Sampling and Analysis Plan (SAP)
Sediment Quality and Selected Upland Areas
Environmental Assessment
Tacoma Boat Property
Tacoma, Washington

Prepared for
Heller, Ehrman, White & McAuliffe

October 16, 1996
J-4564-01

HARTCROWSER

HARTCROWSER
Earth and Environmental Technologies

CONTENTS

TABLES

CONTENTS (Continued)

FIGURES

SAMPLING AND ANALYSIS PLAN (SAP)
SEDIMENT QUALITY AND SELECTED UPLAND AREAS
ENVIRONMENTAL ASSESSMENT
TACOMA BOAT PROPERTY
TACOMA, WASHINGTON

This Sampling and Analysis Plan describes Hart Crowser's scope of work for assessing sediment quality and environmental conditions of selected upland areas at the Tacoma Boat property located in Tacoma, Washington (Figure 1). Based on the project background described below, this SAP is intended to address several objectives:

- Estimate the general extent of sandblasting residues in sediments and adjacent upland areas at the site, and characterize sandblast metals concentrations for the purposes of determining appropriate remedial options;
- Assess concentrations of metals, tributyltin (TBT), and other selected chemical parameters in intertidal and subtidal sediments; and
- Complete a general soil and groundwater assessment in selected upland locations of possible contaminant sources related to historical shipyard activities.

The remainder of this SAP is divided into the following sections:

1.0 PROJECT BACKGROUND;
2.0 SEDIMENT SAMPLING AND ANALYSIS;
3.0 UPLAND SAMPLING AND ANALYSIS;
4.0 SAMPLE LABELING, NOMENCLATURE AND CUSTODY;
5.0 DECONTAMINATION PROCEDURES; and
6.0 DATA EVALUATION AND QA/QC REVIEW.

Sample locations are identified on the Figure 2 Sampling Location Plan, and laboratory analytical methods are listed in Table 1. Sample containers, preservatives, and holding times are summarized in Tables 2 through 5. Except for TBT in sediment samples, the chemical analyses will be conducted by MultiChem Analytical Services (Renton, Washington). TBT analyses will be conducted by Analytical Resources, Incorporated (Seattle).

1.0 PROJECT BACKGROUND

Hart Crowser is currently assisting Heller Ehrman in evaluating environmental issues associated with historical shipyard activities at the Tacoma Boat property. Heller Ehrman represents Ace Tank & Equipment Company, a potential purchaser of the property. Significant environmental concerns for the property include the presence of spent sandblast grit along the shoreline area and historical activities in upland portions of the site. The sandblast residues were derived from historical shipyard activities dating from the late 1960s, and have been noted in numerous Washington State Department of Ecology (Ecology) site inspection reports, and during a 1987 Ecology & Environment field study for the EPA. The sandblast residues represent a potential source of metals and TBT to the waterway and are targeted by Ecology and the EPA for cleanup. In conjunction with these concerns, Ace Tank is interested in further delineating the level of remedial cleanup as it relates to the terms of purchase and to on-going agency discussions.

1.1 Objectives of the Assessment

The scope of work presented in this SAP is intended to provide sufficient information to estimate the areal distribution and volume of sandblast grit residues and to determine appropriate remedial options. Sediments in the subtidal zone, and sediments underlying the sandblast residues in the intertidal zone will be also be analyzed. Site sampling locations and chemical parameters were selected based on results of previous sediment characterization efforts described in the 1989 EPA Record of Decision for the Commencement Bay Nearshore/Tideflats Superfund Site, and Event 1A and Event 1B sampling results supporting pre-remedial design for the Hylebos Waterway. The SAP activities are also consistent with site assessment actions listed in the Enforcement Order (No. DE 96TC-S353) issued to Tacoma Boat by Ecology on October 2, 1996. While Ace Tank & Equipment is not party to the referenced Enforcement Order, the SAP work scope addresses sampling plan requirements listed by Ecology in Item 11 of the Enforcement Order (Shoreline Cleanup) to characterize sandblast and sediment materials for appropriate management.

This SAP also includes activities to complete an assessment of selected areas of upland soil and groundwater to further evaluate possible (but currently unknown) sources of contamination to the waterway. With the exception of sandblast grit and elevated metals in a former drainage ditch between Tacoma Boat and the General Metals property to the west, the 1987 Ecology & Environment field study did not identify potential sources of waterway contaminants. The drainage ditch has since been backfilled and the General Metals site has been capped to prevent further metals migration to groundwater. Some limited groundwater sampling data were obtained from the Tacoma Boat site at three upland locations near the waterway in 1995 by a third party interested in potential purchase/operation of the site. The groundwater samples contained part per billion-level concentrations of dichloroethane and -ethene breakdown products of chlorinated hydrocarbons, and several dissolved metals including lead and arsenic. Additional soil and groundwater sampling described in the current SAP are intended to provide supplementary information regarding potential upland sources.

2.0 SEDIMENT SAMPLING AND ANALYSIS

Hart Crowser will collect representative samples of sandblast grit and underlying sediment in the intertidal and subtidal zones for chemical characterization analyses. Sediment samples will be collected based on PSEP Protocols (Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, Tetra Tech, 1986).

2.1 Intertidal Sediment Sampling

2.1.1 Intertidal Sediment Sampling and Handling

Sandblast grit and near-surface sediment will be collected at four locations (Figure 2) in the intertidal zone along the shoreline, and at five locations in the craneway/launch way area using a post-hole digger and hand-auger. Borings at each of these locations will be completed to a maximum depth of about 3 feet below grade to observe the sandblast grit layer and underlying sediments. Also, five shallow test pits will be completed using a backhoe to maximum depths of about 5 feet below grade to observe the extent and thickness of sandblast residues in the adjacent upland bank area. The test pits will be excavated near the edge of the existing asphalt pavement, or in some cases through the pavement section to provide adequate areal coverage. Hand-auger/post hole digger and test pit explorations will be backfilled with the excavated soil.

Hart Crowser will collect representative samples of the sandblast grit and underlying sediment at each of the intertidal sampling locations. The depth interval for each sample will be determined in the field based on the thickness of the sandblast grit and sediment horizons encountered. Samples of each material type will be composited over the specific sampling interval by mixing the sample with a precleaned stainless steel spoon in a stainless steel bowl. The composited samples will then be spooned into precleaned sample containers provided by the contract laboratory.

Field observations will be maintained on field log notes. These notes will include the following:

- Sampling location and tide elevation;
- Date and time
- Materials thickness and characteristics; and
- Other comments.

Each hand-auger/post hole digger and test pit exploration will be photographed prior to backfilling.

Sample labeling, nomenclature, and custody are discussed in Section 4.0.

2.1.2 Intertidal Chemical Analysis

Three representative samples of the sandblast grit will be selected from the fourteen sampling locations described above. The selected samples will be submitted for laboratory analysis of Total Metals to characterize the grit for the purposes of identifying appropriate remedial options. Total Metals analyses will include As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, and Zn. The samples with the highest Pb, Cd, Cr, Hg, Pb, and Zn concentrations will be also be analyzed for leachable metals using the Toxic Characteristic Leaching Procedure (TCLP) if the concentrations of these Total Metals are high enough to indicate potential for designation as Dangerous Waste. Three representative samples of the sediments underlying the sandblast grit will be submitted for Total Metals and TBT analyses.

2.2 Subtidal Sediment Sampling

2.2.1 Subtidal Sediment Sampling and Handling

Five sediment drill cores will be completed using the Hart Crowser drill rig and a 3-inch-diameter steel sampling tube to collect near-surface sediments (0 to 3 feet depth). Sampling will be accomplished using the Hart Crowser drill rig at the pier's edge and through several existing 3-inch-diameter holes in the pier (Figure 2). Because of the sample volume required for analysis, repeated sampling may be required at each location to collect the necessary volume.

Immediately after retrieval, the acceptability of each sediment core will be assessed and compared to the following criteria:

- Overlying water is present and the surface is intact;
- Calculated compaction is not greater than 25 percent; and
- The core tube appears intact without obstructions or blocking.

Sediment cores not meeting these criteria will be rejected and sample collection repeated. Accepted cores will either be extruded and composited in the field or capped, sealed in plastic, and then packed on ice for transport to the laboratory for sample processing. Sufficient quantity of sample will be collected from each location to perform the required chemical analyses as indicated in Table 3.

From each coring location, Hart Crowser will collect representative sediment samples for compositing. The depth interval for each sample will be determined in the field based on the thickness of sediment or sandblast grit horizons encountered. Samples of each material type will composited over the specific sampling interval by mixing the sample with a precleaned stainless steel spoon in a stainless steel bowl. The composited samples will then be spooned into precleaned sample containers provided by the contract receiving laboratory.

Field observations will be maintained in field log notes. These observations will include the following:

- Sampling location and tide elevation;
- Water depth;
- Date and time;
- Characteristics/observations of sediment sample;
- Core penetration depth and length of recovered sediment; and
- Other comments.

Physical descriptions of each core will be obtained and performed in accordance with ASTM methods (ASTM, 1992). Other observations will include:

- Sediment texture and color (visual classification);
- Winnowing;
- Presence of oily sheen;
- Layering;
- Biological structures;
- Presence of debris; and
- Odor.

Core penetration will be compared to sample depth to assess required sediment compaction correction factors. Sample labeling, nomenclature, and custody procedures are discussed in Section 4.0.

2.2.2 Subtidal Sediment Chemical Analysis

Six representative sediment samples will be selected from the five subtidal sediment cores and submitted for chemical analyses. The selected samples will be analyzed for Total Metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, Zn), TBT, polychlorinated biphenyls (PCBs), total organic carbon, and total solids. Grain size (PSEP method) analyses will also be performed on the six subtidal sediment samples.

3.0 UPLAND SOIL AND GROUNDWATER SAMPLING AND ANALYSIS

The proposed upland soil and groundwater assessment will consist of four Geoprobe explorations to obtain soil and groundwater samples at the locations identified on Figure 2. These areas are located to assess general sources of chemical materials from shipyard activities, and to assess the potential for contaminants in groundwater to migrate to the waterway.

3.1 Geoprobe Boring Explorations

The Geoprobe drilling method will use a truck-mounted drilling rig to drive a 1-inch-diameter, hollow, steel probe rod to collect soil and groundwater samples at specified intervals. We anticipate that groundwater will be encountered within roughly 5 feet below ground surface based on reports from Tacoma Boat site personnel and our understanding of regional hydrogeology in the area. Geoprobe exploration will therefore be 5 to 10 feet in depth to provide adequate subsurface information for soil and groundwater conditions.

3.1.2 Soil Sampling and Handling

Soil samples will be collected continuously from the ground surface to provide adequate sample recovery volume. Soil samples will be retrieved at each depth interval using a plastic sample tube.

The Hart Crowser field representative will visually classify the soil samples recovered from the borings in accordance with the classification system depicted on Figure 3, and prepare a log of soils encountered in the exploration using the logging form presented on Figure 4. The field representative will also record pertinent observations regarding drilling conditions, field screening measurements, types of soils encountered, sample depths, and depth to water. Soil descriptions will include the following properties: estimated density, moisture, color, minor constituents, and major constituents. The presence of non-soil substances (e.g., debris or other foreign material, olfactory and observable sheen) will also be noted.

3.1.3 Field Screening Measurement Procedures and Criteria

A portion of each soil sample will be transferred into clean glass jars for field screening of organic vapors indicative of possible chemical contaminants using a portable photoionization detector (PID HNU Model PI 101). The jars will be covered with aluminum foil capped and allowed to equilibrate for a minimum of 10 minutes. PID measurements will be made by removing the cap and penetrating the aluminum foil with the tip of the PID, taking care not to allow contact between the tip of the PID and soil particles. The maximum organic vapor reading observed during the first 10 seconds will be recorded on the field boring log. Field PID measurements will be used to help select samples to be sent to the laboratory for chemical analysis. The PID will be equipped with an 11.7 eV lamp.

3.1.4 Groundwater Sampling and Handling

One groundwater sample will be collected from each of the four Geoprobe borings. Groundwater samples will be collected by lowering a screen/ sampler assembly to the bottom of the boring, and sampling directly through polyethylene tubing via a peristaltic pump. Samples to be submitted for dissolved metals will be filtered in the field using a 0.45 μm filter.

3.1.5 Chemical Analysis

One soil sample will be selected from each of the four Geoprobe locations for chemical analysis. The soil samples will be selected based on field screening parameters indicative of the presence of potential contaminants as well as visual observations. One groundwater sample from each of the four Geoprobe sampling locations will also be submitted for chemical analysis.

Each of the soil and groundwater samples will be submitted for Total Metals (soils) and Dissolved Metals (water), PCBs, volatile organics, semivolatile organics, and petroleum hydrocarbon screening analyses. The groundwater samples will be filtered in the field for the Dissolved Metals samples. The metals analyses for soil and groundwater will include As, Cd, Cr, Cu, Pb, Hg, Ni, Sb, and Zn.

4.0 SAMPLE LABELING, NOMENCLATURE, AND CUSTODY

Sample Labeling. Sample labels will clearly indicate the sample number, sampler's initials, date, and any pertinent comments. Labels will be filled out at the time of sampling.

Sample Nomenclature. Nomenclature used for designating samples will consist of the sampler ID (HC), the sample type (SS-intertidal hand-auger sediment sample, TP-test pit, SC-subsurface sediment core, GP-geoprobe), location number (HC-TP#), sample type (SB-sandblast grit, SD-sediment, S-soil, GW-groundwater), and sample number (HC-TP1-SB#).

Sample Custody. After recovery, samples will be maintained in Hart Crowser's custody until formally transferred to another party. For purposes of this work, custody will be defined as follows:

- In plain view of the field representatives;
- Inside a cooler which is in plain view of the field representative; or
- Inside any locked space such as a cooler, locker, car, or truck to which the field representative has the only immediately available key(s).

5.0 DECONTAMINATION PROCEDURES

To prevent sample contamination, all sampling equipment (sampler and stainless steel spoons and bowls) will be decontaminated (Alconox scrub, tap water rinse, deionized water rinse) prior to and between collection activities. Guidance provided in the PSEP Protocols for preventing organics and metals sample contamination will be followed.

6.0 DATA EVALUATION AND QA/QC REVIEW

Upon receipt of analytical packages for the sediment, and upland soil and groundwater chemistry analysis, Hart Crowser will check each data package for completeness to ensure sample data requested are present and evaluate the following chemical data quality parameters;

- Adherence to approved methods;
- Holding times;
- Surrogate spike recoveries;
- MS/MSD or MS/Duplicate recoveries;
- Method blanks; and
- Reporting limits.

These parameters represent the basis for sample acceptance criteria to be used for the project.

Hart Crowser will review and interpret the field data to determine the extent of sandblast grit in sediment, and possible sources of upland contaminants. Based on results of the field work and laboratory analyses, we will evaluate site sediment quality, and estimate the volume and spatial distribution of sandblast grit. We will compare the sediment chemistry results to the sediment quality objectives (SQOs) established by the EPA for the Hylebos Waterway, and identify potential remedial alternatives for management of sandblast grit.

7.0 LIMITATIONS

Work for this project will be performed in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Heller, Ehrman, White & McAuliffe for specific application to the referenced property. This document is not meant to represent a legal opinion. No other warranty, express or implied, is made.

456401\tacoma.sap

Table 1 - Methods of Analysis and Reporting Limits for Sediment, Soil, and Groundwater Samples

PARAMETER	Analytical Method	Reporting Limit Sediment and Soil(f)
Conventionals in Percent		
Total Organic in Carbon	EPA Method 9060 (Modified)	0.05
Percent Solids	160.3	
Metals in ppm (mg/kg, mg/L)		
Antimony	EPA Method 6010	2.5
Arsenic	EPA Method 7060	0.25
Cadmium	EPA Method 6010	0.25
Chromium	EPA Method 6010	0.5
Copper	EPA Method 6010	0.5
Lead	EPA Method 6010	1.5
Mercury	EPA Method 7471	0.1
Nickel	EPA Method 6010	0.5
Zinc	EPA Method 6010	0.5
Semivolatile Organics in ppb (ug/kg, ug/L)		
High Molecular Weight PAHs		
Fluoranthene	EPA Method 8270	170
Pyrene	EPA Method 8270	170
Benzo(a)anthracene	EPA Method 8270	170
Chrysene	EPA Method 8270	170
Benzo(b)fluoranthene	EPA Method 8270	170
Benzo(k)fluoranthene	EPA Method 8270	170
Total Benzofluoranthenes	EPA Method 8270	170
Benzo(a)pyrene	EPA Method 8270	170
Ideno(1,2,3-c,d)pyrene	EPA Method 8270	170
Dibenzo(a,h)anthracene	EPA Method 8270	170
Benzo(g,h,i)perylene	EPA Method 8270	170
Low Molecular Weight PAHs		
Total LPAHs	EPA Method 8270	170
Naphthalene	EPA Method 8270	170
Acenaphthylene	EPA Method 8270	170
Acenaphthene	EPA Method 8270	170
Fluorene	EPA Method 8270	170
Phenanthrene	EPA Method 8270	170
Anthracene	EPA Method 8270	170
2-Methylnaphthalene	EPA Method 8270	170
Other Semivolatiles		
Hexachlorobenzene	EPA Method 8270	170
Hexachloroethane	EPA Method 8270	170
Hexachlorocyclopentadiene	EPA Method 8270	170
Nitrobenzene	EPA Method 8270	170
2,4-Nitrotoluene	EPA Method 8270	170
2,6-Dinitrotoluene	EPA Method 8270	170
Isophrone	EPA Method 8270	170

Table 1 - Methods of Analysis and Reporting Limits for Sediment, Soil, and Groundwater Samples

PARAMETER	Analytical Method	Reporting Limit Sediment and Soil(f)
Dibenzofuran	EPA Method 8270	170
N-Nitroso-Dimethylamine	EPA Method 8270	170
N-Nitroso-Diphenylamine	EPA Method 8270	170
N-Nitroso-di-n-propylamine	EPA Method 8270	170
4-Chlorophenyl-phenylether	EPA Method 8270	170
4-Bromophenyl-phenylether	EPA Method 8270	170
2- Chloronapthalene	EPA Method 8270	850
Benzidine	EPA Method 8270	1700
3,3'-Dichlorobenzidine	EPA Method 8270	340
Aniline	EPA Method 8270	170
2-Nitroaniline	EPA Method 8270	850
3-Nitroaniline	EPA Method 8270	850
4-Nitroaniline	EPA Method 8270	850
Benzyl Alcohol	EPA Method 8270	170
Benzoic Acid	EPA Method 8270	850
Dimethyl Phthalate	EPA Method 8270	170
Diethyl Phthalate	EPA Method 8270	170
Di-n-butyl Phthalate	EPA Method 8270	170
Butyl Benzel Phthalate	EPA Method 8270	170
Bis(2-ethylhexyl)Phthalate	EPA Method 8270	170
Di-n-octyl Phthalate	EPA Method 8270	170
Phenol	EPA Method 8270	170
4-Chloro3-methylphenol	EPA Method 8270	170
2,4-Dichlorophenol	EPA Method 8270	170
2-Methylphenol	EPA Method 8270	170
2,4-Dimethylphenol	EPA Method 8270	170
2,4,6-Trichlorophenol	EPA Method 8270	170
2,4,5-Trichlorophenol	EPA Method 8270	850
4-Methylphenol	EPA Method 8270	170
2,4-Dintrophenol	EPA Method 8270	850
2-Nitrophenol	EPA Method 8270	850
4-Nitrophenol	EPA Method 8270	850
4,6-Dinitro-2-methylphenol	EPA Method 8270	850
Pentachlorophenol	EPA Method 8270	170
Volaitle Organics in ppb (ug/kg, ug/L)		
Benzene	EPA Method 8260	10
Bromobenzene	EPA Method 8260	10
Bromochloromethane	EPA Method 8260	10
Bromodichloromethane	EPA Method 8260	10
Bromoform	EPA Method 8260	10
Bromomethane	EPA Method 8260	25
N-Butylbenzene	EPA Method 8260	10
sec-butyl Benzene	EPA Method 8260	25
Carbon Tetrachloride	EPA Method 8260	10

Table 1 - Methods of Analysis and Reporting Limits for Sediment, Soil, and Groundwater Samples

PARAMETER	Analytical Method	Reporting Limit Sediment and Soil(f)
Chlorobenzene	EPA Method 8260	10
Chlorodibromomethane	EPA Method 8260	10
Chloroethane	EPA Method 8260	10
Chloroform	EPA Method 8260	10
Chloromethane	EPA Method 8260	25
2-Chlorotoluene	EPA Method 8260	10
4-Chlorotoluene	EPA Method 8260	10
1,2-Dibromo-3-chloropropane	EPA Method 8260	10
1,2-Dibromoethane	EPA Method 8260	10
Dibromomethane	EPA Method 8260	10
1,2-Dichlorobenzene	EPA Method 8260	10
1,3-Dichlorobenzene	EPA Method 8260	10
1,4-Dichlorobenzene	EPA Method 8260	10
Dichlorodifluoromethane	EPA Method 8260	10
1,1-Dichloroethane	EPA Method 8260	10
1,2-Dichloroethene	EPA Method 8260	10
1,1-Dichloroethene	EPA Method 8260	10
cis-1,2-Dichloroethene	EPA Method 8260	10
trans-1,2-Dichloroethene	EPA Method 8260	10
1,2-Dichloropropane	EPA Method 8260	10
1,3-Dichloropropane	EPA Method 8260	10
1,1-Dichloropropene	EPA Method 8260	10
cis-1,3-Dichloropropene	EPA Method 8260	10
trans-1,3-Dichloropropene	EPA Method 8260	10
Ethylbenzene	EPA Method 8260	10
Hexachlrobutadiene	EPA Method 8260	10
Isopropylbenzene	EPA Method 8260	10
p-Isopropyltoluene	EPA Method 8260	10
Methylene Chloride	EPA Method 8260	50
Napthalene	EPA Method 8260	25
n-Propylbenzene	EPA Method 8260	10
Stryene	EPA Method 8260	10
1,1,1,2-Tetrachloroethane	EPA Method 8260	10
1,1,2,2,- Tetrachloroethane	EPA Method 8260	10
Tetrachloroethene	EPA Method 8260	10
Toluene	EPA Method 8260	10
1,2,3 -Trichlorobenzene	EPA Method 8260	10
1,2,4- Trichlorobenzene	EPA Method 8260	10
1,1,1-Trichloroethane	EPA Method 8260	10
1,1,2-Trichloroethane	EPA Method 8260	10
Trichloroethene	EPA Method 8260	10
Trichlorofluoromethane	EPA Method 8260	10
1,2,3-Trichloropropane	EPA Method 8260	10
1,2,4-Trimethylbenzene	EPA Method 8260	10

Table 1 - Methods of Analysis and Reporting Limits for Sediment, Soil, and Groundwater Samples

PARAMETER	Analytical Method	Reporting Limit Sediment and Soil(f)
1,3,5-Trimethylbenzene	EPA Method 8260	10
Vinyl Chloride	EPA Method 8260	10
Total Xylenes	EPA Method 8260	10
PCBs in ppb (ug/kg, ug/L)		
Aroclor 1016	EPA 8080	33
Aroclor 1221	EPA 8080	33
Aroclor 1232	EPA 8080	33
Aroclor 1242	EPA 8080	33
Aroclor 1248	EPA 8080	33
Aroclor 1254	EPA 8080	33
Aroclor 1260	EPA 8080	33
TPH-HCID in mg/kg	EPA MEthod 8015 modified	20/50/100

Notes:

(a) Based on laboratory method detection limits (MDLs)

tactab1.xls

Table 2 - Sample Container, Preservative, and Holding Times for Sandblast and Intertidal Sediment Samples

Analytes	Container[1]	Recommended Preservative	Standard Holding Time
Total Metals [2]	GT, 16 oz	Cool (4°C)	28/180 days [3]
TBT	GT, 8 oz	Cool (4°C)	14/40[4]
TCLP Metals	GT, 8 oz	Cool (4°C)	28/180 days [3]

(1) GT - borosilicate glass with teflon® (PTFE) caps.
(2) Total metals include: As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, Zn
(3) All metals have 180 day holding time, except mercury, which is 28 days.
(4) Designates extraction holding time/analysis holding time.

Table 3 - Sample Container, Preservative, and Holding Times for Subtidal Sediment Samples

Analytes	Container[1]	Recommended Preservative	Standard Holding Time
Total Solids	GT, 8 oz	Cool (4°C)	14 days
TOC			28 days
Grain Size	P, 16 oz	Cool (4°C)	6 months
Total Metals[2]	GT, 8 oz	Cool (4°C)	28/180 days[3]
TBT	GT, 8 oz	Cool (4°C)	14/40 days[4]
PCBs	GT, 8 oz	Cool (4°C)	7/40 days[4]

(1) GT - borosilicate glass with teflon® (PTFE) caps.
P- Plastic

(2) Total metals include: As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, Zn

(3) All metals have holding time of 180 days, except mercury, which is 28 days.

(4) Designates extraction holding time/analysis holding time.

Table 4 - Sample Container, Analysis Method, and Holding Times for Upland Soil Samples

Analytes	Container[1]	Recommended Preservative	Standard Holding Time
TPH-HCID	GT, 8 oz	Cool (4°C)	14 days
Semivolatiles	GT, 8 oz	Cool (4°C)	7/40 days[4]
Volatiles	GT, 4 oz	Cool (4°C), no headspace	14 days
Total Metals[2]	GT, 8 oz	Cool (4°C)	28/180 days[3]
PCBs	GT, 8 oz	Cool (4°C)	7/40 days[4]

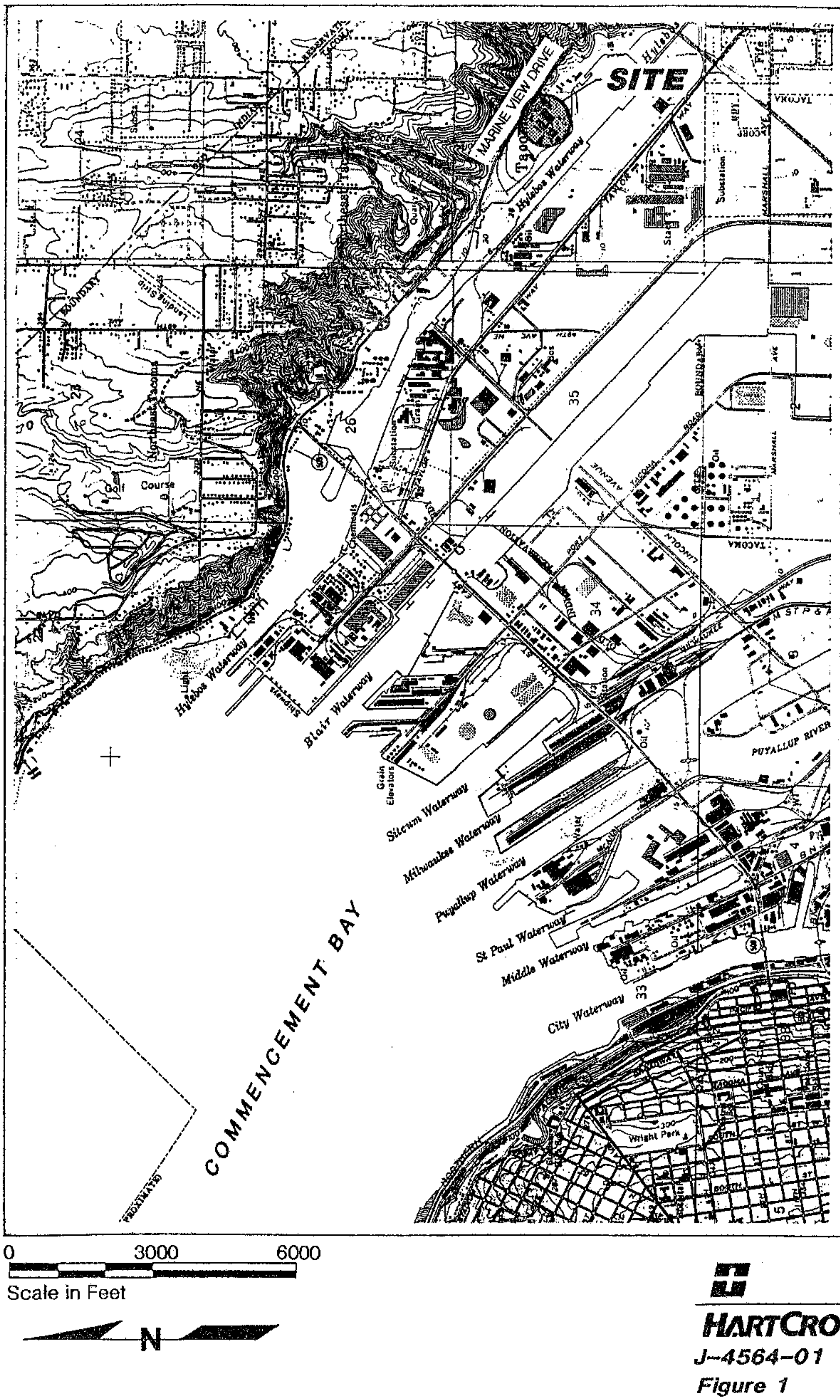
(1) GT - borosilicate glass with teflon® (PTFE) caps.
(2) Total metals include: As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, Zn
(3) All metals have 180 day holding time, except mercury, which is 28 days.
(4) Designates extraction holding time/analysis holding time.

Table 5 - Sample Container, Analysis Method, and Holding Times for Upland Groundwater Samples

Analytes	Container[1]	Recommended Preservative	Standard Holding Time
TPH-HCID	1 40 ml VOA	Cool (4°C)	14 days
Semivolatiles	1 L Amber Glass	Cool (4°C)	7/40 days[4]
Volatiles	2 x 40 ml VOA	Cool (4°C), no headspace	14 days
Dissolved Metals[2]	500 ml P	Cool (4°C), HNO3 pH<2	28/180 days[3]
PCBs	1 L amber Glass	Cool (4°C)	7/40 days[4]

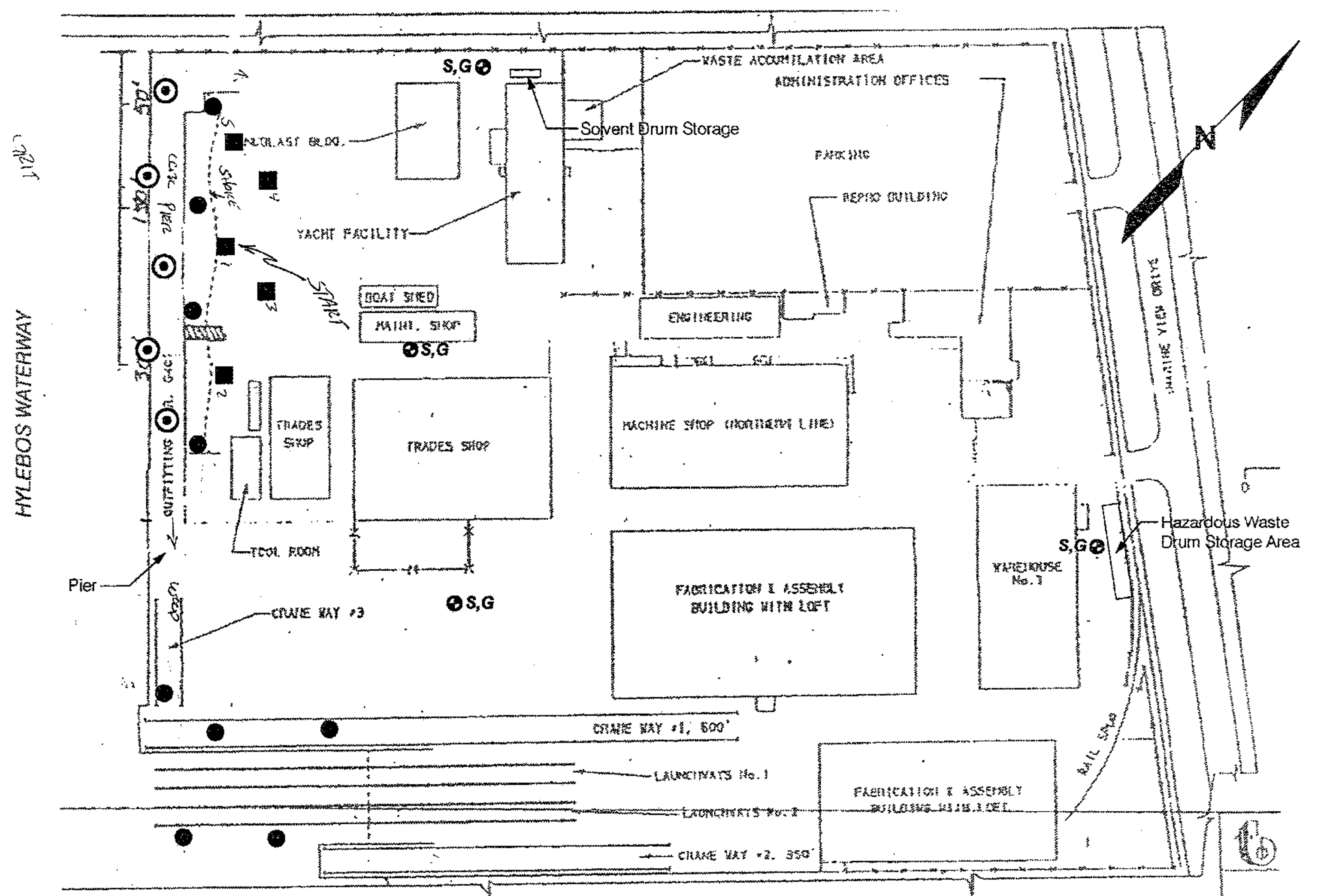
(1) GT - borosilicate glass with teflon® (PTFE) caps.
P -Plastic
(2) Total metals include: As, Cd, Cr, Cu, Hg, Pb, Ni, Sb, Zn
(3) All metals have 180 day holding time, except mercury, which is 28 days.
(4) Designates extraction holding time/analysis holding time.

Vicinity Map



HARTCROWSER
J-4564-01 10/96
Figure 1

Sampling Location Plan - Tacoma Boat Property



Subtidal Sediment Core Location

Intertidal Sediment Hand-Auger Location

Backhoe Test Pit Location (Bank Sandblast Grit)

GeoProbe Sampling Location

S,G S = Soil, G = Groundwater

corel\456401\sampling

HARTCROWSER

J-4564-01 10/96

Figure 2

Key to Exploration Logs

Sample Description

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

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

Density/Consistency

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

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

Moisture

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

Minor Constituents

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

Legends

Sampling Test Symbols

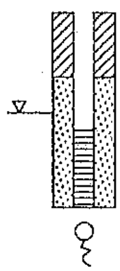
BORING SAMPLES

- Split Spoon
- Shelby Tube
- Cuttings
- Core Run
- * No Sample Recovery
- P Tube Pushed, Not Driven

TEST PIT SAMPLES

- Grab (Jar)
- Bag
- Shelby Tube

Groundwater Observations



Surface Seal

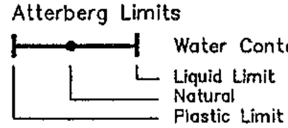
Groundwater Level on Date (ATD) At Time of Drilling

Observation Well Tip or Slotted Section

Groundwater Seepage (Test Pits)

Test Symbols

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



HARTCROWSER

J-4564-01 10/96

Figure 3

Field Boring Log Form

Boring Location Elevation: ______ Datum: ______	HARTCROWSER Boring ______ Date ______ Sheet ___ of ___ Job ______ Job No. ______ Logged By ______ Weather ______ Drilled By ______ Drill Type/Method ______ Sampling Method ______
Obs. Well Install. [Yes] [No]	Bottom of Boring ______ ATD Water Level Depth ______ [No]

Size(%) G Max.	Size(%) S Range	Size(%) F All Units	PID or other	DEPTH From	DEPTH To	SAMPLE Type	SAMPLE Number	Sample Recovery	Penetration Resistance	DESCRIPTION: Den., moist, color, minor, MAJOR CONSTITUENT. NON-SOIL SUBSTANCES: Odor, staining, sheen, scrap, slag, etc.	REMARKS: Drill Action, drill and sample procedures, water conditions, heave,...etc.	SUMMARY LOG (Water and Date)
								0				
								1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				
								0				
								1				
								2				
								3				
								4				
								5				
								6				
								7				
								8				
								9				
								0				

corel\forms\log_fig

HARTCROWSER
J-4564-01 10/96
Figure 4