED	: 02/28/92
PROJECT #	: 3447	DATE RECEIVED	: 02/28/92
PROJECT NAME	: PORT OF SEATTLE	DATE EXTRACTED	: 03/03/92
CLIENT I.D.	: HC-9	DATE ANALYZED	: 03/12/92
SAMPLE MATRIX	: WATER	UNITS	: ug/L
EPA METHOD	: 8080 (LOW LEVEL)	DILUTION FACTOR	: 1

COMPOUNDS	RESULTS
PCB 1016	<0.020
PCB 1221	<0.050
PCB 1232	<0.050
PCB 1242	<0.020
PCB 1248	<0.020
PCB 1254	<0.020
PCB 1260	<0.020

SURROGATE PERCENT RECOVERIES

DECACHLOROBIPHENYL	87
DIBUTYLCHORENDATE	85

AnalyticalTechnologies,Inc.

ATI I.D. # 9202-227

PCB ANALYSIS
QUALITY CONTROL DATA

CLIENT	: HART CROWSER, INC.	SAMPLE I.D. #	: BLANK SPIKE
PROJECT #	: 3447	DATE EXTRACTED	: 03/03/92
PROJECT NAME	: PORT OF SEATTLE	DATE ANALYZED	: 03/11/92
EPA METHOD	: 8080 (LOW LEVEL)	UNITS	: ug/L
SAMPLE MATRIX	: WATER		

COMPOUNDS	SAMPLE RESULT	SPIKE ADDED	SPIKED RESULT	% REC.	DUP. SPIKED SAMPLE	DUP. % REC.	RPD
PCB 1260	<0.020	0.114	0.107	94	0.124	109	15

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

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

AnalyticalTechnologies,Inc.
560 Naches Avenue SW, Suite 101 Renton,WA 98055 (206)228-8335

Chain of Custody

DATE 2/28/92 PAGE 1 OF 1

LABORATORY NUMBER: 9202-227

PROJECT MANAGER: Julie Sowa
COMPANY: HART CROWSER (HC)
ADDRESS: 1910 FAIRVIEW EAST
SEATTLE WA
PHONE: 334-9477 SAMPLED BY: Lightner

SAMPLE DISPOSAL INSTRUCTIONS
☐ ATI Disposal @ $5.00 each ☐ Return

ANALYSIS REQUEST

SAMPLE ID	DATE	TIME	MATRIX	LAB ID	8010 Halogenated Volatiles	8020 Aromatic Volatiles	8020 BETX ONLY	8240 GCMS Volatiles	8270 GCMS BNA	8310 HPLC PNA	8080 Pesticides & PCB's	8080 PCB's ONLY	8140 Phosphate Pesticides	8150 Herbicides	WDOE PAH/HH (WAC 173)	418.1 (TPH)	413.2 Grease & Oil	8015 (Modified)	TOC 9060	TOX 9020	% Moisture	EP TOX Metals (8) EP EXT	Priority Pollutant Metals (13)	TCLP ONLY: 8080 Pesticide (4)	TCLP ONLY: 8240 ZH-EXT	TCLP ONLY: 8270	TCLP ONLY: 8150 Herbicides (2)	TCLP ONLY: Metals (8)			NUMBER OF CONTAINERS
HC-7	2/27/92	1500	Water	1								✓																			3
HC-9	11	1530	11	2								✓																			3

PROJECT INFORMATION	
PROJECT NUMBER:	3447-
PROJECT NAME:	Central Waterfront
PURCHASE ORDER NUMBER:	
ONGOING PROJECT?	YES ☐ NO ☐

SAMPLE RECEIPT	
TOTAL NUMBER OF CONTAINERS	6
COC SEALS/INTACT? Y/N/NA	N/N
RECEIVED GOOD COND./COLD	Y/Y
RECEIVED VIA:	Hand del

PRIOR AUTHORIZATION IS REQUIRED FOR RUSH PROJECTS

TAT: (NORMAL) ☐ 2WKS (RUSH) ☐ 24HR ☐ 48 HRS ☐ 72 HRS ☐ 1 WK

GREATER THAN 24 HR. NOTICE? YES ☐ NO ☐ (LAB USE ONLY)

SPECIAL INSTRUCTIONS:
Contact P.M for Analysis

	RELINQUISHED BY: 1.	RELINQUISHED BY: 2.	RELINQUISHED BY: 3.
Signature / Time:	[signature] 1741		
Printed Name / Date:	Lightner 2/28/92		
Company:	HC		

	RECEIVED BY: 1.	RECEIVED BY: 2.	RECEIVED BY: (LAB) 3.
Signature / Time:	[signature] 1741		
Printed Name / Date:	Roger Fuller 2/28/92		
Company:	ATI WA		Analytical Technologies, Inc.

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APPENDIX E
LAND USE SUMMARY

APPENDIX E
LAND USE SUMMARY

The project area is situated on the central Seattle Waterfront between the Alaskan Way Viaduct (formerly Elliott Avenue), Alaskan Way (formerly Railroad Avenue), Bell Street, and Virginia Street. The upland parcels (includes all project parcels except Pier 66) were on tidelands fronting a steep hill to the east. Although Seattle had been founded in 1852, city growth did not extend to the area until the 1880s, and, with one exception, the waterfront in the vicinity of the project properties did not develop until the 1890s. The exception was facilities built in the 1870s by the Seattle Coal and Transportation Company consisting of a dock, tramway, and railroad terminus at the foot of Pike Street two blocks south of the project area.

The original tideline in the area followed Elliott Avenue (formerly Water Street) which was one block west of Western Avenue and immediately east of the project parcels. By 1888 squatter shacks littered the hillside east of the Lenora Virginia parcel (Pacific Coast Feather Warehouse Parcel). The areas further southeast of the parcel were held the Columbia and Puget Sound Railroad and were undeveloped (Sanborn, 1888).

At the beginning of the 1890s, Seattle was still struggling for rights as a terminus for transcontinental railroad, having lost the Northern Pacific to Tacoma. Two developers of the local shoreline Seattle Lakeshore and Eastern Railway, Thomas Burke and Daniel Gillman, originated the concept for a waterfront mainline route of Elliott Way immediately west of the properties. Burke and Gillman subsequently sold the rights to the Great Northern Railway and in 1893 the railway was constructed west of Elliott Way. This development encouraged construction of cabins on planked pilings along the tidelands margin in Pacific Coast Feather Warehouse Parcel and the property adjacent south. The New York Paint company had a factory in the lot immediately south of Pacific Coast Feather Warehouse Parcel and wharfs were also built to the west of the railroad lines.

Development of the Seattle waterfront expanded between 1900 and 1910 with construction of additional wharfs and commercial facilities. The area west of Pacific Coast Feather Warehouse Parcel was owned by the United Warehouse company where they constructed their Oriental dock. The United Warehouse cold storage and general warehouse (currently still standing) was located at the Pacific Coast Feather Warehouse Parcel property on fill from the 1889 First Avenue regrade. Another company facility in the block north of the parcel (in the Auto Freight Warehouse Parcel) housed cement and salt. The cement probably was used in construction of the great Northern Railway tunnel that shortcut the railroad lines south of the project area by running underneath the growing city. Built between 1902 and 1905, the northern tunnel portal was located just south and east of Pacific Coast Feather Warehouse Parcel. The concrete mixing plant for this effort was located mid-block between Pine and Virginia streets.

The Pike Place Farmer's market, located along Western Avenue to the southeast of the parcels, was completed in 1907 and the Seattle Armory between Virginia and Lenora Streets (currently the site of the Market Place North) was constructed soon after also on Western Avenue. With the advent of the automobile, parking lots and gas stations were constructed adjacent to the Farmer's Market and Amory on the hillside above the project parcels. A major push to redevelop Port of Seattle facilities in the period 1910 to 1920 (Port of Seattle, 1915) lead to the development of still-standing waterfront piers. The entire area was finally filled to the western edge of Alaskan Way using dirt from the last Denny Hill regrade when a seawall was constructed. Little redevelopment has occurred since this time.