Final Remedial Investigation/Feasibility Study Work Plan

Former Custom Plywood Mill

Anacortes, Washington

Prepared for:

GBH Investments, LLC
13941 Gibralter Road
Anacortes, Washington 98221

September 2008

Project No. 10654

Geomatrix

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ACRONYMS AND ABBREVIATIONS

2LAET	second lowest apparent effects threshold
Agreed Order	Agreed Order DE 5235
ARARs	applicable or relevant and appropriate regulations
ARI	Analytical Resources, Inc.
ASTs	aboveground storage tanks
bgs	below ground surface
BMPs	best management practices
BNAs	base/neutral/acid compounds
BNSF	Burlington Northern Santa Fe
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLARC	Cleanup Levels and Risk Calculation
cm	centimeters
COPCs	constituents of potential concern
Corps	U.S. Army Corps of Engineers
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
CPOC	conditional point of compliance
CSL	cleanup screening level
CVAA	cold vapor atomic absorption
DGPS	differential global positioning system
DNR	Washington State Department of Natural Resources
DQOs	data-quality objectives
DQIs	data-quality indicators
Ecology	Washington State Department of Ecology
EDDs	electronic data deliverables
EE/CA	Engineering evaluation/cost analysis
Eh	oxidation/reduction potential
EIM	Environmental Information Management
EMAP	Environmental Monitoring and Assessment Program
EPA	U.S. Environmental Protection Agency
EPH	extractable petroleum hydrocarbons
ERT	Environmental Response Team
°F	degrees Fahrenheit
FID	flame ionization detector
ft^2	square foot
ft^3	cubic feet
GBH	GBH Investments, LLC
Geomatrix	Geomatrix Consultants, Inc.
GFAA	graphite furnace atomic absorption
HASP	Health and Safety Plan
HPAH	heavy PAH
ICP	inductively coupled plasma
LAET	lowest apparent effects threshold

ACRONYMS AND ABBREVIATIONS
(Continued)

LCS	laboratory control sample
LOAEL	Lowest-Observed-Adverse Effect Level
LPAH	light PAH
m	meter
m^2	square meter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
ml	milliliter
MLLW	mean lower low water
mph	miles per hour
msl	Mean sea level
MTCA	Model Toxics Control Act
ng/kg	nanograms per kilogram
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No-Observed-Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NWRO	Ecology Northwest Regional Office
OHWM	ordinary high water mark
PA	preliminary assessment
PAHs	polycyclic aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, comparability, and completeness
PA/SI	Preliminary Assessment/Site Inspection
PCBs	polychlorinated biphenyls
PCLs	preliminary cleanup levels
PDA	City of Anacortes Public Development Authority
PID	photoionization detector
PLP	Potentially liable parties
POC	point of compliance
PQL	practical quantitation limit
PSDDA	Puget Sound Dredged Disposal Analysis
PSEP	Puget Sound Estuary Program
PSI	Puget Sound Initiative
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RRM	regional reference material
SAP	Sampling and Analysis Plan
SI	site inspection
SIM	selected ion monitoring
Site	former Custom Plywood Mill, 35th Street and V Place, Anacortes, Washington

ACRONYMS AND ABBREVIATIONS
(Continued)

SMARM	Sediment Management Annual Review Meetings
SMS	Sediment Management Standards
SOPs	Standard Operating Procedures
SPOC	standard point of compliance
SQS	sediment quality standards
START	Superfund Technical Assessment Response Team
SVOCs	semivolatile organic compounds
TDL	target distance limit
TEE	terrestrial ecological evaluation
TEQ	toxicity equivalent quotient
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons, diesel range
TPH-G	total petroleum hydrocarbons, gasoline range
TPH-Oil	total petroleum hydrocarbons, heavy oil range
TVS	total volatile solids
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micrometer
UV	ultraviolet
VCP	Voluntary Cleanup Program
VOCs	volatile organic compounds
VPH	volatile petroleum hydrocarbons
Work Plan	Draft Final Remedial Investigation/Feasibility Study Work Plan, Former Custom Plywood Mill, Anacortes, Washington
WAC	Washington Administrative Code

FINAL REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

Former Custom Plywood Mill
Anacortes, Washington

1.0 INTRODUCTION

On behalf of GBH Investments LLC (GBH) and in accordance with Agreed Order DE 5235 (the Agreed Order), Geomatrix Consultants, Inc. (Geomatrix), has prepared this Final Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Work Plan) for the former Custom Plywood Mill (the site) located on Fidalgo Bay in Anacortes, Washington (Figure 1). The site is listed on the Washington State Department of Ecology (Ecology) Hazardous Sites List as Facility Site ID 2685. This Work Plan presents the approach to complete the remedial investigation and evaluate remedial options regarding contaminated soil and groundwater in the upland and sediments in the submerged lands. GBH was not involved in any of the activities that contributed to the contamination of the site, having bought the site in December 2007, 15 years after industrial activities ceased.

This Work Plan was prepared under the direction of Ecology and the Puget Sound Initiative (PSI) in accordance with Agreed Order. The former Custom Plywood Mill is one site of about a dozen sites within Fidalgo Bay and nearby Padilla Bay that will be investigated and cleaned up with oversight by PSI.

1.1 DEFINITION OF THE SITE

Primarily because of environmental concerns, the former Custom Plywood Mill has remained mostly undeveloped since 1992, when the majority of the buildings were destroyed by fire. The area occupied by the former plywood plant was once greater than the property currently owned by GBH, and several parcels on the periphery of the former plant have been sold and redeveloped. Parcels owned by GBH constitute the largest land and marine portions of the former plywood mill operation and remain impacted by contaminants. The GBH parcels are the primary subject of this RI/FS. However, properties not owned by GBH that were formerly part of the original plywood mill will be discussed within this Work Plan to the extent that environmental information is known about those properties. For purposes of this Work Plan, the “Site” is defined by the extent of contamination caused by the release of hazardous substances at the Site, and includes areas encompassing the footprint of the former plywood mill operation at its maximum extent during operation, offshore areas used for log storage, and locations to which contaminants have migrated.

1.2 OBJECTIVES AND SCOPE OF WORK

The goals of this RI/FS Work Plan are to:

- Summarize information from the site investigation and remediation work conducted to date;
- Identify and evaluate data gaps that remain from previous investigations;
- Identify the data required to complete the RI and define the nature and extent of contamination at the site;
- Provide detailed sampling approaches to address the data gaps, including a Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP) for upland soil and groundwater and for sediments;
- Provide an FS approach to evaluate cleanup levels, applicable or relevant and appropriate regulations (ARARs), areas and media requiring remedial action, cleanup alternatives, and opportunities for habitat restoration;
- Present the general process for public involvement (in accordance with Washington Administrative Code [WAC] 173-340-600); and
- Provide a schedule for the RI/FS activities and remedial actions in accordance with the Washington State Model Toxics Control Act (MTCA).

The MTCA regulations (WAC Chapter 173-340) require potentially liable parties (PLPs) to characterize the nature and extent of hazardous substances as defined in WAC 173-340-200. In addition, the Washington State Sediment Management Standards (SMS; Chapter 173-204 WAC) require PLPs to characterize the nature and extent of any toxic effects or other deleterious substances in sediment. PLPs are required to compile this information into an RI for Ecology review. For portions of this site that exceed applicable MTCA and/or SMS cleanup levels, the PLP, under Ecology oversight, will develop and evaluate cleanup alternatives and identify a preferred alternative in an FS. The Draft RI/FS report will be released to the public and the public's comments will be solicited. Those comments will be addressed and the selected remedy for the site under MTCA will be set forth in a Draft Cleanup Action Plan (CAP). The Draft CAP will be available for public comment as part of a second Agreed Order or Consent Decree prior to implementation of the CAP.

Documents relating to this project that are released to the public will be available for review in the following repositories and will be posted in electronic form on Ecology's website:

Anacortes Public Library	Washington State Department of Ecology
1220 10th Street	300 Desmond Drive SE
Anacortes, Washington 98221	Lacey, Washington 98503

This Work Plan presents:

- a brief site history and background;
- an overview and evaluation of the previous investigations completed at the site;
- a preliminary conceptual site model;
- proposed preliminary screening levels and a list of constituents of potential concern (COPCs);
- a discussion of the nature and extent of contamination;
- an outline of data quality objectives for the RI/FS;
- the approach for conducting a terrestrial ecological evaluation (TEE);
- a summary of remaining data gaps;
- details of sampling and analysis needed to address uncertainties associated with the scope of cleanup; and
- plans for completing the forthcoming RI/FS documents.

The work to be conducted to fill existing data gaps needed to complete the RI/FS is outlined in Appendix A (Draft Final Uplands Sampling and Analysis Plan) and Appendix B (Draft Final Sampling and Analysis Plan for Sediment Characterization). All work will be conducted according to the Site-Specific Health and Safety Plan (HASP) (Appendix C).

1.3 PROJECT COMMUNICATIONS

The site representative for the project and one of the owners of the GBH property is Mr. Richard (Bud) LeMieux of GBH. Mr. LeMieux may be contacted at:

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Geomatrix Consultants will be assisting GBH with the environmental science and engineering aspects of the project. The project manager for Geomatrix is Kathleen Goodman and the project engineer is Larry McGaughey, who may be contacted at:

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Communications from the public regarding the project can be directed to Ecology's project personnel as follows:

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2.0 SITE DESCRIPTION AND HISTORY

This section presents a description of the property, site operational history, site regulatory and compliance history, and a summary of previous investigations and cleanup actions that have been conducted at the site.

2.1 LOCATION

The former Custom Plywood Mill is a former sawmill and plywood manufacturing facility that was largely destroyed by fire in November 1992. The property is located at the intersection of 35th Street and V Place on the western shore of Fidalgo Bay, within the city limits of Anacortes, Washington (Figures 1 and 2). The former Custom Plywood Mill is situated at latitude $48^{o}29'40''$ North, longitude $122^{o}36'04''$ West (approximate location of the former boiler house), in Section 30, Township 34 North, Range 2 East, in Skagit County, Washington. The portion of the former facility owned by GBH comprises an irregularly shaped parcel that covers approximately 6.6 acres of upland and 34 acres of tidal areas. According to the Skagit County Assessor's records, portions of the former Custom Plywood facility that are currently owned by other parties comprise roughly 7 upland acres and 1.3 tideland acres.

The elevation of upland parcels of the site is generally within the range 10 to 30 feet above mean sea level (msl). Each parcel is relatively flat or sloped slightly toward Fidalgo Bay. Breaks in slope between the various parcels occur via low retaining walls or steepened vegetated slopes.

Fidalgo Bay is an ancient delta of the Skagit River that was abandoned by the river and currently has no significant fresh water stream input. Water depths in Fidalgo Bay are shallow, and generally less than 12 feet below mean lower low water (MLLW). Tidal fluctuation within Fidalgo Bay can vary from -3 feet to +12 feet msl.

Historically, tracts have been defined to identify different portions of the uplands and nearshore areas of the site and vicinity (Figure 2). Marine areas owned by GBH within Tracts No. 5 through 10 extend out to the Inner Harbor Line. Intertidal and subtidal lands within Tract No. 4 out to the Inner Harbor Line are owned by the City of Anacortes. Submerged lands between the Inner Harbor and Outer Harbor Lines are owned by the State of Washington and managed by the Department of Natural Resources (DNR). Historically, some of these DNR-managed marine areas were leased by the plywood mill for rafted log storage.

2.2 HISTORICAL AND CURRENT USE

This section presents a brief history of site operation and ownership, and the history and characteristics of surrounding properties. The current layout of the site is shown in Figure 2. Historical site features discussed in this document are shown in Figure 3. Note that the limits of the site will be determined as part of the RI/FS. The main historical site features are visible on an aerial photograph taken in 1966 (Figure 4). Appendix D contains historical Sanborn fire insurance maps for the mill vicinity and an undated "as-built" sketch of the mill.

2.2.1 Site Ownership

The property was originally developed as a saw and planing mill operated by Fidalgo Mill Company from around 1900 until it burned down sometime after 1925 and prior to 1937. Bill Morrison acquired the property in 1913 and owned it until it was purchased around 1937 by Anacortes Plywood Company. The newly incorporated plywood company failed early on, but was able to reorganize as the Anacortes Veneer Company on April 4, 1939 (Plywood Pioneers Association, 1978). Anacortes Veneer Company operated on the property until it was sold to Publisher's Forest Products in 1969. In 1984, Anacortes Plywood assumed control of the plant. Brent Homes assumed title out of bankruptcy proceedings in January 1991. Custom Plywood became the operating entity sometime prior to 1991 and continued to use the facility until 1992. Most of the wooden structures in the main plant area, many of which were built in the 1940s, were consumed in a fire that occurred on November 28, 1992.

In February 1999, Brent Homes granted a quit claim to Anacortes Joint Venture. Anacortes Joint Venture owned the remaining portion of the Site until May 2006, when it was purchased by Concorde, Inc. In December 2007, Concorde sold the main portion of the site to GBH. Following cleanup, GBH intends to use the site for boat storage and sales. Except for the parcels that have been sold and redeveloped, the main portion of the former plant site has been unused since 1992. The Skagit County Assessor's records show the parcels owned by GBH as P33196, P33197, P33198, P33199, P33208, P33209, and P33210.

At its maximum size, the plywood plant included several parcels not currently owned by GBH (Figures 2 and 3) that are located north and west of the main plant area that was recently acquired by GBH. One large piece of the original property was sold in 1984 when the City of Anacortes purchased the northernmost parcel (currently Parcels P33189, P199600, P199601, P199602, and a portion of P33211) located within Tract No. 4. After the 1992 fire, other portions of the mill site that had not sustained fire damage were sold to different owners, including the former hardboard plant (currently in use by Northern Marine), the former office building (currently in use by Cimarron Trucking), and the former machine shop with the attached former resin/caustic aboveground storage tank (AST) shed (also currently in use by Cimarron Trucking).

The City of Anacortes conducted remediation of the Tract No. 4 uplands, north of the main plant area, in September 1998. Remediation and confirmation groundwater monitoring occurred on what is currently depicted as parcels P119602, P33211, and P33189. After conducting the required long-term groundwater monitoring, the City obtained a “no further action” status through Ecology’s Voluntary Cleanup Program. In October 2002, the City broke up the property into the current parcel layout and sold parcels P119602 and P33189. Parcel P33189 was sold to North Harbor Diesel LLC. Howard and Pamela Bean of Anacortes currently own a portion of the Tract No. 4 uplands (Parcel P33189; purchased in May 2005) and operate dry boat storage under the name North Harbor Diesel. Ownership of the riprap bulkhead and marine area of Tract No. 4 out to the Inner Harbor Line was retained by the City of Anacortes (Parcels P119600 and P119601), and the City of Anacortes owns the V Place right-of-way (Parcel 33211). The V Place roadway was constructed in about 2003.

The Skagit County Assessor’s records show parcels P33056, P33194, and P119602 belonging to Joseph and Jennifer Andrews of Santee, California. The former hardboard plant was sold in July 1999 and ownership transferred from Anacortes Hardboard Investments, Inc., to the Andrews. It is currently leased by Northern Marine for the manufacture of luxury yachts. Parcel P119602 was previously a portion of the former City of Anacortes-owned Tract No. 4 and the location of the majority of the remediation activities that were conducted in 1998. Parcel P119602 was sold to the Andrews in 2004, and is currently used as a parking lot for Northern Marine.

A third portion of the former plywood mill encompassing the former mill office, machine shop, and the resin/caustic storage tank buildings was sold in August 1998 and ownership transferred from Brent Homes, Inc., to Ray Sizemore of Cimarron Trucking (Parcel P33055). Cimarron Trucking has extensively refurbished the buildings, including removing the resin/caustic tanks, and added facilities for truck storage.

Along the west boundary of the current GBH property lies the Tommy Thompson Trail, a public multi-use trail. The trail occupies the former right-of-way (Parcel P112899) for the Burlington Northern Santa Fe (BNSF) rail line that historically connected downtown Anacortes with the petroleum refineries to the east and the main track to Burlington. The City of

Anacortes purchased a 4-mile portion of the rail line in August 1997 from the BNSF railroad (formerly Great Northern Railway Co.). To construct the trail, the City's contractor removed the tracks, cross ties, and unsuitable ballast to approximately 15 inches below ground surface, but to a depth of approximately 30 inches in the vicinity of the former machine shop. The trail was excavated at least 16 feet wide. A geofabric was laid, new subbase ballast placed on top, and a minimum 2-inch asphalt pavement was laid above the new ballast to form the trail (City of Anacortes, 2008).

2.2.2 Site Operations

The manufacturing process used at the plant involved drying veneer (purchased in Canada, Oregon, Montana, and eastern Washington) in one of two kiln dryers heated by hog-fuel boiler steam (U.S. Environmental Protection Agency [EPA], 2000). The graded veneers were glued together and then pressed by three large hot plate hydraulic presses (identified as Press Pits #1 to #3 on Figure 3). Glue rollers were coated with wax prior to rolling to minimize the use of cleaning solvents. Toluene was used to clean the glue application nozzles and tips. There is no indication, historical or chemical, that wood preservatives such as pentachlorophenol were used on site; the only wood preservative that exists on the site is creosote that was used on wood piles and timbers to support the facility structures. The manufacturing operations reached their highest capacity in about the late 1960s, when the annual production capacity was about 150 million square feet (Plywood Pioneers Association, 1978). A steep decline in the locally available timber supply led to an increase in raw materials costs, and to the eventual failure of the company.

The main plant area (currently owned by GBH) was the location of the portion of the plywood mill that contained three hot plate hydraulic presses, a hog-fueled boiler house, a compressor house, a glue tank surrounded by a concrete pad, a propane tank, a paint storage area, a pitch collection tank, and piers (Figure 4). According to a historic map cited in the 1995 Phase I site reconnaissance (Enviros, 1995a), two aboveground fuel oil (18,000 gal and12,000 gal) and one 300-gallon diesel tank were located in the compressor area, but facility personnel interviewed at the time did not recall any ASTs since 1969. Prior to the fire in November 1992, much of the plant was built on piles over the intertidal marine area. Currently, the only visible structures remaining in the tideland area are concrete structures, wood pilings, roof remnants, and a large, L-shaped concrete platform that supported the former hardboard plant building (Figure 3). Concrete foundations for the compressor building, boiler house, and hydraulic presses (labeled press pits #1, #2, and #3 in figures) still remain in the uplands portion of the site (Figure 3). Three outfalls were used by the plywood mill, although only the northern outfall (Outfall #003) can still be seen at low tide; the other two outfalls have not been found and may have been buried or destroyed during the collapse of the building during the fire in 1992.

The three press pits formerly contained hydraulic presses that glued and pressed thin wood sheets (or plys). This area contains the concrete remnants of three separate concrete pits that housed 1,000-gallon hydraulic pumps. The press pits were designed to contain the hydraulic equipment and collect hydraulic leaks during operations. The press pits are numbered 1, 2, and 3 from north to south. Press pit #1 is essentially a concrete foundation with no catchment basin remaining. Press pit #2 has an opening at the top and has an approximate capacity of 3,000 cubic feet (ft^3). Press pit #3 has the largest aboveground area, is also open at the top, and has an approximate capacity of 6,000 ft^3.

According to an Ecology inspection report (Ecology, 1992), the glue-making process used phenolic resin and caustic that was shipped in by truck and stored in ASTs that were located in the shed adjoining the former machine shop. Three tanks were used in the glue-making process: one mixing tank, one intermediate process tank, and one finished product tank. The finished product tank was connected to a pump to supply the glue to the mill. Approximately 20,000 gallons of phenolic resins and caustic were used each month in the glue-making process in the main plant building. The caustic and resin ASTs were located on the property now owned by Ray Sizemore of Cimarron Trucking. Mr. Sizemore had the ASTs removed, and remodeled the former machine shop building several years ago. He also extensively remodeled the former office building and currently uses it as the headquarters for Cimarron Trucking. The City of Anacortes removed soil in this area during the preparation of the sub-base for the Tommy Thompson trail. No confirmation soil samples were collected during the trail construction, and so this area will be evaluated in the RI/FS.

A mixed glue tank was located near the southern edge of the uplands area. During mill operations, this tank contained 10,000 gallons of glue wash water, which was separated from the sediments in the tank and recycled back into the process. The resulting tank sediments were transferred by truck to the hog-fuel pile and burned. In 1989, Ecology expressed concern about surface staining around the mixed glue tank.

Tract 4 (historic Parcel P33189) was an area of tidal flats (see Figure 4) and was used for floating log storage by the plywood mill until the early 1970s, when a new bulkhead was installed and the parcel was filled with dredged sediments from the nearby shipping channel maintained by the U.S. Army Corps of Engineers (Corps). From 1984 to 2002 the parcel was owned by the City of Anacortes. In September 1998 the City of Anacortes successfully removed and disposed of 1,939 tons of soil contaminated with petroleum hydrocarbons from the site under Ecology's Voluntary Cleanup Program (VCP) (see Section 2.5.1). Subsequent to the cleanup, the City of Anacortes built the V Place roadway and split the parcel into multiple parcels. Joe and Jennifer Andrews own the newly created parcel P119602, where the majority of the remedial excavation occurred. North Harbor Diesel is currently operating the other upland portion of historic parcel P33189 (currently P33189) for small yacht and equipment storage.

According to the Skagit County tax records, the original hardboard plant was built in 1951. It was built to manufacture a trademarked product called "Armorbord" (Plywood Pioneers Association, 1978). A 15,500-square foot (ft^2) addition to the former hardboard plant was constructed on the south side of the former hardboard building in about 2001. This addition was placed in the area of the former location of a large group of transformers that had been used by the plywood plant. The transformers were removed from this location in early 1997 without using appropriate decommissioning procedures. In May 1997, the EPA oversaw an investigation to determine whether transformer oil containing polychlorinated biphenyls (PCBs) had been released during the removal of the transformers. Details of this investigation are provided in Section 2.4.8.

Following the cleanup and sale of the uplands portion of Tract No. 4 in 2002, the City of Anacortes constructed the V Place roadway that now forms the northwestern boundary of the GBH portion of the site. In 2004 the City constructed the Tommy Thompson trail over the former rail right-of-way.

2.3 SITE REGULATORY AND COMPLIANCE HISTORY

Since 1993, the previous owners of the properties have funded various site investigations to define the extent of contamination. Each successive investigation targeted the data gaps identified in the previous investigation. In addition to investigations funded by the former owners, the EPA conducted a combined Preliminary Assessment/Site Inspection (PA/SI) to characterize potential sources of contamination, determine off-site migration of contaminants, and to document any threat or potential threat to public health or the environment posed by the site. Based on available Ecology records, this section provides a summary of investigations conducted at the site since 1993 to evaluate the conditions of the soil, groundwater, and offshore sediments. Sampling locations for upland and sediment samples from several of these investigations are shown in Figure 5 and Figure 6, respectively. Concentrations of potential soil and groundwater contaminant compounds are cited but not compared to historic or current cleanup levels in this section. Later sections of this document will discuss the historic data in the context of current potential cleanup levels.

2.3.1 Washington State Department of Ecology Memos and Inspection Reports

Regulatory/compliance information from Ecology files associated with the site is summarized below.

- **National Pollutant Discharge Elimination System (NPDES) 1974 Application** – The NPDES permit was for weekly discharge of 32,000 gallons of plywood dryer discharge water through Outfall 001. Constituents in the discharge water included phosphorus, sodium, oil, grease, and phenols. The discharge went into Fidalgo Bay at a location just south of the L-shaped concrete platform (Figure 2).

- **January 25, 1979, Ecology Memorandum** – A memorandum dated January 25, 1979, described an incident involving discharge of boiler blowdown water to a drainfield.

- **March 14, 1988, Letter From Anacortes Plywood, Inc.** – Anacortes Plywood reported a cracked hydraulic line that resulted in a release behind Press Pit #2 in March 1988.

- **April 5, 1989, Ecology Memorandum** – An Ecology memorandum dated April 1989 reported the dumping of approximately 60 gallons of light lubricating oil in the hog fuel storage area on the north end of the yard. Also, several 5-gallon containers of glue were observed to have overflowed in the offloading area at the south end of the mill.

- **October 10, 1989, Ecology Inspection Report** – Results from the October 10, 1989, inspection are summarized below.

    - An Ecology inspection found problems with the glue wastewater and dried resin solids from the raw material holding tank. There was a stain on the ground coming from the containment around the glue machine wash water holding tank.

    - Ecology noticed that solids that are cleaned out of the raw phenolic resin glue tank were removed from the tank and some were left outside the building. Rain dissolved some of the chunks resulting in purple puddles.

    - There were multiple discharge points for the non-contact cooling water. Some were from the boiler area that discharged across the ground and into the bay, while other points in the plant discharged wherever the machinery was located, usually to the intertidal area.

- **November 27, 1989, Ecology Notice of Violation** – Custom Plywood, Inc., discharged phenolic formaldehyde resin glue wastewater into the waters of Fidalgo Bay.

- **September 26, 1990, Ecology Inspection Report** – The Ecology inspector found that the means for discharging non-contact cooling water from the hog-fueled boiler was unsatisfactory. This flow combines with a sheet-flow of boiler blowdown water. Several of the press pits were observed to be discharging cooling water directly to the Fidalgo Bay tidal flats (Ecology, 1990). The distance from the press pits to the tidal flats is approximately 75 to 100 feet (EPA, 2000). Ecology noted that outside of the discharges of non-contact cooling waters and boiler blowdown, there was little to no generation of process wastewater and no apparent discharge into the Anacortes sanitary system of process wastewaters. Ecology also noted that the facility had apparently achieved a “zero” discharge of process wastewater, and that best management practices (BMPs) would need to be put in place in the company's NPDES permit to maintain a “zero” discharge (Ecology, 1990).

- **March 24, 1992, Ecology Inspection Report** – During the March 24, 1992, site visit, Ecology noted inconsistencies in the discharge rate reported on the facility’s NPDES application. Ecology also observed caustic spillage on the boiler room floor and noted that the spillage was being washed away by boiler blowdown water and subsequently discharged to Fidalgo Bay. Ecology recommended that the facility improve its BMPs to prevent caustic spills from contacting blowdown water and encouraged the facility to recycle the noncontact cooling water (Ecology, 1992).

- **July 10, 1992, Ecology Inspection Report** – Ecology performed an unannounced inspection of the facility on July 10, 1992, to verify that the facility had closed for business. Ecology informed the assistant manager that the facility had not completed its NPDES permit and that a notice of violation would be issued.

- **November 30, 1992, Ecology Environmental Response Team (ERT) Report** – A caller stated that there was a fire at the Custom Plywood Mill Site and noticed oil pools under the main building where machinery had leaked through over the years. The caller described it as deep pools of heavy oil.

- **December 2, 1992, Ecology Inspection** – Ecology visited the site to inspect barrels for substances of concern. Ecology reported that all barrels were blown out by the heat of the fire and either had only ash residue or glass-like substances remaining.

- **June 10, 1993, Ecology Environmental Response Team (ERT) Report** – Ecology received a call indicating that contractors working at the Custom Plywood Mill Site were dumping chemicals onto the ground, including the oil out of old electrical transformers.

- **December 9, 1994, Site Visit** – Ecology noted that soil in the vicinity of the former presses was noted to be very oily in places. It was also noted that a yellow hopper-

> like structure (identified as the Pitch Collection Tank on Figures 3 and 4) was situated on a concrete pad near the area on the south end of the site label "wash water." Material similar to hardened resin was noted on the concrete pad at this location. This resin-like substance was similar to the material at the base of the former glue tanks stored in the southeastern-most building.

Ecology added the site to the Confirmed and Suspected Contaminated Site List on March 5, 1993. The site was listed as having confirmed contamination of soil with petroleum products; suspected soil contamination by PCBs, and suspected contamination of soil, groundwater, surface water, and sediment by metals, phenolic compounds, and polycyclic aromatic hydrocarbons (PAHs).

2.3.2 Skagit County Health Department Site Hazard Assessment

The Skagit County Health Department completed a Site Hazard Assessment for the site in 2001 resulting in a hazard ranking of 1, which represents the highest level of risk. Contaminants identified in the Site Hazard Assessment as exceeding MTCA cleanup levels included various metals, methylene chloride, dioxin, and PAHs in soil, and metals in groundwater. Contaminants identified as a concern in sediment included PAHs, metals, and dioxin.

2.4 PREVIOUS ENVIRONMENTAL CHARACTERIZATION/SAMPLING INVESTIGATIONS

Multiple previous investigations have been conducted at the Former Custom Plywood Mill. This section presents a brief summary of previous site characterization and sampling investigations that have been conducted at the site.

2.4.1 Pinner and Associates 1993 Preliminary Environmental Evaluation

Pinner and Associates performed a preliminary environmental evaluation of the site for Brent Homes in November 1993. Two surface water samples (one sample from the press pit #2 and one from a depression north of press pit #2), and one soil sample (northeast of press pit #3) were collected and analyzed. The soil sample was tested for heavy metals (cadmium, chromium, copper, lead, mercury, and zinc), total petroleum hydrocarbons (TPH) in the heavy oil range (TPH-Oil) (TPH-418.1), phenolic compounds, and PAHs. TPH-Oil was found in the soil sample at a concentration of 4,200 milligrams per kilogram (mg/kg); the other results were unremarkable. The two water samples were analyzed for TPH-Oil (TPH-418.1) resulting in concentrations of 80 micrograms per liter (µg/L) and 380 µg/L. The report did not provide precise sample locations (Pinner and Associates, 1993).

2.4.2 Enviros 1995 Phase I and Limited Phase II Environmental Site Assessment

The owners of the site in 1995, Brent Homes, initiated environmental studies at the site in 1995 by conducting a phase I and limited phase II environmental site assessment. The study included collection and analysis of hand-auger and grab soil samples from areas with the highest likelihood of contamination (Enviros, 1995a). Sampling locations are shown on Figure 5. TPH-Oil concentrations in near-surface soils (depths ranging from 1.5 to 3 feet below ground surface [bgs]) varied from not detectable to 164,000 mg/kg, with the highest concentrations observed around the press pits and the compressor house. TPH-Oil was also found at a concentration of 11,500 mg/kg in a sampled collected at HA3 near the hog fuel area and at a concentration of 4,900 mg/kg in a sample from HA7 located near the reported location of the former 300-gallon diesel tank in the central part of the site (Figure 5). Sample HA-11-1.5, that contained a TPH-Oil concentration of 112,000 mg/kg was analyzed for PAHs. Benzo(a)anthracene was the only cPAH detected (at 0.95 mg/kg). Diesel-range hydrocarbons (TPH-D) were generally associated with the higher TPH-Oil concentrations. However the lab sheets reported that the chromatograms did not appear to represent diesel but rather the lighter range of the heavy oil range. Gasoline-range hydrocarbons (TPH-G) were analyzed but not detected above reporting limits of 25 mg/kg.

Soil samples HA17-0.5 and HA18-2 were collected in areas where the phenolic resins were stored or used. These samples were analyzed for phenols and formaldehyde, but these compounds were not present above the detection limit. Sample HA4-1.5 was collected in soil directly adjacent to the concrete pavement on which the large bank of transformers were located. This sample was analyzed for PCBs, which were not detected at the reporting limit of 50 micrograms per kilogram (µg/kg). Arsenic, cadmium, chromium, and lead were analyzed in three samples (HA5-1.5, G15-S, and HA17-0.5). The only sample returning metals at significant concentrations was sample G15-S, which was collected from a small pile (less than 1 cubic foot) of blue-green sand located just south of press pit #3, with cadmium at 9.5 mg/kg, chromium at 450 mg/kg, and lead at 1,600 mg/kg.

2.4.3 Enviros 1995 Sediment Sampling Report

In September 1995, a preliminary characterization study of sediment chemistry was conducted offshore of the former Custom Plywood Mill (Enviros 1995b). A total of 12 samples (S1–S12) were collected and analyzed (Figure 6). Seven of the samples were analyzed for base/neutral/acid compounds (BNAs) and PAHs, 9 samples were analyzed for PCBs, and 12 samples were analyzed for metals. Analytes were selected based on known or suspected areas of impact in the upland and offshore. The only exceedances of the SMS Sediment Quality

Standards (SQS) or the dry-weight lowest apparent effects threshold (LAET) were for total PCBs in samples S-5 and S-7 (Figure 6). Total PCBs were above the SMS Cleanup Screening Level (CSL) or the second lowest apparent effects threshold (2LAET) at sample S-1 (Figure 6).

2.4.4 URS Greiner 1997 City of Anacortes and Anacortes-Brent Homes Joint Venture Marine Habitat and Resources Survey

In November 1996, a marine habitat and resources survey was conducted offshore of both the City of Anacortes and Custom Plywood properties (URS Greiner, 1997). The objective of this survey was to map the distribution of vegetation and surficial sediment types, and the bathymetric contours, in the area from the shoreline to the outer harbor line. Video data were compiled on the distribution of eelgrass and macroalgae, sediment grain size, wood content, and fauna present. Wood debris was present in the surficial sediment from the shoreline to approximately 300 feet from shore in the area adjacent to the main plant.

2.4.5 Phase I and Limited Phase II Environmental Site Assessment, City of Anacortes, 3205 V Place (lot 3) Woodward-Clyde, March 5, 1997

Woodward-Clyde was retained by the City of Anacortes to conduct a phase I and limited phase II environmental site assessment on the upland portion of the V Place property owned by the City (current parcels P119602, P33211, P33189, and P119600, Figures 2 and 3), in anticipation of sale and subsequent redevelopment of the upland (Woodward-Clyde 1997a). The phase I investigation identified potential conditions that indicated a phase II investigation was warranted. Thirteen test pits (AN1 through AN13, Figure 5) were dug and sampled during the limited phase II site assessment (Woodward-Clyde, 1997a). On January 22, 1997, 16 soil samples were collected and delivered to the lab for analysis of TPH-D and TPH-Oil. Four samples, two collected near the hardboard plant building (AN1-1 and AN6-2) and two from locations midway between the building and the shoreline (AN8-4 and AN13-1), were analyzed for arsenic, barium, cadmium, chromium, lead, selenium, mercury, and silver. Four samples (AN1-1, AN3-1, AN6-2, and AN8-4) were analyzed for PAHs by EPA Method 8310-selected ion monitoring (SIM).

TPH-D and TPH-Oil at concentrations in excess of 10,000 mg/kg were discovered in test pits AN1, AN2, AN4, AN6, and AN7 in the area near the hardboard plant on the west side of the property. The samples in this western group that were also analyzed for metals and PAHs yielded no detectable arsenic, cadmium, lead, selenium, or silver; PAHs were also not detected, but the PAH reporting limits were elevated due to TPH interference. Detectable concentrations of barium (highest concentration 235 mg/kg in AN1-1), chromium (highest concentration

57.6 mg/kg in AN1-1), and mercury (highest concentration 0.114 mg/kg in AN1-1) were found in the samples analyzed. The report recommended remediation of this TPH-impacted soil. The areas including and surrounding test pits AN1, AN2, AN3, AN4, AN-6, and AN7 were excavated in 1998 and disposed at a controlled landfill (see Section 2.5.1). Test pit samples from AN5 yielded concentrations as high as 1,260 mg/kg TPH-D and 600 mg/kg TPH-Oil, and the 1998 remediation activities did not include the immediate area of this test pit.

Of the remaining test pits (AN8 through AN13) that were away from the TPH-impacted building area and closer to the shoreline, the highest detected analyte concentrations were TPH-D at 64 mg/kg (AN10-4), TPH-Oil at 183 mg/kg (AN12-5), barium at 81.4 mg/kg (AN8-4), chromium at 23.7 mg/kg (AN8-4), lead at 27.4 mg/kg (AN8-4), and mercury at 0.0624 mg/kg (AN8-4). Sample AN8-4 contained no detectable PAHs, with the exception of pyrene at 0.0562 mg/kg. The central and eastern portions of the site did not require excavation during the 1998 remediation.

2.4.6 Ecology 1997 Survey for Petroleum and Other Chemical Contaminants in the Sediments of Fidalgo Bay

In April 1997, Ecology conducted a sediment survey to investigate the extent of oil and chemical contamination in Fidalgo Bay (Ecology, 1997b). Three of the sampling locations were located offshore from the project site (Outer_26, Outer_17, and Inner_8). The sediments were analyzed for conventionals (i.e., total organic carbon), metals, semivolatile organic compounds (SVOCs), and PCBs. There were no exceedances of the SMS SQS or CSL criteria.

2.4.7 Woodward-Clyde April 1997 Soil Sampling, 3205 V Place Property

On April 11, 1997, Woodward-Clyde (1997b) collected three soil samples from the area that was described in Section 2.4.5 as having the highest concentrations of TPH. Previous test pits AN1, AN2, and AN4 had been staked in the field during the initial sampling. Additional samples from these soils were collected for analysis of PCBs and volatile organic compounds (VOCs) (by EPA Method 8260) to further evaluate remediation or treatment options. Samples were labeled ANX1-1, ANX2-2, and ANX4-2, noting each of the corresponding previous test pits. Samples were collected immediately adjacent to the corresponding test pit from undisturbed soil. Results indicated all PCBs and VOCs were undetected, with the exception of methylene chloride, a common laboratory solvent.

2.4.8 Woodward-Clyde June 1997 Custom Plywood Soil Sampling

Soil sampling was performed in May 1997 (Woodward-Clyde, 1997c) to investigate the presence of PCBs in the upland soils on the property then owned by Brent Homes (Parcel No. 33194). This investigation was conducted at the direction of the EPA after transformers located on the south side of the hardboard plant had been improperly removed from the site. Sampling locations were selected at the direction of Mike Burnett of EPA's Criminal Investigation Division. Samples in the vicinity of the south end of the hardboard plant were collected in the unpaved area just beyond (and downslope of) the concrete pavement on which the transformers had been located. Soil samples were collected from four borings advanced using push-probe (Geoprobe) techniques to a depth of 10 feet; soil samples were collected using a hand-auger/shovel from 15 additional locations (Figure 5). A total of 22 soil samples were analyzed for PCBs (by individual Arochlors) using EPA Method 8080.

PCBs in the form of Arochlors 1016, 1221, 1242, 1246, and 1260 were not detected in any of the 22 soil samples. Arochlor 1254 was detected in six of the 22 samples at concentrations ranging from 0.082 mg/kg (CP-HA20-1) to 13.0 mg/kg (CP-HA31-0.5). The four highest PCB detections were identified in samples collected near the foundations of the boiler house and compressor building, which were former locations of transformers at the time of plant operation. These PCB-impacted soils in the boiler house and compressor building areas were later excavated and disposed during the interim remedial action in 2007 (Section 2.5.2). Two soil samples collected near the southwest end of the hardboard plant contained detectable levels of PCBs at concentrations ranging from 0.082 mg/kg (CP-HA20-1) to 0.14 mg/kg (CP-HA21-1).

In addition to PCBs, this investigation characterized the contents of three of four ASTs located in the former resin/caustic tank shed; one tank could not be opened. This shed is now located on the property owned by Ray Sizemore of Cimarron Trucking. Contents of the two resin storage tanks (CP-Tank2 and CP-Tank3) were analyzed for phenols, formaldehyde, flash point, and pH. Laboratory results from these samples indicated the presence of formaldehyde in both of the resin tanks and a low concentration of phenols in one of the tanks; pH was 11.2 and 9.8, respectively. Residue from AST CP-Tank4, which was a sodium hydroxide tank, was analyzed for metals (cadmium, chromium, and sodium) and pH. Cadmium was not detected and chromium was at a very low level (0.19 mg/kg); whereas sodium was at a concentration of 210,000 mg/kg. The pH was 11.7. Mr. Sizemore subsequently removed the tanks from the building and remodeled the shed and adjoining former maintenance shop. The final disposal location of the ASTs has not been confirmed.

A third task of this study was to confirm for the EPA that nine drums of liquid waste, temporarily stored in the drum storage area, were characterized and removed. Brent Homes, the site owners at the time, contracted with Philip Environmental to profile and remove the drums of oil, grease, water, and latex paint. All the drums were removed from the site on May 28, 1997, by Burlington Environmental (former affiliate of Philip Environmental).

2.4.9 EPA 1997 EMAP Program

In June 1997, two sampling locations in Fidalgo Bay (Stations WA000007 and WA000008; Figure 6) were surveyed during the EPA's Environmental Monitoring and Assessment Program (EMAP) that were in the general vicinity of the site (EPA, 1997). Sediment samples were analyzed for conventionals (i.e., total organic carbon [TOC]), metals, SVOCs, and PCBs. There were exceedances of the SMS CSL criteria for 4-methylphenol and SMS SQS for phenol. There were also exceedances for several chlorinated benzenes, benzoic acid, and hexachlorobutadiene due to elevated reporting limits.

2.4.10 Woodward-Clyde, September 1997 Limited Phase II Site Assessment

On August 6, 1997, Woodward-Clyde collected soil samples from test pits excavated on both sides of the line separating Tracts No. 4 and 5, which forms the approximate northern property boundary of the parcels currently owned by GBH (Woodward-Clyde, 1997d). The purpose of this investigation was to determine the extent of heavy petroleum hydrocarbon contamination in the area immediately east of the hardboard plant that had been covered by ponded water (due to a buried asphalt slab) during the sampling conducted in January 1997 (Section 2.4.5; Woodward-Clyde 1997a). This heavy oil contamination was thought to be related to a waste oil AST that was rumored to have once been located in this area and to the discharge of oil from piping emanating from the hardboard plant.

A total of 11 test pits were dug: eight on the City of Anacortes' property (ANA-TP1 through ANA-TP6 and ANA-TP10 and ANA-TP11) and three (ANA-TP7, ANA-TP8 and ANA-TP9) on the Brent Homes property. Analytical results for samples collected from three test pits (ANA-TP1 through ANA-TP3) on the north side of the Tract No. 4 line indicated a potential need for remediation of the soils impacted by TPH-Oil and TPH-D, with concentrations between 700 mg/kg and 6,800 mg/kg (ANA-TP1-03A). PCBs were analyzed by Arochlors using EPA Method 8081 in two samples (ANA-TP1-03B and ANA-TP2-04B) and were not detected at practical quantitation limits (PQLs) of 0.093 mg/kg and 0.059 mg/kg, in the respective samples. Samples from test pits ANA-TP4 though ANA-TP11 all returned TPH concentrations below 200 mg/kg, including the test pits on the former Brent Homes property (current GBH property) on the south side of the Tract No. 4 boundary. Test pit ANA-TP7 was located just south of the property boundary between the former City of Anacortes property and the Brent Homes property, and near the hardboard plant. This test pit hit a large concrete slab, and no sample could be collected.

2.4.11 Woodward-Clyde February 1998 Site Investigation and Remedial Options Evaluation

An additional upland investigation was conducted in October 1997 to delineate the extent of petroleum-impacted soil and groundwater in the press pit area, identify the potentially impacted soil in the vicinity of the resin/caustic storage shed and the former mixed glue tank, and assess the quality of surface water contained in the press pits for disposal purposes (Woodward-Clyde, 1998b). A preliminary evaluation of remedial options was also developed for the site.

Seven push-probe (Geoprobe) borings were drilled (CP-GP4 through CP-GP10), five hand-auger soil samples were collected in the vicinity of the press pits (CP-HA36 through CP-HA40), two shallow soil samples were collected adjacent to the resin/caustic AST shed (HARC-1.5A and HARC-1.5B), and one shallow soil sample was collected next to the concrete pad for the mixed glue tank (HAGT-1.5). Grab groundwater samples collected from three push-probe borings (CP-GP5, CP-GP7, and CP-GP8) were analyzed for pH; TPH-G; TPH-D; TPH-Oil; benzene, toluene, ethylbenzene, and xylenes (BTEX); and SVOCs. In addition, water from the open press pits #2 and #3 was analyzed for TPH-D, TPH-Oil, and PCBs.

Ten shallow (1-2 feet bgs) soil samples were analyzed to better define the extent of the hydraulic oil impacts in the vicinity of the press pits. Concentration of TPH-D and TPH-Oil ranged from not detected to 12,000 mg/kg for diesel (C12-C24) and not detected to 91,000 mg/kg for oil (C24-C34). The 10 soil samples were also analyzed for TPH-G and BTEX, with non-detectable concentrations of all analytes, except one sample (CP-HA37-1.5) contained benzene at a concentration of 0.43 mg/kg, one sample (CP-HA40-1.5) contained m,p-xylene at a concentration of 0.62 mg/kg, and one sample (CP-GP9-2.5) contained TPH-G at a concentration of 17 mg/kg. The two soil samples with the highest TPH-D and TPH-Oil concentrations were additionally analyzed for volatile petroleum hydrocarbons (VPH), extractable petroleum hydrocarbons (EPH), PCBs, VOCs, and SVOCs. All PCBs, VPHs, and VOCs (except methylene chloride, a common laboratory solvent) were below the respective reporting limit. Analyses for SVOCs produced detections of pyrene and several additional SVOC compounds. Carcinogenic PAHs (cPAHs) were not detected, although the PQLs were elevated in CP-GP6-2 due to interference.

The three soil samples in the vicinity of the resin/caustic AST shed and the glue tank were analyzed for formaldehyde, phenols, pH, TPH-D, and TPH-Oil. Phenols and formaldehyde were not detected in these samples; pH ranged from 8.47 to 11; TPH-D ranged from 45 mg/kg (CP-HAGT-1.5) to 1,500 mg/kg (CP-HARC-1.5A); TPH-Oil ranged from 130 mg/kg (CP-HAGT-1.5) to 6,800 mg/kg (CP-HARC-1.5A).

Three grab groundwater samples were analyzed for pH; TPH-G, TPH-D, and TPH-Oil; BTEX; and SVOCs. The groundwater sample from CP-GP5-HP returned all compounds at non-detectable concentrations. Sample CP-GP7-HP returned all non-detectable results except for TPH-D at 610 μg/L. Groundwater sample CP-GP8-HP had no detectable BTEX, but detectable concentrations of TPH-G (2.5 milligrams per liter [mg/L]), TPH-D (9.0 mg/L), TPH-Oil (1.5 mg/L), and six SVOCs. Free product was noted in this groundwater sample.

A preliminary evaluation of remedial options was developed for the site based on the areal extent of the petroleum impacts in the vicinity of the press pits, boiler house, and resin/caustic AST shed, as well as the extent of PCBs in shallow soils in the vicinity of the compressor and boiler houses (based on earlier studies). Given the generally high molecular weight of the petroleum, and the shallow extent of the contamination, excavation and off-site disposal was the preferred option.

2.4.12 EPA Region 10 START Preliminary Assessment/Site Inspection, December 2000

In July 2000, EPA conducted a combined PA/SI of the former Custom Plywood Mill (EPA ID No.WASFN1002212) under EPA's Superfund Technical Assessment and Response Team (START) Contract (EPA, 2000). The purpose of the PA/SI was to document the nature and extent of contamination that may be present. As part of this investigation 61 soil samples and 10 sediment samples were collected and analyzed. EPA uplands sampling locations are shown on Figure 5, and sediment sampling locations are shown on Figure 6. Results of the investigation confirmed the findings of previous studies that identified:

- localized upland areas of near-surface soils containing metals and PCBs, and
- larger areas affected by releases of petroleum hydrocarbons, as indicated by the presence of SVOCs, particularly PAHs.

EPA did not analyze for TPH because of EPA's petroleum exclusion policy under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition to the upland sampling, 10 sediment samples (FB01-FB10 on Figure 6) were collected and analyzed for a range of priority pollutants.

While some soil analytes were found at detectable concentrations, no VOCs or pesticides were detected at significant concentrations in any of the samples. Two samples contained PCBs at concentrations up to 2.6 mg/kg total PCB. SVOCs were detected at concentrations ranging from 480 µg/kg (fluoranthene) to 5,100 µg/kg (pyrene). A total of 11 inorganic elements were detected. Dioxins were also detected, but no tetrachlorinated or pentachlorinated homologues were detected. The detected dioxins indicate a signature typical of combustion-generated dioxin.

Six groundwater samples (including one background) were collected from the temporary push probe boreholes and analyzed for SVOCs, VOCs, and 23 inorganic compounds. Water samples were described in the report as turbid or very turbid, sometimes with suspended peaty material or organic matter. Only two of the six groundwater sample descriptions (PP07 and CB01) mentioned that a sheen was observed. No VOCs were detected with the exception of one low concentration (13 µg/L) of methylene chloride, a likely lab-introduced contaminant; and the background sample contained 1,2-dichlorothane detected at the contract required quantitation limit of 10 µg/L.

Water was collected from one shoreline seep that was located approximately 60 feet east of the compressor building, although the report did not provide a latitude/longitude for the sample location. The sample was analyzed for SVOCs, VOCs and inorganics. None of the SVOC or VOC analytes were detected, with the exception of caprolactum at 0.8 µg/L, which was an estimated concentration below the contract required quantitation limits. Of the 23 inorganics analyzed, antimony, arsenic, beryllium, cadmium, cobalt, lead, selenium, silver, and thallium were not detected. Calcium, magnesium, potassium and sodium were detected at percentage concentrations, which is common with the influx of marine water. The other 10 inorganics (aluminum, barium, chromium, copper, iron, manganese, mercury, nickel, vanadium and zinc) were detected at estimated concentrations ranging from 0.11 µg/L (mercury) to 672 µg/L (iron).

EPA designated the site as "Other Cleanup Activity-State Lead" as it was agreed by the agencies that this was the most appropriate approach.

2.4.13 URS, October 2002, Draft Engineering Evaluation/Cost Analysis and Cleanup Action Plan

A draft engineering evaluation/cost analysis (EE/CA) and cleanup action plan was prepared for the City of Anacortes and the Anacortes Public Development Authority (PDA) to evaluate soil and groundwater cleanup alternatives in the upland portion of the Custom Plywood site (URS, 2002). This draft document was intended to summarize the information developed in previous investigations, evaluate remedial technologies, and provide a conceptual plan for the preferred remedial action. Areas that were previously targeted for remediation (Section 2.4.11) were expanded due to additional areas of inorganics that were found during the EPA study in 2000, although the general areas remained similar. The document was not finalized and the work was not performed because of complications during negotiations between the PDA and the former owners during purchase of the property, and because the PDA could not obtain a prospective purchaser agreement/consent decree from the State of Washington.

2.4.14 Ecology and NOAA 2003 Chemical Contamination, Acute Toxicity in Laboratory Tests, and Benthic Impacts in Sediments of Puget Sound

Between 1997 and 1999, sediment samples were collected for analysis at 300 locations within the Puget Sound as part of a joint survey between Ecology and the National Oceanic and Atmospheric Administration (NOAA) (Ecology and NOAA, 2003). Three of the 12 stations within Fidalgo Bay (Stations 17-1-50, 17-2-51, and 17-3-52; Figure 6) are close enough to the project site to provide background information about the vicinity. The sediments were analyzed for conventionals (i.e., TOC), metals, SVOCs, and PCBs. Exceedances of SMS SQS and CSL occurred for various phenolic compounds and benzoic acid. There were also exceedances for di- and trichlorinated benzenes due to elevated reporting limits. There were no exceedances for metals, PAHs, or PCBs.

While the sample stations are outside of the proposed sampling area and are not useful for defining the cleanup areas, the data provide information on possible contaminants in the vicinity of the project area and a rationale for selection of the COPCs.

2.4.15 Geomatrix 2006 North Dock Maintenance Dredging PSDDA Characterization

In April 2006, Geomatrix conducted a Puget Sound Dredged Disposal Analysis (PSDDA) characterization for a maintenance dredging project north of the site (Geomatrix, 2006b). Grab samples were collected from a proposed mitigation site northeast of the site. Sediments from the five grab samples (MSG-1 through MSG-5; Figure 6) were composited and analyzed for dioxins and furans. The calculated toxicity equivalent quotient (TEQ) for the composite sample was 1.8 nanograms per kilogram (ng/kg).

While the sample stations are outside of the proposed sampling area and are not useful for defining the cleanup areas, the data provide information on possible contaminants in the vicinity of the project area and a rationale for selection of the COPCs.

2.4.16 Geomatrix 2006 Wetlands Delineation Study

A Wetlands Delineation Study (Geomatrix, 2006a) was conducted on the site in July 2006. In that study, several small areas were identified (Figure 5) as wetlands that met all three jurisdictional wetland criteria used by the Corps of Engineers and Ecology to define a wetland. (Criteria are: 50% of the dominant vegetation was hydrophytic, the presence of at least one primary or at least two secondary indicators of wetlands hydrology, and the presence of hydric soils within the top 12 inches of the soil surface.) One larger area (Area D) was identified on the western boundary of the GBH site that did not meet all criteria and was not determined to be a wetland at the time of the Geomatrix delineation study. The Department of Ecology conducted a wetlands assessment in April 2008 and found evidence that Area D should be classified as a wetland. GBH will treat this area (now called Wetland D) as a wetland and will prepare a wetlands mitigation plan prior to the start of remedial activities to be discussed in the RI/FS report.

2.4.17 Geomatrix 2007 Underwater Habitat Survey

Geomatrix was contracted by the Washington General Services Administration on behalf of the Washington Department of Community, Trade and Economic Development to conduct an underwater survey of the extent of eelgrass, macroalgae, and debris in the marine areas near the site (Geomatrix, 2007b). The field survey was conducted in late July 2007 (Geomatrix, 2007b).

Results of the survey are depicted on Figure 7. Three primary patches of exceptionally tall (up to 6 feet) eelgrass were found during the survey. Construction debris and wood debris present near the shoreline of the main plant area and along the length of the collapsed finger pier appeared to impair the growth of eelgrass in those areas. Large quantities of macroalgae were mixed with eelgrass in the northern part of the survey area, but only limited quantities of macroalgae occurred in the southern portion of the survey area.

2.5 PREVIOUS CLEANUP ACTIONS

This section presents a summary of previous cleanup actions that have been implemented at the former Custom Plywood Mill.

2.5.1 Woodward-Clyde, November 1998 Soil Remediation Report for 3205 V Place

Previous investigations on the City of Anacortes’ V Place property had indicated that an area of soil heavily impacted with hydraulic oil was located near the hardboard plant (Woodward-Clyde, 1997a,b,c,d). Using EPH/VPH sample results, results of other analyses, and calculations from the interim TPH policy (Ecology, 1997a), site-specific cleanup levels of

15,000 mg/kg total aliphatic hydrocarbons and 1,500 mg/kg total aromatic hydrocarbons were established as a guideline for removal of soils at the site. Three areas of soil with documented exceedances of 15,000 mg/kg TPH (Areas #1, #2, and #3, south to north) had been found at the site.

Remediation was conducted in August 1998 in accordance with the Remedial Options Evaluation and Cleanup Action Plan (Woodward Clyde, 1998a), which was approved by Norm Peck of Ecology's Northwest Regional Office (NWRO) (April 22, 1998). A mobile laboratory supplied by OnSite Environmental Laboratories, Inc., provided gas chromatographic analysis with rapid turnaround time to guide the excavation of contaminated soils. The 1998 excavation areas are shown on Figure 3.

During soil excavation, Areas 1 and 2 coalesced into one large excavation. The large excavation just east of the former hardboard plant extended approximately 50 feet by 100 feet at its maximum extent and to a depth just below the water table at approximately 5.5 feet bgs. Small blebs of free oil were noticed floating in the excavation during the work. Soils were excavated until confirmation samples returned results below 15,000 mg/kg TPH, which occurred in all cases on the northern and eastern sidewalls, where all samples were at or below 8,400 mg/kg. Sidewall samples were collected from the most likely location of high TPH concentration—at the top of the water table. Excavation on the western and southern sidewalls continued until reaching either (1) a line 5 feet from the building (excavation was limited by concern over structural integrity of the building), (2) concrete foundations, or (3) the property line. The site-specific cleanup level was not attained at all confirmation sample locations on the west or south sidewalls, and impacted soil appeared to extend under the building that could not be removed without compromising the structure. Plastic sheeting was placed on the edges of the excavation to minimize recontamination of the clean backfill material.

Area 3 remained a smaller, discrete excavation area in the northern portion of the site. At its maximum extent Area 3 was approximately 25 feet by 25 feet by 6 feet in depth. All sidewalls around the perimeter of Area 3 attained nondetectable concentrations of TPH.

A total of 1,939 tons of soil impacted with hydraulic oil was excavated and disposed in August through September 1998 (Woodward-Clyde, 1998c). The soil was trucked to Olympic View Sanitary Landfill in Bremerton. Locations of confirmation soil sampling and groundwater monitoring wells are shown on Figure 5.

Three groundwater monitoring wells were installed on January 21, 1999, downgradient (east) of the soil excavation areas. Each well was drilled to 17 feet deep and screened from 5 to 15 feet bgs. MW-1 and MW-2 were located midway between the excavation areas and the shoreline (about 160 feet upland of the shoreline). MW-3 was located near the shoreline. Groundwater samples were collected semiannually on a wet season/dry season basis on January 27, 1999; September 2, 1999; January 7, 2000; July 12, 2000; and January 15, 2001. Water elevations were obtained in three sampling events. Water elevations measured during the events fluctuated 1.96 feet in MW-1, 1.52 feet in MW-2, and 5.06 feet in MW-3. Water samples were analyzed for TPH-D and TPH-Oil by method NWTPH-Dx. Of the 15 water sampled collected (5 events and 3 wells), only three samples had detectable TPH, with one detection in each well. The detection in MW-1 was from the sample collected on January 27, 1999, and the concentration was 0.92 mg/L in the oil range. The detection in MW-2 was from the sample collected on January 15, 2001, and the concentration was 0.27 mg/L in the diesel range (although the laboratory flagged the analyses as not similar to a diesel fuel chromatogram). The detection in MW-3 was from the sample collected on January 7, 2000, and the concentration was 1.1 mg/L in the oil range. All other results were not detected below standard reporting limits of 0.25 mg/L for TPH-D and 0.5 mg/L for TPH-Oil.

Following the three years of groundwater monitoring in three wells, the City of Anacortes received a "No Further Action" letter under the VCP through Ecology's NWRO. The City placed a restrictive covenant on the deed of the property. In 2002, the monitoring wells were decommissioned, more fill material was brought into the central and eastern portions of the property, and additional construction occurred on the west side of the site. The area that was excavated in 1998 is currently covered by the asphalt-paved parking lot for Northern Marine employees and the asphalt paved V Place roadway.

2.5.2 Geomatrix 2007 Interim Remedial Action Areas 2 through 5

Previous studies had identified five primary areas that exceeded unrestricted MTCA Method A soil cleanup levels. Four of the five areas (Areas 2–5) were small and located on the northern half of the property. An interim remedial action was conducted in July 2007 to remove and dispose the soils from these four small areas (Figure 8). Figure 8 shows the extent of the four excavation areas and the location of final confirmation samples. About 1,500 tons of contaminated soil was disposed of at Rabanco's Subtitle D landfill in Klickitat County. Backfill material was obtained from Lakeside Industrial in Anacortes. The details for each individual excavation are discussed below.

Area 2. Area 2 is located on the north side of the former boiler house, and the constituents of potential concern (COPCs) included metals (arsenic, cadmium, chromium, lead, and mercury); TPH-G, TPH-D, and TPH-Oil; BTEX; and PCBs. The excavation area was approximately 40 by 53 feet and extended to a depth of approximately 4.5 feet bgs. Approximately 360 cubic yards of soil was removed from Area 2, which consisted of brown silty sand and poorly graded gravel with intermingled layers of brown wood waste overlaying poorly graded clean sand with bricks. Once the excavation was complete, soil confirmation samples were collected on the north, south, east, and west sidewalls, and four samples were collected from the base of the excavation (Figure 8). The final confirmation samples for metals revealed arsenic concentrations less than 17 parts per million (ppm or mg/kg), cadmium less than 1.7 ppm, chromium less than 130 ppm, lead less than 100 ppm, and mercury less than 1.2 ppm. TPH-G, TPH-D, and TPH-Oil were analyzed at less than 27 ppm, less than 83 ppm, and less than 1,400 ppm, respectively. Total PCBs were found in confirmation samples at concentrations less than 0.17 ppm. All BTEX compounds were found at concentrations less than 0.54 ppm. The excavation was backfilled with bank run to within 3 inches of surrounding ground surface and then covered with approximately 3 inches of road ballast to prevent stormwater runoff.

Area 3. Area 3 covers a relatively small area located on the south side of the former boiler house. The COPCs in this area were metals and PCBs. The final excavation was approximately 8 by 39 feet in area and extended to approximately 2.5 feet bgs. Approximately 30 cubic yards of soil was removed from Area 3, which consisted mainly of several layers of asphalt and subgrade overlying brown silty sand and wood waste. Once the excavation was complete, soil confirmation samples were collected on the east and west sidewalls, and one bottom sample was collected from the base of the excavation (Figure 8). Concrete footings extended the length and depth of the excavation on the north and south sides, so confirmation samples could not be collected from those sidewalls. The final confirmation samples had arsenic concentrations of less than 18.1 ppm, cadmium less than 1.1 ppm, chromium less than 46 ppm, lead less than 140 ppm, and mercury less than 0.76 ppm. In addition, total PCBs were analyzed at less than 0.21 ppm. The excavation was backfilled to the surface with bank run and then covered with a thin layer of road ballast to prevent stormwater runoff.

Area 4. Area 4 is located over the former compressor building, upland of the ordinary high water mark (OHWM). It is the largest excavation, covering an area approximately 75 by 40 feet and extending to a depth of 9 feet bgs. The COPCs in this area were metals and PCBs. Approximately 950 cubic yards of soil was removed from Area 4, which consisted mainly of silty sand with wood waste, wood, and other miscellaneous debris. Once the excavation was complete, soil confirmation samples were collected from one location on each of the north, south, and east sidewalls; two locations on the west sidewall; and six locations at the base of the excavation (Figure 8). The final confirmation samples did not contain COPC concentrations above the applicable MTCA Method A cleanup criteria, with the following exceptions: sample Area4-B3 had a PCB concentration of 1 mg/kg, which is equal to the MTCA Method A cleanup level for PCBs; and sample Area4-B4 exceeded the MTCA Method A cleanup level for mercury (2 mg/kg) with a concentration of 2.7 mg/kg. Samples Area4-B3 and Area4-B4 were collected at a depth of 9 feet bgs. Each was adjacent to a different concrete pile cap that could not be removed due to logistical constraints. Sample Area4-W7 was collected beneath a concrete footing (3.5 feet bgs) at the north side of the Area 4 western sidewall. The concentration of cadmium in this sample (4.6 mg/kg) exceeded the MTCA Method A criterion of 2 mg/kg for cadmium. Further excavation could not be completed in this area because of difficulties associated with removing the concrete footing and the attached concrete slab. The excavation was backfilled with bank run to within 6 inches of the surrounding ground surface and then covered with 6 inches of road ballast to protect against wave erosion.

Area 5. Area 5 is located at the north end of the site, approximately 50 feet west of the OHWM. This area was originally delineated from a single sample and the COC was TPH-D. The excavation area measured approximately 27 by 40 feet and extended to a depth ranging from 2 to 4.5 feet bgs. Approximately 145 cubic yards of soil was removed from Area 5, which consisted mainly of a layer of fine-grained wood waste over a gray silty, sandy gravel and gray to black silty sand. Once the excavation was complete, soil confirmation samples were collected from the north, south, east, and west sidewalls, and two samples were collected from the base of the excavation (Figure 8). The final confirmation samples had TPH-D concentrations less than 60 ppm and TPH-Oil concentrations less than 900 ppm. The excavation was backfilled with bank run and graded to match the surrounding ground surface, removing the low spot present in that area prior to excavation. This excavation area was not covered with road ballast because it is generally surrounded by thick vegetation and/or concrete structures and is sloped away from the water, which leads to a graveled road and/or more thick vegetation. The surface finish was monitored for the duration of the site activities and no obvious signs of erosion were observed.

3.0 ENVIRONMENTAL SETTING

In this section we present a discussion of the current site conditions, including surface features, subsurface soil and geology, surface water and groundwater, and meteorology. Also included is a discussion of the terrestrial and aquatic ecological setting comprising ecological receptors and potential threatened or endangered species.

3.1 SITE GEOLOGY

Less than 0.5 mile south of the site is an outcrop of the bedrock that dominates the Anacortes area. This bedrock is late Jurassic (possibly to early Cretaceous) marine sedimentary and volcanic rocks of the Fidalgo Complex. The Fidalgo Complex is an ophiolitic sequence that was thought to have formed in a back-arc basin and obducted during the Tertiary collision of tectonic plates. The complex ranges from gabbroic to sepentinitic sequences of chemically mafic rocks with naturally elevated concentrations of common and trace metals,(including iron, magnesium, and chromium) to more felsic keratophyre and plagiogranite (Brown, et al., 1979). Localized mineralization occurs in an area about 1.25 miles west of the site, where Jurassic granodiorite intruded the Fidalgo Complex. This mineralization was considered of sufficiently high grade in the early 1900s to be mined for copper, gold, and silver. The economic depression in the 1930s and later urban development curtailed further mining. Given the close proximity of significant surface exposures of the Jurassic bedrock, it is likely that this bedrock lies directly below the site at a relatively shallow, but as yet unknown, depth.

Overlying the Jurassic bedrock is a layer of gray clayey sediment that is highly compacted and dense. This unit is the native material that formed the tidal flats on which the site was built and has been found in drilled borings and cored sediments throughout the site and the western portions of Fidalgo Bay, based on studies that Geomatrix employees have conducted over the last 14 years in the Anacortes area. Moreover, this compacted clayey unit was found as far north as the former Scott Paper Mill site near Cap Sante Boat Haven marina approximately 1 mile north of the former Custom Plywood Mill. Heterogeneous fill material was placed above the dense clay in varying thicknesses around the Custom Plywood Mill. A test pit was dug to a depth of 22 feet bgs during the July 2007 excavations to reach the top of the native layer (shown on Figure 5).

Fill soils in the area near the shoreline are generally composed of brown to gray silty clayey sand and gravel with a thickness of approximately 6 feet, although fill thickness is partly dependent on the thickness of debris that remains from collapsed buildings within the GBH parcels. According to the Soil Survey of the Skagit County Area, Washington (Klungland, 1989), the upland soils are mapped as Xerothents, 0 to 5 percent slopes. The Xerothents soil unit consists of areas where the surface layer and subsoil have been highly disturbed and can contain sawdust and other wood wastes. Within the property that is owned by GBH, uplands exist only in Tracts No. 5, 6, 7, and the north part of Tract No. 8. Although the site property boundaries continue south and include Tracts No. 9 and 10, areas south of Tract No. 8 owned by GBH have no upland, except for the shoreline riprap that supports the hiking trail (former rail line).

The uplands portion of the site that was used for industrial purposes was created by placement of fill on top of former shallow tidelands that slope very gradually beyond the MLLW line shown on Figure 9. Inner portions of Fidalgo Bay beyond the Outer Harbor Line remain quite shallow (less than 12 feet below MLLW). Sanborn Maps from 1903, 1907, and 1925 indicate that the early sawmill on the site was built on piles over the tidelands (Appendix D). The sequence of fill placement on top of the intertidal areas could not be ascertained from early records. Observations of the fill in test pits and borings indicate that the fill is highly heterogeneous, and a pattern of placement was not discernable. Much of the fill seen during previous test pits and excavations in Tracts No. 5 and 6 consisted of wood waste, ranging from sawdust to logs. Construction debris from the former structures is also present in the fill, and includes concrete, rebar, piping, brick, and pile-supported concrete foundations. The wood waste content of the fill material averages 30 to 40 percent across the site, but varies significantly. Hand augering west of the press pits encountered 2 to 3 feet of saturated fine wood material overlying sand and gravel. In contrast, fill soil near the V Place roadway contained little wood and consisted of poorly graded, clean sand to a depth of 6 feet bgs.

Much of the large debris in the upland that was left from the fire has been cleared since initial investigations in 1995; several concrete structures and concrete building foundations still remain. Smaller debris, such as brick and remnants of wooden pilings, are present on the surface of the uplands, and brick, concrete pieces, roof remnants, and rafted-in logs are still present in the intertidal area below the OHWM.

3.2 SITE HYDROGEOLOGY

The shallow subsurface of the former Custom Plywood site is tidally influenced. Groundwater was encountered within the fill layer at depths of about 5 to 6 feet bgs during low tide and within 2 feet of the ground surface at high tide in some nearshore locations. With increased distance from the shoreline, it is probable that the tidally influenced fluctuation of the groundwater is increasingly dampened; however, monitoring the degree of fluctuation of the water table elevation has yet to be conducted. At low tide, seepage of water has been observed in the intertidal zone.

Three shallow groundwater wells were monitored from 1999 to 2001 on the Tract No. 4 property to the north of the GBH property that had been sold to the City of Anacortes (Section 2.5.1). Results of groundwater monitoring indicated that the groundwater gradient had consistently been toward the east southeast, toward the shoreline. The three monitoring wells were decommissioned on October 2, 2002, prior to regrading and filling the site for redevelopment.

Two wells (ANCP-MW-01 and ANCP-MW-02) were installed in June 2004 by Aspect Consulting for a previous owner on the main plant parcels currently owned by GBH (see Figure 5). Geomatrix has not been able to obtain information from this investigation, except for the boring logs and well construction details from the two monitoring wells. However, future remedial investigation work will make use of these two wells, assuming they are constructed properly and water samples can be obtained with acceptable quality.

Based on the groundwater gradient observed in the Tract No. 4 wells, it is expected that the shallow groundwater gradient in the fill material is toward the east or southeast toward Fidalgo Bay. Additional shallow groundwater monitoring wells will be placed to evaluate the groundwater quality of the areas downgradient from areas of known contaminated fill material, and to evaluate the shallow groundwater coming onto the site from areas to the west. The thickness of the native clay layer is not known; however, it is unlikely that contaminants of the types that are known to be present on the site would migrate below the native clay and into a deeper aquifer or, less likely, into the Jurassic bedrock.

The parcels to the north and west of the GBH parcels that have been sold and redeveloped are predominantly paved or have buildings in place. The GBH-owned parcels are mostly unpaved, except for remnants of concrete foundations. Natural drainage of surface water trends to the east toward Fidalgo Bay. Under present conditions, most surface water infiltrates, with the exception of large storm wave surges, which tend to pond on the site.

Four small areas of wetlands were identified in the wetlands delineation conducted by Geomatrix (2006a) (Figure 5). A wetlands delineation report was sent to the U.S. Army Corps of Engineers for a jurisdictional determination. The Corps determined that three of the four wetlands (Wetlands A, B, and C) are isolated and not regulated (Corps, 2006). The Corps retained jurisdiction over one wetland, Wetland E. Area D was determined to not meet the criteria for a wetland during the Geomatrix wetlands delineation. The Department of Ecology conducted a wetlands assessment in April 2008 and found new evidence that Area D should be classified as a wetland. GBH will treat this area (now called Wetland D) as a wetland and will prepare a wetlands mitigation plan prior to the start of remedial activities to be discussed in the RI/FS report. Remedial investigation work that is done in Wetland D and E will be coordinated with the Corps and Ecology’s Shorelands and Environmental Assistance Program.

3.3 DISCHARGE AREAS INTO FIDALGO BAY

There were three known historic outfalls from the facility into Fidalgo Bay. Outfall 003 is currently located on the City of Anacortes’ property on Tract No. 4. A metal pipe can still be observed at the shoreline, and is presumed to be this outfall. It is likely that the metal conduit runs along the property boundary easement between Tracts No. 4 and 5. It is not known how the conduit connects farther upland. Outfalls 001 and 002 discharged off of the plywood plant when the building extended over the intertidal zone. Current evidence of these two outfalls has not been observed during recent underwater surveys, and it may be that they were destroyed or covered when the building collapsed during the fire. Figure 4 depicts the approximate locations of the historic outfalls.

Geomatrix has not found evidence to document what may have been discharged from those outfalls. There appears to have been an NPDES permit application filed in 1974 for Outfall 001. The effluent was to be monitored for phosphorus, sodium, oil, grease, and phenol, but no data associated with the NPDES permit have been found.

3.4 METEOROLOGY

The maritime climate in Anacortes, Washington, is characterized by mild winters and cool summers. Mean monthly temperature varies from an average minimum of 34.9 degrees Fahrenheit (^{o}F) in January to an average maximum of 71.9^{o}F in July and August. The highest recorded temperature in Anacortes was 95^{o}F in August 1931, and the lowest recorded temperature was 4^{o}F in December 1964.

Average monthly wind velocity ranges from 4.0 miles per hour (mph) in September to 9.4 mph in February, with gusts in excess of 50 mph during winter storms. The prevailing wind direction is from the southwest.

Mean annual precipitation for Anacortes is 26.2 inches, most of which falls as rain. Average monthly precipitation varies from a low of 0.93 inch in July to a high of 3.79 inches in December.

3.5 ECOLOGICAL SETTING

This section describes ecological and habitat conditions at the site, including a description of habitats within the vicinity of the site; wetlands occurring on site were discussed in Section 2.4.16.

EPA (2000) defined a 15-mile-diameter area around the site as a target distance limit (TDL) for ecological receptors. Inside this TDL is critical habitat for Chinook salmon (Oncorhynchus tshawytscha), a federally listed threatened species (NOAA, 2000). In addition, the bald eagle (Haliaeetus leococephalus), a recently delisted species, has several breeding habitats within the TDL. The closest bald eagle habitat is approximately 1.5 miles south of the site. The state-listed endangered species the peregrine falcon (Falco peregrinus anatum) has several habitats within the TDL; its closest habitat is 2 miles northwest of the site. It is estimated that 3.25 miles of wetland frontage exist within the 15-mile TDL (EPA, 2000). Padilla Bay National Estuarine Reserve and the San Juan National Wildlife Refuge are located 6 miles and 4 miles from the site, respectively (EPA, 2000).

4.0 PRELIMINARY SITE CONCEPTUAL MODEL

This section presents a preliminary conceptual site model, including a summary of current conditions, water and groundwater beneficial uses, source areas, release and transport mechanisms, potential exposure pathways, and public access.

4.1 SURROUNDING LAND USE AND POPULATIONS

This section describes the current and future planned land use of the site and the immediate area.

4.1.1 Current Conditions

Land uses on properties immediately adjacent to the site include the following.

- The Eastern boundary is Fidalgo Bay, a shallow marine embayment.
- The northern parcel of the site is used by North Harbor Diesel for dry dock boat storage, and north of this parcel is a stuffed animal manufacturing facility.
- On the western and southwestern edge of the site is an asphalt-paved multi-use trail built on a former rail line easement.
- Beyond the multi-use trail to the west is Cimarron Trucking, a trucking company that hauls municipal waste to disposal facilities. On the northwest is V Place road, and adjacent to the road is Northern Marine, a yacht manufacturing company that leases the completely renovated former hardboard plant associated with the former plywood mill. A number of transformers that were moved to the south end of the hardboard plant prior to the fire, and were undamaged in the fire, were moved off site and disposed. A new addition to the hardboard plant building was placed in the location of the former transformers and is being used at the present time for yacht manufacturing.
- Along the southern boundary is an undeveloped embankment leading up to Fidalgo Bay Road. Across from Fidalgo Bay Road and up the steep embankment from the southwest portion of the site are several residential properties.
- The site and surroundings are zoned for industrial use. Maintaining the current industrial zoning is a priority for the City and is part of the City of Anacortes Comprehensive Plan.

Principal land uses in the area surrounding the former Custom Plywood Mill are industrial/commercial businesses. Fidalgo Bay is primarily used for recreational boating and fishing. No commercial fishing is documented to occur within 15 miles of the site (EPA, 2000). Tidal areas of the site may be used by the public for recreational fishing and shellfish collection; however, the heavy debris in the intertidal zone precludes digging. From 1992 until the most recent excavations of Areas 2 through 5 in 2007, the GBH property has not been disturbed except to clear debris and weeds, and to temporarily store some equipment and boat parts. The land surrounding the site is moderately populated; as of 2000, 3,961 residents live within 1 mile of the site and a total of 13,316 residents live within 4 miles of the site.

4.1.2 Future Developed Conditions and Terrestrial Ecological Evaluation Exclusion

The site may qualify for an exclusion from a TEE under WAC 173-340-7491(1)(b) because all of the upland area will be covered by structures, pavement, or heavy base course material to prevent exposure to wildlife or plants. Stormwater runoff will be controlled in areas with hard surfaces and routed to catchment basins prior to discharge. Planned landscape areas will be sampled prior to construction and planting to confirm the absence of contaminants in excess of cleanup levels. If such areas contain residual contamination and the soil cannot be readily removed, those landscaped areas will be engineered and controlled to eliminate exposure; however, every effort will be made to avoid landscape plantings in areas with residual contamination, if any such areas remain.

There is a possibility that the City of Anacortes may construct a public access pathway on the southernmost 0.1-acre wedge of the site to provide access from the multi-use trail to Fidalgo Bay. This wedge area was not part of the historical operational area and has no known contamination. If public access becomes the land use for this small area, it will be fenced from the industrial portion such that no access to the industrial portion of the site will be allowed.

The site was fenced with temporary fencing during the July 2007 excavation activities and permanent fencing was installed in May 2008. The fencing will be maintained during the proposed remedial activities.

4.2 HIGHEST BENEFICIAL USE OF SITE GROUNDWATER

Section (2)(b)(i) and (ii) of WAC 173-340-720 states that groundwater at a site can be considered nonpotable if it contains natural background concentrations of organic or inorganic constituents that make use of the water not practicable. The former Custom Plywood Mill abuts Fidalgo Bay, the groundwater at the site is most likely tidally influenced (hydraulically connected) by Fidalgo Bay, and influx of marine water with higher total dissolved solids (TDS) render this groundwater nonpotable. Further, the area surrounding the site has City-supplied domestic water. Thus, no groundwater at the site will be used for potable purposes. Site groundwater is shallow and perched above the clayey native material that is present at about 6 to 22 feet bgs.

In addition to the definition of nonpotability described above, Section (2)(b)(ii) of WAC 173-340-720, defines nonpotability as groundwater that contains natural background concentrations of organic or inorganic constituents that make use of the water as a drinking water source not practicable. An example of inorganic constituents that would make the groundwater nonpotable under this definition is groundwater that contains greater than 10,000 mg/L TDS. TDS concentrations greater than 10,000 mg/L would be expected in groundwater in a nearshore area with an influx of seawater that typically contains a minimum of 30,000 mg/L TDS. Groundwater from the monitoring wells will be analyzed for TDS during this RI

4.3 TRANSPORT AND EXPOSURE MECHANISMS

Potentially impacted groundwater and soil particles could be released and transported off site through various mechanisms, such as surface water runoff, groundwater migration to Fidalgo Bay, direct discharge, and fugitive dust. Each transport mechanism is discussed in more detail below.

- Surface water runoff: Surface water on the site (originating as overland flow from upgradient areas or from rain events) could potentially entrain soil particles and/or dissolved fractions of COPCs at the site. Surface water with entrained COPCs may potentially be transported via overland flow to Fidalgo Bay.

- Groundwater migration to Fidalgo Bay: COPCs in soil may leach into groundwater due to infiltration of precipitation into COPC-impacted soil. Leaching may also occur due to the daily tidal cycle, lowering and raising the water table elevation and thereby flushing residual contamination in soil into groundwater. This impacted water may potentially discharge to marine surface water via groundwater to sediment pore water transport. COPCs in groundwater may have the potential to migrate to surface water, based on the historical presence of seeps along the shoreline.

- Direct Discharge: Direct discharge either to soil or groundwater at the site is considered highly unlikely due to the current state of the site. No industrial activity is currently present on the site, and the site has remained dormant since the early 1990s.

- Fugitive Dust: COPCs in soil may mobilize in fugitive dust throughout the site due to the lack of pavement. The fugitive dust could potentially be transported off site either to other uplands areas or to Fidalgo Bay.

4.4 EXPOSURE PATHWAYS

This section presents a description of potential exposure pathways for different parcels that comprise the former Custom Plywood Mill.

4.4.1 Andrews, Sizemore, Bean Parcels

Redeveloped portions of the Andrews, Sizemore, and Bean parcels are surfaced with asphalt, concrete, or building structures, with the exception of narrow landscaped areas on both sides of the multi-use trail. The undeveloped GBH upland parcels have permanent 6-foot-high chain-link fencing that was placed in May 2008. Consequently, exposure of the public to any impacted soils or groundwater is precluded throughout most of the site, with the exception of the narrow landscaped trail corridor.

4.4.2 GBH Parcels

Following remedial activities, future development of the GBH-owned upland areas will be consistent with the applicable City of Anacortes industrial zoning (Zone I). Currently, GBH envisions the short-term site use as a boat storage yard. Longer term site use could include boat launch facilities with ramp and pier structures, and structures for dry storage of boats. Redevelopment will include adding several feet of fill over the ground surface to a relatively consistent height (final elevation yet to be determined). Where necessary, structural fill, followed by asphalt or concrete, will be placed on the surface to control settlement and to function as an engineering control, if needed.

Potential exposure pathways are:

- **Soil**
  - Human direct contact (i.e., ingestion and dermal exposure) with soil by construction and site maintenance workers, and future industrial workers;
  - Direct contact with soil by terrestrial ecological receptors (e.g., mammals, birds, vegetation, etc.).
  - Uptake of soil contaminants into terrestrial ecological species (i.e., terrestrial plant and animal bioaccumulation) who then would be consumed as prey by upper trophic-level terrestrial ecological receptors.
  - Cross-media transfer pathway associated with hazardous substances in upland soil leaching to adjacent groundwater.

- **Air**
  - Exposure through inhalation of soil contaminants that have migrated to air either as windblown dust or as vapor. Receptors may include site trespassers, construction and site maintenance workers, future industrial workers, and terrestrial ecological receptors. This pathway should include future indoor air exposure to industrial workers who may occupy future on-site buildings.
  - Exposure through inhalation of groundwater contaminants that have migrated to air as vapor. Receptors may include site trespassers, construction and site maintenance workers, future industrial workers, and terrestrial ecological receptors. This pathway may include future indoor air exposure to industrial workers who may occupy future on-site buildings.
- **Groundwater**
  - Human direct contact with shallow groundwater by construction and site maintenance workers.
  - Media transfer pathway associated with hazardous substances in shallow groundwater migrating to surface water.
- **Surface Water and Sediment**
  - Human direct contact with Fidalgo Bay surface water and sediment by recreational users.
  - Direct contact with Fidalgo Bay surface water and sediment by aquatic ecological receptors (e.g., fish, invertebrates such as shellfish, birds, amphibians etc.).
  - Uptake of surface water/sediment contaminants into aquatic ecological species such as fish and shellfish (i.e. aquatic organism bioaccumulation) who then would be consumed as prey by humans.
  - Uptake of surface water/sediment contaminants into aquatic ecological species who then would be consumed as prey by upper-tropic-level aquatic ecological receptors.

4.4.3 Public Access Areas

Granting the City of Anacortes the right to use a small part of the site for public access to Fidalgo Bay has been discussed, but no specific location for this public access area has been defined. If the City is granted the use of a small part of the site for public access, an investigation will be conducted prior to allowing such use, unless such area has been sufficiently investigated during the RI/FS process.

5.0 CLEANUP SCREENING LEVELS

Cleanup levels under MTCA are categorized as Methods A, B, or C (WAC 173-340-700). Method A cleanup levels, which apply to soil, groundwater, and surface water media, are intended to be used for routine site cleanups. Cleanup levels under Method A are available for only about 25 of the more commonly found contaminants among the hundreds of potential hazardous substances. Tables of the MTCA Method A cleanup levels are available for potable groundwater, unrestricted land use (includes residential) soil, and Industrial land use Method A cleanup levels for these media must be at least as stringent as concentrations established under applicable state and federal laws. In addition, Method A soil cleanup levels must also be protective of terrestrial ecological receptors. Method A groundwater concentrations must be protective of surface water beneficial uses (if the pathway for surface water-groundwater is complete). Unlike for groundwater and soil, the regulation does not provide a table of Method A cleanup levels for surface water. Surface water Method A cleanup levels must be at least as stringent as concentrations established under applicable state and federal laws and other requirements (See WAC 173-340-730(2)).

Method B may be used at any site and is the most common method for setting cleanup levels when sites are contaminated with substances not listed under Method A. Cleanup levels under Method B are established using applicable state and federal laws and the risk assessment equations and other requirements specified in the MTCA Rule for each medium. In addition to accounting for human health impacts, Method B cleanup levels must account for any potential terrestrial or aquatic ecological impacts (unless it can be demonstrated that such impacts are not a concern at the site). Ecology’s Cleanup Levels and Risk Calculations (CLARC) database contains hundreds of precalculated/established levels for hazardous substances in air, groundwater, surface water, and soil media (Ecology, 2008). The Method B cleanup levels in the CLARC database are provided as a service to the public. Also, the CLARC database does not contain cleanup levels for all exposure pathways, such as soil concentrations protective of groundwater and/or surface water.

In contrast to Method B, Method C cleanup levels are intended for industrial sites where exposure to potential contaminants is limited and controllable. As under Method B, potential terrestrial and aquatic ecological impacts must be accounted for in addition to human health impacts when establishing Method C cleanup levels.

In general, the text and tables in this document compare analytical results to the most rigorous cleanup levels, that is, Method A unrestricted and Method B, because Ecology recommends this approach as part of the early RI screening process. However, because future use of the GBH parcels, as well as the Sizemore, Bean, and Andrews parcels, is intended to remain industrial in accordance with the area zoning, less stringent industrial cleanup levels may eventually apply to the site. However, public access areas will require the more stringent unrestricted land-use cleanup levels.

Preliminary screening levels for soil and groundwater are shown in Tables 1 and 2, respectively. Tables 1 and 2 include screening levels for all constituents detected during previous analyses based on screening levels available in the CLARC database. Final cleanup levels will be determined during the RI/FS process that follows from this Work Plan.

5.1 SCREENING LEVELS FOR SOIL

Many contaminants have either a Method A or Method B level for soil. However, some contaminants have both Method A and Method B levels. Method B is further broken down into levels for individual exposure pathways, such as a Method B level for protection of direct human contact versus a different Method B level for protection of terrestrial ecological receptors and for protection of groundwater as marine surface water. Preliminary soil screening levels are shown in Table 1. Method A and Method B levels will be used in this plan if they apply, although the lowest of the levels will be used for screening the existing data, unless regional background levels are higher.

Soil concentrations protective of groundwater were estimated using the fixed parameter three-phase partitioning model in accordance with WAC 174-340-747(4). Because groundwater at the site is not a current or future source of drinking water, and because it migrates to marine surface water, marine surface water concentrations protective of human health and aquatic organisms developed in accordance with WAC 174-340-730 were used in the calculation. Accordingly, the three-phase model provides a conservative estimate of the concentration of a contaminant in soil that is protective of groundwater as marine surface water. Estimated soil concentrations protective of groundwater as marine surface water are listed in Table 1.

Soil cleanup levels for metals may be adjusted to no less than natural background concentrations, in accordance with WAC 173-340-740(5)(c). With the exception of chromium, statewide background metals concentrations were obtained from a state background soil metals study conducted by Ecology (1994) for comparison with Method A and Method B cleanup levels for the site. According to the Ecology study, background total chromium levels in Northern Skagit and Whatcom Counties are elevated compared to the rest of the state. Because elevated background levels of total chromium are expected, and because the site is located outside of the four main regional areas selected by Ecology for the calculation of soil background concentrations, a site-specific total chromium background concentration for the Anacortes area was calculated.

Data for the calculation were obtained from the Ecology (1994) report for ten sample locations closest to Anacortes. Ecology's MTCAStat program was used to calculate the 90th percentile concentration and four times the 50th percentile concentration for total chromium. Background is defined as the lower of the two values for lognormally distributed data sets, in accordance with WAC 173-340-709(3)(c). The lower value (four times the 50th percentile concentration) was selected as the Anacortes area background, yielding a background total chromium concentration of 117 mg/kg. The site cleanup level for chromium was adjusted upward to this value to reflect elevated chromium background concentrations present in the area. MTCAStat output for the background calculation is provided in Appendix E.

5.2 SCREENING LEVELS FOR GROUNDWATER

Preliminary screening levels for groundwater based on protection of marine surface water are shown in Table 2. Groundwater results were compared to marine surface water criteria, rather than MTCA Method A or B drinking water criteria, because groundwater will not be used for drinking water, and the marine surface water criteria are more conservative for many of the constituents. Although Method C (industrial) cleanup levels for groundwater exist, Ecology places severe restrictions on their use for industrial sites. Given the proximity of the site to Fidalgo Bay, it is unlikely that Method C cleanup levels for groundwater would ever apply to this site.

5.3 SCREENING LEVELS FOR SEDIMENT

Screening levels to assess sediment biological functions are the SMS (WAC 173-204) SQS (WAC 173-204-320) and CSLs (WAC 173-204-520). These standards contain both chemical and biological effects criteria. The SMS screening levels are presented in Table 3. The biological effects criteria for sediments are presented in Table 4. Additional criteria for PCBs, dioxins/furans, and other bioaccumulative compounds will be used for sediments at the site. Screening levels for PCBs and dioxins will be based on human health risk using the seafood ingestion pathway. Exposure scenarios will be provided by Ecology for evaluation of human health risks due to PCBs. Site-specific SQS screening criteria for total volatile solids (TVS), TOC, and surficial wood coverage have been developed at other sites within Fidalgo Bay. A similar site-specific approach will be applied at this site for these constituents. The SQS for

TVS at these other locations was 9.7% and the CSL was 17%. The SQS screening criteria for TOC at these locations was 10%. The SQS for surficial wood coverage at these other locations was 25% and the CSL is 50%.

6.0 EVALUATION OF EXISTING DATA

This section will present an evaluation of data garnered from previous investigations, including the nature of sources of previous data, evaluation of previous data with respect to the RI/FS data quality objectives (DQOs), identification of data suitable for use in the RI/FS, and the approach to establishing a database of available environmental data for the site.

6.1 PREVIOUS INVESTIGATION AND INTERIM ACTION DATA

This section summarizes the data available from previous investigations and interim actions for groundwater, soil, and sediments.

6.1.1 Soil Data

Previous investigations indicated the presence of soils impacted (i.e., concentrations exceeding MTCA screening levels) with metals, PCBs, TPH (diesel and oil range) and petroleum derivatives, and SVOCs, particularly cPAHs. Soils with concentrations in excess of cleanup levels protective of human health (MTCA Method A for Unrestricted Land Use) and groundwater as drinking water have been excavated from known areas on Tracts No. 4, 5, and 6, although excavation could not progress completely in all directions due to impediments from concrete foundations and buildings (see Section 2.5.2). Soils with elevated concentrations of TPH, PAH, and metals are known to remain on large portions of the upland of Tract No. 7 and, to a lesser extent, on the northern portion of the upland of Tract No. 8.

Relatively low concentrations of dioxin/furan have been detected in three upland soil samples to date (collected as part of the EPA 2000 PA/SI). All concentrations were below the MTCA Method B screening level for 2,3,7,8-TCDD. These concentrations are consistent with levels expected for urban areas and are likely attributable to combustion of building materials. Additional delineation of dioxins and furans will be conducted as part of this study.

6.1.2 Groundwater Data

With the exception of the 3 years of post-remediation groundwater monitoring conducted on the former City of Anacortes (current Bean) property, historic groundwater data were derived from groundwater grab samples collected from push-probe borings. As such, those analyses are useful indicators of groundwater quality but introduce uncertainty regarding the reliability of the data. There are no historical data available for groundwater turbidity, except for the samplers' observations of high turbidity. However, based on our previous experience evaluating data from push probes, we believe the collected push probe data suffered data quality problems due to elevated turbidity, which leads to groundwater grab samples that are not representative of actual groundwater quality. In some cases, older laboratory technologies or matrix interference resulted in detection limits above current cleanup levels.

Results from earlier groundwater sampling are useful as a general indicator of the types of issues that should be investigated during the RI. Those historic analyses indicated that TPH-Oil and TPH-D should be evaluated further. Although analyses for TPH-G and BTEX returned results of nondetectable for all but one of the groundwater samples in the various studies, detection limits in some cases exceeded current screening levels and therefore will require further evaluation. Areas that have significant TPH levels in soil are at risk for elevated concentrations of SVOCs, particularly cPAHs, although the presence of these compounds in groundwater has been confirmed in only one groundwater grab sample (BH01). The groundwater sample collected at BH01 was a grab sample that, in our professional opinion, may not reflect the true groundwater quality at the sample point because the temporary well was not installed with a sand filter pack and most likely was not properly developed following Ecology standards.

Historic analyses of inorganic constituents (arsenic, cadmium, chromium, copper, lead, mercury, nickel, thallium, and zinc) are the most unreliable of all the previously analyzed constituents in the grab groundwater samples due to the introduction of turbidity in grab samples. The data on inorganic constituents are not considered reliable and will be rejected for purposes of the RI.

Previous studies have not confirmed the presence of pesticides or PCBs in groundwater, although neither class of compounds has been extensively analyzed in water. Based on operator interviews, pesticides are not reported to have been used on site, and soil results do not indicate exceedances of pesticide screening levels.

Hydrophobic compounds such as PCBs have extremely low solubility in groundwater, and will be analyzed for in groundwater, but are not expected given that soil concentrations have not been found that exceed residual saturation levels. VOCs found in previous studies were found at low concentrations and J-flagged, including in background samples, and were likely laboratory contaminants. VOCs will be analyzed in groundwater samples in the RI to rule out further consideration as a COPC.

6.1.3 Sediment Data

Existing sediment chemistry data for the site and the surrounding areas were compared to the SMS SQS and CSL criteria (or the LAET dry weight equivalents) for the SMS list of COPCs (Table 3). Carbon normalization of many of the SMS organic compounds is inappropriate when TOC is ≤ 0.5%. Carbon normalization may also be inappropriate when TOC is ≥ 1.67%. All of the sediments sampled during the previous investigations had levels of metals below the SMS SQS criteria. Light PAH (LPAH) and heavy PAH (HPAH) values were also below the SMS SQS criteria or the LAET dry weight equivalents. Several of the stations had exceedances of SQS and CSL criteria for chlorinated hydrocarbons and benzoic acid due to elevated reporting limits. Phenol was found at elevated concentrations above the SQS at two sample locations. The compound 4-methylphenol was above the CSL at four locations. Sediment data that are older than 10 years will be used as a general indicator of potential chemistry issues but will not be used to determine nature and extent of contamination. The EPA (2000) sediment data will not be entered into the EIM database per agreement with Ecology.

6.2 DATA QUALITY ASSESSMENT

The following criteria were identified to evaluate existing available data. Data meeting the following criteria were input into the project database.

6.2.1 Recency

In order to ensure that the data used for the evaluation were representative of current environmental conditions, only those data collected since 1995 were included in the project database. Data collected prior to 1995 may be of historical interest, but are less likely to be representative of current conditions due to the potential for physical, chemical, and biological transformations and transport. Thus, the Enviros sediment data collected in 1995 will not be used in the RI/FS process to define nature and extent of contamination.

6.2.2 Data Validation/Suitability Review

Non-detect results may be good quality data, but introduce uncertainty depending on reporting limits. To assess this potential uncertainty, non-detect values were evaluated to determine how detection limits compared to screening levels. Older analytical methods may not have been capable of detecting constituents at the low levels that are currently achievable by the project laboratory. Detection limits are also often higher than expected due to interference caused by detections of other constituents present in the sample, general laboratory dilution, or matrix issues. For this data evaluation, historic data were conservatively considered to exceed screening levels if the reporting limits were higher than the screening levels.

6.2.3 Sample Collection Methods

The soil data that were entered into the database were collected using standard, acceptable methods of sample collection, ensuring that sample integrity was not compromised during the collection efforts. Groundwater analyses from previous push-probe grab sampling were not entered since they were not collected using standard collection methods.

6.2.4 Analytical Methods

The data that were entered into the database were analyzed using the EPA's SW-846 Methods, and Ecology TPH Methods, ensuring that the sample results were analyzed using standard and acceptable methods.

6.2.5 Locations

The samples in the database all have existing location information (northings and eastings) and no samples were rejected due to lack of location information. Historical sampling points were located relative to existing site features by taping. The distance between at least two existing site features and the actual sample point was measured, and this information was then used to located the sampling point based on the 1997 surveyed map by Larry Steele and Associates

6.3 DATABASE DEVELOPMENT

Data were compiled as hard copy and entered or received in electronic format and entered into a Microsoft Access relational database. Historical data, sample results from 1995 through 2000, were entered from Microsoft Excel tables; however, these were not electronic data compiled by the laboratories. The recent data collected in 2007 were imported directly into the database in electronic format using laboratory electronic data deliverables. The information in the database includes:

- sample identifications and locations,
- sample types,
- sample locations, including depth, and
- analytical chemistry results.

The database was queried to compare the data to the applicable and relevant screening criteria for soils presented in Section 5.

As discussed in Section 6.1.3, the EPA sediment data will not be entered into the database.

7.0 CONSTITUENTS OF POTENTIAL CONCERN

This section presents COPCs for soil, groundwater, and sediments. Tables 5 and 6 present a summary of the analytical test results that have exceeded preliminary screening levels for soil and groundwater, respectively.

7.1 SOIL

Table 5 presents a summary of analytical results that have exceeded the most stringent of all screening criteria for human health, terrestrial ecological, and protection of groundwater as marine surface water. Any constituent that has resulted in an exceedance of applicable screening criteria will be considered a COPC to be evaluated further in the RI/FS. The RI will investigate areas where the nature and extent of the COPCs require better definition so that an appropriate range of remedial options can be evaluated in the FS.

In some areas, soils in excess of human health cleanup levels have already been excavated and disposed. Areas that have been excavated to meet human health protection criteria will be further evaluated in the RI/FS to ensure compliance with protection of other receptors under applicable exposure scenarios.

The primary COPCs in soil are TPH-D, TPH-Oil, PCBs, inorganic constituents (arsenic, barium, cadmium, copper, chromium, lead, mercury, nickel, selenium, thallium, vanadium, and zinc), SVOCs, and dioxins/furans. TPH-G, BTEX, and dioxin/furans were found in the soils in one or two samples site-wide and at generally very low concentration occurrences. Where the concentrations of petroleum hydrocarbons are highest, some SVOCs (e.g., phenanthrene, fluoranthene, and pyrene) were detected. Due to analytical interference from the elevated oil concentrations, the detection limits for some SVOCs were often above current MTCA Method B cleanup levels.

VOCs and pesticides are not reported to have been used on site, with the exception of toluene and gasoline constituents. Previous soil testing for VOCs has indicated only one exceedance of benzene in soil and multiple detections of common laboratory contaminants, including carbon disulfide, carbon tetrachloride, methylene chloride, acetone, and 1,2-dichloroethane. Although VOCs are not likely to be a site-wide concern, given the history of non-use, the one location with lingering potential is the former paint storage area. Soil samples collected in this area as part of the RI will be analyzed for VOCs. Benzene and toluene will continue to be considered COPCs for purposes of this Work Plan.

Pesticides were analyzed as part of the EPA 2000 study. No pesticides were detected above screening levels, and therefore pesticides will not be carried forward as a COPC.

7.2 GROUNDWATER

TPH-Oil, TPH-D, TPH-G, various metals, and BTEX are retained as COPCs in groundwater. Analytical results for TPH-D in groundwater push-probe samples ranged from nondetectable to 9.0 mg/L (CP-GP8). For TPH-Oil, results ranged from nondetectable to 1.5 mg/L (CP-GP8). Areas that have significant TPH levels in soil are at risk for elevated concentrations of SVOCs, particularly cPAHs, although the presence of these compounds in groundwater has not been confirmed, except for at location BH01. SVOCs will be considered as COPCs for groundwater until the groundwater analytical results confirm or refute the presence of SVOCs. BTEX analyses returned results of nondetectable for all the groundwater samples. TPH-G was detected in only one groundwater sample in the various studies, although detection limits in some cases exceeded current MTCA Method A cleanup levels and will require further evaluation.

Inorganic constituents (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc) that are considered COPCs in soil will be considered COPCs in groundwater until reliable groundwater data are available from the new monitoring wells planned for the RI. Conventional analyses of temperature, pH, conductivity, turbidity, and dissolved oxygen will be measured at the time of additional sampling conducted as part of the RI.

Previous studies have not confirmed the presence of pesticides in soil, and the few grab groundwater samples analyzed did not yield PCBs or pesticides. Hydrophobic compounds such as PCBs would not be expected to dissolve in groundwater and will be initially analyzed in groundwater to rule out their consideration as a COPC. VOCs found in previous studies were found at low concentrations and J-flagged, including in background samples, and were likely laboratory contaminants (see discussion in Section 7.1). However, VOCs will be analyzed in groundwater samples in the RI in the former paint shop area and the initial seep water samples.

7.3 SEDIMENT

There are some detected exceedances of the SQS or CSL chemical criteria in sediment samples that have been collected in the vicinity of the former mill; however, the chemical parameters listed in WAC 173-204-320 will be used as COPCs for the site as requested by Ecology. Based on the history of the site being used for log rafting and storage, Ecology has also requested that the following be identified as COPCs for site sediments:

- pore water ammonia,
- pore water sulfides,
- surficial wood coverage,
- TOC,
- TVS, and
- dioxins/furans, and
- construction debris (e.g., bricks, concrete, scrap metal).

8.0 NATURE AND EXTENT OF CONTAMINATION

This section identifies areas of contamination based on available information. Known or suspected source areas are summarized in Section 8.1. Sections 8.2 to 8.4 describe the nature and extent of constituents of potential concern (COPCs) for soil, groundwater, and sediments, respectively, individually and in the context of the known and potential source areas. Constituents identified in one or more samples at concentrations greater than the screening levels presented in Section 5.0 are retained as COPCs and will be addressed further during the RI. Some constituents, such as VOCs, will be carried forward as COPCs in select areas (e.g., vicinity of the former paint shop area).

8.1 HISTORIC SOURCES AREAS—KNOWN AND POTENTIAL

This section presents a discussion of known or suspected historic source areas based on a review of available information for the site. All the sources discussed are historic because the main plant area has been unused since the 1992 fire, and current operations on other portions of the site appear to be environmentally compliant (although Geomatrix has not conducted an audit of the facilities to verify their compliance status).

Previous investigations have compiled information about the history and manufacturing processes used at the plant (Section 2.2.2). Following the evaluation of the existing data that was developed in Sections 5 through 7, preliminary conclusions can be made regarding known or potential historic sources of contamination associated with the site. These historic sources include the following:

- Boiler house,
- Compressor house,
- Hog fuel pile area,
- Aboveground storage tanks,
- Transformer Yard,
- Paint storage and spraying areas,
- Press pits,
- Mixed glue tank,
- Former Hardboard Plant (including 1998 Excavation Area), and

- Resin/Caustic AST shed.

8.1.1 GBH Parcels

8.1.1.1 Boiler House, Compressor House, Hog Fuel Area

Several areas in the vicinity of the boiler house, the compressor house, and the hog fuel area were excavated in 2007 to remove soils with elevated concentrations of metals, PCBs, and TPH (Geomatrix, 2007a). Excavations were conducted iteratively, with excavation pit confirmation samples analyzed and excavation continuing until MTCA Method A unrestricted use cleanup levels were attained (Section 2.5.2).

8.1.1.2 Aboveground Storage Tanks and Paint Storage and Spraying Areas

Areas in the vicinity of the former locations of the ASTs and paint storage and spraying areas were investigated during early investigations and during the 2007 soil removal activities (Section 2.5.2), but will undergo additional investigation to determine the need for additional remediation.

8.1.1.3 Press Pit Area

Press pits #2 and #3 contain water that might have a hydraulic connection to groundwater. Press pits #2 and #3 have been observed to contain approximately 1,000 ft^3 and 1,500 ft^3 of water, respectively. During the summers, press pit #2 is typically empty except for a wet scum on the concrete bottom. Press pit #3 generally contains water during all times of the year.

The water in press pits #2 and #3 have been found to contain hydrocarbons, based on analytical results and the intermittent presence of an oily sheen. High concentrations of hydrocarbons within the soil surrounding the press pits are presumed to be the source of the contamination. Water removal and disposal or treatment will be required prior to the demolition of the concrete in the press pits.

Soil in the press pit area has significant concentrations of diesel and heavy oil, presumably originating from leakage of the hydraulic lines. The soil also contains extensive amounts of decayed wood and organic material. The volume of hydrocarbon-impacted soil in Area 1 was estimated in a previous study to be about 3,300 cubic yards; a more refined estimate of the volume will be developed during the RI/FS.

8.1.1.4 *Mixed Glue Tank Area*

A soil sample (HAGT) (Figure 5) collected from 5 feet north of the glue tank returned results of 45 mg/kg for TPH-D and 130 mg/kg for TPH-Oil. One soil sample (HAGT) from the glue tank area was further analyzed for phenols (EPA Method 8270) and formaldehyde (EPA Method 8315) and returned results below laboratory detection limits (Woodward-Clyde, 1998b).

Surface and subsurface soil samples were collected in this area and analyzed for SVOCs, VOCs, pesticides/PCBs, and inorganic constituents during the EPA (2000) study. No SVOCs, pesticides, or PCBs were detected above screening levels. Some inorganic constituents (copper, nickel, thallium, vanadium, and zinc) were detected above screening levels.

8.1.2 Andrews, Bean, and Sizemore Parcels, City of Anacortes Rights-of-Way

The upland parcels on the west and north of the GBH parcels are not known to have contributed to contamination on the GBH upland parcels. Likewise, the nature of the known contamination on the GBH upland parcels is unlikely to have impacted the other sites that are all located presumably upgradient from the GBH parcels. High concentrations of TPH are suspected to remain under the building foundation of the former hardboard plant; however 3 years of post-excavation groundwater sampling did not indicate that migration of the residual TPH is a concern for either the current Bean property or the GBH property.

8.1.2.1 *Sources Associated with the Former Hardboard Building-Tract No. 4 Area (Currently Andrews' Parcels, Bean Parcel, and V Place Roadway)*

In 1997, oil-impacted soils were discovered in the area that is currently the paved parking lot for Northern Marine employees on one of the Andrews' parcels (Sections 2.4.7, 2.4.10, and 2.4.11). The oil-impacted soil extended east onto the western part of what is now the V Place roadway. This contaminated soil was removed and disposed in 1998 by the City of Anacortes under an Ecology VCP agreement (Section 2.5.1; Woodward-Clyde, 1998c). Prior to the soil removal, Woodward-Clyde, the City's consultant, negotiated a site-specific soil cleanup level of 15,000 mg/kg for TPH-Oil with Ecology based on calculations made using prior chemical results and Ecology's Interim TPH Guidance Document (Ecology, 1997a). Soil was removed until TPH concentrations in confirmation samples were at or below 8,400 mg/kg, using a mobile laboratory on site. The only soils in excess of the site-specific cleanup level that could not be excavated were in areas under the building foundations where soil could not be removed so as not to undermine the structure, or in the case of one sidewall sample, at the property boundary.

8.1.2.2 Sources Associated with the Sizemore Parcel and City of Anacortes Right-of-Way/Hiking Trail Area

The former plywood operation used a building located immediately west of the former railroad right-of-way (currently the Tommy Thompson Trail) as a machine shop. This building was not damaged in the fire in 1992. The southern portion of the machine shop building housed four caustic or resin ASTs that were connected via a pump to the former glue loft. According to Ecology files, these tanks held as much as 20,000 gallons of phenolic resin and caustic each month during plant operations. The building is currently owned by Ray Sizemore of Cimarron Trucking. Mr. Sizemore conducted an extensive renovation of the shop and AST shed, including the decommissioning, removal, and disposal of the ASTs in 2003.

Near-surface soil samples collected on October 29, 1997, from the area east and adjacent to the former machine shop building returned results in samples from 1.5 feet to as high as 1,500 mg/kg for TPH-D and 6,800 mg/kg for TPH-Oil (sample CP-HARC-1.5A). These soil samples were also analyzed for phenols (EPA Method 8270) and formaldehyde (EPA Method 8315) and returned results below laboratory detection limits (Woodward-Clyde, 1998b).

Surface and subsurface soil samples and one groundwater sample were collected in this area and analyzed for SVOCs, VOCs, pesticides/PCBs, and inorganic constituents during the EPA (2000) study. Based on the EPA study (2000), no SVOCs, VOCs, pesticides, or PCBs were detected at concentrations exceeding screening levels in any of the soil or groundwater samples.

These results from the previous studies suggest that the elevated TPH readings resulted from an apparently minor surface release of TPH adjacent to the former resin/caustic shed. No releases of phenols, formaldehyde, or other constituents were indicated. The area of the detected inorganic constituents was paved by the City with asphalt to create the multi-use trail after excavation of railroad ballast to a depth of 12 to 15 inches (below the depth at which the EPA samples were collected). An unpaved area adjacent to the AST building may not have been disturbed during trail construction.

8.1.3 Aquatic Areas

The aquatic areas east of the GBH parcels are not known to have contributed to contamination on the GBH upland parcels. Contamination from uplands source (see Section 4.3) could potentially migrate into aquatic areas. Potential direct contamination sources in the aquatic areas were limited to wood debris associated with log storage and rafting. There are no other potential direct contamination sources associated with the intertidal or shallow subtidal aquatic areas. Surface waves and water currents might have resulted in limited redistribution along the shoreline, but significant movement or relocation is unlikely.

8.2 NATURE AND EXTENT OF SOIL COPCS

This section presents a discussion of soil COPCs. The locations where soil sample results exceed preliminary screening criteria based on protection of marine surface water or based on protection of human health and terrestrial ecological receptors are shown in Figures 10 and 11, respectively. The primary COPCs in soil are TPH-D, TPH-Oil, inorganic constituents (arsenic, barium, cadmium, copper, chromium, lead, mercury, nickel, selenium, thallium, vanadium, and zinc), select SVOCs (primarily cPAHs), PCBs, and dioxins/furans. Of these, TPH-Oil has the most significant relative exceedance with concentrations up to 164,000 mg/kg (or 82 times the MTCA Method A cleanup level of 2,000 mg/kg) found in the vicinity of the press pits. TPH-G, benzene, and toluene were also found in one or two soils samples in very localized and generally low concentration occurrences. Where the concentrations of petroleum hydrocarbons are highest, some SVOCs were detected (e.g., phenanthrene, fluoranthene, pyrene). Due to analytical interference from the elevated oil concentrations, detection limits for SVOCs were often above current MTCA Method B cleanup levels. Dioxin/furan were detected in three soil samples at low concentrations consistent with combustion generation. Additional selected dioxin/furan analyses will be conducted.

8.2.1 Inorganic Constituents

Prior to the July 2007 excavations, a total of 104 upland samples collected from the GBH parcels during various investigations had been analyzed for various inorganic constituents. Table 5 indicates the number of samples that exceeded screening levels for each of the inorganic constituents.

Eight of the highest concentration sample locations were excavated during the July 2007 work (Geomatrix, 2007a). One location is adjacent to the concrete next to the boiler house foundation (BH01SS00, 0-1 foot; BH1 in Figures 10 and 11) and could not be excavated.

Changes to MTCA completed in 2001 specify total chromium to be separated into trivalent chromium (less toxic species) and hexavalent chromium (more toxic species). At the time sampling occurred in most of the previous studies, total chromium was not speciated because the earlier MTCA (1996) Method A industrial cleanup level of 500 mg/kg was based on total chromium. Following the 2007 interim action only one total chromium concentration sample on the north half of the upland exceeded 117 mg/kg, Area 2-S (130 ppm). The sample from Area 2 and was collected at the final extent at the time of excavation abutting a concrete pad which could not be removed. Another single sample exceeded a total chromium concentration of 117 mg/kg in the south half of the GBH upland, G-15-S (450 mg/kg), which was located adjacent to Press Pit 3.

It is likely that all of the chromium is in the trivalent form because under the conditions of pH and oxidation/reduction potential (Eh) typical of this environment, trivalent chromium minerals are stable and relatively insoluble. Consequently, in this Work Plan, chromium results are compared to the northern Puget Sound background level of 117 mg/kg (Ecology, 1994) (See Section 5.1 for discussion). Confirmation sampling conducted as part of the July 2007 soil removal (Geomatrix, 2007a) included analyses of total chromium in over 50 samples. The highest concentration of total chromium in a sample that was not excavated later was additionally analyzed for hexavalent chromium. This sample, Area2-S, yielded a total chromium result of 130 mg/kg and hexavalent chromium was not detected at a reporting limit of 2.5 mg/kg.

8.2.2 Semivolatile Organic Compounds

A total of 46 soil samples have been analyzed for SVOCs or specific cPAHs during the various investigations at the site. Of the 46 soil samples analyzed, 30 samples analyzed had a toxicity equivalent concentration [relative to benzo(a)pyrene] above 0.14 mg/kg for cPAHs. Other SVOCs, including pentachlorophenol, were either below screening levels or below detection limits. As previously discussed, elevated concentrations of petroleum hydrocarbons in samples from the press pits area created analytical interferences that resulted in higher than normal detection limits for SVOCs. As such, SVOCs, and particularly cPAHs, will be retained as a COPC group until the RI investigation can eliminate or confirm their absence at the site.

8.2.3 Polychlorinated Biphenyls

In July 2007, soil was excavated and disposed in all locations where previous samples contained PCBs at a concentration of greater than 1.0 mg/kg. A total of 57 soil samples had been analyzed for PCBs during the course of investigations prior to 2007. PCB sampling was targeted at locations where transformers were known or suspected to have operated, or in areas where the transformers were stored temporarily, particularly at the south end of the former hardboard plant building. Most sampling locations were specified directly by the EPA with consultation from Ecology. Of the 57 soil samples analyzed, all but five were below the MTCA Method A unrestricted cleanup level of 1 mg/kg for total PCBs. Of those five samples, the highest concentration found anywhere on site occurred in a sample collected in the boiler area and had a concentration of 13.87 mg/kg total PCBs. Three additional samples from the compressor area and boiler house yielded concentrations of total PCBs between 1.0 mg/kg (the MTCA Method A unrestricted land use cleanup level) and 2.6 mg/kg. Based on the historic information referenced above and the 2007 excavation confirmation sample data, PCBs will be a COPC for the RI/FS process because they have been previously reported on site.

8.2.4 Total Petroleum Hydrocarbons and BTEX

All soil samples analyzed for TPH-G, toluene, ethylbenzene, and xylenes (using Washington Method NWTPH-G/BTEX) were below laboratory detection limits or below the screening levels, which are MTCA Method A unrestricted-use cleanup levels. Only one sample (HA37-1.5) yielded a benzene concentration (0.43 mg/kg) that exceeded the Work Plan screening level of 0.03 mg/kg. This sample was collected west of press pit #2 and also contained TPH-D and TPH-Oil at a combined concentration above 27,000 mg/kg.

For some samples from the early studies where TPH-D and TPH-Oil were at high concentrations, detection limits for benzene were elevated above the screening level of 0.03 mg/kg. It is common to have higher detection limits for minor constituents when the laboratory must significantly dilute the sample to analyze the high concentrations of major constituents. However, in those early studies, detection limits for benzene never exceeded the MTCA Method A cleanup level of 0.5 mg/kg that was in effect until 2001.

Numerous soil samples exceeded the MTCA Method A cleanup levels for TPH-D (C12-C24) and TPH-Oil (C24-C34), with the highest concentrations around the press pits. TPH-D concentrations ranged from nondetectable to 12,000 mg/kg, and TPH-Oil concentrations ranged from nondetectable to 164,000 mg/kg. The highest concentrations and most widespread occurrences of TPH-impacted soil were in the press pit area.

Accurate analysis of TPH in soils is confounded by the presence of wood debris. Natural oils in wood can dramatically affect analytical results for petroleum compounds, although results would be expected to vary depending on the type and age of the wood. Using gas chromatography, the analytical instrument used for the NWTPH method, compounds originating from wood are detected in the TPH-Oil range and can cause false positives of hundreds to thousands of parts per million. The NWTPH method designed by Ecology allows the use of silica gel/acid wash cleanup that is intended to remove the non-petroleum hydrocarbons prior to analysis. However, this cleanup technique is incomplete in removing non-petroleum hydrocarbons from samples with a matrix high in wood content. Consequently, samples collected during the RI that have a significant wood fraction, based on visual observation during sampling, will be analyzed using additional analytical comparisons that more accurately distinguish petroleum-derived versus wood-derived hydrocarbon compounds. A technical memorandum describing the approach is provided as an attachment to Appendix A.

8.2.5 Volatile Organic Compounds

A total of 55 soil samples collected over the years from the GBH parcels have been analyzed for VOCs. No samples exceeded screening levels except for typical laboratory solvents, and benzene and toluene. Thus, the broad suite of VOCs will not be carried forward as a COPC during the RI/FS process, although benzene and toluene will be carried forward as COPCs.

8.2.6 Dioxin/Furans

Three upland soil samples were analyzed for dioxins and furans (EPA, 2000). One of the upland samples analyzed was the background sample, BG01SB01 (Shown as BG01 on Figures 10 and 11), collected from a depth of 7.5 feet bgs. Total TEQ was calculated in parts per trillion (ng/kg) for the detected congeners per EPA and Ecology 2007 MTCA rule. The TEQs for the upland samples were 3.46 ng/kg (sample CB01SB01, CB01 on Figures 10 and 11) and 0.994 ng/kg (sample BH01SB01, BH01 on Figures 10 and 11). The background sample yielded a calculated TEQ of 0.069 ng/kg. The TEQ results for the samples are below the MTCA Method B soil cleanup level of 11 ng/kg, and below 4.1 ng/kg, which is the mean dioxin concentration for urban soils in Washington State (Yake et al., 2000). Although dioxin has not been shown to be a concern in the soil, if distinct layers of ash are found in the boiler area, dioxin/furan will be analyzed.

8.2.7 Remaining Data Gaps for Soil

Gaps remain in the soil data that will be addressed in the RI. Reasons for the gaps are summarized below.

- Although extensive analytical testing has been performed on upland soil samples, areas of lower risk, based on reported historic facility operations, have not been thoroughly investigated. Given the 90-year history of industrial operations, and that the fire destroyed most of the evidence of the operations, it is prudent to sample areas that have no known releases.

- In some cases, previous investigations focused toward a specific objective, such as the PCB investigation following the improper transformer decommissioning. A more comprehensive approach (lower detection limits and wider areal coverage) to the RI is required to meet the conditions of the Agreed Order.

- Previous investigations and remedial actions were conducted under earlier versions of MTCA. Subsequent changes to MTCA have created a need to compare the existing data in some cases to more stringent cleanup standards, thereby necessitating lower laboratory detection limits than laboratories historically provided. Data acquired in the RI will be evaluated against the most current (2007) version of MTCA. (MTCA is required to be reviewed and revised every 5 years.)

- Previous evaluations of the extent of TPH contamination have sampled areas with high TPH concentrations; consequently, analytical results for individual petroleum hydrocarbon compounds (especially BTEX, PAHs), have been confounded by high detection limits due to necessary laboratory dilution. TPH constituent compounds must be evaluated around the perimeter of the press pit area with lower TPH concentrations to evaluate risks of a range of remediation options and to determine site-specific cleanup levels and remediation levels.

- Previous evaluations of the extent of inorganic constituents have focused on human health risk-based cleanup levels. New data will be collected to better evaluate the terrestrial ecological risks and protection of groundwater as marine surface water, which for some constituents are more stringent than human health criteria.

- Soils with abundant wood in the matrix can confound the laboratory methodology for TPH chemical analysis. Wood has natural organic compounds that are not easily separated from petroleum hydrocarbons using standard analytical methods, even with silica gel/acid wash cleanup procedures. The presence of wood in a sample can cause an overly estimated result for TPH. The RI will evaluate analytical techniques and sample cleanup methods or approaches to minimize the interference from wood in the TPH results.

A Draft Uplands Sampling and Analysis Plan included as Appendix A and the uplands Quality Assurance Project Plan (QAPP) included as an attachment to Appendix A provide the detailed approach and methodology that will be used in the RI to address the soil data gaps.

8.3 NATURE AND EXTENT OF GROUNDWATER/SURFACE WATER COPCS

This section describes the methods that will be followed in the RI to identify COPCs for groundwater and surface water.

8.3.1 Groundwater

Groundwater sampling and testing to date have been inadequate to meet the conditions of the Agreed Order. Except for the three wells that were monitored for 3 years on the Bean property, no groundwater well data are available. Based on our previous experience analyzing data from groundwater samples collected from push probes, we believe the results from earlier push-probe borings suffered data quality problems because high turbidity makes groundwater grab samples not representative of groundwater quality. In some cases, older laboratory technologies or matrix interference resulted in detection limits above current cleanup levels. For example, TPH-G analyzed in groundwater push-probe samples (e.g., CP-GP 8) was nondetectable, but detection limits were as high as 2.6 mg/L (CP-GP 8).

Results from earlier groundwater sampling are useful as a general indicator of the types of issues that will be encountered in the RI. BTEX has not been detected in groundwater samples, but TPH-D and TPH-Oil results from several samples exceeded current MTCA Method A cleanup levels in groundwater of 0.5 mg/L for each. As would be expected, detections of TPH-G, BTEX, and TPH-D in groundwater push-probe samples indicate that the lighter end petroleum compounds have aged and degraded with time. The results also indicate that, despite high concentrations of oil in the soil, the oil does not appear to be very soluble in the groundwater. Future groundwater sampling will evaluate the extent to which the various petroleum fractions have dissolved and potentially become mobilized in the groundwater.

Evaluation of inorganic constituents in groundwater has been incomplete to date, which constitutes a data gap that will be addressed during the RI. For the inorganic constituents in groundwater, concentrations found during the RI will be screened against groundwater cleanup levels based on protection of marine surface water (WAC 173-340-730(3)). If needed, cleanup levels will be adjusted to be no less than the PQL or natural background concentration, in accordance with WAC 173-340-730(5)(c). The point of compliance (POC) will be defined as the point of discharge to Fidalgo Bay. The proposed POCs will be four shoreline wells that will be monitored during the RI.

To address the groundwater data gap, groundwater samples will be collected from a minimum of six permanent monitoring wells, and potentially four temporary well points. The temporarily wells will be installed if there is evidence of contamination in the soil boring. Temporary wells, if deemed necessary, will be constructed of ¾-inch-diameter PVC blank well casing and machine-slotted well screen. After groundwater and soil samples are collected, the temporary wells will be abandoned. Additional wells may be indicated depending on the results of the initial rounds of sampling, or as part of the design process.

Human ingestion of groundwater contaminants is not a potential exposure pathway, because the site will have potable water supplied by the City of Anacortes. However, the groundwater to sediment or groundwater to surface water exposure pathway must be considered. Based on previous investigations, there are few known COCs in groundwater. Notably, no VOCs or SVOCs have been found, apart from suspect lab contaminants, in any of the groundwater samples. Nonetheless, groundwater baseline sampling will involve analysis for SVOCs, BTEX, inorganic constituents, and TPH (as gasoline, diesel, and oil). If baseline sampling indicates no SVOCs, or CPAHs only, Ecology will be consulted regarding eliminating analytes from continued monitoring. Formaldehyde will not be analyzed because analysis for formaldehyde in groundwater is difficult when concentrations are at very low levels (if any), as would be expected in groundwater at the former Custom Plywood site, in light of no detectable previous concentrations. No labs in or outside the state of Washington that were contacted are able to achieve PQLs for formaldehyde below the groundwater cleanup level due to interference from high ambient air concentrations resulting from off-gassing of formaldehyde from standard building materials.

All six permanent wells will be monitored quarterly for a baseline round and one quarterly round. If there is any indication that exceedances of cleanup levels are occurring in the groundwater, and are unlikely to abate naturally, an evaluation will be conducted of the need and options for hydraulic control or groundwater remediation. Details of the evaluation and the recommended course of action will be presented in the FS. As mentioned previously, groundwater monitoring will continue, but it is unlikely that the RI/FS document can wait for an entire year of quarterly sampling, given the aggressive schedule.

8.3.2 Press Pit Surface Water

Water samples previously collected from press pits #2 and #3 were analyzed for TPH and PCBs to better evaluate costs of disposal of the water prior to demolition of the concrete pits (Woodward-Clyde, 1998b). Results indicated concentrations of TPH-D and TPH-Oil up to 3.7 mg/L, and no detectable concentrations of PCBs. Press pit #1 has no depression and has never been observed to contain water. Further sampling of the press pit water will be conducted closer to the time of demolition to evaluate treatment and/or disposal requirements of the city wastewater treatment plant or other commercial waste water handler.

8.3.3 Seep Sample

Water was collected from a shoreline seep about 60 feet north of the compressor building (EPA, 2000). The original report did not provide a specific location for the seep sample, and the sample location was not included on any figure (EPA, 2000). The sample was analyzed for SVOCs, VOCs, and inorganic constituents. None of the analytes was detected at significant concentrations (EPA, 2000). Additional seep sampling may be indicated. Seep sampling may be conducted to evaluate the presence of COPCs, if the compliance wells indicate potential migration to the sediments. In such a case, the concern would be that the groundwater is causing contaminants from the upland to impact the sediments, and seep samples could be used as an indicator of the extent of potential impact.

8.3.4 Remaining Data Gaps

Two wells were installed at the site in 2004 by consultants for a previous owner, and Geomatrix was provided the boring and construction logs by Ecology. These two existing wells will be augmented with four additional monitoring wells, two nearshore, one on the west side, and one on the northwest side of the GBH site (Appendix A). All six of the wells will be surveyed horizontally and for elevations at the tops of casing and ground surface.

All the wells will be developed, purged, and sampled as part of the groundwater monitoring program planned for the site. Groundwater will be removed from the wells by low-flow methods to reduce turbidity in the samples and allow for better comparability between wells. Groundwater and seep samples will be analyzed initially for SVOCs, TPH-D, TPH-G, BTEX, total and dissolved inorganic constituents (arsenic, cadmium, copper, chromium, lead, mercury, nickel, thallium, zinc), and PCBs. If groundwater analytical results indicate that some constituents are consistently at nondetectable concentrations, or concentrations below the groundwater cleanup levels, Geomatrix will discuss with Ecology the elimination of selected constituents from the analysis protocol.

During the baseline sampling round, metals constituents will be analyzed for total concentrations and dissolved concentrations (following filtration with a 0.45-micrometer [µm] filter). If baseline sampling indicates that there is no significant difference between the total and dissolved metals results, except in samples with high turbidity, samples will be analyzed only for dissolved constituents in subsequent quarterly analyses. During the RI process, wells will be sampled initially, and for one quarterly round, with those results incorporated into the RI/FS report. Because the schedule imposed by the Agreed Order will not accommodate the incorporation of additional quarterly or semiannual rounds, subsequent rounds of sampling will be reported in annual reports to Ecology, until the point at which the wells are deemed unnecessary.

8.4 NATURE AND EXTENT OF SEDIMENT COPCS

Available data for sediments are limited to the Enviros (1995b) and EPA (2000) sediment sampling in the intertidal areas of the project site and a limited number of stations located well offshore analyzed as part of other investigations. The findings from these limited data are summarized in this section. These data do not provide sufficient coverage to adequately assess the nature and extent of contamination at the site. Data gaps are discussed in Section 8.4.6.

8.4.1 Inorganics

A total of 14 sediment samples have been analyzed for inorganic metals. The available analytical data do not identify any metals as COPCs. All the samples from the previous investigations demonstrated levels below the SMS SQS criteria.

8.4.2 SVOCs

Data from a total of 20 samples were analyzed for the full or a partial list of the SMS list of SVOC COPCs. None of the LPAHs, HPAHs, or phthalates was identified as a COPC; however, several chlorinated benzenes and phenols were found at levels above the SMS SQS or CSL criteria and were identified as COPCs.

8.4.3 PCBs

A total of 14 samples were analyzed for PCBs. Three of the samples had elevated levels (two above the SQS and one above the CSL) of PCBs. PCBs were identified as a COPC.

8.4.4 Wood/Conventionals

Video surveys of aquatic areas adjacent to the site showed significant accumulation of surficial wood debris (Geomatrix, 2007b). The presence of significant wood debris is of significant concern to Ecology because of its direct impact on benthic communities as well as the evolution of hazardous substances, such as sulfides, ammonia, phenol, and 4-methylphenol, upon its decomposition. Wood content (and wood surrogates TVS, TOC, pore water sulfide, and pore water ammonia) are identified as COPCs.

8.4.5 Dioxin/Furan

Four samples collected from the sediment surface were analyzed for dioxin/furans during the EPA (2000) study. One sample exceeded the PSDDA (2000) risk-based criterion of 15 ng/kg. In addition, one composite sample was collected from the sediment surface and analyzed for dioxin/furans from a site approximately 0.5 mile north of the site. The composite included sediments from six grab samples. The calculated TEQ for the composite was 1.8 ng/kg.

Because of the potential human health risk associated with ingestion of seafood from Fidalgo Bay, dioxins were identified by Ecology as a COPC.

8.4.6 Remaining Data Gaps

Sediment sampling and testing conducted to date have been inadequate to meet the conditions of the Agreed Order. The data collected during the Enviros (1995b) and EPA (2000) sediment sampling were limited to the intertidal areas of the project site. The remaining available data are from a limited number of stations located well offshore and do not provide sufficient coverage to adequately assess the nature and extent of contamination at the site. In addition, recency guidelines state that the sediment data greater than 10 years old cannot be used in the RI to define the nature and extent of contamination. These data are useful, however, for identifying COPCs.

The gaps remaining in the sediment data will be addressed in the RI. A Sampling and Analysis Plan for Sediments (Appendix B) describes the proposed sampling effort. The results of the sampling and analysis will be sufficient to identify areas for potential cleanup. Additional sampling and analysis (including determining the depth of potential contamination) will be coordinated with Ecology and covered (if required) by supplemental addendums to the SAP.

9.0 DATA QUALITY OBJECTIVES

The planned RI/FS will build from the results of data collection activities conducted over the past 13 years. The Data Quality Objectives (DQOs) for the prior phases of investigation and interim actions have varied. In preparation for the RI/FS, this Work Plan assesses the existing data and selects the portions of that data that are relevant to the RI/FS. We have identified the following general DQOs for the RI/FS:

- Summarize the historical data;
- Identify historical source areas;
- Develop a conceptual site model based on existing and anticipated future conditions, to be further refined as additional sampling occurs in the RI; and
- Determine assumptions, limitations, and remaining data gaps based on current and potential future uses of the site.

Specific DQOs for soil, groundwater, and sediment data are discussed below.

9.1 SOIL DQOS

Soil data that will be collected in the RI will be needed to support the evaluation of potential remedial technologies in the FS. In order to do an appropriate evaluation, the following DQOs are necessary.

- The sampling design, field procedures, laboratory procedures, and quality control procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability, including precision, bias, accuracy, representativeness, comparability, completeness, and reporting limits, are discussed in detail in the QAPP (included as an attachment to Appendix A).
- Screening levels as discussed in Section 5.0 will be used to develop laboratory reporting limits associated with soil sampling. Geomatrix will work with the laboratory so that reporting limits (PQL) are below the screening levels identified in this Work Plan.
- Soil analyses for TPH are confounded by the presence of wood in the sample matrix. Geomatrix will work with Ecology’s Manchester Environmental Laboratory, as necessary, to address potential TPH interference associated with wood waste in the uplands.
- The soil data will address identified data gaps in the understanding of the nature and extent of impacts.

- Soil data will be used to calculate the COPC concentrations that are protective of the receptors potentially affected by the exposure pathways outlined in Section 4.4.

9.2 GROUNDWATER DQOS

As previously discussed, groundwater sampling and testing to date have been inadequate to meet the conditions of the Agreed Order. Except for the three wells on the Bean property that were monitored for 3 years, no groundwater data are available. Results from earlier push-probe borings suffered data quality problems because high turbidity makes groundwater grab samples not representative of groundwater quality. Groundwater samples collected as part of the RI will be used to establish baseline groundwater quality data and will be needed to support the evaluation of potential remedial technologies in the FS. In order to do an appropriate evaluation, the following DQOs are necessary.

- Groundwater sampling procedures, laboratory procedures, and quality control procedures are designed to provide high-quality data for the intended uses. Factors that can influence data usability are discussed further in the QAPP (included as an attachment to Appendix A).

- Groundwater screening levels discussed in Section 5.2 will be used to develop laboratory reporting limits (or PQL) associated with groundwater sampling. Geomatrix will work with the laboratory so that reporting limits are below the Screening levels identified in this Work Plan.

- Groundwater data will provide current conditions of water quality at the shoreline (downgradient) wells to evaluate the potential for impacts to surface water and sediments.

- Groundwater data from the two existing wells on the western side of the GBH property are intended to evaluate the impacts to the downgradient parcels from potential historical sources on the adjacent upland parcels.

- Long-term groundwater monitoring will provide information to assess seasonal variability in water quality and evaluate the effectiveness of previous interim actions.

- Long-term groundwater monitoring will be used to evaluate the effectiveness of any future interim actions, final cleanup remedies, or development activities on the site.

9.3 SEDIMENT DQOS

The goals for sediment analytical data are to produce data of sufficient quality to meet the project DQOs. The primary DQOs for this project have been established to ensure that the PQLs for sediment concentrations are sufficiently accurate to compare to the SMS SQS

(WAC 173-204-320) for marine sediments (see Table 3). Because the SQS for many organic compounds is based on carbon-normalized concentrations, the samples must also be analyzed for TOC. Comparison of carbon-normalized values against the SQS listed in Table 3 may be inappropriate if TOC values are below 0.5% or above 1.67% (Michelsen, 1992). The upper limit of TOC where carbon normalization is inappropriate is, at this site, a site-specific value based on background levels for the surrounding sediments. This site-specific value is 1.67% (Peter Adolphson, Ecology, personal communication). At TOC values below 0.5% and above 1.67% the project DQOs for PAH and PCB data must be accurate at the dry-weight-based standards specified in Table 3. The PQLs for the analytes in this study must be at least as low as the concentrations presented in Table 3.

To meet the goal of returning data accurate enough to be within the SQSs, data-quality indicators (DQIs) also need to be established. DQIs are specific measured parameters, including the familiar PARCC parameters (precision, accuracy, representativeness, comparability, and completeness), as well as sensitivity. The PARCC parameters are discussed in detail in Section 6.1 of the Sediments SAP (Appendix B).

The quality assurance (QA)/quality control (QC) procedures for the Microtox® toxicity assessment, the amphipod 10-day acute/lethal bioassay, and the sediment larval abnormality bioassay are described in the applicable protocols. The QA/QC requirements include control limits for water quality parameters (e.g., temperature, salinity dissolved oxygen, pH). Monitoring of sulfides and ammonia is also required during the sediment bioassays. Protocols also specify acceptable performance limits for negative controls, positive controls, and reference sediments. The percentage of fines in reference sediments should be within 20% of the percentage of fines in the test sediment.

10.0 TERRESTRIAL ECOLOGICAL EVALUATION AND SOIL RISK ASSESSMENT

A TEE will be conducted during the RI that meets criteria set forth in WAC 173-340-7490. The site will be initially evaluated to determine whether all or portions of the site qualify for an exclusion from a TEE. Under WAC 173-340-7490 (3)(b), industrial properties with current and future exposure to soil contamination need to be evaluated only for wildlife protection. All parcels that make up the site are considered industrial based on City of Anacortes zoning, with the exception of the hiking trail, and the potential small public access area (Section 4.1.2). A simplified or site-specific TEE will be conducted as part of the RI, as required, and cleanup levels can be established for industrial and public access land uses on the site.

Under the TEE procedures in MTCA, exposure to contamination at industrial sites need only evaluate terrestrial wildlife and not plant or soil biota (WAC 173-340-7490 (b)), except in areas where vegetation must be maintained to comply with local government land-use regulations or if a site-identified species is protected under the Endangered Species Act.

Site-specific TEE procedures are described in WAC 173-340-7493. The first step Geomatrix would complete is the Problem Formulation, which identifies (COPCs; complete potential pathways for exposure of plants or animals to COPCs; and current or potential future terrestrial groups reasonably likely to live or feed at the site. Ecological receptors for which complete pathways exist for exposure to COPCs are subsequently evaluated in a Toxicological Assessment. A variety of approaches are allowed under MTCA cleanup regulations for completing this step to evaluate the potential for adverse effects to ecological receptors (WAC 173-340-7493 (3). The problem formulation and Method Selection Steps will be done in consultation with Ecology, and Ecology's approval will be obtained for the procedures selected.

One potential remedial alternative for the site uplands would be a low-permeability cap. Potential impacts to ecological receptors would be limited to organisms that can burrow under the cap and be exposed to site COPCs. Other organisms may also be exposed by consuming these burrowing organisms. The wildlife exposure model for site-specific investigations under MTCA includes five categories of ecological receptors along with surrogate receptors for the analysis. These five categories are (1) plants; (2) soil biota (e.g., earthworms); (3) mammalian herbivore (e.g., vole); (4) mammalian predator (e.g., shrew); and (5) avian predator (e.g., American robin). Plants would not exist on a low-permeability cap, so for this remedial action potentially complete exposure pathways would exist only for the earthworm (soil biota), shrew (mammalian predator), and American robin (avian predator).

Geomatrix proposes to complete the Toxicological Assessment by a combination of soil bioassay testing and risk calculations. For areas in which vegetation must be maintained, soil concentrations that would be protective of soil biota would be determined by conducting earthworm soil bioassays using protocols described in Ecology Publication No. 96-327: Earthworm Bioassay Protocol for Soil Toxicity Screening. Bioassays would be conducted over the range of COPC site concentrations to determine a No-Observed-Adverse Effect Level (NOAEL) and Lowest-Observed-Adverse Effect Level (LOAEL) for the site. The NOAEL or LOAEL would provide a site-specific screening level that is protective of soil biota. The use of a lettuce bioassay test may be conducted where plants must be maintained to ensure protection of plants as well as soil biota and wildlife.

The potential for adverse effects to mammalian and avian predators would be assessed using the wildlife exposure model equations described under WAC 173-340-7493 (3) (c). The default exposure parameters that are used in these equations will be reviewed to ensure they are relevant to the site-specific conditions that would exist following completion of the remedial option.

11.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN

This RI/FS Work Plan outlines the approach for assessing the nature and extent of affected media and evaluating the feasibility of remedial alternatives. The approach will be consistent with MTCA requirements to ensure protection of human health and the environment by eliminating, reducing, or otherwise controlling risk posed through each exposure pathway and migration route (WAC 173-340-350). Requirements for selection of cleanup actions (WAC 173-340-360) will also be addressed as appropriate in selection of the preferred alternatives.

11.1 REMEDIAL INVESTIGATION WORK PLAN

A considerable amount of existing data are available that can be used to help define the nature and extent of contamination at the site during the RI. These available data include the operational history of the former sawmill and plywood plant and subsequent redevelopment activities, as well as extensive site characterization data acquired to date. To identify data gaps, all available site characterization data for soils, groundwater, and sediment, along with site history information, will be compiled in the RI. Additional data will be collected and evaluated as part of the RI to fill the remaining data gaps and complete the characterization of the nature and extent of contamination at the site.

Work to be conducted to fill existing data gaps is outlined in Appendix A (Final Uplands Sampling and Analysis Plan) and Appendix B (Final Sampling and Analysis Plan for Sediment Characterization). All work will be conducted according to the Site-Specific Health and Safety Plan (HASP) (Appendix C).

11.1.1 Upland Soils

For upland soils, areas of potential concern were identified for the purpose of this Work Plan based on detections of analytes that exceed the screening levels outlined in Section 5.0 (Figures 10 and 11). Two sets of screening levels were considered to identify areas of potential concern. One set of preliminary screening levels is based on protection of marine surface water (Figure 10). The other set is based on protection of human health (unrestricted land use scenario) and terrestrial ecological receptors (Figure 11). Soil samples that exceed the screening levels are generally concentrated in six upland areas identified as areas of potential concern.

1. *Potential public access area.* A small area in Tract 8 at the south end of the site has been proposed for public access to connect the Tommy Thompson Trail to Fidalgo

Bay. The specific location of such a hypothetical public access area has not been specified. This general area will be investigated for potential site contaminants to determine if it is suitable for this suggested site use.

2. *Press pit area.* Soil in the press pit area has significant concentrations of SVOCs, diesel, and heavy oil in soil. Screening level exceedances of arsenic, cadmium, copper, lead, selenium, thallium, vanadium, and zinc were also identified. The water in press pits #2 and #3 contains petroleum hydrocarbons (both diesel fuel and oil range) based on analytical results and the presence of an oily sheen. Samples will be collected from this area to better evaluate the areal and vertical extent of soils impacted by SVOCs (particularly cPAHs), petroleum, and metals.

3. *The boiler house/compressor area.* Soil samples surrounding this area exceed the screening levels for barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, vanadium, lead, cPAHs, PCBs, and/or TPH-D and TPH-Oil. A former smokestack was also present in this location. Much of the impacted soil was removed during a remedial effort in 2007, but a few historic samples indicate that some soil may have been left that exceeds the screening levels for protection of terrestrial ecological receptors or the screening levels for the protection of marine surface water. The areal extent of impacted soil around the boiler house and compressor building will be evaluated as part of the RI.

4. *Paint storage area.* A single sample was previously collected from the east side of the paint storage area within Tract No. 6 and analyzed for metals (arsenic, cadmium, chromium, and lead) and VOCs. Additional sampling will be completed in this area to identify if other metals, cPAHs, or selected VOCs are present at concentrations above the screening levels.

5. *Tract No. 5.* Few samples have been collected from the western half of Tract No. 5. A sample collected there by EPA in 2000 had a total cPAH concentration of 0.332 mg/kg, which exceeds the screening criteria for protection of human health and for protection of terrestrial ecological receptors. Concentrations of mercury, nickel, thallium, and vanadium also exceeded the screening criteria for protection of marine surface water.

6. *Former fuel tanks.* Approximately 70 feet north of the boiler house is the possible location of a former 18,000-gallon aboveground fuel oil tank (based on a drawing that is difficult to read). A former 12,000-gallon aboveground fuel oil tank was previously believed to have been located approximately 60 feet north of the compressor building. Although the one sample collected between these two locations indicated that no contamination is present above the screening levels, no samples have been collected from the area immediately adjacent to each former tank. A third fuel oil tank with a capacity of approximately 990 gallons was previously located 50 feet northeast of the hog fuel area. No samples have been collected from the vicinity of this tank to assess if it has impacted soil nearby. Approximately 70 feet south of the former compressor building is the location of a former 300-gallon fuel oil tank. A single soil sample contained 4,900 mg/kg of

> TPH-Oil, which exceeds the screening criteria for protection of human health, protection of terrestrial ecological receptors, and protection of marine surface water. Additional samples will be collected from the areas around the former tanks to identify any historic releases and to estimate the extent of contaminated soil.

To complete the RI, soil samples will be collected from approximately 30 soil sampling locations and from four well boreholes throughout the site, as shown on Figure 12. Samples will be analyzed for soil COPCs, as detailed in the Uplands Sampling and Analysis Plan (Appendix A).

11.1.2 Groundwater

Existing groundwater sampling data available for the site include grab groundwater samples collected by EPA (2000) and the 3 years of data from groundwater monitoring conducted following the removal of TPH-impacted soil on the former City of Anacortes parcel (Tract No. 4). Based on the chemical concentrations detected from the grab groundwater samples, groundwater was identified as a potential contaminant transport pathway at the site. However, due to high turbidity in groundwater samples, analytical results for inorganic constituents from the samples are not considered representative of actual groundwater concentrations. Two groundwater monitoring wells were installed in 2004; however, no analytical data are available from these wells. In order to complete characterization of groundwater flow directions and water quality conditions, four additional wells will be installed. Two rounds of groundwater sampling will be conducted using the two existing wells and the four additional wells as part of this RI to assess groundwater conditions. Additional groundwater monitoring will likely be required, and results will be presented in follow-up reports.

Water was also collected from a shoreline seep about 60 feet north of the compressor building (EPA, 2000), although the precise location was not specified. The sample was analyzed for SVOCs, VOCs, and inorganic constituents. None of the analytes was detected at significant concentrations (EPA, 2000). Seep sampling will be conducted at four locations downgradient of the nearshore monitoring wells to assess the potential migration of COPCs to the sediments.

11.1.3 Sediments

For sediments, areas that exceed SQS chemical and/or biological criteria will be considered areas of potential concern to be addressed in the RI. Remaining gaps in the sediment data to be addressed in the RI were described in Section 8.4.6. A Sampling and Analysis Plan for Sediments (Appendix B) describes the proposed sampling effort. Grab samples will be collected using a modified systematic grid design. Samples will be submitted for analysis according to a tiered analysis schedule (Figure 13). Sample locations are shown on Figure 14. Screening for accumulation of wood debris will be conducted using visual, analytical (TVS, TOC, pore water ammonia, and sulfide), and biological toxicity assessment methods (Microtox®), as requested by Ecology.

Visual estimation of surficial wood cover will use a point contact method, a statistically defensible method of reducing biases associated with visual estimation of cover (Foster et al., 1991). Stations with surficial coverage of wood greater than 50% will be considered areas of potential concern and will be addressed in the RI.

The remaining samples that fail the initial screening criteria will be tested for biological effects using standard SMS bioassay procedures. In addition, the initial screening results for all the stations will be reviewed in consultation with Ecology. Additional stations may be selected for bioassay testing based on the initial screening results. Stations failing the SMS bioassay criteria (Table 4) will be analyzed for the SMS list of COCs (Table 3) as requested by Ecology.

Sediments from sample locations that pass the initial screening criteria or the biological effects criteria will be combined into one or more composite samples and screened for PCBs and dioxins using criteria supplied by Ecology. If a composite sample exceeds the screening criteria then sediments from each of the stations comprising the composite will be individually analyzed for dioxins or PCBs as appropriate for defining the areas of potential concern.

The results of the sampling and analysis are expected to be sufficient to identify areas for potential cleanup. Additional sampling and analysis (including determining the depth of potential contamination and refinement of the cleanup area) will be coordinated with Ecology and covered (if required) by supplemental addendums to the SAP.

11.1.4 Preliminary Cleanup Levels

The RI report will present a definitive assessment of historic hazardous substance releases from the facility. Appropriate preliminary cleanup levels (PCLs) will be developed as part of the RI for each COPC identified in the RI. The PCLs will be used to evaluate the results of the soil, groundwater, and sediment investigation to determine if potential risks are present for either human health or the environment. This may require site-specific assessments of both human health and ecological risk.

11.2 FEASIBILITY STUDY WORK PLAN

The objective of the FS is to evaluate appropriate remediation alternatives and select the preferred remedial alternative. This will be accomplished by identifying and evaluating potential remedial alternatives appropriate for the risks to human health and/or the environment posed by the site. The FS will be performed in accordance with the requirements of the Agreed Order and MTCA regulations, specifically WAC 173-340-350 (8).

Potential remedial alternatives to be evaluated in the FS will be screened as follows.

- Remedial technologies to be evaluated are limited to those that have been proven effective through field implementation.
- Only remedial alternatives capable of attaining remediation objectives will be considered in the FS.
- Technologies and alternatives considered in the study are limited to those that are compatible with site constraints.

Professional engineering judgment, based on the current state of the remediation industry, will be used to select the technologies and alternatives to be addressed in the FS. This experience base has been accrued from implementing corrective action under MTCA, the Resource Conservation and Recovery Act (RCRA), and CERCLA at many sites over the past 25 years. The remedial technologies selected for the site will be selected after considering the investigation activities that have been conducted at the site, the present state of site development, and the projected continued industrial site use.

Regulations issued pursuant to MTCA specify the requirements for completing an FS and selecting a cleanup action. These requirements will be addressed in the FS. Each remedial alternative considered must be designed to comply with the MTCA rules. These rules provide general requirements for the FS and remedial alternatives, specify procedures for establishing cleanup levels and points of compliance, establish procedures for performing a risk assessment, and provide minimum requirements for establishing institutional controls and for selecting the preferred cleanup actions.

In general, MTCA requires an FS to comply with applicable state and federal laws and regulations. WAC 173-340-350 (8) specifies the following general requirements and guidelines for conducting an FS.

- Alternatives considered in the FS must be protective of human health and the environment by addressing site risks and exposure pathways.

- A reasonable number and type of alternatives must be considered in the FS.

- Alternatives may consist of several components, including removal/destruction technologies, immobilization technologies, engineering controls, institutional controls, and monitoring.

- Alternatives may include remediation levels to define when cleanup action components will be used.

- If appropriate, residual risks that may remain after implementation of a remedial alternative must be considered.

- Remedial alternatives capable of attaining the standard point of compliance must be included in the FS unless it is demonstrated that all such alternatives cannot be implemented.

- Conditional points of compliance (CPOCs) may be included in remedial alternatives considered in the FS. CPOCs are allowed if it is not practicable to meet groundwater cleanup levels at the standard POC in a reasonable restoration time frame.

- Alternatives must be evaluated relative to the criteria of WAC 173-340-360.

- At least one permanent cleanup action alternative must be considered for each area of concern unless permanent alternatives are determined to be impracticable or have disproportionate costs per WAC 173-340-350(8)(c)(ii)(B).

Ecology has defined expectations regarding cleanup action alternatives that are documented in WAC 173-340-370. As noted in these rules, "these expectations represent the types of cleanup actions the department considers likely results of the remedy selection process… ." These expectations are summarized below and will be addressed in the FS.

- Treatment technologies will be emphasized at locations with liquid wastes, high COC concentrations, highly mobile substances, and/or discrete affected areas that are amenable to treatment.

- Hazardous substances will be destroyed, detoxified, and/or removed throughout sites with small quantities of affected media.

- Use of engineering controls is accepted for sites with large quantities of media with low COC levels where treatment is impracticable.

- Active measures will be taken to prevent rainfall and/or surface water runoff from contacting affected soil or waste.
- If impacted media will remain on site at concentrations exceeding cleanup levels, the media will be consolidated to the extent practicable if necessary to prevent direct exposure and migration.
- If a facility is adjacent to surface water bodies, active measures will be taken to prevent releases of COCs via surface water runoff and groundwater discharge.

Natural attenuation of COCs may be appropriate at sites where removal or treatment of the source has been performed to the maximum extent practicable, unacceptable risks to human health and the environment do not result during the attenuation period, natural degradation has been proven effective, and appropriate monitoring is performed.

11.2.1 Remedial Action Objectives

To effectively develop and focus remediation alternatives, it is necessary to establish remediation objectives for the site. This section outlines the remedial action objectives to be addressed in the FS.

11.2.1.1. Upland Area

The overall remedial action objective (RAO) for uplands soil and groundwater is to select remedies that are protective of human health and the environment and that comply with MTCA and other applicable or relevant and appropriate regulations (ARARs) (see Section 11.2.2). Specific goals for protecting human health and the environment will be developed during the FS based on COPCs, the site conceptual model, exposure routes, and receptors at a site. The preliminary RAOs for uplands soil and groundwater are presented below.

- Prevent human exposure to site COPCs that exceed screening levels protective of human health.
- Prevent exposure of potential ecological receptors to site COPCs that exceed applicable ecological receptor screening levels.
- Prevent migration of site COPCs in soil or groundwater to surface water or sediment.
- Attain applicable soil and groundwater cleanup standards meeting requirements specified in the MTCA regulations.
- Prevent the release of soil and groundwater COPCs to surface water, marine water, or sediments in Fidalgo Bay.

- Prevent exposure of on-site workers and recreational users visiting the potential public access area described in Section 4.1.2 to soil and groundwater constituents at levels that may cause adverse human health impacts.
- Support future redevelopment of the site for future productive use.
- Comply with MTCA and other ARARs.

The RAOs will be finalized during the FS and will be based on the results of the RI and the cleanup levels developed as part of the RI/FS process.

Other remedial objectives developed in the FS will be based on the site conceptual model that will be completed in the RI and will take site-specific considerations into account, such as site use and zoning, potential future site uses, including public access, and the potential future uses of groundwater.

11.2.1.2 Marine Area

Sediments that fail ecological or human health criteria will be considered for remedial action. Any objective of sediment remedial action will be to meet the SQS and human health criteria that are developed as part of the RI/FS, at the point of compliance which will be the top 10 centimeters (cm) of sediment.

11.2.1.3 Habitat Restoration

The site is being overseen by Ecology and work will be conducted under the Governor's PSI. Ecology is striving to combine remediation and habitat restoration to maximize the synergy of the process. As a result, the FS will evaluate elements of the remedial alternatives for opportunities to coincidentally improve the value of habitat and/or provide for shoreline restoration in conjunction with remedial actions.

11.2.1.4 Areas Outside of the GBH parcels

Upland areas outside the GBH property boundary located within the historic footprint of the plywood mill are developed with active businesses. As such, any invasive remedial actions beyond those that have occurred may be impracticable. The FS will evaluate options for implementation of institutional and engineering controls for areas of the site that cannot be remedied by currently available technologies.

11.2.2 ARARs

The FS report will discuss compliance of the preferred alternative with ARARs, including state and federal laws, in accordance with WAC 173-340-350, WAC 173-340-710, and the requirements of the Agreed Order. "Applicable" requirements mean those regulatory cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a COPC, remedial action, location, or other circumstance at the site and that are applicable to the site under law. "Relevant and appropriate" requirements are regulatory requirements or regulatory guidance that do not apply to the site under law but have been determined to apply by Ecology. ARARs are often identified as chemical-specific, location-specific, or remedial action-specific. A number of regulations include requirements in more than one of these three categories.

Chemical-specific requirements are health- or risk-based numerical standards or methods that, when applied to the site-specific conditions, enable selection of the cleanup levels. If a COPC has more than one such requirement, the most stringent will generally be selected. This approach is consistent with Ecology cleanup level guidance (Ecology, 2001).

Action- and location-specific requirements influence the character and nature of the cleanup standard, cleanup action, and/or remediation level. An example of location-specific requirements that may be included for consideration in the FS would be the state Shoreline Management Act. This state law may affect future remedial actions at the site if such actions have the potential to affect areas within 200 feet of the shoreline. During initial FS development, location- and action-specific ARARs will be identified. When the detailed analysis of cleanup actions is completed, all location- and action-specific ARARs will be tailored to each alternative before a comparison of alternatives begins.

11.2.3 Cleanup Levels, POC, and Remediation Levels

This section describes the approach to developing cleanup levels, the point of compliance, and remediation levels.

11.2.3.1 Cleanup Levels

MTCA regulations define three basic methods of determining cleanup levels for soil and groundwater.

- Method A applies to "routine" sites or where few hazardous substances are involved. Method A cleanup levels have been established for unrestricted and industrial land uses.

- Method B is the "universal" method that can be applied to all media at all sites (unrestricted and industrial use). Two types of Method B cleanup levels can be used: (1) standard (or default) cleanup levels, and (2) modified cleanup levels (incorporating chemical-specific or site-specific information).
- Method C is the conditional method that can be used where more rigorous cleanup levels cannot be achieved. Similar to Method B, Method C comprises two types: standard (default) and modified. Use of Method C cleanup levels requires institutional controls to ensure future protection of human health and the environment, and is generally applicable only to industrial sites.

For carcinogenic COPCs, Method B and Method C levels are generally defined as the upper bound of the estimated lifetime cancer risk, which cannot exceed 1 x 10^{-6} and 1 x 10^{-5} for Method B and Method C, respectively, for individual carcinogens. Cumulative hazard indices for both Methods B and C cannot exceed 1.0.

PCLs and the potentially applicable exposure pathways will be identified in the RI for each constituent found at the site. Soil and groundwater cleanup levels will be calculated as appropriate in the FS, based upon the nature and extent of affected soil, the specific COPCs present, the conceptual model of transport and receptors, and the current and projected land uses. The site meets the industrial criteria outlined in WAC 173-340-745, based on the current and projected future industrial land use. It is anticipated that industrial soil cleanup levels and modified Method B groundwater cleanup levels will be the most appropriate for all parcels, except the public access areas.

Soil cleanup levels that protect groundwater and marine surface water [specifically Method B cleanup levels under WAC 173-340-745(5)(b)(iii)(A)], will be derived in the RI and reevaluated in the FS. Site-specific parameters, where available, will be used as input parameters in the equations from WAC 173-340-747(4). Soil analytical results from the RI will be used to derive average, site-specific hydrogeological parameters applicable to the site. Where difficulty in achieving soil cleanup levels in the source area is predicted due to site constraints, the FS will evaluate the use of remediation levels for near-source soils, with the concurrent goal of attaining cleanup levels at an appropriate CPOC established in accordance with MTCA requirements.

11.2.3.2 Points of Compliance

Cleanup levels are applied at a specific location to assess compliance with MTCA regulations. The location where the cleanup level must be met is known as the POC. The POC can be defined independently for each medium (i.e., soil or groundwater). Under the MTCA regulations, the POC may be a standard POC (SPOC) or a conditional POC. The SPOC for soil or groundwater is defined in the MTCA regulations as applying throughout the site (i.e., to all soil or groundwater present at a site). A CPOC is defined as a POC located at a specified distance from the source of the contamination. If it can be demonstrated in accordance with the MTCA regulations that it is not practicable to meet the cleanup level at the SPOC within a reasonable time frame, Ecology may approve a CPOC. It should also be noted that different cleanup approaches may lead to different points of compliance for the same constituent and medium. As an example, the CPOC that would be used for a cleanup action based upon pump and treat would likely be substantially different from the CPOC that would apply to natural attenuation. The potential use of a CPOC in the remedial alternatives will be evaluated in the FS.

A CPOC must be as close as practicable to the contaminant source and cannot exceed the property boundary, except if the property is near to or abutting surface water or if there is an area-wide groundwater contamination problem per the provisions of WAC 173-340-720(8). Where the groundwater cleanup level is based on protection of surface water, Ecology may approve a CPOC that is located within the surface water as close as technically possible to the point or points where groundwater flows into the surface water. The site is abutting Fidalgo Bay; therefore, CPOCs may be proposed at locations between the source areas and the shoreline. A POC or CPOC must be associated with each remedial alternative evaluated in detail in the FS.

The relevant regulatory provisions for establishing CPOCs for affected groundwater at the site are presented in WAC 173-340-720(8). These provisions also provide for establishment of a CPOC beyond the site property lines. The specific requirements applicable to the site, where groundwater discharges to surface water, are as follows.

- It must be demonstrated through the RI/FS and cleanup action selection/planning process conducted in accordance with WAC 173-340-350 through 173-340-390 that it is not practicable to attain the SPOC within a reasonable time frame.

- Explain how all practicable methods of treatment have been used for cleanup of the affected groundwater before it discharges to surface water.

- Evidence showing affected groundwater will not continue to discharge to the surface water after implementation of the cleanup action.

- No mixing zone has been used in attaining cleanup levels at the CPOC.

- Evidence showing the groundwater discharge will not cause violations of sediment quality values specified in WAC 173-204.

- Groundwater and surface water monitoring must be conducted as appropriate to assess the long-term performance of the cleanup action, including the potential for bioaccumulation for constituents below detection limits.

- A public notice of the CPOC must be provided to the natural resource trustees, Washington Department of Natural Resources, and the U.S. Army Corps of Engineers.

- If the CPOC is on an off-site property, any property owners located between the source property and the surface water body agree in writing to the CPOC.

- If the CPOC is on an off-site property and the extent of the plume exceeding the cleanup level is known and does not reach the surface water body, the CPOC cannot be located beyond the extent of affected groundwater exceeding the cleanup level at the time the CPOC is approved.

These requirements will be addressed as appropriate in the FS. For cleanup alternatives incorporating a CPOC, the regulations at WAC 173-340-720(8)(e) provide for use of upland monitoring wells to demonstrate compliance at the groundwater CPOC. Under these provisions, Ecology must consider that natural attenuation of groundwater constituents may occur between the monitoring wells and the surface water. An estimate of natural attenuation that considers the rate of attenuation, presence of preferential flow pathways, and any effects that changes in water chemistry due to natural attenuation processes may have on attaining surface water or sediment quality standards can be used to assess attainment of cleanup levels at the CPOC.

The relevant provisions for establishing a POC for soil located on industrial sites are presented in WAC 173-340-740(6). These provisions are as follows:

- For soil cleanup levels based upon protection of groundwater, the soil POC shall be the SPOC.

- For soil cleanup levels based upon protection from vapors, the POC shall be all soils above the uppermost saturated zone.

- For soil cleanup levels based upon direct contact human exposure, the POC shall be the upper 15 feet of soil throughout the site.

- For soil cleanup levels based upon ecological considerations, the POC must be established in accordance with WAC 173-340-7490.

- For cleanup actions incorporating containment, Ecology recognizes that the cleanup levels specified in the regulation will typically not be met at the required POC, and that the cleanup action will be determined to be in compliance provided that the following conditions are met.
  - The cleanup action is demonstrated to be permanent to the extent practicable under the provisions of WAC 173-340-360.
  - The cleanup action is protective of human health.
  - The cleanup action is demonstrated to be protective of ecological receptors under WAC 173-340-7490 to 173-340-7494.
  - Institutional controls are implemented in accordance with WAC 173-340-440 that prohibit activities that may adversely affect the cleanup action.
  - Compliance monitoring under WAC 173-340-410 and periodic reviews under WAC 173-340-430 are conducted.
  - The types, levels, and amounts of hazardous substances remaining after implementation of the cleanup action and the measures to prevent migration of and contact with the hazardous substances are specified in the draft cleanup action plan.

These requirements will be addressed as appropriate in the FS.

11.2.3.3 Remediation Levels

MTCA regulations provide for remediation levels in the development and evaluation of cleanup action alternatives. Remediation levels are constituent concentrations in affected media that differentiate between different cleanup action components of a comprehensive cleanup action. By definition, remediation levels exceed cleanup levels. Remediation levels may be identified by a constituent concentration or by some other means of identifying the hazardous constituent, such as appearance. Remediation levels included in an approved CAP are enforceable under MTCA regulations, must incorporate plans for adequate monitoring, and must be protective of human health and the environment. Cleanup action alternatives to be developed for the FS may incorporate remediation levels. If remediation levels are used in a cleanup action alternative considered in the FS, the provisions of WAC 173-340-355 will be addressed.

Cleanup action alternatives considered in the FS that incorporate remediation levels will be evaluated in the same manner and using the same standards specified in WAC 173-340-360 as used for other cleanup action alternatives. The methods used to establish remediation levels may be qualitative or quantitative. If appropriate, a quantitative risk assessment performed in accordance with WAC 173-340-357 may be used to support remediation levels. Fate and transport considerations, including natural attenuation, biodegradation, and soil/groundwater partitioning, may also be used in developing and assessing remediation levels, as noted in WAC 173-340-355(4). The methods used for establishing remediation may be simple or complex, as appropriate to the site under evaluation.

11.3 REMEDIATION CONSTRAINTS

Site-specific factors and potential future use can pose significant obstacles that may limit the practicability of some remedial technologies. The remedial technologies proposed in the FS will take into account technical considerations that could prevent successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil properties. Administrative limitations will also be considered, including the ability to obtain permits and the availability of qualified contractors, equipment, and disposal services. Some of the site-specific technical and administrative difficulties are outlined below, and will be further discussed in the FS.

Complex chemistry. The historical use of the site as a sawmill and plywood production facility has left a significant amount of wood waste in site soils. The wood waste ranges in size from boards and timbers to fine sawdust. In one area the wood waste was observed to a depth of 22 feet bgs. Wood naturally contains a complex mixture of chemicals, which may be falsely identified as petroleum contamination when analyzed using standard analytical methods for petroleum hydrocarbons (NWTPH-Dx). Some types of trees, notably cedar, have a significant concentration of natural oils. Indeed, cedar oil is used widely as a scent. Special consideration must be given to the presence of this wood waste in order to accurately delineate the area of petroleum hydrocarbon contamination on site.

Debris. A significant number of wooden piles, concrete foundations and pile caps, miscellaneous structures, and debris remain on site from the former mill and plywood facility, particularly in the marine area. Most of the aboveground debris (wooden piles, concrete foundations, and pile caps) in the uplands has been removed as part of the site cleanup and should not be a hindrance to accessing areas of contamination.

Non-GBH-owned parcels. The area covered by the Agreed Order includes actively used areas outside of the property owned by GBH. A public hiking trail that was once a former rail line is adjacent to the western edge of the GBH parcels. An active yacht manufacturing facility is present at the northwestern portion of the Agreed Order Area. Both of these areas have been previously investigated. These areas are further discussed in Section 2.2.

11.4 SCREENING OF REMEDIAL TECHNOLOGIES

The first step in developing potentially practicable remedial alternatives for the site will be to identify remedial technologies for each general response action, and then screen them relative to MTCA criteria. The screening process removes from further consideration technologies that are not applicable or feasible for the site, or that can be represented by other, comparable technologies in order to simplify the development of remedial alternatives. The technology identification and screening process will be focused in this case by limiting the universe of technologies to those that have been successfully applied at other similar sites. General screening criteria under MTCA were outlined above in Section 11.2.

The media-specific remedial technologies that pass the screening process will be combined into site-wide remedial alternatives. The remedial alternatives that are implementable and practicable will be assembled for detailed evaluation and evaluated according to the evaluation criteria described in Section 11.5.

11.5 EVALUATION CRITERIA TO BE CONSIDERED

A detailed analysis of each remedial alternative will be conducted according to the requirements of WAC 173-340-350, "Remedial Investigation and Feasibility Study." The remedial alternatives will be evaluated for compliance with the requirements of WAC 173-340-360, "Selection of Cleanup Actions," including a detailed evaluation of remedial alternatives relative to the following criteria:

1. Compliance with Cleanup Standards and Applicable Laws;
2. Protection of Human Health;
3. Protection of the Environment;
4. Provision for a Reasonable Restoration Time Frame;
5. Use of Permanent Solutions to the Maximum Extent Practicable;
6. The Degree to which Recycling, Reuse, and Waste Minimization are Employed;
7. Short-term Effectiveness;
8. Long-Term Effectiveness;

9. Net Environmental Benefit;
10. Implementability;
11. Provision for Compliance Monitoring;
12. Cost-Effectiveness; and
13. Prospective Community Acceptance.

The remedial alternative that is judged to best satisfy the evaluation criteria listed above will be identified. Rationale for the selection will be provided, and the recommended remedial alternative further developed, either in the FS Report or in the ensuing Draft Cleanup Action Plan.

12.0 APPROACH FOR FUTURE WORK

Following approval of this Final Work Plan by Ecology, investigation work will be implemented during summer 2008. Investigation will include soil and sediment sampling, installation of wells, groundwater sampling, and surveying. Details on the work to be completed are presented in the Final SAPs for uplands and sediments (Appendix A and Appendix B). In addition, GBH has installed a permanent fence around the GBH parcels and removed woody debris and aboveground concrete in the uplands. Concrete was sampled for TPH and PCBs (TPH and PCBs are the COPCs most likely to be present in concrete). Concrete that passes those analyses will be crushed and used on site for base course when the site is ready for development. Concrete and other debris in the marine areas beyond the OHWM will not be demolished and removed until permits can be obtained for in-water work. Large concrete structures in the intertidal zone could be demolished during an early interim action, upon receipt of permits.

12.1 FIELD TASKS—PHASES OF SAMPLING

This section outlines general the approach to accomplish field work to be conducted as part of the RI.

12.1.1 Uplands

GBH has removed much of the large woody and concrete debris within the upland area, which will facilitate access to portions of the site. Those areas that remain inaccessible due to soft soils or protruding pilings will be sampled with a hand auger. Areas that can be accessed by a push-probe drill rig will be continuously sampled to the top of the native clay layer or at the point of refusal. Soils from the four new monitoring wells will be sampled at 5-foot intervals to the point at which the top of the native clay is reached. Screened casing will be placed such that it extends from the base of the boring to 2 feet above the top of the water table.

Areas in which planned monitoring wells are to be installed are currently very wet and may be unsafe for a drilling rig to access. Road ballast material may need to be placed to create an access route to the areas where the hollow-stem auger is needed to drill the four new monitoring wells, particularly the southernmost well. Field activities are expected to be conducted within a period of 2 weeks. Well development will be conducted by the driller at the time of well installation, and well sampling will be performed no sooner than 48 hours after the wells are developed.

The RI field investigation may be conducted in two phases. The first phase of the investigation proposed in this Work Plan is designed to identify the full nature and extent of contaminants and toxic effects in upland areas. Phase 2 field investigation (if necessary based on Phase 1 results) will be conducted to further define the nature and extent of contamination and toxic effects based on findings during Phase 1.

12.1.2 Marine Area

A Sampling and Analysis Plan, meeting the requirements specified in Ecology's guidance (Ecology 2003), is provided as Appendix B. The SAP for Sediment Characterization (Appendix B) details the approach to sediment collection and analysis of sediment samples adjacent to the former mill. For this project a tiered testing approach will be used to:

- identify wood debris areas of concern,
- screen the project site for areas of dioxin and PCB contamination that pose a potential human health risk, and
- conduct additional analysis for COPCs in areas that show significant biological impacts.

A tiered analytical testing scheme (Figure 13) based on the screening criteria discussed in the Sediment SAP (Appendix B) will be employed. The tiered analysis approach was developed in consultation with Ecology. Figure 14 shows the location of the proposed sample stations. The number and location of the sample stations were developed based on requirements specified by Ecology.

12.2 SCHEDULE AND DELIVERABLES

This section outlines the preliminary schedule for conducting the RI/FS. The schedule includes time for and is dependent on required Ecology review and approval of various draft and final reports.

12.2.1 RI/FS Work Plan

Per the schedule set forth in the Agreed Order with GBH, the Final RI/FS Work Plan is due on May 16, 2007. This deadline assumes that there will be Ecology review of this Draft Final Work Plan and revisions to the Draft Final Work Plan prior to submittal of a Final RI/FS Work Plan.

12.2.2 RI/FS Field Investigation Activities

Field activities for the RI/FS will occur during summer 2008. Upland soil sampling, well installation, and well sampling can occur as soon as this Work Plan is approved. Portions of the site are difficult to access due to wet soils at the surface that create conditions constraining the movement of large drilling equipment. If areas in which planned monitoring wells are to be installed do not dry out sufficiently for a drilling rig to access, road ballast material may need to be placed to create an access route. Field activities are expected to be conducted within a period of 2 weeks and will involve mobilization of a push-probe drilling rig for soil sampling and a hollow-stem auger rig for well installation. Well development will be conducted by the driller at the time of well installation. Well sampling will be performed no sooner than 48 hours after the wells are developed.

Sediment sampling activities will be conducted within 30 days of Ecology approval of the sediment SAP and receipt of all required permits. Sediment sampling will be conducted within the period between August 15 and September 15 (assuming all approvals and permits are received) as mandated by Ecology. Field activities for the initial grab sample collection will be conducted over a period of approximately 1 week.

12.2.3 RI/FS Laboratory Analyses

The laboratory will deliver final data within approximately 30 days of the end of sampling, with the possible exception of dioxin analyses that may require 45 days. Geomatrix will validate the chemical data within approximately 30 days of receipt of data from the laboratory. Information will be compiled into an environmental information management (EIM) data set compatible with electronic data deliverables (EDDs), beginning with laboratory reports and including data validation activities. Per the terms of the Agreed Order, data transfer to Ecology will be performed within 45 calendar days of receipt of all laboratory data.

As the preliminary data are received from the laboratory, the results will be reviewed to ascertain whether previously unidentified COPCs are present. In such a case, it may be warranted to request additional analyses from the laboratory while the sample is still within holding times.

If analytical results from the upland investigation indicate a newly discovered area of concern, or that the extent of contamination has not been adequately addressed, a second phase of sampling and analysis may be necessary. Additional investigation efforts will be coordinated with the Ecology project manager and conducted using procedures and protocols outlined in this Work Plan, SAPs, and applicable QAPP (Appendixes A and B).

Sediment analyses will be based on the tiered approach described in detail in the Sediment SAP/QAPP (Appendix B). Sampling stations will be successively analyzed per the tiered approach to determine the potential for human or biological impacts, and to provide information for design of remedial alternatives. Additional samples may be required to better assess the extent of COPCs as part of a second phase or during remedial design. The analytical and field data will be compiled into an EIM-compatible electronic data deliverable for potential submission to Ecology. The analytical data will also be maintained in the electronic Laboratory Information Management System or archival system at Analytical Resources, Inc. (ARI), the designated project laboratory.

12.2.4 Report

A Draft RI/FS report will be submitted within 100 calendar days after receipt of all analytical data collected in the RI/FS. The final RI/FS report will be delivered to Ecology 115 days after submittal of the Draft RI/FS report, which includes 30 days for Ecology to review the Draft RI/FS report, 21 days for Ecology to review the Draft Final RI/FS report, and 30 days for a public comment period.

Comments from the public will be addressed in the development of the Final RI/FS report, and the RI/FS report will be finalized. In accordance with the terms of the Agreed Order, the Draft Cleanup Action Plan will be submitted within 45 days of approval of the Final RI/FS.

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TABLES

Geomatrix

TABLE 1

SOIL SCREENING LEVELS, UPLANDS AREA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	MTCA Method B Soil-Direct Contact Unrestricted Land Use Carcinogen (mg/kg)	MTCA Method B Soil-Direct Contact Unrestricted Land Use NonCarcinogen (mg/kg)	MTCA Method B Protective of Groundwater as Marine Surface Water [1] (mg/kg)	Area Background (mg/kg)	MTCA Method B Protective of Terrestrial Ecological Receptors[2] (mg/kg)	Selected Screening Level (mg/kg)	Henrys Law Constant (unitless) (Hcc) (unitless)	Kd (Distribution Coefficient for metals) (L/kg)	Koc (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)
Metals									
antimony	-- [3]	32	579	--	--	**32**	0E+00	4.5e+01	--
arsenic	0.67	24	0.08	8.47	20	**8.47** [4]	0E+00	2.9e+01	--
barium compounds	--	16,000		--	1,250	**1,250**	0E+00	4.1e+01	--
beryllium	--	160	4,267	1.5	25	**25**	0	790	--
cadmium	2 [5]	80	1.21	1.2	25	**1.21**	0E+00	--	--
chromium (total)	2,000 [5]	--	--	1.7	42	**117** [4]	--	--	--
copper	--	3,000	1.07	52.9	100	**52.9** [4]	0E+00	2.2e+01	--
lead	250 [5]	--	1,620	--	220	**220**	0E+00	1e+04	--
mercury	2 [5]	24	0.03	0.13	9	**0.13** [4]	4.7e-01	5.2e+01	--
nickel	--	1,600	10.7	54.2	100	**54.2** [4]	0E+00	6.5e+01	--
selenium	--	400	7.38	--	0.8	**0.8**	0E+00	5e+00	--
silver	--	400	0.32	--	--	**0.32**	0E+00	8.3e+00	--
thallium	--	5.6	0.67	--	--	**0.67**	0E+00	7.1e+01	--
zinc	--	24,000	101	85.6	270	**101**	0E+00	6.2e+01	--
Polychlorinated Biphenyls									
Aroclor 1016	--	5.6	--		--	**5.6**	--	--	1.1e+05
Aroclor 1221	--	--	--		--	**--**	--	--	--
Aroclor 1232	--	--	--		--	**--**	--	--	--
Aroclor 1242	--	--	--		--	**--**	--	--	--
Aroclor 1248	--	--	--		--	**--**	--	--	--
Aroclor 1254	--	1.6	--		--	**1.6**	--	--	--
Aroclor 1260	--	--	--		--	**--**	--	--	8.2e+05
Aroclor 1262	--	--	--		--	**--**	--	--	--
Aroclor 1268	--	--	--		--	**--**	--	--	--
Total polychlorinated biphenyls	0.5	--	--		2	**0.5**	--	--	3.1e+05
Dioxins and Furans									
1,2,3,4,6,7,8-HpCDD	--	--	--		--	**--**	--	--	--
1,2,3,4,6,7,8-HpCDF	--	--	--		--	**--**	--	--	--
1,2,3,4,7,8,9-HpCDF	--	--	--		--	**--**	--	--	--
1,2,3,4,7,8-HxCDD	--	--	--		--	**--**	--	--	--
1,2,3,4,7,8-HxCDF	--	--	--		--	**--**	--	--	--
1,2,3,6,7,8-HxCDD	--	--	--		--	**--**	--	--	--
1,2,3,6,7,8-HxCDF	--	--	--		--	**--**	--	--	--
1,2,3,7,8,9-HxCDD	--	--	--		--	**--**	--	--	--
1,2,3,7,8,9-HxCDF	--	--	--		--	**--**	--	--	--
1,2,3,7,8-PeCDD	--	--	--		--	**--**	--	--	--
1,2,3,7,8-PeCDF	--	--	--		--	**--**	--	--	--
2,3,4,6,7,8-HxCDF	--	--	--		--	**--**	--	--	--
2,3,4,7,8-PeCDF	--	--	--		--	**--**	--	--	--
2,3,7,8-TCDD	0.000011	--			--	**0.000011**	--	--	--
2,3,7,8-TCDF	--	--	--		--	**--**	--	--	--
OCDD	--	--	--		--	**--**	--	--	--
OCDF	--	--	--		--	**--**	--	--	--
Total ecological TEQ dioxin	--	--	--		5.00E-06	**0.000005**	--	--	--
Total ecological TEQ furan	--	--	--		3.00E-06	**0.000003**	--	--	--

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Former Custom Plywood Mill
Anacortes, Washington

Analyte	MTCA Method B Soil-Direct Contact Unrestricted Land Use Carcinogen (mg/kg)	MTCA Method B Soil-Direct Contact Unrestricted Land Use NonCarcinogen (mg/kg)	MTCA Method B Protective of Groundwater as Marine Surface Water [1] (mg/kg)	Area Background (mg/kg)	MTCA Method B Protective of Terrestrial Ecological Receptors[2] (mg/kg)	Selected Screening Level (mg/kg)	Henrys Law Constant (unitless) (Hcc) (unitless)	Kd (Distribution Coefficient for metals) (L/kg)	Koc (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)
Total Petroleum Hydrocarbons									
diesel range hydrocarbons	2,000 [5]	--	--		460	**460**	--	--	--
lube oil	2,000 [5]	--	--		--	**2,000**	--	--	--
gasoline range hydrocarbons (no benzene)	100 [5]	--	--		200	**100**	--	--	--
gasoline range hydrocarbons (with benzene)	30 [5]	--	--		200	**30**	--	--	--
Benzene, Toluene, Ethylbenzene, Xylenes									
benzene	18	320	0.29		--	**0.29**	2.3e-01	--	6.2e+01
ethylbenzene	--	8,000	17.96		--	**17.96**	3.2e-01	--	2e+02
toluene	--	6,400	109		--	**109**	2.7e-01	--	1.4e+02
m,p-xylenes	--	16,000	--		--	**16,000**	2.8e-01	--	2.3e+02
o-xylene	--	160,000	--		--	**160,000**	2.1e-01	--	2.4e+02
Volatile Petroleum Hydrocarbons									
C5-C6 Aliphatics	--	--	--		--	**--**	--	--	--
>C6-C8 Aliphatics	--	--	--		--	**--**	--	--	--
>C8-C10 Aliphatics	--	--	--		--	**--**	--	--	--
>C10-C12 Aliphatics	--	--	--		--	**--**	--	--	--
Total Aliphatics	--	--	--		--	**--**	--	--	--
>C8-C10 Aromatics	--	--	--		--	**--**	--	--	--
>C10-C12 Aromatics	--	--	--		--	**--**	--	--	--
>C12-C13 Aromatics	--	--	--		--	**--**	--	--	--
Total Aromatics	--	--	--		--	**--**	--	--	--
methyl tert-butyl ether	560	69,000	--		--	**560**	1.8e-02	--	1.1e+01
benzene	18	320	0.29		--	**0.29**	2.3e-01	--	6.2e+01
toluene	--	6,400	109		--	**109**	2.7e-01	--	1.4e+02
ethylbenzene	--	8,000	17.96		--	**17.96**	3.2e-01	--	2e+02
m,p-xylene	--	16,000	--		--	**16,000**	2.8e-01	--	2.3e+02
o-xylene	--	160,000	--		--	**160,000**	2.1e-01	--	2.4e+02
Extractable Petroleum Hydrocarbons									
C8-C10 Aliphatics	--	--	--		--	**--**	**--**	**--**	**--**
>C10-C12 Aliphatics	--	--	--		--	**--**	**--**	**--**	**--**
>C12-C16 Aliphatics	--	--	--		--	**--**	**--**	**--**	**--**
>C16-C21 Aliphatics	--	--	--		--	**--**	**--**	**--**	**--**
>C21-C34 Aliphatics	--	--	--		--	**--**	**--**	**--**	**--**
C8-C10 Aromatics	--	--	--		--	**--**	**--**	**--**	**--**
>C10-C12 Aromatics	--	--	--		--	**--**	**--**	**--**	**--**
>C12-C16 Aromatics	--	--	--		--	**--**	**--**	**--**	**--**
>C16-C21 Aromatics	--	--	--		--	**--**	**--**	**--**	**--**
>C21-C34 Aromatics	--	--	--		--	**--**	**--**	**--**	**--**
Volatile Organic Compounds									
tetrachloroethane;1,1,1,2-	38	2,400	--		--	**38**	--	--	--
trichloroethane;1,1,1-	--	72,000	3373		--	**3373**	7.1e-01	--	1.4e+02
tetrachloroethane;1,1,2,2-	5	--	0.02		--	**0.02**	1.4e-02	--	7.9e+01
trichloroethane;1,1,2-	18	320	0.09		--	**0.09**	3.7e-02	--	7.5e+01
dichloroethane;1,1-	--	16,000	--		--	**16,000**	2.3e-01	--	5.3e+01
dichloroethylene;1,1-	--	4,000	0.02		--	**0.02**	1.1e+00	--	6.5e+01

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Volatile Organic Compounds (Continued)									
1,1-dichloropropene	--	--	--		--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--		--	--	--	--	--
trichloropropane;1,2,3-	0.14	480	--		--	**0.14**	--	--	--
trichlorobenzene;1,2,4-	--	800	2.67		--	**2.67**	5.8e-02	--	1.7e+03
trimethylbenzene;1,2,4-	--	4,000	--		--	**4,000**	--	--	--
dibromo-3-chloropropane;1,2-	0.71	--	--		--	**0.71**	--	--	--
1,2-dibromoethane (EDB)	0.012	--	--		--	**0.012**	--	--	66
dichlorobenzene;1,2-	--	7,200	15.26		--	**15.26**	7.8e-02	--	3.8e+02
dichloroethane;1,2-	11	1,600	0.18		--	**0.18**	4e-02	--	3.8e+01
dichloropropane;1,2-	15	--	0.08		--	**0.08**	1.2e-01	--	4.7e+01
trimethylbenzene;1,3,5-	--	4,000	--		--	**4,000**	--	--	--
dichlorobenzene;1,3-	--	--	13.04		--	**13.04**	--	--	--
1,3-dichloropropane	--	--	--		--	--	--	--	--
dichlorobenzene;1,4-	42	--	3.15		--	**3.15**	1e-01	--	6.2e+02
2,2-dichloropropane	--	--	--		--	--	--	--	--
2-butanone (MEK)	--	48,000	--		--	**48,000**	--	--	--
2-chloroethylvinylether	--	--	--		--	--	--	--	--
chlorotoluene;o-	--	1,600	--		--	**1,600**	--	--	--
2-hexanone	--	--	--		--	--	--	--	--
4-chlorotoluene	--	--	--		--	--	--	--	--
methyl isobutyl ketone	--	6,400	--		--	**6,400**	--	--	--
acetone	--	8,000	--		--	**8,000**	1.6e-03	--	5.8e-01
benzene	18	320	0.29		--	**0.29**	2.3e-01	--	6.2e+01
bromobenzene	--	--	--		--	--	--	--	--
bromochloromethane	--	--	--		--	--	--	--	--
bromodichloromethane	16	1,600	0.09		--	**0.09**	6.6e-02	--	5.5e+01
bromoform	130	1,600	0.93		--	**0.93**	2.2e-02	--	1.3e+02
bromomethane	--	110	6.95		--	**6.95**	2.6e-01	--	9e+00
carbon disulfide	--	8,000	--		--	**8,000**	1.2e+00	--	4.6e+01
carbon tetrachloride	7.7	56	0.01		--	**0.01**	1.3e+00	--	1.5e+02
chlorobenzene	--	1,600	13.86		--	**13.86**	1.5e-01	--	2.2e+02
c hloroethane	350	32,000	--		--	**350**	--	--	--
chloroform	160	800	2.5		--	**2.5**	1.5e-01	--	5.3e+01
chloromethane	77	--	--		--	**77**	--	--	6e+00
dichloroethylene;1,2-,cis	--	800	--		--	**800**	1.7e-01	--	3.6e+01
cis-1,3-dichloropropene	--	--	--		--	--	--	--	--
dibromochloromethane	12	1,600	0.07		--	**0.07**	3.2e-02	--	6.3e+01
dibromomethane	--	--	--		--	--	--	--	--
dichlorodifluoromethane	--	16,000	--		--	**16,000**	--	--	--
ethylbenzene	--	8,000	17.96		--	**17.96**	3.2e-01	--	2e+02
hexachlorobutadiene	13	16	19.52		--	**13**	3.3e-01	--	5.4e+04
Iodomethane	--	--	--		--	--	--	--	--
Isopropylbenzene	--	--	--		--	--	--	--	--
m,p-xylenes	--	16,000	--		--	**16,000**	2.8e-01	--	2.3e+02
methyl tert-butyl ether	560	69,000	--		--	**560**	1.8e-02	--	1.1e+01
methylene chloride	130	4,800	2.57		--	**2.57**	9e-02	--	1e+01

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Volatile Organic Compounds (Continued)									
naphthalene	--	1,600	137.4		--	**137.4**	2e-02	--	1.2e+03
n-butylbenzene	--	--	--		--	--	--	--	--
propylbenzene;n-	--	--	--		--	--	--	--	--
o-Xylene	--	160,000	--		--	**160,000**	2.1e-01	--	2.4e+02
p-Isopropyltoluene	--	--	--		--	--	--	--	--
sec-butylbenzene	--	--	--		--	--	--	--	--
styrene	33	16,000	--		--	**33**	1.1e-01	--	9.1e+02
tert-butylbenzene	--	--	--		--	--	--	--	--
tetrachloroethylene	1.9	800	0.04		--	**0.04**	7.5e-01	--	2.7e+02
Toluene	--	6,400	109		--	**109**	2.7e-01	--	1.4e+02
dichloroethylene;1,2-,trans	--	1,600	54.36		--	**54.36**	3.9e-01	--	3.8e+01
trans-1,3-Dichloropropene	5.6 [6]	2,400 [6]	--		--	**5.6**	--	--	--
trichloroethylene	11	24	0.2		--	**0.2**	4.2e-01	--	9.4e+01
trichlorofluoromethane	--	24,000	--		--	**24,000**	--	--	--
vinyl acetate	--	80,000	--		--	**80,000**	2.1e-02	--	5.3e+00
vinyl chloride	0.67	240	0.02		--	**0.02**	1.1e+00	--	1.9e+01
trichlorobenzene;1,2,4-	--	800	2.67		--	**2.67**	5.8e-02	--	1.7e+03
dichlorobenzene;1,2-	--	7,200	15.26		--	**15.26**	7.8e-02	--	3.8e+02
1,2-Dinitrobenzene (o-dintirobenzene)	--	32	--		--	**32**	--	--	--
diphenylhydrazine;1,2-	1.3	--	--		--	**1.3**	--	--	--
dichlorobenzene;1,3-	--	--	13.04		--	**13.04**	--	--	--
1,3-Dinitrobenzene (m-dinitrobenzene)	--	8	--		--	**8**	--	--	--
dichlorobenzene;1,4-	42	--	3.15		--	**3.15**	1e-01	--	6.2e+02
1,4-Dinitrobenzene	--	32	--		--	**32**	--	--	--
methyl naphthalene;1-	--	--	--		--	--	--	--	--
tetrachlorophenol;2,3,4,6-	--	2,400	--		--	**2,400**	--	--	2.8e+02
2,3,5,6-Tetrachlorophenol	--	--	--		--	--	--	--	--
2,3-Dichloroaniline	--	--	--		--	--	--	--	--
trichlorophenol;2,4,5-	--	8,000	129.6		--	**129.6**	1.8e-04	--	1.6e+03
trichlorophenol;2,4,6-	91	--	0.03		--	**0.03**	3.2e-04	--	3.8e+02
dichlorophenol;2,4-	--	240	2.03		--	**2.03**	1.3e-04	--	1.5e+02
dimethylphenol;2,4-	--	1,600	6.97		--	**6.97**	8.20E-05	--	2.1e+02
dinitrophenol;2,4-	--	160	21.2		--	**21.2**	1.8e-05	--	1e-02
dinitrotoluene;2,4-	--	160	0.02		--	**0.02**	3.80E-06	--	9.6e+01
dinitrotoluene;2,6-	--	80	--		--	**80**	3.1e-05	--	6.9e+01
Semivolatile Organic Compounds									
2-Chloronaphthalene	--	6,400	42.56		--	**42.56**	1.27E-07	--	1130
chlorophenol;2-	--	400	1.15		--	**1.15**	1.6e-02	--	3.9e+02
2-Methyl-4,6-dinitrophenol	--	--	--		--	--	--	--	--
methyl naphthalene;2-	--	320	--		--	**320**	--	--	--
2-Methylphenol	--	4,000	--		--	**4,000**	--	--	--
nitroaniline, 2-	--	--	--		--	--	--	--	--
2-Nitrophenol	--	--	--		--	--	--	--	--
3-Methylphenol	--	4,000	--		--	**4,000**	--	--	--
4-Methylphenol	--	400	--		--	**400**	--	--	--
dichlorobenzidine;3,3'-	2.2	--	0.001		--	**0.001**	1.60E-07	--	7.2e+02

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Semivolatile Organic Compounds (Continued)									
3-Nitroaniline	--	--	--		--	**--**	--	--	--
4-bromophenyl-phenylether	--	--	--		--	**--**	--	--	--
4-chloro-3-methylphenol	--	--	--		--	**--**	--	--	--
chloroaniline;p-	--	320	--		--	**320**	1.4e-05	--	6.6e+01
4-chlorophenyl-phenylether	--	--	--		--	**--**	--	--	--
4-nitroaniline	--	--	--		--	**--**	--	--	--
4-nitrophenol	--	--	--		--	**--**	--	--	--
acenaphthene	--	4,800	100.99		--	**100.99**	6.4e-03	--	4.9e+03
acenaphthylene	--	--	--		--	**--**	--	--	--
aniline	180	--	--		--	**180**	--	--	--
anthracene	--	24,000	18,560		--	**18,560**	2.7e-03	--	2.3e+04
benzidine	0.0043	240	0.0007		--	**0.0007**	--	--	--
benzo[a]anthracene	--	--	0.13		--	**0.13**	1.40E-04	--	3.60E+05
benzo[a]pyrene	0.14	--	0.35		30	**0.14**	4.60E-05	--	9.70E+05
benzo[b]fluoranthene	--	--	0.43		--	**0.43**	4.60E-03	--	1.20E+06
benzo(g,h,i)perylene	--	--	--		--	**--**	--	--	--
benzo[k]fluoranthene	--	--	0.43		--	**0.43**	3.40E-05	--	1.20E+06
benzyl alcohol	--	24,000	--		--	**24,000**	--	--	--
bis(2-chloroethoxy) methane	--	--	--		--	**--**	--	--	--
bis(2-chloroethyl)ether	0.91	--	0.003		--	**0.003**	7.4e-04	--	7.6e+01
bis(2-chloroisopropyl) ether	--	3,200	--		--	**3200**	--	--	--
bis(2-ethylhexyl) phthalate	71	1,600	4.85		--	**4.85**	4.2e-06	--	1.1e+05
bis-2-Ethylhexyladipate	830	48,000	--		--	**830**	--	--	--
butyl benzyl phthalate	--	16,000	539.6		--	**539.6**	5.2e-05	--	1.4e+04
carbazole	50	--	--		--	**50**	6.3e-07	--	3.4e+03
chrysene	--	--	0.14		--	**0.14**	3.9e-03	--	4e+05
dibenzo[a,h]anthracene	--	--	0.65		--	**0.65**	6e-07	--	1.8e+06
dibenzofuran	--	160	--		--	**160**	--	--	--
diethyl phthalate	--	64,000	248		--	**248**	1.9e-05	--	8.2e+01
Dimethylphthalate	--	80,000	5280		--	**5,280**	--	--	--
di-butyl phthalate	--	8,000	162		200	**162**	3.9e-08	--	1.6e+03
di-n-octyl phthalate	--	1,600	--		--	**1600**	2.7e-03	--	8.3e+07
fluoranthene	--	3,200	137.8		--	**137.8**	6.6e-04	--	4.9e+04
fluorene	--	3,200	837.4		--	**837.4**	2.6e-03	--	7.7e+03
hexachlorobenzene	0.63	64	0.0005		31	**0.0005**	5.4e-02	--	8e+04
hexachlorobutadiene	13	16	19.52		--	**13**	3.3e-01	--	5.4e+04
hexachlorocyclopentadiene	--	480	4407		--	**480**	1.1e+00	--	2e+05
hexachloroethane	71	80	0.13		--	**0.13**	1.6e-01	--	1.8e+03
indeno[1,2,3-cd]pyrene	--	--	1.26		--	**1.26**	6.6e-05	--	3.5e+06
isophorone	1,100	16,000	2.96		--	**2.96**	2.7e-04	--	4.7e+01
naphthalene	--	1,600	137.4		--	**137.4**	2e-02	--	1.2e+03
nitrobenzene	--	40	4.42		--	**4.42**	9.8e-04	--	1.2e+02
nitrosodimethylamine;N-	0.02	--	--		--	**0.02**	--	--	--
nitroso-di-n-propylamine;N-	0.14	--	0.002		--	**0.002**	9.2e-05	--	2.4e+01
nitrosodiphenylamine;N-	200	--	0.48		--	**0.48**	2.10E-04	--	1.3e+03
pentachlorophenol	8.3	2,400	0.05		11	**0.05**	1e-06	--	5.9e+02

TABLE 1

SOIL SCREENING LEVELS, UPLANDS AREA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	MTCA Method B Soil-Direct Contact Unrestricted Land Use Carcinogen (mg/kg)	MTCA Method B Soil-Direct Contact Unrestricted Land Use NonCarcinogen (mg/kg)	MTCA Method B Protective of Groundwater as Marine Surface Water [1] (mg/kg)	Area Background (mg/kg)	MTCA Method B Protective of Terrestrial Ecological Receptors[2] (mg/kg)	Selected Screening Level (mg/kg)	Henrys Law Constant (unitless) (Hcc) (unitless)	Kd (Distribution Coefficient for metals) (L/kg)	Koc (Soil Organic Carbon-Water Partitioning Coefficient) (L/kg)
Semivolatile Organic Compounds (Continued)									
phenanthrene	--	--	--		--	**--**	--	--	--
phenol	--	48,000	7,786		--	**7,786**	1.6e-05	--	2.9e+01
pyrene	--	2,400	5,456		--	**2,400**	4.5e-04	--	6.8e+04
pyridine	--	80	--		--	**80**	--	--	--
Total cPAHs - benzo(a)pyrene TEQ [7]	0.14	--	0.35		30	**0.14**	--	--	--

Notes:

1. Calculated using fixed-parameter three-phase partitioning model WAC 173-340-747(4).
2. Based on simplified terrestrial evaluation in WAC 173-340-7492, criteria listed in Table 749-2.
3. -- = value not available.
4. Some metals are adjusted for regional background value based concentrations within Skagit/Whatcom counties or Western Washington from Ecology 1994 Natural Background Soil Metals Concentrations .
5. Method A value if no Method B available
6. Value is for total trans-1,3-Dichloropropene
7. Toxicity equivalent quotient (TEQ) methodology in WAC 173-340-708(8).

Abbreviations

L/kg = liters per kilogram
mg/kg = milligrams per kilogram

TABLE 2

SCREENING LEVELS FOR GROUNDWATER BASED ON MARINE SURFACE WATER CRITERIA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L) [1]	Surface Water ARAR - Aquatic Life - Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3, 4] (ug/L)
1,1-Dichloropropene	--[5]	--	--	--	--	--	--	--	--	--	--
1,2,3-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	--	--	--	--	--	--	--	--	--	--	--
1,3,5-Trimethylbenzene	--	--	--	--	--	--	--	--	--	--	--
1,3-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--
2,2-Dichloropropane	--	--	--	--	--	--	--	--	--	--	--
2,3,5,6-Tetrachlorophenol	--	--	--	--	--	--	--	--	--	--	--
2,3-Dichloroaniline	--	--	--	--	--	--	--	--	--	--	--
2-Butanone (MEK)	--	--	--	--	--	--	--	--	--	--	--
2-Chloroethylvinylether	--	--	--	--	--	--	--	--	--	--	--
2-Chloronaphthalene (beta-chloronaphthalene)	--	--	--	--	--	--	1,600	--	--	1,000	**1,600**
2-Hexanone	--	--	--	--	--	--	--	--	--	--	--
2-Methyl-4,6-dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
2-Nitrophenol	--	--	--	--	--	--	--	--	--	--	--
3-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
3-Nitroaniline	--	--	--	--	--	--	--	--	--	--	--
4-Bromophenyl-phenylether	--	--	--	--	--	--	--	--	--	--	--
4-Chloro-3-methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	--	--	--	--	--	--	--	--	--	--	--
4-Chlorotoluene	--	--	--	--	--	--	--	--	--	--	--
4-Nitroaniline	--	--	--	--	--	--	--	--	--	--	--
4-Nitrophenol	--	--	--	--	--	--	--	--	--	--	--
acenaphthene	--	--	--	--	--	--	990	--	--	640	**990**
acenaphthylene	--	--	--	--	--	--	--	--	--	--	--
acetone	--	--	--	--	--	--	--	--	--	--	--
aniline	--	--	--	--	--	--	--	--	--	--	--
anthracene	--	--	--	--	--	--	40,000	110,000	--	26,000	**40,000**
antimony	--	--	--	--	--	--	640	4300	--	1,000	**640**
aroclor 1016	--	--	--	--	--	0.03	--	--	--	0.0058	**0.03**
Aroclor 1221	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1232	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1242	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1248	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1254	--	--	--	--	--	0.03	--	--	--	0.0017	**0.03**
Aroclor 1260	--	--	--	--	--	0.03	--	--	--	--	**0.03**
Aroclor 1262	--	--	--	--	--	--	--	--	--	--	--
Aroclor 1268	--	--	--	--	--	--	--	--	--	--	--
arsenic, inorganic	69	69	69	36	36	36	0.14	0.14	0.098	18	**0.14**
barium and compounds	--	--	--	--	--	--	--	--	--	--	--
benzene	--	--	--	--	--	--	51	71	23	2000	**51**

TABLE 2

SCREENING LEVELS FOR GROUNDWATER BASED ON MARINE SURFACE WATER CRITERIA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L) [1]	Surface Water ARAR - Aquatic Life - Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3, 4] (ug/L)
benzidine	--	--	--	--	--	--	0.0002	0.00054	0.00032	89	**0.0002**
benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	--	--	**--**
benzo[a]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
benzo[a]pyrene	--	--	--	--	--	--	0.018	0.031	0.03	--	**0.018**
benzo[b]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
benzo[k]fluoranthene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
benzyl alcohol	--	--	--	--	--	--	--	--	--	--	**--**
beryllium	--	--	--	--	--	--	--	--	--	270	**270**
bis(2-Chloroethoxy) methane	--	--	--	--	--	--	--	--	--	--	--
bis(2-chloroethyl)ether	--	--	--	--	--	--	0.53	1.4	0.85	--	**0.53**
bis(2-chloroisopropyl) ether	--	--	--	--	--	--	65,000	170,000	--	42,000	**65,000**
bis(2-ethylhexyl) phthalate	--	--	--	--	--	--	2.2	5.9	3.6	400	**2.2**
bis-2-Ethylhexyladipate	--	--	--	--	--	--	--	--	--	--	--
Bromobenzene	--	--	--	--	--	--	--	--	--	--	--
Bromochloromethane	--	--	--	--	--	--	--	--	--	--	--
bromodichloromethane	--	--	--	--	--	--	17	22	28	14,000	**17**
bromoform	--	--	--	--	--	--	140	360	220	14,000	**140**
bromomethane	--	--	--	--	--	--	1,500	4,000	--	970	**1,500**
butyl benzyl phthalate	--	--	--	--	--	--	1,900	--	--	1,300	**1,900**
cadmium in water	42	40	42	9.3	8.8	9.3	--	--	--	20	**8.8**
carbazole	--	--	--	--	--	--	--	--	--	--	**--**
carbon disulfide	--	--	--	--	--	--	--	--	--	--	**--**
carbon tetrachloride	--	--	--	--	--	--	1.6	4.4	2.7	97	**1.6**
chloroaniline;p-	--	--	--	--	--	--	--	--	--	--	**--**
chlorobenzene	--	--	--	--	--	--	1,600	21,000	--	5,000	**1,600**
Chloroethane	--	--	--	--	--	--	--	--	--	--	--
chloroform	--	--	--	--	--	--	470	470	280	6,900	**470**
chloromethane	--	--	--	--	--	--	--	--	130	--	**130**
chlorophenol;2-	--	--	--	--	--	--	--	--	--	97	**97**
chlorotoluene;o-	--	--	--	--	--	--	--	--	--	--	**--**
chromium (total)	--	--	--	--	--	--	--	--	--	--	**--**
chrysene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
cis-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	--
copper	4.8	4.8	2.4	3.1	3.1	2.4	--	--	--	2700	**2.4**
dibenzo[a,h]anthracene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
dibenzofuran	--	--	--	--	--	--	--	--	--	--	**--**
dibromo-3-chloropropane;1,2-	--	--	--	--	--	--	--	--	--	--	**--**
dibromochloromethane	--	--	--	--	--	--	13	34	21	14,000	**13**
Dibromomethane	--	--	--	--	--	--	--	--	--	--	--

TABLE 2

SCREENING LEVELS FOR GROUNDWATER BASED ON MARINE SURFACE WATER CRITERIA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L) [1]	Surface Water ARAR - Aquatic Life - Marine/Acute - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)	Screening Level [2, 3, 4] (ug/L)
di-butyl phthalate	--	--	--	--	--	--	4,500	12,000	--	2,900	**4,500**
dichlorobenzene;1,2-	--	--	--	--	--	--	1,300	17,000	--	4,200	**1,300**
dichlorobenzene;1,3-	--	--	--	--	--	--	960	2,600	--	--	**960**
dichlorobenzene;1,4-	--	--	--	--	--	--	190	2,600	4.9	--	**190**
dichlorobenzidine;3,3'-	--	--	--	--	--	--	0.028	0.077	0.046	--	**0.028**
dichlorodifluoromethane	--	--	--	--	--	--	--	--	--	--	**--**
dichloroethane;1,1-	--	--	--	--	--	--	--	--	--	--	**--**
dichloroethane;1,2-	--	--	--	--	--	--	37	99	59	43,000	**37**
dichloroethylene;1,1-	--	--	--	--	--	--	7100	3.2	--	23,000	**3.2**
dichloroethylene;1,2-,cis	--	--	--	--	--	--	--	--	--	--	**--**
dichloroethylene;1,2-,trans	--	--	--	--	--	--	10,000	--	--	33,000	**10,000**
dichlorophenol;2,4-	--	--	--	--	--	--	290	790	--	190	**290**
dichloropropane;1,2-	--	--	--	--	--	--	15	--	23	--	**15**
diethyl phthalate	--	--	--	--	--	--	44,000	120,000	--	28,000	**44,000**
dimethyl phthalate	--	--	--	--	--	--	1,100,000	2,900,000	--	72,000	**1,100,000**
dimethylphenol;2,4-	--	--	--	--	--	--	850	--	--	550	**850**
dinitrobenzene;m-	--	--	--	--	--	--	--	--	--	--	**--**
dinitrobenzene;o-	--	--	--	--	--	--	--	--	--	--	**--**
dinitrobenzene;p-	--	--	--	--	--	--	--	--	--	--	**--**
dinitrophenol;2,4-	--	--	--	--	--	--	5,300	14,000	--	3,500	**5,300**
dinitrotoluene;2,4-	--	--	--	--	--	--	3.4	9.1	--	1,400	**3.4**
dinitrotoluene;2,6-	--	--	--	--	--	--	--	--	--	--	**--**
di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	**--**
diphenylhydrazine;1,2-	--	--	--	--	--	--	0.2	0.54	0.33	--	**0.2**
ethylbenzene	--	--	--	--	--	--	2,100	29,000	--	6,900	**2,100**
fluoranthene	--	--	--	--	--	--	140	370	--	90	**140**
fluorene	--	--	--	--	--	--	5,300	14,000	--	3,500	**5,300**
hexachlorobenzene	--	--	--	--	--	--	0.00029	0.00077	0.00047	0.24	**0.00029**
hexachlorobutadiene	--	--	--	--	--	--	18	50	30	190	**18**
hexachlorocyclopentadiene	--	--	--	--	--	--	1,100	17,000	--	3,600	**1,100**
hexachloroethane	--	--	--	--	--	--	3.3	8.9	5.3	30	**3.3**
indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	0.018	0.031	--	--	**0.018**
Iodomethane	--	--	--	--	--	--	--	--	--	--	--
isophorone	--	--	--	--	--	--	960	600	1,600	120,000	**600**
Isopropylbenzene	--	--	--	--	--	--	--	--	--	--	--
lead	210	210	210	8.1	8.1	8.1	--	--	--	--	**8.1**
mercury	1.8	1.8	2.1	0.025	0.94	0.025	0.3	0.15	--	--	**0.025**
methyl isobutyl ketone	--	--	--	--	--	--	--	--	--	--	**--**
methyl naphthalene;1-	--	--	--	--	--	--	--	--	--	--	**--**
methyl naphthalene;2-	--	--	--	--	--	--	--	--	--	--	**--**
methyl tert-butyl ether	--	--	--	--	--	--	--	--	--	--	**--**
methylene chloride	--	--	--	--	--	--	590	1,600	960	170,000	**590**

TABLE 2

SCREENING LEVELS FOR GROUNDWATER BASED ON MARINE SURFACE WATER CRITERIA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (μg/L) ^{1}	Surface Water ARAR - Aquatic Life - Marine/Acute - Clean Water Act §304 (μg/L)	Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (μg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (μg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (μg/L)	Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (μg/L)	Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (μg/L)	Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (μg/L)	Surface Water, Method B, Carcinogen, Standard Formula Value (μg/L)	Surface Water, Method B, Non-Carcinogen, Standard Formula Value (μg/L)	Screening Level $^{2, 3, 4}$ (ug/L)
naphthalene	--	--	--	--	--	--	--	--	--	4,900	**4,900**
n-butylbenzene	--	--	--	--	--	--	--	--	--	--	**--**
nickel soluble salts	74	74	74	8.2	8.2	8.2	4,600	4,600	--	1,100	**8.2**
nitroaniline, 2-	--	--	--	--	--	--	--	--	--	--	**--**
nitrobenzene	--	--	--	--	--	--	690	1,900	--	450	**690**
nitrosodimethylamine;N-	--	--	--	--	--	--	3	8.1	4.9	--	**3**
nitroso-di-n-propylamine;N-	--	--	--	--	--	--	0.51	--	0.82	--	**0.51**
N-Nitrosodiphenylamine	--	--	--	--	--	--	--	16	--	9.7	**16**
pentachlorophenol	13	13	13	7.9	7.9	7.9	3	8.2	4.9	7,100	**3**
phenanthrene	--	--	--	--	--	--	--	--	--	--	**--**
phenol	--	--	--	--	--	--	1,700,000	4,600,000	--	1,100,000	**1,700,000**
p-Isopropyltoluene	--	--	--	--	--	--	--	--	--	--	**--**
polychlorinated biphenyls	10	--	--	0.03	0.03	0.03	0.000064	0.00017	0.00011	--	**0.000064**
propylbenzene;n-	--	--	--	--	--	--	--	--	--	--	**--**
pyrene	--	--	--	--	--	--	4,000	11,000	--	2,600	**4,000**
pyridine	--	--	--	--	--	--	--	--	--	--	**--**
sec-butylbenzene	--	--	--	--	--	--	--	--	--	--	**--**
selenium and compounds	290	290	290	71	71	71	4,200	--	--	2,700	**71**
silver	1.9	1.9	1.9	--	--	--	--	--	--	26,000	**1.9**
styrene	--	--	--	--	--	--	--	--	--	--	**--**
tert-butylbenzene	--	--	--	--	--	--	--	--	--	--	**--**
tetrachloroethane;1,1,1,2-	--	--	--	--	--	--	--	--	--	--	**--**
tetrachloroethane;1,1,2,2-	--	--	--	--	--	--	4	11	6.5	--	**4**
tetrachloroethylene	--	--	--	--	--	--	3.3	8.9	0.39	840	**3.3**
tetrachlorophenol;2,3,4,6-	--	--	--	--	--	--	--	--	--	--	**--**
thallium, soluble salts	--	--	--	--	--	--	0.47	6.3	--	1.6	**0.47**
toluene	--	--	--	--	--	--	15,000	200,000	--	19,000	**15,000**
TPH, diesel range organics	--	--	--	--	--	--	--	--	--	--	**500** ^{6}
TPH, heavy oils	--	--	--	--	--	--	--	--	--	--	**500** ^{6}
TPH, mineral oil	--	--	--	--	--	--	--	--	--	--	**500** ^{6}
TPH: gasoline range organics, benzene present	--	--	--	--	--	--	--	--	--	--	**800** ^{6}
TPH: gasoline range organics, no detectable benzene	--	--	--	--	--	--	--	--	--	--	**1,000** ^{6}
trans-1,3-Dichloropropene	--	--	--	--	--	--	--	--	--	--	**--**
trichlorobenzene;1,2,4-	--	--	--	--	--	--	70	--	--	230	**70**
trichloroethane;1,1,1-	--	--	--	--	--	--	--	--	--	420,000	**420,000**
trichloroethane;1,1,2-	--	--	--	--	--	--	16	42	25	2,300	**16**
trichloroethylene	--	--	--	--	--	--	30	81	6.7	71	**30**
trichlorofluoromethane	--	--	--	--	--	--	--	--	--	--	**--**
trichlorophenol;2,4,5-	--	--	--	--	--	--	3,600	--	--	--	**3,600**
trichlorophenol;2,4,6-	--	--	--	--	--	--	2.4	6.5	3.9	--	**2.4**
trichloropropane;1,2,3-	--	--	--	--	--	--	--	--	--	--	**--**

TABLE 2

SCREENING LEVELS FOR GROUNDWATER BASED ON MARINE SURFACE WATER CRITERIA

Former Custom Plywood Mill
Anacortes, Washington

Analyte	**Surface Water ARAR - Aquatic Life - Marine/Acute - Ch. 173-201A WAC (µg/L) ^{1}**	**Surface Water ARAR - Aquatic Life - Marine/Acute - Clean Water Act §304 (µg/L)**	**Surface Water ARAR - Aquatic Life - Marine/Acute - National Toxics Rule, 40 CFR 131 (µg/L)**	**Surface Water ARAR - Aquatic Life - Marine/Chronic - Ch. 173-201A WAC (µg/L)**	**Surface Water ARAR - Aquatic Life - Marine/Chronic - Clean Water Act §304 (µg/L)**	**Surface Water ARAR - Aquatic Life - Marine/Chronic - National Toxics Rule, 40 CFR 131 (µg/L)**	**Surface Water ARAR - Human Health – Marine – Clean Water Act §304 (µg/L)**	**Surface Water ARAR - Human Health – Marine – National Toxics Rule, 40 CFR 131 (µg/L)**	**Surface Water, Method B, Carcinogen, Standard Formula Value (µg/L)**	**Surface Water, Method B, Non-Carcinogen, Standard Formula Value (µg/L)**	**Screening Level $^{2, 3, 4}$ (ug/L)**
trimethylbenzene;1,2,4-	--	--	--	--	--	--	--	--	--	--	**--**
trimethylbenzene;1,3,5-	--	--	--	--	--	--	--	--	--	--	**--**
vinyl acetate	--	--	--	--	--	--	--	--	--	--	**--**
vinyl chloride	--	--	--	--	--	--	2.4	530	3.7	6,600	**2.4**
xylene;m-	--	--	--	--	--	--	--	--	--	--	**--**
xylene;o-	--	--	--	--	--	--	--	--	--	--	**--**
xylene;p-	--	--	--	--	--	--	--	--	--	--	**--**
xylenes	--	--	--	--	--	--	--	--	--	--	**--**
zinc	90	90	90	81	81	81	26,000	--	--	17,000	**81**

Notes:

1. µg/L = micrograms per liter.
2. Screening levels will be used for comparison to data developed in the RI.
3. Screening levels may be adjusted depeing on lab PQLs.
4. Screening levels may be adjusted based on background data result sin RI.
5. -- = Not established.
6. Screening levels based on MTCA Method A.

TABLE 3

SEDIMENT MANAGEMENT STANDARDS FOR THE CONSTITUENTS OF POTENTIAL CONCERN

Former Custom Plywood Mill
Anacortes, Washington

Chemical Parameter	Sediment Management Standards		LAET[3]
	SQS[1]	CSL[2]	
Metals	**mg/kg dry wt[4]**	**mg/kg dry wt**	**mg/kg dry wt**
Arsenic	57	93	57
Cadmium	5.1	6.7	5.1
Chromium	260	270	260
Copper	390	390	390
Lead	450	530	450
Mercury	0.41	0.59	0.41
Silver	6.1	6.1	6.1
Zinc	410	960	410
Nonionizable Organic Compounds			
Aromatic Hydrocarbons	**mg/kg carbon**	**mg/kg carbon**	**µg/kg dry wt[5]**
Total LPAH	370	780	5,200
Naphthalene	99	170	2,100
Acenaphthylene	66	66	1,300
Acenaphthene	16	57	500
Fluorene	23	79	540
Phenanthrene	100	480	1,500
Anthracene	220	1,200	960
2-Methylnaphthalene	38	780	670
Total HPAH	960	5,300	12,000
Fluoranthene	160	1,200	1,700
Pyrene	1,000	1,400	2,600
Benz[a]anthracene	110	270	1,300
Chrysene	110	460	1,400
Total benzofluoranthenes	230	450	3,200
Benzo[a]pyrene	99	210	1,600
Indeno[1,2,3-c,d]pyrene	34	88	600
Dibenzo[a,h]anthracene	12	33	230
Benzo[g,h,i]perylene	31	78	670

TABLE 3

SEDIMENT MANAGEMENT STANDARDS FOR THE CONSTITUENTS OF POTENTIAL CONCERN

Former Custom Plywood Mill
Anacortes, Washington

Chemical Parameter	Sediment Management Standards SQS[1]	CSL[2]	LAET[3]
Nonionizable Organic Compounds	**mg/kg carbon**	**mg/kg carbon**	**µg/kg dry wt**
Chlorinated Benzenes			
1,2-Dichlorobenzene	2.3	2.3	35
1,4-Dichlorobenzene	3.1	9	110
1,2,4-Trichlorobenzene	0.81	1.8	31
Hexachlorobenzene	0.38	2.3	22
Phthalate Esters			
Dimethyl phthalate	53	53	71
Diethyl phthalate	61	110	200
Di-n-butyl phthalate	220	1700	1400
Butyl benzyl phthalate	4.9	64	63
Bis[2-ethylhexyl] phthalate	47	78	1300
Di-n-octyl phthalate	58	4500	6200
Miscellaneous			
Dibenzofuran	15	58	540
Hexachlorobutadiene	3.9	6.2	11
N-Nitrosodiphenylamine	11	11	28
Total PCBs	12	65	130
Ionizable Organic Compounds	**µg/kg dry wt**	**µg/kg dry wt**	**µg/kg dry wt**
Phenol	420	1200	420
2-Methylphenol	63	63	63
4-Methylphenol	670	670	670
2,4-Dimethylphenol	29	29	29
Pentachlorophenol	360	690	360
Benzyl alcohol	57	73	57
Benzoic acid	650	650	650

Notes:
1. Sediment Management Standards Sediment Quality Standards (WAC 173-204-320).
2. Sediment Management Standards Cleanup Screening Levels (WAC 173-204-520).
3. LAET = Lowest Apparent Effects Threshold.
4. mg/kg dry wt = milligrams per kilogram dry weight.
5. µg/kg dry wt = micrograms per kilogram dry weight.

TABLE 4

BIOLOGICAL EFFECTS CRITERIA FOR PUGET SOUND MARINE SEDIMENTS

Former Custom Plywood Mill
Anacortes, Washington

Biological Tests	Sediment Quality Standards	Cleanup Screening Levels
Microtox®	The mean light output of the highest concentration of the test sediment is less than 80% of the reference sediment, and the two means are statistically different (T-test, $P \leq 0.05$).	NA[1]
Amphipod	The test sediment has a significantly higher (t-test, $P \leq 0.05$) mean mortality than the reference sediment, and the test sediment mean mortality is more than 25 percent greater, on an absolute basis, than the reference sediment mean mortality.	The test sediment has a significantly higher (t-test, $P \leq 0.05$) mean mortality than the reference sediment, and the test sediment mean mortality is more than 30 percent greater, on an absolute basis, than the reference sediment mean mortality.
Sediment Larval	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, $P \leq 0.1$) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 85 percent of the mean normal survivorship in the reference sediment.	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, $P \leq 0.1$) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 70 percent of the mean normal survivorship in the reference sediment.

Notes:
1. NA = Not applicable

TABLE 5

SUMMARY OF SOIL SCREENING EXCEEDANCES[1, 2]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[3]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Maximum Non-detected Value	Minimum Non-detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detection Location
Dioxin	1,2,3,4,6,7,8-HpCDD	--	ng/kg	4	0	0.0	2	50.0	20.303	8.574	198.978	89.44	CB01SB01
Dioxin	1,2,3,4,6,7,8-HpCDF	--	ng/kg	4	0	0.0	3	75.0	79.956	79.956	28.398	1.184	CB01SB01
Dioxin	1,2,3,4,7,8,9-HpCDF	--	ng/kg	4	0	0.0	0	0.0	6.039	0.41	--[4]	--	--
Dioxin	1,2,3,4,7,8-HxCDD	--	ng/kg	4	0	0.0	0	0.0	3.727	0.703	--	--	--
Dioxin	1,2,3,4,7,8-HxCDF	--	ng/kg	4	0	0.0	1	25.0	3.376	0.511	0.572	0.572	BG01SB01
Dioxin	1,2,3,6,7,8-HxCDD	--	ng/kg	4	0	0.0	0	0.0	2.51	0.473	--	--	--
Dioxin	1,2,3,6,7,8-HxCDF	--	ng/kg	4	0	0.0	0	0.0	2.532	0.384	--	--	--
Dioxin	1,2,3,7,8,9-HxCDD	--	ng/kg	4	0	0.0	1	25.0	1.256	0.542	10.588	10.588	CB01SB01
Dioxin	1,2,3,7,8,9-HxCDF	--	ng/kg	4	0	0.0	0	0.0	4.009	0.607	--	--	--
Dioxin	1,2,3,7,8-PeCDD	--	ng/kg	4	0	0.0	0	0.0	2.331	0.574	--	--	--
Dioxin	1,2,3,7,8-PeCDF	--	ng/kg	4	0	0.0	0	0.0	1.768	0.374	--	--	--
Dioxin	2,3,4,6,7,8-HxCDF	--	ng/kg	4	0	0.0	0	0.0	2.961	0.448	--	--	--
Dioxin	2,3,4,7,8-PeCDF	--	ng/kg	4	0	0.0	0	0.0	1.787	0.378	--	--	--
Dioxin	2,3,7,8-TCDD	--	ng/kg	4	0	0.0	0	0.0	2.338	0.571	--	--	--
Dioxin	2,3,7,8-TCDF	--	ng/kg	4	0	0.0	0	0.0	2.12		--	--	--
Dioxin	OCDD	--	ng/kg	4	0	0.0	2	50.0	164.757	57.913	1344.337	865.047	CB01SB01
Dioxin	OCDF	--	ng/kg	4	0	0.0	2	50.0	31.326	9.117	139.697	138.707	CB01SB01
Dioxin	TEQ (ND = 0)	11	ng/kg	4	0	0.0	4	100.0	--	--	4.3977152	0.2590595	CB01SB01
Dioxin	TEQ (ND = 1/2 DL)	11	ng/kg	4	0	0.0	4	100.0	--	--	7.1074852	1.02035745	CB01SB01
Formaldehyde	Formaldehyde	--	µg/kg	2	0	0.0	0	0.0	1000	1000	--	--	--
Metals	Aluminum	--	mg/kg	56	0	0.0	56	100.0	--	--	23800	1600	SL01SS00
Metals	Antimony	32	mg/kg	44	0	0.0	12	27.3	11.4	1	13.8	1.7	RC03SS00
Metals	Arsenic	20	mg/kg	104	9	8.7	72	69.2	19	3.9	54	2.5	Area 3-B
Metals	Barium	675	mg/kg	60	4	6.7	60	100.0	--	--	1250	13.8	BH03SS00
Metals	Cadmium	1.2	mg/kg	104	29	27.9	36	34.6	2	0.1	9.5	0.12	G-15-5
Metals	Calcium	--	mg/kg	56	0	0.0	56	100.0	--	--	129000	3600	BH03SS00
Metals	Chromium	117	mg/kg	104	4	3.8	91	87.5	29.3	2.6	450	3.3	G-15-5
Metals	Cobalt	--	mg/kg	56	0	0.0	55	98.2	2.4	2.4	84.8	1.1	BH06SS00
Metals	Copper	51	mg/kg	57	32	56.1	56	98.2	14	14	1330	18.6	UL02SS00
Metals	Hexavalent Chromium	19	mg/kg	1	0	0.0	0	0.0	2.5	2.5	--	--	
Metals	Iron	--	mg/kg	56	0	0.0	56	100.0	--	--	147000	2410	UL02SS00
Metals	Lead	220	mg/kg	105	17	16.2	96	91.4	26	0.2	1600	1.9	G-15-5
Metals	Magnesium	--	mg/kg	56	0	0.0	56	100.0	--	--	17100	3290	GT01SB01
Metals	Manganese	--	mg/kg	56	0	0.0	56	100.0	--	--	5690	101	BH01SB01
Metals	Mercury	0.026	mg/kg	101	101	100.0	49	48.5	1.5	0.05	67	0.06	CB03SS00
Metals	Nickel	11	mg/kg	57	53	93.0	53	93.0	17.1	7.6	102	9.3	GT03SS00
Metals	Potassium	--	mg/kg	56	0	0.0	55	98.2	2130	2130	18700	391	BH03SS00
Metals	Selenium	0.8	mg/kg	60	56	93.3	20	33.3	7.5	0.79	6.6	0.8	BH04SB01
Metals	Silver	400	mg/kg	60	0	0.0	49	81.7	2.6	0.76	39.8	0.59	RC03SB01
Metals	Sodium	--	mg/kg	56	0	0.0	56	100.0	--	--	28300	428	SL01SS00
Metals	Thallium	0.67	mg/kg	57	57	100.0	15	26.3	11.1	1.6	8.8	1.9	BH01SB01
Metals	Vanadium	26	mg/kg	56	47	83.9	56	100.0	--	--	77	9.7	GT01SB01

TABLE 5

SUMMARY OF SOIL SCREENING EXCEEDANCES[1, 2]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[3]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Maximum Non-detected Value	Minimum Non-detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detection Location
Metals	Zinc	101	mg/kg	57	31	54.4	56	98.2	1310	1310	5070	31.3	BH06SS00
PCBs	Arochlor 1016	--	µg/kg	68	0	0.0	0	0.0	870	50	--	--	--
PCBs	Arochlor 1221	--	µg/kg	68	0	0.0	0	0.0	1800	50	--	--	--
PCBs	Arochlor 1232	--	µg/kg	68	0	0.0	0	0.0	870	50	--	--	--
PCBs	Arochlor 1242	--	µg/kg	68	0	0.0	0	0.0	870	50	--	--	--
PCBs	Arochlor 1248	--	µg/kg	118	0	0.0	4	3.4	880	34	290	95	Area 4-B1
PCBs	Arochlor 1254	--	µg/kg	118	0	0.0	26	22.0	880	34	13000	50	CP-HA31-0.5
PCBs	Arochlor 1260	--	µg/kg	118	0	0.0	5	4.2	880	34	160	44	Area 4-N4
PCBs	Arochlor 1262	--	µg/kg	40	0	0.0	0	0.0	560	53	--	--	--
PCBs	Arochlor 1268	--	µg/kg	40	0	0.0	0	0.0	560	53	--	--	--
PCBs	Total PCBs	1000	µg/kg	50	9	18.0	15	30.0	1320	51	13870	85	CP-HA31-0.5
Pesticides	4,4'-DDD	1000	µg/kg	26	0	0.0	1	3.8	13	3.4	6.9	6.9	PP03SS00
Pesticides	4,4'-DDE	1000	µg/kg	26	0	0.0	1	3.8	13	3.4	3.7	3.7	BG01SS00
Pesticides	Aldrin	16.3	µg/kg	26	0	0.0	1	3.8	6.8	1.8	8.5	8.5	UL03SS00
Pesticides	Dieldrin	14.5	µg/kg	26	0	0.0	1	3.8	13	3.4	9	9	PP02SS00
Pesticides	Endrin Ketone	--	µg/kg	26	0	0.0	3	11.5	13	3.4	21	4.3	CB02SS00
Pesticides	Methoxychlor	12995.4	µg/kg	26	0	0.0	1	3.8	68	18	21	21	UL02SS00
SVOCs	1,1'-Biphenyl	4000000	µg/kg	26	0	0.0	7	26.9	2600	160	130	21	UL02SS00
SVOCs	1-Methylnaphthalene	--	µg/kg	1	0	0.0	0	0.0	8.9	8.9	--	--	--
SVOCs	2,4,5-Trichlorophenol	8000000	µg/kg	3	0	0.0	0	0.0	40	40	--	--	--
SVOCs	2,4,6-Trichlorophenol	91000	µg/kg	5	0	0.0	0	0.0	5000	40	--	--	--
SVOCs	2,4-Dichlorophenol	1328.0	µg/kg	5	1	20.0	0	0.0	5000	40	--	--	--
SVOCs	2,4-Dimethylphenol	1600000	µg/kg	51	0	0.0	3	5.9	5000	40	490	50	UL03SS00
SVOCs	2,4-Dinitrophenol	13828.0	µg/kg	5	0	0.0	0	0.0	5000	580	--	--	--
SVOCs	2-Chlorophenol	1179.4	µg/kg	5	1	20.0	0	0.0	5000	40	--	--	--
SVOCs	2-Methyl-4,6-dinitrophenol	--	µg/kg	5	0	0.0	0	0.0	10000	160	--	--	--
SVOCs	2-Methylnaphthalene	320000	µg/kg	47	0	0.0	16	34.0	2600	8.9	260	27	UL03SS00
SVOCs	2-Methylphenol	4000000	µg/kg	29	0	0.0	2	6.9	2600	160	75	61	UL03SS00
SVOCs	2-Nitrophenol	--	µg/kg	5	0	0.0	0	0.0	50000	40	--	--	--
SVOCs	4-Chloro-3-methylphenol	--	µg/kg	5	0	0.0	0	0.0	5000	160	--	--	--
SVOCs	4-Methylphenol	400000	µg/kg	62	0	0.0	6	9.7	2600	160	570	43	BH02SB01
SVOCs	4-Nitrophenol	--	µg/kg	5	0	0.0	0	0.0	50000	160	--	--	--
SVOCs	Acenaphthene	66118.3	µg/kg	52	0	0.0	11	21.2	2600	8.9	1500	23	BH02SB01
SVOCs	Acenaphthylene	--	µg/kg	32	0	0.0	7	21.9	2600	8.9	85	20	UL03SS00
SVOCs	Acetophenone	8000000	µg/kg	46	0	0.0	4	8.7	2600	340	51	25	UL03SS00
SVOCs	Anthracene	24000000	µg/kg	52	0	0.0	16	30.8	2600	8.9	250	21	PP04SS00
SVOCs	Atrazine	4500	µg/kg	26	0	0.0	2	7.7	2600	340	32	18	RC01SS00
SVOCs	Benzaldehyde	8000000	µg/kg	46	0	0.0	12	26.1	2600	340	550	24	CB03SS00
SVOCs	Benzo(a)anthracene	216.1	µg/kg	54	30	55.6	26	48.1	2600	50	950	21	HA-11-1.5
SVOCs	Benzo(a)pyrene	582.1	µg/kg	54	12	22.2	19	35.2	2600	100	510	17	BH02SS00
SVOCs	Benzo(b)fluoranthene	720.1	µg/kg	54	12	22.2	22	40.7	2600	100	720	17	PP04SS00
SVOCs	Benzo(g,h,i)perylene	--	µg/kg	52	0	0.0	19	36.5	2600	100	1200	14	BH01SB01

TABLE 5

SUMMARY OF SOIL SCREENING EXCEEDANCES[1, 2]
Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[3]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Maximum Non-detected Value	Minimum Non-detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detection Location
SVOCs	Benzo(k)fluoranthene	720.1	µg/kg	54	10	18.5	22	40.7	2600	100	640	5	PP02SS00
SVOCs	bis(2-Ethylhexyl)phthalate	71000	µg/kg	59	0	0.0	49	83.1	2600	340	7500	21	PP04SS00
SVOCs	Butylbenzylphthalate	359169.0	µg/kg	26	0	0.0	2	7.7	2600	340	49	33	RC01SS00
SVOCs	Carbazole	50000	µg/kg	52	0	0.0	6	11.5	2600	340	110	42	PP01SS00
SVOCs	Chrysene	240.1	µg/kg	54	27	50.0	28	51.9	2400	50	900	27	BH02SS00
SVOCs	Dibenz(a,h)anthracene	1080	µg/kg	54	11	20.4	3	5.6	2600	8.9	170	22	BH02SS00
SVOCs	Dibenzofuran	0.003	µg/kg	26	26	100.0	13	50.0	2600	340	490	31	UL03SS00
SVOCs	Dimethylphthalate	80000000	µg/kg	26	0	0.0	1	3.8	2600	340	20	20	RC03SS00
SVOCs	Di-n-butylphthalate	200000	µg/kg	26	0	0.0	6	23.1	2600	340	250	23	UL01SS00
SVOCs	Endosulfan I	480000	µg/kg	26	0	0.0	3	11.5	6.8	1.8	2.8	1.8	BH06SS00
SVOCs	Endosulfan II	480000	µg/kg	26	0	0.0	3	11.5	13	3.4	12	3.4	BH06SS00
SVOCs	Fluoranthene	85037.1	µg/kg	52	0	0.0	35	67.3	2400	50	5900	21	HA-11-1.5
SVOCs	Fluorene	550000	µg/kg	52	0	0.0	8	15.4	2600	8.9	3200	24	HA-11-1.5
SVOCs	Indeno(1,2,3-cd)pyrene	2100	µg/kg	54	2	3.7	17	31.5	2600	100	790	12	BH01SB01
SVOCs	Naphthalene	5	µg/kg	65	65	100.0	20	30.8	2400	50	540	11	PP06SB01
SVOCs	n-Nitrosodiphenylamine	200000	µg/kg	26	0	0.0	1	3.8	2600	340	150	150	PP04SS00
SVOCs	Pentachlorophenol	8300	µg/kg	35	1	2.9	3	8.6	10000	250	860	36	GT02SS00
SVOCs	Phenanthrene	--	µg/kg	52	0	0.0	35	67.3	2400	50	9100	18	HA-11-1.5
SVOCs	Phenol	5038000	µg/kg	31	0	0.0	2	6.5	5000	40	120	73	UL03SS00
SVOCs	Pyrene	2400000	µg/kg	52	0	0.0	34	65.4	2400	50	5900	24	HA-11-1.5
SVOCs	Total cPAH	140	µg/kg	39	31	79.5	39	100.0	--	--	1952.5	25.485	PP03SS00
TPH	Diesel Range Hydrocarbons	460	mg/kg	112	57	50.9	41	36.6	6300	10	12000	18.1	CP-GP6-2
TPH	Gasoline Range Hydrocarbons	100	mg/kg	25	0	0.0	1	4.0	33	4.8	17	17	CP-GP9-2.5
TPH	Heavy Fuel Oil	2000	mg/kg	16	6	37.5	14	87.5	25	25	241000	27.9	AN2-4
TPH	Lube Oil	2000	mg/kg	18	1	5.6	14	77.8	170	58	2100	120	SP1-1
TPH	Motor Oil	2000	mg/kg	58	42	72.4	48	82.8	1900	50	190000	130	11
TPH	Total Petroleum Hydrocarbons	--	mg/kg	19	0	0.0	18	94.7	50	50	169913	88	HA14-1.5
VOCs	1,1,1,2-Tetrachloroethane	38000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1,1-Trichloroethane	2000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1,2,2-Tetrachloroethane	5000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1,2-Trichloroethane	12822.7	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1-Dichloroethane	8000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1-Dichloroethene	4000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,1-Dichloropropene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2,3-Trichlorobenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2,3-Trichloropropane	140	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2,4-Trichlorobenzene	8979.9	µg/kg	29	0	0.0	1	3.4	120	10	2	2	UL03SS00
VOCs	1,2,4-Trimethylbenzene	4000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2-Dibromo-3-chloropropane	710	µg/kg	16	1	6.3	0	0.0	1200	12	--	--	--
VOCs	1,2-Dibromoethane	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2-Dichlorobenzene	48896.7	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,2-Dichloroethane	11000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--

TABLE 5

SUMMARY OF SOIL SCREENING EXCEEDANCES[1, 2]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[3]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Maximum Non-detected Value	Minimum Non-detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detection Location
VOCs	1,2-Dichloropropane	15000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,3,5-Trimethylbenzene	4000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,3-Dichlorobenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,3-Dichloropropane	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	1,4-Dichlorobenzene	42000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	2,2-Dichloropropane	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	2-Butanone	48000000	µg/kg	51	0	0.0	8	15.7	130	10	56	1	GT03SB01
VOCs	2-Chlorotoluene	1600000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	4-Chlorotoluene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Acetone	8000000	µg/kg	39	0	0.0	5	12.8	920	10	5900	210	BH04SB01
VOCs	Benzene	30	µg/kg	47	15	31.9	1	2.1	290	10	430	430	CP-HA37-1.5
VOCs	Bromobenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Bromodichloromethane	16000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Bromoform	90578.8	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Bromomethane	4423.1	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Carbon Disulfide	8000000	µg/kg	51	0	0.0	23	45.1	29	10	62	1	BH03SB01
VOCs	Carbon Tetrachloride	883.8	µg/kg	3	1	33.3	0	0.0	1200	660	--	--	--
VOCs	Chlorobenzene	44903.7	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Chloroethane	350	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Chloroform	36296.3	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Chloromethane	77000	µg/kg	29	0	0.0	1	3.4	120	10	2	2	BH06SS00
VOCs	cis-1,2-Dichloroethene	800000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	cis-1,3-Dichloropropene	5600	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Dibromochloromethane	12000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Dibromomethane	800000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Dichlorodifluoromethane	16000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Ethylbenzene	9000	µg/kg	34	0	0.0	1	2.9	330	4	8	8	BH03SB01
VOCs	Hexachlorobutadiene	13000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Isopropylbenzene	8000000	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	m,p-Xylene	--	µg/kg	11	0	0.0	0	0.0	270	48	--	--	--
VOCs	Methylene Chloride	20	µg/kg	54	28	51.9	17	31.5	260	10	110	6	PP02SS00
VOCs	Naphthalene	5	µg/kg	3	3	100.0	0	0.0	1200	660	--	--	--
VOCs	n-Butylbenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	n-Propylbenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	o-Xylene	--	µg/kg	11	0	0.0	0	0.0	270	48	--	--	--
VOCs	p-Isopropyltoluene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	sec-Butylbenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Styrene	33000	µg/kg	28	0	0.0	3	10.7	120	10	3	2	PP04SS00
VOCs	tert-Butylbenzene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Tetrachloroethene	50	µg/kg	17	3	17.6	1	5.9	120	10	3	3	UL03SS00
VOCs	Toluene	7000	µg/kg	71	0	0.0	19	26.8	330	10	120	1	ANX2-2
VOCs	Total Xylene	9000	µg/kg	10	0	0.0	1	10.0	330	86	620	620	CP-HA40-1.5

TABLE 5

SUMMARY OF SOIL SCREENING EXCEEDANCES[1, 2]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[3]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Maximum Non-detected Value	Minimum Non-detected Value	Maximum Detected Value	Minimum Detected Value	Maximum Detection Location
VOCs	trans-1,2-Dichloroethene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	trans-1,3-Dichloropropene	--	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	trans-1,3-Dichloropropene	5600	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--
VOCs	Trichloroethene	30	µg/kg	29	4	13.8	1	3.4	120	10	3	3	RC03SS00
VOCs	Trichlorofluoromethane	24000000	µg/kg	29	0	0.0	10	34.5	120	10	22	2	PP04SS00
VOCs	Vinyl Chloride	670	µg/kg	3	0	0.0	0	0.0	120	66	--	--	--

Notes:

1. Where analytes were not detected but the reporting limit exceeded the screening levels, the sample was counted as an exceedance.
2. Four areas with soil exceedances were remediated during 2007; the table includes he pre-excavation results, but not the post-excavation confirmation samples.
3. Unit abbreviations:
   ng/kg = nanograms per kilogram.
   µg/kg = micrograms per kilogram.
   mg/kg = milligrams per kilogram.
4. -- = Not established / not applicable.

TABLE 6

SUMMARY OF GROUNDWATER SCREENING EXCEEDANCES[1]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[2]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Minimum Non-detected Value	Maximum Non-detected Value	Minimum Detected Value	Maximum Detected Value	Maximum Detection Location
Metals	Aluminum	--	mg/L	7	0	0.0	6	85.7	7.4	7.4	17800	955000	RC02GW01
Metals	Antimony	0.64	mg/L	7	7	100.0	6	85.7	4.9	4.9	25.5	64.8	BG01GW02
Metals	Arsenic	0.00014	mg/L	7	7	100.0	6	85.7	5.6	5.6	75.4	470	BG01GW02
Metals	Barium	3.20	mg/L	7	7	100.0	7	100.0	--[3]	--	66.6	10900	RC02GW01
Metals	Beryllium	--	mg/L	7	0	0.0	1	14.3	0.2	0.2	18	18	RC02GW01
Metals	Cadmium	0.0088	mg/L	7	7	100.0	6	85.7	0.5	0.5	11.1	108	RC02GW01
Metals	Calcium	--	mg/L	7	0	0.0	7	100.0	--	--	189000	833000	RC02GW01
Metals	Chromium	0.05	mg/L	7	7	100.0	6	85.7	1.5	1.5	99.4	1580	RC02GW01
Metals	Cobalt	--	mg/L	7	0	0.0	6	85.7	1.7	1.7	22.9	923	RC02GW01
Metals	Copper	0.0031	mg/L	7	7	100.0	7	100.0	--	--	14.1	9100	RC02GW01
Metals	Iron	--	mg/L	7	0	0.0	7	100.0	--	--	672	1770000	RC02GW01
Metals	Lead	0.0081	mg/L	7	7	100.0	6	85.7	2.6	2.6	485	2330	RC02GW01
Metals	Magnesium	--	mg/L	7	0	0.0	7	100.0	--	--	155000	587000	SP01GW01
Metals	Manganese	--	mg/L	7	0	0.0	7	100.0	--	--	127	38300	RC02GW01
Metals	Mercury	0.000025	mg/L	7	7	100.0	7	100.0	--	--	0.11	16.8	CB01GW01
Metals	Nickel	0.0082	mg/L	7	7	100.0	7	100.0	--	--	1.2	2660	RC02GW01
Metals	Potassium	--	mg/L	7	0	0.0	7	100.0	--	--	94900	516000	RC02GW01
Metals	Selenium	0.071	mg/L	7	7	100.0	3	42.9	3.9	3.9	10	30.1	BG01GW02
Metals	Silver	0.0019	mg/L	7	7	100.0	6	85.7	1.8	1.8	7.4	39.8	RC02GW01
Metals	Sodium	--	mg/L	7	0	0.0	7	100.0	--	--	30100	1670000	PP07GW01
Metals	Thallium	--	mg/L	7	0	0.0	3	42.9	7.8	7.8	20	25	UL02GW01
Metals	Vanadium	0.11	mg/L	7	7	100.0	7	100.0	--	--	4.9	2950	RC02GW01
Metals	Zinc	0.081	mg/L	7	7	100.0	7	100.0	--	--	19.7	7350	RC02GW01
PCBs	Arochlor 1016	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1221	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1232	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1242	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1248	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1254	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
PCBs	Arochlor 1260	--	µg/L	2	0	0.0	0	0.0	0.05	0.05	--	--	--
SVOCs	1,2,4-Trichlorobenzene	70	µg/L	3	0	0.0	0	0.0	1	11	--	--	--
SVOCs	1,2-Dichlorobenzene	720	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	1,3-Dichlorobenzene	960	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	1,4-Dichlorobenzene	1.8	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2,4,5-Trichlorophenol	800	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2,4,6-Trichlorophenol	2.4	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2,4-Dichlorophenol	24	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2,4-Dimethylphenol	160	µg/L	10	0	0.0	1	10.0	1	12	22	22	UL02GW01
SVOCs	2,4-Dinitrophenol	9.1	µg/L	3	3	100.0	0	0.0	15	15	--	--	--
SVOCs	2,4-Dinitrotoluene	3.4	µg/L	6	6	100.0	0	0.0	4	4	--	--	--
SVOCs	2-Chloronaphthalene	640	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2-Chlorophenol	40	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2-Methyl-4,6-dinitrophenol	280	µg/L	3	0	0.0	0	0.0	4	4	--	--	--

TABLE 6

SUMMARY OF GROUNDWATER SCREENING EXCEEDANCES[1]

Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[2]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Minimum Non-detected Value	Maximum Non-detected Value	Minimum Detected Value	Maximum Detected Value	Maximum Detection Location
SVOCs	2-Methylnaphthalene	32	µg/L	10	0	0.0	2	20.0	1	12	2	16	CP-GP8-HP
SVOCs	2-Methylphenol	400	µg/L	3	0	0.0	0	0.0	4	4	--	--	--
SVOCs	2-Nitroaniline	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	2-Nitrophenol	--	µg/L	3	0	0.0	0	0.0	2	2	--	--	--
SVOCs	3,3'-Dichlorobenzidine	0.028	µg/L	3	3	100.0	0	0.0	4	4	--	--	--
SVOCs	3-Nitroaniline	--	µg/L	3	0	0.0	0	0.0	4	4	--	--	--
SVOCs	4-Bromophenyl-phenylether	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	4-Chloro-3-methylphenol	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	4-Chloroaniline	32	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	4-Chlorophenyl-phenylether	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	4-Methylphenol	40	µg/L	10	1	10.0	5	50.0	4	10	1	120	BG01GW02
SVOCs	4-Nitroaniline	0.00	µg/L	3	3	100.0	0	0.0	4	4	--	--	--
SVOCs	4-Nitrophenol	0.00	µg/L	3	3	100.0	0	0.0	4	4	--	--	--
SVOCs	Acenaphthene	960	µg/L	10	0	0.0	2	20.0	1	10	1	2	RC02GW01
SVOCs	Acenaphthylene	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Aniline	7.7	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Anthracene	71	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Benzaldehyde	--	µg/L	7	0	0.0	2	28.6	10	12	0.8	2	UL02GW01
SVOCs	Benzidine	0.0002	µg/L	3	3	100.0	0	0.0	1	1	--	--	--
SVOCs	Benzo(a)anthracene	0.018	µg/L	3	3	100.0	0	0.0	1	1	--	--	--
SVOCs	Benzo(a)pyrene	0.012	µg/L	16	16	100.0	6	37.5	1	10	0.7	0.7	BH01GW01
SVOCs	Benzo(b)fluoranthene	0.018	µg/L	16	16	100.0	6	37.5	1	10	0.7	0.7	BH01GW01
SVOCs	Benzo(g,h,i)perylene	0.00	µg/L	8	8	100.0	3	37.5	1	10	2	2	BH01GW01
SVOCs	Benzo(k)fluoranthene	0.018	µg/L	8	8	100.0	3	37.5	1	10	0.7	0.7	BH01GW01
SVOCs	Benzoic acid	64000	µg/L	3	0	0.0	0	0.0	15	15	--	--	--
SVOCs	Benzyl alcohol	2400	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	bis(2-Chloroethoxy) methane	--	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Bis-(2-Chloroethyl) ether	0.04	µg/L	3	3	100.0	0	0.0	1	1	--	--	--
SVOCs	bis(2-Chloroisopropyl)ether	320	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	bis(2-Ethylhexyl)phthalate	2.2	µg/L	6	6	100.0	6	100.0	--	--	3	6.9	CP-GP5-HP
SVOCs	Butylbenzylphthalate	1900	µg/L	3	0	0.0	0	0.0	4	4			
SVOCs	Caprolactam	8000	µg/L	7	0	0.0	4	57.1	10	10	0.6	2	BG01GW02
SVOCs	Carbazole	4.4	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Chrysene	0.018	µg/L	6	6	100.0	0	0.0	1	1	--	--	--
SVOCs	Dibenz(a,h)anthracene	0.018	µg/L	3	3	100.0	0	0.0	1	1	--	--	--
SVOCs	Dibenzofuran	32	µg/L	10	0	0.0	1	10.0	1	12	0.7	0.7	RC02GW01
SVOCs	Diethylphthalate	13000	µg/L	10	0	0.0	2	20.0	1	12	0.5	0.5	BG01GW02
SVOCs	Dimethylphthalate	16000	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Di-n-butylphthalate	1600	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Di-n-Octyl phthalate	320	µg/L	3	0	0.0	0	0.0	4	4	--	--	--
SVOCs	Fluoranthene	140	µg/L	10	0	0.0	1	10.0	1	10	4	4	BH01GW01
SVOCs	Fluorene	640	µg/L	10	0	0.0	1	10.0	1	12	1	1	RC02GW01
SVOCs	Hexachlorobenzene	0.00029	µg/L	3	3	100.0	0	0.0	1	1	--	--	--

TABLE 6

SUMMARY OF GROUNDWATER SCREENING EXCEEDANCES[1]

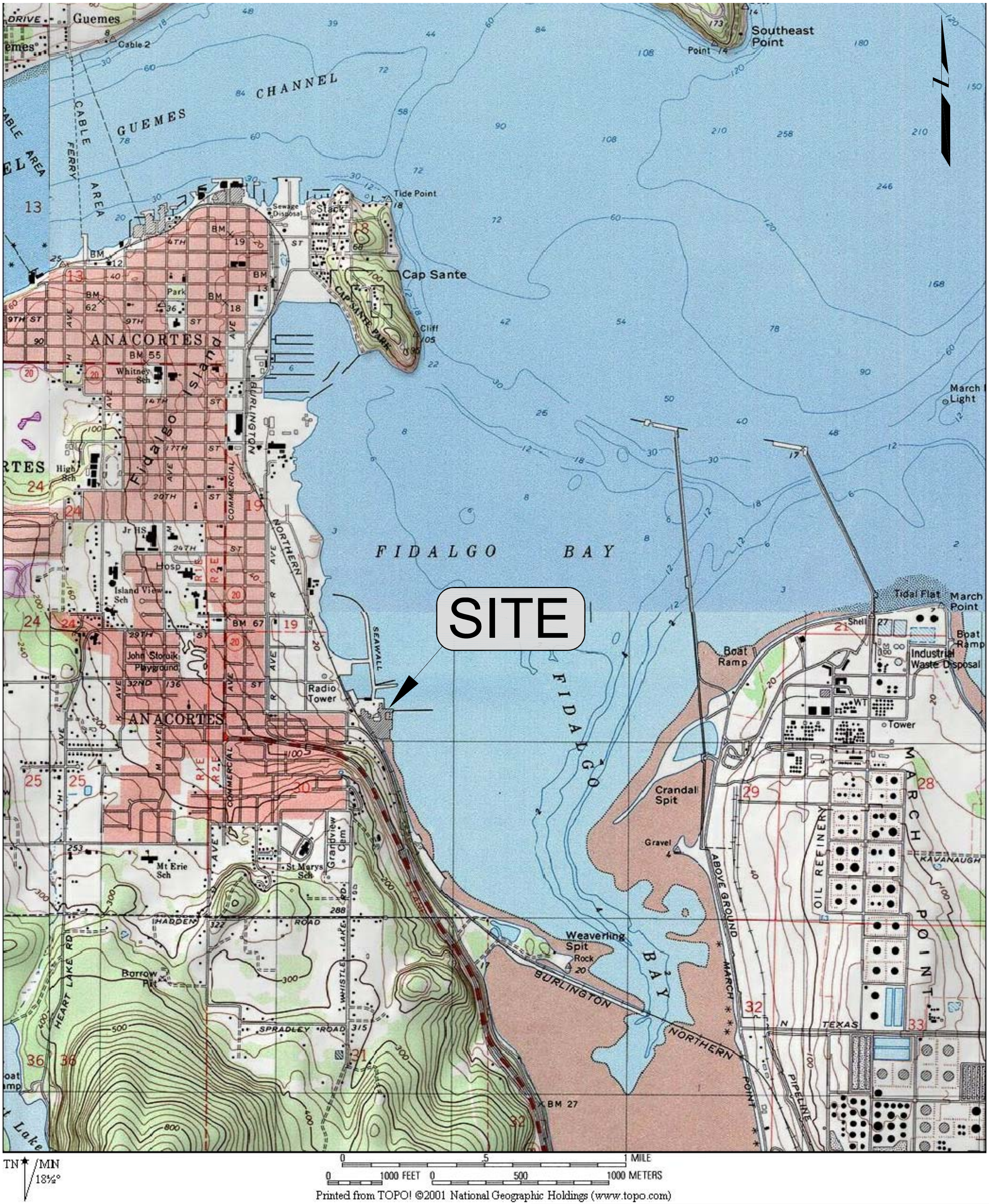
Former Custom Plywood Mill
Anacortes, Washington

Method Group	Analyte	Screening Level	Units[2]	Number of Samples Analyzed	Frequency of Exceedance (non-detects reported at RL)	Percent Exceeding Screening Level	Frequency of Detection	Percent Detected	Minimum Non-detected Value	Maximum Non-detected Value	Minimum Detected Value	Maximum Detected Value	Maximum Detection Location
SVOCs	Hexachlorobutadiene	0.56	µg/L	3	3	100.0	0	0.0	4	4	--	--	--
SVOCs	Hexachlorocyclopentadiene	48	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Hexachloroethane	3.1	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	Indeno(1,2,3-cd)pyrene	0.018	µg/L	8	8	100.0	3	37.5	1	10	1	1	BH01GW01
SVOCs	Isophorone	46	µg/L	10	0	0.0	2	20.0	1	10	0.9	3.8	CP-GP8-HP
SVOCs	Naphthalene	160	µg/L	10	0	0.0	2	20.0	1	10	3	6	RC02GW01
SVOCs	Nitrobenzene	4	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
SVOCs	N-Nitroso-di-n-propylamine	0.5	µg/L	3	3	100.0	0	0.0	1	1	--	--	--
SVOCs	n-Nitrosodiphenylamine	6	µg/L	3	1	33.3	1	33.3	1	1	6.7	6.7	CP-GP8-HP
SVOCs	Pentachlorophenol	0.73	µg/L	3	3	100.0	0	0.0	15	15	--	--	--
SVOCs	Phenanthrene	--	µg/L	10	0	0.0	2	20.0	1	12	2	3.8	CP-GP8-HP
SVOCs	Phenol	4800	µg/L	10	0	0.0	3	30.0	1	12	1	3	BG01GW02
SVOCs	Pyrene	480	µg/L	3	0	0.0	0	0.0	1	1	--	--	--
TPH	Diesel Range Hydrocarbons	500.00	µg/L	25	4	16.0	5	20.0	250	500	270	9,000	CP-GP8-HP
TPH	Gasoline Range Hydrocarbons	500.00	µg/L	3	1	33.3	1	33.3	100	100	2,600	2,600	CP-GP8-HP
TPH	Heavy Fuel Oil	2000	µg/L	20	0	0.0	2	10.0	500	500	920	1,100	MW-3
TPH	Motor Oil	2000.00	µg/L	5	2	40.0	3	60.0	1,000	1,000	1,500	3,000	press pit 3
VOCs	1,2-Dichloroethane	0.48	µg/L	7	7	100.0	1	14.3	10	50	10	10	BG01GW02
VOCs	Benzene	0.8	µg/L	3	3	100.0	0	0.0	1	5	--	--	--
VOCs	Ethylbenzene	700	µg/L	3	0	0.0	0	0.0	1	5	--	--	--
VOCs	m,p-Xylene	16000	µg/L	3	0	0.0	0	0.0	1	5	--	--	--
VOCs	Methylene Chloride	5	µg/L	6	6	100.0	1	16.7	10	10	13	13	RC02GW01
VOCs	o-Xylene	16000	µg/L	3	0	0.0	0	0.0	1	5	--	--	--
VOCs	Toluene	640	µg/L	3	0	0.0	0	0.0	1	5	--	--	--

Notes:

1. Where analytes were not detected but the reporting limit exceeded the screening levels, the sample was counted as an exceedance.
2. Unit abbreviations:
   µg/L = micrograms per liter.
   mg/L = milligrams per liter.
3. -- = Not established / not applicable.

FIGURES



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SITE VICINITY MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/12/08	Project No. 10654
Geomatrix		Figure 1

Plot Date: 09/12/08 - 5:19pm, Plotted by: astenberg
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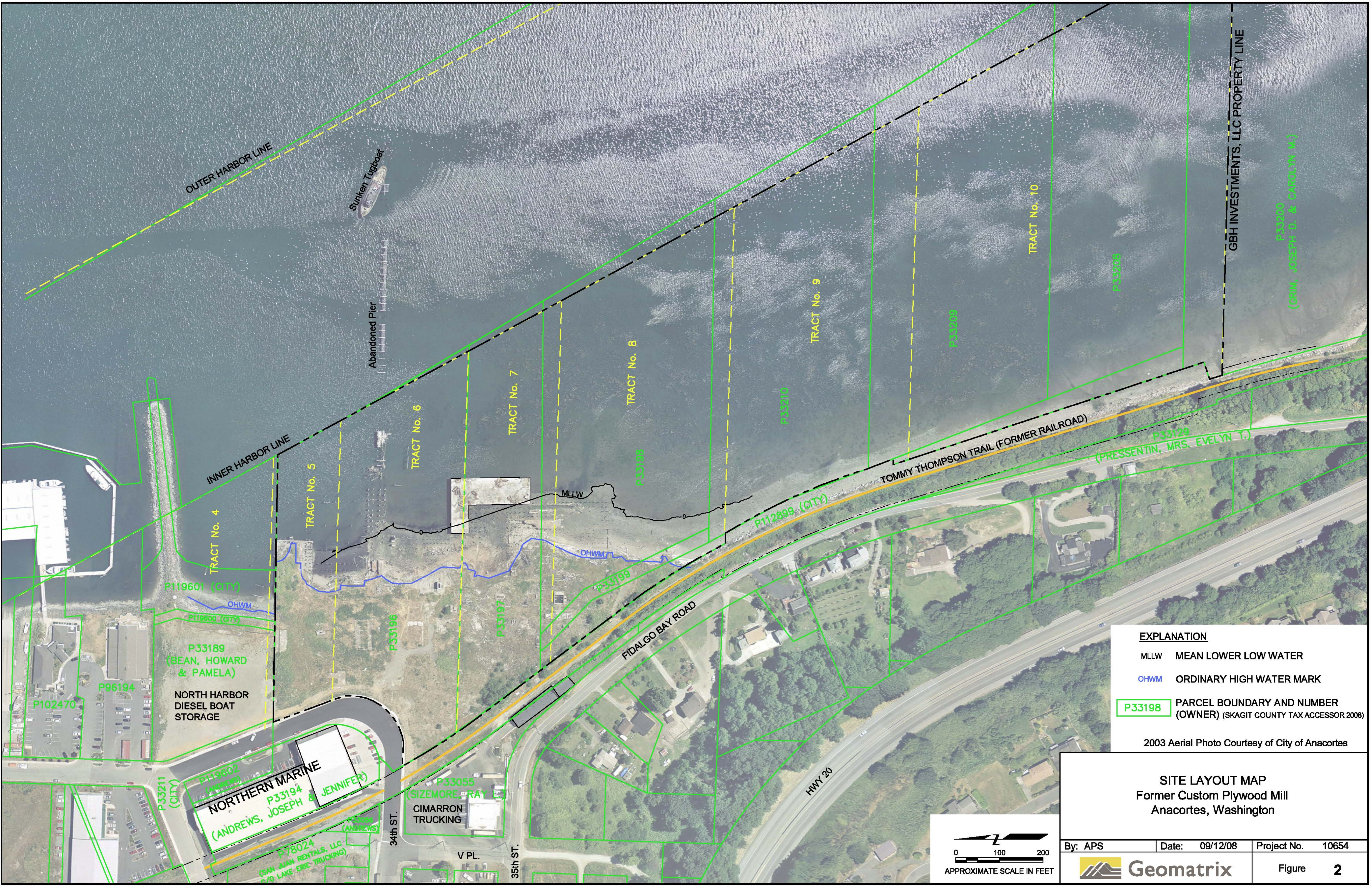


EXPLANATION

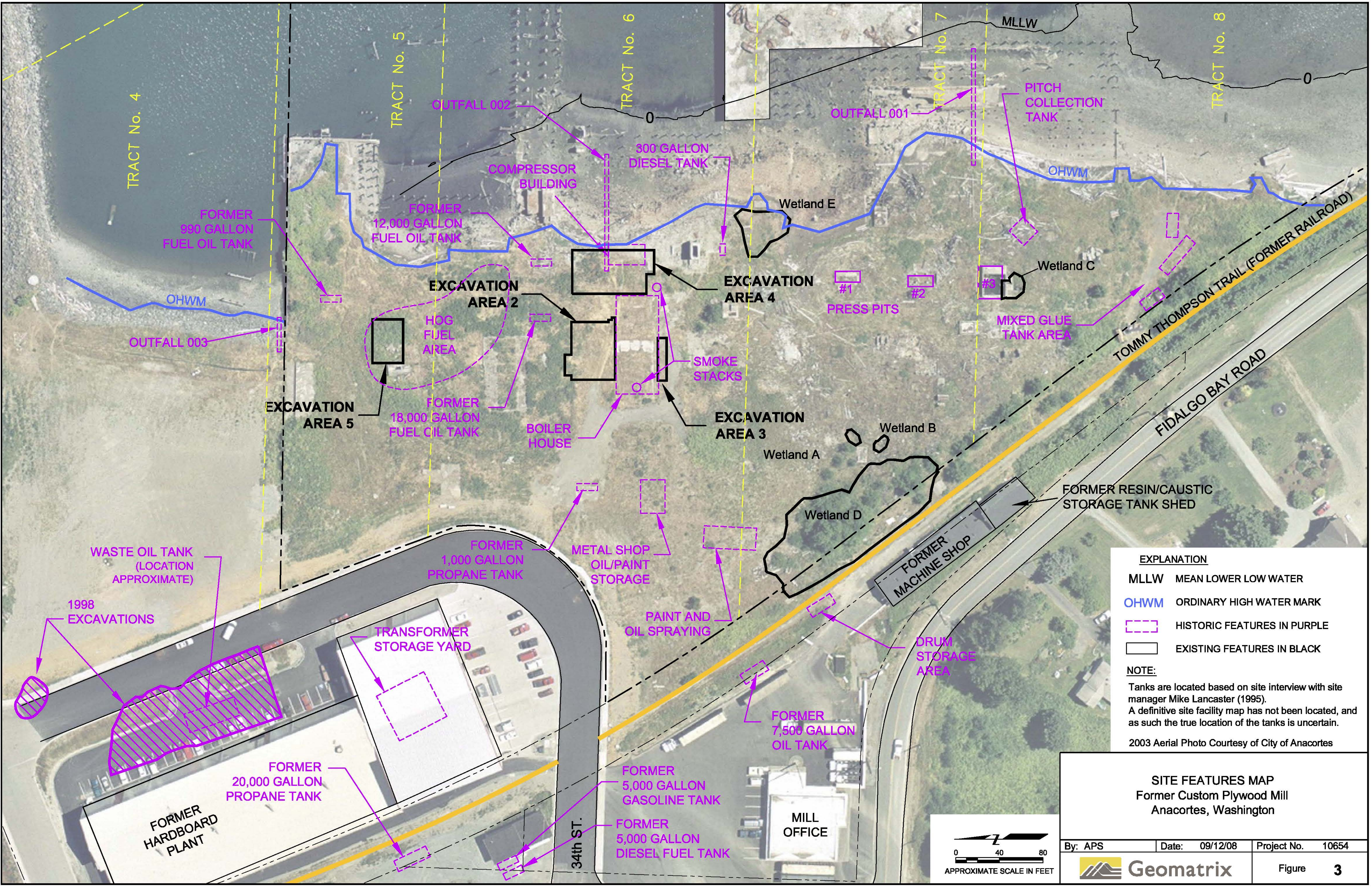
MLLW	MEAN LOWER LOW WATER
OHWM	ORDINARY HIGH WATER MARK
P33198	PARCEL BOUNDARY AND NUMBER (OWNER) (SKAGIT COUNTY TAX ACCESSOR 2008)

2003 Aerial Photo Courtesy of City of Anacortes

SITE LAYOUT MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/12/08	Project No. 10654
Geomatrix		Figure 2

Plot Date: 09/12/08 - 5:21pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 2_FormerCustom_SiteMap.dwg



EXPLANATION

MLLW	MEAN LOWER LOW WATER
OHWM	ORDINARY HIGH WATER MARK
▭	HISTORIC FEATURES IN PURPLE
▭	EXISTING FEATURES IN BLACK

NOTE:

Tanks are located based on site interview with site manager Mike Lancaster (1995).
A definitive site facility map has not been located, and as such the true location of the tanks is uncertain.

2003 Aerial Photo Courtesy of City of Anacortes

SITE FEATURES MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/12/08	Project No. 10654
Geomatrix		Figure 3

Plot Date: 09/12/08 - 5:25pm, Plotted by: astenberg
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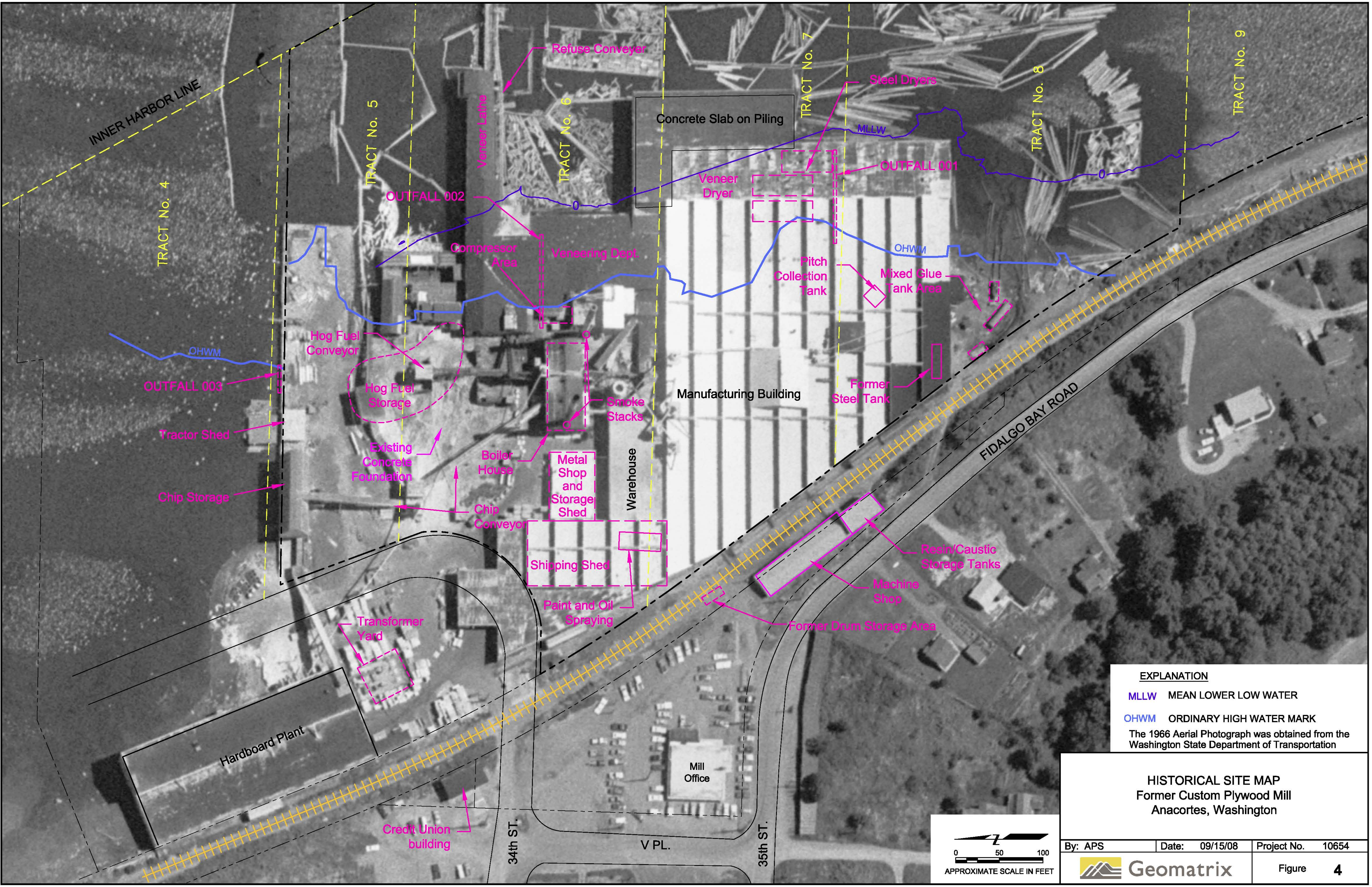

EXPLANATION

MLLW MEAN LOWER LOW WATER

OHWM ORDINARY HIGH WATER MARK

The 1966 Aerial Photograph was obtained from the Washington State Department of Transportation

HISTORICAL SITE MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 4

Plot Date: 09/15/08 - 8:56am, Plotted by: astenberg
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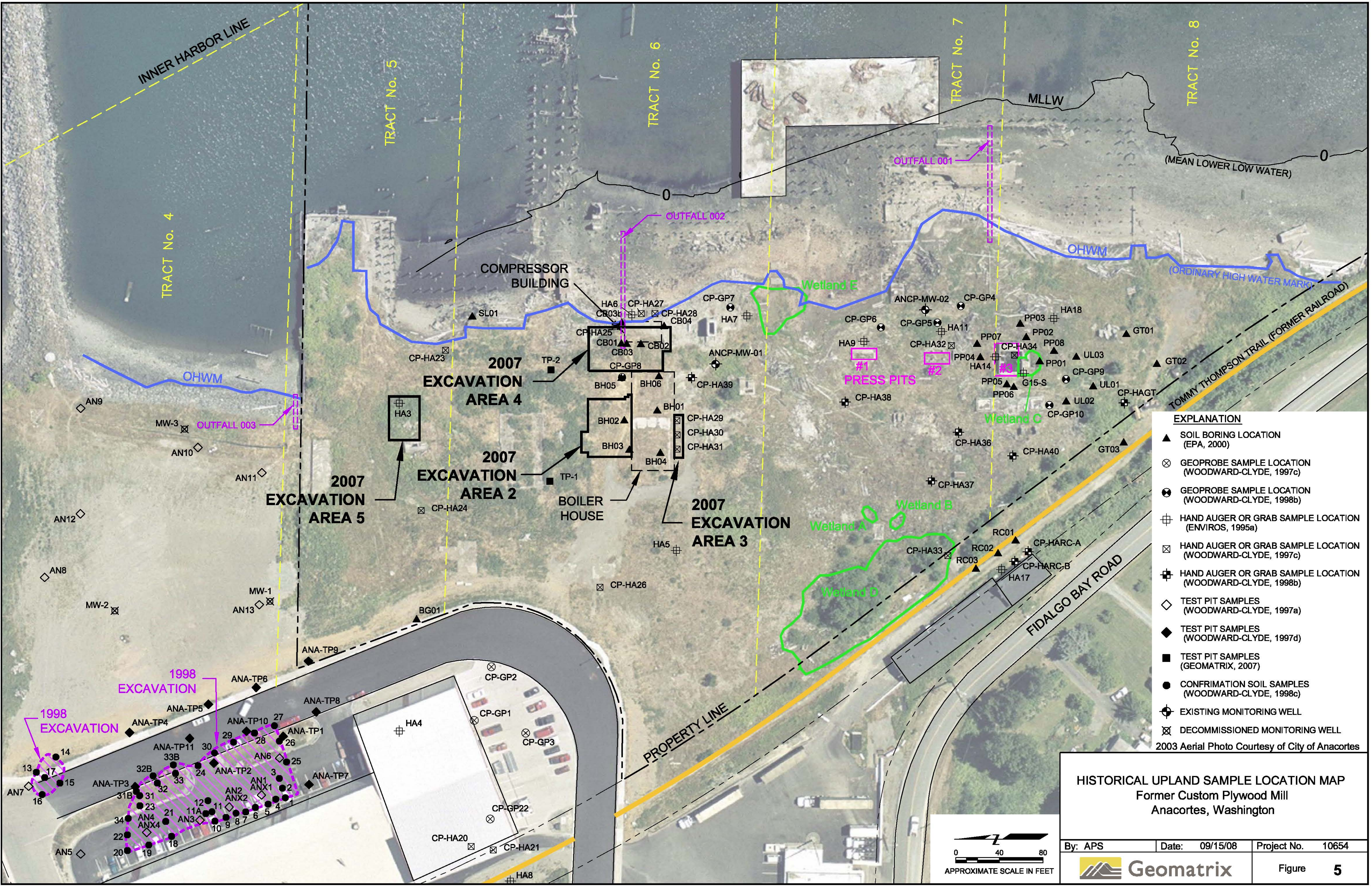

2003 Aerial Photo Courtesy of City of Anacortes

HISTORICAL UPLAND SAMPLE LOCATION MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 5

Plot Date: 09/15/08 - 9:29am, Plotted by: astenberg
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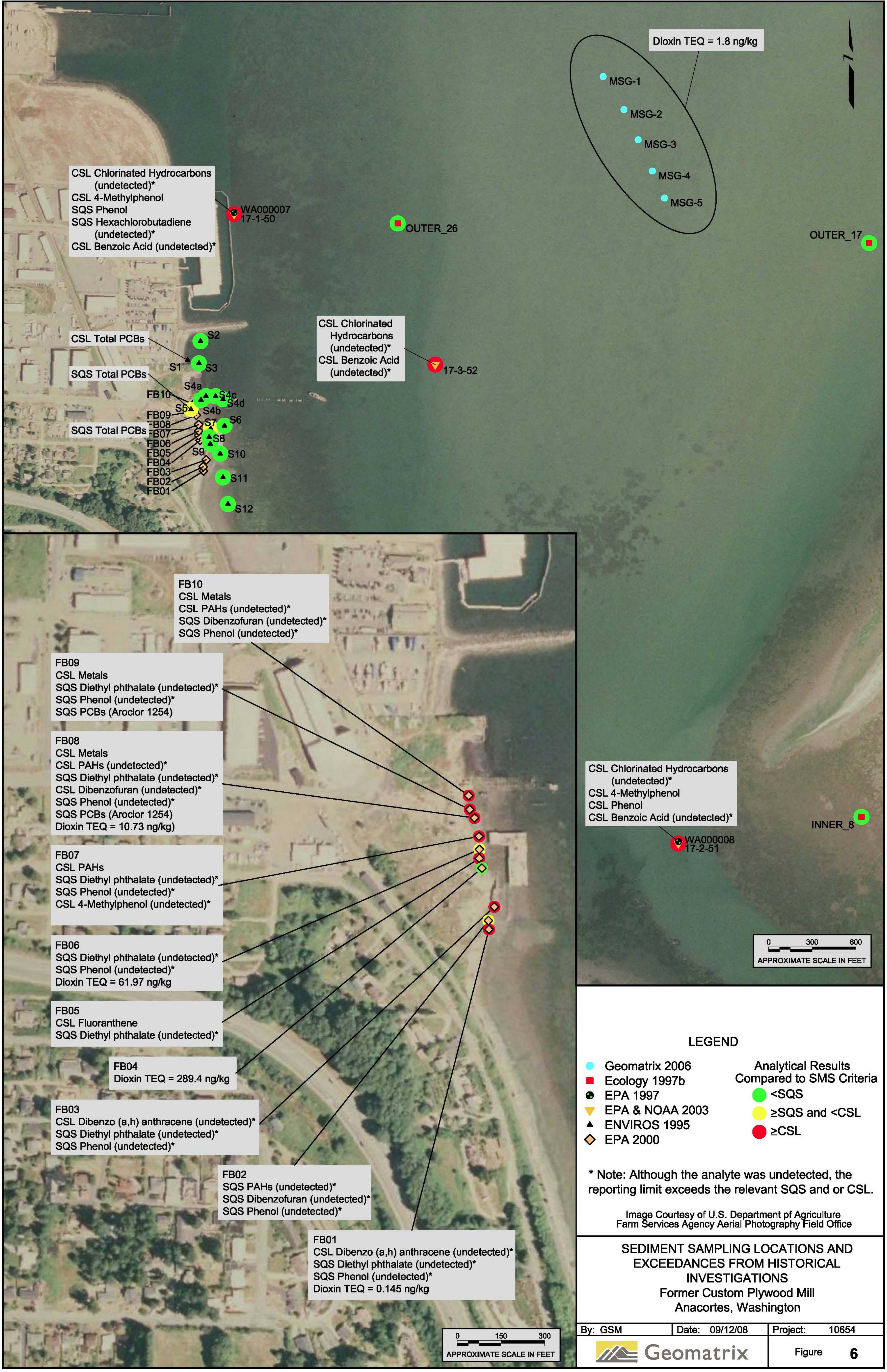

* Note: Although the analyte was undetected, the reporting limit exceeds the relevant SQS and or CSL.

Image Courtesy of U.S. Department pf Agriculture
Farm Services Agency Aerial Photography Field Office

SEDIMENT SAMPLING LOCATIONS AND EXCEEDANCES FROM HISTORICAL INVESTIGATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM	Date: 09/12/08	Project: 10654
Geomatrix		Figure 6

Plot Date: 09/15/08 - 9:49am, Plotted by: astenberg
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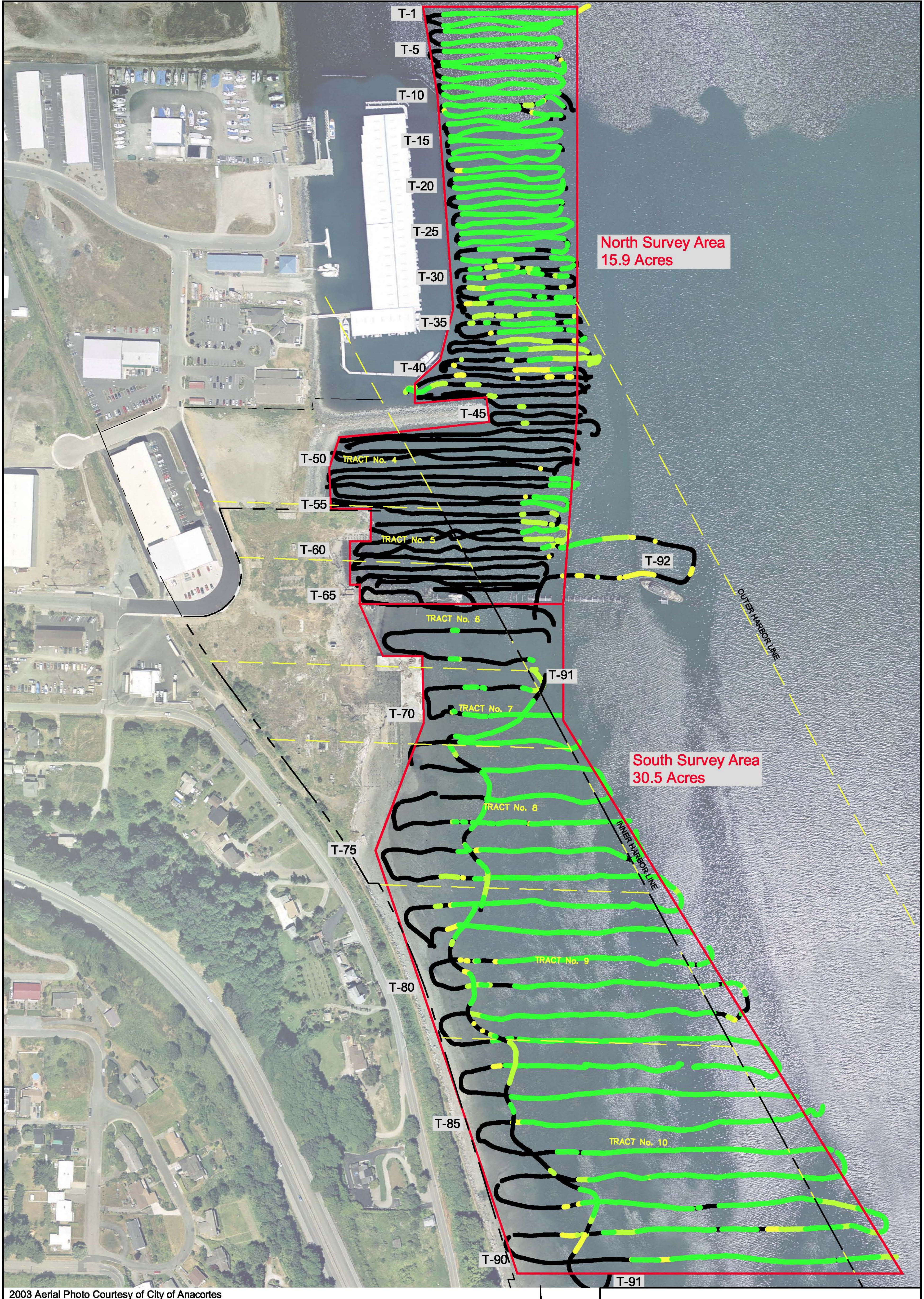


2003 Aerial Photo Courtesy of City of Anacortes

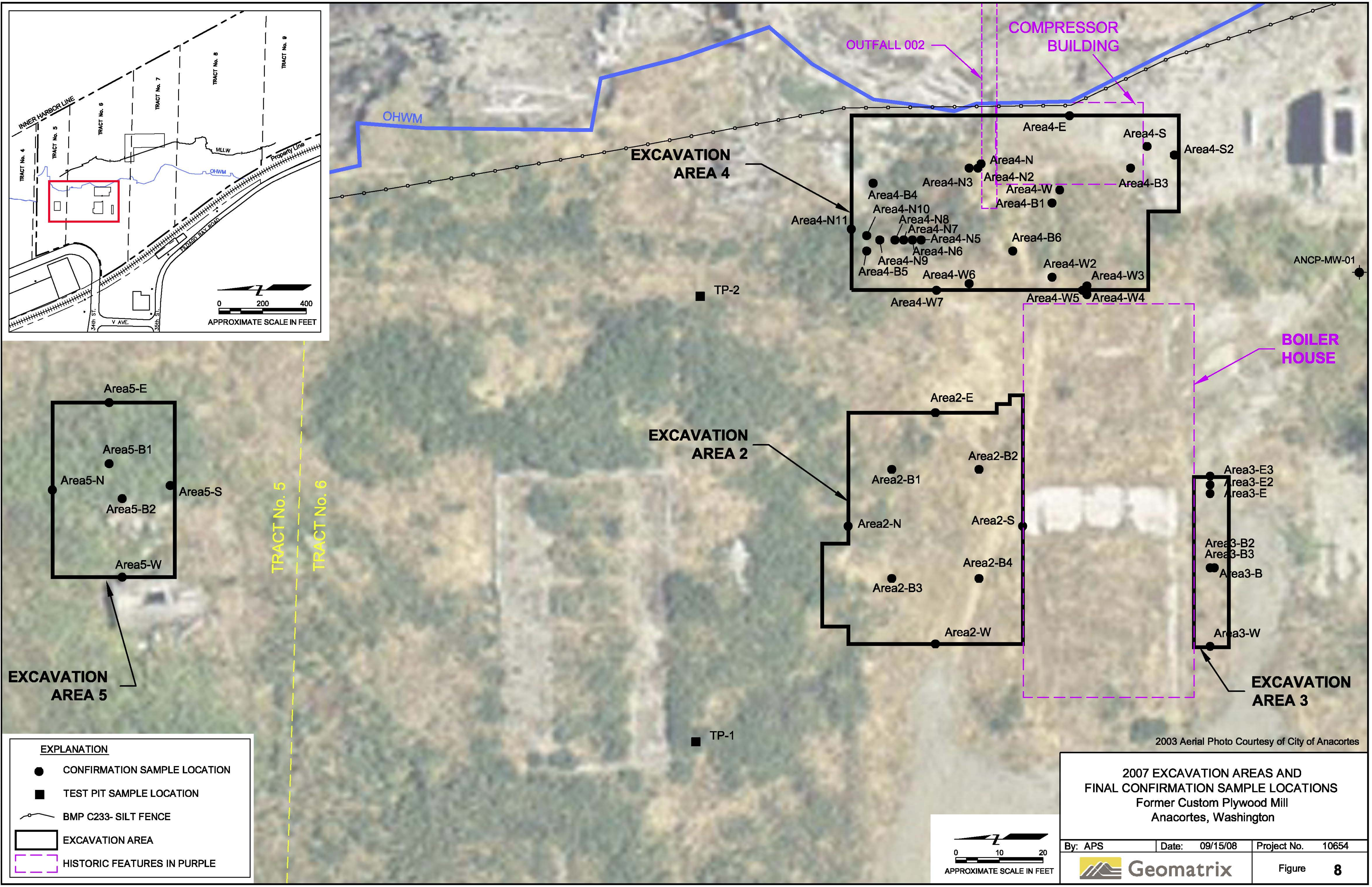
ESTIMATED EELGRASS COVERAGE

- ● None
- ● Low 1 to 25%
- ● Medium 25 to 75 %
- ● High > 75%

0 125 250
APPROXIMATE SCALE IN FEET

BENTHIC/EELGRASS SURVEY RESULTS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 7



2003 Aerial Photo Courtesy of City of Anacortes

2007 EXCAVATION AREAS AND
FINAL CONFIRMATION SAMPLE LOCATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 8

Plot Date: 09/15/08 - 10:00am, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 8_FormerCustom_ExcavConfirmSamp_091508.dwg

Plot Date: 09/15/08 - 9:55am, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 7&9_FormerCustom_EelgrassBathy_091508.dwg

2003 Aerial Photo Courtesy of City of Anacortes

MLLW	MEAN LOWER LOW WATER
OHWM	ORDINARY HIGH WATER MARK

Bathymetry Datum: MLLW
CRA Northwest, January 2006

N

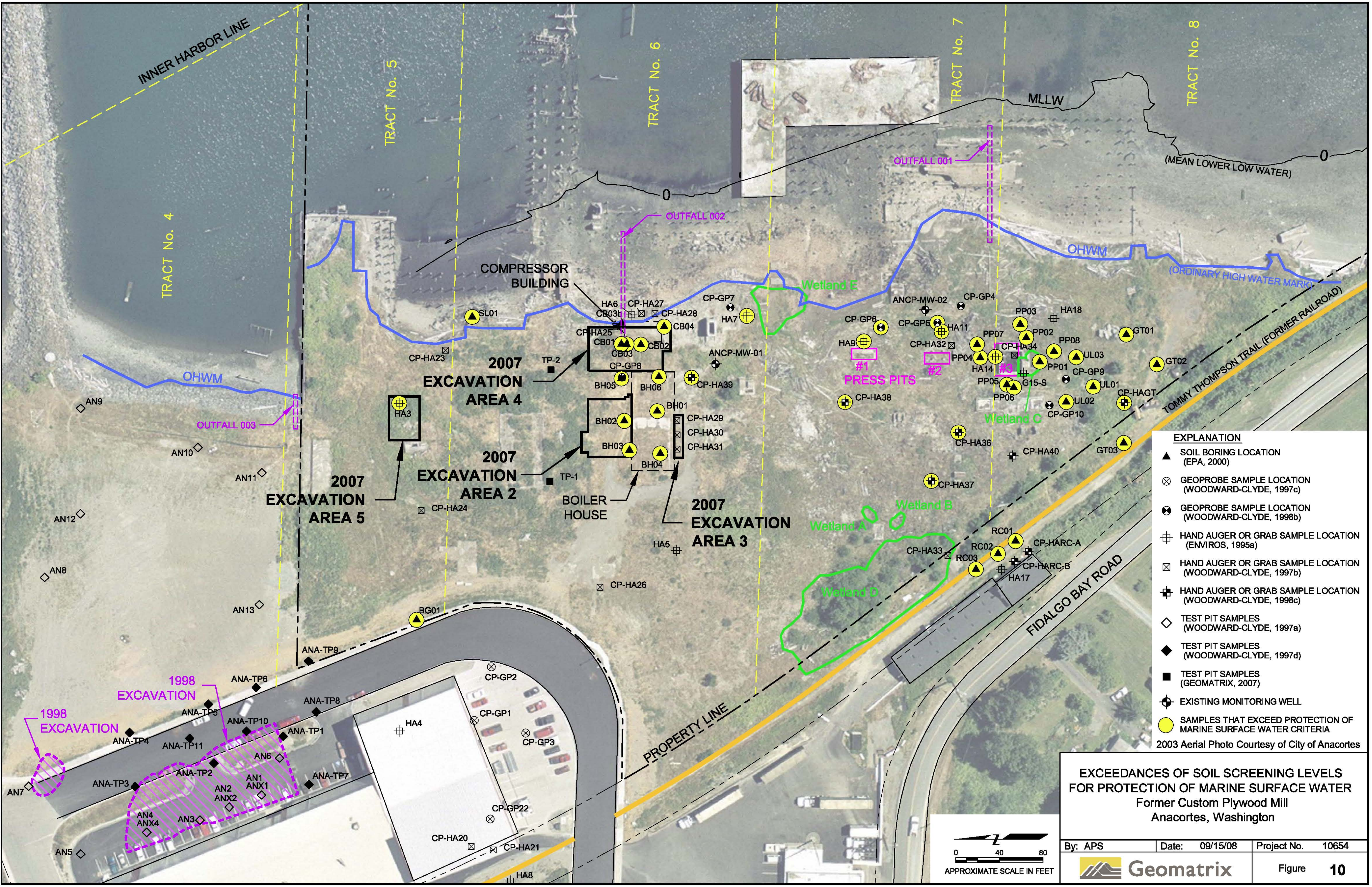
0 125 250
APPROXIMATE SCALE IN FEET

BATHYMETRIC MAP OF TIDELANDS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM
Date: 09/15/08
Project No. 10654

Geomatrix

Figure 9



EXPLANATION

▲	SOIL BORING LOCATION (EPA, 2000)
⊗	GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1997c)
●	GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1998b)
⊕	HAND AUGER OR GRAB SAMPLE LOCATION (ENVIROS, 1995a)
☒	HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1997b)
✚	HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1998c)
◇	TEST PIT SAMPLES (WOODWARD-CLYDE, 1997a)
◆	TEST PIT SAMPLES (WOODWARD-CLYDE, 1997d)
■	TEST PIT SAMPLES (GEOMATRIX, 2007)
⊕	EXISTING MONITORING WELL
●	SAMPLES THAT EXCEED PROTECTION OF MARINE SURFACE WATER CRITERIA

2003 Aerial Photo Courtesy of City of Anacortes

EXCEEDANCES OF SOIL SCREENING LEVELS FOR PROTECTION OF MARINE SURFACE WATER

Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 10

Plot Date: 09/15/08 - 10:08am, Plotted by: astenberg
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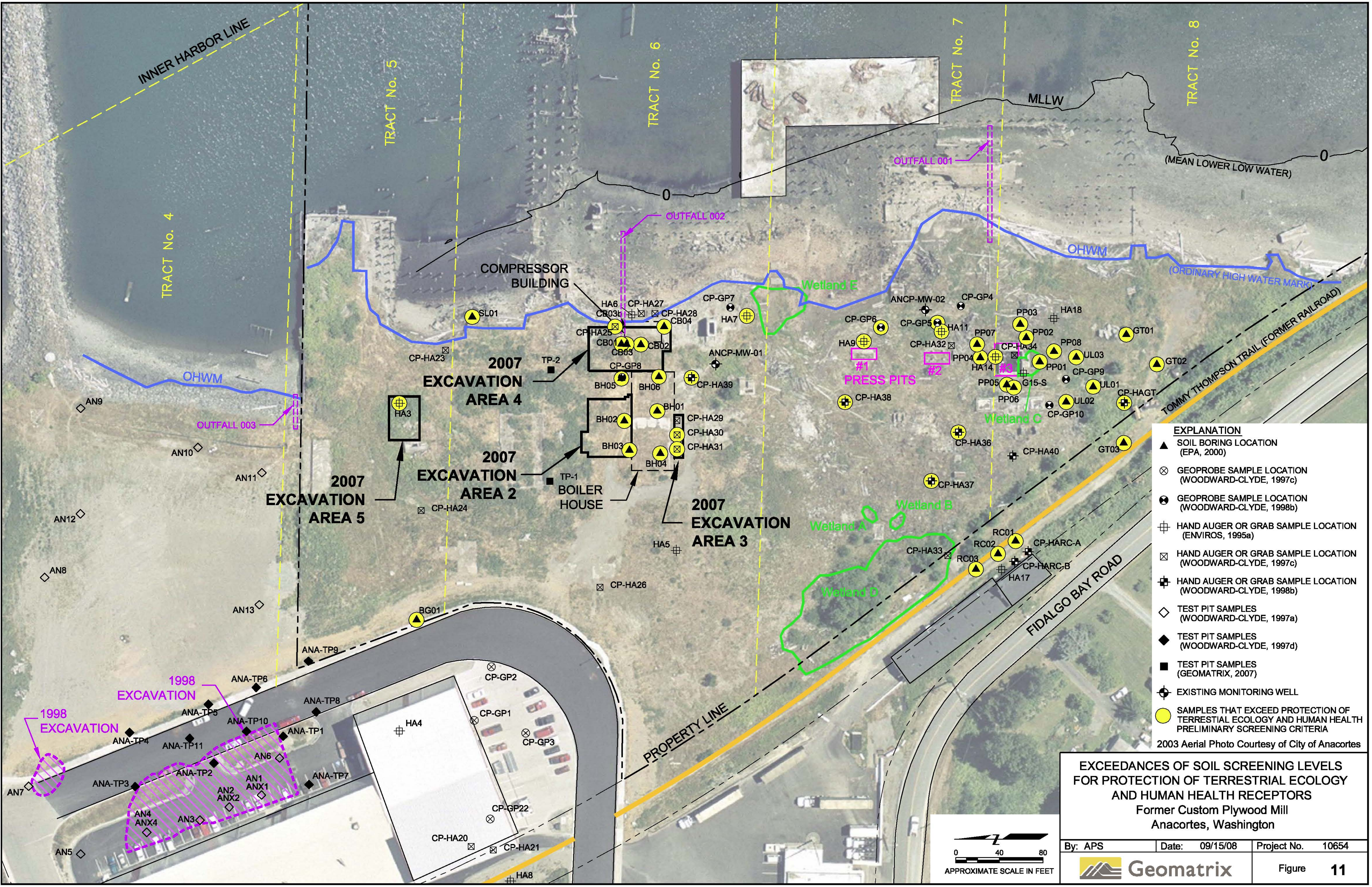

EXPLANATION

- ▲ SOIL BORING LOCATION (EPA, 2000)
- ⊗ GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1997c)
- ⊗ GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1998b)
- ⊕ HAND AUGER OR GRAB SAMPLE LOCATION (ENVIROS, 1995a)
- ☒ HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1997c)
- ✚ HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1998b)
- ◇ TEST PIT SAMPLES (WOODWARD-CLYDE, 1997a)
- ◆ TEST PIT SAMPLES (WOODWARD-CLYDE, 1997d)
- ■ TEST PIT SAMPLES (GEOMATRIX, 2007)
- ⊕ EXISTING MONITORING WELL
- ● SAMPLES THAT EXCEED PROTECTION OF TERRESTIAL ECOLOGY AND HUMAN HEALTH PRELIMINARY SCREENING CRITERIA

2003 Aerial Photo Courtesy of City of Anacortes

EXCEEDANCES OF SOIL SCREENING LEVELS
FOR PROTECTION OF TERRESTRIAL ECOLOGY
AND HUMAN HEALTH RECEPTORS
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/15/08	Project No. 10654
Geomatrix		Figure 11

Plot Date: 09/15/08 - 10:13am, Plotted by: astenberg
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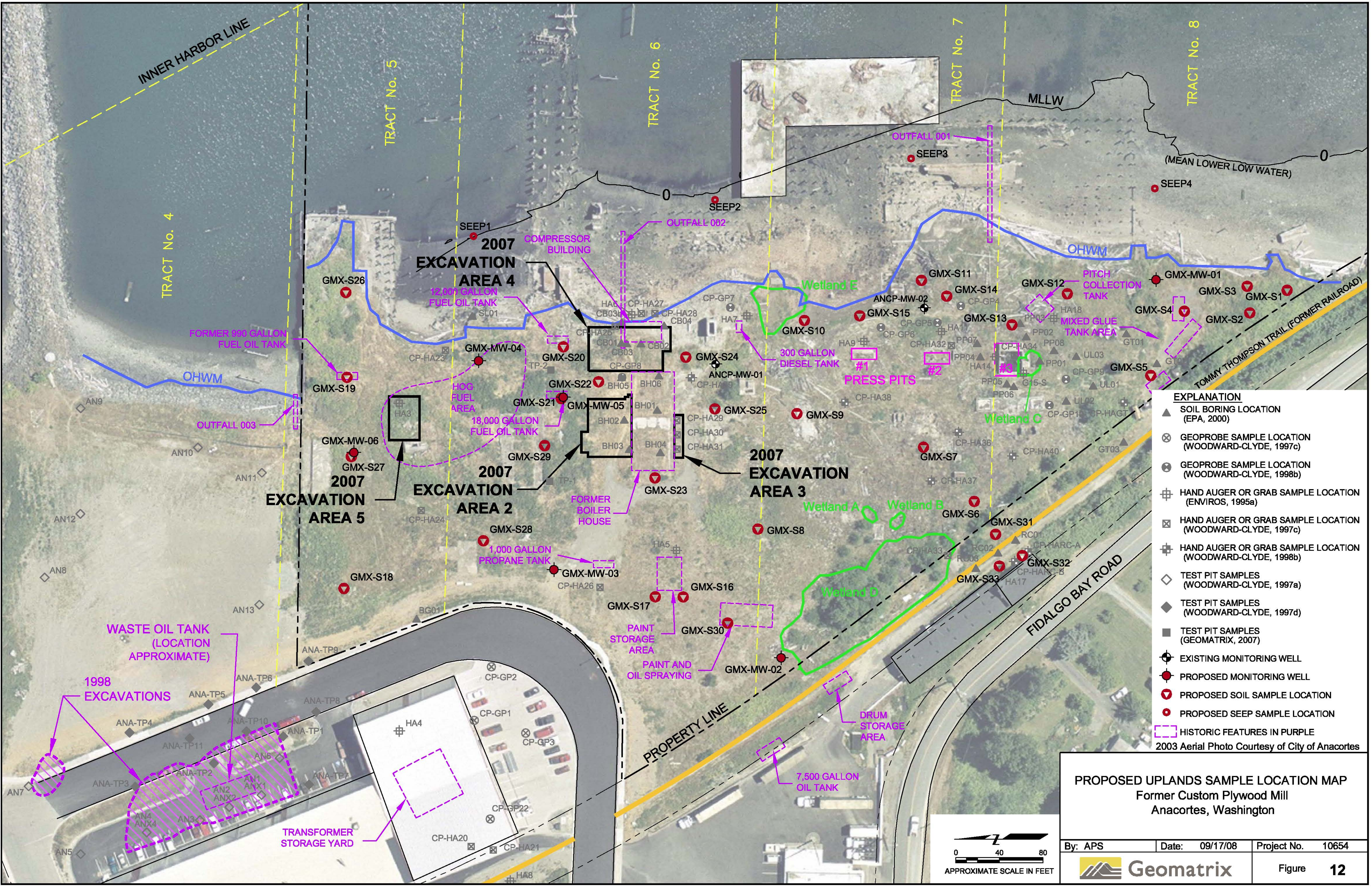

2003 Aerial Photo Courtesy of City of Anacortes

PROPOSED UPLANDS SAMPLE LOCATION MAP
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/17/08	Project No. 10654
Geomatrix		Figure 12

Plot Date: 09/17/08 - 2:01pm, Plotted by: astenberg
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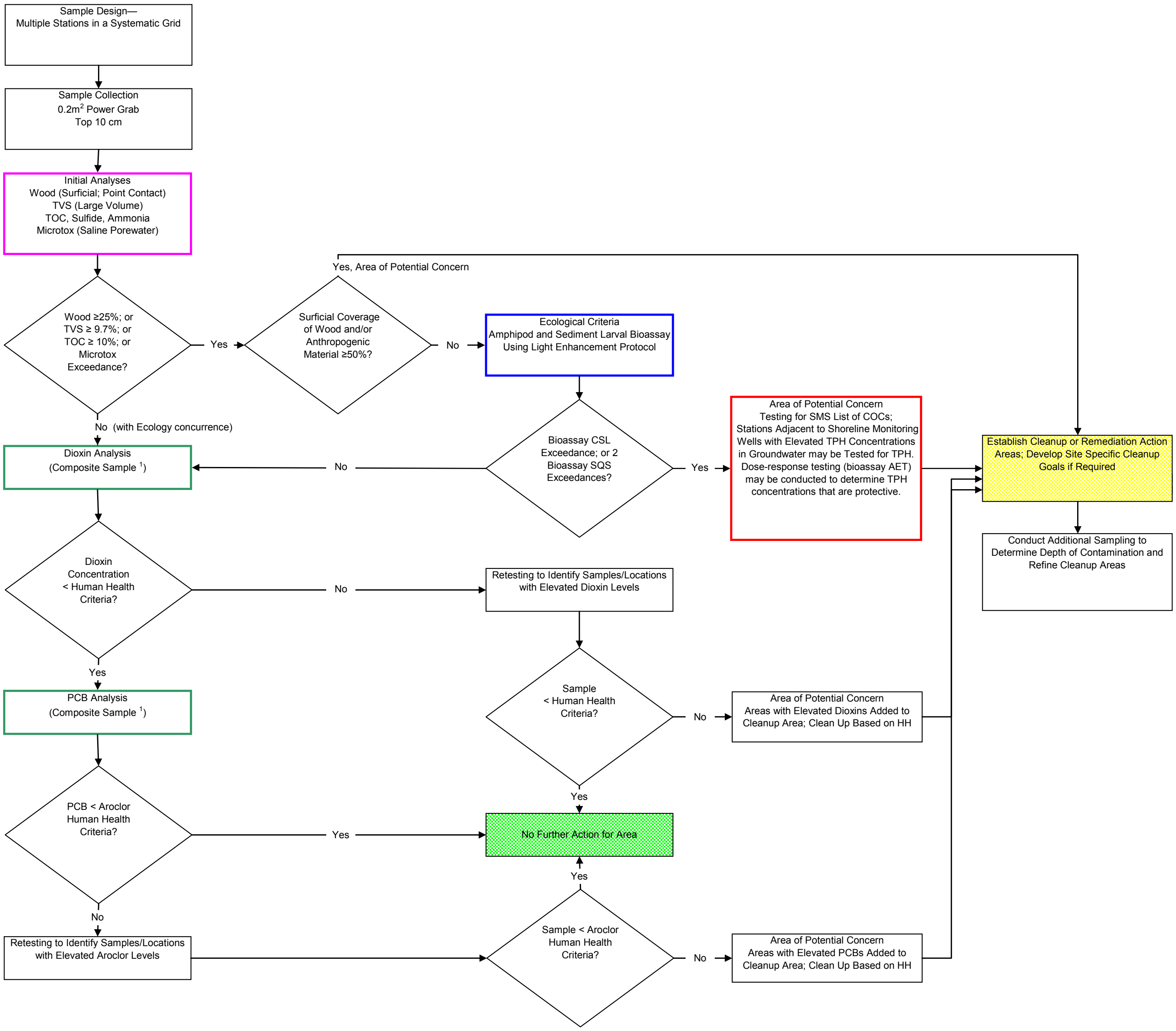
Non-GDS



Note:

[1] Dioxin and PCB composite samples will include homogenized aliquots from sample locations that pass the initial screening criteria or biological criteria. Composites may be created from all stations combined or for station groupings.

🟪 Tier 1 Analysis (see Table 1 in Sampling and Analysis Plan)

🟦 Tier 2 Analysis (see Table 1 in Sampling and Analysis Plan)

🟩 Tier 3 Analysis (see Table 1 in Sampling and Analysis Plan)

🟥 Tier 4 Analysis (see Table 1 in Sampling and Analysis Plan)

Geomatrix

FLOWCHART OF TIERED ANALYSIS SCHEDULE
Former Custom Plywood Mill
Anacortes, Washington

Project No.
10654

Figure
13

S:\10654\013_Revised RIFS WP\Word & Excel\Figure 13_Flow Chart.doc

Plot Date: 09/12/08 - 5:01pm, Plotted by: astenberg
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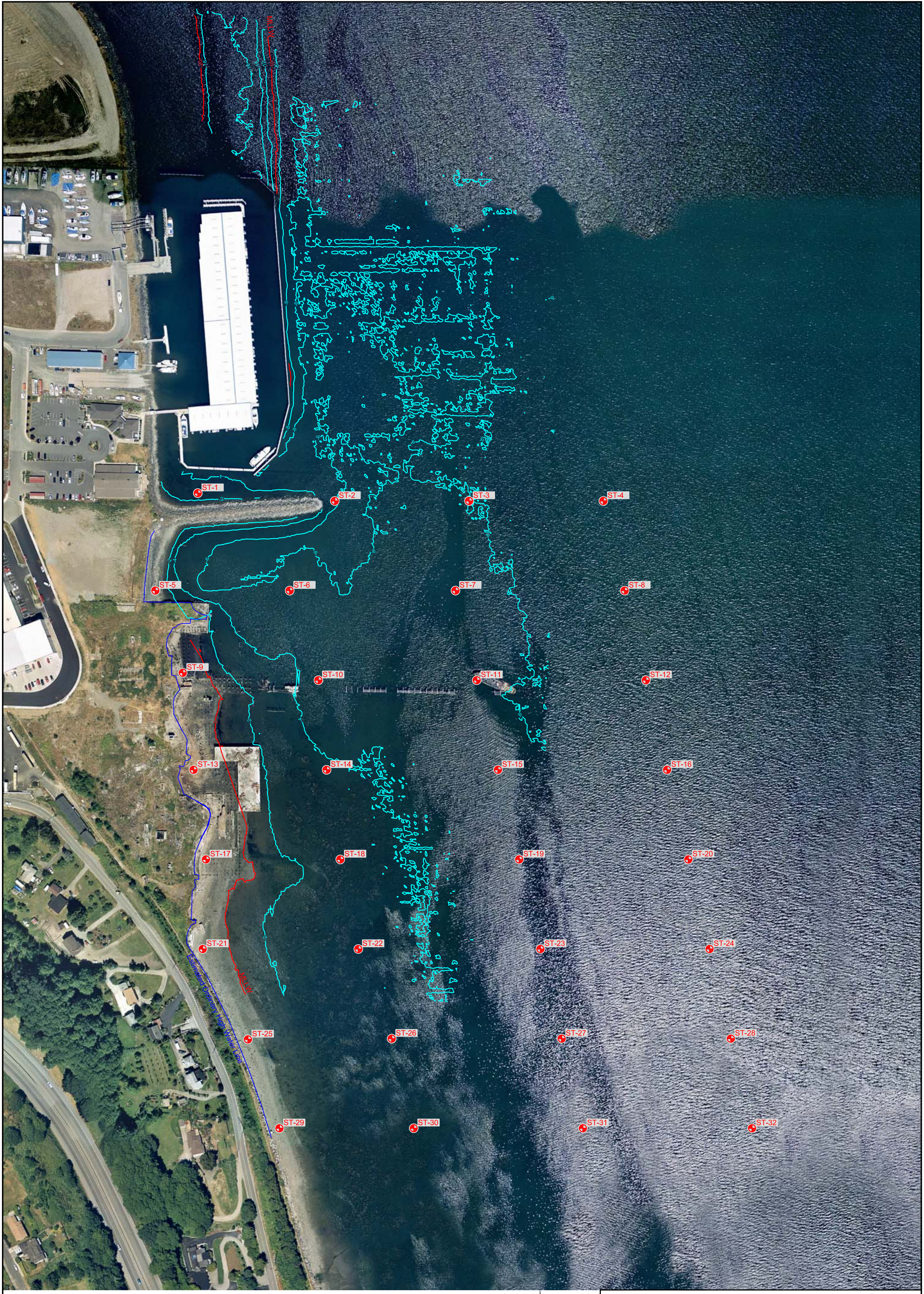

Aerial Photo Courtesy of City of Anacortes

● Proposed Sediment Grab Sampling Location

0 100 200
APPROXIMATE SCALE IN FEET

PROPOSED SEDIMENT GRAB
SAMPLING LOCATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM	Date: 09/12/08	Project: 10654
Geomatrix		Figure **14**

APPENDIX A

Final Uplands Sampling and Analysis Plan

Final Uplands Sampling and Analysis Plan

Former Custom Plywood Mill

Anacortes, Washington

Prepared for:

GBH Investments, LLC
13941 Gibralter Road
Anacortes, Washington 98221

Prepared by:

Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
(206) 342-1760

September 2008

Project No. 10654

Geomatrix

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TABLES

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(Continued)

FIGURES

ATTACHMENTS

FINAL UPLANDS SAMPLING AND ANALYSIS PLAN
Former Custom Plywood Mill
Anacortes, Washington

1.0 INTRODUCTION

Geomatrix Consultants, Inc. (Geomatrix), prepared this Final Uplands Sampling and Analysis Plan (SAP) on behalf of GBH Investments, LLC (GBH), the current owner of the Former Custom Plywood mill (site). This document presents the proposed sampling methodology for conducting soil investigation sampling, monitoring well installation, and sampling activities in the vicinity of the site located at the intersection of 35th Street and V Place on the western shore of Fidalgo Bay in Anacortes, Washington.

1.1 BACKGROUND

This section provides a brief background of previous characterization activities that have occurred at the site. The previous environmental investigations are discussed in more detail in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan.

The site consists of an irregularly shaped parcel that covers approximately 6.6 acres of upland and 34 acres of tidal areas. The site was used for operation of a sawmill, and later a plywood mill, under various owners from the early 1900s until 1992, when the mill went out of business and the wooden structures burned down.

Environmental studies at the site were initiated in 1993 with a Preliminary Environmental Evaluation (Pinner, 1993) where one soil and two surface water samples were collected and analyzed. A more extensive environmental assessment occurred 2 years later that included soil sampling and analysis from areas with the highest likelihood of contamination (Enviros, 1995). Significant concentrations of hydrocarbons, particularly heavy oils, were found in shallow soils around the press pits and the compressor house in the central part of the site. Subsequent studies found isolated occurrences of polychlorinated biphenyl compounds (PCBs), and inorganics (arsenic, cadmium, lead, and mercury). Taken together, these characterization studies, along with the sampling to be conducted under this SAP, satisfy the remedial investigation (RI) component requirement of the Washington Model Toxics Central Act (MTCA), as set out in Washington Administrative Code (WAC) 173-340-350. The previous environmental investigations are discussed in more detail in the RI/FS Work Plan that this SAP accompanies.

The following upland source areas on the GBH property were identified for further investigation due to lack of historical information or due to exceedances of the preliminary screening levels that occurred in soil.

- **Press pit area.** Soils in the press pit area have significant concentrations of diesel and heavy oil in soil. Isolated occurrences of arsenic, lead, and cadmium were also identified. Samples will be collected from this area to better evaluate the areal and vertical extent of soils impacted by petroleum and metals. The water in press pits #2 and #3 contain hydrocarbons based on analytical results and the intermittent presence of an oily sheen. The water in the press pits will eventually be extracted, and treated or disposed, at the time of demolition. Analyses of the water will be conducted just prior to the demolition work to evaluate treatment or disposal options.

- **Boiler house, Compressor House, and Hog Fuel Area.** Soil samples surrounding this area exceed the preliminary screening criteria for metals, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), PCBs, and/or total petroleum hydrocarbons (TPH) as diesel (TPH-D) and oil (TPH-Oil). A former smokestack was also present in this location. Much of the impacted soil was removed during a remedial effort in 2007, but a few historic samples indicate that some soil may remain that exceeds the preliminary screening criteria for the protection of terrestrial ecological receptors or the preliminary screening criteria for the protection of marine surface water. The areal extent of impacted soil around the boiler house/compressor will be evaluated as part of the RI.

- **Paint storage and spraying area.** A single sample was previously collected from the east side of the paint storage area on Tract No. 6 and analyzed for chromium. Additional sampling will be completed to identify if other metals, phenols, or volatile organic compounds (VOCs) are present at concentrations above the preliminary screening levels.

- **Tract 5.** Few samples have been collected from the western half of Tract 5. A sample collected there by EPA (2000) had a total cPAH concentration of 0.332 milligrams per kilogram (mg/kg), which exceeds the preliminary screening criteria for protection of human health and terrestrial ecological receptors. Concentrations of mercury, nickel, and thallium also exceeded the preliminary screening criteria for protection of marine surface water.

- **Former fuel tanks.** Based on a historic facility 1925 Sanborn map, approximately 70 feet (ft) north of the boiler house may be the former location of an 18,000-gallon aboveground fuel oil tank (the map was of poor quality, and so the capacity is uncertain). A former 12,000-gallon aboveground fuel oil tank may have been present approximately 60 ft north of the compressor building. Because of access difficulties during previous investigations, sampling in these areas was incomplete. The one sample collected between these two locations indicated that no contamination is present above the preliminary screening levels. A third fuel oil tank, approx 990-gallons in volume, may have been 50 ft northeast of the hog fuel area. Prior site access difficulties also constrained sampling in this area. Therefore, in the RI samples will be collected from the vicinity of this tank to assess if it has impacted soil nearby. Approximately 70 ft south of the former compressor building is the former location of a possible 300-gallon fuel oil tank. A single soil sample yielded 4,900 mg/kg for TPH-Oil, which exceeds the preliminary screening criteria for the protection of human health and terrestrial ecological receptors and for the protection of marine surface water. Additional samples will be collected from around the potential former tanks to identify any historic releases and to estimate the extent of contaminated soil. Grab groundwater samples may be collected, or additional monitoring wells installed, if contamination is apparent based on visual or olfactory observations.

- **Potential public access area.** A small triangular-shaped piece of land in Tract 8 at the south end of the site may be used in the future to provide public access to connect the City of Anacortes (City) hiking trail to Fidalgo Bay. This area will be investigated for potential site contaminants to determine if it is suitable for this suggested site use.

- **Groundwater.** Three shallow groundwater wells were monitored from 1999 to 2001 on the Tract 4 property to the north of the GBH property. The Tract 4 property was originally a part of the plywood plant that was tideflat, filled in the 1970s, and then sold to the City in 1984. The City received a "No Further Action" letter from the Washington State Department of Ecology (Ecology) for the cleanup conducted on that property, and the wells were subsequently abandoned. Six groundwater samples were collected from temporary borings during the EPA 2000 study. No VOCs were detected, except for methylene chloride (a common lab contaminant) in one sample, and 1,2-dichloroethane (1,2-DCA) in the background sample at the quantitation limit. Semivolatile organic compounds (SVOCs) and inorganics were detected at wide-ranging concentrations (see Section 2.4.12 in the Work Plan) and will continue to be considered contaminants of potential concern (COPCs) for groundwater. Two wells were installed on the main plant site in 2004 by consultants for a previous owner. Geomatrix has not been able to obtain information from this investigation, except for the boring logs and well construction details from the two monitoring wells. Additional groundwater monitoring wells will be installed and sampled as part of the RI to assess groundwater quality at the site.

- **Seeps.** Water was collected from a shoreline seep approximately 60 ft east of the compressor building (EPA, 2000). The sample was analyzed for SVOCs, VOCs, and inorganics. None of the SVOC or VOC analytes was detected, except for caprolactum at a concentration of 0.8 micrograms per liter (µg/L) (estimated) (EPA, 2000). Seep sampling will be conducted to assess the potential migration of COPCs to the sediments downgradient of the monitoring wells.

1.2 OBJECTIVES AND SCOPE

The objectives of the work to be performed under this SAP are to:

- collect additional soil samples to fill remaining data gaps for upland soil; and
- conduct groundwater and seep monitoring to fill the remaining data gaps for groundwater and determine what, if any, further groundwater investigation is necessary.
- Further sampling of the water in Press Pits #2 and #3 will occur closer to the time of demolition to evaluate the water volume and chemistry, and determine whether pre-treatment and disposal to the city wastewater plant or disposal by a commercial wastewater handler is the more viable option.

The following field tasks will be performed to gather the necessary data to meet these objectives:

- Collect soil samples from 33 soil sampling locations and four monitoring well boreholes distributed around the site to fill the remaining data gaps;
- Collect groundwater grab samples from up to four temporary push-probe borings, if photoionization detector (PID), visual, or olfactory observations indicate a petroleum hydrocarbon concern.
- Install and develop four new groundwater monitoring wells;
- Potentially install up to two additional new groundwater monitoring wells at selected push-probe soil sampling locations, if warranted based on field observations and in consultation with Ecology;
- Conduct one round of groundwater sampling at the new and previously existing monitoring wells; thereafter, quarterly monitoring from all permanent monitoring wells;
- Survey the elevation of the new and previously existing monitoring wells;
- Conduct quarterly groundwater sampling at the new and at the two previously existing monitoring wells; and
- Document the activities and results and submit them to Ecology as part of the RI.

This SAP outlines how these tasks will be performed. Approximate sampling locations are shown on Figure 1.

1.3 ORGANIZATION

The names of the sampling contractor and the analytical laboratory are provided below:

Sampling Contractor
Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
Contact: Ms. Kathleen Goodman
Phone: (206) 342-1760

Analytical Laboratory for Soil and Groundwater Sampling
OnSite Environmental Inc. (OnSite)
14648 NE 95th Street
Redmond, Washington 98052
Contact: Mr. David Baumeister
Phone: (425) 883-3881

Data Validation Contractor
Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
Contact – Ms. Crystal Neirby
Phone: (206) 342-1760

Ecology’s Contact for Sampling Coordination
Hun Seak Park
Site Manager
Washington State Department of Ecology
Toxics Cleanup Program
P.O. Box 47600
Olympia, Washington 98504-7600
Phone: 360-407-7189
email: hpar461@ecy.wa.gov

1.4 HEALTH AND SAFETY

The proposed field activities will be conducted in accordance with the Site-Specific Health and Safety Plan (HASP) included as Appendix C to the RI/FS Work Plan.

2.0 SOIL INVESTIGATION

This section describes the methods that will be used to collect and analyze soil samples as part of the RI. Previous investigations at the site and historical information have identified areas of potential concern. Some areas do not show any indication of being contaminated, but, given the long industrial history of the site, Geomatrix believes that sampling in areas that are apparently uncontaminated would provide more assurance that all contamination has been identified. Table 1 summarizes the field activities to be conducted and samples to be collected. The Geomatrix Environmental Field Protocols are included in Attachment A1.

Depending on the sample depth, soil samples will be collected using a geoprobe rig or a hollow-stem auger rig to reach the desired sample depth. In case some areas of the site are inaccessible with the full-size drill rig either a limited-access geoprobe or an excavator will be used to collect soil for sampling. Except for samples to be analyzed for VOCs; TPH as gas (TPH-G); and benzene, toluene, ethylbenzene, and xylenes (BTEX), soil samples will be collected using stainless steel spoons and homogenized in a stainless steel bowl. Following homogenization the material will be placed into precleaned glass jars supplied by the analytical laboratory. All sampling equipment will be properly decontaminated between each confirmation sample location, as discussed in Section 4.1.

Samples will be analyzed in accordance with the methods described in the Quality Assurance Project Plan (QAPP) (Attachment A2).

2.1 FIELD SAMPLING TECHNIQUES

Figure 1 shows the proposed sample locations at the site. Soil samples will be collected from approximately 33 soil sample locations throughout the site plus from four well boreholes.

The majority of the samples will be shallow samples collected from depth intervals of 0 to 1 ft, 2 to 4 ft, and 4 to 6 ft below ground surface (bgs) (Table 1 and Figure 1). Sample collection will proceed as follows.

- A push-probe rig, a hollow stem auger rig, or an excavator will be used to perform soil sampling to the maximum desired depth at each soil sample location. The sampling team will include at least one professional. Drilling will be completed by a driller licensed in Washington State. The drilling and soil sampling will be supervised by a geologist licensed in Washington State.

- For each sample (except for volatile analyses), a portion of soil will be collected from the designated sample depth interval and placed into a stainless steel bowl for homogenization prior to being placed into a labeled, precleaned sample jar. Each sample jar will be sealed and retained on ice until transported to the contract laboratory.

- If refusal is encountered at a sample location prior to reaching the target depth, the sample location will be moved approximately 1 ft away, as directed by the project geologist, and the boring will be repeated.

- If the soil from the boring appears to contain ash (i.e., fly or bottom ash), then additional jars will be filled for a potential dioxin and furan analysis, upon further consultation with the Ecology project manager.

- The sampling equipment will be decontaminated between each sampling location using the decontamination procedures outlined in Section 4.1.

- The Project Geologist will be responsible for noting any changes in sampling methods caused by sampling difficulties and for ensuring that field observations, sample locations, and lithologic logs of each boring deeper than 2 ft bgs are properly recorded in the field logbook and on individual core logs.

The sampling equipment will be cleaned prior to conducting borings at the site, and decontaminated before sampling begins at each sample location. A global positioning system (GPS) unit will be used to log the approximate coordinates of the sample locations and any locations where buried waste is identified. The margin of error will be 2 to 3 ft using Coast Guard radio beacon correction.

The soil samples will be delivered to OnSite Environmental Services laboratory in Redmond, Washington, for analysis. Standard procedures will be followed using chain-of-custody (COC) forms for all samples sent to the laboratory.

3.0 GROUNDWATER INVESTIGATION METHODS

This section describes the methods that will be used for well installation, including site preparation, soil sampling, and well installation procedures.

A minimum of four new groundwater monitoring wells will be installed at the site (Table 1). The wells will be placed between areas of known contamination and the surface water of Fidalgo Bay, in the presumed downgradient direction. Up to two additional new monitoring wells may be installed immediately adjacent to selected push-probe boring locations if warranted based on field observations and in consultation with Ecology. Grab groundwater samples may also be collected during the investigation from up to four push-probe borings, depending on observations made in the field.

These new wells will be used to fill remaining data gaps in the groundwater investigation. The proposed wells will be located as follows (see also Figure 1).

- **GMX-MW-01** will be located southeast of the press pits. This well will monitor the area downgradient of the TPH-impacted press pits to assess the water quality of groundwater in this area and to detect potentially impacted groundwater migrating toward the intertidal zone.

- **GMX-MW-02** will be located east of the hiking trail (former railroad right-of-way), downgradient of a rumored former 7,500-gallon fuel tank and Custom Plywood’s former office building. The land occupied by the former office building is currently owned by Ray Sizemore of Cimarron Trucking. This well will monitor groundwater downgradient of the potential former fuel tank to assess the groundwater quality in this area and to detect potentially impacted groundwater migrating toward the GBH property from upgradient locations.

- **GMX-MW-03** will be located southeast of the former hardboard plant where the transformers were located, which is currently owned by Joseph and Jennifer

Andrews of Santee, California. This well will monitor the groundwater downgradient of the former transformers to assess the groundwater quality and to detect potentially impacted groundwater migrating toward the GBH site from off site.

- **GMX-MW-04** will be located east of the hog fuel area. This well will monitor the groundwater downgradient of the hog fuel area to assess the groundwater quality and to detect potentially impacted groundwater migrating toward the intertidal zone.
- **GMX-MW-05** may be installed in a new borehole located at the location of GMX-S21 to monitor the suspected location of a former 18,000-gallon fuel tank. This well will be installed if warranted based on field observations and in consultation with Ecology,
- **GMX-MW-06** may be installed in a new borehole located at the location of GMX-S27 to monitor the vicinity of the suspected location of a former 990-gallon fuel tank. This well will be installed if warranted based on field observations and in consultation with Ecology,

Two existing wells will also be used as part of the groundwater monitoring network. The existing wells are as follows (see also Figure 1):

- **ANCP-MW-1** is located south of the boiler house and compressor building. This well will be used to assess the groundwater quality downgradient of the boiler house and to detect potentially impacted groundwater migrating toward the intertidal zone.
- **ANCP-MW-2** is located east of the press pits. This well, along with GMX-MW-01, will be used to assess the groundwater quality downgradient of the press pits and to detect potentially impacted groundwater migrating toward the intertidal zone.

3.1 SITE PREPARATION

Prior to the commencement of drilling, the following procedures will be followed for site preparation.

- Inspect each potential drilling location in the field for potential access problems (e.g., overhead obstructions or hazards, excessive slopes, soft ground, on-site materials or equipment obstructing access, etc.).
- Clear each drilling location of any brush or debris that may be present.
- Remove any equipment or materials that may be stored in the immediate vicinity of the drilling location.
- Mark the ground locations of the proposed drilling sites.

- Contract an independent service (and if necessary government agencies) to locate underground utilities in the vicinity of each proposed drilling location. Based on the outcome of the search for underground obstructions, it may be necessary to modify the location of one or more proposed drilling sites.

After the locations of drilling sites have been finalized, and any required permits have been obtained, Geomatrix will begin final site preparations. The following steps will be included.

- Grade or level the drilling location, if necessary.
- Mark the final drilling locations on the ground.
- Set up receptacles for temporary storage of investigation-derived waste (IDW).
- Complete any concrete sawing or coring to remove surface pavement from those drilling locations where the ground surface is paved with asphalt or concrete.

The drilling subcontractor will submit well construction notifications (start cards) to Ecology at least 72 hours before beginning well construction. Each well will be uniquely numbered and coordinated with the site's current well numbering system. The well installation will be documented in accordance with WAC 173-160 using Ecology's required format.

3.2 MONITORING WELL INSTALLATION

Borings will be advanced by hollow-stem auger (HSA), using the appropriate sampler to obtain soil samples for lithologic logging, according to the following procedures.

3.2.1 Soil Lithologic Logging

All subsurface borings completed during well installation will be logged continuously by a field geologist to the monitoring well's total depth. The lithologic log for each boring will be based on visual observation and description of the corresponding soil samples in accordance with American Society for Testing and Materials (ASTM D2488). Each sample lithologic description will contain the following information (based on EPA, 1992):

- Boring identifier;
- Sample depth interval, in ft bgs;
- Color (based on Munsell® color chart);
- Signs of weathering (e.g., rust-colored stains or coatings);
- Texture (particle size, angularity/roundness, and degree of sorting);

- Soil type, based on the Unified Soil Classification System (USCS)(ASTM D2487-98);
- Estimated moisture content (qualitative);
- Organic matter (e.g., plant detritus, woody or fibrous vegetative matter, shell fragments), if any;
- PID reading;
- Noticeable odor, if any; and
- Sheen test results and observations regarding heaviness of the sheen or free product.

3.2.2 Monitoring Well Construction

All drilling and well installation will be performed by a licensed well drilling contractor in compliance with WAC 173-160 (Minimum Standards for Construction and Maintenance of Wells). Once a stable borehole has been advanced to the desired depth using an HSA, the well screen and riser will be installed. The riser, screen, and bottom cap will all be decontaminated immediately before assembly and installation unless they arrive already decontaminated from the manufacturer. The procedures for equipment decontamination are described in Section 4.

The well will be assembled within the HSA by adding sections to the top of the riser until the screened section is set at the desired depth. At the request of Ecology the screen will be completely submerged in the saturated zone. Care will be taken to prevent any materials from entering the well during down-hole assembly. A well cap will be used to prevent materials from entering the well.

The uppermost section of the well riser will be precut so that when the well is in place, the top of the well riser will be approximately 3 ft above the ground surface for the stand pipe finish, or the riser will be cut so that it will be 6 inches bgs for a flush mount well casing. The survey measuring point on the upper rim of the polyvinyl chloride (PVC) riser will be permanently identified by cutting a double notch into the rim or by labeling with a permanent marker.

The chemically inert filter pack will be placed within the annular space surrounding the well screen while the HSA is removed simultaneously. The filter pack will be added slowly in order to prevent bridging of the sand between the riser and the auger. When adding the filter pack below the water table, a tremie pipe may be used. The augers or casings will be extracted in increments no greater than 2 ft to minimize the potential for native sediments to cave or slump into the annular space to ensure all annular space is filled with filter pack. The well will be surged after the filter pack has been installed to eliminate any voids that may exist. Additional filter pack will be added after surging if the filter pack settles lower as a result of surging.

The filter pack will extend to at least 2 ft above the top of the screen. An annular sealant of hydrated bentonite chips or bentonite grout will be placed directly above the filter pack while the augers or casing are removed in 2-ft increments. The seal will be extended a minimum of 2 ft above the top of the filter pack. The seal will be hydrated with water of a known chemistry every 2 ft when placed in the unsaturated zone.

The wells will be screened just below the predicted groundwater table from approximately the Mean Higher High Water (MHHW) elevation to approximately the Mean Lower Low Water (MLLW) elevation, unless free product is observed, as described previously in this section.

Table 2 shows proposed well construction details and names.

3.2.3 Monitoring Well Development

Monitoring wells will be developed using a bailer and/or submersible pump combined with surging. The well will be surged for 5 minutes, after which two borehole volumes of water will be removed. Water quality parameters (temperature, pH, specific conductivity, dissolved oxygen [DO], oxidation reduction potential [ORP], and turbidity) of well development water will be measured and recorded, and another borehole volume of well water will be removed. Development will be considered complete when the following conditions are met.

1. A minimum of 10 borehole volumes of water have been removed.
2. The development water is free of sediment and turbidity compared to the beginning of development. If zero turbidity cannot be achieved we will strive for turbidity of less then 10 Nephelometric Turbidity Units (NTU). If turbidity less than 10 NTU is not achievable, the samples will be sent to the lab unpreserved, particles will be allowed to settle, and then the supernate will be analyzed.
3. Three consecutive measurements of all water quality parameters do not vary by more than 10%.

If parameters have not stabilized after 13 borehole volumes of water have been purged, then the well development will be considered to be complete. In addition, well development will be considered complete if the well goes dry prior to removal of the minimum 10 borehole volumes. All well development water will be contained pending testing to determine the appropriate disposal method. The bottom of the well will be “sounded” with a weighted tape, to ensure fine material has been removed from the interior of the well casing.

Bailers and surge blocks used to develop more than one well will be decontaminated by wiping with a detergent such as Simple Green, washing with an Alconox solution, followed by a tap water rinse and distilled water rinse. The outside of pump tubing will be decontaminated by spraying with an Alconox solution and distilled water rinse. The interior of pumps and pump tubing will be decontaminated by pumping distilled water through the pump and tubing until the electrical conductance of the discharge water is equal to or less than 50 microSiemens. All decontamination fluids will be containerized pending testing to determine the appropriate disposal method. If dedicated tubing is used to purge the well water, the tubing will be disposed of after each hole.

Baseline sampling will proceed in developed wells no sooner than 48 hours following development.

3.3 SURVEYING

The horizontal position of all soil and groundwater sample locations will be surveyed following the sampling events by a professional surveyor or recorded using a high-accuracy GPS unit. Survey data will be based on the horizontal Washington State Plane North American Datum of 1983 (NAD83) coordinate system that will be compatible with Environmental Information Management (EIM) submission requirements. The survey shall use such practices that result in horizontal errors no greater than 0.10 ft. Monitoring wells will be surveyed by a licensed surveyor after completion.

3.4 GROUNDWATER SAMPLING

The new wells, in addition to the two existing monitoring wells, will be sampled quarterly. Sampling will be timed to occur as close to low tide as possible during the daytime hours. Sampling during low tide is preferred in order to optimize the influx of low-saline groundwater in the area of the well, rather than reflecting varying amounts of seawater influx. If water levels are too low in the well at low tide to properly purge the well and obtain enough sample volume, sampling will be conducted when the water level is higher in the well.

During the RI process, the wells will be sampled initially (baseline), and for two quarterly rounds, with those results incorporated into the RI/FS report. Groundwater samples will be analyzed initially for SVOCs, as well as inorganics (Ag, As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn), TPH-D, and TPH-G/BTEX. If groundwater sampling results indicate that some constituents are consistently at nondetectable concentrations, or concentrations below the groundwater cleanup levels, Geomatrix will discuss with Ecology the elimination of selected constituents. If there is an indication that exceedances of finalized cleanup levels are occurring in the groundwater, and are unlikely to abate naturally, evaluation of the need and options for hydraulic control or groundwater remediation will be conducted. Details of the evaluation and the recommended course of action will be presented in the FS. Groundwater monitoring will continue but it is unlikely that the RI/FS document can wait for an entire year of quarterly sampling, given the aggressive schedule.

During the baseline sampling, inorganics will be analyzed for total concentrations and dissolved concentrations (following field filtration with a 0.45-micrometer [µm] filter). If the baseline sampling indicates that there is no significant difference between the total and dissolved results, dissolved samples will be analyzed in subsequent quarterly analyses.

Because the schedule imposed by Agreed Order DE 5235 (Agreed Order) will not accommodate the incorporation of additional quarterly or semiannual sampling rounds, subsequent rounds of sampling will be reported in annual reports to Ecology, until the point at which the wells are abandoned or deemed unnecessary.

3.4.1 Sample Collection and Preparation

Groundwater will be collected using low-flow sampling techniques in order to collect samples representative of actual site conditions and to reduce the possibility of stripping VOCs from groundwater or mobilizing colloids that are immobile during normal groundwater flow conditions.

The following equipment will be needed to sample the groundwater monitoring wells:

- Well access equipment (key, socket set, etc.);
- An electric water-level indicator calibrated to 0.01 ft, and sufficiently long to reach the bottom of the well;
- A peristaltic pump and associated tubing;
- A sufficient number of containers to store all purge water;
- A calibrated flow-through water quality meter and calibration solutions to measure temperature, pH, specific conductivity, DO, turbidity, and ORP;
- In-line filters for metals analyses, if found to be necessary;
- Sampling containers, including containers for quality control samples;

- All required documentation;
- Personal protective equipment as described in the HASP; and
- Decontamination equipment, including Alconox or nonphosphate detergent and distilled or deionized water.

All reusable equipment in contact with the well or water samples will be decontaminated prior to its use, as outlined in Section 4 below.

Water levels will be measured prior to and during purging. Wells will be purged at a low rate (approximately 200 to 500 milliliters per minute [ml/minute]), and groundwater quality parameters (temperature, pH, specific conductivity, DO, ORP, and turbidity) will be monitored every 3 to 5 minutes for stabilization prior to sample collection. Stabilization will be considered reached when all parameters have been within +/-10% of each other for three consecutive readings. Once stabilization has been achieved, the groundwater samples will be collected directly from the sample discharge tube connected to the pump.

Groundwater samples will be analyzed for SVOCs, TPH-D, TPH-G/BTEX, total and dissolved inorganics (Ag, As, Ba, Cd, Cr, Cu, Pb, Ni, Hg, Sb, Se, Tl, and Zn), and PCBs. One duplicate sample will be collected during each sampling event. During the baseline sampling round, samples for metals will be unfiltered and unpreserved. Additional sample volume will be collected and filtered in the field using a 0.45-microliter (μL) filter if turbidity in the sample is greater than 10 NTU. Sample preservation requirements and quality control sample collection methods are described in the QAPP (Attachment A2). Unfiltered samples will be analyzed first. If screening levels are exceeded, filtered samples will be analyzed. Samples will be analyzed for hardness cations if needed for calculating cleanup levels.

Grab groundwater samples may be collected from up to four push-probe borings, dependent on field observations of petroleum. Grab groundwater sampling typically generates low-volume, turbid samples that are unreliable for analysis of inorganic constituents. If grab groundwater samples are collected, samples will be analyzed for TPH-G, TPH-D, and BTEX, as volume allows. If TPH-D concentration is greater than 500 μg/L, and sample volume is sufficient, analysis for cPAHs or SVOCs will be conducted.

3.4.2 Sample Labeling and Chain-of-Custody

A sample label will be affixed to each groundwater sample container. Each label will include:

- sample number;

- sampling event location;
- sate and time of sample collection;
- sample name;
- preservatives added to the sample; and
- parameter(s) for which the sample is to be analyzed.

After sampling is completed for the day, all samples will be packed for shipping and placed in iced transport containers. The transport containers will consist of sturdy, insulated, commercially produced coolers. All bottle caps will be secured tightly. All glass containers will be placed secured into position within the shipping container to avoid breakage. Trip blanks will be included in all transport containers that carry water samples being analyzed for VOCs. The COC form will be taped to the inside lid of the cooler or shipping container, unless the container is hand-delivered to the analytical laboratory.

During sample collection or at the end of each day and prior to shipping or storage, COC forms will be completed for all samples collected by Geomatrix. The COC form should include information such as sample names, sample times, sample dates, the type of media, and the analyses requested. Any necessary changes to COC forms, sample container labels, or the field log book will be made by striking out the error with one line, initialing and dating the error, and reentering the correct information. Samples with extra volume for laboratory quality control procedures (matrix spike/matrix spike duplicate [MS/MSD] and laboratory duplicates) will be designated as such on the COC form. The field team will ensure that analyte method numbers and analyte lists required for the project are listed on, attached to, or referred to on the COC form. Every person who takes possession of the samples while transporting the samples from the field to the laboratory must sign the COC form.

Geomatrix personnel will transport the samples to the laboratory at the end of the sampling day. Upon receipt of the sample transport containers by the analytical laboratory, laboratory personnel will open the containers and examine the contents for problems such as damaged transport containers, broken custody seals, missing or broken sample bottles, COC discrepancies, and documentation errors. Problems will be reported immediately to Geomatrix. After the samples are analyzed by the analytical laboratory, laboratory personnel will store the samples in a secure location at the laboratory for the remainder of their holding times.

3.5 SEEP SAMPLING

Seep sampling will be conducted to evaluate the presence of COPCs and to determine if groundwater is causing contaminants from the upland to impact the sediments. Four seep locations will be sampled as part of the RI process, and the results will be included in the RI/FS report. The four seep locations correspond to the assumed downgradient locations of the four nearshore monitoring wells. Seep samples will be analyzed for SVOCs, VOCs, inorganics, TPH-D, TPH-G, and PCBs. Seep results will be compared with results from those wells directly upland to identify potential COPCs that may be migrating.

3.5.1 Sample Collection and Preparation

Seep samples will be collected at the shoreline at low tide by one of two methods. The first method involves driving a narrow ¼-inch diameter, 6-foot-long stainless steel sample point manually into the intertidal sediment at the desired location above the water line. Tubing will then be attached to the top of the narrow tubing and a groundwater sample withdrawn using a peristaltic pump as described for groundwater sampling. If the layer of debris in the intertidal zone is too thick or dense to push the narrow sample point to the required depth needed to reach groundwater, a second sampling method will be attempted. Geomatrix will reposition to a more favorable location within a 10-ft radius of the desired location. A shovel, hand auger, or post-hole digger may be needed to remove some of the surficial debris and start the hole, advancing the hole below the static water level as far as possible. A 5-foot-long stainless steel drive point will be driven quickly into the hand-dug hole, and the sides of the hole will be allowed to slough into the hole. The drive point has a 3-ft long integral stainless steel screen. Tubing will be lowered into the drive point and below the water level. Water will then be purged from the point using a peristaltic pump, and a groundwater sample collected in a similar manner as described for groundwater sampling.

Seep samples will be collected by directly filling labeled, precleaned sample jars. Each sample jar will be sealed and retained on ice until transported to the contract laboratory.

The following equipment will be needed to sample the seeps:

- a calibrated flow-through water quality meter and calibration solutions to measure temperature, pH, specific conductivity, DO, turbidity, and ORP;
- filters for metals analyses;
- sampling containers, including containers for quality control samples;

- all required documentation;
- personal protective equipment as described in the HASP; and
- decontamination equipment, including Alconox or nonphosphate detergent and distilled or deionized water.

All reusable equipment in contact with the well or water samples will be decontaminated prior to its use, as outlined in Section 4 below.

Seep samples will be analyzed for SVOCs, VOCs, TPH-D, TPH-G, total and dissolved inorganics (Ag, As, Ba, Cd, Cr, Cu, Pb, Ni, Hg, Sb, Se, Tl, and Zn), and PCBs. One duplicate sample will be collected during the sampling event. Samples for dissolved metals will be filtered in the field using a 0.45-µL filter. Sample preservation requirements and quality control sample collection methods are described in the QAPP (Attachment A2).

3.5.2 Sample Labeling and Chain-of-Custody

A sample label will be affixed to each seep sample container. Each label will include:

- sample number;
- sampling event location;
- date and time of sample collection;
- sample name;
- preservatives added to the sample; and
- parameter(s) for which the sample is to be analyzed.

After sampling is completed for the day, all samples will be packed for shipping and placed in iced transport containers. The transport containers will consist of sturdy, insulated, commercially produced coolers. All bottle caps will be secured tightly. All glass containers will be placed secured into position within the shipping container to avoid breakage. Trip blanks will be included in all transport containers that carry water samples being analyzed for VOCs. The COC form will be taped to the inside lid of the cooler or shipping container, unless the container is hand-delivered to the analytical laboratory.

During sample collection or at the end of each day and prior to shipping or storage, COC forms will be completed for all samples collected by Geomatrix. The COC form should include information such as sample names, sample times, sample dates, the type of media, and the analyses requested. Any necessary changes to COC forms, sample container labels, or the field log book will be made by striking out the error with one line, initialing and dating the error, and reentering the correct information. Samples with extra volume for laboratory quality control procedures (MS/MSD and laboratory duplicates) will be designated as such on the COC form. The field team will ensure that analyte method numbers and analyte lists required for the project are listed on the COC form, attached to the COC form, or referred to on the COC form. Every person who takes possession of the samples while transporting the samples from the field to the laboratory must sign the COC form.

Geomatrix personnel will transport the samples to the laboratory at the end of the sampling day. Upon receipt of the sample transport containers by the analytical laboratory, laboratory personnel will open the containers and examine the contents for problems such as damaged transport containers, broken custody seals, missing or broken sample bottles, COC discrepancies, and documentation errors. Problems will be reported immediately to Geomatrix. After the samples are analyzed by the analytical laboratory, laboratory personnel will store the samples in a secure location at the laboratory for the remainder of their holding times.

4.0 DECONTAMINATION

Decontamination is performed as a quality assurance measure and a safety precaution to prevent cross-contamination between samples and to maintain a clean working environment. The purpose of decontamination is to remove contaminated materials clinging to gloves, boots, equipment, and sample containers prior to their removal from the work area. Decontamination also includes the removal and disposal of contaminated clothing and gloves.

Decontamination is achieved mainly by rinsing with soap or detergent solutions, tap water, and deionized water. Equipment will be allowed to air dry after being cleaned. Decontamination will be accomplished between each sample collection station and/or depth.

The following is a list of supplies needed to decontaminate equipment and personnel:

- Clean gloves: inner and outer;
- Cleaning liquids and dispensers: soap and/or a powdered detergent solution such as Alconox, tap water, and deionized water;
- Waste storage containers: drums, boxes, and plastic bags;

- Plastic ground cover;
- Chemical-free paper towels;
- Cleaning containers: plastic or stainless steel buckets and pans; and
- Cleaning brushes.

4.1 SAMPLING EQUIPMENT

At a minimum, sampling equipment will be decontaminated prior to initial use and between sampling stations. Sampling equipment (i.e., spoons, bowls) decontaminated prior to field use will be wrapped in aluminum foil and stored in a sealed plastic bag to prevent contamination. Monitoring equipment (i.e., well probe, pH probe, tape measures) will be rinsed in distilled water and wiped dry with chemical free paper towels. Decontamination procedures will include washing and scrubbing with an Alconox soap solution, rinsing with tap water, rinsing with distilled water, and air drying. If heavy, oily substances are found on sampling equipment, Simple Green, dilute acids, or acetone will be used to clean the equipment. Cross-contamination will be minimized by sequencing sampling events from areas expected to have lower concentrations of suspected contaminants to areas suspected of relatively higher concentrations.

4.2 PERSONNEL

Although it is expected that investigations will be conducted under Level D protection (disposable Tyvek coveralls, steel-toe boots, hard hat, and protective gloves), full Level C protective equipment (Level D plus respirator) may be used. The following steps will be used for personnel decontamination when using Level C equipment.

1. Wash boots and outer gloves with brush and detergent water, then rinse twice with tap water.
2. Remove disposable Tyvek coveralls, remove outer gloves, and place both coveralls and gloves in a disposal container.
3. Remove respirator for cleaning and storage.
4. Wash and remove inner gloves.
5. Wash and rinse face and hands with potable water or waterless cleaner.
6. Clean and sanitize respirator face piece after each day’s use.
7. Discard respirator cartridges daily.

8. Shower and shampoo as soon as possible at end of each work day.

When Level D or modified Level C equipment is used, these steps will be appropriately modified.

4.3 DOWN-HOLE DRILLING TOOLS

HSA casing and sampling equipment will be on racks mounted on a support truck. The auger casing and sampling equipment will be decontaminated on the racks using a high-pressure steam cleaner. Spray curtains will be mounted on the periphery of the steam cleaning racks to prevent overspray from leaving the decontamination area. Decontamination water generated during steam cleaning will be collected in a sump below the racks on the support truck. Decontamination water will be transferred from the sump to storage drums pending analysis and disposal.

Well casing, screen, and well caps not delivered to the wellhead in the original packing box will be steam cleaned by the drillers prior to installation.

4.4 HEAVY EQUIPMENT

Contractors will be required to bring decontaminated equipment to the site. It is the responsibility of the site geologist/engineer to ensure that all heavy equipment (e.g., drill rigs) removed from the work area is properly decontaminated. An equipment decontamination area will be designated. Most heavy equipment (e.g., drill rigs) will be decontaminated by brushing, scraping, and hot water pressure washing. The heavy equipment decontamination area will be constructed to contain decontamination fluids and residuals. Decontamination fluids and residual will be collected and transferred to labeled drums pending analysis and disposal. Heavy equipment decontamination will be documented in the field notebook, which will become part of the permanent project files.

5.0 ANALYTICAL PROCEDURES

The QAPP for the sampling work is provided in Attachment A2. The analyses and applicable methods to be performed on all samples, including quality assurance samples to be collected, are described in the QAPP. The Quality Assurance Manual for Onsite Environmental is provided in Attachment A3.

6.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

The sampling methods described in this SAP will generate IDW that may include soil, decontamination water, and purge water. Based on site history and results of previous investigations, potential contaminants in IDW may include petroleum hydrocarbons, SVOCs metals, and PCBs. All IDW generated by field investigations will be properly handled and disposed of according to local, state, and federal laws.

All IDW generated during the field investigation will be temporarily stored in 55-gallon drums at the site, and appropriate disposal arrangements will be made after receipt of analytical results. Drums will be clearly labeled with the type of material contained, the date the drum was filled, and sample location numbers from which the IDW originated.

7.0 SCHEDULE AND DELIVERABLES.

Results of these sampling activities will be used during completion of the final RI report. Results will be included in the RI, to be submitted to Ecology, after analytical results are received from the laboratory and validated by Geomatrix.

8.0 REFERENCES

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EPA, 2000, Custom Plywood Mill Preliminary Assessment/Site Inspection, Anacortes, Washington: Prepared by Ecology and Environment for EPA Region 10, under START Contract No. 68-W6-0008, Seattle, Washington, December.

Pinner, John A., and Associates, 1993, Preliminary Environmental Evaluation, Custom Plywood Mill, November 29.

TABLES

TABLE 1

FIELD ACTIVITIES SUMMARY

Former Custom Plywood Site
Anacortes, Washington

Proposed Sample Name	Location	Sample Media	Depth Interval (ft bgs)	TPH-Dx[1]	EPH/ VPH[2]	TOC[3]	Metals[4]	PCBs[5]	cPAHs[6]	SVOCs[7]	VOCs[8]	Phenols	Dioxins/ Furans[13]	TPH-G/BTEX[14]
GMX-S1	Potential Public Access area	Soil	0-1, 2-4, 4-6[15]	X			X		X[9]					
GMX-S2	Potential Public Access area	Soil	0-1, 2-4, 4-6[15]	X			X		X[9]					
GMX-S3	Potential Public Access area	Soil	0-1, 2-4, 4-6[15]	X			X		X[9]					
GMX-S4	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S5	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S6	Machine Shop	Soil	0-1, 2-4, 4-6[15]	X			X			X[11]		X		X
GMX-S7	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X	X[16]	X			X[11]	X[11]				X
GMX-S8	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S9	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X	X[16]	X			X[11]	X[11]				X
GMX-S10	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S11	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S12	Press Pits - Area Delineation	Soil	0-1, 2-4, 4-6[15]	X		X			X[11]	X[11]				X
GMX-S13	Press Pits - Depth Delineation	Soil	0-1, 2-4, 4-6[15]	X	X[16]	X	X		X[11]	X[11]				X
GMX-S14	Press Pits - Depth Delineation	Soil	0-1, 2-4, 4-6[15]	X		X	X		X[11]	X[11]				X
GMX-S15	Press Pits - Depth Delineation	Soil	0-1, 2-4, 4-6[15]	X	X[16]	X	X		X[11]	X[11]				X
GMX-S16	Paint Storage Area	Soil	0-1, 2-4, 4-6[15]	X			X	X		X[11]	X	X		
GMX-S17	Paint Storage Area	Soil	0-1, 2-4, 4-6[15]	X			X	X		X[11]	X	X		
GMX-S18	Tract No. 5	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				X
GMX-S19	Former 990 Gallon Fuel Oil Tank	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S20	Former 12,000 Gallon Fuel Oil Tank	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S21	Former 18,000 Gallon Fuel Oil Tank	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S22	Boiler House	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				X
GMX-S23	Boiler House	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				X
GMX-S24	Boiler House	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				X
GMX-S25	Boiler House	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				X
GMX-S26	Near former Hog Fuel Storage Area	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S27	Near former Hog Fuel Storage Area	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S28	Near former Hog Fuel Storage Area	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S29	Near former Hog Fuel Storage Area	Soil	0-1, 2-4, 4-6[15]	X		X	X	X	X[11]	X[11]				X
GMX-S30	Paint and Oil Spraying Area	Soil	0-1, 2-4, 4-6[15]	X			X	X	X[11]	X[11]				
GMX-S31	Trail right-of-way	Soil	4-6	X			X		X[11]					X
GMX-S32	Trail right-of-way	Soil	4-6	X			X		X[11]					X
GMX-S33	Trail right-of-way	Soil	4-6	X			X		X[11]					X
GMX-MW-01	Press Pit Area	Soil	0-2; 6-8; 12-14[12]	X		X	X	X	X[11]					
GMX-MW-02	Former 7,500 Gallon Fuel Oil Tank	Soil	0-2; 6-8; 12-14[12]	X			X							
GMX-MW-03	Downgradient of fmr Transformer Area	Soil	0-2; 6-8; 12-14[12]	X			X	X						
GMX-MW-04	Hog Fuel Area	Soil	0-2; 6-8; 12-14[12]	X			X							
GMX-MW-01	Press Pit Area	Groundwater	NA	X			X[10]	X		X[11]	X			X
GMX-MW-02	Rail area	Groundwater	NA	X			X[10]	X		X[11]	X			X
GMX-MW-03	Downgradient of fmr Transformer Area	Groundwater	NA	X			X[10]	X		X[11]	X			X

TABLE 1

FIELD ACTIVITIES SUMMARY

Former Custom Plywood Site
Anacortes, Washington

Proposed Sample Name	Location	Sample Media	Depth Interval (ft bgs)	TPH-Dx[1]	EPH/ VPH[2]	TOC[3]	Metals[4]	PCBs[5]	cPAHs[6]	SVOCs[7]	VOCs[8]	Phenols	Dioxins/ Furans[13]	TPH-G/BTEX[14]
GMX-MW-04	Hog Fuel Area	Groundwater	NA	X			X[10]	X		X[11]	X			X
ANCP-MW-1	Boiler House	Groundwater	NA	X			X[10]	X		X[11]	X			X
ANCP-MW-2	Press Pit Area	Groundwater	NA	X			X[10]	X		X[11]	X			X
GMX-S9[17]	Press Pit Area	Grab Groundwater	NA	X			X[10]			X[11]	X			X
GMX-S13[17]	Press Pit Area	Grab Groundwater	NA	X			X[10]			X[11]	X			X
GMX-S21 (poss. GMX-MW-05)[18]	Boiler House	Groundwater	NA	X			X[10]	X		X[11]	X			X
GMX-S27 (poss. GMX-MW-06)[18]	Former 990 Gallon Fuel Oil Tank	Groundwater	NA	X			X[10]	X		X[11]	X			X
GMX-Seep-1	Seeps	Seepwater	NA	X			X[10]	X		X[11]	X			X
GMX-Seep-2	Seeps	Seepwater	NA	X			X[10]	X		X[11]	X			X
GMX-Seep-3	Seeps	Seepwater	NA	X			X[10]	X		X[11]	X			X
GMX-Seep-4	Seeps	Seepwater	NA	X			X[10]	X		X[11]	X			X

Notes

1. TPH-Dx - Total Petroleum Hydrocarbons, diesel-extended range.
2. EPH/VPH = Extractable Petroleum Hydrocarbons/Volatile Petroleum Hydrocarbons.
3. TOC = Total Organic Carbon.
4. Metals = Priority Pollutant List = Ag, As, Ba, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn.
5. PCBs = Polychlorinated Biphenyls.
6. cPAHs = Carcinogenic polycyclic aromatic hydrocarbons.
7. SVOCs = Semivolatile Organic Compounds, incl. cPAHs, phenols.
8. VOCs = Volatile Organic Compounds.
9. Analyze cPAHs only if TPH-Dx exceeds 460 mg/kg.
10. For water samples, analyze for total metals (unpreserved samples) in decant liquid; if results exceed screening levels, analyze field-filtered samples (0.45 µm filter).
11. Analyze one (highest concentration) sample per boring for cPAHs only if the total TPH concentration in the sample exceeds 1,000 ppm (500 µg/L for water). Up to 10% of samples with TPH >1,000 mg/kg (by NWTPH-Dx) will be run for the full SVOC suite instead of cPAH list.
12. Deeper samples will be analyzed only for constituents that exceed the preliminary screening levels. TPH-Dx in deeper samples will be analyzed only if total TPH concentrations exceed 1,000 mg/kg in shallower samples.
13. Any soils indicating the presence of ash will also be sampled for dioxins and furans.
14. TPH-G - Total Petroleum Hydrocarbons as gasoline by Ecology NWTPH-Gx. BTEX = benzene, toluene, ethylbenzene, and xylenes. BTEX will not be analyzed with TPH-G if VOCs are also analyzed.
15. The 0-1' sample will be archived and the 2-4' sample analyzed for analyses shown. The 4-6' sample will be analyzed for TPH-Dx only if the 2-4' interval exceeds 1,000 ppm TPH-Dx.
16. Potentially analyze VPH/EPH, but only if TPH exceeds 1,000 mg/kg.
17. The decision to collect a grab groundwater sample will be based on field observations, and with Ecology in the field.
18. The decision to install a monitoring well will be based on field observations, and with Ecology in the field.

TABLE 2

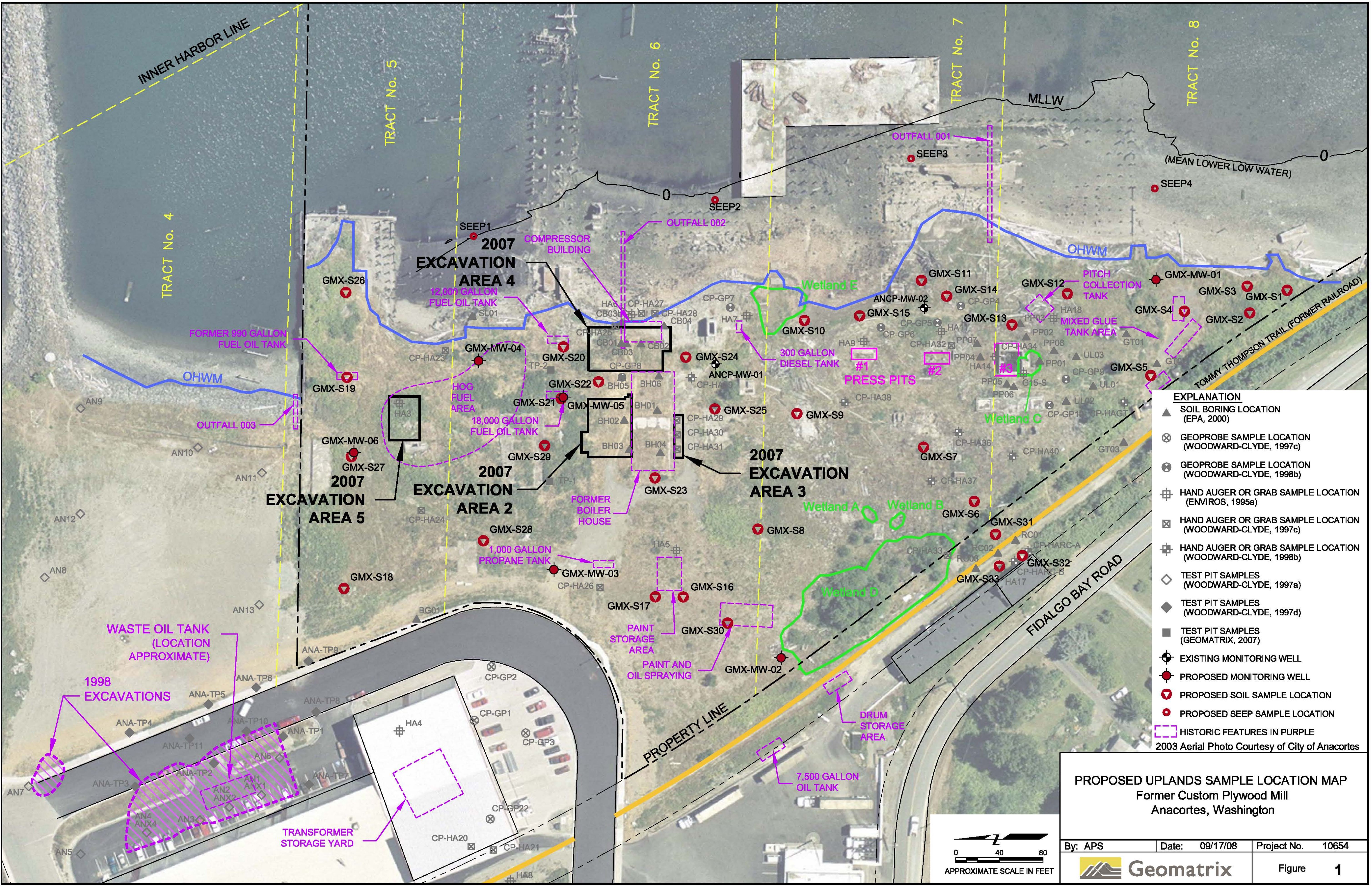
PROPOSED WELL CONSTRUCTION SUMMARY

Former Custom Plywood Site
Anacortes, Washington

Well ID	Drilling Technique	Estimated Total Borehole Depth (ft bgs)[1]	Proposed Screened Interval (ft bgs)[2]	Filter Pack	Well Diameter (inches)	Well Material	Slot Size (inches)[4]
GMX-MW-01	Hollow-Stem Auger	15	5-15	10/20 silica sand	2	Sch. 40 PVC[3]	0.01
GMX-MW-02	Hollow-Stem Auger	15	5-15	10/20 silica sand	2	Sch. 40 PVC	0.01
GMX-MW-03	Hollow-Stem Auger	15	5-15	10/20 silica sand	2	Sch. 40 PVC	0.01
GMX-MW-04	Hollow-Stem Auger	15	5-15	10/20 silica sand	2	Sch. 40 PVC	0.01

Notes:
1. ft bgs = feet below ground surface.
2. Screened interval may be modified based on Ecology consultation and/or field conditions.
3. PVC = polyvinyl chloride
4. Slot size selected based on grain size of predominant soil type from previous investigations.

FIGURES



EXPLANATION

▲ SOIL BORING LOCATION (EPA, 2000)

⊗ GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1997c)

● GEOPROBE SAMPLE LOCATION (WOODWARD-CLYDE, 1998b)

⊕ HAND AUGER OR GRAB SAMPLE LOCATION (ENVIROS, 1995a)

☒ HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1997c)

⊕ HAND AUGER OR GRAB SAMPLE LOCATION (WOODWARD-CLYDE, 1998b)

◇ TEST PIT SAMPLES (WOODWARD-CLYDE, 1997a)

◆ TEST PIT SAMPLES (WOODWARD-CLYDE, 1997d)

■ TEST PIT SAMPLES (GEOMATRIX, 2007)

⊕ EXISTING MONITORING WELL

● PROPOSED MONITORING WELL

▼ PROPOSED SOIL SAMPLE LOCATION

○ PROPOSED SEEP SAMPLE LOCATION

☐ HISTORIC FEATURES IN PURPLE

2003 Aerial Photo Courtesy of City of Anacortes

PROPOSED UPLANDS SAMPLE LOCATION MAP

Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 09/17/08	Project No. 10654
Geomatrix		Figure 1

Plot Date: 09/17/08 - 5:28pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: App-A_Figure 1_FormerCustom_ProposedSamples_091708.dwg

ATTACHMENT A1

Geomatrix Environmental Field Protocols

ENVIRONMENTAL FIELD PROTOCOLS

ENVIRONMENTAL SCIENCE AND ENGINEERING GROUP

Prepared by

GEOMATRIX CONSULTANTS, INC.

March 1996

ENVIRONMENTAL FIELD PROTOCOLS
MARCH 1996

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PROTOCOL

DRILLING AND DESTRUCTION OF SOIL BORINGS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during drilling and destruction of soil borings. The soil borings will provide information about geologic conditions, soil engineering properties, and/or soil quality. If the soil boring is utilized for well installation, the well will be installed in accordance with the protocol INSTALLATION OF WELLS.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

If required, permits for drilling of soil borings will be acquired from the appropriate agency(s) before drilling is initiated, and an underground utility check will be conducted before drilling begins. An underground utility check will, at a minimum, consist of contacting a local utility alert service, if available.

2.0 DRILLING

A DAILY FIELD RECORD will be completed for each day of fieldwork, and the original will be kept in the project files.

The soil borings will be drilled using rotary, hollow stem auger, direct-push, or other appropriate method. In all rotary borings, compressed air will be filtered to remove oils before being circulated into the borehole. In mud rotary borings, appropriate drilling fluid additives, such as bentonite, will be used to maintain an open hole and to carry cuttings to the surface. However, organic drilling fluid additives will only be used with prior project manager approval. The drilling mud will be circulated into a settling tank or basin located near the boring. The viscosity of the drilling fluid will be assessed periodically by the driller and will be controlled throughout the drilling operation to achieve the required results (hole stability, sample return, and mud cake thickness along borehole wall). Only potable water will be used as makeup water for drilling fluid. Exploratory borings drilled using the hollow stem auger method generally do not require the use of drilling fluid. If required, potable water from a municipal supply will be used to maintain boring stability.

The planned depth of each soil boring will be determined by the project manager before drilling. The Geomatrix field geologist/engineer will specify to the drill rig operator the depth of soil sample collection, method of sample retrieval, and other matters pertaining to the satisfactory completion of the borings. Geomatrix staff will observe the volume of drill cuttings returned to assess whether significant cavitation has occurred. Drill cuttings, unused soil samples, and drilling fluids generated during drilling of soil borings will be stored properly for future disposal by the client, unless other arrangements have been made.

The drill rods, augers, hoses, bits, and other components that fluids and cuttings contact will be steam-cleaned before drilling each boring, as well as at the beginning of each project and at the completion of field activities. Drive samplers will be cleaned with Alconox and water or steam-cleaned before each sampling event. Only potable water from a municipal supply will be used for decontamination of drilling equipment. Decontamination rinsate will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

3.0 SAMPLING AND LOGGING

3.1 OBTAINING SAMPLES

Borings will be continuously cored or sampled at depth intervals specified by the project manager, based on the intended use of the boring. Continuous sampling is recommended; however, samples and/or cuttings will be obtained for logging purposes at least every 5 feet for all borings. Drive samples will be used to log hollow stem auger borings if continuous cores are not collected. The samples and/or drill cuttings will be collected and described. A lithologic log of these samples will be made. Samples for chemical analysis will be collected in accordance with the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

3.1.1 Discrete Sampling

For discrete sampling of mud rotary or auger borings, sampling will be accomplished by driving or pushing a split-barrel sampler or Shelby tube. The field geologist/engineer will record information on the BORING LOG pertaining to the sampling, such as rate of penetration, hydraulic ram pressure or drive-hammer blow count, coring smoothness, and sample recovery.

In general, the split-barrel sampler will be opened for observation and logging of the retrieved core.

At selected depth intervals, the split-barrel sampler may be fitted with brass or stainless steel liners for collection of soil samples for possible subsequent chemical or physical testing. Samples may be retained for future review and/or preserved for chemical or physical testing, as specified by the project manager. The samples will be stored and labeled to show project number, boring number, and cored interval denoted either by depth or a sequential numbering system. Procedures for preservation and transport of soil samples retained for chemical analysis are presented in the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

3.1.2 Collecting Drill Cuttings

The field geologist/engineer may observe drill cuttings from the drilling fluid return for lithologic information to supplement discrete sampling. Sampling and logging cuttings will be performed as follows:

1. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods should be taken into account in calculating the depth of penetration.
2. In mud rotary drilling, a small-diameter, fine mesh hand screen will be used to obtain a sample of the cuttings from the borings by holding the screen directly in the flow of the drill fluid return line. In air rotary drilling, cuttings will be collected after discharge from the cyclone.
3. In rotary drilling, a composite sample may be obtained from the return line by leaving the screen in place during the time it takes the driller to advance the boring to a preselected depth.
4. In rotary drilling, the travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after circulation is resumed. This travel time can be used along with the depth of penetration to estimate the start and finish of each 5-foot sampling interval.

3.2 LOGGING OF EXPLORATORY BORINGS

The observations of the field geologist/engineer will be recorded on a BORING LOG OR WELL LOG at the time of drilling. The drill rig operator and the field geologist/engineer will discuss significant changes in material penetrated, drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The field geologist/engineer will be present during drilling of soil borings and will observe and record such changes by time and depth.

Drill cuttings and core samples will be observed in the field. A lithologic description will be recorded on the BORING LOG using the Unified Soil Classification System (USCS) as described in the American Society of Testing and Materials (ASTM) Standard D 2488-90. This description will include the USCS soil type, grain sizes and estimated percentages of each, moisture content, color according to the Munsell color charts (Kollmorgen Instruments Corp.), plasticity for fine-grained materials, consistency, and other pertinent information, such as degree of induration, calcareous content, presence of fossils and other distinctive materials.

The original field logs will be retained by the Geomatrix office for review by the responsible professional and for storage in the project files.

4.0 GEOPHYSICAL LOGS

Following completion of drilling, downhole geophysical logs may be performed after the drilling fluid has been circulated to decrease the amount of suspended sediment in the return fluid. Geophysical methods and equipment will be selected to provide stratigraphic or hydrogeologic data appropriate for the project. Geophysical logging will be done as quickly and promply after drilling as feasible, while the boring sidewall is still in stable condition, to reduce the possibility of bridging. Instruments on the logging unit will be adjusted to try to give the maximum definition of strata boundaries. All downhole geophysical equipment will be cleaned before and after use in each borehole.

5.0 FIELD SCREENING

Soil samples collected from the borings may be screened using a portable meter such as a photoionization detector (PID), a flame ionization detector (FID), a lower explosion limit (LEL) meter or other organic vapor meter. The meter may be used to assess the presence of volatile organic compounds (VOCs) or other gases in soil samples. Additional field screening techniques for chemical characterization of soils may include x-ray fluorescence (XRF) and thin-layer chromatography (TLC). Procedures for field screening are described in the protocol SOIL SAMPLING FOR CHEMICAL ANALYSIS.

6.0 DESTROYING SOIL BORINGS

Soil borings that are not completed as monitoring wells will be destroyed by filling the holes with a neat cement grout, cement/sand grout, or cement/bentonite grout. A high-solids bentonite grout may be used if appropriate. Geomatrix field staff will calculate the borehole volume and compare it to the volume of grout used to evaluate whether bridging has occurred. These calculations and the actual volume emplaced will be noted on the BORING LOG. The grout will be placed in continuous lifts from the bottom of the boring to a depth of 20 feet above the water table. The grout will be emplaced by pumping it through the hollow stem augers, drill pipe, tremie pipe, or flexible hose initially lowered to the bottom of the borings and raised incrementally as placement proceeds. If hollow stem augers are used, the augers should be raised incrementally as grout emplacement proceeds. Augers will not be raised in increments greater than 20 feet or greater than allowed by borehole stability. Borings that are terminated above the water table and not greater than 20 feet deep may be destroyed by continuous lifts originating at the ground surface. The grout will be pumped or poured until a return of fresh grout is visible at the surface. Additional grout may need to be added to the soil boring if significant settlement has occurred after the grout has set.

Attachments: Daily Field Record
Boring Log
Well Log

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

Geomatrix

PROJECT:	Log of Boring No.
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR:	DATE STARTED: DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH: MEASURING POINT:
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST COMPL
SAMPLING METHOD:	LOGGED BY:
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL: REG. NO.

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter. Surface Elevation:	REMARKS

Project No.	**Geomatrix Consultants**	Figure

Geomatrix

PROJECT:	Log of Boring No.

DEPTH (feet)	SAMPLES Sample No.	 Sample	 Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	REMARKS

Project No.	**Geomatrix Consultants**	Figure

Geomatrix

PROJECT:	**Log of Well No.**	
BORING LOCATION:	ELEVATION AND DATUM:	
DRILLING CONTRACTOR:	DATE STARTED:	DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST COMPL	CASING:
SAMPLING METHOD:	LOGGED BY:	
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL: REG. NO.	

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows/ Foot		Surface Elevation:	

Project No.	**Geomatrix Consultants**	Figure

I:\FORMS\Eng & Envir Srvs (ETC-ES)\WellLogForm.penny.xls

Geomatrix

PROJECT:	**Log of Well No.**

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows/ Foot			

Project No.	**Geomatrix Consultants**	Figure

PROTOCOL

SOIL SAMPLING FOR CHEMICAL ANALYSIS

1.0 INTRODUCTION

This protocol describes the procedures to be followed for collecting soil samples for chemical analysis and conducting soil field screening in conjunction with drilling soil borings and excavating soil. The laboratory must be certified by the appropriate regulating agency for the analyses to be performed.

If required, permits will be acquired from the appropriate agency, and an underground utility check will be performed before drilling or excavating begins. An underground utility check will, at a minimum, consist of contacting a local utility alert service, if available.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 SAMPLE COLLECTION

Soil samples may be collected during drilling or excavating activities. The procedures for sample collection are discussed below.

2.1 SAMPLE COLLECTION DURING DRILLING

The drilling of soil borings will be conducted in accordance with the protocol DRILLING AND DESTRUCTION OF SOIL BORINGS. The soil sampler either will be washed with laboratory grade detergent-water solution to remove soil present and rinsed with potable water, or it may be steam-cleaned prior to and between sampling. Soil samples will be collected in clean brass or stainless steel liners that have been washed with detergent-water solution and rinsed with potable water or steam-cleaned. The liners will generally be placed in a 2-inch- or 2.5-inch-diameter split-spoon sampler and then driven or pushed into the soil at the selected sampling depth. The sample will be parted at the joints between the liners using a clean, sharp stainless steel knife or spatula. Alternatively, a subsample for chemical analyses may also be collected by driving a smaller-diameter liner into the center of the larger core sample, taking care to reduce the potential for sample disturbance and air space within the liner. If the soil sample is collected using a hand auger, a subsample should be collected from the core of the auger, again taking care to reduce the potential for sample disturbance and air space within the liner. If the sample is to be analyzed for non-volatiles only, a loose sample may be placed in a glass jar. Samples to be analyzed for metals may be homogenized before analysis either in the field or by the laboratory to provide results more representative of average concentrations in the sampling interval.

2.2 Sample Collection During Excavation

Excavated soil will be sampled as required under the appropriate agency guidelines, if applicable, or as necessary to provide the data desired. The lateral and vertical dimensions of the excavation, as well as the sample location and depth, will be mapped, and the volume estimated. If possible, samples will be collected from the backhoe or excavator bucket without entering the excavation. Samples may be collected directly from the walls or floor of the excavation, provided Occupational Safety and Health Administration (OSHA) regulations are followed before entering an excavation.

Soil stockpiles also may be sampled after completion of excavation. If they are sampled, the stockpile location, dimensions, and sample locations will be mapped, and the stockpile volume will be estimated. If compositing of soil samples containing volatile compounds is required, it should be performed by the laboratory.

The soil from excavations or stockpiles should be sampled by scraping away 3 to 6 inches of surface soil or hand augering to a known depth. A clean glass jar, brass tube, or stainless steel tube will be forced into the soil to completely fill the container, or a clean hammer sampler may be used in conjunction with brass or stainless steel liners.

3.0 SAMPLE HANDLING AND PRESERVATION

Soil samples will be handled using the following procedures:

1. Clean gloves appropriate for the chemicals of concern will be worn by the sampler before touching the sample containers, and care will be taken to avoid contact with the sample.
2. The sample will be quickly observed for color, appearance, and composition. The ends of the liners will be immediately covered with Teflon® sheeting and/or

aluminum foil, capped with plastic end caps, and sealed with tape. Glass jars will be immediately sealed with a lid.

3. The sample container will be labeled before or immediately after sampling with a self-adhesive label having the following information written in waterproof ink:
    - Geomatrix
    - Project number
    - Sample ID number
    - Date and time sample was collected
    - Initials of sample collector
4. The sample will be placed in a chest, that contains ice or blue ice if required, for transport to the laboratory. Table 1 lists common analyses performed and the appropriate storage and handling requirements.

4.0 DOCUMENTATION

4.1 FIELD DATA SHEETS

A DAILY FIELD RECORD will be completed for each day of fieldwork. Locations and unique identification of soil samples collected from soil borings will be recorded on the BORING LOG or WELL LOG. Locations and unique identification of soil samples collected from excavations or stockpiles will be recorded on a DAILY FIELD RECORD, site map, and/or other appropriate form. Samples may also be recorded on a SAMPLE CONTROL LOG SHEET or in the DAILY FIELD RECORD as a means of identifying and tracking the samples. Following review by the project manager, the original field records will be kept in the project file.

4.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory on the analytical services required.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD will include:

- Project number
- Signature of sampler
- Date and time sampled
- Sample I.D.
- Number of sample containers

- Sample matrix (soil, water, or other)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control measures
- Turnaround time and person to receive laboratory report
- Method of shipment to the laboratory
- Release signature of sampler and signatures of all people assuming custody
- Condition of samples when received by laboratory (to be completed by the laboratory)

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between the last sample listed and the signatures at the bottom of the sheet.

The field sampler will sign the CHAIN-OF-CUSTODY RECORD and will record the time and date at the time of transfer to the laboratory or an intermediate person. A set of signatures is required for each relinquished/received transfer, including transfer within Geomatrix. The original imprint of the CHAIN-OF-CUSTODY RECORD will accompany the sample containers; a duplicate copy will be kept in the Geomatrix project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY relinquishing the samples will be sealed inside a plastic bag within the ice chest, and the chest will be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent chain-of-custody document. The shipping company (e.g., Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receiver; instead the laboratory will sign as a receiver when the samples are received.

5.0 SOIL FIELD SCREENING

Soil will occasionally be screened using a field instrument or method. Readings should be recorded on the BORING LOG, WELL LOG, DAILY FIELD RECORD, or another form prepared for this purpose. Two screening methods are described below.

5.1 ORGANIC VAPOR METERS

A portable photoionization detector (PID), flame ionization detector (FID), lower explosive limit meter (LEL), or other type of organic vapor meter (OVM) may be used to screen soil. The purpose of the field screening is to assess the presence of volatile organic compounds (VOCs) in the soil. The meter measures total VOCs in the air in parts per million (ppm) by volume in reference to a selected standard. The meter will be calibrated each day prior to the soil sampling. The meter cannot specifically identify each volatile compound, but can be adjusted to be sensitive to selected volatile organics. Before choosing a meter, the response factor of the meter to the chemicals of concern at the site should be considered. Soil should be screened as soon as possible after being exposed to the atmosphere. The general procedure for screening is as follows:

1. Using a clean tool, dig a hole to expose fresh soil in a backhoe bucket or stockpile, or separate the brass liners from a driven sample.
2. Insert the probe of the OVM into the hole, taking care not to clog the probe with soil. Alternatively, headspace readings may be taken by placing soil in a covered (e.g., aluminum foil or Teflon® sheet) clear glass jar or plastic resealable bag, and after several minutes have elapsed, introducing the probe into the headspace area. No soil sample used for headspace screening will be submitted to the laboratory for chemical analysis.
3. Record the results in ppm for PIDs and FIDs, and in percent of the lower explosive limit for LELs.
4. Ensure that the instrument returns to a zero measurement before the next reading. If necessary, move to an area without measurable organic vapors to zero-out the instrument.

6.0 EQUIPMENT CLEANING

The sampler, brass or stainless steel liners, spatula, and tools used in assembly and disassembly of the soil sampler will be cleaned before and after each use. All soil will be removed from the tools and parts, and the tools will be steam-cleaned or washed in laboratory-grade detergent water with a brush, followed by rinsing in potable water. Decontamination rinsate will be collected and stored properly for future disposal by the client unless other arrangements have been made.

Attachments:	Table:	Water and Soil Analytical Methods and Sample Handling
	Figures:	Daily Field Record Boring Log Well Log Chain-of-Custody Record Sample Control Log Sheet

TABLE 1

WATER AND SOIL ANALYTICAL METHODS AND SAMPLE HANDLING

Parameter	Method	Water Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
• as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool on ice	14 days (unacidified water, 7 days)
• as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Volatile Organics with BTEX	EPA 8021[3]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Oil and Grease	5520 E & F (soil)[4] 5520 C & F (water)[4]	2 - 1 liter amber glass	H_2SO_4 to pH <2 in water samples: cool on ice	28 days
Volatile Organics	EPA 8010	2 - 40 ml VOA glass	cool on ice[6]	14 days (unacidified water, 7 days)
	EPA 8240[5]	2 - 40 ml VOA glass	HCl to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Semi-volatile Organics	EPA 8270	2 - 1 liter amber glass	cool on ice	7 days for extraction, water 14 days for extraction, soil 40 days for analysis
Polynuclear Aromatic Hydrocarbons	EPA 8310	2 - 1 liter amber glass	cool on ice	7 days, water 14 days, soil
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Water Samples: field filtration (0.45 micron filter) and field acidify to pH 2 with HNO_3 except: Cr^{+6} - cool on ice	6 months, except: Hg - 28 days Cr^{+6} - 24 hours, water; 24 hours after prep, soil

Notes:

[1] All soil samples should be collected in full, clean brass liners, capped with aluminum foil or Teflon and plastic caps, and sealed with tape. If soil samples are to be analyzed for metals, they may be placed in laboratory-prepared clean glass jars. Soil should be cooled as indicated under “preservation” and maximum holding times apply to both soil and water unless otherwise noted.

[2] For analysis in California, use California DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector. In other states, local requirements should be followed. Method 3660M is silica gel cleanup.

[3] EPA Method 8021 is equivalent to 8010/8020 in series.

[4] Method to be used in California Regional Water Quality Control Board North Coast and Central Valley Regions. In other areas, local requirements should be followed. Method 5520F is silica gel cleanup.

[5] Chloroethylvinylether may be detected at concentrations below 50 parts per billion due to degradation of HCl. EPA Method 8260B was formerly 8240.

[6] If EPA Methods 8010 and 8020 are to be run in sequence, HCl may be added. Check with the project manager before adding acid.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July, and final amendments.

California State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.

California Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1990, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 10 August.

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

Geomatrix

PROJECT:

Log of Boring No.

BORING LOCATION:

ELEVATION AND DATUM:

DRILLING CONTRACTOR:

DATE STARTED:

DATE FINISHED:

DRILLING METHOD:

TOTAL DEPTH:

MEASURING POINT:

DRILLING EQUIPMENT:

DEPTH TO WATER:
FIRST COMPL

SAMPLING METHOD:

LOGGED BY:

HAMMER WEIGHT: DROP:

RESPONSIBLE PROFESSIONAL: REG. NO.

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	REMARKS
	Sample No.	Sample	Blows/ Foot		Surface Elevation:	

Project No.	**Geomatrix Consultants**	Figure

PROJECT:	Log of Boring No.

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	REMARKS

Project No.	**Geomatrix Consultants**	Figure

Geomatrix

PROJECT:

Log of Well No.

BORING LOCATION:

ELEVATION AND DATUM:

DRILLING CONTRACTOR:

DATE STARTED:

DATE FINISHED:

DRILLING METHOD:

TOTAL DEPTH:

SCREEN INTERVAL:

DRILLING EQUIPMENT:

DEPTH TO WATER:
FIRST COMPL

CASING:

SAMPLING METHOD:

LOGGED BY:

HAMMER WEIGHT: DROP:

RESPONSIBLE PROFESSIONAL: REG. NO.

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter. Surface Elevation:	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows/ Foot			

Project No.	**Geomatrix Consultants**	Figure

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PROJECT:

Log of Well No.

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows/ Foot			

Project No.	**Geomatrix Consultants**	Figure

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CHAIN-OF-CUSTODY RECORD

Nº

Date:

Page of

Project No.:

Samplers (Signatures):

			ANALYSES																		REMARKS			
Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8020 (BTEX only)	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel													Cooled	Soil (S), Water (W), or Vapor (V)	Acidified	Number of containers

Additional Comments

Turnaround time:

Results to:

Total No. of containers:

Relinquished by (signature):	Date:	Relinquished by (signature):	Date:	Relinquished by (signature):	Date:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:
Company:		Company:		Company:	
Received by (signature):	Date:	Received by (signature):	Date:	Received by (signature):	Date:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:
Company:		Company:		Company:	

Method of Shipment:

Laboratory Comments and Log No.:

Geomatrix

Forms(PF).012b (Revised 12/95)

SAMPLE CONTROL LOG

Geomatrix

Project Name: ______________________ **Laboratory:** ______________________

Project and Task No.: ______________________ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due

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PROTOCOL

THIN LAYER CHROMATOGRAPHY

1.0 INTRODUCTION

This protocol describes procedures to be followed using thin layer chromatography (TLC) which is a field method to evaluate approximate concentrations of a petroleum hydrocarbon in a soil sample. TLC typically is used when the presence of heavy petroleum hydrocarbons such as diesel fuel or oil is suspected. The procedure involves comparing the intensity of an extract from the soil sample to that of laboratory-prepared standards.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

The procedure for performing the TLC analysis is as follows:

1. Zero the balance and put on gloves.
2. Pour hexane into the dispenser. Set dispenser to discharge 5 milliliters (ml).

   CAUTION: Hexane is flammable and vapors can travel distances to an ignition source and flash back.

3. Discharge 15 ml of hexane into the jar labeled "clean-up."
4. Clean syringes with hexane by drawing the hexane from the "clean-up" jar into the syringe and dispensing the hexane in the jar labeled "waste." Do this three times. Perform this procedure each time you use a syringe. It is very important to clean the syringe every time you use a new standard and sample.

<u>TLC Slide Preparation</u>

5. Obtain a clean TLC slide and label it for the standards. Obtain another clean TLC slide and label it for samples. You can mark multiple standards or sample extracts on a slide (see Figure 1).
6. With the syringe, draw approximately 6 microliters (µl) of the standard or sample and dispose of it in the waste jar. Do this three times. It is important to purge the syringe with the new sample before it is placed onto the TLC slide.

7. Draw 5 µl of the same standard or sample and place it on a labeled TLC slide. It is important to place the 5 □l at the same rate for all standards and samples.

8. Perform Step 4 to clean the syringe and Steps 6 and 7 for each standard or sample extract placed on the TLC slide.

Preparation of Sample Extract

9. Zero the balance with one Teflon□ sheet on the scale. These sheets are the same sheets used for lining the ends of the brass tubes.

10. Weigh the Teflon□ sheet with 5 grams of soil sample by placing the soil sample on top of the Teflon□ sheet.

11. Place the soil sample into a 40-ml volatile organic analysis (VOA) vial and add 5 ml of hexane from the dispenser. Close the lid and shake the sample vigorously. Let the extract settle for five minutes.

12. Perform Steps 4, 6, and 7 for the sample; make sure to change your gloves every time you weigh out a new sample.

Quantitation

13. Place a TLC plate prepared with the standards and a TLC plate prepared with your soil sample extracts into a jar containing a few crystals of iodine and let the spots develop (about 2 to 5 minutes). Compare the intensity of the sample extract spots to the standard spots to quantify the approximate concentration of petroleum in the soil samples. If the spots are not clear, place the TLC plates under UV light to compare the intensities. Record results on a TLC SAMPLE LOG (attached).

Dilution

14. For concentrated sample extracts, it may be necessary to make dilutions to allow comparison of a sample extract's intensity to the intensity of available standards. For example, consider a sample extract spot that is extremely dark in color compared to the 1000 ppm standard intensity. Try diluting the sample by one-fifth by spotting only 1 µl of the sample on the plate, followed by 4 µl of hexane on the same spot, and then comparing its intensity to the 5-µl spots of the standards. If the sample intensity is comparable, for example, to the 1000-ppm standard intensity, the sample is approximately 5000 ppm [5x1000 ppm].

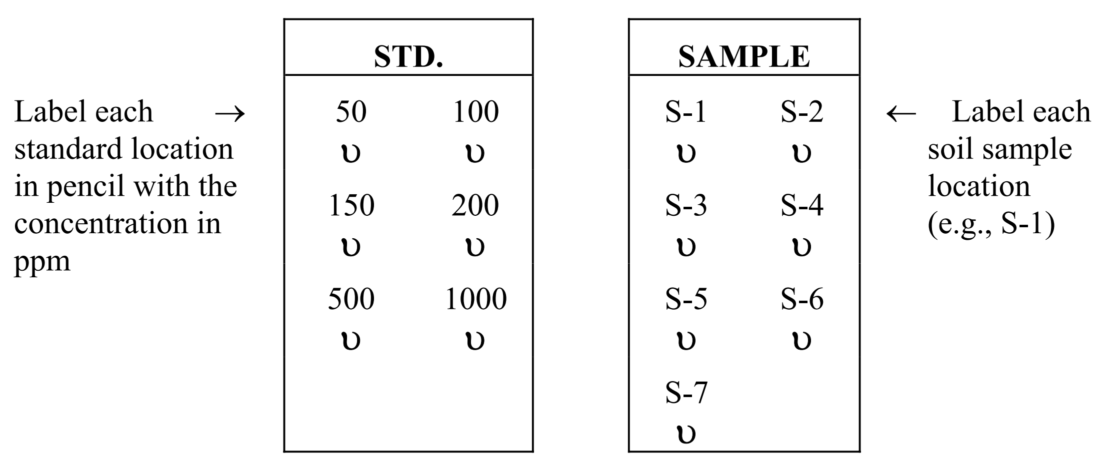
TLC Cleaning

15. Clean the syringe in hexane three times before inserting the needle into the sample extract to prevent cross-contamination. Do not touch the TLC plate on the front side without gloves because oil and grease from your hands will be observed on the plate when placed in iodine and/or under UV light.

16. Solutions and samples resulting from the TLC procedure will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

FIGURE 1

EXAMPLE OF PREPARED TLC SLIDES USED FOR QUANTITATIVE PROCEDURE



Attachments: TLC Sample Log

Geomatrix

TLC SAMPLE LOG

Page ______

of ______

Project Name: ______________________________ Project No.: ____________________

Date: ____________________ Recorded by: ______________________________

Sample I.D. Number: ____

Standards: ____

Sample No.	Standard Concentrations	Dilution	Sample Concentrations Estimate	Remarks

Forms(PF).001 (Revised 12/95)

PROTOCOL

INSTALLATION AND DESTRUCTION OF WELLS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during the installation or destruction of monitoring, groundwater extraction, and vapor extraction wells. Drilling and logging of soil borings for the well installation will be in conformance with the protocol DRILLING OF SOIL BORINGS. The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 WELL INSTALLATION

A DAILY FIELD RECORD will be completed for each day of fieldwork, and the original will be kept in the project files. If required, permits will be acquired from the appropriate agency(s), and an underground utility check will be performed before drilling begins. An underground utility check will, at a minimum, consist of contacting a local utility alert service, if available.
After well installation, well completion report(s) will be completed and filed with the State Department of Water Resources or the appropriate agency.

Each groundwater monitoring well will be designed to enable measurement of the potentiometric surface and to permit water sampling of a specific water-bearing zone. Each vapor monitoring well will be designed to enable measurement of pressure conditions and permit sampling of a specific zone. The field geologist/engineer, in consultation with the project geologist or engineer, who will be licensed in the state in which the work is performed if required, will specify the screened interval using the lithologic log and geophysical log (if performed) and will select the well materials and techniques for well completion to be compatible with the subsurface conditions and the intended use of the well. Construction of all wells will be in conformance with the following provisions. A TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM is attached.

2.1 WELL SCREEN AND CASING

The well casing will generally consist of threaded stainless steel or schedule 40 (minimum) polyvinyl chloride (PVC) casing. The inside diameter of the casing will be large enough to permit easy passage of an appropriate water-level probe and equipment for purging wells and water sample collection.

The well screen will generally consist of machine-slotted PVC or wire-wrapped stainless steel screen. The slot sizes will be compatible with the selected filter material. The screened sections will provide flow between the target zone and the well, allowing efficiency in well development and collection of representative samples.

2.2 FILTER MATERIAL

Filter material will be well-graded, clean sand (generally less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material). The filter material will be either a standard sand gradation designed for a range of anticipated soil types or a sand gradation specifically designed to fit the soils collected from anticipated well completion zone.

2.3 SETTING SCREENS AND RISER CASING

Upon completion of drilling and/or geophysical logging, the boring will be sounded to verify the total depth, and the well casing will be assembled and lowered into the boring. Well casing materials will be measured to the nearest 0.1 foot and steam-cleaned before being lowered into the borehole. The well assembly will be designed so that the well screen is opposite the target zone. The bottom of the well will be fitted with a secure bottom-end cap. No PVC cement or other solvents will be used to fasten the well casing joints, well screen joints, or end caps. When installing wells in an open borehole, stainless steel centralizers will be used immediately above and below the well screen and approximately every 30 to 50 feet along the length of the casing. Centralizers need not be placed on well assemblies installed within augers or drill casings because the auger or drill casing will adequately center the well casing and screen in the borehole.

For borings drilled by the mud rotary method, potable water may be added to the drill mud and circulated in the borehole after completion of the boring. Circulation will continue until the suspended sediment in the return fluid has been decreased. If borehole conditions are relatively stable, the mud will be thinned before the casing assembly is lowered to the specified depth. This is preferred because it reduces the potential for clogging the well screen with thick mud.

Conversely, if borehole conditions are relatively unstable, the mud will be thinned after the casing is placed at the specified depth but prior to installation of annular fill materials. After installation of the well assembly, a slurry of filter sand and potable water will then be tremied into the annular space.

For borings drilled using the hollow stem auger method, the filter sand will be placed after the well assembly has been lowered to the specific depth through the augers. The augers will be incrementally raised as the filter sand is placed by free fall through the augers. The depth to the top of the filter pack will be measured after each increment to detect possible bridging. If bridging occurs, it will be broken by washing the filter materials into proper place with potable water or by repeatedly raising and lowering the augers slightly. The amount of water, if any, added to the borehole should be noted on the BORING LOG or DAILY FIELD RECORD.

For monitoring wells, the filter sand will be placed in a calculated quantity sufficient to fill the annular space to a level of about 1 to 2 feet above the top of the well screen. For extraction wells, the level of filter sand above the well screen will be based on site conditions. The depth to the top of the filter pack will be verified by measuring, using a tremie pipe or a weighted tape. Groundwater extraction wells or monitoring wells may be surged before placement of the transition seal to promote filter material settlement, as specified by the project manager.

Once the depth to the top of the filter material has been verified, bentonite or fine sand may be placed in the annular space as a transition seal between the filter material and the grout. A sufficient quantity of bentonite or fine sand will be poured to fill the annular space to a level of about 2 feet above the top of the filter pack. If bentonite is to be placed below standing water, a high-solids bentonite grout will be pumped through a tremie pipe, or pellets may be poured through the annulus. If bentonite is to be placed above standing water, a high-solids bentonite grout should be used or pellets may be placed in 6-inch lifts. Unless prohibited by well conditions, each lift should be hydrated using approximately 1 gallon of potable water per lift of pellets. The completed bentonite transition seal will be allowed to hydrate for at least 30 minutes prior to placing the grout. If a layer of fine sand is placed as the transition seal, the fine sand will be mixed with potable water and placed as a slurry through the tremie pipe or poured dry through the annulus. The depth to the top of the transition seal will be verified by measuring, using the tremie pipe or a weighted tape.

A neat cement grout, cement/sand grout, cement/bentonite grout, or high-solids bentonite grout will be placed from the top of the transition seal to the ground surface. The grout seal will be placed by pumping through a tremie pipe lowered to within 5 feet of the top of the transition seal in mud rotary borings. The grout seal will be placed in hollow stem auger borings by free fall through the augers as they are incrementally raised or by pumping through flexible hose or tremie pipe lowered to near the bottom of the zone to be grouted. The grout must be tremied if there is standing water in the augers above the transition seal. Grout/additive/water mixtures will be determined on a site-specific basis. Typical specifications of grout mixtures include: (a) neat cement/bentonite grout, consisting of a mixture of one sack (94 pounds) of Portland Type I/II cement, approximately 2 to 5 percent by weight (of cement) powdered bentonite, and approximately 6 to 8 gallons of water; (b) neat cement grout, consisting of one sack of Portland cement and approximately 5 to 6 gallons of water; and (c) cement/sand grout, consisting of no more than two parts sand to one part cement and approximately 7 gallons of water. Only potable water will be used to prepare the grout. No work will be done on the monitoring well until after the grout has set approximately 24 hours.

2.4 SURFACE COMPLETION

Upon completion of the well, a suitable slip-on cap, threaded end cap, or waterproof cap will be fitted on the top of the riser casing to reduce the potential for entry of surface runoff or foreign matter. Either a steel protective well cover (e.g., stovepipe) or a vault which may have a traffic-rated cover will be completed at the ground surface. All wells will be locked for security and will be designed to limit surface water infiltration.

2.5 DEVELOPMENT OF GROUNDWATER MONITORING OR EXTRACTION WELLS

When the well installation is complete and the grout has cured a minimum of 24 hours, the well will be developed by surging, bailing, and/or pumping, or other appropriate method as specified by the project manager. The objectives of well development are to remove sediment that may have accumulated during well installation, to consolidate the filter pack around the well screen, and to enhance the hydraulic connection between the target zone and the well. In most instances, a bailer will be used to remove sediment and turbid water from the bottom of the well. A surge block may then be used within the entire screened interval to flush the filter pack of fine sediment. Surging will be conducted slowly to reduce disruption to the filter pack and screen. The well will be bailed again to remove sediment drawn in by the surging process until suspended sediment is reduced.

Following bailing and surging, the well may be further developed using air-lift or pumping methods. A bailer may be used for low-yield wells. If possible, the well will be developed at a higher pumping rate than the anticipated rate of future purging. During development, the turbidity of the water will be monitored, and the pH, specific conductance, and temperature of the return water will be measured. Drawdown and recovery will be measured during and at the end of the development process, respectively, using an electric sounder. Well development will proceed until, in the judgment of the Geomatrix field personnel, the return water is of sufficient clarity. If the screened interval is too long to be developed adequately in one stage, multiple stages will be employed, in which the end of the pump intake will be raised or lowered to various depths, as required.

2.6 DOCUMENTATION

A well construction diagram for each well will be completed in the field on the WELL LOG by the field geologist/engineer and submitted to the reviewing geologist or engineer upon completion of each well. Well installation and construction data will be summarized on the DAILY FIELD RECORD or on a specialized form produced for this purpose. Well development notes and field measurements of water quality parameters will be summarized on a WELL SAMPLING AND/OR DEVELOPMENT RECORD. Following review by the project manager, the original records will be kept in the project file.

3.0 CLEANING OF DRILLING EQUIPMENT

Cleaning of the drill rig and associated drilling equipment will follow the procedures discussed in Section 2.0 of the protocol DRILLING AND DESTRUCTION OF SOIL BORINGS.

All well casing materials will be cleaned before they are installed. Well development equipment will be cleaned before use. The following cleaning procedure has been found to be effective and will be used or adapted as appropriate for general conditions of materials or equipment to be cleaned.

1. Steam-rinse with potable water or rinse in deionized or organic-free water.
2. Cover with clean plastic to protect materials and equipment from contact with chemical products, dust, or other contaminants.

Alternatively, well casing materials that have been steam-cleaned and sealed in individual airtight plastic bags by the factory can be used.

Decontamination rinsate will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

4.0 WELL DESTRUCTION

Destruction of wells will be completed in accordance with applicable state and local requirements. If required, permits for destruction will be obtained from the appropriate regulatory agency. As part of destruction design and implementation, care will be taken to seal groundwater pathways between multiple aquifers and to limit surface water infiltration through the destroyed borehole.

If practical, the well casing will be removed from the borehole. If the well casing cannot be removed, the casing should be cut and/or pressure-grouted in accordance with regulating agency requirements. For shallow wells and if the well has been completed in the uppermost aquifer, the casing may be pulled from the borehole before auger entry. Alternatively, and if the well has been completed below the uppermost aquifer, the annular fill may be drilled out with hollow stem augers and the casing removed from the borehole through the augers. If the well casing is PVC or other similar material and cannot be removed as described above, it may be removed by drilling out the casing and annular fill using a tricone or drag bit and a rotary drilling method. The borehole will be redrilled to the same or a slightly larger diameter than the original borehole. The redrilled borehole will be plumb and adequately centered, and all of the well casing will be removed.

The borehole will be filled with a neat cement, cement/sand, cement/bentonite grout, or a high-solids bentonite grout. Before its initial set, the grout will be placed in one continuous pour from the bottom of the boring to the ground surface. The grout will be emplaced by pumping through a tremie pipe or flexible hose which is initially lowered to the bottom of the borehole. The augers should be raised incrementally as emplacement proceeds, but not exceed increments of 20 feet or increments greater than allowed by borehole stability. Boreholes that are terminated above the water table and are not greater than 20 feet deep may be grouted by a continuous pour originating at the ground surface. If the aquifer is confined and the head pressure is great, the grout may need to be placed under pressure.

The volume of sealing material used will be calculated and compared to the casing or borehole volume to ensure that bridging has not occurred during well destruction. If the well is in an urban area and if the casing remains in the borehole, a hole will be excavated around the well to a depth of 5 feet, and the casing will be removed to the bottom of the excavation. The sealing material will be allowed to spill over into the excavation to form a cap. The remainder of the excavation will be backfilled with either native material, grout, or concrete.

Attachments: Daily Field Record
Typical Monitoring Well Construction Diagram
Well Log
Well Sampling and/or Development Record

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

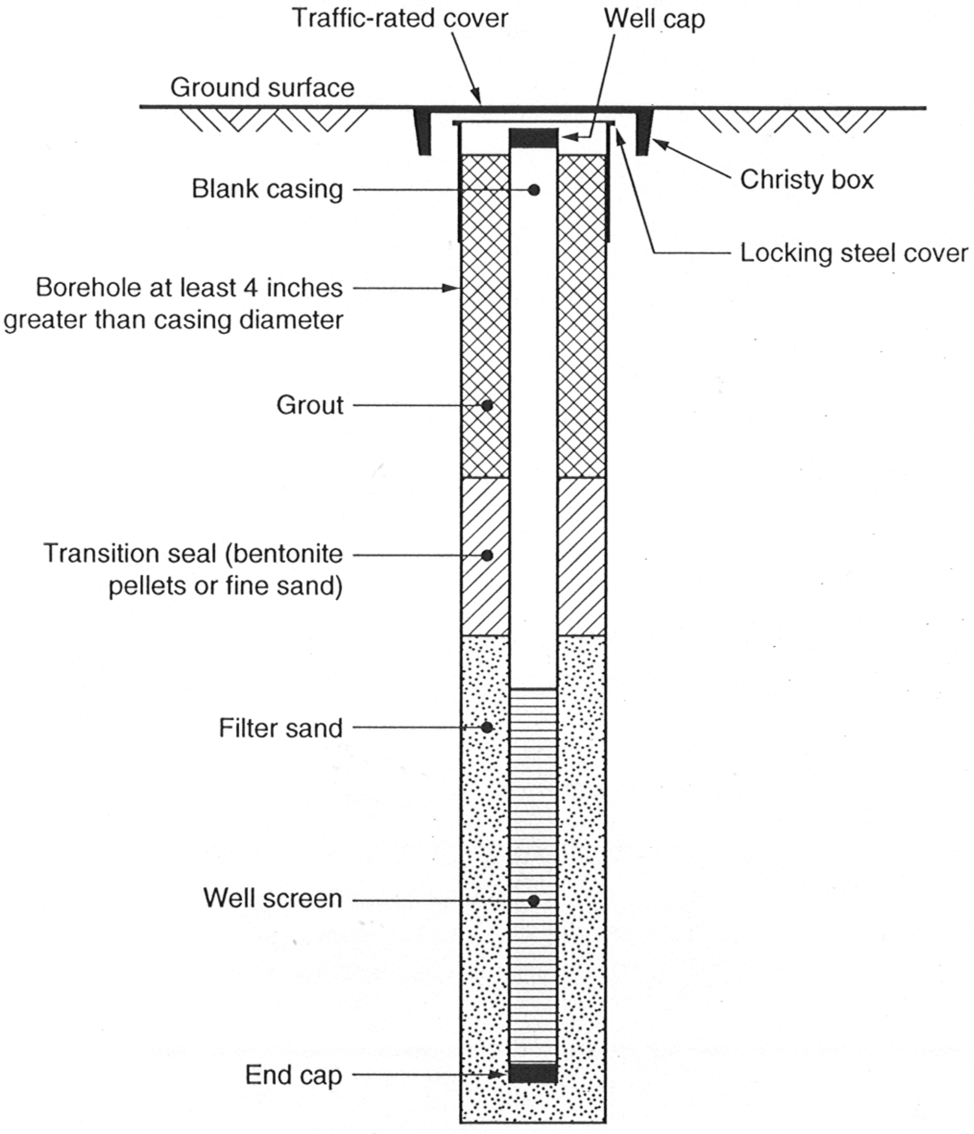
Project and Task Number:

Date:

TIME	DESCRIPTION OF WORK PERFORMED

Geomatrix

TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM



Not to scale

Geomatrix

PROJECT:	**Log of Well No.**
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR:	DATE STARTED: / DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH: / SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER: FIRST COMPL / CASING:
SAMPLING METHOD:	LOGGED BY:
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL: REG. NO.

DEPTH (feet)	SAMPLES			OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows/ Foot		Surface Elevation:	

Project No.	**Geomatrix Consultants**	Figure

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Geomatrix

PROJECT:	**Log of Well No.**

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Sample	SAMPLES Blows/ Foot	OVM Reading (ppm)	DESCRIPTION NAME (USCS Symbol): color, moist. % by weight, plast., consistency, structure, cementation, react. W/HCl, geo. inter.	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Project No.	**Geomatrix Consultants**	Figure

Geomatrix

WELL SAMPLING
AND/OR DEVELOPMENT RECORD

Well ID: ______________________

Sample ID: __________ **Duplicate ID:** __________

Sample Depth: ______________________

Project and Task No.: ______________________

Project Name: ______________________

Date: ______________________

Sampled By: ______________________

Method of Purging: ______________________

Method of Sampling: ______________________

Initial Depth to Water:

Depth to Water after Sampling: ______________________

Total Depth to Well: ______________________

Well Diameter: ______________________

1 Casing/Borehole Volume: ______________________
(Circle one)

4 Casing/Borehole Volumes: ______________________
(Circle one)

Total Casing/Borehole Volumes Removed: ______________________

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (μS/cm)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)

Buffer Solution	**pH 4.0**	**pH 7.0**	**pH 10.0**	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (μS/cm=μmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

PROTOCOL

WATER LEVEL, WELL DEPTH, AND FLOATING PRODUCT MEASUREMENTS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during water level, well depth, and free product measurements. The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 WATER LEVEL AND WELL DEPTH MEASUREMENTS

A DAILY FIELD RECORD will be completed for each day of fieldwork. Water levels will be recorded on a WATER LEVEL MONITORING RECORD. Following review by the project manager, the original records will be kept in the project files.

Water level measurements at a site will be taken as quickly as practical, to best represent the potentiometric surface across the site at a single time. If pressure is suspected or has developed inside the well casing, the well will be allowed to stand without a cap for a few minutes or until the water level stabilizes before taking the water level measurement. Water level measurements will be recorded to the nearest hundredth (0.01) foot, and well depth measurements will be noted to at least the nearest half (0.5) foot. Equipment placed in the wells for water level and well depth measurements will be cleaned prior to reuse, as discussed in Section 4.0. Care will be taken not to drop foreign objects into the wells and not to allow the tape or sounding device to touch the ground around the well during monitoring.

2.1 WATER LEVEL MEASUREMENTS

Water level measurements will be performed by one of the following methods:

A. Wetted-Tape Method

A steel surveyor's tape will be prepared by coating several feet of the lower end of the tape with chalk or water-finding paste. A weight is attached to the lower end of the steel tape to keep it taut. The tape is lowered into the well until a foot or two of the chalked portion is submerged.

A tape without weight can be used if the well opening or pump casing clearance is too small and restricts the passage of the weight. The proper length to lower the tape may have to be determined experimentally. Measurement will be done as follows:

1. Lower and hold the tape at an even foot mark at the measuring point (MP) and note this tape reading.
2. Remove the steel tape from the well. Add or subtract the wetted length from the even foot mark noted in Step 1, as appropriate for your tape, and record this as water level below MP on the WATER LEVEL MONITORING RECORD.

B. Electric Sounder Method

An electric sounder consists of a contact electrode suspended by an insulated electric cable from a reel that has an ammeter, a buzzer, a light, or other closed circuit indicator attached. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. Electric sounders will be calibrated periodically by measuring each interval and remarking them where necessary.

The procedure for measuring water levels with an electric sounder is as follows:

1. Turn sounder on, and check that it is working.
2. Lower the electric sounder cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.
3. With the cable in this fixed position, note the length of cable at the MP.
4. If the electric cable is not graduated between foot markings, use a pocket steel tape measure (graduated in hundredths of a foot) to interpolate between consecutive marks. Care must be taken to ensure that the tape measurements are subtracted from the graduated mark footage value when the water level hold point (determined in Step 3) is below the graduated mark and added when it is above the mark. Record the resulting value as water level below MP on the WATER LEVEL MONITORING RECORD.

2.2 WELL DEPTH MEASUREMENTS

The depth of a well will be measured by sounding with a weighted steel surveying tape or an electric sounding line, weighted when possible. Procedures to be followed are described below.

1. Measure the distance between the zero mark on the end of the measuring line and the bottom of the weight.

2. Lower the weighted measuring line into the well until the line becomes slack or there is a noticeable decrease in weight, which indicates the line is touching the bottom of the well. Raise the line slowly until it becomes taut (this may have to be done several times to determine the taut point) and, with the line in this fixed position, note the reading at the MP. Add the distance described in Step A to this reading, and record the resulting value as well depth. This procedure will be performed before and after initial well development or as necessary to determine well casing depth.
3. Record the well depth value on a WATER LEVEL MONITORING RECORD.

3.0 FLOATING PRODUCT MEASUREMENTS

Floating product level/thickness will be measured using an interface probe or steel tape and paste. The electric sounder and bailer method is limited to checking the wells for the presence or absence of floating product. Procedural details are provided below.

All floating product level measurements shall be recorded to the nearest hundredth foot (0.01 foot). All equipment placed in the wells for floating product level measurement will be cleaned prior to reuse, as discussed in Section 4.0. Care will be taken not to drop foreign objects into the wells and not to allow the measuring device to touch the ground around the well during monitoring.

3.1 INTERFACE PROBE METHOD

The floating product-water interface probe consists of a electrode suspended by a graduated tape from a reel that has a light and two-toned audible signals. Audible and visual signals occur when the electrode touches the floating product surface and then the water surface.

The procedure for measuring floating product levels using the interface probe is as follows:

1. Turn interface meter on, and check that it is working.
2. Lower the interface meter into the well slowly until the meter signals an interface. Note if the interface is oil or water.
3. Raise and lower the meter slightly until the shortest length of cable that gives the maximum response on the meter is found.
4. With the cable in this fixed position, note the length of cable at the measuring point.
5. If the interface recorded above was oil, slowly lower the meter until a water interface signal is given.
6. Repeat steps 3 and 4 above.
7. Turn the probe off and store in a case after cleaning.

3.2 ELECTRIC SOUNDER AND BAILER METHOD

The procedure for checking present of floating product using an electric sounder and an acrylic bailer is as follows:

1. Measure the water level with the electric sounder as described in Section 2.1.
2. Suspend a clean acrylic bailer on a line and slowly lower the bailer into the well until it partially intersects the groundwater surface.
3. Slowly pull the bailer to the surface.
4. Let the bailer stand for several minutes.
5. Observe the surface of the water within the bailer. Measure the thickness of the product in the bailer to the nearest 0.01 foot and record the value on the sampling record. If the product is less than 0.01 foot thick, the amount should be recorded as less than 0.01 foot. If only a sheen is observed or no floating product is seen, these observations should be recorded.

3.3 STEEL TAPE AND PASTE METHOD

1. Measure the water level with an electric sounder as described in Section 2.1.
2. Spread a thin layer of gasoline or oil-finding paste on one side of a steel surveyor's tape, beginning at the zero-foot mark and extending up the tape about 1-foot more than the anticipated thickness of the floating product.
3. Spread a thin film of water-finding paste on the opposite side of the tape, beginning at the zero-foot mark and extending up the tape about 1 foot.
4. Slowly lower the tape into the well until the zero-foot mark is located, about 6 inches below the water level (the tape reading at the measuring point should be 6 inches greater than the actual depth to water). Take care not to touch the sides of the well with the tape.
5. Slowly remove the tape from the well. The pastes will have changed color upon contact with the water or the floating product. The product thickness is the difference between the tape reading at the point where water-finding paste indicates the water level and the point where the gasoline or oil-finding paste indicates the top of the floating product.

4.0 EQUIPMENT CLEANING

Steel tapes, electric well sounders, and acrylic bailers will be cleaned after measurements in each well. Cleaning procedures will be as follows:

1. Wipe floating product off with disposable towels. Rinse probe or portion of instrument that was immersed in well water with a solution of laboratory-grade detergent and potable water.

2. Rinse with potable water.
3. Dry with a clean paper towel.
4. The interface probe may also be cleaned with acetone at this stage.

Solutions resulting from cleaning procedures will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

Attachments: Daily Field Record
Water Level Monitoring Record

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:

Date:

TIME	DESCRIPTION OF WORK PERFORMED

WATER LEVEL MONITORING RECORD

Geomatrix

Project Name: ______________________________ Project and Task Number: __________________________

Date: _____________ Measured by: __________________ Instrument Used: __________________________

Note: For you convenience, the following abbreviations may be used.

P = Pumping I = Inaccessible D = Dedicated Pump
ST = Steel Tape ES = Electric Sounder MP = Measuring Point WL = Water Level

Well No.	Time	MP Elevation (feet)	Water Level Below MP (feet)	Water Level Elevation (feet)	Previous Water Level Below MP	Remarks

Page ____ of ____

PROTOCOL

SAMPLING OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY WELLS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during sampling of groundwater monitoring wells and water supply wells for laboratory chemical analysis. The laboratory must be certified by the appropriate regulating agency for the analyses to be performed.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 SAMPLING

2.1 SAMPLE COLLECTION

A. Monitoring Wells

Methods for purging and sampling monitoring wells with dedicated and non-dedicated equipment are described in this Section. When practical, the purging and sampling technique adopted for a given site will remain consistent from one sampling event to the next.

A.1 Purging Monitoring Wells

A submersible pump, diaphragm pump, positive displacement pump, which may contain a bladder, or a bailer will be used for evacuating (purging) the monitoring well casing. If the well is to be sampled using equipment that must be separately introduced into the well, the purge intake will be located near the top of the water column for removal of at least one casing volume to remove stagnant water above the screened interval in the well casing; the pump may then be moved to the midscreen interval to complete the purging progress, if required. If a bailer is used to purge the monitoring well, it will be gently lowered into the well to reduce the potential for aeration of water. Purging will progress at a rate intended to minimize differential drawdown between the interior of the well screen and the filter material to limit cascading water along the inside of the well casing. Procedures for purging slowly recharging wells are discussed in Section A.3.

A minimum of four well casing volumes or one saturated borehole volume, whichever is greater, will be removed to purge the well prior to collection of groundwater samples if the well will be purged with non-dedicated equipment. If a low-flow capacity pump is dedicated in the well, the micropurge method described in Section A.4 may be used to reduce the purge volume. If the well goes dry before four casing volumes are removed, the procedure discussed in Section A.3 will be followed. The saturated borehole volume is the volume of water in the well casing plus the volume of water in the filter pack. For a well with a dedicated pump and packer, a casing volume is defined as the volume of water in the well casing below the inflated packer.

Periodic observations of turbidity and measurements of temperature, pH, and specific electrical conductance (SEC) will be made with field equipment during purging to evaluate whether the water samples are representative of the target zone. Samples will be collected when: (1) a minimum of four sets of parameter readings have been taken; and (2) the temperature, pH, and SEC reach relatively constant values, and the turbidity has stabilized.

A.2 Sampling Monitoring Wells

The sampler will wear clean gloves appropriate for the chemicals of concern while collecting the sample. Samples will be collected directly in laboratory-prepared bottles from the sampling device.

Each sampling episode or day should generally begin with the well having the least suspected concentrations of target compounds. Successive wells should generally be sampled in sequence of increasing suspected concentration.

A Teflon® bailer, new disposable bailer, stainless steel positive displacement Teflon® bladder pump with Teflon® tubing, or a clean electric submersible pump with low-flow sampling capacity will be used to collect the water samples for laboratory chemical analysis.
If a bailer is being used to collect the sample, it will be gently lowered into the well below the point where the purge device was located. Samples will collected in the following order: (1) volatile organic compounds; (2) semi-volatile organic compounds; (3) metals; (4) other analytes.

If a bladder pump or electric submersible pump is being used to sample the well for volatile compounds, the flow rate will be adjusted to either 1) approximately 100 milliliters per minute; 2) a rate specifically selected for the well based on groundwater flow rates and well hydraulic conditions; or 3) as low as possible. This rate will be maintained until the discharge line has been purged and the sample collected.

A.3 Purging and Sampling Wells With Slow Recharge

Wells that recharge very slowly may be purged dry once, allowed to recharge, and then sampled as soon as sufficient water is available. In this case, at least two sets of parameter readings of field water quality should be taken, one initially and one after recharge.

A.4 Purging and Sampling Wells Using "Micropurge" Sampling Method

Based on current research, a low-flow-rate, reduced purge method may be used to purge and sample a well with a dedicated pump (Barcelona et al., 1994; Kearl et al., 1994). This method may be used if acceptable to applicable agencies. This method assumes the water within the screened interval is not stagnant, and a small change to the natural flow rate in the screened interval will result in samples with particulates and colloidal material representative of groundwater. The pump should be preset in the screen interval at least 24 hours before the sampling event. A minimum of two pump plus riser pipe volumes should be purged at a flow rate of approximately 100 milliliters per minute or as low as possible based on groundwater flow and well hydraulic conditions. Purging should progress until water quality parameters (pH, SEC, temperature) have reached relatively constant values. Dissolved oxygen readings are recommended, if practical.

B. Water Supply Wells

Water supply wells will be sampled by purging the wells for a period of time adequate to purge the pump riser pipe. Alternatively, if the volume of the riser pipe is unknown, the pressure tank will be drained until the pump cycles on, or the well may be purged until three successive field measurements performed 5 to 10 minutes apart have stabilized. If the well is currently pumping, the sample can be taken without purging the well. Water samples will then be collected from the discharge point nearest the well head. Samples will be collected directly into laboratory-prepared bottles.

C. Extraction Wells

Extraction wells will be sampled while extraction is occurring. Samples will be collected from an in-line sampling port after purging the sampling line. Samples will be collected directly into laboratory-prepared bottles.

A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used to record the following information:

- Sample I.D.
- Duplicate I.D., if applicable
- Date and time sampled
- Name of sample collector
- Well designation (State well numbering system for water supply wells, and unique sequential number for other wells)
- Owner's name, or other common designation for water supply wells
- Well diameter
- Depth to water on day sampled
- Casing volume on day sampled
- Method of purging (bailing, pumping, etc.)
- Amount of water purged
- Extraordinary circumstances (if any)
- Results of instrument calibration/standardization and field measurements (temperature, pH, specific electrical conductance) and observed relative turbidity
- Depth from which sample was obtained
- Number and type of sample container(s)
- Purging pump intake depth
- Times and volumes corresponding to water quality measurement

- Purge rate

2.2 SAMPLE CONTAINERS AND PRESERVATION

Appropriate pre-cleaned sample containers and preservatives for the analyses to be performed will be obtained from the subcontracted analytical laboratory. Frequently requested analyses and sample handling requirements are listed in Table 1.

2.3 SAMPLE LABELING

Sample containers will be labeled before or immediately after sampling with self-adhesive tags having the following information written in waterproof ink:

- Geomatrix
- Project number
- Sample I.D. number
- Date and time sample was collected
- Initials of sample collector

2.4 QUALITY CONTROL SAMPLES

In order to evaluate the precision and accuracy of analytical data, quality control samples, such as duplicates and blanks, will be periodically prepared. These samples will be collected or prepared and analyzed by the laboratory, as specified in the project Quality Assurance Project Plan (QAPP) or by the project manager.

2.5 HANDLING, STORAGE, AND TRANSPORTATION

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination will be avoided. Immediately following collection, samples will be placed in a clean chest that contains ice or blue ice (if cooling is required), and will be transported to the subcontracted laboratory as soon as practical, or in accordance with the project QAPP.

3.0 FIELD MEASUREMENTS

Field measurements of temperature, pH, and SEC will be performed on aliquots of groundwater that will not be submitted for laboratory analysis. Field water quality measurements and instrument calibration details will be recorded on the WELL SAMPLING AND/OR DEVELOPMENT RECORD.

3.1 TEMPERATURE MEASUREMENTS

Temperature measurements will be made with a mercury-filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

3.2 PH MEASUREMENT

The pH measurement will be made as soon as possible after collection of the sample, generally within a few minutes. The pH will be measured by immersing the pH probe into an aliquot of groundwater.

The pH meter will be calibrated at the beginning of and once during each sampling day and whenever appropriate, in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the specific pH meter used. Two buffers (either pH-4 and pH-7, or pH-7 and pH-10, whichever most closely bracket the anticipated range of groundwater conditions) will be used for instrument calibration.

3.3 SPECIFIC ELECTRICAL CONDUCTANCE MEASUREMENT

SEC will be measured by immersing the conductivity probe into an aliquot of groundwater. The probes used should automatically compensate for the temperature of the sample. Measurements will be reported in units of micro-Siemens (ΦS) per square centimeter (equivalent to micromhos or Φmhos) at 25 degrees Celsius.

The SEC meter will be calibrated at the beginning and once during each sampling day in accordance with the equipment manufacturer's specifications, as outlined in the instruction manual for the SEC meter used. The SEC meter will be calibrated with the available standardized potassium chloride (KCl) solution that is closest to the SEC expected in groundwater below the site.

4.0 DOCUMENTATION

4.1 FIELD DATA SHEETS

A DAILY FIELD RECORD will be completed for each day of fieldwork. A WELL SAMPLING AND/OR DEVELOPMENT RECORD will be used for each well to record the information collected during water quality sampling. Samples may also be recorded on a SAMPLE CONTROL LOG SHEET or in the DAILY FIELD RECORD as a means of identifying and tracking the samples. Following review by the project manager, the original records will be kept in the project file.

4.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory for analytical services.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD will include:

- Project number
- Signature of sampler(s)
- Date and time sampled
- Sample I.D.
- Number of sample containers
- Sample matrix (water)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control measures
- Turnaround time and person to receive laboratory report
- Method of shipment to the laboratory
- Release signature of sampler(s), and signatures of all people assuming custody.
- Condition of samples when received by laboratory

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between the last sample listed and the signatures at the bottom of the sheet.

The field sampler will sign the CHAIN-OF-CUSTODY RECORD and will record the time and date at the time of transfer to the laboratory or to an intermediate person. A set of signatures is required for each relinquished/reserved transfer, including transfer within Geomatrix. The original imprint of the chain-of-custody record will accompany the sample containers. A duplicate copy will be placed in the project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY will be sealed inside a plastic bag within the ice chest, and the chest will be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent chain-of-custody document. The shipping company (e.g., Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receivor; instead the laboratory will sign as a receivor when the samples are received.

5.0 EQUIPMENT CLEANING

Bailers, sampling pumps, purge pumps, and other non-dedicated purging or sampling apparatus will be cleaned before and after sampling each well. Factory new and sealed disposable bailers may be used for sampling, but may not be reused. Thermometers, pH electrodes, and SEC probes that will be used repeatedly will be cleaned before and after sampling each well and at any time during sampling if the object comes in contact with foreign matter.

Purged waters and solutions resulting from cleaning of purging or sampling equipment will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

Cleaning of reusable equipment that is not dedicated to a particular well will consist of the following:

- Bailers - the inside and outside of bailers will be cleaned in a solution of laboratory-grade detergent and potable water, followed by a rinse with deionized (DI) water. They may also be steam-cleaned, followed by a DI water rinse. If samples are to be collected for metals analysis, the Teflon[8] bailer may be rinsed with a pH2 nitric acid solution followed by a double DI rinse.
- Purge Pumps - All downhole, reusable portions of purge pumps will be steam-cleaned on the outside. If the pump does not have a backflow check valve, the

inside of the pump and tubing also should be steam-cleaned. For a purge pump with a backflow check valve, the interior of the pump and tubing may be cleaned by pumping a laboratory-grade detergent and potable water solution through the system followed by a potable water rinse, or by steam-cleaning.

- Water Quality Meters - All meters will be cleaned by rinsing the probe portions in DI water, and allowing to air dry.
- Bailer Tripod - The tripod cable will be steam-cleaned or rinsed with DI water.

Sample bottles and bottle caps will be cleaned by the subcontracted laboratory using standard EPA-approved protocols. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contamination. Sample bottles will not be reused.

6.0 REFERENCES

Barcelona, M.J., et al., 1994, Reproducible Well-Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling: *Groundwater*, January-February.

Kearl, P.M., et al., 1994, Field Comparison of Micropurging vs. Traditional Ground Water Sampling: *Ground Water Monitoring Review*, Fall.

Attachments: Water and Soil Analytical Methods and Sample Handling
Well Sampling and/or Development Record
Daily Field Record
Chain-of-Custody Record
Sample Control Log Sheet

TABLE 1

WATER AND SOIL ANALYTICAL METHODS AND SAMPLE HANDLING

Parameter	Method	Water Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
• as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool on ice	14 days (unacidified water, 7 days)
• as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Volatile Organics with BTEX	EPA 8021[3]	2 - 40 ml VOA glass	HCL to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days)
Oil and Grease	5520 E & F (soil)[4] 5520 C & F (water)[4]	2 - 1 liter amber glass	H_2SO_4 to pH <2 in water samples: cool on ice	28 days
Volatile Organics	EPA 8010 EPA 8240[5]	2 - 40 ml VOA glass 2 - 40 ml VOA glass	cool on ice[6] HCl to pH 2 in water samples: cool on ice	14 days (unacidified water, 7 days) 14 days (unacidified water, 7 days)
Semi-volatile Organics	EPA 8270	2 - 1 liter amber glass	cool on ice	7 days for extraction, water 14 days for extraction, soil 40 days for analysis
Polynuclear Aromatic Hydrocarbons	EPA 8310	2 - 1 liter amber glass	cool on ice	7 days, water 14 days, soil
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Water Samples: field filtration (0.45 micron filter) and field acidify to pH 2 with HNO_3 except: Cr^{+6} - cool on ice	6 months, except: Hg - 28 days Cr^{+6} - 24 hours, water; 24 hours after prep, soil

Notes:

[1] All soil samples should be collected in full, clean brass liners, capped with aluminum foil or Teflon and plastic caps, and sealed with tape. If soil samples are to be analyzed for metals, they may be placed in laboratory-prepared clean glass jars. Soil should be cooled as indicated under “preservation” and maximum holding times apply to both soil and water unless otherwise noted.

[2] For analysis in California, use California DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector. In other states, local requirements should be followed. Method 3660M is silica gel cleanup.

[3] EPA Method 8021 is equivalent to 8010/8020 in series.

[4] Method to be used in California Regional Water Quality Control Board North Coast and Central Valley Regions. In other areas, local requirements should be followed. Method 5520F is silica gel cleanup.

[5] Chloroethylvinylether may be detected at concentrations below 50 parts per billion due to degradation of HCl. EPA Method 8260B was formerly 8240.

[6] If EPA Methods 8010 and 8020 are to be run in sequence, HCl may be added. Check with the project manager before adding acid.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July, and final amendments.
California State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.
California Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1990, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 10 August.

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WELL SAMPLING
AND/OR DEVELOPMENT RECORD

Well ID: ______________________________

Sample ID: __________ **Duplicate ID:** __________

Sample Depth: ______________________________

Project and Task No.: ______________________________

Project Name: ______________________________

Date: ______________________________

Sampled By: ______________________________

Method of Purging: ______________________________

Method of Sampling: ______________________________

Initial Depth to Water:

Depth to Water after Sampling: ______________________________

Total Depth to Well: ______________________________

Well Diameter: ______________________________

1 Casing/Borehole Volume: ______________________________
(Circle one)

4 Casing/Borehole Volumes: ______________________________
(Circle one)

Total Casing/Borehole Volumes Removed: ______________________________

Time	Intake Depth	Rate (gpm)	Cum. Vol. (gal.)	Temp. (°C)	pH (units)	Specific Electrical Conductance (µS/cm)	Remarks (color, turbidity, and sediment)

pH CALIBRATION (choose two)

Buffer Solution	pH 4.0	pH 7.0	pH 10.0	
Temperature C				
Instrument Reading				

Model or Unit No.:

SPECIFIC ELECTRICAL CONDUCTANCE – CALIBRATION

KCL Solution (µS/cm=µmhos/cm)			
Temperature C			
Instrument Reading			

Model or Unit No.:

Notes:

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

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DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:

Date:

TIME	DESCRIPTION OF WORK PERFORMED

CHAIN-OF-CUSTODY RECORD

Nº

Date:

Page of

Project No.:

Samplers (Signatures):

			ANALYSES																			REMARKS				
Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8020 (BTEX only)	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel													Cooled	Soil (S), Water (W), or Vapor (V)	Acidified	Number of containers	Additional Comments

Turnaround time:

Results to:

Total No. of containers:

Relinquished by (signature):	Date:	Relinquished by (signature):	Date:	Relinquished by (signature):	Date:	Method of Shipment:
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:	Laboratory Comments and Log No.:
Company:		Company:		Company:		
Received by (signature):	Date:	Received by (signature):	Date:	Received by (signature):	Date:	
Printed Name:	Time:	Printed Name:	Time:	Printed Name:	Time:	
Company:		Company:		Company:		Geomatrix

Forms(PF).012b (Revised 12/95)

SAMPLE CONTROL LOG

Geomatrix

Project Name: ______________________ Laboratory: ______________________

Project and Task No.: ______________________ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due

PROTOCOL

DISCRETE-DEPTH SAMPLING

1.0 INTRODUCTION

This protocol describes the procedures to be followed during collection of discrete-depth groundwater samples using either the Enviro Probe® or the HydroPunch®. These tools are generally used to collect groundwater samples for chemical analysis during groundwater screening programs, and in some cases to measure water levels or pore pressure at discrete depths.

A DAILY FIELD RECORD will be completed for each day of fieldwork, and the original will be kept in the project files after review by the project manager. Soil borings drilled in conjunction with the collection of discrete-depth groundwater samples will be in accordance with the protocol DRILLING and DESTRUCTION OF SOIL BORINGS. Groundwater samples collected for chemical analysis should be handled in accordance with the protocol SAMPLING OF GROUNDWATER MONITORING WELLS AND WATER SUPPLY WELLS.

The procedures presented herein are intended to be of general use and, where necessary, may be supplemented by a work plan and/or health and safety plan. As the work progresses, and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable agency requirements.

2.0 SAMPLING EQUIPMENT

The Enviro Probe® and HydroPunch® can be used with several subsurface exploration methods, including hollow stem auger drilling, mud rotary drilling, and cone penetrometer testing (CPT). Selection of the appropriate sampling tool should be based on anticipated field conditions such as the site hydrogeology (e.g., depth of sampling location below the water table, soil grain size, and estimated permeability) and type of subsurface exploration method employed. If required, permits for drilling soil borings will be acquired from the appropriate agency(s) before the drilling is initiated. An underground utility check will, at a minimum, consist of contacting a local utility alert service, if available.

2.1 ENVIRO PROBE®

The Enviro Probe® consists of a stainless steel drive point with a retractable outer sleeve, a stainless steel, wire-cloth filter, various viton rubber O-rings, and a flexible viton rubber seal (septum) at the upper end of the probe, as shown on the figure BAT ENVIRO PROBE® SCHEMATIC. The rubber septum provides a watertight seal that prevents water from readily entering or exiting the top of the probe. The filter is attached to the inside body of the probe and is protected by the retractable outer sleeve. The sample reservoir is part of a separate assembly, as discussed in Section 3.1. The tool can be disassembled readily for cleaning between sampling events.

2.2 HYDROPUNCH®

The HydroPunch® consists of a drive point, a stainless steel screen section, a sample reservoir integral with the tool body, and assorted O-rings and check valves to create watertight seals between the various components. Two models of the HydroPunch® have been developed, having slightly different designs and/or component parts as shown on the attached HydroPunch® I and II Schematics. All components are made of stainless steel, Teflon, or other relatively inert materials. The tool can be disassembled easily for cleaning between sampling events.

3.0 SAMPLING METHODS

Installation of the Enviro Probe® and HydroPunch® generally follows the same methods. A target sample interval (target zone) is usually identified prior to collecting a sample. When sampling while using conventional drilling methods, the soil boring is advanced to a depth immediately above the target zone prior to installing the sampling tool. The sampling tool is attached to one of several different types of standard drilling rods (minimum 1-inch inside diameter for the Enviro Probe®), lowered to the bottom of the existing borehole, and advanced (driven or pushed) approximately 2 to 4 feet into undisturbed formation. Internal seals and/or check valves create a water-tight sampling tool while in the closed position, so that the Enviro Probe® or HydroPunch® can be used in fluid-filled boreholes.

After the sampling tool is emplaced at the target sample depth, the outer sleeve is retracted approximately 1 to 1.5 feet (generally 1 foot of retraction for the Enviro Probe® and 1.5 feet of retraction for the HydroPunch®). As the outer sleeve is retracted, subsurface friction retains the drive point in place, exposing the screen section and allowing water to enter the sampling tool. When sampling while using CPT methods, the sampling tool can be attached directly to the uninstrumented CPT rods (for the HydroPunch®) or 1-inch-inside-diameter rods (for the Enviro Probe®) and pushed from the ground surface to the desired sampling depth. The retractable sleeve on both sampling devices ensures that the internal parts are sealed from cross-contamination as the tools are advanced.

3.1 ENVIRO PROBE® SAMPLING PROCEDURES

Groundwater samples are collected by lowering the appropriate groundwater monitoring system (GMS) tool down the drive rod (i.e., drill rod or CPT rod). The GMS tools consist of a pore pressure transducer unit (i.e., an in situ pressure transducer with a cable of appropriate length and an electronic data logger or other type of read-out unit) and a GMS groundwater sample collection kit. The GMS groundwater sample collection kit consists of sample vials, ranging in size from 35 to 1000 milliliters (ml), and a sample vial housing assembly. The sample vial(s) are sealed with a flexible viton rubber septum and cap similar to the upper end of the probe. Prior to collecting a groundwater sample, the pore pressure unit is connected in series with the sample vial housing via an arrangement of double-ended hypodermic needles. After the housing and pore pressure unit have been connected, the sample vial is evacuated with a hand vacuum pump. Sampling and pore pressure measurements are obtained by lowering the pressure transducer unit and housing assembly down the drive rod. The tools connect to the Enviro Probe® via a quick-coupling system through the hypodermic needles, which provides a temporary, closed-system, hydraulic connection. Groundwater samples are obtained directly from the Enviro Probe® into the pre-evacuated sample vials. The pressure transducer is used to monitor filling of the sample vial and to measure hydrostatic pressure of the formation after the sample vial has filled. If needed, the pore pressure unit or the GMS groundwater sampling unit can be used independently. The time allowed to fill the vial depends on the physical properties of the target formation and the groundwater pressure at the depth of the probe.

After the sample vial has filled, the sample housing is withdrawn from the drive rods and the sample vial removed. The Enviro Probe® is generally purged by removing one probe volume (approximately 15 ml) of groundwater prior to collecting a sample for preservation and transport to the laboratory. The probe can be sampled repeatedly at the same depth by repeating the sample collection procedures.

3.2 HYDROPUNCH® SAMPLING PROCEDURES

HydroPunch® I groundwater samples are usually collected under hydrostatic conditions, whereby groundwater flows from the formation through the screen section and into the sample reservoir. Accordingly, HydroPunch® I cannot be used at depths less than approximately 5 feet below the water table. The sample reservoir is allowed to fill until groundwater enters the drive rod. The water level inside the drive rod can be detected using a well sounder. The actual sample collection time at each depth depends upon the physical properties of the target zone and the fluid pressure outside the probe. Once the sample reservoir is filled, the HydroPunch® is returned to the surface. Although the sample reservoir is sealed at both ends by internal one-way check valves, care must be taken to avoid sample cross-communication with transmissive units or borehole fluids at a higher potentiometric head than the target zone. Before retrieving the tool, deionized water should be added to the drive rod to a level that exceeds the highest potentiometric surface in the borehole.

HydroPunch® II can be used below the water table, in a manner similar to HydroPunch® I, or it can be used at the water table in the “hydrocarbon mode.” If HydroPunch® II is used in the “hydrocarbon mode,” the sample is collected by lowering a narrow diameter bailer through the drive rod (minimum 1-inch-diameter) and bailing out the volume of groundwater required for analysis. The screen and drive point are left in the hole as the HydroPunch® II tool is removed.

When the sample is retrieved to the surface, it is decanted into laboratory-prepared sample containers suitable for the analysis desired. The HydroPunch® is then disassembled for decontamination and preparation for subsequent sampling depths. The HydroPunch® I can be continued in the same borehole to the next desired sampling depth.

4.0 EQUIPMENT DECONTAMINATION

The Enviro Probe® and HydroPunch® are cleaned by complete disassembly, including O-rings and/or check valves, followed by a laboratory-grade detergent and potable water wash and then followed by a deionized-water rinse. All decontamination rinsate will be collected and stored properly for future disposal by the client, unless other arrangements have been made. The condition of O-rings should be checked during each cleaning and replaced as necessary. The screen should be discarded after each use. The tool will be assembled after cleaning, following the instructions provided in the appropriate sampling kits.

5.0 EQUIPMENT CONSTRAINTS

The Enviro Probe® and its associated GMS assembly require drive rods of a minimum 1-inch inside diameter. HydroPunch® I and HydroPunch® II (in the “groundwater mode”) require drive rods of sufficient diameter to allow passage of the well sounder, generally about 1/2-inch.

HydroPunch® II in the "hydrocarbon mode" (water table sampling) requires drive rods of a minimum 1-1/8-inch diameter to allow passage of the 1-inch-outside-diameter bailer.

As stated earlier, HydroPunch® I (and HydroPunch® II in the "groundwater mode") cannot be used at sampling depths less than 5 feet below the water table. HydroPunch® I, when full, holds 500 ml; HydroPunch® II, when full, holds 1250 ml. The Enviro Probe® system and HydroPunch® II in the "hydrocarbon mode" allow for collection of unlimited sample volumes. The HydroPunch® I can be assembled to allow samples to be bailed in a manner similar to hydrocarbon mode so that unlimited sample volume is available.

Attachments: Daily Field Record
BAT Enviro Probe® Schematic
HydroPunch® I Schematic

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:

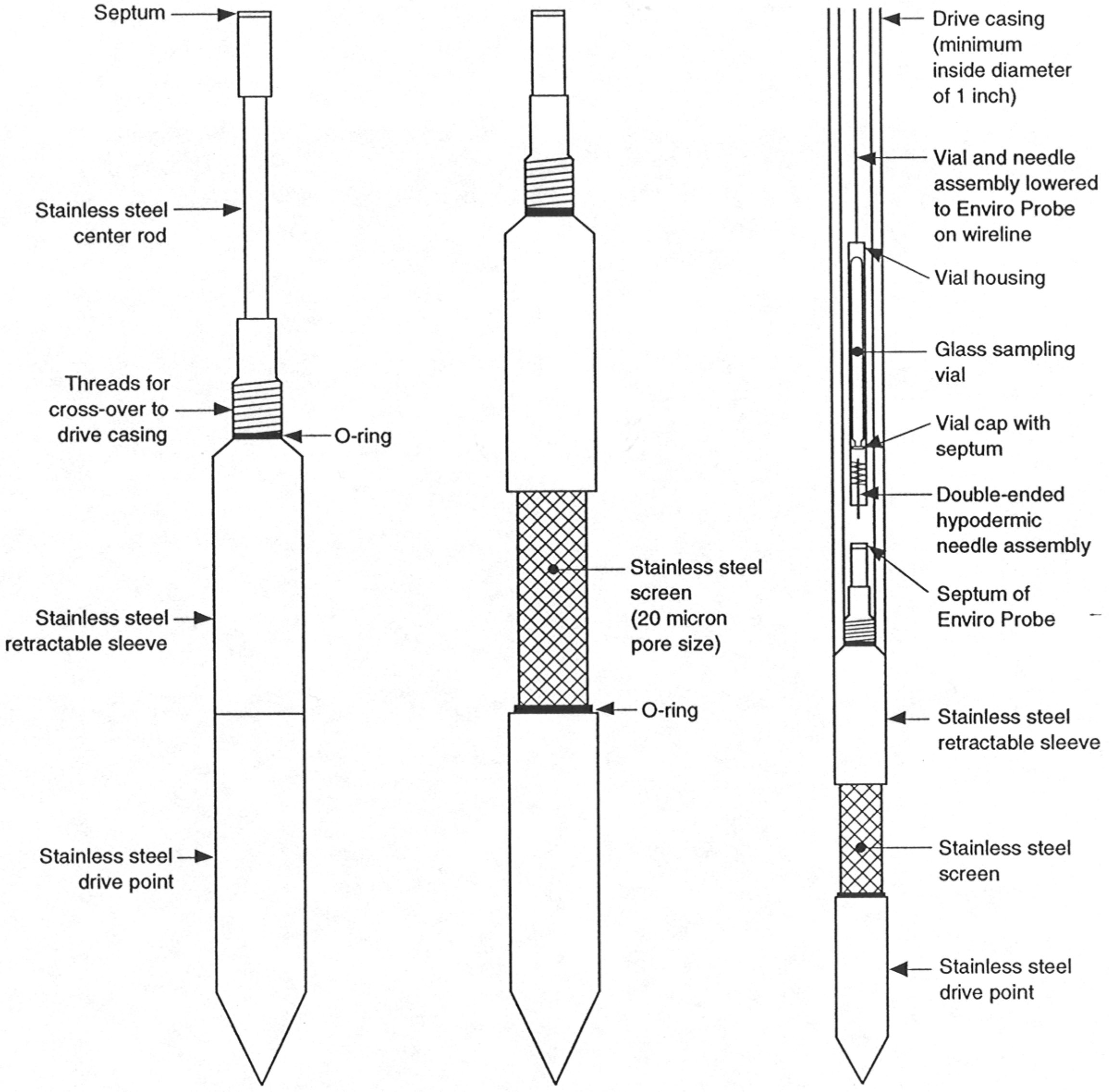
Date:

TIME	DESCRIPTION OF WORK PERFORMED

Geomatrix

BAT ENVIRO PROBE SCHEMATIC

(Not to scale)



Enviro Probe: Closed Position

Enviro Probe: Open Position

Sample Collection Configuration

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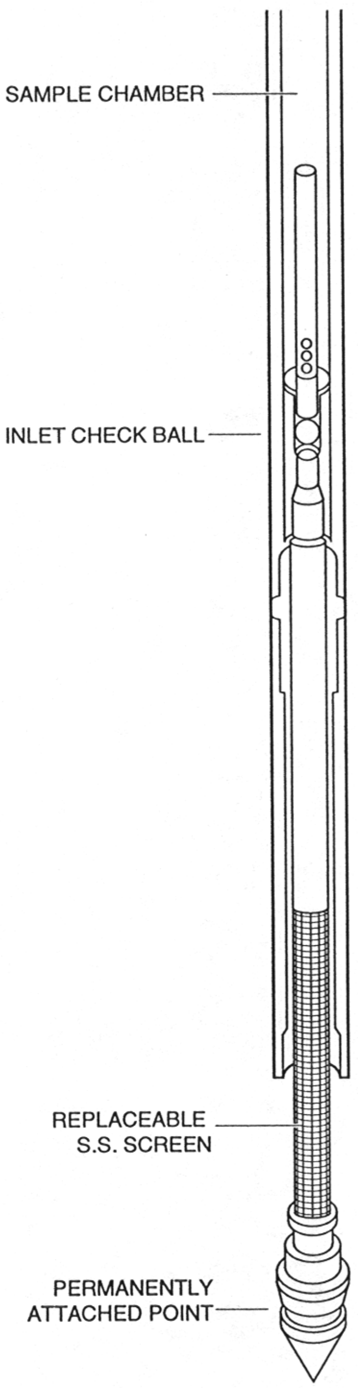
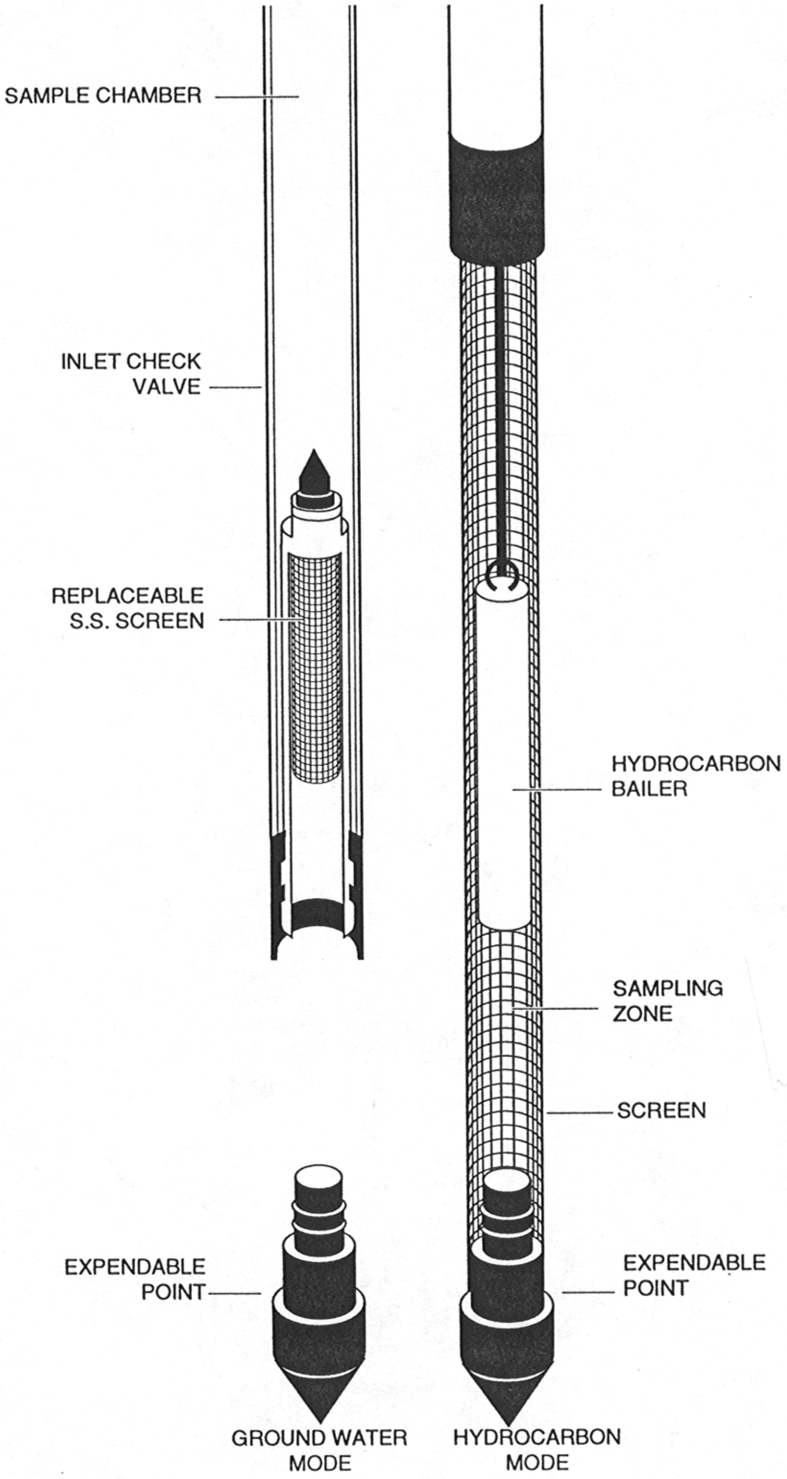
HYDROPUNCH® I and II SCHEMATICS





HydroPunch® I

- Collects ground water samples only (not floating layer)
- Permanently-attached drive cone and screen (leaves nothing in the ground)
- Can be used with cone penetrometer or drill rig

HydroPunch® II

- Collects floating layer and ground water
- Replaceable cones and screens are left in ground (note: screens may be retrievable)
- Stronger for tough duty; used with drill ring

PROTOCOL

AQUIFER TESTING

1.0 INTRODUCTION

This protocol describes the procedures to be followed for conducting step-drawdown, constant discharge, and slug aquifer tests and specific capacity tests. The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in the protocol may be superseded by applicable regulatory requirements.

A DAILY FIELD RECORD will be completed for each day of fieldwork. Weather conditions, proximity of surface water bodies, irrigation, or other observations that may affect results of the aquifer testing will be noted on the DAILY FIELD RECORD.

An AQUIFER TEST DATA FORM will be completed for each well observed during the test, during both drawdown and recovery phases. Alternatively, a data-logger may be used in each well, and the set-up parameters determined by the project hydrogeologist should be recorded on a form developed for this purpose. If a data-logger is used, data should be transferred to a computer as soon as possible after collection. As data is collected, it will be checked periodically in the field for accuracy and completeness.

During aquifer testing, care must be taken to contain or direct the discharged water to avoid recharge of the aquifer during the test. Water discharge from the aquifer will be collected and stored properly for future disposal by the client, unless other arrangements have been made.

2.0 STEP-DRAWDOWN TEST

The step-drawdown aquifer test is performed to estimate a maximum sustainable discharge rate for the pumping well. The pretest phase, conducted prior to the aquifer test, will consist of water level measurements taken in the pumped well and observation wells that are to be monitored throughout the duration of the test. The water level measurements will be taken using electric sounders or pressure transducers and a data logger, and will be recorded for the appropriate well.

The pumping phase of the step-drawdown test will consist of: (1) pumping the well at successively higher pumping rates (steps) specified by the responsible professional, with an approximate duration of two to four hours per step; (2) periodically and at similar times measuring the water levels in the pumped well and observation wells during each step; (3) measuring the instantaneous and cumulative discharge from the pumped well using a flow meter or other appropriate means; and (4) recording the time at which all measurements were taken.

The pumping rate for each step will be maintained relatively constant. The rate will be checked periodically (at least hourly) and adjusted if necessary. The accuracy of the flow meter also may be verified periodically using the sweep needle on the flow meter, if available, and a stopwatch. The accuracy of the flow meter will be checked using a container of known volume and a stopwatch.

The recovery phase of the step-drawdown test begins immediately after the pump is shut off at the completion of the final step of the pumping phase. Recovery water-level measurements will be made periodically in the pumped well and observation wells. Water level measurements will conclude when one of the following is satisfied: (1) the water level in the pumped well has recovered to pre-test level; (2) the water level in the pumped well has remained constant for at least 2 hours; or (3) 24 hours has elapsed since the time of pump shut-off.

3.0 CONSTANT DISCHARGE TEST

During the pretest phase, water level measurements will be taken in the pumped well and all observation wells that are to be monitored throughout the duration of the test. Water level measurements will be taken with electric sounders, pressure transducers with a data-logger, or a steel tape. All pretest water level measurements for the pumping well and observation wells will be recorded for the appropriate well.

3.1 PUMPING PHASE

During the pumping phase of the aquifer test, the following measurements will be made: (1) water levels in the pumped well and the observation wells; (2) instantaneous and cumulative discharge from the pumped well; and (3) time at which measurements are taken.

The duration of the pumping phase will be established prior to the start of the aquifer test. Time-drawdown curves for the observation wells may be plotted in the field on semi-logarithmic graph paper during the pumping phase to evaluate the progress of the test. If the plots indicate steady-state conditions in the aquifer, the test may be ended before its planned conclusion if approval is given by the responsible professional. Likewise, the pumping phase of the test may be extended at the discretion of the responsible professional.

The water levels in the pumped well and the observation wells will be measured simultaneously on a pre-determined time schedule. An example time schedule is outlined below.

(EXAMPLE)

Time Since Pump Started (min.)	Time Intervals Between Measurements (min.)
0-2	0.25
2-5	0.50
5-15	1
15-60	5
60-240	30
240-Conclusion	60

Discharge from the pumped well will be measured using a flow meter and a stopwatch or other appropriate methods. Accuracy of the flow meter may be verified periodically using the sweep needle, if available, and the stopwatch. Discharge will be maintained at a relatively constant rate. The discharge rate will be checked and adjusted (if necessary, at 10-minute intervals during the first hour of pumping and 1-hour intervals thereafter). Rate of discharge, cumulative gallons discharged, and time of measurement will be recorded.

3.2 ABORTED TEST

Failure of pumping operations (mechanical breakdown of generator, pump, etc.) for a period greater than 2 percent of the elapsed pumping time may require postponement of the test. The pumping phase of the test may be resumed when one of the following conditions has been reached: (1) the water level in the pumped well has recharged to within 5 percent of the pretest water level; or (2) the well has not been pumped for a period at least equal to the elapsed pumping time of the test before postponement.

3.3 RECOVERY PHASE

At completion of the pumping phase of the test, the pump will be shut off. In the recovery phase, water level measurements will be taken simultaneously in the pumped well and the observation wells immediately following pump shut-off according to a predetermined schedule. An example time schedule is presented below.

Time Since Pump Stopped (min.)		Time Intervals Between Measurements (min.)
0-2		0.25
2-5		0.50
5-15		1
15-60		5
60-240	**(EXAMPLE)**	30
240-Conclusion		60

Water level measurements will be concluded when one of the following conditions applies: (1) the water level in the pumped well has recovered to the pretest water level; (2) the water level in the pumped well has remained constant for at least 2 hours; or (3) 24 hours has elapsed from the time the pump was shut off.

4.0 SLUG TESTS

Slug tests involve a single well in which the response to an "instantaneous" raising or lowering of the water level is measured. Slug tests are generally of short duration, usually less than 5 minutes, with the first 30 seconds being most important. As such, measurement of water levels during the test should be measured using a pressure transducer and data logger. If the formation is relatively low yielding, the test period may be longer and manual measurement methods may be used.

During the pretest phase, the static water level is measured. Then a known volume of water is either bailed from or added to the well, or a weighted slug of known volume is lowered into or raised from the well. The water level is measured immediately after the slug or water is added or removed, and then the change in water level with time is measured in pre-determined increments. The water level measurements and time at which the measurements will be recorded.

5.0 SPECIFIC CAPACITY TESTS

A specific capacity test is a constant discharge-constant drawdown pumping test. The purpose of specific capacity testing is to determine the specific capacity (SC) of the pumping well and to estimate transmissivity (T) by using an established empirical relationship between SC and T (see Driscoll, 1986). These estimates can be used as a quick check on hydraulic parameters collected during long-term pumping tests or as a preliminary estimate of T when long-term pumping tests have not been performed.

The practical requirement of the field method is to achieve a stabilized drawdown in the pumping well at a constant pumping rate. The pumping rate should be low enough for the results to be indicative of aquifer properties and not overly influenced by losses due to well efficiency. The stabilized drawdown condition ("0.05 foot) should be achieved at a constant pumping rate for a duration of at least 30 minutes. Water levels are measured to the nearest 0.01 foot using an electric sounder or pressure transducer. Pumping rate is measured in gallons per minute (gpm). Cumulative gallons pumped should be recorded at the time water level measurements are taken. Time should be measured in seconds with a stopwatch. Pumping rate in gpm can be calculated after the test is completed. Static and pumping water levels, pumping rate and/or cumulative gallons removed, and time at which measurements were taken will be recorded.

6.0 REFERENCES

Driscoll, F.G., 1986, *Groundwater and Wells*, 2nd edition, Johnson Division.

Attachments: Daily Field Record
Aquifer Test Data Form

DAILY FIELD RECORD

Geomatrix

Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Geomatrix

Page ____ of ____

Project and Task Number:

Date:

TIME	DESCRIPTION OF WORK PERFORMED

Geomatrix

AQUIFER TEST DATA

Page ______ of ______

Well No.: __________ **Project Name:** ____________________ **Project No.:** __________

Owner ____________________ Address ____________________ County __________ State ______

Date __________ Company Performing Test ____________________ Measured By ______________

Well No. ______________ Distance from Pumping Well __________ Type of Test ______________ Test No. ______

Pumping Well _____ Observation Well _____ Measurement Equipment ____________________

TIME DATA

Pump on: Date________ Time________ (t_0)

Pump off: Date________ Time________ (t'_0)

Duration of aquifer test:

Pumping ________ Recovery ________

WATER LEVEL DATA

Static Water Level ______________

Measuring Point ______________

Elevation of Measuring Point ______________

DISCHARGE DATA

How Q Measured ______________

Depth of Pump/Air Line ______________

Previous Pumping? Yes ______ No ______

Duration ________ End ________

TIME DATA					WATER LEVEL DATA				DISCHARGE DATA			COMMENTS ON FACTORS AFFECTING TEST DATA
Date	Clock Time	Time Since Pump Started t	Time Since Pump Stopped t'	t/t'	Water Level Measurement	Correction or Conversion	Water Level	Water Level Change s or s'	Discharge Measurement	Discharge Rate	Recorded By	

PROTOCOL

SOIL VAPOR SAMPLING

1.0 INTRODUCTION

This protocol describes the procedures to be followed for soil vapor sampling associated with Soil Vapor Extraction (SVE) pilot tests, vapor extraction system operation, and soil gas surveys. Selected vapor samples may be submitted to a designated laboratory for chemical analysis. The laboratory must be certified by the appropriate regulating agency for the analyses they are to perform.

The procedures presented herein are intended to be of general use and may be supplemented by a work plan and/or health and safety plan. As the work progresses and if warranted, appropriate revisions may be made by the project manager. Detailed procedures in this protocol may be superseded by applicable regulatory requirements.

2.0 SAMPLING

2.1 SAMPLE COLLECTION

Soil vapor sampling is performed to evaluate the chemical composition of subsurface soil vapor. The well or probe to be sampled should be purged before sampling in order to obtain vapor that is representative of general subsurface conditions. If the sampling is being performed at vadose zone monitoring wells or probes that are not being operated as SVE wells, the well or probe should be purged and sampled as follows:

1. Connect a device that measures pressure/vacuum to the top of the well or probe to be sampled. A static pressure less than atmospheric indicates that air may have been flowing into the well or probe. Pressures greater than atmospheric indicate that soil vapor was probably venting or flowing out of the well or probe. Record the readings and time on a Field Data Sheet.

2. Connect the well or probe to be sampled to the extraction device. Purge at least enough vapor from the well to remove air from the sampling train and head space in the well, using estimated flow rates and volumes. The volume purged should be appropriate for the purpose of the testing and consistent in samples collected from the same site for the same purpose. Purged vapor should be routed through a treatment system, if necessary, to meet health and safety and/or discharge permit

requirements. Record pressure and, if available, vapor temperature and flow rates during the purging process.

3. Install a piece of new tubing compatible with the anticipated chemical compounds between the sample port on the well and the inlet of the sample chamber. When appropriate, the sampling end of the tubing should have a hydraulic quick-disconnect fitting attached. Attach the purging device/vacuum line to the tubing and purge the tube. Atmospheric air will not be allowed to enter the system upsteam of the sampling port. Disconnect the purging device. The hydraulic disconnect or suitable valve should seal the tube and prevent the introduction of fresh air to the sample line.

4. Connect the sample container (Tedlar bag, Summa canister, or sorbent tube) to the sample line. If using a Summa canister, open the valve and allow the canister to fill; you should be able to hear the canister fill. Close the Summa canister valve before disconnecting the tubing. Vacuum in the Summa cannister may be measured upon arrival at the laboratory. This pressure should be similar to the pressure measured during sampling. If using a Tedlar bag, place the bag in the sample chamber and connect it to the sample line with new tubing. Pump air from the sample chamber to fill the bag. Record pressure in the sampling train and, if available, vapor temperature and flow rates during the sampling process, if applicable. Care should be taken not to fill the Tedlar bag to capacity in order to protect the bag during shipment.

   If a sorbent tube is used, multiple tubes should be used in series to provide protection against saturation and breakthrough of a single tube during sampling. Measure flow rates at the beginning and end of sampling, at a minimum, and accurately record sample start and stop times. Sampling duration may be determined based on the anticipated analyte concentration range.

If sampling is being conducted on a well connected to an operating vapor extraction system, then proceed as above starting at Step 3. Stagnant portions in the piping used for sampling should be purged before sampling.

2.2 SAMPLE CONTAINERS

Appropriate sample containers (e.g., Tedlar bags, Summa canisters, or sorbent tubes) for the analyses to be performed will be obtained, precleaned or new, from the subcontracted analytical laboratory.

2.3 SAMPLE LABELING

Label sample containers before or immediately after sampling with a self-adhesive label or tag having the following information written in waterproof ink:

- Geomatrix
- Project number
- Sample ID number
- Date and time sample was collected
- Initials of sample collector

2.4 QUALITY CONTROL SAMPLES

In order to evaluate the precision and accuracy of analytical data, quality control samples such as duplicates, blanks, spikes, or site background samples may be included. These samples will be collected or prepared and analyzed by the laboratory as specified in the project Quality Assurance Project Plan (QAPP) or by the project manager.

2.5 HANDLING, STORAGE, AND TRANSPORTATION

Care must be taken to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, or adverse weather conditions and possible contamination will be avoided. Samples collected in Tedlar bags should be stored in an opaque container to reduce the potential for photo chemical degradation. Therefore, immediately following collection, place Tedlar bag samples in a clean box or chest to protect them from damage and exposure to sunlight and transport them to the subcontracted laboratory as soon as possible, or in accordance with the project QAPP to meet holding time criteria.

3.0 DOCUMENTATION

3.1 FIELD DATA SHEETS

A DAILY FIELD RECORD will be completed for each day of fieldwork. Well operating conditions (vacuum or pressure, flow rate, temperature, PID reading, etc.) should be recorded, if possible, on the DAILY FIELD RECORD or another form created for this purpose. Sample identification and other information may be recorded on a SAMPLE CONTROL LOG or in the DAILY FIELD RECORD as a means of identifying and tracking the samples. Original field records will be kept in the project file, after review by the project manager.

3.2 CHAIN-OF-CUSTODY PROCEDURES

After samples have been collected and labeled, they will be maintained under chain-of-custody procedures. These procedures document the holding conditions and transfer of custody of samples from the field to the laboratory. Each sample sent to the laboratory for analysis will be recorded on a CHAIN-OF-CUSTODY RECORD, which will include instructions to the laboratory regarding the analytical services required.

Information contained on the triplicate CHAIN-OF-CUSTODY RECORD will include:

- Project number
- Signature of sampler
- Date and time sampled
- Sample I.D.
- Number of sample containers
- Sample matrix (vapor)
- Analyses required
- Remarks, including preservatives, special conditions, or specific quality control easures
- Turnaround time and person to receive laboratory report
- Release signature of sampler, and signatures of all people assuming custody
- Condition of samples when received by laboratory

Blank spaces on the CHAIN-OF-CUSTODY RECORD will be crossed out between last sample listed and signatures at the bottom of the sheet.

The field sampler will sign the CHAIN-OF-CUSTODY RECORD and will record the time and date at the time of transfer to the laboratory or an intermediate person. A set of signatures is required for each relinquished/received transfer, including transfer within Geomatrix. The original imprint of the CHAIN-OF-CUSTODY RECORD will accompany the sample containers. A duplicate copy will be retained by the field staff and placed in the Geomatrix project file.

If the samples are to be shipped to the laboratory, the original CHAIN-OF-CUSTODY relinquishing the samples will be sealed inside a plastic bag within the ice chest, and the chest will be sealed with custody tape which has been signed and dated by the last person listed on the chain-of-custody. U.S. Department of Transportation shipping requirements will be followed and the sample shipping receipt will be retained in the project files as part of the permanent chain-of-custody document. The shipping company (e.g., Federal Express, UPS, DHL) will not sign the chain-of-custody forms as a receiver; instead the laboratory will sign as a receiver when the samples are received.

Attachments: Daily Field Record
Chain-of-Custody Record
Sample Control Log Sheet

DAILY FIELD RECORD

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Page 1 of ___

Project and Task Number:	Date:
Project Name:	Field Activity:
Location:	Weather:

PERSONNEL: Name	**Company**	**Time In**	**Time Out**

PERSONAL SAFETY CHECKLIST

	Steel-toed Boots		Hard Hat		Tyvek Coveralls
	Rubber Gloves		Safety Goggles		1/2-Face Respirator

DRUM I.D.	**DESCRIPTION OF CONTENTS AND QUANTITY**	**LOCATION**

TIME	**DESCRIPTION OF WORK PERFORMED**

DAILY FIELD RECORD (continued)

Page ____ of ____

Project and Task Number:	Date:

TIME	DESCRIPTION OF WORK PERFORMED

CHAIN-OF-CUSTODY RECORD

Nº

Date:

Page of

Project No.:

Samplers (Signatures):

			ANALYSES																			REMARKS				
Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8020 (BTEX only)	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel													Cooled	Soil (S), Water (W), or Vapor (V)	Acidified	Number of containers	Additional Comments

Turnaround time:

Results to:

Total No. of containers:

Relinquished by (signature):
Date:
Printed Name:
Time:
Company:

Received by (signature):
Date:
Printed Name:
Time:
Company:

Relinquished by (signature):
Date:
Printed Name:
Time:
Company:

Received by (signature):
Date:
Printed Name:
Time:
Company:

Relinquished by (signature):
Date:
Printed Name:
Time:
Company:

Received by (signature):
Date:
Printed Name:
Time:
Company:

Method of Shipment:

Laboratory Comments and Log No.:

Geomatrix

Forms(PF).012b (Revised 12/95)

Geomatrix

SAMPLE CONTROL LOG

Project Name: ______________________________ **Laboratory:** ______________________________

Project and Task No.: ______________________________ Page ____ of ____

Sampling Date	Sampling Time	Sample Number (ID)	C.O.C. Number	Analyses Requested	Turnaround Time, Sample Location, Handling Notes, Chain-of-Custody Remarks, etc. (Duplicate, Blank info, etc.)	Date Sent to Lab	Date Results Due

\\sf3\deptdata\FORMS\ETC & ES\Sample Control Log Form.doc

ATTACHMENT A2

Quality Assurance Project Plan

Final Quality Assurance Project Plan

Former Custom Plywood Mill

Anacortes, Washington

Prepared for:

GBH Investments, LLC
13941 Gibralter Road
Anacortes WA, 98221

Prepared by:

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September 2008

Project No. 10654

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FINAL QUALITY ASSURANCE PROJECT PLAN

Former Custom Plywood Mill
Anacortes, Washington

1.0 INTRODUCTION

Geomatrix Consultants, Inc. (Geomatrix), has prepared this Quality Assurance Project Plan (QAPP) on behalf of GBH Investments, LLC (GBH), to document the planning, implementation, and assessment procedures for quality assurance and quality control (QA/QC) activities associated with the remedial investigation (RI) field activities at the Former Custom Plywood Mill in Anacortes, Washington (site). This QAPP is part of the Uplands Sampling and Analysis Plan (SAP) that is an appendix to the Remedial Investigation/Feasibility Study (RI/FS) Work Plan. The Uplands SAP documents the proposed scope of work and methodologies for further soil and groundwater characterization, and installation of monitoring wells necessary for completion of the RI.

The Geomatrix project manager overseeing the RI/FS work is Mrs. Kathleen Goodman, LG, LHg, and the data validator is Mrs. Crystal Neirby of Geomatrix.

2.0 BACKGROUND AND PURPOSE

The property consists of an irregularly shaped parcel that covers approximately 6.6 acres of upland and 34 acres of tidal areas. The site was used for operation of a sawmill, and later a plywood mill, under various owners from the early 1900s until 1992, when the mill went out of business and the wooden structures burned down.

The purpose of the activities being conducted under the SAP is to fill remaining gaps in data that are needed to complete the RI. Additional details regarding the background and purpose of this project are described in the RI/FS Work Plan.

3.0 PROJECT DESCRIPTION

The RI/FS Work Plan and associated SAP and QAPP are designed to identify remaining gaps in data that are needed to complete the RI for the site and determine what data review and field work tasks are necessary to fill the identified data gaps. The data collection and reporting methodologies are detailed in the SAP.

This objective will be met by collecting soil samples, installing and sampling groundwater monitoring wells, collecting seep samples, and evaluating the data in relation to historical data and the designated preliminary screening levels. Two sets of screening levels are being used – one protective of human health and terrestrial ecological receptors, and the other protective of marine surface water. The field sampling work is described in the SAP.

4.0 DATA QUALITY OBJECTIVES

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in this project. Specific data quality factors that may affect data usability include precision, bias, accuracy, representativeness, comparability, completeness, and reporting limits.

4.1 PRECISION

Precision is the agreement among a set of replicate measurements without assuming knowledge of the true value. Precision is measured for this project by calculating the relative percent difference (RPD) for field duplicate and lab duplicate results. Precision is optimized by collecting data at multiple locations and adhering to strict procedural guidelines that minimize possible sample contamination. RPD results of >50% for soils, or outside control limits if specified by the laboratory, will be assessed as having poor precision and qualified appropriately during data validation.

4.2 BIAS

Bias is the systematic deviation of a measured value from the true value, often due to matrix effects. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample. Bias is minimized for this project by standardizing field activity methodologies, including equipment decontamination, sample collection methods, field observation and documentation, sample transport, and chain-of-custody control. Descriptions of the methodologies are described in the SAP.

4.3 ACCURACY

Accuracy is the degree of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will depend on a combination of random error and of common systematic error (or bias). Accuracy will be evaluated for this project by evaluating laboratory spike sample recoveries that represent the difference between an observed value and an accepted reference value. Control limits for spike recoveries will be specified by the laboratory. Results showing poor accuracy will be qualified appropriately during data validation. Accuracy will be optimized for this project by using procedures designed to reduce potential error that might impact the accuracy of results. Proper decontamination methods and equipment are used during field activities to ensure accurate results. The laboratory QC procedures, described in Section 8.3, also reduce error to improve accuracy.

4.4 REPRESENTATIVENESS

Representativeness is the measure of how well data reflect the actual environment and the conditions under which the data are collected. Representativeness will be optimized for this project by using general historical and investigative information to determine proper locations of new sampling points that represent the areas of concern surrounding the facility. The methodologies used to collect samples and measurements, as detailed in the SAP, are also designed to collect representative data with minimal disturbance of the environment from which they are collected.

4.5 COMPARABILITY

Comparability is how well multiple data sets can be used for a common interpretation. Comparability will be optimized for this project by using the same standards for data collection at each location, and the same analytical procedures and QA procedures that are used during other sampling events at the site.

4.6 COMPLETENESS

Completeness is a measure of the amount of data collected that are found to be valid in relation to the total amount of data intended to be collected according to the sampling design. Completeness will be optimized for this project by having all analytical results validated by an expert data validator to assess the validity of the data and by performing field work in a multi-phased progression so that sufficient data are collected. The data quality objective for completeness for this project is 100%. Completeness below 100% will require review of the sampling objectives in order to determine whether further sampling may be required.

4.7 REPORTING LIMITS

The laboratory's reporting limits must be low enough to compare to potential cleanup levels for the facility. Reporting limit goals for analytical samples will be consistent with the preliminary screening levels in the RI/FS Work Plan.

5.0 SAMPLING DESIGN

The sampling design, including figures showing fieldwork locations and tables of samples to be collected, are included in the SAP.

6.0 FIELD PROCEDURES

Procedures for all field activities are described in the SAP. All field personnel will have completed 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Operations training, as specified in the Final Site-Specific Health and Safety Plan (HASP) (Appendix C of the RI/FS Work Plan).

All instruments used in the collection of samples will be properly calibrated according to the manufacture's recommendations and decontaminated between samples if the instrument is reusable and comes in contact with samples. All samples will be placed in iced coolers immediately following sample collection, and strict chain-of-custody control will be maintained at all times. Samples will be delivered or shipped to OnSite Environmental in Redmond, Washington, as specified in the SAP.

7.0 LABORATORY PROCEDURES

A list of analyses and reporting requirements for this project are provided in Tables 1 and 2. The analytical and QA/AC procedures used by the laboratory are described in Attachment A3 of the SAP.

8.0 QUALITY CONTROL

This section outlines QC procedures to be followed both by the field personnel as well as the analytical laboratory. Following these QC procedures will ensure the development of a complete and accurate data set following laboratory analysis and data validation.

8.1 FIELDWORK QUALITY CONTROL

In this section we describe fieldwork QC procedures for sample identification, sample labeling, and maintenance of field logs.

8.1.1 Sample Identification

Each sample will be assigned a unique alphanumeric identification code (identifier) that contains sufficient information to identify the sample location and date (e.g., "GMX-12-0608" for a sample at location 12 collected in June 2008). The sample identifier will consist of alphanumeric strings separated by hyphens.

Equipment blanks and trip blanks will be named “Equipment Blank” and “Trip Blank,” respectively, and will be uniquely identified by date and time.

8.1.2 Sample Labeling

A label will be securely attached to every sample container. Each label will include the following information:

- sample identifier;
- facility name;
- date and time of collection (using 24-hour time clock to minimize potential confusion about a.m. and p.m.; e.g., “1300” vs. “1:00 p.m.”); and
- analyses to be performed.

8.1.3 Field Log Maintenance

All sample location descriptions, sample identifiers, and analyte lists will be recorded in the field log. The field log will record, but not be limited to, the following information:

- all incidents observed during each sampling event;
- the names of all personnel on site involved in the sampling event;
- the major events that occurred during the day;
- details about field procedures conducted; and
- details about samples collected or problems that occurred.

Procedures for maintaining the field log are described in the Geomatrix Field Protocols (Attachment A1 of the SAP).

8.2 SAMPLE HANDLING

In this section we describe QC procedures for sample handling, including specifications for sample containers and preservatives, sample storage and transportation, and chain-of-custody.

8.2.1 Sample Containers and Preservatives

Tables 1 and 2 list the analyses to be performed on all samples. All sample containers will be provided by the laboratory and will include the appropriate preservatives.

Sample containers will be placed in opaque, insulated coolers that are packed with ice to minimize their exposure to light and to cool them approximately to the recommended temperature. The coolers will be packed with sufficient packing material to prevent sample container breakage and/or leakage during transport.

The project leader and field personnel will plan sampling activities, and coordinate sample delivery with laboratory personnel, so that the sample holding time limits and temperatures specified in Tables 1 and 2 are not exceeded.

8.2.2 Sample Storage and Transportation

The exteriors of all sample containers will be wiped clean after they have been closed. Blank samples will be packaged with the regular samples that they control. Any vacant space in the cooler will be filled with ice or packing material. If the cooler has a drain, it will be taped shut. Then each cooler will be secured.

8.2.3 Sample Chain of Custody

Chain-of-custody (COC) procedures will be followed by all project personnel to document sample transfer, sample possession, and sample integrity, from the time of sample collection through the completion of sample analysis. A COC form will be initiated at the time of sampling, and will accompany the samples at all times until sample analysis is complete. The COC form has blank fields for entering the sample identifier, the date and time of sample collection, the name of the person who collected the sample, and the requested laboratory analyses. Each COC form will be signed by every person who handles the sample containers. Sample transfers will be noted on the COC form for each sample.

The COC form documents sample identifications, locations, sample times, and the analyses required for each sample. This is the only document shared by the sample generator and the laboratory. Therefore accuracy and completeness are extremely important. Personnel initiating the COC form will refer to the field forms and the field log (described below) to access the required information. This continuity will help to insure that the various forms of documentation are consistent and reduce the risk of transcription error. The COC form will accompany all samples during transport. The field sampler also will keep a copy of the COC form for the project file.

All samples will be delivered directly to those laboratory personnel who are authorized to receive samples (sample custodians). When the laboratory receives the samples, the sample custodian will inspect the condition of the shipping container's exterior. Then the sample custodian will open and examine the interior of the shipping container. Next the sample custodian will examine the sample containers and check the contents of the shipping container against the COC form. The sample custodian will record any inconsistencies or problems with the sample shipment (breakage or signs of leakage, and missing or extra samples) on the COC record, and notify the Geomatrix project manager for immediate resolution. Official acceptance of sample custody will be documented by the sample custodian's signature on the COC form. The samples will then be tracked through the laboratory by the laboratory's internal custody procedures.

8.3 ANALYTICAL LABORATORY QUALITY CONTROL

The chemical analysis laboratories use the following QC procedures to verify the validity of data being produced:

- Holding times;
- Instrument tuning;
- Initial calibrations and continuing calibration verification;
- Method blanks;
- Surrogate spike compounds;
- Matrix spike samples and matrix spike duplicates (MS/MSD);
- Laboratory control samples (LS);
- Laboratory duplicates (LD); and

- Internal standards.

Details are provided in the laboratory Quality Assurance Manual for the laboratory provided in Attachment A3 of the SAP.

8.4 FIELD QC SAMPLES

Field QC samples are collected and analyzed to assess sample collection techniques, possible sources of contamination, interferences that may be attributed to the sample matrix, and, to some degree, the bias and precision of the reported results. Field QC will be evaluated, along with laboratory QC, by the independent data validator during data review and validation. Affected data will be qualified in accordance with U.S. Environmental Protection Agency (EPA) Contract Laboratory Guidelines (EPA, 1999 and 2002). A description of each type of QC sample is described below. For the purpose of this discussion, the term “regular sample” is defined to be a field sample of environmental medium (e.g., soil) other than a field QC sample.

Multiple sample locations have been selected for this project to produce more representative data for the site and high-quality results.

8.4.1 MS/MSD

Extra sample volume must be collected to enable the lab to run this lab QC procedure. MS/MSD sample volume is collected at a rate of one per 20 samples collected, or one per field mobilization at a minimum, and is noted on the COC form. MS samples are analyzed to assess the effects of the sample matrix on the accuracy of analytical measurements. MSD samples are used to assess both accuracy and precision.

8.4.2 Equipment Rinsate Blanks

Equipment blanks are used to assess potential contamination of the equipment used in sampling. Equipment blanks will be collected at a rate of one per groundwater sampling event and used to assess potential contamination coming from the sampling equipment or insufficient decontamination methods. Equipment blanks are collected by filling a set of sample bottles with clean deionized water, supplied by the laboratory, that has been run over the decontaminated sampling equipment before passing into the sample containers.

8.4.3 Trip Blanks

Trip blanks will be collected at a rate of one per day for all volatile (e.g., BTEX) analyses in groundwater and are used to assess potential contamination that may impact groundwater samples during transport. Trip blanks consist of a sample container that comes from the laboratory full of clean deionized water. Trip blanks remain sealed during sampling and are kept in the sample transport container at all times.

8.4.4 Field Duplicates

Field duplicates for water samples are used to assess the homogeneity of samples collected in the field and the precision of sampling methods. Field duplicates will be collected at a rate of one per groundwater sampling event. Field duplicates are collected by filling a second set of sample containers from the same location as a regular sample, using the same sampling methods and equipment.

9.0 DATA MANAGEMENT PROCEDURES

The sampling and reporting schedule is described in the associated RI/FS Work Plan and Uplands SAP. The laboratory will deliver final data within approximately 30 days of the end of sampling, unless a shorter turnaround time is requested. Geomatrix will validate the chemical data within approximately 30 days of receipt from the laboratory. Data transfer will be performed using electronic data deliverables (EDDs), beginning with laboratory reports and including data validation activities.

9.1 LABORATORY DATA REPORTS

OnSite Environmental will complete all analyses as described in the SAP and present the following, at a minimum, in a report to Geomatrix within approximately 30 days of the last day of sampling, unless a shorter turnaround time is requested.

- Case narrative: The case narrative should describe the analytical methods used and discuss any irregularities encountered during sample analyses and any resulting data qualification.

- Analyte concentrations: A summary of analyte results should be presented for each sample.

- Method reporting limits: Method reporting limits achieved by the laboratory should be presented with the analyte concentrations.

- Laboratory data qualifier codes and a summary of code definition: Data qualifiers should appear next to analyte concentrations and associated definitions should be summarized in the report.

- Lab QC results: Results for method and calibration blanks, MS/MSD, LS/LD, and surrogate recoveries should be provided with final results.
- EDD version of results: A full set of results should be provided in database format.

10.0 REPORTS

As described in Section, 9.0, all data will be independently validated before upload into the project database. All laboratory results reports and data validation reports will be provided as part of a technical memorandum to the Department of Ecology (Ecology). Tabulated data produced from the project database may also be presented to facilitate data interpretation.

11.0 DATA REVIEW, VERIFICATION, AND VALIDATION

Geomatrix will be in charge of planning all field activities. Field forms, EDDs, and COCs will be reviewed by the project manager after the field work is completed. The forms will be checked to determine if the field staff followed all aspects of the SAP and QAPP methodologies, and any deviations from the specified procedures will be noted. Specifically, the forms will be reviewed for:

- correct documentation of sample location;
- complete and accurate procedures for sample collection or measurement and proper documentation;
- proper COC methodology, including sample shipment and preservation during transport; and
- evaluation of field QC results; field QC sample contamination could result in data qualification.

The analytical laboratories will complete a data review and verification prior to producing results. This verification will include checking that QC procedures were included at the required frequencies and that the QC results meet control limits as defined in the laboratory's Quality Assurance Manual (Attachment A3 to the SAP). Any QA issues found by the lab will be described in the case narrative and may result in qualification of some of the results by the laboratory. After receiving all results from the laboratory, the data validator will prepare an abbreviated data validation report in accordance with EPA Contract Laboratory Guidelines (EPA 1999 and 2002) and review 100% of the concentration data. The report will provide a summary evaluation of:

- COC;

- case narrative;
- analytical holding times;
- laboratory and field/equipment blank contamination;
- System monitoring compound (SMC)/surrogate compounds recoveries;
- MS and LS recoveries; and
- laboratory duplicate sample or MSD results.

12.0 DATA QUALITY ASSESSMENT

The objectives of the RI/FS Work Plan and associated SAP and QAPP will be reviewed as data are received and used for reporting and other interpretive purposes. Data that do not meet the data quality requirements as described in the RI/FS Work Plan, SAP, and QAPP will be qualified or rejected during data validation. Rejected data will not be used for any purpose.

13.0 REFERENCES

EPA (U.S. Environmental Protection Agency), 1999, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA540/R-99/008, October.

EPA, 2004, USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Data Review, EPA 540-R-04-004, October.

TABLES

TABLE 1

SOIL ANALYSIS LIST AND REPORTING LIMITS

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Analytical Method[1]	Reporting Limit (mg/kg)[2]	Sample Container	Preservation Temperature	Holding Time
PCBs[3]	EPA 8082	0.05	8-oz. jar	4°C	extraction: 14 days; analysis: 40 days after extraction
Benzo(a)anthracene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Benzo(a)pyrene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Benzo(b)fluoranthene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Benzo(k)fluoranthene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Chrysene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Dibenzo(a,h)anthracene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
Indeno(1,2,3-cd)pyrene	EPA 8270	0.033	8 oz. wide-mouth glass jar	4°C	14 days
TPH - diesel	Ecology NWTPH-Dx	25	4 oz. wide-mouth glass jar	4°C	14 days
TPH - motor oil	Ecology NWTPH-Mo	50	4 oz. wide-mouth glass jar	4°C	14 days
TPH-G[4]/BTEX[5]	Ecology NWTPH-G; EPA 8021B	TPH-G 5.0 Benzene 0.02	4 x 40-mL vial	4°C	14 days if preserved or frozen, 2 days if unpreserved
Extractable Petroleum Hydrocarbons	Ecology Method EPH	2.0	8 oz. wide-mouth glass jar	4°C	14 days
Volatile Petroleum Hydrocarbons	EPA 5035A	5.0	4 x 40-mL vial	4°C	14 days if preserved or frozen, 2 days if
Volatile Organic Compounds	EPA 8260B/ EPA 5035	varies	4 x 40-mL vial	4°C	14 days
Antimony	EPA 6010B	5.0	4 oz. wide-mouth glass jar	4°C	6 months
Arsenic	EPA 6010B	10	4 oz. wide-mouth glass jar	4°C	6 months
Barium	EPA 6010B	2.5	4 oz. wide-mouth glass jar	4°C	6 months
Beryllium	EPA 6020	0.8	4 oz. wide-mouth glass jar	4°C	6 months
Cadmium	EPA 6010B	0.5	4 oz. wide-mouth glass jar	4°C	6 months
Chromium	EPA 6010B	0.5	4 oz. wide-mouth glass jar	4°C	6 months

TABLE 1

SOIL ANALYSIS LIST AND REPORTING LIMITS

Former Custom Plywood Mill
Anacortes, Washington

Analyte	Analytical Method[1]	Reporting Limit (mg/kg)[2]	Sample Container	Preservation Temperature	Holding Time
Chromium (VI)[6]	SM3500 Cr-D[7]	1	4 oz. wide-mouth glass jar	4°C	28 days
Copper	EPA 200.7/6010	0.5	4 oz. wide-mouth glass jar	4°C	6 months
Lead	EPA 7421	5	4 oz. wide-mouth glass jar	4°C	6 months
Mercury	EPA 7471A	0.025	8 oz. wide-mouth glass jar	4°C	analysis: 28 days
Nickel	EPA 200.7/6010	2.5	4 oz. wide-mouth glass jar	4°C	6 months
Selenium	EPA 6020	0.78	4 oz. wide-mouth glass jar	4°C	6 months
Silver	EPA 6020	0.61	4 oz. wide-mouth glass jar	4°C	6 months
Thallium	EPA 200.8/6020	0.25	4 oz. wide-mouth glass jar	4°C	6 months
Zinc	EPA 200.7/6010	2.5	4 oz. wide-mouth glass jar	4°C	6 months
Total Organic Carbon	Plumb, 1981[8]	200	4 oz. wide-mouth glass jar	4°C	14 days
Semivolatile Organic Compounds	EPA 8270	varies	8 oz. wide-mouth glass jar	4°C	14 days
Phenols	EPA 8270D	0.033	4 oz. wide-mouth glass jar	4°C	14 days
Dioxins and Furans	EPA 8290A	varies - TCDD 1 ng/kg[9]	4 oz. wide-mouth glass jar	4°C	30 days

Notes:

1. Method numbers refer to EPA SW-846 or other EPA-approved analytical methods; Washington State Department of Ecology analytical methods; or as noted.
2. Reporting limits based on wet weight and will be slightly higher on a dry weight basis, including matrix interference; mg/kg = milligrams per kilogram or parts per million.
3. PCBs = Polychlorinated biphenyls.
4. TPH-G = Total petroleum hydrocarbons as gasoline.
5. BTEX = benzene, toluene, ethylbenzene, and xylenes. RLs for benzene may be elevated due to high moisture content.
6. Samples that contain concentrations of chromium above MTCA Method B cleanup levels may be analyzed for hexavalent chromium, as determined by the task manager.
7. Standard Methods for Examination of Water and Wastewater.
8. Plumb, R.J., Jr., 1981, Procedures for Handling and Chemical Analysis of Sediment and Water Samples, Technical Report EPA/CE-81-1, U.S. Army Corps of Engineers, Vicksburg, MS.
9. ng/kg = nanograms per kilogram or parts per trillion.

TABLE 2

GROUNDWATER ANALYSIS LIST AND REPORTING LIMITS

Former Custom Plywood Mill
Anacortes, Washington

Analyte[1]	Analytical Method[2]	Reporting Limit (µg/L)[3]	Sample Container	Preservation Temperature	Holding Time
TPH-G/BTEX	Ecology NWTPH-Gx	100/1	40 mL VOA[4]	4°C	14 days
TPH - diesel	Ecology NWTPH-Dx	250	500 mL glass	4°C	7 days to extract, 40 days after extraction
TPH - motor oil	EPA 1664	400	1 liter glass	4°C	28 days
PCBs[6]	EPA 8082	0.03	2 x 500 mL glass	4°C	7 days
SVOCs	EPA 8270	varies	2 x 500 mL glass	4°C	7 days
VOCs	EPA 5035	varies	4 x 40-mL vial	4°C	14 days
antimony	EPA 6010B or 6020	100	500 mL poly	4°C	6 months
arsenic	EPA 6020	1.0	500 mL poly	4°C	6 months
barium	EPA 6020	50	500 mL poly	4°C	6 months
beryllium	EPA 200.8	4	500 mL poly	4°C	6 months
cadmium	EPA 6020	4.4	500 mL poly	4°C	6 months
chromium	EPA 6010B or 6020	10	500 mL poly	4°C	6 months
chromium(VI)[5]	EPA 7196A	10	500 mL poly	4°C	24 hours
copper	EPA 6010B or 6020	3.0	500 mL poly	4°C	6 months
lead	EPA 6020	1.0	500 mL poly	4°C	6 months
mercury	EPA 7471A	0.125	500 mL poly	4°C	28 days
nickel	EPA 6020	8	500 mL poly	4°C	6 months
selenium	EPA 6020	5.6	500 mL poly	4°C	6 months
silver	EPA 6020	8	500 mL poly	4°C	6 months
thallium	EPA 6020	5.6	500 mL poly	4°C	6 months
zinc	EPA 6010B or 6020	50	500 mL poly	4°C	6 months

Notes:

1. TPH = Total petroleum hydrocarbons;
   TPH-G = Total petroleum hydrocarbons as gasoline;
   BTEX = benzene, toluene, ethylbenzene, and xylenes;
   PCBs = Polychlorinated biphenyls;
   SVOCs = Semivolatile organic compounds;
   VOCs = Volatile organic compounds.
2. Method numbers refer to SW-846 EPA Analytical Methods or Washington State Department of Ecology analytical methods.
3. µg/L = micrograms per liter.
4. VOA = volatile organic analysis.
5. Samples that contain concentrations of chromium above MTCA Method B cleanup levels may be resampled for hexavalent chromium as determined by the task manager.
6. Reporting limits for Aroclor 1016 and 1221 may be 0.05 due to instrument constraints.

ATTACHMENT A3

OnSite Environmental Laboratory Quality Assurance Manual

QUALITY ASSURANCE MANUAL

Revision No. 9.1
January 28, 2004

OnSite Environmental Inc.
14648 NE 95th Street
Redmond, Washington 98052
(425) 883-3881

Approved By:
Kelley Wilt
Laboratory QA/QC Officer
Date

Approved By:
Karl Hornyik
Laboratory Manager
Date

Approved By:
Robert Wallace
President/Technical Director
Date

Copy No.: ____________________

Issued To: ____________________

Date Issued: ____________________

Revision History

Origination Date: **Unknown**

Revisions 1.0 through 8.0
The status of the electronic files and originals of these versions is unknown.

Revision 8.1 (February 26, 2002)
A copy of this revision is filed in the QA/QC files. The electronic copy is on the server and has been backed up.

Revision 9.0 (August 28, 2003)
The Quality Assurance Manual underwent significant major upgrade in response to an EPA review, which noted many deficiencies in the document. The NELAC Manual was used to insure the Quality Assurance Manual more fully addressed the issues that regulators and clients would be looking for in our Quality Assurance Manual and to anticipate possibly getting accredited under NELAC in the near future.

Revision 9.1 (January 28, 2004)
The Quality Assurance Manual underwent the annual review. The organization chart, instrument list, and SOP list were updated to reflect changes since the last revision.

Table of Contents

Appendices

1.0 Quality Assurance Policy and Objectives

1.1 Mission Statement

OnSite Environmental Inc. provides high quality and timely chemical analyses to primarily environmental, engineering and industrial clients.

1.2 Core Values

At OnSite Environmental Inc. we hold the following principles and values to be the most important, and we consider these values in making decisions in our business:

- Honesty
- Safety of our employees and community
- Good science
- Fairness, and
- Quality

1.3 Ethics Policy

Ethics is a set of moral principles, a code of right and wrong, or behavior that conforms to accepted professional practices.

Fraud is an intentional act of deceit that may result in legal prosecution. Unethical actions become fraudulent when a law is violated. For example, it is unethical to change the acquisition date of a file for a chromatogram to meet holding times. It becomes fraud when the results are mailed or faxed to the client (wire fraud or mail fraud).

All employees at all times shall conduct themselves in an honest and ethical manner. Compliance with this policy will be strictly enforced. Unethical behavior is grounds for immediate termination.

Examples of unethical behavior include, but are not limited to the following:

- Artificially fabricating results
- Misrepresenting data such as peak integration, calibration, tuning, or system suitability
- Improper clock settings to meet holding times
- Intentional deletion of non-compliant data
- Improper manipulation of data or software
- Improper handling of data errors, non-compliant data, or QC outliers
- Lack of reporting unethical behavior by others

An employee must report any suspected unethical behavior or fraudulent activities to one of the following management representatives: Robert Wallace, Technical Director; Karl Hornyik, Laboratory Manager; or Kelley Wilt, Laboratory QA/QC Officer. If an employee wishes to remain anonymous, they may choose to describe the situation in an unsigned note to one of the above representatives. If the facts of the case are not clear after an investigation, a committee of senior employees may be asked to investigate the situation further and offer an opinion to the owners of the corporation.

1.4 Standards of Conduct

Our standards are those generally expected of employees in any professional business organization. Employees engaged in any of the following activities, or others deemed equally serious, will forfeit all benefits of employment:

- Theft or embezzlement
- Willful violation of safety or security regulations
- Conviction of a felony
- Working for a competitor
- Establishing a competing business
- Being intoxicated or under the influence of drugs or alcohol while at work
- Possession of drugs on the job
- Falsification of records
- Abuse, destruction, waste or unauthorized use of equipment, facilities or materials
- Gambling while on premises
- Chronic tardiness or absenteeism
- Breech of company or client confidentiality

This list of offenses is to highlight general company expectations and standards and does not include all possible offenses or types of conduct that will result in discipline or discharge. Management reserves the absolute right to determine the appropriate degree of discipline, including discharge, warranted in individual cases.

There may be no alcoholic beverages on the company premises, other than at times designated as company functions. At such times, non-alcoholic beverages will be provided as well.

Company policy requires employees to have no relationships or engage in any activities that might impair their independence or judgement. Employees must not accept gifts, benefits or hospitality that might tend to influence them in the performance of their duties. It is expected that there will be no employment by any competing company, nor any employment by any outside interest or engaging in any outside activity that might impair an employee's ability to render full time service to OnSite Environmental Inc.

1.5 Confidentiality

During the course of business, employees are privy to data or information considered confidential or proprietary by our clients. This information includes, but is not limited to, test results, origin of samples, business relationship with client, any procedures and processes that they conduct or investigate, information about their business, our own laboratory procedures, and clients. All such information is kept strictly confidential and discussed only with corporate officers for the client's company. **The information will not be discussed with anyone**, even those within the client's company not designated as a contact, without prior permission from the client.

We are often contacted by government agencies or consultants hired by our clients. Without express permission, we only discuss the test methods or QC limits, and then solely if it is obvious from the conversation that the caller has a copy of the original report. Any discussion of the information listed in the above paragraph requires written permission from the designated contact. Permission by the designated contact may be granted by phone and should be followed in writing.

1.6 Complaint Resolution

Anytime a serious complaint is received, it is recorded in a permanent record so it can be tracked to insure resolution and brought to the attention of management.

A serious complaint is one that questions the validity of our results. Standard Operating Procedure 1.13 addresses the steps taken to document and resolve the complaint. In general, the nature of the complaint is documented and then given to the President or Technical Director. Someone is assigned to resolve the issues. The progress of the complaint is tracked during weekly staff meetings. Finally, after resolution, the complaint is fully documented and kept in the Laboratory QA/QC Officer's files for future reference.

1.7 Objectives

The overall objective of the quality assurance program for OnSite Environmental Inc. is to provide legally defensible analytical data that meet or exceed customer and regulatory requirements. To accomplish this, the following are done.

- Maintain appropriate chain of custody of samples submitted to the laboratory.
- Maintain an effective, on-going quality control program to measure and verify laboratory performance.
- Monitor daily operational performance of the laboratory and provide timely corrective action for out of control events.
- Track corrective actions for resolution and appropriateness.
- Meet data requirements for accuracy, precision and completeness.
- Maintain traceability of measurements.
- Maintain complete records of data and reports generated by the laboratory.
- Provide sufficient flexibility to allow controlled changes in routine methods and Standard Operating Procedures to meet specific client data quality objectives.
- Maintain a data review process.
- Train employees in good analytical technique and in requirements of Standard Operating Procedures they are responsible to perform.

In order to facilitate these objectives, OnSite Environmental Inc. uses four controlled types of documents to establish the steps necessary to achieve these objectives.

Quality Assurance Manual (QAM) -- The primary Quality Control/Quality Assurance document for the laboratory is the Quality Assurance Manual. This manual provides an overview of the entire quality assurance program for OnSite Environmental Inc. The President/Technical Director, Laboratory Manager and Laboratory QA/QC Officer must approve the Quality Assurance Manual. The Quality Assurance Manual will be reviewed and revised, if necessary, at least annually.

Standard Operating Procedures (SOP) – Standard Operating Procedures document in sufficient detail the steps necessary to reproduce specific tasks within the laboratory. They are written to insure consistency from employee to employee and from day to day. They also serve as excellent training and reference documents for new employees. The author of the SOP, the Laboratory Manager and the Laboratory QA/QC Officer must approve Standard Operating Procedures. Each SOP will be reviewed and revised, if necessary, at least annually.

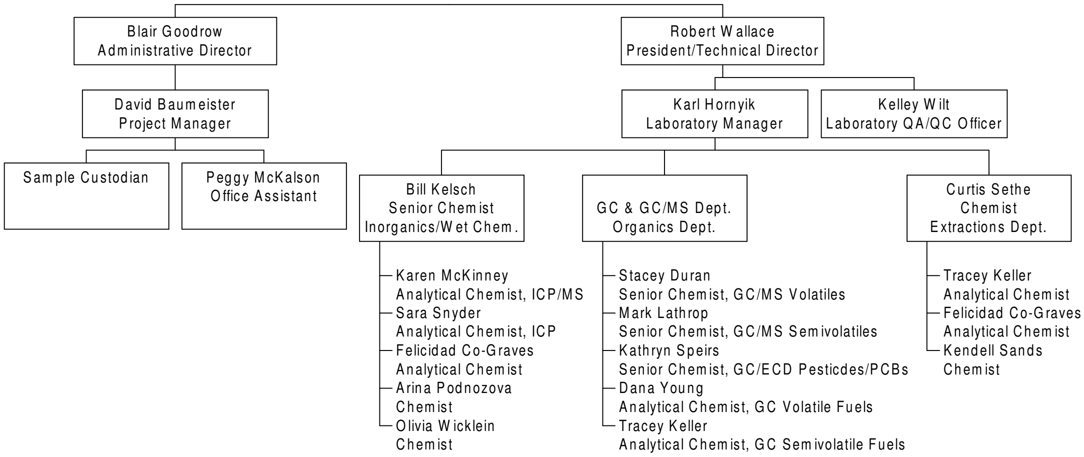
Laboratory Notebooks – Laboratory notebooks are used to document critical measurements and information such as sample weights, sample volumes, extract final volumes, dilutions, standard preparations, instrument maintenance, refrigerator, pipette and balance calibration and verification activities etc. These bound notebooks are controlled documents that are tracked by the Laboratory QA/QC Officer. The procedure for controlling, maintaining and reviewing Laboratory Notebooks can be found in Standard Operating Procedure 1.01.

Quality Assurance Project Plans (QAPP) – These documents are typically created and provided by our clients. These documents may detail specific data quality objectives that are to be met for a specific client project. Since these data quality objectives may differ from what is internally defined by OnSite Environmental's QA/QC program, it is absolutely required that the QAPP be submitted to OnSite Environmental Inc. for approval before work is started at the laboratory so that we can determine if the data quality objectives can be met and what, if any, changes need to be made in our Standard Operating Procedures, QA/QC program or reporting process to achieve these data quality objectives. OnSite Environmental Inc. will not be responsible for external data quality objectives that are not achieved unless we have approved a written QAPP prior to the beginning of the project. **Clients that submit work to us without an approved written QAPP specifically agree to the data quality objectives specified by OnSite Environmental's internal QA/QC program.**

2.0 Organization and Personnel

2.1 Organization

The organization of the laboratory personnel is organized in the following manner:



2.2 Job Descriptions and Quality Assurance Responsibilities

The following positions are presently defined at OnSite Environmental Inc. Resumes of the key management positions can be found in Appendix A. Although the minimum requirements are desirable, equivalent education, experience or demonstrated transferable skills may be substituted for the requirements at the discretion of the Technical Director.

<u>President/Technical Director</u>

Requires a minimum of a BA or BS in chemistry or related scientific field and at least eight years of laboratory experience. Management experience is highly desirable.

The Technical Director is ultimately responsible for the entire laboratory and the implementation of the quality assurance program.

The Technical Director shall certify that personnel with appropriate educational and/or technical background perform all tests for which the laboratory is accredited. Such information shall be documented.

Administrative Director

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least three years of management experience.

The Administrative Director is responsible for the front office activities, which include:

- Client services
- Payroll
- Personnel
- Purchasing
- Accounts payable
- Accounts receivable
- Contract administration.

Laboratory Manager

Requires a minimum of a BA or BS in chemistry or related scientific field and at least five years of laboratory experience at the analyst level. Management experience is highly desirable. The Laboratory Manager reports directly to the President/Technical Director.

The Laboratory Manager is responsible for:

- Manage and help laboratory staff with production issues such as work schedules, workloads, instrument troubleshooting, and reporting of data.
- Implement and supervise the quality assurance program.
- Supervise and maintain the data review processes.
- Perform Tier II data reviews.
- Train staff.

Laboratory QA/QC Officer

Requires a minimum of a BA or BS in chemistry or related scientific field and at least four years of laboratory experience at the analyst level. Experience in data validation, statistics or previous QA/QC experience is highly desirable. The Laboratory QA/QC Officer reports directly to the President/Technical Director.

The Laboratory QA/QC Officer shall:

- Serve as the focal point for QA/QC and be responsible for the oversight and review of quality control data.

- Have functions independent from laboratory operations for which one has quality assurance oversight.
- Be able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence.
- Have documented training and experience in QA/QC procedures.
- Have a general knowledge of the analytical test methods for which data review is performed.
- Arrange internal laboratory audits at least annually.
- Arrange for performance evaluations and maintaining accreditations.
- Notify laboratory management of deficiencies in the quality assurance program and monitor corrective action.
- Maintain QA/QC documents and reports.
- Monitor complaints and corrective actions for resolution.
- Assist Laboratory Manager with Tier II data reviews.

Project Manager

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least one year of laboratory experience at the analyst level. The Project Manager reports directly to the Administrative Director except for technical issues, which should be directed to the Technical Director, Laboratory Manager and/or Laboratory QA/QC Officer as appropriate.

Typical duties of the Project Manager include:

- Work with clients on establishing the analytical scope of each client project.
- Review client data quality objectives to make sure we can meet them.
- Initiate specialized work plans for projects under QAPP guidance.
- Supervise the purchasing, preservation and shipment of bottles and containers for client projects.
- Supervise the Sample Custodian in receiving and maintaining proper chain of custody procedures of incoming samples.
- Coordinate sample testing within holding time and turn around time restrictions within the laboratory.
- Coordinate subcontracting of analytical work to other laboratories.
- Perform Tier III data reviews.
- Coordinate preparation of preliminary and final reports and electronic data deliverables.

Senior Chemist

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least three years of laboratory experience at the analyst level. Experience and training may be substituted for educational requirements. Senior Chemists report directly to the department supervisor or the Laboratory Manager.

Senior Chemists duties include:

- Help extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Document non-conformances.
- Perform Tier I and Tier II data reviews.

- Troubleshoot and repair analytical equipment.
- Develop new methods.

Analytical Chemist

Requires a minimum of a BA or BS, preferably in chemistry or other scientific field, and at least one year of laboratory experience. Experience and training may be substituted for educational requirements. Analytical Chemists report to their department supervisor or to the Laboratory Manager in the absence of a department supervisor.

Analytical Chemists duties include:

- Help extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Perform Tier I data reviews.
- Document non-conformances.

Chemist

Requires a minimum of a high school diploma and preferably at least one year of college chemistry. Chemists report to the department supervisor or to the Laboratory Manager in absence of a department supervisor.

Chemist duties typically include:

- Extract or digest samples.
- Maintain and calibrate instruments.
- Prepare and analyze samples.
- Process and report data.
- Perform Tier I data reviews.
- Document non-conformances.

Sample Custodian

Requires a minimum of a high school diploma. The Project Manager supervises the Sample Custodian.

Sample Custodian duties include:

- Log in samples maintaining proper chain of custody protocols.
- Document non-conformances.
- Maintain sample storage facilities.
- Coordinate sample disposal.
- Pack and ship sample containers to clients.
- Assist Project Manager and Administrative Director in their duties.

Office Assistant

Requires a minimum of a high school diploma. The Project Manager supervises the Office Assistant.

Office Assistant duties include:

- Create reports from submitted sample data.
- Assist Project Manager and Administrative Director in their duties.

2.3 Personnel Training

OnSite Environmental Inc. has a formal training program covered in Standard Operating Procedure 1.06. In general, employees are familiarized with the Quality Assurance Manual, the Health and Safety Manual, the Employee Manual, and the Standard Operating Procedures they are expected to perform. A tour of the laboratory is given with attention given to the safety features of the laboratory such as fire extinguishers, first aid kits, eye wash stations, spill kits, fire escapes, etc.

Training in first aid and CPR is offered to the employees occasionally to make sure most employees have current certifications.

A training record is kept for each employee documenting when and what training has been received by the employee and by whom the training was given.

Each chemist must also pass a Demonstration of Capability procedure to document that they can achieve acceptable precision and accuracy from their technique with each of the technical Standard Operating Procedures they perform.

Employees are encouraged to attend external training courses to further their knowledge of analytical chemistry. Employees should contact the Technical Director for what steps they need to take to coordinate time off and reimbursement if the suggestion is approved.

2.4 Quality Assurance Document Control, Distribution and Revision

The Quality Assurance Manual, Standard Operating Procedures and Laboratory Notebooks are controlled documents. The revision history and distribution of these documents must be recorded using the Standard Operating Procedure 1.07 used to control documents. The Laboratory QA/QC Officer is responsible for document control.

Uncontrolled versions of these documents are acceptable but the distribution and revision distributed must also be documented as discussed in SOP 1.07. Only the Technical Director, Laboratory Manager and Laboratory QA/QC Officer may authorize the release of controlled documents.

Standard Operating Procedure 1.00 details the process required to create, review, revise, promulgate, retire and archive Standard Operating Procedures.

Standard Operating Procedure 1.01 details the process required to create, promulgate and archive Laboratory Notebooks and to do a QA/QC review of their contents.

The Quality Assurance Manual and appropriate Standard Operating Procedures are distributed by the Laboratory QA/QC Officer to each department for access by all employees.

2.5 Quality Assurance Assessments

2.5.1 Internal Audits

The Laboratory QA/QC Officer manages internal audits at two levels. A monthly audit is performed using Standard Operating Procedure 1.14 and an annual audit is performed using Standard Operating Procedure 1.15.

In general, the monthly audit consists of a random 10% QA/QC review of the reports generated from the previous month. Spot checks on these reports generally focus on issues related to the normal production procedures associated with the processing of samples within the laboratory such as:

- Check in and acceptance of sample into laboratory
- Storage temperature and location of client samples
- Sample extraction SOPs followed correctly
- Samples analyzed using correct SOP procedures
- Initial Calibration, Initial Calibration Verification and Continuing Calibration Verifications performed properly
- Quality Control limits met for precision and accuracy
- Non-conformances documented properly
- Corrective actions on non-conformances appropriate
- Data review process followed
- Raw and electronic data properly documented, gathered and archived
- Report generated correctly and without transcription errors
- Case narrative included and adequately addresses any issues with data

A report of any deficiencies and issues found during the audits will be submitted to the Technical Director, Administrative Director, Laboratory Manager and Project Manager. A copy of the report will be maintained in the Laboratory QA/QC Officer's files. The Laboratory Manager is required to address any deficiencies and document their resolution.

The annual audit is a more thorough look at all QA/QC operations for the laboratory. This audit is to occur in January of each year following Standard Operating Procedure 1.15. Following the audit, the Laboratory QA/QC Officer shall prepare a report summarizing the results of the annual audit and the monthly audits from the previous year. The report will be presented to management for the management review process.

2.5.2 Managerial Review

In February of each year, the Technical Director, Administrative Director, Laboratory Manager, Laboratory QA/QC Officer and Project Manager will hold a meeting to conduct a review of its quality system and its testing and calibration activities to ensure its continuing suitability and effectiveness and to introduce any necessary changes or improvements in the quality system and laboratory operations. The review shall take account the outcome of recent internal audits, performance audits, any changes in the volume and type of work undertaken, feedback from clients, corrective actions and other relevant factors. This procedure is covered in more detail in Standard Operating Procedure 1.16. The results from this meeting shall be documented and a copy of the report shall be kept in the Laboratory QA/QC Officer's files. The Laboratory Manager is required to address and document the resolution of any deficiencies.

2.5.3 Performance Audit

Performance audits are typically performed as part of the accreditation process. The audit can include three different activities including performance evaluation samples, reviews of QA/QC documents such as the Quality Assurance Manual and Standard Operating Procedures and onsite audits by the accrediting authority. The Technical Director, Laboratory Manager or Laboratory QA/QC Officer may also order a single blind or double blind performance evaluation if they feel it would be helpful in identifying QA/QC problems within the laboratory. The performance audit process is covered in Standard Operating Procedure 1.17. The report of any performance audits shall be kept in the QA/QC Officer's files and the Laboratory Manager is required to address and document the resolution of any deficiencies.

2.5.4 Audit Review/Corrective Actions

The review and corrective action process is included as part of the Internal Audit, Management Review and Performance Audit Standard Operating Procedures 1.15, 1.16 and 1.17. Standard Operating Procedure 1.18 details the process for documenting non-conformances and the associated corrective action.

3.0 Facilities and Equipment

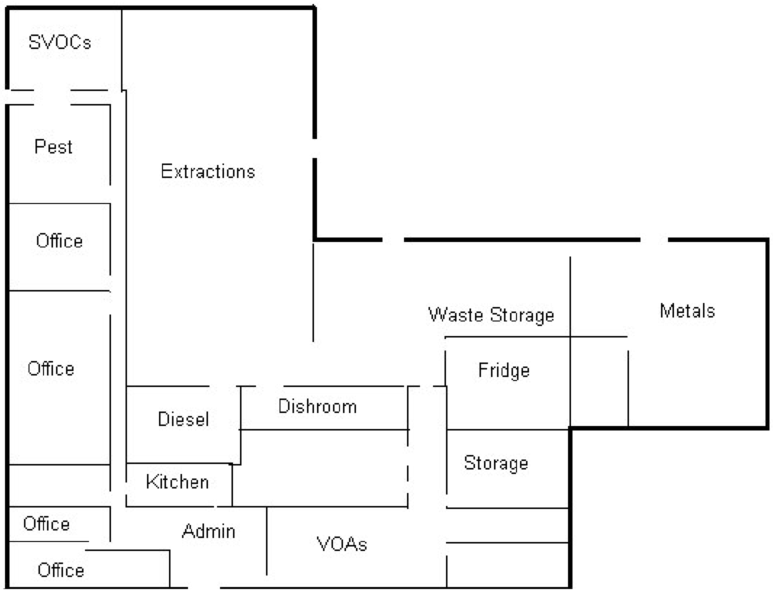
3.1 Facility Description

OnSite Environmental Inc. is located at 14648 NE 95th Street, Redmond, Washington 98052. This facility supports all normal laboratory operations.

The volatiles department has its own HVAC system that is independent from the extractions lab, semivolatiles labs and inorganic lab.

Zoned heating and air-conditioning maintain temperature within the laboratory. Temperature is generally set for employee comfort at normal room temperature of 68-72 °F. If a specific test method requires a controlled temperature, humidity or other environmental control, such controls can be found in the individual test Standard Operating Procedure.

Floorplan



3.2 Instrumentation and backup alternatives

All GC and GC/MS departments have back-up instrumentation. The metals department uses the ICP/MS to backup all functions of the ICP. The ICP can partially backup the ICP/MS; however, it cannot achieve the ultra low detection limits of this instrument.

GC Volatiles

Daryl:	GC Serial #3235A46317 Hewlett Packard 5890 Series II GC/PID/FID Tekmar/Hewlett Packard 2032 Automatic Liquid Sampler Tekmar Liquid Sample Concentrator 2000
Hope:	GC Serial #3203A40474 Hewlett Packard 5890A Series II GC/PID/FID Varian Archon Autosampler Tekmar Liquid Sample Concentrator 2000

GC/MS Volatiles

Albert:	GC Serial #3336A57367 MS Serial #3440A02022 Hewlett Packard 5890 Series II plus Gas Chromatograph Hewlett Packard 5972A Mass Spectrometer Varian Archon Autosampler Hewlett Packard Liquid Sample Concentrator
Jessie:	GC Serial #US00033566 MS Serial #US94260049 Hewlett Packard 6890A Gas Chromatograph Hewlett Packard 5973N Mass Spectrometer

Varian Archon Autosampler
Tekmar/Dohrmann Liquid Sample Concentrator 3100

GC Semivolatiles

Lucy: GC Serial #3235A45841
Hewlett Packard 5890 Series II GC/FID/FID
Dual Hewlett Packard Autosamplers

Isaac: GC Serial #2728A13937
Hewlett Packard 5890 GC/FID/FID
Dual Hewlett Packard Autosamplers

GC/MS Semivolatiles

Ralph: GC Serial #3336A55281
MS Serial #3434A01677
Hewlett Packard 5890 Series II plus Gas Chromatograph
Hewlett Packard 5972 Mass Spectrometer
Hewlett Packard Autosampler

Corey: GC Serial #US00007773
MS Serial #US82321650
Hewlett Packard 6890 Gas Chromatograph
Hewlett Packard 5973 Mass Spectrometer
Hewlett Packard Autosampler

GC/ECD

George: GC Serial #3140A39359
Hewlett Packard 5890 Series II Gas GC/ECD/ECD
Hewlett Packard Autosampler

Frank: GC Serial #US92305459
Hewlett Packard 6890 plus GC/ECD/ECD
Hewlett Packard Autosampler

Inorganics/Wet Chemistry

Phoenix (ICP) ICP Serial #ELO3068480
Varian Vista-MPX
Varian SPS-5 Autosampler

Elan (ICP/MS): ICP/MS Serial #0779906
Perkin Elmer Elan 6100 ICP/MS
Perkin Elmer AS90/91 Autosampler

Grandma (CVAA): AA Serial #128132
Perkin Elmer 2380 Atomic Absorption Spectrophotometer

Aquamate UV/VIS Spectrophotometer Serial #AQA 113606
Thermo Spectronic Helios Aquamate

3.3 Maintenance Activities

Preventative maintenance is an important part of a Quality Assurance Program. Maintenance activities are all described in their respective Standard Operating

Procedures for the following equipment:

Refrigerator Maintenance	8.01
Pipette Calibration	8.03
Thermometer Calibration	8.04
Balance Calibration	8.05
Sonicator Calibration	8.08
Microwave Calibration	8.09
DI Water System Maintenance	8.10
Laboratory Maintenance	8.13
Glassware Cleaning and Washing	8.14
Oven Maintenance	8.15

4.0 Sample Processing

4.1 Sample Receiving and Storage

When samples arrive in the laboratory, the Sample Custodian logs the samples into the laboratory using Standard Operating Procedure 1.02. The Sample Custodian works closely with the Project Manager to make sure the analysis plan meets the customer requirements and that any special requirements detailed in a client quality assurance project plan are met and conveyed to the rest of the laboratory. This procedure includes the following steps:

- Verify samples for damage and proper preservation and temperature
- Verify samples arrived within acceptable holding time
- Verify the sample labels match the chain of custody
- Verify that the samples meet the acceptance policy of the laboratory
- Assign a project number to the sample group
- Assign a sample identification number to each sample and labels each sample
- Log the required information into a sample notebook for record keeping
- Complete and sign the chain of custody and creates a project file
- Document any non-conformances found
- Store samples in the proper refrigerators
- Complete and distribute the paperwork required for each testing protocol
- Prepare documents and shipments of samples to be subcontracted

Evidence of collection, shipment, receipt and laboratory custody until disposal must be documented. Documentation is accomplished by means of a chain of custody record that records each sample and the individuals responsible for sample collection, shipment and receipt. A sample is considered to be in custody if it is:

- In a person’s actual possession
- In view after being in a person’s actual possession
- Locked or sealed to prevent tampering
- In a secured area accessible only to authorized personnel

OnSite Environmental Inc. refrigerators and laboratory space are considered a secured area thus chain of custody is considered to be maintained the entire time they are stored and processed while at our facility. This procedure is adequate and acceptable for the vast majority of our clients.

Some quality assurance project plans require a much stricter custody procedure. In such cases, the samples will be stored in locked refrigerators maintained by assigned sample custodians. Employees will have to obtain the samples from the sample custodian and sign for the samples. The employee will return the sample to the sample custodian immediately after using the sample unless it is to be consumed in analysis. Sample extracts will also be kept in locked refrigerators and the sample custodian will release them to the chemist when they are ready to analyze the sample extract. This procedure is detailed in Standard Operating Procedure 1.03.

4.2 Sample Preparation

The actual sample preparation steps are provided in the Standard Operating Procedure for each analytical method. The extraction and digestion departments also are careful to document proper chain of custody and non-conformances as the samples are being processed. The organic extraction and inorganic digestion departments maintain the following Standard Operating Procedures to maintain consistency in the actual practices they use to prepare samples:

Organic Extraction Department

♦ Separatory Funnel Water Extractions	Method 3510C	SOP 3.08
♦ Ultrasonic Soil Extractions	Method 3550B	SOP 3.07
♦ Waste Dilution	Method 3580A	SOP 3.06
♦ Acid Cleanup	Method 3665A	SOP 3.00
♦ Silica Gel Cleanup	Method 3630C	SOP 3.03
♦ Florisil Cleanup	Method 3620B	SOP 3.01
♦ Alumina Cleanup	Method 3611B	SOP 3.02
♦ Sulfur Cleanup		SOP 3.04
♦ Sonicator Calibration		SOP 8.08
♦ Diazomethane Generation		SOP 3.09
♦ Glassware Washing and Cleaning		SOP 8.14

Inorganic Digestion Department

♦ Dissolved Metals Water Preparation	Method 3005A	SOP 6.02
♦ Hotplate Water Digestion	Method 3010A	SOP 6.03
♦ Hotplate Soil Digestion	Method 3050B	SOP 6.06
♦ Microwave Assisted Water Digestion	Method 3015	SOP 6.04
♦ Microwave Assisted Soil Digestion	Method 3051	SOP 6.07
♦ Calibration of Microwave		SOP 8.09
♦ TCLP Preparation	Method 1311	SOP 6.00
♦ SPLP Preparation	Method 1312	SOP 6.01
♦ Glassware Washing and Cleaning		SOP 8.14

4.3 Sample Analysis & Data Generation

The sample analysis and data generation procedures for sample holding time, sample preparation, instrument tuning and calibration, quality control requirements and data reduction e.g. are detailed in the Standard Operating Procedure for each method. See Appendix B for a list of tests and the associated Standard Operating Procedure number for which OnSite Environmental Inc. currently maintains accreditation.

4.3.1 Manual Integrations

The initials of the analyst and the date of any manual integrations are required on all raw data. Standard Operating Procedure 1.12 gives examples of proper and improper integrations for different situations and how to document any manual integrations that are done to correct for improper auto-integration.

4.3.2 **Traceability of Standards and Calibrations**

It is important to be able to trace and document the standards we purchase, prepare and use to calibrate and verify the calibration of our instruments. Standards and neat chemicals used to make analytical standards and spiking solutions internally are tracked by lot number and are assigned internal identification numbers as they are recorded in laboratory notebooks upon receipt from the vendor. Calibration standards and spiking solutions prepared from these materials are also tracked in laboratory notebooks and assigned identification numbers so they can be tracked during sample preparation and sample analysis. Standard Operating Procedure 1.11 details this procedure.

4.3.3 **Initial Calibration Verification**

It is OnSite Environmental Inc. policy that all initial calibrations for SW-846 methods must be verified with an initial calibration verification (ICV) standard. This standard should be near the midpoint of the calibration curve and is typically the same concentration as the continuing calibration verification standard. The ICV should be from a different manufacturer unless this is not feasible. In this case, a standard with a different lot number may be selected from the same manufacturer.

The ICV requirement can be useful to identify the following issues:

- Manufacturer incorrectly made the standard
- Standard has degraded and needs to be replaced
- Errors in standard preparation by the analyst
- Identifying poor (non-linear) calibration curves.

4.4 **Data Review**

OnSite Environmental Inc. employs a three-tiered data review process. Checklists are used to document each level of review. In general, the chemist performs the Tier I review. The chemist then submits the data to a senior chemist, the Laboratory Manager, the Laboratory QA/QC Officer, or the Technical Director for a Tier II review. If corrections need to be made after the Tier II review, then the data is given back to the chemist to correct and resubmit to the Tier II process. Otherwise, the data is submitted to the Project Manager who coordinates the generation of the report and performs the final Tier III review before signing off on the data and submitting it to the client. Any changes in the data found during a Tier III review need technical agreement by the Technical Director, Laboratory Manager or Laboratory QA/QC Officer. Preliminary data submitted to the client must pass through the Tier II level and be clearly marked as preliminary data. The data can then be reviewed again at a later time before the final report is submitted to the client. This review procedure is detailed in Standard Operating Procedure 1.04.

In addition to this three-tiered data review process, a random 10% of all final reports generated each month undergo an audit by the Laboratory QA/QC Officer as outlined in Standard Operating Procedure 1.14.

4.5 **Data Reporting and Electronic Data Deliverables**

The Administrative Director and Project Manager coordinate report generation with assistance from the Office Assistant. The reporting requirements and the process to generate reports are described in Standard Operating Procedure 1.19. OnSite Environmental Inc. makes a concerted effort, whenever possible, to reduce the amount of hand entering of data to avoid transcription errors. Results from the instruments are electronically processed into a report using software or macros (typically Microsoft Excel). The results are then cut and pasted into the final report (Microsoft Word) with the help of macros so that data that is entered by hand is minimized.

The Laboratory Manager coordinates electronic Data Deliverables (EDDs). Since each client requires their own format, Standard Operating Procedure 1.19 only addresses how to verify the EDD to insure its accuracy and agreement with the final report.

4.6 Back up of Electronic Data and Archiving of Data

The file server is backed up once a month. The data backed up includes all analytical data files, final reports and any other documents generated by the front office. A redundant back up copy is also made and stored at an off-site location.

The hardcopy of all the raw data and reports are kept on file for several months so staff has easy access to the data or reports. When the files begin to get full, the excess data is archived into file boxes, labeled and sent to a secure, third party, off-site archival company where the data can be accessed upon request. Data is maintained for a minimum of five years.

The back up and archival procedures are detailed in Standard Operating Procedure 1.05.

4.7 Sample and Waste Disposal

It is OnSite Environmental Inc. policy to store samples for 30 days following analysis for follow-up analyses and to give the client time to request that the samples be archived, returned or disposed. Clients are typically not charged for sample disposal unless the material is extremely hazardous and could not be disposed of in our normal waste streams. If the client wishes us to return the samples, the client can either pick them up at the laboratory or pay for us to ship them back under chain of custody. If the client selects to archive the samples, a small fee per sample per month is assessed. The procedures for sample return, archival and disposal are addressed in Standard Operating Procedure 1.08.

Organic sample extracts are kept, at a minimum, until the holding time specified by the method expires (typically 45 days or less). Inorganic sample digests are kept, at a minimum, for 30 days.

When samples are scheduled for disposal, employees follow Standard Operating Procedure 1.08, which specifies that the samples be segregated into the following waste streams:

- Solid wastes (predominately hydrocarbon contaminated soils)
- Acidified aqueous wastes (predominately hydrochloric, nitric & sulfuric acid)
- Solvent wastes (predominately hexane, methylene chloride and acetone)
- PCB contaminated oils

Samples that do not fit these waste streams are set aside and handled on a case by case basis.

5.0 Quality Control

5.1 Definition of a Batch

Samples from different projects and clients may be batched together for quality control purposes unless a quality assurance project plan specifies that the quality control samples must be selected from that particular project. A batch can consist of up to twenty client samples in addition to any quality control samples that are required. The samples must be extracted, digested or otherwise prepared for analysis within a twelve-hour window. If more than twenty samples are to be extracted, a second batch of quality control samples must be generated. The types of quality control samples can differ depending on the method. Accuracy is assessed with any surrogates that are used and the spike blank and any matrix spike samples that are required by the method. Precision is assessed by any sample duplicates or matrix spike duplicates that are required by the method.

5.2 Method Blanks

Method blanks are used to make sure that the extraction and analysis procedures did not contribute contamination to the analysis.

5.3 Spike Blanks

Spike blanks are used to make sure that the analytes of interest can be accurately recovered from a blank matrix.

5.4 Matrix Spike/Matrix Spike Duplicate Samples

Matrix spike samples are used to make sure the analytes of interest can be accurately recovered from the sample matrix. The matrix spike duplicate is also used to make sure the analytes can be repeatedly recovered in an accurate and precise manner.

5.5 Duplicate Samples

Duplicate samples are used to make sure that sample results can be reproduced in a precise manner.

5.6 Surrogates

Surrogate compounds are compounds similar to the analytes of interest that are added to the sample at known concentration in order to track the accuracy of the sample extraction and analysis.

5.7 Standard Reference Materials

Standard Reference Materials are typically soil or sediment samples obtained from third party sources that have been extensively tested and have certified concentrations or concentration ranges of analytes of interest. Some quality assurance project plans require us to process a standard reference material while processing their samples as an accuracy check on our extraction and analysis procedures. OnSite Environmental Inc. currently analyzes standard reference material only if required by a client’s quality assurance project plan.

Clients are responsible for the cost of purchasing or providing standard reference materials if required by their project.

5.8 Trip and Storage Blanks

Trip and storage blanks are useful in tracking potential contamination issues with sample shipping and storage. These types of blanks are analyzed only if specified or submitted by the client or quality assurance project plan. Clients are typically charged for these samples.

5.9 Method Detection Limit Studies

Method detection limit studies are conducted annually for all accredited test methods. Standard Operating Procedure 1.20 specifies how this procedure is to be handled.

5.10 Demonstration of Capability

New methods must undergo a Demonstration of Capability (initial precision and accuracy study) to verify that the method is performing adequately. Standard Operating Procedure 1.21 specifies how this test is to be done. Each sample preparation technician and chemist as part of our training program also conducts these studies.

5.11 Solvent and Chemical Lot Checks

Each new lot of solvents, acids and bulk chemicals used to extract or digest samples is checked for interferences and contamination before it is used in the laboratory. Standard Operating Procedure 1.10 details how this is done.

6.0 Quality Assurance

6.1 Accuracy

Accuracy is generally expressed as percent recovery, which is calculated as:

$$\text{Percent Recovery (\%R)} = \frac{X_s}{C_t} * 100$$

Where: X_s is the observed concentration of the analyte.
C_t is the true concentration of the analyte.

The acceptable range for accuracy is determined by the method or by control charting of actual laboratory samples. The analyst is responsible for verifying that the surrogate, spike blank and MS/MSD percent recoveries meet the quality control limits. A non-conformance memo and corrective action must be initiated if the analyte does not fall within the appropriate quality control limits.

6.2 Precision

Precision is generally expressed as relative percent difference, which is calculated as:

$$\text{Relative Percent Difference (RPD)} = \frac{|X_1 - X_2|}{\left[\frac{X_1 + X_2}{2}\right]} * 100$$

Where: X_1 is the concentration from the first replicate sample.
X_2 is the concentration from the second replicate sample.

The acceptable range for precision is determined by the method or by control charting of actual laboratory samples. The analyst is responsible for verifying that the duplicate or MS/MSD recoveries meet the quality control limits. A non-conformance memo and corrective action must be initiated if the analyte does not fall within the appropriate quality control limits.

6.3 Completeness

Completeness is expressed as the percentage of data quality objectives that are expected to be met by OnSite Environmental Inc. This requirement is generally specified as part of a quality assurance project plan. Although OnSite does not track this information routinely or have a specific limit that we internally specify must be met, we strive to achieve 100% at all times.

6.4 Representativeness

In order that the reported results are representative of the sample received, OnSite Environmental Inc. makes a reasonable effort to assure that the samples are adequately homogenized prior to sampling for analysis. OnSite Environmental Inc. cannot control factors in the field affecting sample representativeness; thus, it is ultimately the client's responsibility to insure that the sample submitted is well homogenized prior to submitting it to the laboratory.

6.5 Control Charting & Control Limits

OnSite Environmental Inc. routinely tracks and control charts surrogate percent recoveries, spike blank percent recoveries, MS/MSD percent recoveries and the relative percent difference of MS/MSD samples for all methods that require these quality control samples. The chemist is responsible for recording this information.

Control limits are derived from the control charts and are updated at least once a year. The control limit is established as three standard deviations from the mean of the data set. Standard Operating Procedure 1.22 provides additional guidance on generating and maintaining control charts and quality control limits.

6.6 Non-conformances & Corrective Action

Non-conformances are generated throughout the laboratory by sample receiving, the extractions/digestion departments, the different analytical groups, the Tier I/II/III review process, the front office, and from monthly and yearly audits. In order to make sure that each non-conformance is documented and that a resolution was implemented, the non-conformance procedure is governed under Standard Operating Procedure 1.18.

The non-conformances and corrective actions that are generated during 3rd party audits, internal audits, monthly and yearly audits, management reviews and through non-conformance forms are summarized each month in the monthly audit as part of SOP 1.14. The progress for each item is tracked in the following monthly audits until the item is finally resolved.

Appendix A

Resumes

President/Technical Director
Robert Wallace

Education:

Southwest Texas State University
San Marcos, Texas
Master of Science in Chemistry, 1982

Midwestern State University,
Wichita Falls, Texas
Bachelor of Science in Chemistry, 1981

Key Qualifications:

- Over eighteen years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
President/Technical Director, 1992 - present
Technical Director of environmental analytical laboratory. Responsible for client relations and overall laboratory operations.

Analytical Services, Inc., Kirkland, Washington
Laboratory Manager, 1989 - 1992
Helped start and then managed a twelve person environmental analytical laboratory. Responsible for quality control, review of data, and client contact.

Farr, Friedman & Bruya, Seattle, Washington
Chemist, 1986 - 1989
Performed analytical testing of soil, water and air matrices using gas chromatographic and infrared techniques of analyses. Worked as an on-site chemist at various locations in the Western United States.

National Marine Fisheries Services (NOAA), Seattle, Washington
Chemist, 1983 -1986
Performed various gas chromatographic and HPLC analyses in the study of pollution in the Puget Sound Region.

Project Experience:

Port of Seattle: Provided analytical chemistry support for the Lockheed Environmental Cleanup Project. Mr. Wallace assumed responsibility for the analytical support of this project, when the original laboratory could not keep up with the quick turnaround of analyses. The project involved the cleanup of PAHs and metals contamination.

Port of Seattle: Managed the environmental chemistry support for the Southwest Harbor Island Cleanup and Redevelopment Project. Project involved a remedial investigation of a site with contaminated soil and groundwater. Contaminates of concern were metals, pesticides and PCBs, volatile and semi-volatile organics, and petroleum hydrocarbons.

U.S. Army Corps of Engineers: Lead chemist for the laboratory support of the UST Management Services Contract for Eastern Washington. This involved the removal of underground storage tanks and the cleanup of contaminated soil and groundwater at over 20 sites in eastern Washington. Responsibilities included the development of a QA/QC plan, which was submitted and approved by the Army Corps of Engineers, and final review of all analytical data.

U.S. Army Corps of Engineers, Fort Lewis: Managed the analytical support of a project that involved the hazardous waste characterization of soil and sludge from over 60 oil/water separators at the army base. Worked with the Army Corps of Engineers and the Department of Ecology to coordinate and help better define the analytical methodologies to be used.

Administrative Director
Blair Goodrow

Education:

Certified Public Accountant, 1986

San Jose State University
San Jose, California
Post Graduate Studies in Accounting, 1982

University of California
Santa Barbara, California
Bachelor of Arts in Business-Economics, 1980

Employment:

OnSite Environmental, Inc., Redmond, Washington
Administrative Director, 1992 - present
Responsible for the marketing, financial and administrative functions of the company.

Analytical Services, Inc., Kirkland, Washington
Controller, 1989 - 1992
Responsible for all financial, banking, and administrative functions of the company. Set-up and maintained a computerized accounting system. Prepared monthly financial statements and all required tax reports.

Clothier & Head, PS
Senior Accountant, 1983 -1989
Reviewed and compiled financial statements and projections. Prepared and reviewed corporate, partnership and individual tax returns. Supervised and trained staff accountants.

Laboratory Manager
Karl Hornyik

Education:

University of Oregon
Eugene, Oregon
Bachelor of Science in Pre-Medicine, 1990

Key Qualifications:

- Over ten years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Laboratory Manager, 1993 - present
Supervise all areas of laboratory operations, including extractions and analyses. Coordinate staffing and scheduling of employees of the laboratory. Responsible for the implementation of the quality assurance program of the laboratory.

Laucks Testing Laboratories, Inc., Seattle, Washington
GC Chemist, 1991-1993
Extracted and analyzed soil, water and waste samples for volatiles and semi-volatiles constituents.

Project Experience:

Tulalip Landfill Superfund Site, Washington
Project involved analytical testing of pre-construction fill prior to the principal remedial action. Contaminants of concern were volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

EPA Superfund Technical Assessment and Response Team (START), Washington
Projects typically involve analytical testing of hazardous materials for characterization prior to determining remedial actions. Contaminants that are typically analyzed for are volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

Port of Seattle, Environmental Services Group, Seattle, Washington
Environmental Analytical Laboratory Services Contract. Project involves analytical testing in support of Phase II Environmental Assessments. Contaminants of concern are total petroleum hydrocarbons (TPH), volatile organics, semivolatile organics, PCBs, pesticides, herbicides, and metals.

Laboratory QA/QC Officer
Kelley Wilt

Education:

Whitman College
Walla Walla, Washington
Bachelor of Arts in Chemistry, 1991

Key Qualifications:

- Over ten years experience in environmental chemistry.
- Experienced in analytical support of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Laboratory Quality Assurance/Quality Control Officer, 2001 – present
Responsible for the implementation and improvement of the laboratory's quality assurance/quality control program.

EcoChem, Inc., Seattle, Washington
Quality Assurance/Quality Control Chemist, 1998 – 2000
Validated GC, GC/MS, HPLC, AA, ICP and ICP/MS data from environmental laboratories using CLP, EPA Regional, USACE, and AFCEE guidelines. Authored technical reports summarizing validation findings.

Laucks Testing Laboratories, Inc., Seattle, Washington
GC/MS Chemist, 1997 – 1998
Analyzed environmental samples by CLP and EPA SW-846 methodologies using GC, GC/MS and HPLC instrumentation. Prepared data packages for validation. Assisted in sample extraction and cleanup of water, soil, air, and tissue matrices.

Friedman & Bruya, Inc., Seattle, Washington
Project Manager/Chemistry Consultant, 1993 – 1997
Planned and implemented clients' projects to provide analytical services to meet or exceed the data quality objectives. Analyzed environmental samples by GC and GC/MS. Provided litigation support (deposition and expert witness testimony) on chemistry issues. Provided age dating and identification services for petroleum hydrocarbons.

Alden Analytical Laboratories, Inc., Seattle, Washington
Extractions Supervisor 1991
GC/MS Chemist 1992 – 1993
Scheduled samples for extraction. Extracted air, water, soil, and tissue samples by SW-846 and other methodologies. Analyzed environmental samples by GC and GC/MS protocols (Methods 8010, 8020, 8240, 8260, and 8270).

Project Manager
David Baumeister

Education:

Emory University
Atlanta, Georgia
Bachelor of Arts in Biology, 1990

Key Qualifications:

- Over ten years experience in environmental chemistry and environmental regulations.
- Experienced in project management of projects involving UST management services, remediation of contaminated sites, site assessments, groundwater monitoring, and waste characterization.

Employment:

OnSite Environmental, Inc., Redmond, Washington
Project Manager, 1999 – present
Coordinate and manage analytical projects from inception to completion. Serve as a liaison between the laboratory and clients.

Analytical Chemist-Extractions Supervisor, 1994 – 1998
Analyzed environmental samples by GC methods. Supervised extraction of all organic laboratory samples.

Alden Analytical Laboratories, Inc., Seattle, Washington
Extractions Supervisor, 1993 – 1994
Supervised staff of chemists performing extractions of all laboratory samples. Coordinated daily operations of group. Developed methods as needed.

Analytical Technologies, Inc., Renton, Washington
Extractions Technician 1992 – 1993
Performed extractions of laboratory samples. Responsible for chemical inventory.

Weyerhaeuser
Physical Chemist, 1991 -- 1992
Analyzed paper products for quality control. Established QA/QC guidelines for various products.

Relevant Experience:

King County Department of Health. Soils investigation involving the support and development of a database of environmental information regarding the extent of contamination from the Tacoma metal smelter.

Appendix B

Table of Standard Operating Procedures

1.00	Standard Operating Procedures
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1.14	Monthly Audit
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1.16	Management Review
1.17	Performance Evaluations
1.18	Nonconformances and Corrective Actions
1.19	Report Generation
1.20	Method Detection Limit Studies
1.21	Demonstration of Capability
1.22	Establishing Method Control Limits
2.00	Turbidity - Method 180.1
2.01	Total Solids - Method 160.3
2.02	Flashpoint - Method 1010
2.03	Never issued
2.04	pH Soils (9045C)
2.05	Retired
2.06	Paint Filter Test
2.07	pH Waters (9040)
2.08	Sulfate (Turbidimetric) – Method 375.4
2.09	Nitrogen, Nitrate+Nitrite – Method 353.3
2.10	Phosphorous – Method 365.3
2.11	Alkalinity – Method 310.1
2.12	Total Suspended Solids – Method 160.2
2.13	Total Dissolved Solids – Method 160.1
2.14	Nitrogen, Ammonia – Method 350.3
2.15	Settleable Solids – Method 160.5
3.00	Acid Clean-up of Semivolatile Extracts
3.01	Florisil Clean-up of Pesticide Extracts – Method 3620B
3.02	Alumina Clean-up for PAHs – Method 3611B
3.03	Silica Gel Clean-up – Method 3630
3.04	Never issued
3.05	Sulfur Clean-up Procedure for Organic Extracts
3.06	Waste Dilution - Method 3580A
3.07	Ultrasonic Extraction – Method 3550
3.08	Separatory Funnel Extraction – Method 3510
3.09	Diazomethane Generation
4.00	Herbicides by GC/ECD – Method 8151
4.01	Organochlorine Pesticides by GC/ECD – Method 8081

4.02	Polychlorinated Biphenyls (PCBs) by GC/ECD – Method 8082
4.03	Semivolatile Organic Compounds by GC/MS – Method 8270
4.04	Retired
4.05	Retired
4.06	Semivolatile Petroleum Products by GC/FID – Method NWTPH-Dx
4.07	Hydrocarbon Identification by GC/FID – Method NWTPH-HCID
4.08	Washington EPH
4.09	Diesel Range Organics by GC/FID – Method AK102
4.10	Never issued
4.11	PAHs in Water by Selective Ion Monitoring (GC/MS-SIM) – Method 8270-SIM
4.12	Residual Range Organics by GC/FID – Method AK103
4.13	EDB and DBCP by GC/ECD – Method 8011
4.14	Retired
4.15	Hexane Extractable Material – Method 1664
5.00	Gasoline by GC/FID – Method NWTPH-Gx
5.01	Volatile Organics by GC/MS – Method 8260
5.02	Gasoline Range Organics – Method AK101
5.03	Washington VPH
5.04	BTEX by GC/PID – Method 8021B
5.05	Retired
6.00	TCLP – Method 1311
6.01	SPLP – Method 1312
6.02	Dissolved Metals in Water – Method 3005
6.03	Hotplate Digestion for Water – Method 3010A
6.04	Microwave Digestion for Water – Method 3015
6.05	Retired
6.06	Hotplate Digestion for Soils – Method 3050B
6.07	Microwave Digestion for Soils – Method 3051
6.08	Water Extraction for Hexavalent Chrome
6.09	Alkaline Digestion for Hexavalent Chrome
7.00	Retired
7.01	Retired
7.02	Metals by ICP – Method 6010
7.03	Metals by ICP/MS – Method 200.8
7.04	Mercury in Soil – Method 7471A
7.05	Mercury in Water – Method 7470A
7.06	Hexavalent Chrome – Method 7196
7.07	Metals by ICP/MS – Method 6020
8.00	Method Detection Limits and Instrument Detection Limits
8.01	QA/QC & Maintenance for Refrigerators & Freezers
8.02	Never issued
8.03	Calibration of Volumetric Pipettes
8.04	Thermometer Calibration
8.05	Balance Calibration
8.06	Never issued
8.07	Never issued
8.08	Sonicator Calibration
8.09	Microwave Calibration
8.10	Maintenance and Use of High Purity Water System
8.11	Never issued
8.12	Never issued
8.13	Instrument Maintenance
8.14	Glassware Cleaning & Washing
8.15	Oven Maintenance

APPENDIX B

Final Sampling and Analysis Plan for Sediment Characterization

Final Sampling and Analysis Plan for Sediment Characterization

Former Custom Plywood Mill

Anacortes, Washington

Prepared for:

GBH Investments, LLC
13941 Gibralter Road
Anacortes, Washington 98221

Prepared by:

Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
(206) 342-1760

September 2008

Project No. 10654

Geomatrix

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FINAL SAMPLING AND ANALYSIS PLAN FOR SEDIMENT CHARACTERIZATION
Former Custom Plywood Site
Anacortes, Washington

1.0 INTRODUCTION

This Final Sampling and Analysis Plan (SAP) describes work to be conducted for the characterization of sediments adjacent to the former Custom Plywood Mill site in Anacortes, Washington. This plan conforms to the requirements of the Washington State Department of Ecology's (Ecology) Sediment Sampling and Analysis Plan Appendix (Ecology, 2003). The investigation and cleanup will be conducted under oversight of Department of Ecology. This SAP has been prepared by Geomatrix Consultants, Inc. (Geomatrix), on behalf of GBH Investments, LLC (GBH).

Ecology investigated the site numerous times in 1993 and 1994 in response to citizen complaints about the conditions of the facility and environmental concerns. Ecology added the site to the Confirmed and Suspected Contaminated Site List on March 5, 1993. The site was listed as having confirmed contamination of soil with petroleum products; suspected contamination of soil, groundwater, surface water, and sediment by phenolic compounds and polycyclic aromatic hydrocarbons (PAHs); and suspected soil contamination by polychlorinated biphenyls (PCBs).

In response to the Washington Governor's Puget Sound Initiative, GBH will characterize the sediments as described in this SAP to determine what, if any, remediation or other action needs to be taken to seek a delisting of the project site from the Contaminated Site List.

1.1 SITE HISTORY

The Custom Plywood Mill is the site of a former sawmill and plywood manufacturing facility that was largely destroyed by fire in November 1992. Primarily because of environmental concerns, the former Custom Plywood Mill has remained mostly undeveloped since 1992. A detailed description of the site history is provided in the RI/FS Work Plan.

The aquatic portion of the site includes intertidal areas that were within the plant's building footprint. The shallow subtidal areas were also used as log rafting and storage areas. An underwater video survey conducted in 2007 mapped extensive areas with significant amounts of wood debris visible on the sediment surface. Aquatic vegetation (eelgrass) prevented complete mapping of the wood debris and did not provide estimates of the amount of wood debris that was buried within the biologically active surface sediments.

1.2 REVIEW OF EXISTING SEDIMENT DATA

A review of the results of previous sediment investigations is presented in the RI/FS Work Plan. All of the offshore sediments sampled during the previous investigations had levels of metals below the Sediment Management Standards (SMS) Sediment Quality Standards (SQS) criteria. Light PAH (LPAH) and heavy PAH (HPAH) values were also below the SMS SQS criteria or the lowest apparent effects threshold (LAET) dry weight equivalents. Several of the stations had exceedances of the SQS and cleanup screening level (CSL) criteria for chlorinated hydrocarbons and benzoic acid due to elevated reporting limits. Phenol was found at elevated concentrations above the SQS at two sample locations. The compound 4-methylphenol was above the CSL at two locations.

2.0 OBJECTIVE AND DESIGN OF SEDIMENT INVESTIGATION

The primary objectives of the sediment investigation are to evaluate surface sediments in the intertidal area located within the former building footprint of the Custom Plywood Plant and within offshore log rafting areas. Surface sediments will be screened and evaluated for detrimental accumulations of wood debris and for contamination by bioaccumulative constituents of potential concern (COPCs), such as dioxins and PCBs. This evaluation is being conducted to determine potential biological effects that may be caused by the surface sediments. Significant accumulations of wood debris have shown a negative effect on benthic communities. Dioxins and PCBs are potential threats to biological communities and to human health through ingestion of contaminated fish and shellfish. This investigation will help identify the horizontal and vertical boundaries of any potential cleanup areas and help to determine the appropriate cleanup responses for the identified areas of concern.

This project is part of a RI/FS site investigation of the former Custom Plywood Mill site that in addition to the sediment evaluation includes upland soil and groundwater investigations.

2.1 PROJECT DESIGN

This project uses a tiered testing approach to identify areas for cleanup. The approach includes screening the project site for areas of dioxin and PCB contamination that pose a potential human health risk, and additional analysis for COPCs in areas that show significant biological impact. Figure 1 presents a flow chart of the tiered analytical testing scheme with the proposed screening criteria. Table 1 provides an analytical schedule for each tier of testing with analysis methods and proposed screening criteria.

2.2 SAMPLING DESIGN

The initial round of sediment sampling will include the collection of grab samples at 32 stations in a systematic grid layout with a random start. The grid layout covers the offshore aquatic portions of the site as presently defined by Ecology. The proposed sample locations are listed in Table 2 and shown on Figure 2. Locations of historical sampling locations are shown in Figure 3. Based on phone discussions with Peter Adolphson, shoreline samples (ST-5, ST-9, ST-13, ST-21, and ST-25) will be located within approximately 25 ft of the estimated Ordinary High Water mark. The second and third row of samples will be moved to provide more uniform coverage of the area of investigation. Ecology acknowledges the upper intertidal area of the shoreline may have significant debris coverage that may necessitate the movement of sample locations. The top 10-cm of the sediment will be sampled at each of the intertidal locations; however, if the substrate is covered with debris then to the extent practicable the material will be removed and the underlying sediment surface analyzed. Secondary samples may be collected during subsequent rounds of grab sampling to further define the horizontal boundaries of any proposed cleanup areas. Additional samples may also be collected by coring to determine the depth of contamination.

2.3 ANALYSIS SCHEDULE

The initial round of analysis (Tier 1) is focused on identifying areas with detrimental accumulations of wood debris (Figure 1). Surficial wood cover will be visually estimated for each grab sample using a point contact method, a statistically defensible method of reducing biases associated with visual estimation of cover (Foster et al., 1991). Surface sediments (top 10 centimeters [cm]) will be analyzed for total volatile solids (TVS) and total organic carbon (TOC). TVS and TOC are used as surrogates for the percentage of wood debris within the sediments biologically active zone. Pore water will also be collected from the top 10 cm for sulfide and ammonia analysis. Sediment pore water will also be tested for adverse biological effects using a saline Microtox® toxicity assessment.

If surficial wood cover is greater than or equal to 50% then the area represented by the sample will be considered an area of potential concern (Figure 1 and Table 1). If surficial wood cover is greater than 25% but less than 50%, or if TVS or TOC is greater than or equal to the criteria noted in Table 1, or if Microtox® shows a significant biological effect, then additional biological effects (bioassay) testing (Tier 2) will be conducted (Figure 1).

Sediments from sample locations that pass the initial screening criteria (Tier 1) or the biological effects criteria (Tier 2) will be combined into one or more composite samples and screened for PCBs and dioxins (Tier 3).

The compositing scheme for dioxin and PCB screening will be coordinated with the Ecology project manager. The spatial arrangement of stations (e.g., station grouping or distance from potential contaminate sources) may influence the initial compositing scheme. If dioxin or PCB concentrations in the composite samples pose an adverse human health risk using an exposure scenario selected by Ecology, then samples from each grab sample making up the composite may be analyzed to identify stations with elevated levels (Figure 1).

Stations that fail the bioassay testing and require cleanup will be analyzed for the SMS list of COPCs (Table 3). In addition, if a station that has failed bioassay screening is adjacent to a monitoring well that shows elevated levels of TPH then the stations may be analyzed for TPH. The decision to conduct additional analyses will be coordinated with the Ecology project manager.

2.4 ADDITIONAL SAMPLING

Additional grab and core samples may be collected to further refine the horizontal and vertical extent of the cleanup areas. Collection of additional samples and analysis will be coordinated with the Ecology project manager, as appropriate. Collection methods and analysis procedures that are not covered in this SAP will be presented in addendums to this SAP.

3.0 FIELD SAMPLING METHODS

Sediment sampling methods and procedures will follow Ecology's SAPA (Sediment Sampling Analysis Plan Appendix 2008). A brief summary of sampling procedures is presented below. The detailed grab collection and processing procedures are presented in Attachment B1.

3.1 STATION POSITIONING

The planned grab sampling locations are shown on Figure 2. Sample stations will be located with a Differential Global Positioning System set up on board the sampling vessel. Samples will be collected within 3 meters (m) of the proposed sampling locations. If samples cannot be collected after two attempts the project manager will be notified and an alternative location may be selected after conferring with the Ecology project manager. Sample locations will be recorded and logged. Water depth will be determined using an electronic depth sounder or a lead line. The time and date of sample collection will also be recorded so that tidal height corrections can be done.

3.2 GRAB SAMPLES

Samples will initially be collected at 32 locations (Figure 2 and Table 2). A stainless-steel, 0.2-square-meter (m^2) pneumatically operated grab sampler will be used to collect an undisturbed sample of the bottom sediments. The surface of the sediment will be photographed, visually inspected, and logged. Pore water will be collected for sulfide and ammonia analysis from the top 10 cm of sediment. The top 10 cm of sediment that does not contact the sides of the grab will be collected, homogenized, and archived for future chemical analysis and biological testing.

3.3 SURFICIAL WOOD COVERAGE

Surficial wood debris cover will be estimated using a visual point contact method. The surface of each grab sample will be photographed using a digital camera mounted on a bracket. The photographs will provide identical views of the sediment surface of each grab. Post-processing of the images will overlay a 10 by 10 grid on each image. Twenty of the 100 grid intersection points will be chosen randomly and the presence or absence of wood debris noted for each intersection. Surficial wood debris will be recognized by its shape, color, and texture. Wood coverage will be estimated from the proportion of the 20 randomly selected grid intersections that overlay visually identifiable wood debris. The presence of wood at each additional intersection will represent a 5 percent increment in coverage.

3.4 PORE WATER SAMPLES

Pore water will be collected from the sediment using two methods. Pore water analyzed for sulfide and ammonia during the Tier 1 testing will be collected from each grab using a syringe type pore water sampler. Pore water for the Microtox® toxicity assessment will be obtained using centrifugation (see Section 5.2.1).

The pore water sampler used for the sulfide and ammonia analysis consists of a 50 milliliter (ml) plastic syringe attached to a perforated aluminum tube filled with a glass fiber filter media. The perforated portion of the aluminum tube spans 10 cm. Inserting the tube to the correct depth in the sediment and applying a vacuum with the syringe will extract pore water from the top 10 cm of sediment. The pore water is transferred to suitable containers and preserved. Multiple samplers may be used to obtain sufficient sample volume.

3.5 DECONTAMINATION PROCEDURES

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material must meet high standards of cleanliness.

All sediment-handling equipment will be cleaned and decontaminated prior to arrival at the site. The grab sampler will be precleaned prior to arrival at the site. The grab sampler will be rinsed clean of any visible sediment between uses. Sediment touching the sides or any part of the grab will not be collected. All equipment and instruments used to remove sediment from the sampler or to homogenize samples will be stainless steel and will be decontaminated before and in between each use. The Geomatrix standard decontamination procedure for the grab sampler, core tubes, and other sample handling equipment is modeled after Puget Sound Estuary Program (PSEP) protocols (PSEP, 1997); however, the decontamination procedure will not use any acid or solvent rinses (the final rinse will use distilled water). The detailed decontamination procedure is presented in Attachment B1.

3.6 SAMPLE COMPOSITING

During the initial round of sampling, surface sediment (top 10 cm) from each grab will be collected and homogenized. Aliquots of homogenized medium from each grab that pass the initial Tier 1 screening criteria or the Tier 2 ecological criteria will be composited into one or more composite samples and analyzed for dioxins and PCBs.

3.7 WASTE SEDIMENT

All solid waste derived during this investigation will be placed in proper containers, labeled, characterized, and disposed of by GBH or Geomatrix in accordance with appropriate regulations.

4.0 SAMPLE HANDLING PROCEDURES

This section outlines the protocol for field and laboratory handling and storage of samples.

4.1 SAMPLE CONTAINERS

Sample containers will be provided by Analytical Resources, Inc. (ARI), and are precleaned, certified, and individually labeled with a lot number traceable to a Certificate of Analysis.

4.2 SAMPLE STORAGE

Samples scheduled for the Tier 1 analysis will be refrigerated until delivered to the laboratory. Samples not scheduled for the initial analysis round will be archived and stored at the analytical laboratory in a secure area. Storage requirements for bioassay sediments will include storage in the dark at 4°C. Any headspace left in the bioassay jars after filling will be purged with nitrogen. Storage requirements for all archived chemistry samples will include freezing and storage of the samples in a temperature-monitored freezer at –18°C.

4.3 CHAIN OF CUSTODY

Sediment samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples will be placed in coolers with prefrozen commercial chill packs (“blue ice”) or frozen until transferred to the testing laboratories. Transfer of samples from Geomatrix custody to the laboratory will be documented using chain-of-custody procedures (see Attachment B1, Figure 2). If someone other than the sample collector transports samples to the laboratory, the collector will sign and date the chain-of-custody form and insert the name of the person or firm transporting the samples under “transported by” before sealing the container with a Custody Seal.

5.0 LABORATORY ANALYTICAL METHODS

5.1 CHEMICAL ANALYSES AND TARGET DETECTION LIMITS

All analytical methods will follow rigorous standard testing protocols. ARI’s Standard Operating Procedures (SOPs) are not included in this SAP due to their proprietary nature. The specific analyses chosen for the samples must be capable of returning accurate results at the concentrations listed in Table 3. Test methods selected to achieve these results are presented in Table 4 along with the reporting limits for each analytical method provided by ARI.

Despite the time constraints imposed by waiting for the conventional and/or bioassay testing, the chemical analysis of mercury must not occur outside of the 28-day holding time. Therefore, to avoid a problem of exceedance of the holding time, the mercury samples will be digested within the 28-day holding time, and the digestate will be archived for future analysis, as necessary, depending on the bioassay results.

As described in the SMS, total PCB concentrations will be calculated by summing the detected concentrations for seven Aroclors (i.e., Aroclor 1016, 1221, 1232, 1242, 1248, 1254, and 1260). Undetected Aroclors will not be included in the calculation of total PCB values. If all seven Aroclors are reported as undetected, then the value reported as the total PCB value will be the highest reporting unit among the individual Aroclors.

Total LPAHs will be calculated by summing the detected concentrations for naphthalene, acenaphthylene, acenaphthene, phenanthrene, anthracene, and fluorene. If all LPAHs are reported as undetected, then the value reported as the total LPAH value will be the LPAH compound with the highest reporting limit.

Total HPAHs will be calculated by summing the detected concentrations of fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene. If all HPAHs are reported as undetected, then the value reported as the total HPAH value will be the HPAH compound with the highest reporting limit.

Analytical laboratory quality control (QC) checks include the use of standard U.S. Environmental Protection Agency (EPA) analytical methodologies (including analysis of method blanks, spikes, and surrogates) and laboratory QC samples. These QC checks are detailed in Tables 5 through 10. Additionally, the analyses will be carried out under the laboratory's SOPs.

As specified in the laboratory's SOPs, the PCB analysis will include running suitable standards for calibration purposes. The calibration standard will be run with every analytical batch of samples. A result outside of three standard deviations for the continuing calibration is cause for corrective action, to include rerunning the batch. In addition, suitable regional reference material (RRM) will be run with every third batch of samples, beginning with the first batch. Finally, one matrix spike/matrix-spike duplicate will be run every batch to evaluate matrix interferences and recoveries.

5.2 BIOLOGICAL ANALYSES

A Marine Microtox® pore water toxicity assessment will be run on all test sediments during the initial Tier 1 testing. Tier 2 sediment bioassays, if needed, will be conducted by an accredited laboratory after the results of the initial Tier 1 analyses are reported. Every effort will be made to run the sediment bioassays within the 56-day sediment holding time to allow for retesting should problems occur. Requests for additional holding time will be coordinated with the Ecology project manager as necessary.

The sediment bioassay testing conducted during the Tier 2 testing will include the 10-day amphipod bioassay using *Rhepoxynius abronius, Eohaustorius estuarius,* or *Ampelisca abdita* and the sediment larval bioassay using a molluscan species or an echinoderm species (e.g., *Dendraster excentricus*). Bioassay procedures will follow PSEP protocols (PSEP, 1995) with any applicable revisions or modifications recommended during the annual Sediment Management Annual Review Meetings (SMARM). The following general requirements apply to all Tier 2 sediment bioassays.

- Reference test sediments are analyzed for grain size, TVS, bulk ammonia, and TOC.
- Blind testing is done by randomized test sequence and code numbers.
- Water quality is controlled throughout the entire bioassay, and the following water quality variables are measured daily: salinity, dissolved oxygen, pH, and temperature. Ammonia and sulfides are measured at the beginning and end of each test.
- Seawater for conducting these tests is obtained from Port Gamble, Washington. Seawater is filtered to 0.45 micrometer (µm).

- All tests are aerated during the exposure period.
- Standard laboratory procedures are followed in all testing, including proper documentation, proper cleaning, avoidance of contamination, and maintenance of appropriate test conditions.
- Bioassay-specific controls and use of reference sediments are observed or sediments may need to be retested.
- All unusual observations or deviations from established procedures are recorded and reported.

The project manager will be kept informed of all aspects of the bioassay analyses. Final selection of the test organisms will be made in consultation with the testing laboratory and the Ecology project manager. Bioassay testing requires that test sediments be matched and run with appropriate reference sediments to factor out sediment grain-size effects on bioassay organisms. The approach for selecting reference sediment samples is described below.

The analytical laboratory will give priority to the grain-size analyses. The grain-size data will allow selection of appropriate reference sediment(s). After the analytical laboratory has completed the grain-size analyses, a recommendation on the appropriate reference sediment will be made to the Ecology project manager. The project manager will then coordinate reference-sediment selection with Geomatrix.

5.2.1 Microtox (Marine Pore Water) Toxicity Assessment

The Microtox® sediment pore water toxicity assessment is a rapid bioassay procedure that uses differences in bioluminescence between test, reference, and control samples as an indication of relative toxicity. The test will be conducted using the marine bacteria *Vibrio fisheri* as recommended in Subappendix B: *Marine Microtox® 100 Percent Sediment Pore Water Toxicity Assessment* (Ecology, 2003). Tests are run using pore water extracted from both test and reference sediments. Collection of suitable reference sediments will be coordinated with the Ecology project manager.

Pore water extraction involves centrifugation of 500 ml of sediment at approximately 4,500 G for 30 minutes. A pore water volume of 25 ml is needed. Salinity and pH are adjusted as needed and the samples aerated for dissolved oxygen saturation between 50 to 100%.

Freeze-dried bacterial suspensions are reconstituted and allowed to equilibrate before adding to the test, reference, and laboratory control samples. After an initial 5-minute incubation period, the samples bioluminescence is determined (reading I0). After an additional 5 minutes (I5) and at 15 minutes (I15) the samples are measured and the final light readings are collected.

Statistical comparisons are made between the reference and test sediment data. All information concerning testing conditions and environments, all positive and negative controls, and experimental sediments will be included in the final report.

5.2.2 Amphipod Sediment Bioassay

The amphipod sediment bioassay is a 10-day acute–lethal test used to determine the influence of experimental sediments on amphipod survival. The amphipod test is conducted using *Rhepoxynius abronius, Eohaustorius estuarius,* or *Ampelisca abdita* as recommended in PSEP (1995). The selection of amphipod species is based on sediment interstitial salinity and grain size. *Rhepoxynius* is collected from West Beach, Whidbey Island, Washington. *Eohaustorius* is collected from Yaquina Bay, Oregon. *Ampelisca* is purchased.

Upon arrival in the laboratory, amphipods are acclimated to the testing temperature in sediments provided by the supplier and then introduced to the sediment-loaded test vessels and aerated during the test. Seawater used in acclimation and each bioassay test vessel is filtered to 0.45 µm. Each test is run with the appropriate negative (native sediment supplied by the vendor) and positive (cadmium chloride) controls. Individual test vessels are inspected daily for the emergence of individual amphipods from sediments to determine the number of organisms that refuse to rebury. Positive controls are also inspected daily and are terminated after 4 days, at which time survivorship at each concentration is determined. After 10 days, control, reference, and experimental sediments are sieved, and surviving individuals are recovered and counted. Statistical comparisons of amphipod survivorship are made between test vessels from the reference and experimental sediments. All information concerning testing conditions and environments, positive controls, negative controls, and experimental sediments will be included in the final report.

5.2.3 Sediment Larval Bioassay

The larval sediment bioassay is a 48- to 96-hour mortality and abnormal development test used to determine the influence of experimental sediments on larval development. Depending on the time of year, one of several species of echinoderm or mollusc is used for this test. Sampling is scheduled for the late summer or early fall. The bioassay will be run using an echinoderm species, *Dendraster excentricus*, if possible. Final selection of the test organism will be made in consultation with the testing laboratory and the Ecology project manager.

Adult molluscs or echinoderms are induced to spawn using temperature stimuli. Eggs are fertilized at the appropriate concentration, and the resultant embryos are introduced into prepared testing vessels and aerated during the test. Seawater used in acclimation and each bioassay test vessel is filtered to 0.45 µm. Each test is run with the appropriate negative (seawater) and positive (cadmium chloride) controls. Replicate test vessels are monitored daily for water quality. The test is terminated after 48 hours by which time the organisms will have developed to the appropriate larval stage in the seawater control and any unaffected test vessels. The test is terminated by the addition of 5% buffered formalin to well-mixed aliquots from each test vessel. Determination of development stage is made by microscope. Statistical comparisons of embryo development are made between test vessels from the reference and experimental sediments. All information concerning testing conditions and environments (e.g., stocking density and aliquot size), positive controls, negative controls, experimental sediments, initial counts for the seawater control, and the number of normal and abnormal embryos in each container at the end of the test will be included in the final report.

5.2.4 Photoactivation of PAHs

The photoactivation of PAHs exposed to ultraviolet (UV) radiation can result in increased toxicity for exposed organisms. UV exposure is a potential problem in intertidal and shallow subtidal communities. A majority of the aquatic areas at the project site are shallow areas with elevations above -12 ft mean lower low water (MLLW). The sediment bioassays conducted under the Tier 2 testing will be performed using full-spectrum laboratory lighting to include UV light intensities similar to the site conditions and will follow the recommendations presented in Subappendix D: *Recommendations for Conducting Bioassays on Sediment Containing Polycyclic Aromatic Hydrocarbons (PAHS) Exposed to Ultra-violet (UV) Radiation* (Ecology, 2003).

6.0 QUALITY OBJECTIVES AND CRITERIA

This section outlines the objectives of the SAP, and summarizes relevant quality assurance (QA) criteria.

6.1 QUALITY OBJECTIVES AND CRITERIA FOR ANALYTICAL DATA

The goals for the analytical data are to produce data of sufficient quality to meet the project data-quality objectives (DQOs). The primary DQO for this project is that the sediment concentrations must be sufficiently accurate to compare to the Sediment Management Standards Sediment Quality Standards (SQS; Washington Administrative Code [WAC] 173-204-320) for marine sediments (Table 3). Because the SQS for many organic compounds is based on carbon-normalized concentrations, the samples must also be analyzed for TOC. The upper limit of TOC where carbon normalization is inappropriate is, at this site, a site-specific value based on background levels of the surrounding sediments. This site-specific value is 1.67% (Peter Adolphson, Ecology, personal communications). At TOC values below 0.5% and above 1.67%, the PAH and PCB data must be accurate at the dry-weight-based standards specified in Table 3. The practical quantitation limits for the analytes in this study must be at least as low as the concentrations presented in Table 3.

To meet the goal of returning data accurate to within the SQSs, data-quality indicators (DQIs) also need to be established. DQIs are specific measured parameters, including the familiar PARCC parameters (precision, accuracy, representativeness, comparability, and completeness), as well as sensitivity.

The basis for assessing each of these elements of data quality is discussed in the following sections. Precision and accuracy QC limits for analytical methods are identified in Tables 5 through 10.

6.1.1 Precision

Precision measures the reproducibility of measurements. Precision is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. Analytical precision is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. If the recoveries of analytes in the laboratory control sample (LCS) are within established control limits, then precision is within limits. Total precision is the measurement of the variability associated with the entire sampling and analysis process. Total precision measures variability introduced by both the laboratory and field operations and is determined by analysis of duplicate or replicate field samples. Field-duplicate samples (5% frequency) and matrix duplicate spiked samples (one per analytical batch) shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference between the duplicate sample results. For replicate analyses, the relative standard deviation is determined.

6.1.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For compounds, such as PCBs, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy returns a percent recovery from pure and sample matrices. Limits of accuracy for Method 8082 (PCBs), Method 6010 (inductively coupled plasma [ICP] metals), Method 7000 series (graphite furnace atomic absorption/cold vapor atomic absorption [GFAA/CVAA metals]), Method 8270D (semivolatile organic compounds [SVOCs]), Method 1613B (dioxin and furans), and the standard methods for conventionals analysis are contained in Tables 5 through 10, respectively.

6.1.3 Representativeness

Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper grab sample locations, sampling procedures, and sample intervals. Decisions regarding sample locations and numbers are documented in Section 3.0.

6.1.4 Comparability

Comparability is the confidence with which one data set can be compared to another data set. An objective for this QA/QC program is to produce data comparable to previously collected data. The range of field conditions encountered is considered in determining comparability. Comparability will be achieved by using standard methods for sampling and analysis, reporting data in standard units, using RRM, and using standard reporting formats. Field documentation using standardized data collection forms shall support the assessment of comparability.

6.1.5 Completeness

Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of intended individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag (see Table 11 for an explanation of flagging criteria). The requirement for completeness is 90% for the sediment samples scheduled for the initial round of analyses.

6.2 QUALITY OBJECTIVES AND CRITERIA FOR BIOLOGICAL DATA

The quality assurance/quality control procedures for the Microtox® toxicity assessment, the amphipod 10-day acute/lethal bioassay, and the sediment larval abnormality bioassay are described in the applicable protocols. The QA/QC requirements include control limits for water quality parameters (e.g., temperature, salinity dissolved oxygen, pH). Monitoring of sulfides and ammonia is also required during the sediment bioassays. Protocols also specify acceptable performance limits for negative controls, positive controls, and reference sediments. The percentage of fines in reference sediments should be within 20% of the percentage of fines in the test sediment.

6.3 FIELD QUALITY ASSURANCE

Field QC will include the collection and analysis of two duplicate grab samples for a frequency of approximately 5%. Field QC samples will be collected at locations ST-9 and ST-20. Decontamination blanks will not be collected because sample material that has been in contact with the grab sampler will not be used (see Attachment B1, Section 4.0), or sampling will be conducted using only precleaned, disposable sampling equipment (see Attachment B1, Section 4.0).

6.4 DOCUMENTATION AND RECORDS

6.4.1 Field

Data and log forms produced in the field will be reviewed daily by the person recording the data, so that any errors or omissions can be corrected. All completed data sheets are removed daily from the field clipboard and photocopied; the original data sheets are filed in a fireproof file cabinet and the photocopies stored in the project file. All data transcribed from field forms into electronic forms and tables will be 100% verified for accuracy and freedom from transcription errors.

6.4.2 Analytical Laboratory

Analytical laboratory documentation will consist of a case narrative, providing descriptions of any problems and corrective actions, copies of the chain-of-custody forms, tabulated analytical results, data qualifiers, and blank and matrix spike results with calculated percent recoveries and differences. A detailed documentation package (raw data, analyst's reports, extraction logs, chromatograms, etc.) will be provided by the laboratory in case the basic data review discussed in Section 7.1 encounters deficiencies requiring more thorough laboratory documentation.

6.4.3 Bioassay Laboratory

The bioassay laboratory will prepare written reports for each test system (i.e., organism) documenting all sample analyses and associated activities, including the following:

- Chain-of-custody procedures and discussion of any deviations from them;
- A summary of protocols implemented during analyses and discussion of any deviations from the protocols;
- Tabulated bioassay and QC results;
- Discussion of laboratory documentation, laboratory notebooks, and chain-of-custody forms and their use to record data and storage location;
- All data qualifications and explanations for all departures from the protocols;
- Results of water quality monitoring;
- Results for all the QA/QC checks initiated by the laboratory.

6.4.3.1 Microtox® (Saline Pore Water) Toxicity Assessment

The following data should be reported by all laboratories performing this bioassay:

- Initial and adjusted pore water salinities and pH of test and reference samples;
- Initial light readings (I_0) and final light readings (I_5 or I_{15}) for each replicate and the mean and standard deviation for each treatment;
- Final Control and Reference mean light output;
- Any problems that may have influenced data quality;

6.4.3.2 Amphipod Mortality Test

The following data should be reported by all laboratories performing this bioassay:

- Daily water quality measurements during testing (dissolved oxygen, temperature, salinity, pH, plus ammonia + sulfides at start and end of test);
- Daily emergence for each beaker and the 10-day mean and standard deviation for each treatment;
- 10-day survival in each beaker and the mean and standard deviation for each treatment;
- Interstitial salinity values of test sediments;
- 96-hour LC_{50} values with reference toxicants;
- Any problems that may have influenced data quality.

6.4.3.3 Echinoderm or Bivalve Sediment Larval Test

The following data should be reported by all laboratories performing this bioassay:

- Daily water quality measurements (dissolved oxygen, temperature, salinity, pH, plus ammonia + sulfides at start and end of test);
- Individual replicate and mean and standard deviation data for larval survival at test termination;
- Individual replicate and mean and standard deviation data for larval abnormalities at test termination;
- 48-hour LC_{50} and EC_{50} values with reference toxicants;

- Any problems that may have influenced data quality.

All project documentation records related to sediments testing will be kept on file at the Geomatrix office in Lynnwood, Washington.

6.5 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, MAINTENANCE, AND CALIBRATION

6.5.1 Field Equipment

Prior to each daily sampling event, the differential global positioning system (DGPS) will be tested. A checkpoint accessible to the sampling boat will be occupied. At the DGPS checkpoint, the sampling boat will be stationed and a position reading will be taken. The DGPS position will be compared to the known checkpoint coordinates. The DGPS position readings should agree within 1 to 2 m of the known checkpoint coordinates.

6.5.2 Analytical Laboratory

Analytical instruments shall be calibrated in accordance with the analytical methods specified in the laboratory SOPs. All analytes reported shall be included in the initial and continuing calibrations, and these calibrations shall meet the acceptance criteria specified in Tables 5 through 10. Records of standard preparation and instrument calibration shall be maintained and calibration standards shall be traceable to RRMs.

Instrument calibration shall be checked at the frequency specified by the relevant analytical method, using materials prepared independently of the RRM. Multipoint calibrations shall contain the minimum number of calibration points specified by the applicable analytical method, with all points used for the calibration being contiguous. If more than the minimum number of standards are analyzed for the initial calibration, all of the standards analyzed shall be included in the initial calibration. The continuing calibration verification cannot be used as the LCS.

6.6 DATA MANAGEMENT

The analytical and field data will be compiled into an Environmental Information Management (EIM) System and MyEIM Portal v1.0 electronic data deliverable for potential submission to Ecology. The analytical data will also be maintained in ARI's electronic Laboratory Information Management System or archival system. Hard copies of the analytical laboratory data reports will be retained at the offices of Geomatrix.

6.7 ASSESSMENTS AND RESPONSE ACTIONS

This section describes laboratory oversight, procedures for corrective actions, and reporting responsibilities.

6.7.1 Field

The field manager will be responsible for correcting equipment malfunctions during the field sampling. In addition to equipment failures, conditions that require a modification of the intent of the sampling program will be coordinated with the Ecology project manager by the field manager or the consultant team project manager. All response actions will be documented in a field logbook.

6.7.2 Analytical Laboratory

ARI participates in Ecology's Environmental Laboratory Accreditation Program and has participated in the EPA Contract Laboratory Program. The laboratory is periodically audited by a variety of outside agencies, including EPA, Ecology, the U.S. Army Corps of Engineers, and the Washington State Department of Health. Results of recent audits are available from ARI upon request.

Corrective actions will occur whenever the QC limits are exceeded for any method specified in Tables 5 through 10. Details of the corrective actions to be taken are contained in the laboratory SOPs for each analytical method and conform to the corrective actions outlined in the Sediment Sampling and Analysis Plan Appendix (Ecology, 2003).

Whenever a corrective action does occur, the laboratory manager is notified. If the corrective action is judged to be routine, such as a slight exceedance of a percent recovery limit, the corrective action will be implemented without notifying the consultant team project manager. If the corrective action requires reanalysis or re-extraction, the consultant team project manager and laboratory coordinator will be notified. Following removal of material for the initial analyses the samples will be frozen, which allows for a 6-month hold time. Therefore, the laboratory will be able to reanalyze/re-extract samples well within the holding time interval.

6.7.3 Biological Laboratory

Biological laboratories selected for toxicity testing will be participants in Ecology's Environmental Laboratory Accreditation Program. Corrective actions will occur whenever the QC limits are exceeded for any protocol specified in PSEP (1995), Ecology (2003), and any relevant annual updates to the protocols and procedures. Details of the corrective actions to be taken are contained in the bioassay laboratory SOPs for each method and conform to the corrective actions outlined in the Sediment Sampling and Analysis Plan Appendix (Ecology, 2003).

Whenever a corrective action does occur, the laboratory manager is notified. If the corrective action is judged to be routine, such as a slight exceedance of a water quality parameter, the corrective action will be implemented without notifying the consultant team project manager. If the corrective action requires rerunning of a bioassay, the consultant team project manager and laboratory coordinator will be notified. The standard holding time for bioassay sediment is 56 days from data of collection. The biological laboratory should be able to conduct any required bioassay testing within the 56-day holding time. However, if bioassay testing or retesting is needed and the standard holding time will be exceeded, then the Ecology project manager will be notified prior to running the test.

7.0 DATA VALIDATION AND USABILITY

This section describes procedures for data validation, verification, and usability.

7.1 DATA REVIEW, VERIFICATION, AND VALIDATION

One hundred percent of the data received from the laboratory will be validated at a Level 1 (basic) review. This Level 1 review will include the following steps.

- Verify that the lab utilized the specified extract, analysis, and cleanup methods.
- Review sample holding time.
- Verify that sample numbers and analyses match those requested on the chain-of-custody form.
- Verify that the required reporting limits have been achieved.
- Verify that field duplicates, matrix spikes, and laboratory control samples were run at the proper frequency and have met QC criteria.
- Verify that the surrogate compound analyses have been performed and have met QC criteria.
- Verify that initial and continuing calibrations were run at the proper frequency and have met acceptance criteria.
- Verify that the lab blanks are free of contaminants.

7.2 VERIFICATION AND VALIDATION METHODS

Data that appear to have significant deficiencies will be validated using the more comprehensive Level 2 verification and review in accordance with the EPA's functional guidelines for data validation (EPA, 1999 and 2004). Following this review, data qualifiers assigned by the laboratory may be amended.

7.3 RECONCILIATION WITH USER REQUIREMENTS

Following receipt of all of the analytical data reports, the consultant team project manager will review the sample results to determine if they fall within the acceptance limits and goals set forth in this SAP/QAPP. If the DQIs do not meet the project requirements, the data may be discarded and reanalysis performed. This decision will be made jointly between the consultant team and the client. If the failure is traced to the analytical laboratory (e.g., sample handling, extraction, or instrument calibration and maintenance), techniques will be reassessed prior to reanalysis.

8.0 DATA ANALYSIS AND REPORTING REQUIREMENTS

8.1 ANALYSIS OF SEDIMENT DATA

Surficial wood debris coverage, TOC, and TVS results will be compared against the project-specific criteria provided in Figure 1 and summarized in Table 1. Additional sediment chemistry data collected as part of the Tier 4 analyses will be compared against the Sediment Management Standards SQS and CSL numerical criteria.

The Sediment Management Standards SQS for many organic compounds is based on carbon-normalized concentrations. The upper limit of TOC where carbon normalization is inappropriate is a site-specific value based on background levels. The upper limit of TOC where carbon normalization is inappropriate is, at this site, a site-specific value based on background levels of the surrounding sediments. This site-specific value is 1.67% (Peter Adolphson, Ecology, personal communications). At TOC values below 0.5% and above 1.67% the PAH and PCB data will be compared to the dry-weight-based standards specified in Table 3 (i.e., LAET).

8.2 ANALYSIS OF BIOLOGICAL DATA

The bioassay data will be compared to the SMS biological effects criteria (Table 12).

8.3 REPORTS TO MANAGEMENT

A data report summarizing the results of the characterization will be prepared by the consultant team and the client for submittal to Ecology. This report will include:

- a narrative of field activities,
- chain-of-custody records,
- a Level 1 data review,
- data tables and maps for sample locations,
- data tables and maps summarizing the results of the analytical analyses, and
- electronic data tables including an EIM compatible data deliverable.

9.0 HEALTH AND SAFETY

All work performed under this SAP will be conducted following the project-specific Health and Safety Plan presented in the RI/FS Work Plan and Geomatrix's Corporate Health and Safety Plan.

10.0 SCHEDULE

The field work for this investigation is dependent on:

1. Ecology approval of this SAP; and
2. issuance of permits.

Field work will start shortly after completion of the above events (assuming no permit restrictions on when the sampling may be conducted). But all sediment sampling will conducted within a month period between August 15 and September 15. Field activities for the sampling are expected to take up to 7 days. The schedule and duration of the field sampling, laboratory analysis, and reporting are presented below.

Task	Schedule
Collect sediment samples, photograph, and process	1 week, Week 1
Conduct post-processing analysis of wood debris coverage	3 weeks, Weeks 2 through 4
Receive initial chemical laboratory data	3 weeks, Weeks 2 through 4
Evaluate preliminary data	2 weeks, Weeks 5 and 6
Meeting with the client and Ecology to discuss results	1 week, Week 7
Potentially conduct additional analyses	Dependent on results of meeting
Perform data quality review and prepare data report	Dependent on results of meeting

11.0 PROJECT MANAGEMENT

This section provides an overview of the project organization, as well as a summary of the nature of the project and QA objectives.

11.1 PRIME CONSULTANT

Geomatrix is the prime consultant working under contract to GBH for the former Custom Plywood Mill project.

11.2 CONSULTANT TEAM PROJECT MANAGER

Geomatrix's Project Manager is Kathleen Goodman. She will be responsible for the overall conduct of the work described in this SAP.

11.3 QA MANAGER

Rob Gilmour of Geomatrix will be the QA Manager for the project. He will be responsible for performing field and quality reviews and ensuring that the sampling and analysis are conducted as per the requirements specified in this SAP.

11.4 FIELD MANAGER

Gary Maxwell will be the Field Manager for the project. He will be responsible for:

- Ensuring that all samples are collected in accordance with this SAP;
- Obtaining authorization to work and anchor at the site;
- Establishing and following chain-of-custody procedures;
- Overseeing compliance with Geomatrix's Corporate Health and Safety Plan;
- Ensuring that all sediment sampling and analysis equipment as described in the Appendix is available and in working order.

11.5 ANALYTICAL LABORATORY COORDINATOR

Cari Sayler of Sayler Data Solutions, Inc., will be the Laboratory Coordinator for the work conducted under this SAP. She will:

- Communicate with and oversee the analytical laboratory, to ensure that project goals are met;

- Coordinate sample analysis with the analytical laboratory.

11.6 BIOLOGICAL LABORATORY COORDINATOR

Rob Gilmour of Geomatrix will be the Biological Laboratory Coordinator for the work conducted under this SAP. He will:

- Communicate with and oversee the bioassay laboratory, to ensure that project goals are met;
- Coordinate sample testing with the bioassay laboratory.

11.7 DATA MANAGEMENT

Cari Saylor will be responsible for the analytical data management for the project. She will:

- Import the electronic data deliverable (EDD) provided by the analytical laboratory into a data management system;
- Produce analytical data tables for the data report that will be provided as part of this work (see Section 8.3); and
- Produce the EIM compatible EDD described in Section 8.3.

11.8 DATA VALIDATION

Cari Sayler will also perform the validation of all analytical data as described in Section 7.0 of this SAP.

11.9 ANALYTICAL LABORATORY PROJECT MANAGER

Analytical testing will be conducted by ARI, Tukwila, Washington. ARI is a Washington accredited full-service chemical analytical laboratory. Mark Harris will be the ARI Project Manager.

11.10 BIOASSAY LABORATORY PROJECT MANAGER

Bioassay testing will be conducted by NewFields Northwest, LLC, Port Gamble, Washington. NewFields Northwest is an accredited bioassay laboratory. Brian Hester will be the NewFields Northwest project manager.

12.0 REFERENCES

Ecology (Washington State Department of Ecology), 2003, Sediment Sampling and Analysis Plan Appendix: Ecology, Olympia.

EPA (U.S. Environmental Protection Agency), 1999, Contract Laboratory Program National Functional Guidelines for Organic Data Review: OSWER, EPA 540/R 99-008, Washington, D.C.

EPA, 2004, Contract Laboratory Program National Functional Guidelines for Inorganic Data Review: OSWER, EPA 540/R 04-004, Washington, D.C.

Foster, M.S., C. Harrold, and D.D. Hardin, 1991, Point vs Photo Quadrat Estimates of the Cover of Sessile Marine Organisms, Journal of Experimental Marine Biology and Ecology 146: 193-203.

Michelsen, T.C., 1992, Technical Information Memorandum, Organic Carbon Normalization of Sediment Data: Sediment Management Unit, Washington State Department of Ecology, Publication No. 05-09-050, Olympia.

PSEP (Puget Sound Estuary Program), 1995, Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments, Interim Final Report, Puget Sound Estuary Report, U.S. EPA Region 10, Seattle, Washington

PSEP, 1997, Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound: Prepared for the U.S. Environmental Protection Agency and Puget Sound Water Quality Action Team.

TABLES

TABLE 1

TIERED ANALYSIS SCHEDULE

Former Custom Plywood Mill
Anacortes, Washington

Testing Round	Stations Tested	Parameters[1]	Methods[2]	Criteria[3]	
Tier 1 Wood Debris Sampling					
	All grab samples	Surficial Wood Coverage	Visual Method (Point Contact)	≥ 25%	≥ 50% AoPC
		Total volatile solids (TVS)	ASTM D2974 (large volume)	≥9.7%	≥ 17%
		Total organic carbon (TOC)	SM 5310B Modified	≥ 10%	
		Pore water Sulfide	SM 4500-S2		
		Pore water Ammonia	EPA 350.1		
		Pore water Microtox	Ecology, 2003	SMS SQS	N/A
Tier 2 Ecological Testing				SMS	
	All samples with wood coverage < 50% that fail Tier 1 criteria	Amphipod	PSEP 1995	SQS	CSL AoPC
		Sediment Larval	PSEP 1995	SQS	CSL AoPC
Tier 3 Human Health Risk Screening					
	Composite of all samples that pass Tier1 and Tier 2 criteria.	Dioxins	EPA 1613B	> Human health AoPC	
		PCBs by Aroclor	EPA 8082	> Human health AoPC	
Tier 4 Sediment Management Standards COCs				SMS	
	All samples that fail Tier 3 ecological criteria	SMS Metals	EPA 6010/ EPA 7471A	SQS	CSL
		SMS Aromatic hydrocarbons	EPA 8270D	SQS	CSL
		SMS Chlorinated benzenes	EPA 8270D	SQS	CSL
		SMS Phthalate esters	EPA 8270D	SQS	CSL
		SMS Miscellaneous	EPA 8270D/ EPA 8082	SQS	CSL
		SMS Ionizable organic compounds	EPA 8270D	SQS	CSL
Additional Analyses					
	Stations adjacent to upland wells that have elevated TPH	TPH	Ecology		

Notes:
1. PCBs = Polychlorinated biphenyls; SMS = Sediment Management Standards; TPH = Total petroleum hydrocarbons.
2. Methods are U.S. Environmental Protection Agency (EPA) method number; Standard Method (SM) for the Examination of Water and Wastewater Method; ASTM International (ASTM) standard test method; or Washington Department of Ecology (Ecology) Methods.
3. AoPC = Area of Potential concern; SQS = Sediment Quality Standards; CSL = Cleanup screening levels.

TABLE 2

PROPOSED SAMPLE LOCATIONS

Former Custom Plywood Mill
Anacortes, Washington

Station Name	Proposed Sample Location (SPCS WA N [4601] NAD83 Survey Feet)[1]	
	Easting	Northing
ST-1	1211927	550734
ST-2	1212310	550712
ST-3	1212685	550712
ST-4	1213060	550712
ST-5	1211994	550462
ST-6	1212369	550462
ST-7	1212744	550462
ST-8	1213119	550462
ST-9[2]	1212049	550233
ST-10	1212428	550212
ST-11	1212803	550212
ST-12	1213178	550212
ST-13	1212116	549962
ST-14	1212487	549962
ST-15	1212862	549962
ST-16	1213237	549962
ST-17	1212172	549712
ST-18	1212547	549712
ST-19	1212922	549712
ST-20[2]	1213297	549712
ST-21	1212172	549462
ST-22	1212606	549462
ST-23	1212981	549462
ST-24	1213356	549462
ST-25	1212264	549210
ST-26	1212665	549212
ST-27	1213040	549212
ST-28	1213415	549212
ST-29	1212350	548962
ST-30	1212725	548962
ST-31	1213100	548962
ST-32	1213475	548962

Notes:

1. State Plane Coordinate System for northern Washington (SPSC WA N), Zone 4601, based on the North American Datum of 1983 (NAD83).
2. A duplicate grab sample will be collected at this location.

TABLE 3

DATA QUALITY OBJECTIVES FOR THE CONSTITUENTS OF CONCERN PRACTICAL QUANTITATION REQUIREMENTS

Former Custom Plywood Mill
Anacortes, Washington

Chemical Parameter	**Sediment Management Standards**		**LAET[3]**
	SQS[1]	**CSL[2]**	
Metals	**mg/kg dry wt[4]**	**mg/kg dry wt**	**mg/kg dry wt**
Arsenic	57	93	57
Cadmium	5.1	6.7	5.1
Chromium	260	270	260
Copper	390	390	390
Lead	450	530	450
Mercury	0.41	0.59	0.41
Silver	6.1	6.1	6.1
Zinc	410	960	410
Nonionizable Organic Compounds			
Aromatic Hydrocarbons	**mg/kg carbon**	**mg/kg carbon**	**µg/kg dry wt[5]**
Total LPAH	370	780	5,200
Naphthalene	99	170	2,100
Acenaphthylene	66	66	1,300
Acenaphthene	16	57	500
Fluorene	23	79	540
Phenanthrene	100	480	1,500
Anthracene	220	1,200	960
2-Methylnaphthalene	38	780	670
Total HPAH	960	5,300	12,000
Fluoranthene	160	1,200	1,700
Pyrene	1,000	1,400	2,600
Benz[a]anthracene	110	270	1,300
Chrysene	110	460	1,400
Total benzofluoranthenes	230	450	3,200
Benzo[a]pyrene	99	210	1,600
Indeno[1,2,3-c,d]pyrene	34	88	600
Dibenzo[a,h]anthracene	12	33	230
Benzo[g,h,i]perylene	31	78	670

TABLE 3

DATA QUALITY OBJECTIVES FOR THE CONSTITUENTS OF CONCERN PRACTICAL QUANTITATION REQUIREMENTS

Former Custom Plywood Mill
Anacortes, Washington

Chemical Parameter	**Sediment Management Standards**		**LAET[3]**
	SQS[1]	**CSL[2]**	
Nonionizable Organic Compounds	**mg/kg carbon**	**mg/kg carbon**	**µg/kg dry wt**
Chlorinated Benzenes			
1,2-Dichlorobenzene	2.3	2.3	35
1,4-Dichlorobenzene	3.1	9	110
1,2,4-Trichlorobenzene	0.81	1.8	31
Hexachlorobenzene	0.38	2.3	22
Phthalate Esters			
Dimethyl phthalate	53	53	71
Diethyl phthalate	61	110	200
Di-n-butyl phthalate	220	1700	1400
Butyl benzyl phthalate	4.9	64	63
Bis[2-ethylhexyl] phthalate	47	78	1300
Di-n-octyl phthalate	58	4500	6200
Miscellaneous			
Dibenzofuran	15	58	540
Hexachlorobutadiene	3.9	6.2	11
N-Nitrosodiphenylamine	11	11	28
Total PCBs	12	65	130
Ionizable Organic Compounds	**µg/kg dry wt**	**µg/kg dry wt**	**µg/kg dry wt**
Phenol	420	1200	420
2-Methylphenol	63	63	63
4-Methylphenol	670	670	670
2,4-Dimethylphenol	29	29	29
Pentachlorophenol	360	690	360
Benzyl alcohol	57	73	57
Benzoic acid	650	650	650

Notes:
1. Sediment Management Standards Sediment Quality Standards (WAC 173-204-320).
2. Sediment Management Standards Cleanup Screening Levels (WAC 173-204-520).
3. LAET = Lowest Apparent Effects Threshold.
4. mg/kg dry wt = milligrams per kilogram dry weight.
5. µg/kg dry wt = micrograms per kilogram dry weight.

TABLE 4

ANALYTICAL METHODOLOGIES AND REPORTING LIMITS

Former Custom Plywood Mill
Anacortes, Washington

Parameter	Sample Prep/Extraction[1]	Analytical Method[2]	Reporting Limit[3]
Conventionals			
Total Organic Carbon		ARI SOP 602S	200 ppm
Total Volatile Solids		ASTM D2974	0.1%
Total Solids		ARI SOP 639S	0.01%
Pore Water Ammonia		EPA 350.1	0.10 mg-N/L
Pore Water Sulfide		SM 4500-S2	0.50 mg/L
Metals			
Arsenic	ARI SOP 515S	EPA 6010	5 ppm wet weight
Cadmium	ARI SOP 515S	EPA 6010	0.2 ppm wet weight
Chromium	ARI SOP 515S	EPA 6010	0.5 ppm wet weight
Copper	ARI SOP 515S	EPA 6010	0.2 ppm wet weight
Lead	ARI SOP 515S	EPA 6010	2 ppm wet weight
Mercury	ARI SOP 515S	EPA 7471A	0.05 ppm wet weight
Silver	ARI SOP 515S	EPA 6010	0.3 ppm wet weight
Zinc	ARI SOP 515S	EPA 6010	0.6 ppm wet weight
Nonionizable Organic Compounds			
Aromatic Hydrocarbons			
Total LPAH			
Naphthalene	Sonication	EPA 8270D	20 ppb dry weight
Acenaphthylene	Sonication	EPA 8270D	20 ppb dry weight
Acenaphthene	Sonication	EPA 8270D	20 ppb dry weight
Fluorene	Sonication	EPA 8270D	20 ppb dry weight
Phenanthrene	Sonication	EPA 8270D	20 ppb dry weight
Anthracene	Sonication	EPA 8270D	20 ppb dry weight
2-Methylnaphthalene	Sonication	EPA 8270D	20 ppb dry weight
Total HPAH			
Fluoranthene	Sonication	EPA 8270D	20 ppb dry weight
Pyrene	Sonication	EPA 8270D	20 ppb dry weight
Benz[a]anthracene	Sonication	EPA 8270D	20 ppb dry weight
Chrysene	Sonication	EPA 8270D	20 ppb dry weight
Total benzofluoranthenes			
Benzo(b)fluoranthene	Sonication	EPA 8270D	20 ppb dry weight
Benzo(k)fluoranthene	Sonication	EPA 8270D	20 ppb dry weight
Benzo[a]pyrene	Sonication	EPA 8270D	20 ppb dry weight
Indeno[1,2,3-c,d]pyrene	Sonication	EPA 8270D	20 ppb dry weight
Dibenzo[a,h]anthracene	Sonication	EPA 8270D	20 ppb dry weight
Benzo[g,h,i]perylene	Sonication	EPA 8270D	20 ppb dry weight

TABLE 4

ANALYTICAL METHODOLOGIES AND REPORTING LIMITS

Former Custom Plywood Mill
Anacortes, Washington

Parameter	Sample Prep/Extraction	Analytical Method	Reporting [1] Limit
Nonionizable Organic Compounds			
Chlorinated Benzenes			
1,2-Dichlorobenzene	Sonication	EPA 8270D	20 ppb dry weight
1,4-Dichlorobenzene	Sonication	EPA 8270D	20 ppb dry weight
1,2,4-Trichlorobenzene	Sonication	EPA 8270D	20 ppb dry weight
Hexachlorobenzene	Sonication	EPA 8270D	20 ppb dry weight
Phthalate Esters			
Dimethyl phthalate	Sonication	EPA 8270D	20 ppb dry weight
Diethyl phthalate	Sonication	EPA 8270D	20 ppb dry weight
Di-n-butyl phthalate	Sonication	EPA 8270D	20 ppb dry weight
Butyl benzyl phthalate	Sonication	EPA 8270D	20 ppb dry weight
Bis[2-ethylhexyl] phthalate	Sonication	EPA 8270D	20 ppb dry weight
Di-n-octyl phthalate	Sonication	EPA 8270D	20 ppb dry weight
Miscellaneous			
Dibenzofuran	Sonication	EPA 8270D	20 ppb dry weight
Hexachlorobutadiene	Sonication	EPA 8270D	20 ppb dry weight
N-Nitrosodiphenylamine	Sonication	EPA 8270D	20 ppb dry weight
Total PCBs	Sonication	EPA Method 8082	20 ppb dry weight per Aroclor
Ionizable Organic Compounds			
Phenol	Sonication	EPA 8270D	20 ppb dry weight
2-Methylphenol	Sonication	EPA 8270D	20 ppb dry weight
4-Methylphenol	Sonication	EPA 8270D	20 ppb dry weight
2,4-Dimethylphenol	Sonication	EPA 8270D	20 ppb dry weight
Pentachlorophenol	Sonication	EPA 8270D	100 ppb dry weight
Benzyl alcohol	Sonication	EPA 8270D	100 ppb dry weight
Benzoic acid	Sonication	EPA 8270D	200 ppb dry weight

Notes:

1. ARI SOP = Analytical Resources, Inc., Standard Operating Procedures.
2. Methods given as Analytical Resources, Inc., Standard Operating Procedures (ARI SOP); U.S. Environmental Protection Agency (EPA) Method; ASTM International (ASTM) method number; or Standard Methods (SM) for the analysis of water and wastewater number.\
3. Reporting limits obtained from Analytical Resources, Inc (ARI).

TABLE 5

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 8082—PCBs[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	After CCVs fail	RSD $\leq$ 20% or r $\geq$ 0.995
Continuing Calibration Verification (CCV)	At the beginning and end of analytical sequence, and every 10 samples	% Recovery = 75% to 125%
Method Blank (MB)	1 per extraction batch of <20 samples	Analytes < RL
Laboratory Control Sample (LCS)	1 per extraction batch of <20 samples	Solids: % Recovery = 50% to 130%
Matrix Spike (MS)	1 per 20 samples	% Recovery = 40% to 140%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	1 per 20 samples	RPD $\leq$ 50%
Regional Reference Material (RRM)	1 per 60 samples	Advisory Limits: Average +/- 2SD % Recovery 19% to 112%
Surrogates	Every sample as specified	% Recovery = 30% to 150%
Target Analyte Confirmation		RPD $\leq$ 40%

Notes:

1. RSD = relative standard deviation.
   RPD = relative percent difference.
   RL = reporting limit.
   SD = standard deviation.

TABLE 6

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 6010—ICP METALS[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Description of Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	Option 1: 1 standard and blank, and a low-level-check standard at 2 X RL	Daily	Option 1: Low-level-check standard ± 1 RL
	Option 2: 3 standards and blank		Option 2: r $\geq$ 0.995
Instrumental Precision	% RSD 3 integrations (exposures)	Each calibration and calibration verification standards (ICV/CCV)	% RSD < 5%
Initial Calibration Verification (ICV)	Midlevel (2nd source) verification	After initial calibration	% Recovery 90% to 110%
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination	After initial calibration	Analytes < RL
Continuing Calibration Verification (CCV)	Midlevel verification	Every 10 samples and at end of analytical sequence	% Recovery 90% to 110%
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination	Every 10 samples and at end of analytical sequence	Analytes < RL
Method Blank (MB)	Interference-free matrix to assess overall method contamination	1 per extraction batch of $\leq$20 samples	Analytes < RL or < 1/10th lowest sample instrument concentration.
Laboratory Control Sample (LCS)	Interference-free matrix containing all target analytes	1 per extraction batch of $\leq$20 samples	% Recovery = 80% to 120% Sporadic Marginal Failures[2]; % Recovery = 80% to 140%
Matrix Spike (MS)	Sample matrix spiked with all or a subset of target analytes prior to digestion	1 per 20 samples	% Recovery = 75% to 125%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	Refer to text for MD or MS	1 per 20 samples	RPD $\leq$ 20%

Notes:

1. RL = Reporting limit.
   RPD = Relative percent difference.
   RSD = Relative standard deviation.
2. The number of Sporadic Marginal Failure (SMF) allowances depend on the number of target analytes reported from the analysis. In the instance of only seven metals, one SMF is allowed.

TABLE 7

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 7000 SERIES—METALS VIA GFAA/CVAA[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Description of Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	3 standards and blank	Daily	r > 0.995
Instrumental Precision	RPD of 2 injections	All standards, and ICV/CCV	RPD ≤ 10%
Initial Calibration Verification (ICV)	Midlevel (2nd source) verification	After initial calibration	% Recovery = 90% to 110%
Initial Calibration Blank (ICB)	Interference-free matrix to assess analysis contamination	After initial calibration	Analytes < RL
Continuing Calibration Blank (CCB)	Interference-free matrix to assess analysis contamination	Every 10 samples and at end of analytical sequence	Analytes < RL
Continuing Calibration Verification (CCV)	Midlevel verification	Every 10 samples and at end of analytical sequence	% Recovery = 80% to 120%
Method Blank (MB)	Interference-free matrix to assess overall method contamination	1 per preparation batch of ≤20 samples	Analytes < RL
Laboratory Control Sample (LCS)	Interference-free matrix containing target analytes	1 per preparation batch of ≤20 samples	% Recovery = 80% to 120%
Matrix Spike (MS)	Sample matrix spiked with target analytes prior to digestion	1 per 20 samples	% Recovery = 75% to 125%
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	Refer to text for MD or MS	1 per 20 samples	RPD <20%
Post-Digestion Spike (PDS)	Sample digestate spiked with target analytes	As needed to confirm matrix effects	% Recovery = 85% to 115%

Notes:

1. RL = Reporting limit.
   RPD = Relative percent difference.

TABLE 8

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 8270D—SVOCs[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	**Frequency of Implementation**	**Acceptance Criteria**
Initial Calibration	After CCV fails	r ≥ 0.995 or RSD ≤ 15%, RRF >0.050 for SPCC and >0.010 for other compounds.
Continuing Calibration Verification (CCV)	At the beginning of each 12 hour shift	%D < 20% for CCC and < 40% for other compounds, RRF >0.050 for SPCC and >0.010 for other compounds.
Method Blank (MB)	1 per extraction batch of ≤20 samples	Analytes < RL
Laboratory Control Sample (LCS)	1 per extraction batch of ≤20 samples	Solids: % Recovery = 50% to 130% B/N compounds % Recovery = 40% to 140% A compounds
Matrix Spike (MS)	1 per 20 samples	Solids: % Recovery = 40% to 140% B/N compounds % Recovery = 30% to 150% A compounds
Matrix Duplicate (MD) or Matrix-Spike Duplicate (MSD)	1 per 20 samples	RPD ≤ 60%
Surrogates: Interference-Free Matrix Project Sample Matrix	Every sample as specified	Interference-Free Matrix Solids: % Recovery = 50% to 130% B/N compounds % Recovery = 40% to 140% A compounds Project Sample Matrix Solids: % Recovery = 40% to 140% B/N compounds % Recovery = 30% to 150% A compounds

Notes:

1. RSD = relative standard deviation
   RPD = relative percent difference
   RRF = relative response factor.
   %D = percent difference.
   RL = reporting limit.
   SPCC = System performance check compounds.
   CCC = Calibration check compounds.
   B/N compounds = Base neutral extractable compounds
   A compounds = Acid-extractable compounds.

TABLE 9

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 1613B—DIOXINS/FURANS[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Frequency of Implementation	Acceptance Criteria
Initial Calibration	Until CCV fails	m/z ratio within ± 15% of theoretical Signal/noise ratio ≥10:1 RR RSD ≤ 20% RRF RSD ≤ 35% RTs within windows GC resolution ≤ 25%
Mass Calibration and Mass Spectrometer Resolution	Beginning and end of each 12-hour shift	Resolving power ≥ 10,000
Window Defining Mix	Beginning of each 12-hour shift	RTs within windows
Continuing Calibration Verification (CCV)	Beginning of each 12-hour shift	m/z ratio within ± 15% of theoretical Signal/noise ratio ≥10:1 RR %D ≤ ± 20% RRF %D ≤ ± 35% RTs within windows
Method Blank (MB)	1 per extraction batch	Analytes < RL or < 5x Sample Conc.
Ongoing Precision and Recovery (OPR)	1 per sample batch	2,3,7,8-TCDD 67-158% 2,3,7,8-TCDF 75-158% 1,2,3,7,8-PeCDD 70–142% 1,2,3,7,8-PeCDF 80-134% 2,3,4,7,8-PeCDF 68-160% 1,2,3,4,7,8-HxCDD 70-164% 1,2,3,6,7,8-HxCDD 76-134% 1,2,3,7,8,9-HxCDD 64-162% 1,2,3,4,7,8-HxCDF 72-134% 1,2,3,6,7,8-HxCDF 84-130% 1,2,3,7,8,9-HxCDF 78-130% 2,3,4,6,7,8-HxCDF 70–156% 1,2,3,4,6,7,8-HpCDD 70–140% 1,2,3,4,6,7,8-HpCDF 82-132% 1,2,3,4,7,8,9-HpCDF 78-138% OCDD 78-144% OCDF 63-170 %

TABLE 9

SUMMARY OF METHOD QUALITY OBJECTIVES FOR METHOD 1613B—DIOXINS/FURANS

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Frequency of Implementation	Acceptance Criteria	
Labeled compound recoveries	Each sample and QC sample	13C12-2,3,7,8-TCDF	24-169%
		13C12-1,2,3,7,8-PeCDD	25-181%
		13C12-1,2,3,7,8-PeCDF	24-185%
		13C12-2,3,4,7,8-PeCDF	21-178%
		13C12-1,2,3,4,7,8-HxCDD	32-141%
		13C12-1,2,3,6,7,8,-HxCDD	28-130%
		13C12-1,2,3,4,7,8-HxCDF	26-152%
		13C12-1,2,3,6,7,8-HxCDF	26-123%
		13C12-1,2,3,7,8,9-HxCDF	29-147%
		13C12-2,3,4,6,7,8,-HxCDF	28-136%
		13C12-1,2,3,4,6,7,8-HpCDD	23-140%
		13C12-1,2,3,4,6,7,8-HpCDF	28-143%
		13C12-1,2,3,4,7,8,9-HpCDF	26-138%
		13C12-OCDD	17-157%
		37C14-2,3,7,8-TCDD	35-197%
		13C12-2,3,7,8-TCDD	25-164%
2,3,7,8-TCDF Confirmation	Each sample with 2,3,7,8-TCDF detected concentration above RL	Second dissimilar column meeting all analysis criteria	

Notes:

1. RR = Relative response.
   RRF = Relative response factor.
   RSD = Relative standard deviation.
   RL = Reporting limit.
   %D = Percent difference.
   RT = Retention time.
   m/z = Ion abundance.
   GC = Gas chromatography.

TABLE 10

SUMMARY OF METHOD QUALITY OBJECTIVES FOR SEDIMENT CONVENTIONALS[1]

Former Custom Plywood Mill
Anacortes, Washington

Quality Control Element	Suggested Control Limit					
	Total Organic Carbon	**Ammonia**	**Sulfide**	**Total Volatile Solids**	**Grain Size**	**Total Solids**
Initial Calibration	r > 0.995	r > 0.995	r > 0.990	NA	NA	NA
Continuing Calibrations	% recovery + 10%	% recovery + 10%	% recovery + 15%	NA	NA	NA
Calibration Blank	Analytes < RL	Analytes < RL	Analytes < RL	NA	NA	NA
Laboratory Control Sample (LCS)	% recovery + 20%	% recovery + 20%	% recovery + 35%	NA	NA	NA
Matrix Spike (MS)	% recovery + 25%	% recovery + 25%	% recovery + 35%	NA	NA	NA
Laboratory Triplicates	RSD < 20%	RSD < 20%	RSD < 20%	RSD < 20%	RSD < 20%	RSD < 20%
Method Blank	Analytes < RL	Analytes < RL	Analytes < RL	Analytes < RL	NA	Analytes < RL

Notes:

1. RL = reporting limit.
   RSD = relative standard deviation.
   NA = Not applicable.

TABLE 11

DATA QUALIFIERS

Former Custom Plywood Mill
Anacortes, Washington

Qualifier	Description
J	The analyte was positively identified; the quantitation is an estimation.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification.
UJ	The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

TABLE 12

BIOLOGICAL EFFECTS CRITERIA FOR PUGET SOUND MARINE SEDIMENTS

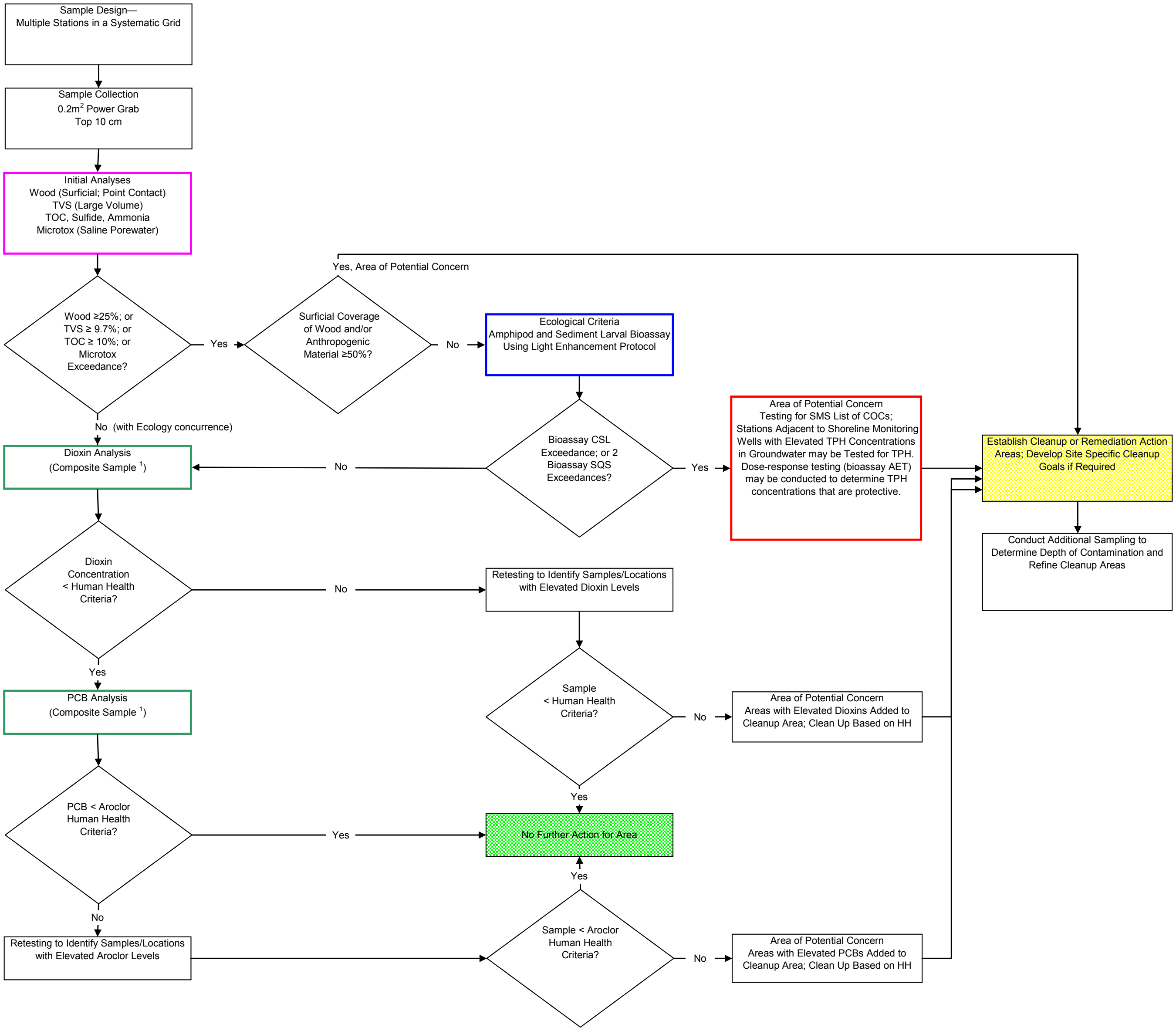
Former Custom Plywood Mill
Anacortes, Washington

Biological Tests	Sediment Quality Standards	Cleanup Screening Levels
Microtox®	The mean light output of the highest concentration of the test sediment is less than 80% of the reference sediment, and the two means are statistically different (T-test, $P \leq 0.05$).	NA[1]
Amphipod	The test sediment has a significantly higher (t-test, $P \leq 0.05$) mean mortality than the reference sediment, and the test sediment mean mortality is more than 25 percent greater, on an absolute basis, than the reference sediment mean mortality.	The test sediment has a significantly higher (t-test, $P \leq 0.05$) mean mortality than the reference sediment, and the test sediment mean mortality is more than 30 percent greater, on an absolute basis, than the reference sediment mean mortality.
Sediment Larval	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, $P \leq 0.1$) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 85 percent of the mean normal survivorship in the reference sediment.	The test sediment has a mean survivorship of normal larvae that is significantly less (t-test, $P \leq 0.1$) than the mean normal survivorship in the reference sediment, and the mean normal survivorship in the test sediment is less than 70 percent of the mean normal survivorship in the reference sediment.

Notes:

1. NA = Not applicable

FIGURES



Note:

[1] Dioxin and PCB composite samples will include homogenized aliquots from sample locations that pass the initial screening criteria or biological criteria. Composites may be created from all stations combined or for station groupings.

🟪 Tier 1 Analysis (see Table 1 in Sampling and Analysis Plan)

🟦 Tier 2 Analysis (see Table 1 in Sampling and Analysis Plan)

🟩 Tier 3 Analysis (see Table 1 in Sampling and Analysis Plan)

🟥 Tier 4 Analysis (see Table 1 in Sampling and Analysis Plan)

Geomatrix

FLOWCHART OF TIERED ANALYSIS SCHEDULE
Former Custom Plywood Mill
Anacortes, Washington

Project No.
10654

Figure
1

Plot Date: 09/12/08 - 4:58pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 14_Former Mill Sediment Sampling_081908.dwg

Aerial Photo Courtesy of City of Anacortes

● Proposed Sediment Grab Sampling Location

0 100 200
APPROXIMATE SCALE IN FEET

PROPOSED SEDIMENT GRAB
SAMPLING LOCATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM | Date: 09/12/08 | Project: 10654

Geomatrix

Figure **2**

Plot Date: 09/12/08 - 5:02pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 6_Historic Sampling Stations.dwg

● Geomatrix 2006
■ Ecology 1997b
⊕ EPA 1997
▼ EPA & NOAA 2003
▲ ENVIROS 1995
◇ EPA 2000
⊕ Proposed Grab Sampling Location

Image Courtesy of U.S. Department pf Agriculture
Farm Services Agency Aerial Photography Field Office

0 250 500
APPROXIMATE SCALE IN FEET

PROPOSED SEDIMENT SAMPLING LOCATIONS AND HISTORICAL INVESTIGATIONS

Former Custom Plywood Mill
Anacortes, Washington

By: GSM	Date: 09/12/08	Project: 10654
Geomatrix		Figure 3

ATTACHMENT B1

Sample Collection Procedures

Final Sediment Sample Collection Procedures

Former Custom Plywood Mill

Anacortes, Washington

Prepared for:

GBH Investments, LLC
13941 Gibralter Road
Anacortes, Washington 98221

Prepared by:

Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
(206) 342-1760

September 2008

Project No. 10654

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FINAL SEDIMENT SAMPLE COLLECTION PROCEDURES
Former Custom Plywood Mill
Anacortes, Washington

1.0 GENERAL

Surficial sediment grab samples will be collected at 32 locations (plus duplicate samples at 2 of these locations for a total of 34 grab samples; Figure 1). Table 1 presents a list of grab sampling locations and coordinates. A minimum of 15 centimeters (cm) of penetration will be needed for an acceptable grab sample. If penetration is less than 15 cm, a second attempt will be made to obtain a satisfactory grab. Stations ST-9 and ST-20 will have a duplicate grab collected within approximately 2 meters (m) (6.5 feet) of the original grab location to serve as a field duplicate.

2.0 SAMPLE COLLECTION METHODS

Surficial sediment samples will be collected using a modified stainless-steel, 0.2-square-meter (m^2) pneumatically operated grab sampler. The sampler will be decontaminated prior to arrival at the site in accordance with Section 4.0. The planned sampling locations are shown on Figure 1. Grab sample stations will be located with a differential global positioning system set up on board the sampling vessel. Sample locations will be recorded for each attempted grab. Water depth at the grab location will be determined using an electronic depth sounder or a weighted lead line.

The sampler will be deployed and retrieved with minimum swinging out of the water. Excessive swinging can cause the sampler to trigger prematurely upon deployment and disturb the sediment sample upon retrieval. Swinging is minimized by heading the survey vessel into any waves when the sampler is out of the water and by attaching handling lines to the cable operated by the sampling team.

Because form drag and skin friction of the sampler can produce a bow wave when the device is lowered too quickly, it is essential that the sampler enter the sediment at a relatively slow speed. The lowering speed of the sampler upon entering the sediment must be 0.3 meters per second (m/sec) or less (~1 foot/sec). Lowering rates through the water column can be faster until the sampler is several meters from the bottom as long as the speed at sediment entry is 0.3 m/sec or less. Swell and chop can significantly degrade samples because of effects on the entry speed of the sampler (vertical ship motion alternately adds to and subtracts from entry velocity). These factors will be considered when swell and chop are present.

After the sampler contacts the bottom, it is initially retrieved slowly to permit the device to close properly. After the jaws are closed, a constant retrieval speed will be maintained to avoid jerking the sampler and possibly disturbing the sample. The sampler will be secured as soon as possible after being brought on board.

3.0 SAMPLE PROCESSING METHODS

This section describes the procedures for processing grab samples. Processing steps include the initial inspection and acceptance of a grab, photography and sediment description, pore water collection for sulfide and ammonia analysis, and sediment collection and homogenation. The proposed tiered sample analysis schedule is presented in Table 2.

3.1 SAMPLE ACCEPTABILITY CRITERIA

After the sampler has been secured, the sediment sample will be inspected carefully before being accepted. The following acceptability criteria should be satisfied.

- The sampler is not overfilled with the sample such that the sediment surface is pressed against the top of the sampler.
- Overlying water is present (indicates minimal leakage).
- The overlying water is not excessively turbid (clear water indicates minimal sample disturbance).
- The sediment surface is relatively flat (indicates minimal disturbance or winnowing).
- The penetration depth is at least 15 cm for a 10-cm-deep surficial sample.

If a sample does not meet any one of these criteria, it will be rejected.

If the sample is acceptable, the overlying water must be removed. The water is slowly siphoned off near one side of the sampler with a minimum of sample disturbance.

3.2 PHOTOGRAPHY AND SEDIMENT DESCRIPTION

Once the overlying water has been removed, the surface of the grab is photographed using a digital camera. The digital camera is mounted on a removable bracket that attaches to the grab sampler and provides a consistent field of view. The photograph is used to document the grab and also for estimating the surficial wood debris coverage. Wood debris coverage is estimated using a modified point contact method presented in Section 3.3 of the Sampling and Analysis Plan for Sediment Characterization.

A qualitative sample characteristics form is filled out for each acceptable grab. Surface and subsurface sediment characteristics are documented. Penetration depth is recorded.

3.3 PORE WATER COLLECTION

Once the grab has been photographed, pore water will be collected from the surface of the grab using syringe-type pore water samplers. The samplers will be decontaminated and assembled prior to arrival on site. The samplers will be filled with nitrogen gas to inert them prior to use. The nitrogen in the samplers will be purged prior to insertion in the sediment. The perforated sample tubes will be inserted to the correct depth to sample the top 10 cm of sediment. Suction will be applied to the sampler until sufficient sample volume is obtained. If a single sampler does not collect sufficient volume then multiple samplers may be used. A minimum volume of approximately 30 milliliters (ml) of pore water from each grab is needed to meet the reporting limits. The pore water is transferred into the sulfide and ammonia sample containers and preserved appropriately.

3.4 SEDIMENT COLLECTION AND HOMOGENATION

After pore water collection the surface sediment can be removed for bioassay testing and additional analysis as needed. Surface sediments (0-10 cm) for the pore water Microtox® toxicity assessment will be placed directly from the grab into a 16-ounce (oz) glass jar (i.e., no homogenization). A minimum of 6 liters (L) of the remaining surface sediments will be removed from the grab and thoroughly homogenized. Sample material that is, or has been, in direct contact with the grab sampler will not be homogenized. Table 3 lists by analyte the holding time requirements and required sample containers.

4.0 EQUIPMENT DECONTAMINATION

Sample containers, instruments, working surfaces, technician protective gear, and other items that may come into contact with sediment sample material must meet high standards of cleanliness. Sample containers will be provided by Analytical Resources, Inc., and are pre-cleaned, certified, and individually labeled with a lot number traceable to a Certificate of Analysis.

The grab sampler will be precleaned prior to arrival at the site using the procedure described below. All equipment and instruments used to remove sediment from the sampler or to homogenize samples will be stainless steel and will be decontaminated before and in between each use using the procedure described below. The Geomatrix standard decontamination procedure for the grab sampler and other sample handling equipment is modeled after Puget Sound Estuary Program (PSEP) protocols (PSEP, 1997); however, the decontamination procedure will not use any acid or solvent rinses (the final rinse will use distilled water). The decontamination procedure is as follows:

- Prewash rinse with tap water;
- First wash with solution of tap water and Alconox soap (brush);
- Second rinse with tap water;
- Second wash with solution of tap water and Alconox soap (brush);
- Final rinse with tap water;
- Final rinse with distilled water;
- Coverage (no contact) of all decontaminated items with aluminum foil;
- Storage in clean, closed container prior to use.

The grab sampler will be rinsed free of any sediment between attempts. Sediment touching the stainless steel sides or bottom of the sampler will not be collected for testing or analysis.

5.0 SAMPLE DESIGNATIONS

All samples will be assigned a unique identification code. Grab samples will be designated by a numeric code consisting of a project number (10654) and sample number code (e.g., 10654001). The sample labels will be sequentially printed starting at sample 10654001. Using a sequential numeric code streamlines the sample process and reduces the risk of mislabeled sample jars.

6.0 SAMPLE HANDLING

Sediment samples will be kept in sight of the sampling crew or in a secure, locked vehicle at all times. Samples will be transported to the Geomatrix office at the end of the sampling event for storage (samples will be placed in coolers with prefrozen commercial chill packs [“blue ice”] or frozen) until transferred to the testing laboratories. Transfer of samples from Geomatrix custody to the laboratory will be documented using chain-of-custody procedures (Figure 2). If someone other than the sample collector transports samples to the laboratory, the collector will sign and date the chain-of-custody form and insert the name of the person or firm transporting the samples under “transported by” before sealing the container with a Custody Seal.

Samples not scheduled for the initial analysis round will be archived and stored at the analytical laboratory in a secure area. Storage requirements for all archived analytical samples will include freezing and storage of the samples in a temperature-monitored freezer at −18°C. Archived bioassay sediments will be stored in a temperature-monitored refrigerator in the dark at 4°C.

7.0 FIELD QUALITY CONTROL REQUIREMENTS

Data and log forms produced in the field will be reviewed daily by the person recording the data, so that any errors or omissions can be corrected. All completed data sheets will be removed daily from the field clipboard and photocopied; the original data sheets will be filed in a fireproof file cabinet and the photocopies stored in the project file. All data transcribed from field forms into electronic forms and tables will be 100 percent verified for accuracy and freedom from transcription errors.

8.0 WASTE MANAGEMENT

All waste derived during this investigation will be placed in proper containers, labeled, characterized, and disposed of by the client or Geomatrix in accordance with the appropriate regulations.

9.0 REFERENCE

PSEP (Puget Sound Estuary Program), 1997, Recommended Guidelines for Sampling Marine Sediment, Water Column, and Tissue in Puget Sound: Prepared for the U.S. Environmental Protection Agency and Puget Sound Water Quality Action Team.

TABLES

TABLE 1

PROPOSED SAMPLE LOCATIONS

Former Custom Plywood Mill
Anacortes, Washington

Station Name	Proposed Sample Location (SPCS WA N [4601] NAD83 Survey Feet)[1]	
	Easting	**Northing**
ST-1	1211927	550734
ST-2	1212310	550712
ST-3	1212685	550712
ST-4	1213060	550712
ST-5	1211994	550462
ST-6	1212369	550462
ST-7	1212744	550462
ST-8	1213119	550462
ST-9[2]	1212049	550233
ST-10	1212428	550212
ST-11	1212803	550212
ST-12	1213178	550212
ST-13	1212116	549962
ST-14	1212487	549962
ST-15	1212862	549962
ST-16	1213237	549962
ST-17	1212172	549712
ST-18	1212547	549712
ST-19	1212922	549712
ST-20[2]	1213297	549712
ST-21	1212172	549462
ST-22	1212606	549462
ST-23	1212981	549462
ST-24	1213356	549462
ST-25	1212264	549210
ST-26	1212665	549212
ST-27	1213040	549212
ST-28	1213415	549212
ST-29	1212350	548962
ST-30	1212725	548962
ST-31	1213100	548962
ST-32	1213475	548962

Notes:

1. State Plane Coordinate System for northern Washington (SPSC WA N), Zone 4601, based on the North American Datum of 1983 (NAD83).
2. A duplicate grab sample will be collected at this location.

TABLE 2

TIERED ANALYSIS SCHEDULE
Former Custom Plywood Mill
Anacortes, Washington

Testing Round	Stations Tested	Parameters[1]	Methods[2]	Criteria[3]	
Tier 1 Wood Debris Sampling					
	All grab samples	Surficial Wood Coverage	Visual Method (Point Contact)	≥ 25%	≥ 50% AoPC
		Total volatile solids (TVS)	ASTM D2974 (large volume)	≥9.7%	≥ 17%
		Total organic carbon (TOC)	SM 5310B Modified	≥ 10%	
		Pore water Sulfide	SM 4500-S2		
		Pore water Ammonia	EPA 350.1		
		Pore water Microtox	Ecology, 2003	SMS SQS	N/A
Tier 2 Ecological Testing				SMS	
	All samples with wood coverage < 50% that fail Tier 1 criteria	Amphipod	PSEP 1995	SQS	CSL AoPC
		Sediment Larval	PSEP 1995	SQS	CSL AoPC
Tier 3 Human Health Risk Screening					
	Composite of all samples that pass Tier1 and Tier 2 criteria.	Dioxins	EPA 1613B	> Human health AoPC	
		PCBs by Aroclor	EPA 8082	> Human health AoPC	
Tier 4 Sediment Management Standards COCs				SMS	
	All samples that fail Tier 3 ecological criteria	SMS Metals	EPA 6010/ EPA 7471A	SQS	CSL
		SMS Aromatic hydrocarbons	EPA 8270D	SQS	CSL
		SMS Chlorinated benzenes	EPA 8270D	SQS	CSL
		SMS Phthalate esters	EPA 8270D	SQS	CSL
		SMS Miscellaneous	EPA 8270D/ EPA 8082	SQS	CSL
		SMS Ionizable organic compounds	EPA 8270D	SQS	CSL
Additional Analyses					
	Stations adjacent to upland wells that have elevated TPH	TPH	Ecology		

Notes:
1. PCBs = Polychlorinated biphenyls; SMS = Sediment Management Standards; TPH = Total petroleum hydrocarbons.
2. Methods are U.S. Environmental Protection Agency (EPA) method number; Standard Method (SM) for the Examination of Water and Wastewater Method; ASTM International (ASTM) standard test method; or Washington Department of Ecology (Ecology) Methods.
3. AoPC = Area of Potential concern; SQS = Sediment Quality Standards; CSL = Cleanup screening levels.

TABLE 3

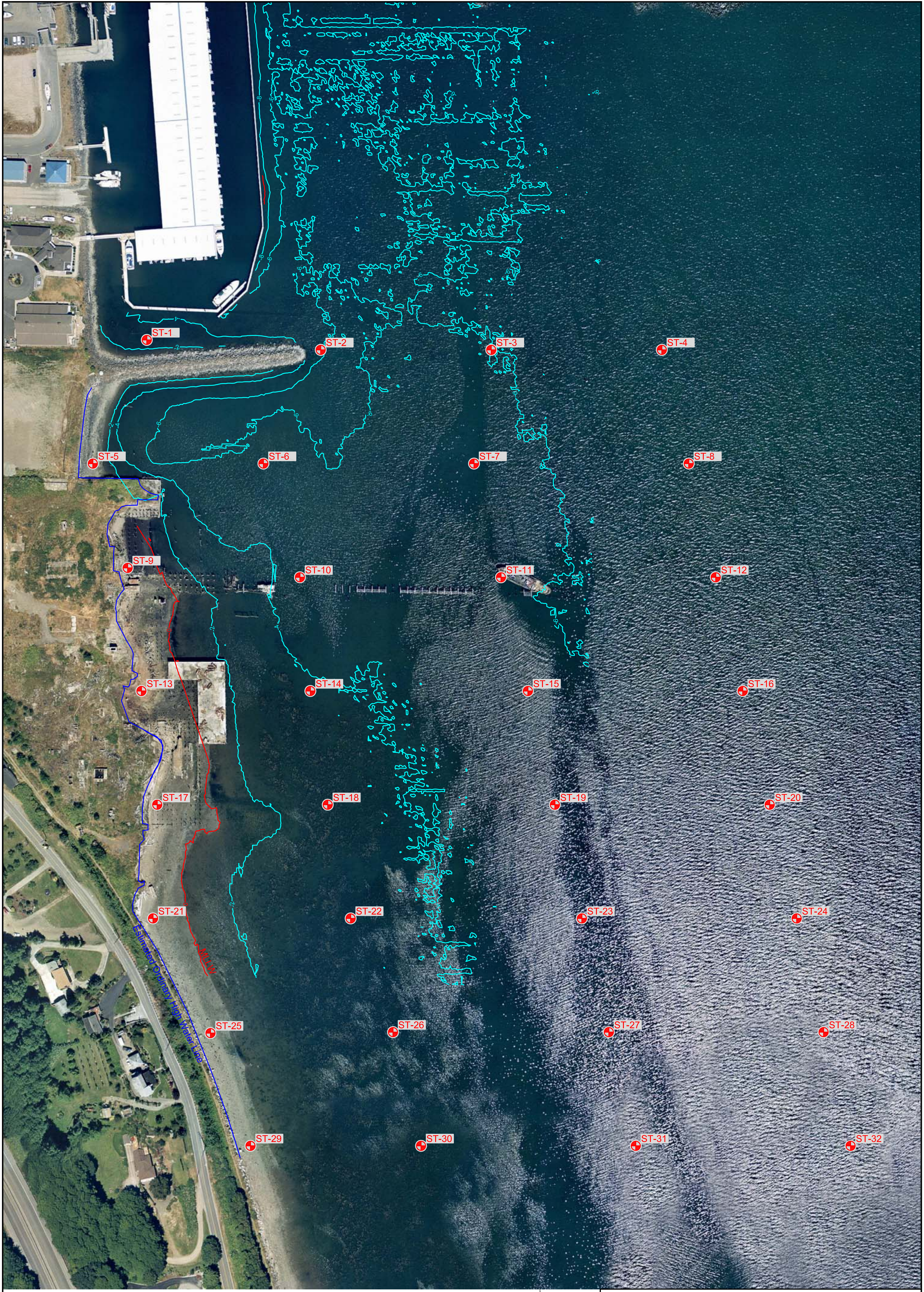
SAMPLE CONTAINERS AND HOLDING TIMES FOR ANALYSES

Former Custom Plywood Mill
Anacortes, Washington

Initial Round of Analysis		
Analyte	**Holding Time**	**Sample Container**
Total Organic Carbon (TOC)	14 days (4°C)	8-oz glass
Total Volatile Solids (TVS)	14 days (4°C)	8-oz glass
Ammonia (pore water)	7 days (4°C)	25-ml glass vial
Sulfide (pore water)	7 days (4°C)	25-ml glass vial
Microtox® (pore water)	56 day (4°C)	16-oz glass
Additional Rounds of Analysis		
Analyte	**Holding Time**	**Sample Container**
Dioxins	1 year (-18°C)	2 x 8-oz glass
PCBs	1 year (-18°C)	2 x 8-oz glass
Bioassays (Amphipod and Sediment Larval)	56 day (4°C)	3 x 1-liter glass
Grain size	6 months (4°C)	16-oz glass
Total Solids	6 months (-18°C)	8-oz glass
Semivolatile organic compounds, PCBs, dioxins	1 year (-18°C) 14 days to extraction (4°C) after thawing 40 days after extraction (4°C)	1-liter glass (combined; with sufficient headspace in sample container to allow for expansion during freezing)
Metals (except mercury)	2 years (-18°C)	
Mercury	28 days (-18°C)	

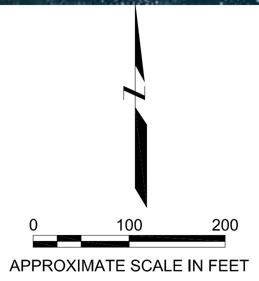
FIGURES

Plot Date: 09/12/08 - 4:55pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Figure 14_Former Mill Sediment Sampling_081908.dwg



Aerial Photo Courtesy of City of Anacortes

● Proposed Sediment Grab Sampling Location



PROPOSED SEDIMENT GRAB
SAMPLING LOCATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: GSM	Date: 09/12/08	Project: 10654
Geomatrix		Figure 1

Non-GDS

Geomatrix Consultants, Inc.
600 University Street, Suite 1020
Seattle, Washington 98101
(206) 342-1760

CHAIN OF CUSTODY

Place COC Form Number Label Here
or write in seq. number below.

Recorded by: ____________

Checked by: ____________

		Analysis Containers												
		PCBs/TOC	Archive											
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers
Place Sample ID Label Here or Write ID Number Here	Date: Time:													Number of containers

Laboratory Sample Receipt	
Number of Sample Containers in Shipping Container	
Shipping Container Chain of Custody Seal Intact (Y/N)	
Receipt Condition Comments (e.g., thawed, warm)	

Relinquished By	Transported By	Received By
Name: Date: Time:		Name: Date: Time:
Name: Date: Time:		Name: Date: Time:
Name: Date: Time:		Name: Date: Time:

Geomatrix

EXAMPLE OF CHAIN-OF-CUSTODY FORM
Former Custom Plywood Site
Anacortes, Washington

Project No.
10654

Figure
2

S:\10654\012_Sediments SAP_QAPP\Word\Figure 2_Example COC.doc

APPENDIX C

Final Site-Specific Health & Safety Plan

Final Site-Specific Health & Safety Plan

Former Custom Plywood Site

Anacortes, Washington

Prepared for:

GHB Investments, LLC
13941 Gibralter Road
Anacortes, Washington 98221

Prepared by:

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600 University Street, Suite 1020
Seattle, Washington 98101
(206) 342-1760

September 2008

Project No. 10654

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FINAL SITE-SPECIFIC HEALTH & SAFETY PLAN

Former Custom Plywood Site
Anacortes, Washington

1.0 PURPOSE

This Site-Specific Health and Safety Plan (HASP) outlines the health and safety procedures that shall be followed during field work conducted at the Former Custom Plywood Site (the site) during the Remedial Investigation/Feasibility Study (RI/FS). The observance and practice of the procedures in this plan are mandatory for all Geomatrix Consultants, Inc. (Geomatrix), employees at the site. All contractors and site visitors shall be made aware of the requirements of this plan; however, contractors are responsible for the health and safety of their own employees and for following all applicable federal, state, and local regulations. All contractors shall develop their own HASPs as necessary to be in compliance with WAC 296-843. Geomatrix will review their HASPs well in advance of fieldwork.

This plan defines site-specific hazards and controls to prevent injury and illness among Geomatrix personnel for tasks performed by Geomatrix. Its implementation is in concert with the written Geomatrix Accident Prevention Program.

This plan has been reviewed by the Project Manager and Project Health and Safety Officer. Prior to entering the site, Geomatrix personnel shall read this plan and be familiar with health and safety procedures required when working on site. A copy of the plan shall be available on site for inspection and review.

2.0 ADMINISTRATIVE INFORMATION

Project Name: Former Custom Plywood Site

Project Start Date: June 1, 2007 Project Number: 10654.000

Project Address: Intersection of 35th St. and V Place, Anacortes, Washington

Project Manager: Kathleen Goodman (Geomatrix)

Telephone No.: (206) 342-1780 office/(425) 301-2700 cell

Project Health & Safety Officer: Tim Reinhardt (Geomatrix)

Telephone No.: (206) 838-8464 office/(425) 241-5816 cell

Site Safety Officer: Uplands: Abby Bazin or Zanna Satterwhite (Geomatrix)

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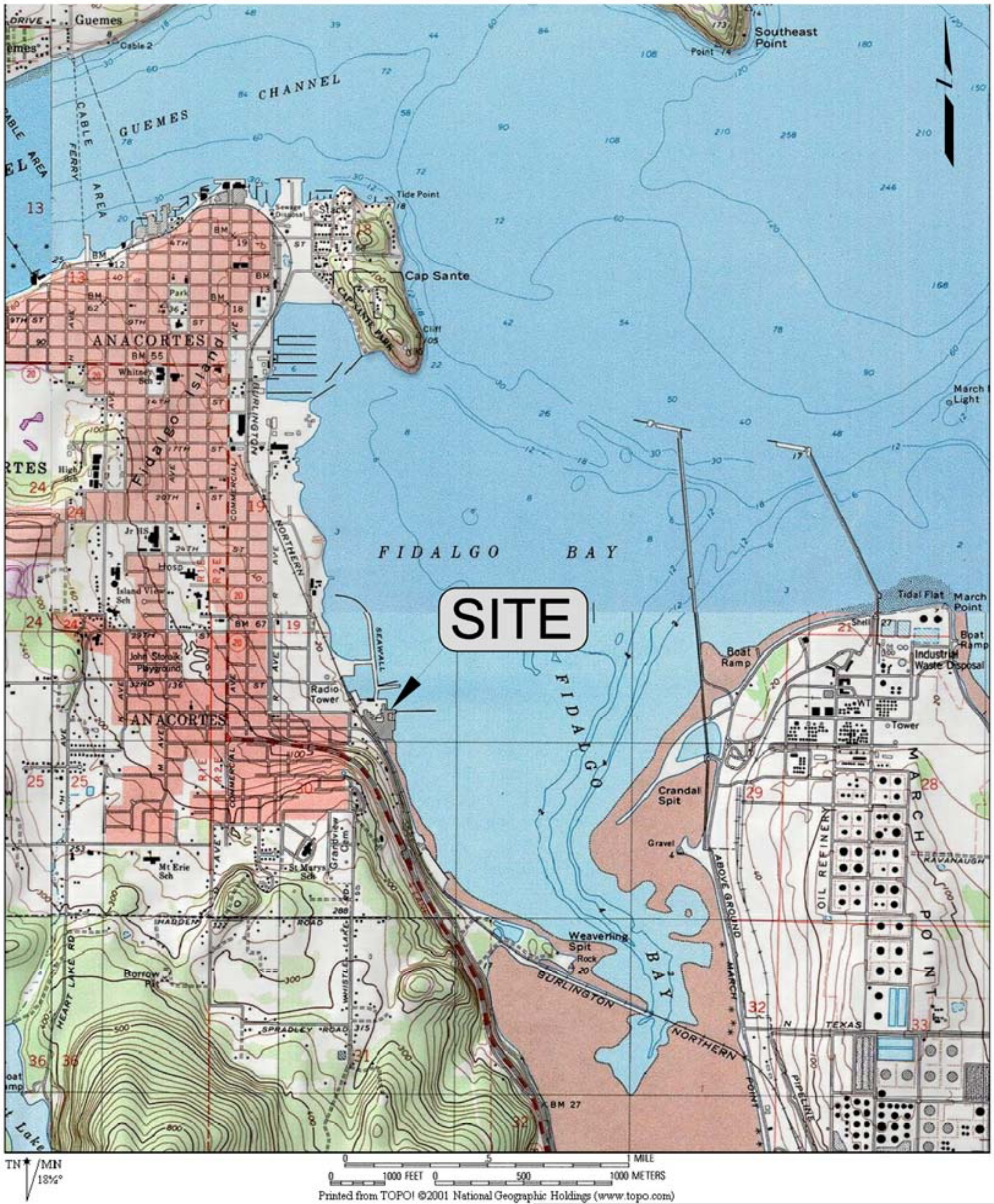
3.0 PROJECT DESCRIPTION

An interim remedial action has already removed contamination in the four most-contaminated areas of the Former Custom Plywood Site (Figure 1). This HASP addresses the hazards associated with multiple tasks associated with the RI/FS of the site in areas that are expected to be less contaminated. The property consists of an irregularly shaped parcel that covers approximately 6.6 acres of upland and 28 acres of tidal areas. The site was used for operation of a sawmill, and later a plywood mill, under various owners from the early 1900s until 1992, when the mill went out of business and the wooden structures burned down. Significant concentrations of hydrocarbons, particularly heavy oils, were found in shallow soils around the press pits and the compressor house in the central part of the property. Subsequent studies found isolated occurrences of polychlorinated biphenyl compounds (PCBs), and inorganics (arsenic, cadmium, lead, and mercury).

Additional characterization activities will be conducted to provide the information necessary to fill the critical data gaps. Geomatrix will perform the following additional tasks:

1. Collect additional soils samples by hand auger in the non-hotspot areas to fully delineate the extent of site contaminants;



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Plot Date: 11/20/06 - 10:49am, Plotted by: astenberg
Drawing Path: S:\10654\005_EXCAV\, Drawing Name: Concorde_VicinityMap.dwg

SITE VICINITY MAP
Former Custom Plywood Site
Anacortes, Washington

By: APS	Date: 11/20/06	Project No.	10654
Geomatrix		Figure	1

2. Drill belowgrade in key areas and collect soil samples from the corings;
3. Install several new monitoring wells to assess potential groundwater impact at the site; and
4. Obtain sediment samples offshore from a research boat using a pneumatic Van Veen Grab Sampler.

3.1 SITE PHYSICAL DESCRIPTION

The Custom Plywood property is located at the intersection of 35th Street and V Place on the western shore of Fidalgo Bay in Anacortes. The property consists of an irregularly shaped parcel that covers approximately 6.6 acres of upland and 28 acres of tidal areas. The site was used for operation of a sawmill, and later a plywood mill, under various owners from the early 1900s until 1992 when the mill went out of business and the wooden structures burned down. The former plywood mill was larger at one time than the subject site addressed by this document. Over the past 20 years, small portions of the former mill site have been sold and redeveloped. However, the largest upland portion of the property, the main plant area, remains contaminated and is the focus of the RI/FS.

The main plant area was the location of the plywood manufacturing operations, which had three hydraulic presses, a hog-fueled boiler house, a compressor house, four aboveground fuel oil tanks, and piers. Prior to the fire, much of the plant was built out over the shoreline, intertidal zone, and shallow subtidal zone.

Upland and offshore areas have been identified for further investigation due to potential exceedances of MTCA cleanup levels that occurred in soil, groundwater, and/or sediments. Offshore, the intertidal and subtidal sediments are of unknown quality, but may be expected to have somewhat lower levels of site contaminants due to natural transport.

4.0 PRIMARY RESPONSIBILITIES

4.1 PROJECT MANAGER

The Project Manager (PM) will have overall responsibility for the success of the project, including the successful implementation of this HASP. The PM will review health and safety issues as needed and as consulted and will have the authority to reallocate resources and personnel to safely accomplish the field work.

In addition the PM shall:

1. Direct all Geomatrix personnel involved in investigative, monitoring, and remedial activities at the site and vicinity;
2. Make the Project Health and Safety Officer aware of all pertinent project developments and plans;
3. Make available the resources that are necessary for a safe working environment;
4. Maintain communications with the client, as necessary; and
5. Ensure that all Geomatrix project personnel have received required training, are aware of the potential hazards associated with site operations, have been instructed in the work practices necessary for personal health and safety, and are familiar with the site HASP's procedures for all scheduled activities and for dealing with emergencies.

4.2 PROJECT HEALTH AND SAFETY OFFICER

The Project Health and Safety Officer (PHSO) shall:

1. Advise project manager and project personnel on all health and safety aspects of investigative, monitoring, and remedial activities conducted by Geomatrix personnel at the site and vicinity;
2. Specify required exposure monitoring to assess site health and safety conditions;
3. Review any accident/incident reports and make corrective action recommendations;
4. Modify the site HASP as required based on accidents/incidents and findings regarding site hazards and work practices;
5. Report all accidents/incidents and findings regarding personnel exposure, site hazards, and work practices to the PM; and
6. If the PHSO believes that Geomatrix or a contractor's personnel are or may be exposed to an immediate health hazard, the PHSO shall suspend the hazardous site work.

4.3 SITE SAFETY OFFICER

The Site Safety Officer (SSO) may be a person dedicated to this task, or the SSO functions may be a collateral duty of the Site Supervisor. The SSO shall:

1. Ensure that appropriate personal protective equipment is available for the Geomatrix site personnel and enforce proper utilization of personal protective equipment by all on-site Geomatrix personnel;
2. Ensure that all Geomatrix personnel have received required training, are aware of the potential hazards associated with site operations, have been instructed in the work practices necessary for personal health and safety, and are familiar with the site HASP's procedures for all scheduled activities and for dealing with emergencies;
3. Observe Geomatrix's and contractor's procedures with respect to health and safety. If the SSO believes that Geomatrix or a contractor's personnel are or may be exposed to an imminent health hazard, the SSO shall suspend the hazardous site work. If site personnel do not have required protective equipment, the SSO shall consult with the PHSO before proceeding with the work;
4. Implement the site HASP and report any observed significant differences from the site conditions anticipated in the plan to the project manager;
5. Conduct daily site safety briefings and additional briefings as needed;
6. Calibrate monitoring equipment daily and properly record and file calibration and monitoring results;
7. Under direction of the PHSO perform required exposure monitoring;
8. Maintain monitoring equipment or arrange maintenance as necessary;
9. Assume other duties as directed by the PHSO; and
10. Prepare reports of any observed accidents/incidents or inadequate work practices and communicate them to the PM and PHSO.

4.4 SITE SUPERVISOR

The Site Supervisor (SS) shall:

1. Maintain control of the site and direct daily site operations to be consistent with applicable environmental and health and safety regulations, site work plans and this project HASP, and enforce safe work practices and proper utilization of personal protective equipment by all on-site Geomatrix and contractor personnel;

2. With guidance from the PHSO, observe Geomatrix and contractor's procedures with respect to health and safety. If the SS believes that Geomatrix or a contractor's personnel are or may be exposed to an imminent health hazard, the SS shall suspend the hazardous site work coordinating that suspension through the subcontractor's site supervisor. If site personnel do not have required protective equipment, the SS shall consult with the PHSO before proceeding with the work;

3. Implement the site HASP and report any observed significant differences from the site conditions anticipated in the plan to the project manager;

4. Conduct site safety briefings as needed;

5. Ensure that required personal protective, monitoring, and emergency equipment is provided and maintained in effective working condition at all times when work occurs on site; and

6. Report observed accidents/incidents or inadequate work practices to the project manager and the PHSO.

4.5 PROJECT PERSONNEL

Project personnel involved in on-site investigations and operations shall:

1. Take reasonable precautions to prevent injury to themselves and to their fellow employees;

2. Perform only those tasks that they can do safely and immediately report accidents and/or unsafe conditions to the SSO or PHSO;

3. Follow the procedures set forth in the site HASP and report to the SSO, SS, or PHSO any observed deviations by Geomatrix or contractor personnel from the procedures described in the plan; and

4. Inform the SSO and PHSO of any physical conditions that might affect their ability to perform the planned field tasks.

4.6 TRAINING REQUIREMENTS

All project personnel must comply with applicable regulations specified in the Washington Administrative Code (WAC) Chapter 296-843, hazardous waste operations (HAZWOPER), administered by the Washington State Department of Labor and Industries (L&I). These include completion of a 40-hour health and safety training course for HAZWOPER, an annual 8-hour refresher training, and participation in Geomatrix's medical surveillance program and respiratory protection program. In addition to the 40-hour course and 8-hour refreshers, the SS (and SSO, if performing the duties of the SS) will have completed an 8-hour course for hazardous waste site supervisors as required by WAC 296-843-20015. Each site worker will also have a minimum of 3 days of supervised field experience at hazardous waste sites before being allowed to work on site without close direct supervision. At least one person on site will be current in CPR/First Aid. Documentation of all required training will be maintained on site by the SS.

Additional site-specific training that covers on-site hazards, personal protection equipment (PPE) requirements, use and limitations, decontamination procedures, and emergency response information as outlined in this site HASP will be given by the PHSO or SSO before beginning on-site work. Site-specific training briefings should be documented on the "Project Health and Safety Field Meeting Form" provided at the end of this HASP.

4.7 MEDICAL SURVEILLANCE

All Geomatrix personnel on site shall participate in Geomatrix's medical surveillance program, which includes annual audiometric and physical examinations for employees involved in HAZWOPER projects. It requires that all such personnel have medical clearance before being issued a respirator and participating in field activities. Frequency of medical examinations which comply with 29 CFR § 1910.120(f)(3) and WAC 296-843-21005 are:

1. Prior to performing field work;
2. At least once every 12 months;
3. At termination of employment;
4. Upon occurrence of possible unprotected overexposure to chemicals or harmful physical agents; and
5. More frequently if deemed necessary by a physician.

5.0 HAZARD ASSESSMENT

An assessment of the potential hazards that may be encountered during field activities at the site is summarized by field task in the table below and discussed further in this section. Task-specific Job Safety Analyses are included in Attachment C1. These cover the hazards to Geomatrix staff only. Subcontractors have many additional hazards specific to their activities, which are identified and appropriate controls specified, in their HASP.

ANTICIPATED HAZARDS

	Hazards														
		Physical													
Task	Chemical	Slip/Trip/Fall	Heavy Equipment	Underground Utilities	Overhead Power Lines	Noise	Heat Stress	Cold Stress	Sunburn	Sharp/Abrasion	Pinch points	High Pressure Air	Flammable liquids	Strains/Sprains	Drowning
Soil sampling (hand auger)	X	X	X	X	X	X	X	X	X	X				X	
Soil sampling (drill rig)	X	X	X	X	X	X	X	X	X	X	X				
Monitoring well installation	X	X	X	X	X	X	X	X	X	X					
Well development	X	X	X				X	X	X		X			X	
Offshore sediment sampling	X	X				X	X	X	X	X	X	X	X	X	X

5.1 POTENTIAL CHEMICAL HAZARDS AT SITE

Listed below are hazardous substances that have been found or are suspected to be present at the site. Additional information on these chemicals, including their acute exposure effects, is included at the end of this HASP.

HAZARDOUS SUBSTANCES KNOWN OR POTENTIALLY PRESENT AT SITE

Chemical, Form	Media	Maximum Concentrations Detected at Site	Routes of Exposure[1]	Acute Exposure Symptoms
Antimony	**Sediment**	**138 mg/kg**	**RI**	Dermatitis, rhinitis, respiratory inflammation, laryngitis, bronchitis, gastritis, septal perforations, alterations of the ECG, especially T-wave abnormalities, myocardial changes, pneumoconiosis, pneumonitis, tracheitis, , pustular skin, and reproductive problems in women
Arsenic	**Soil**	**54 mg/kg**	**RISE**	Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, [potential occupational carcinogen]

HAZARDOUS SUBSTANCES KNOWN OR POTENTIALLY PRESENT AT SITE

Chemical, Form	Media	Maximum Concentrations Detected at Site	Routes of Exposure[1]	Acute Exposure Symptoms
Cadmium	**Soil**	**7 mg/kg**	**RI**	Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen
Chromium	**Soil**	**190 mg/kg**	**RISE**	Irritation eyes; sensitization dermatitis
Copper	**Soil**	**2,670 mg/kg**	**RISE**	Irritation eyes, respiratory system; cough, dyspnea (breathing difficulty), wheezing; [potential occupational carcinogen]
Lead	**Soil**	**1,260 mg/kg**	**RISE**	Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension
Mercury	**Soil**	**67 mg/kg**	**RISE**	SKIN; Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria
Nickel	**Soil**	**553 mg/kg**	**RISE**	Sensitization dermatitis, allergic asthma, pneumonitis; [potential occupational carcinogen]
Thallium	**Soil**	**11.1 mg/kg**	**RISE**	SKIN, Nausea, diarrhea, abdominal pain, vomiting; ptosis, strabismus; peri neuritis, tremor; retrosternal (occurring behind the sternum) tightness, chest pain, pulmonary edema; convulsions, chorea, psychosis; liver, kidney damage; alopecia; paresthesia legs

HAZARDOUS SUBSTANCES KNOWN OR POTENTIALLY PRESENT AT SITE

Chemical, Form	Media	Maximum Concentrations Detected at Site	Routes of Exposure[1]	Acute Exposure Symptoms
Zinc	**Soil**	**5,070 mg/kg**	**I**	Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function
TPH-Diesel Range	**Soil**	**12,000 mg/kg**	**RISE**	SKIN; Irritation
TPH-Motor Oil	**Soil**	**164,000 mg/kg**	**RISE**	Dermatitis; headache and slight giddiness; nausea, vomiting, and cramping; depression of central nervous system ranging from mild headache to anesthesia, coma, and death; kidney and liver damage; and severe lung irritation
Benzene	**Soil**	**0.43 mg/kg**	**RISE**	Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]
cPAHs	**Soil**	**1.953 mg/kg**	**RIS**	lung cancer; genotoxic; mutagenic; tumorigenic;[potential occupational carcinogen]
PCBs	**Soil**	**13.9 mg/kg**	**RISE**	SKIN; Irritation eyes; chloracne; liver damage; reproductive effects; [potential occupational carcinogen]

Notes:
1. Exposures routes: R = respiratory, I = ingestion, S = skin absorption, E = eyes.

Air monitoring requirements and action levels related to potential chemical hazards on the site are discussed in Section 6.0. Sampling for site contaminants in soils and groundwater is discussed in the Sampling and Analysis Plan.

5.2 POTENTIAL PHYSICAL HAZARDS AT SITE

Potential physical hazards listed in the table above are discussed below.

5.2.1 Physical Hazards

Common field safety hazards include slip/trip/fall hazards, sharp or rough-surface equipment, debris and tools, strains and sprains, and hazards associated with working around heavy equipment. All field personnel will keep materials, equipment, ropes, lines and debris organized and flagged as necessary to prevent trip hazards. Field personnel will wear sturdy work boots or shoes at the upland portion of the site. Steel toe and shanks are required on site when working around heavy loads, heavy equipment, or in areas where construction debris that contains nails or screws is present. On the boat and dockside, nonskid soles will be worn. Field personnel will wear sturdy outer gloves when handling sharp or rough-surfaced objects.

5.2.2 Underground Utility Hazards

An underground utility check via the Washington State Utilities and Transportation Commission (WUTC) shall be performed prior to initiating any subsurface investigation or work. The check will include:

__X__ WUTC Note: WUTC must be notified at least 2 working days before any subsurface work begins (800-424-5555). The confirmation number will be recorded in project field notes.

__X__ Private Locator: APS Locating (425) 888-2590

______ Plans Check. Facility Contact:

______ Geophysical Survey.

5.2.3 Electrical Hazards

Whenever possible, site personnel will avoid working under overhead high voltage lines. The SS is responsible for documenting a determination of the voltage and minimum approach distance to any potentially energized electrical distribution line. Lines will be confirmed to be deenergized when minimum approach distances cannot be met. The following are minimum clearances for overhead high voltage lines.

Minimum Clearances For Overhead High Voltage Lines

Normal Voltage (phase to phase)	Minimum Required Clearance (feet)
less than or equal to 50,000	10
more than 50,000	10 + 0.4 inch per kV

(Reference: WAC 296-24-963)

To prevent electrocution hazards from utilization equipment, all electrical extension cords will be rated for the combined amperage of the equipment they power, and must be factory listed as rated SJOW or STOW (an "-A" extension is acceptable for either) and inspected prior to use for defects in the cord and plugs. Any reduction in the original jacket, gap between the strain relief, or any evidence of overheating (cord discoloration or melting) will result in the immediate destruction of the cord and replacement as necessary. The following safe work practices will also be enforced:

- No exposed energized conductors operating above 50 volts to ground will be allowed on site unless properly guarded from contact by unqualified persons;
- Electrical distribution systems and repairs to utilization equipment operating above 50 volts to ground will be performed only by a qualified licensed electrician;
- All portable power tools will be inspected for defects before use, and of a double-insulated design;
- Any generator brought on site will be grounded to a suitable earth and will be equipped with overcurrent protection;
- All extension cords running outside will be protected by a ground-fault circuit interrupter, which will be tested daily; and
- No extension cords will be routed through walls, ceilings, doors or windows.

5.2.4 Noise Hazards

Site personnel will wear hearing protection when working on the boat while compressors or loud engines are operating, and on the uplands near large heavy equipment, such as drill rigs, or in other noisy conditions. Hearing protection will be worn when two people standing within

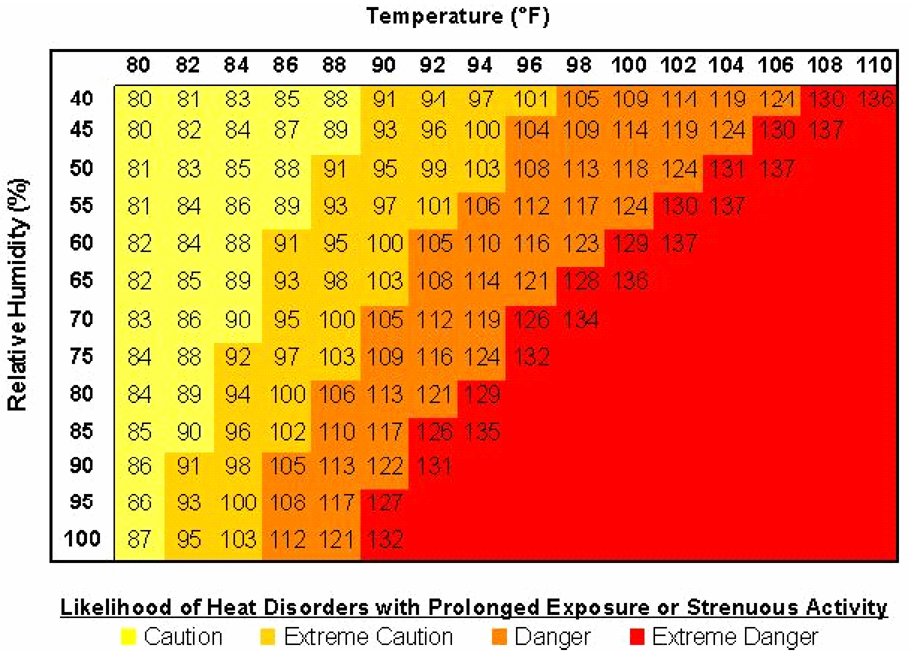
3 feet of each other cannot communicate at normal conversational voice levels. This is to prevent hearing loss that can occur when daily 8-hr time weighted average noise exposures meet or exceed 85 dBA (WAC 296-817-20015). Work will be limited to the hours of 7 AM to 7 PM during which normal construction noise impacts are permitted.

5.2.5 Heat Stress Hazards

Heat stress is a moderate hazard during the summer months in the Pacific Northwest, but becomes a significant hazard for workers wearing protective clothing. To avoid heat stress, cool potable water will be readily available, and site personnel will be encouraged to drink plenty of fluids and take periodic work breaks in hot weather. The signs, symptoms, and treatment of heat stress include:

- Heat rash, which may result from exposure to heat or humid air.
- Heat cramps, which are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: muscle spasms and pain in the hands, feet, and abdomen. Persons experiencing these symptoms should rest in a cooler area, drink cool (not cold) liquids and gently massage cramped muscles.
- Heat exhaustion, which occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: pale, cool, moist skin; heavy sweating; dizziness; nausea; and fainting. Persons experiencing these symptoms should lie down in a cooler area, drink cool liquids with electrolytes (Gatorade, etc.), remove any protective clothing, and cool body with wet compresses at forehead, back and neck, and/or armpits.
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; and coma.

If site temperatures are forecast to exceed 85 degrees Fahrenheit and physically demanding site work will occur in impermeable clothing, the SSO will promptly consult with a certified industrial hygienist (CIH) and a radial pulse monitoring method will be implemented to ensure that heat stress will be properly managed among the affected workers. The following chart indicates the relative risk of heat stress.



Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

🟨 Caution 🟧 Extreme Caution 🟧 Danger 🟥 Extreme Danger

Combined temperature and humidity conditions that result in a heat index exceeding 100 will trigger mandatory radial pulse monitoring and heat stress management.

5.2.6 Cold Stress Hazards

Exposure to even moderate levels of cold can cause the body's internal temperature to drop to a dangerously low level (hypothermia). This is a significant hazard any time on the boat and on the uplands in the fall, winter and spring months in the Pacific Northwest. Exposure to temperatures below freezing can cause frostbite of hands, feet, and face.

Symptoms of hypothermia include:

- vague, slow, slurred speech
- forgetfulness, memory lapses
- inability to use hands
- frequent stumbling
- drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene). Site personnel will keep hands and feet well protected at all times.

5.2.7 Sunburn Hazards

Skin exposure to ultraviolet radiation can result in sunburn. Site personnel will use long-sleeved shirts, hats, and sunscreen to protect against sunburn.

5.2.8 Confined Spaces and Excavations

No confined space entries or excavations are anticipated for this project. If entry into a confined space is required, the PHSO must be consulted and a confined space entry plan prepared and followed prior to anyone entering the space. Excavations will be overseen and inspected daily by a competent person.

5.2.9 Heavy Equipment

Personnel working on site in the vicinity of operating equipment will wear high-visibility safety vests and maintain safe distances from the equipment to avoid contact with moving equipment parts, such as drill rig/geoprobe rig (be aware of swing radius), tires, tracks, etc. Site personnel will be sure heavy equipment operators can see them or know where they are whenever they are within strike distance of the equipment. Equipment will only be approached from the front or side of the cab, and eye contact will be made with the equipment operator and their acknowledgement that it is safe to approach will be obtained.

5.2.10 Pinch Points

Well cover manipulation and marine sediment grab sampler operations pose a significant hazard of pinch points to workers. Personnel will:

- keep clear of the mast pivots and hydraulic cylinders when raising and lowering the mast,
- engage the safety valve before deconning the grab,
- stay clear of winch and dock lines on the boat, and between the boat and fixed items,
- coordinate arming the grab with the winch operator and never reaching inside the grab after it is armed, and
- keep hands clear of the stand as the grab is being lowered onto it.

5.2.11 Biohazards

Wildlife and insects are not expected, but persons with known allergies to bees will alert the SSO and carry a personal anaphylactic shock kit as prescribed by a physician. Any wildlife encountered on site will not be approached by the field team.

5.2.12 Drowning

All personnel on the boat will wear a Type I, II or III personal flotation device (PFD) at all times. An approved life ring with attached line will be available and ready for deployment. All personnel will be watchful for waves and wakes and will not lean over the side when upset conditions are present.

5.3 GENERAL SAFE WORK PRACTICES

In working with or around any hazardous or potentially hazardous substances or situations, site personnel should plan all activities before starting any task. Site personnel shall identify health and safety hazards involved with the work planned and consult with the PHSO or SSO as to how the task can be performed in the safest manner, if he/she has any uncertainties.

All field personnel will adhere to the following general safety rules.

1. Wear protective equipment and clothing provided, when required.
2. Wear a hard hat and safety glasses in all construction areas.
3. Do not eat, drink, or use tobacco or cosmetics in restricted work areas.
4. Prevent splashing of liquids containing chemicals, and minimize emissions of dust.
5. Prevent back injury by never lifting or carrying a load that is heavier than you can comfortably handle. When lifting heavy objects, bend the knees and use the leg muscles, and get assistance when necessary.
6. Keep all heat and ignition sources away from combustible liquids, gases, or any flammable materials. When working in areas where combustible gases are present, use only intrinsically safe (non-sparking) equipment.
7. Field personnel shall be familiar with the physical characteristics of the site, including:
    - wind direction in relation to restricted work areas
    - accessibility of other personnel, equipment, and vehicles

- areas of known or suspected chemicals in soil and groundwater
- site access
- nearest water sources
- location of communication devices.

8. Personnel and equipment in restricted work areas (Exclusion Zone and Contaminant Reduction Zone) should be limited to the number necessary to perform the task at hand. The buddy system will apply when working in restricted work areas.
9. All wastes generated during investigative activities at the site shall be disposed of as directed by the Project Manager.
10. Suspend cords only with nylon rope or plastic ties.
11. When in doubt of your safety, it is better to overprotect.
12. Practice defensive driving.
13. A first-aid kit shall be kept at the site and/or in a field vehicle when performing field work.

6.0 AIR MONITORING

This section defines the air monitoring necessary to protect workers on site from overexposure, in accordance with L&I rules. Site characterization data indicate that only very limited amounts of volatile compounds (benzene, toluene and xylenes) are present in the site contaminants, and thus volatile contaminants are not expected to pose a significant inhalation hazard for the planned tasks. Semivolatile organic compounds (SVOCs) and metals are present and elevated in limited areas. However, based on existing site characterization data and the unlikely potential for significant dust generation by the planned tasks, no significant inhalation exposure to these chemicals is expected. Dust is readily visible at 1 mg/m^3, which is over an order of magnitude below the level at which total dust exposure is expected to pose a potential hazard. Dust control measures (work pacing and watering) will be undertaken if sustained visible dusts are created.

6.1 ACTION LEVELS

The applicable L&I PELs (both 8-hour and 15-minute short-term exposure limits, or STELs) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommended

Threshold Limit Values® (TLV®s) for the most likely chemicals of concern at the site are presented below.

Chemical	L&I PEL (8-hr/15-min. STEL)	ACGIH TLV® (8-hr/15-min. STEL)
Particulate not otherwise regulated (nuisance dust—total fraction)	10 mg/m^3 / 20 mg/m^3	10 mg/m^3 / 30 mg/m^3 [a]
Lead	0.05 mg/m^3 / 0.15 mg/m^3 [a]	0.05 mg/m^3 / 0.15 mg/m^3 [a]
Chromium	0.5 mg/m^3 / 1.5 mg/m^3 [a]	
Mineral Oil	5 mg/m^3 / 10 mg/m^3	5 mg/m^3 / 10 mg/m^3

a. Generic STEL—30 minute duration maximum exposure recommended.

Relatively nontoxic diesel and motor oil was noted in many soil samples, and along with lead and chromium posed the only possible inhalation hazards to site workers. Lead is not expected to be a widespread hazard at the site, but was found in discrete areas of contamination (in a small pile of greenish sand and in some soil samples at the compressor building and boiler house areas. At the nonvolatile contaminant levels found in existing samples, respiratory protection is not anticipated to be necessary because Geomatrix site workers are not expected to be exposed to sustained high levels of dust while performing the tasks delineated in this plan, and dust has good warning properties that will trigger action to suppress dust and control the hazard. At the average soil concentrations found on site for each metal and SVOC, the associated airborne dust would have to exceed a total dust concentration of 13 mg/m^3 to approach the occupational exposure limit for the combined hazards.

Because work activities are not expected to create significant airborne dust levels that could pose a hazard to adjacent properties due to transport, no boundary air monitoring is required for the tasks defined in this HASP. The SS or SSO will implement dust control measures if visible dust is observed for a sustained period (>15 minutes).

If at any time workers suspect significant chemical exposures (e.g., detect unusual odors, develop symptoms of occupational exposure to the site contaminants) or have other unexplained adverse health effects (e.g., dizziness, nausea), workers will be encouraged to stop work and notify the PHSO.

7.0 PERSONAL PROTECTIVE EQUIPMENT

A modified Level D PPE ensemble will be used with the main objective to prevent unnecessary dermal exposure. The PHSO will be consulted to up- or downgrade the PPE requirements. The following PPE is required, unless conditions change:

PPE Required	General site work & Sampling
Steel-Toe/Shank Boots (Rubber or Leather)	X
Hard Hat	X
Safety Glasses/Goggles	X/O
Face Shield (for pressure washing)	X
Ear Plugs	Av
Gloves (nitrile inner/leather outer):	Av
Inner and Outer	Av
Inner Only	
Tyvek Coverall (permeable)	Av
Saranex Coverall	
High-visibility Vest	X
Other (specify)	

Key: X = PPE Required
O = PPE Optional
Av = Have available at work site, use as needed
Other – specify

8.0 SITE CONTROL

The purpose of site control is to minimize the potential exposure to site hazards, to prevent vandalism at the site and access by children and other unauthorized persons, and to provide adequate facilities for workers. A daily field log will be maintained by the SS. The field log will include a list of all persons present, and will be updated whenever a visitor or contractor is allowed on site. Their arrival and departure times will be noted to enable an accurate roll call in the event of an emergency.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities. The support zone for the site is considered to be all areas outside the work area and decontamination areas. Readily available restroom and washing facilities (within 5 minutes) will be identified by the SS and maintained in hygienic conditions at all times.

8.1 WORK AREA

An exclusion zone (EZ) will be set up around each upland work area. Only authorized personnel shall be permitted access to the EZ. The EZ will be demarcated with barrier hazard tape or cones as needed to effectively limit unauthorized access. No eating, drinking, or smoking is allowed in the EZ. Egress from the EZ will only be through a contamination reduction zone (CRZ)—unless warranted for imminent hazards during an emergency. A buddy system will be implemented at all times when workers are in the EZ and CRZ. In this system, for each worker in the EZ or CRZ, either another worker in that zone will be designated to keep an eye on them and maintain alertness for imminent hazards and symptoms of distress, or a standby person will be outside the work zone in the appropriate PPE and ready to immediately enter the work area and assist the person in the work zone. Any open excavation (greater than 4 feet deep) will be fenced if left overnight, or sloped to prevent a fall hazard.

8.2 COMMUNICATIONS

If working alone, the Geomatrix field representative will contact the PM or office at the start and end of each day while on site. Upon initial mobilization to the site, cell phone signals will be checked for those phones available to the SS and SSO.

On-site communications will be by voice, hand held radio, or cell phone. Under noisy conditions on site, or when electronic systems are ineffective, a written system of hand signals will be established by the SS and reviewed with all site personnel to enable basic communications among field staff.

9.0 DECONTAMINATION

Decontamination procedures will be strictly followed to prevent off-site spread of site contaminants. If boots or equipment are covered with contaminated soil or sediments, they will be brushed off, then washed with soapy water, then rinsed with water. Rinsate will be collected and containerized on site. Heavy equipment will be swept off to prevent off-site migration of soil borne hazards. Decontamination on the boat will include containerization of the wash water for proper disposal upon characterization.

10.0 EMERGENCY RESPONSE

This section defines the emergency action plan for the site. It will be rehearsed with all site personnel and reviewed with visitors upon their initial site visit, and whenever the plan is modified or the SS or SSO believe that site personnel are unclear about the appropriate emergency actions.

A muster point of refuge will be identified by the SS and communicated to the field team each day. This point will be clear of adjacent hazards and preferably up- or cross-wind for the entire day. In an emergency, all site personnel and visitors will evacuate to the muster point for roll call versus the daily site log. It is important that each person on site understand their role in an emergency, and that they remain calm and act efficiently to ensure everyone's safety.

After every emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame, but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PHSO. Modifications to the emergency plan will be approved by the PHSO.

Reasonably foreseeable emergency situations include: medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as fire, thunderstorm, flooding, and earthquake. For on-water operations, potential additional emergencies include vessel sinking and man overboard. Expected actions for each potential incident are outlined below.

10.1 MEDICAL EMERGENCIES

In the event of a medical emergency, the following procedures should be used.

1. Stop any imminent hazard if you can safely do it.
2. Remove ill, injured or exposed person(s) from immediate danger if moving them will clearly not cause them harm, and no hazards exist to the rescuers.
3. Evacuate other on-site personnel to a safe place in an upwind or cross-wind direction until it is safe for work to resume.
4. If serious injury or life-threatening condition exists, call:

   911 – for paramedics, fire department, police

   Clearly describe the location, injury and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP, to alert them to chemicals of potential concern.

5. Trained personnel may provide first aid/cardiopulmonary resuscitation if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
6. Call the PHSO or PM.
7. Immediately implement steps to prevent recurrence of the accident.

A map showing the nearest hospital location is attached to this HASP (Attachment C2).

Island Hospital
1211 24th Street
Anacortes, WA 98221
(360) 299-1311

Telephone number of nearest Poison Control Center: (800) 222-1222

Other emergency notifications and phone numbers: ________________________

10.2 ACCIDENTAL RELEASE OF HAZARDOUS MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the PHSO determines that it is safe for work to resume.
2. Instruct a designated person to contact the PHSO and confirm a response.
3. Contain spill, if it is possible and it can be done safely.
4. Initiate cleanup.

10.3 GENERAL EMERGENCIES

Uplands: In the case of fire, explosion, earthquake or other imminent hazard, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/ fire department shall be notified if the emergency poses a continuing hazard by calling 911.

- In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated.
- During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so.

Marine: In the case of fire, the fire extinguisher(s) on board will be used to put out the fire. If the fire cannot be extinguished and abandoning ship is necessary, the captain will put the boat as close to shore as possible given the circumstances, and instruct the crew to get off the boat.

10.4 EMERGENCY COMMUNICATIONS

Uplands: In the case of an emergency, the air horn or car horn will be used as needed to signal the emergency. One long (5-sec.) blast will be given as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

Marine: The emergency will be communicated verbally to the crew by the captain of the vessel or his designee. Assistance will be summoned as needed by marine VHF radio and cellular phone.

10.5 EMERGENCY EQUIPMENT

Uplands: The following minimum emergency equipment will be readily available on site and functional at all times:

- First Aid Kit—Contents approved by the PHSO, including two bloodborne pathogen barriers;
- Sorbent material sufficient to contain the volume of the largest single container of hazardous materials (e.g., gas and diesel) brought on site;
- Portable fire extinguisher (6: B/C min) e.g. in each vehicle;
- Two spare sets of PPE suitable for entering the EZ; and
- A copy of the current site-specific health and safety plan.

Marine: The following minimum emergency equipment will be readily available on the boat and functional at all times:

- First Aid Kit—Contents approved by the PHSO, including one bloodborne pathogen barrier;
- Sorbent material sufficient to contain the volume of the largest single container of hazardous materials (e.g., gas and diesel) brought on board;
- One Type I, I or III PFD worn by each occupant;

- One throwable approved life ring with attached line;
- Two B-I (or one B-II) rated portable fire extinguishers;
- Marine VHF radio and cell phone;
- Three hand held red flares or equivalent visual distress signals;
- An air horn; and
- A copy of the current site-specific health and safety plan.

11.0 APPROVALS

Project Manager	Date
Project Health & Safety Officer	Date
Site Safety Officer	Date

PROJECT HEALTH AND SAFETY FIELD MEETING FORM

Date: ______________________________ Time: ___________________ Project No.: _________________

Project Name: ____

Location: ____

Meeting Conducted by: ____

Topics Discussed:
Physical Hazards: ____

Chemical Hazards: ____

Personal Protection: ____

Decontamination: ____

Other:____

____

____

____

____

Emergency Information: ____

Hospital Location: ____

Attendees

Name/Company (printed)	Signature

Meeting Conducted by: ____

Signature

ATTACHMENT C1

Job Safety Analyses

Geomatrix

JOB SAFETY ANALYSIS

JSA #

Project Name:	CUSTOM Plywood RIFS	Project No:	10654	Date:	2/22/08
Task:	Boat Trailer Towing and Use	Task Location:			
Completed by:	G. MAXWELL	Reviewed by:	Z Reinhardt		
Notes:					

Task	Hazard	Risk Control Method
Mobilization To Site	Driving accidents	Vehicle to be fit for purpose and well maintained.
		Loads to be secure and not to exceed vehicle specifications or legal limits.
		Driver to be licensed trained and medically fit.
		Driver to be rested and alert.
		Drive should not use cell phone while driving.
		PLAN YOUR ROUTE AHEAD OF TIME, avoid narrow streets, sharp corners, and low overpasses.
		Driver must not be under the influence of alcohol, drugs or medication that impairs ability to drive vehicle.
		Inspect that trailer is in good operating condition (tires properly inflated, trailer lights working, hitch properly latched, boat properly tied down.)
		Boat and towing vehicle fuel level are adequate for anticipated tasks.
		When driving, allow extra stopping distance between you and the vehicle in front of you.
		Use extra caution when changing lanes or turning corners to avoid hitting objects with the trailer.
	Flat Tire / Breakdown	If possible, get completely off the freeway at next exit.
		If vehicle is in the traffic lane, call 911. It is usually best to not leave the vehicle if traffic is heavy.
		Do not hesitate to call a tow truck if repairs cannot be made safely.
		Use extreme caution when outside of a broken down vehicle. Avoid standing behind or on the traffic side of the vehicle.
Launching Boat	Ramp accidents	Prepare boat for launch in a safe location.
		Inspect for overhead power lines that might hit A frame mast.
		Attach mooring lines and fenders to boat prior to launching.
		Boat operator should don life jacket before launching boat.
		Watch for pedestrian traffic when backing.
		Firmly set parking brake when parked on boat ramp. Make sure the brake is holding before exiting cab.
		Boat operator and vehicle driver must coordinate actions.
	Leaving Dock	Check for other vessel traffic.
		Crew should not untie mooring lines until the captain instructs them to.
		Always untie down wind / current mooring line first.
		Do not jump from dock to boat.
All On Water Activities	Drowning	All personnel on boat must wear life jacket while on the water.
		Have a throwable life ring readily available.
		Use caution to avoid falling overboard.

		Maintain visual contact with a man overboard as the vessel circles round to pick the victim up.
	Head Injuries	Wear hard hat when equipment is being lifted.
		The winch operator should coordinate lifting of equipment with deck crew.
	Eye Injuries	Use safety glasses if there are any splash hazards.
		Wear UV filtering sun glasses to avoid sun burn to eyes.
	Sunburn	Wear long sleeve shirts to protect skin from sun exposure.
		Reapply SPF 30 or better sun screen often.
		Wear a wide brimmed hat.
	Trips / Falls	Use care when moving about the boat.
		Maintain good housekeeping practices. Avoid unnecessary deck clutter.
		Wear appropriate PPE including non-slip rubber boots if working on wet or slick surfaces
	Heat / cold stress	Take regular breaks on hot days or if feeling faint or overexerted
		Consume adequate food / beverages (water / sports drink)
		If possible, adjust work schedule to avoid temperature extremes
		Wear clothing appropriate for the temperature conditions.
		Crew should watch each other for signs of thermal stress.
	Fire	Avoid refueling while on the water if possible.
		Have a dry chemical fire extinguisher readily available.
		Smoking is prohibited.
		Avoid the use of flammable chemicals if possible.
	Sinking	Continually assess weather conditions. Go back to harbor is the weather conditions become dangerous.
		If vessel is taking on water, immediately contact USCG on VHF radio Ch. 16 to inform them of the situation. If possible run a sinking vessel onto the beach. If you must abandon ship, place emergency calls to the USCG and 911 if time allows. Take the emergency signaling kit and the hand held VHF radio (which is waterproof) with you.
	Oil Spills	Avoid pouring oil products while on the water if possible.
		Have absorbent pads available to contain any oil spills.
		If any oil spill enters the water, promptly notify the oil spill response line at 1 (800) 424-8802.
	Collision	All crew members should keep alert for other vessel traffic.
		Observe proper "Rules of the Road".
		Stay to the right side of designated shipping channels.
	Homeland Security	Maintain a minimum distance of 500 yards from Washington State ferry boats and US Navy vessels. If this is not possible, contact the vessel using VHF radio to request permission to approach closer. After radio contact, if distance is less than 500 yards, maintain a dead slow speed. Failure to do so may result in fines and/or arrest.
Anchoring	Entanglement	Make sure anchor lines are untangled prior to deploying anchor.

		Keep feet out of the bight of the anchor line.
		Avoid throwing the anchor. It is safer to lower the anchor to the bottom.
	Back Strain	If possible, use an anchor winch to recover the anchor.
		Keep back straight to minimize strain.
		If the anchor is set hard into the bottom, use the boat to break it free.
	Returning to dock	Approach dock slowly.
		Crew should not jump from boat to dock.
		Tie up upwind/stream mooring line first.
Recovering Boat	Ramp accidents	Watch for pedestrian traffic when backing.
		Firmly set parking brake when parked on boat ramp.
		Boat operator and vehicle driver must coordinate actions.
		Confirm that boat is resting properly on the trailer.
		Prepare boat for trailering in a safe location, watch for other vehicle traffic.
		Remove mooring lines, fenders, and other objects that could fall off while trailering the boat.
		Secure all cargo.
		Secure boat to trailer.
		Confirm that trailer lights are working properly.
On the Job Accident	Minor Injury	Assess accident site to avoid further injury to victim or rescuers.
		Render first aid as necessary.
		Transport victim to local first aid facility for follow up treatment if necessary.
		Fill out Incident Report Form as soon as possible.
	Serious Injury / Fatality	Assess accident site to avoid further injury to victim or rescuers.
		Call 911 or if access to the beach is difficult, USGS on VHF channel 16.
		Render first aid as necessary. Avoid moving the victim.
		Do not move any equipment that was involved in the accident except as necessary to facilitate rescue or to assure safety of other personnel.
		Contact Geomatrix Corporate H&S Manager Don Kubik (510) 368-6433.
		You must report the death, or probable death, of any employee, or the in-patient hospitalization of two or more employees within 8 hours to the Washington Department of Labor and Industries at 1 (800) 423-7233.

Geomatrix

JOB SAFETY ANALYSIS

JSA #

Project Name:	Former Custom Plywood	Project No:	10654.000	Date:	2/25/08

Task: Mobilization to and from site

Task Location: Anacortes, WA

For this Project and Task, this document is a Certification of Hazard Assessment

Completed by: A. Bazin

Reviewed by: T. Reinhardt

Notes:

Task	**Hazard**	**Risk Control Method**
Mobilization To Site	Driving accidents	Vehicle to be fit for the purpose and well maintained. If using your own vehicle, note that company insurance may not apply. Best to use a rental car or Flexcar, which are usually well maintained.
		Loads to be secure and not to exceed vehicle specifications or legal limits. If loading vehicle heavily or towing, check vehicle Gross Vehicular Weight Rating (GVWR) and towing limits for vehicle and hitch. Get instruction in proper hitch operation if unfamiliar with towing equipment.
		Driver to be currently licensed and medically fit.
		All occupants will wear their seat belts whenever traveling.
		Driver to be rested and alert. If driving long distances, take breaks to stretch and keep alert. Change drivers or park safely off the road to sleep if having difficulty staying awake.
		Minimize cell phone use. Use only a hands-free system, or park safely off the road to use the cell phone.
		Plan your route ahead of time. Have maps or turn directions at hand for reference; highlight them to show critical turns.
		Check driver attitude—Be relaxed, unhurried, and do not drive aggressively. Keep right except to pass, pass only where sufficient distance and visibility exist, and maintain a spacing buffer for other drivers to make mistakes.
		Driver must not be under the influence of alcohol, drugs, or medication that impairs the ability to drive vehicle.

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JOB SAFETY ANALYSIS

JSA #

Project Name:	Former Custom Plywood	Project No:	10654.000	Date:	2/25/08
Task:	Excavation and Soil Sampling	Task Location:	Anacortes, WA		

For this Project and Task, this document is a Certification of Hazard Assessment

Completed by:	A. Bazin	Reviewed by:	T. Reinhardt
Notes:			

Task	**Hazard**	**Risk Control Method**
Mobilization To Site	Driving accidents	Reference Driving/Mobilization JSA
Set Up Work Site	Auto / public traffic	Notify attendant or site manager / owner of work activities and location.
		Work location to be barricaded off.
		High visible clothing to be worn at all times while in operational areas.
	Uneven or unstable ground	Visually examine site prior to entry.
Excavation	Heavy Equipment Operation	Work location to be barricaded off.
	Struck by:	High visibility clothing to be worn at all times while in operational area.
		Personnel must make eye contact with operator before approaching the equipment and remain safely outside the swing radius of the equipment.
		Operators must be aware of personnel in the area and use proper hand signals before maneuvering.
	Underground Utilities:	Properly locate utilities with 1-call (ID # 52133) 800-424-5555 and private locator. Deenergize lines where feasible. If additional utilities are suspected, work with facility to identify and locate them.
		Examine initial 3 feet of excavations for utility backfill.
		Have subcontractor hand excavate or air knife within 2 feet of identified underground utilities.
	Utility contact:	Operators must use spotters and be cautious when maneuvering equipment within 15 feet of overhead utility lines, and maintain safe distances at all time.
	Slip, trip & fall	Keep work area tidy and clean.
		Keep work surfaces dry where possible.
		Wear appropriate PPE including non-slip soles or rubber boots if working on wet or slick surfaces.
		Stay aware of footing and do not run.
	Heat / cold stress	Take regular breaks on hot days or if feeling faint or overexerted.
		Consume adequate food / beverages (water / sports drink).
		If possible, adjust work schedule to avoid temperature extremes.
	Biological hazards: insects, vegetation	Open enclosures slowly, do not put hands inside enclosures where view is obstructed.
		Survey site for presence of biological hazards and maintain safe distance.
	UV exposure	Wear correct PPE (neck to toe clothing & sun block, as needed).
	Lifting heavy equipment	Do not lift or move heavy equipment without assistance.
		Use proper bending / lifting techniques by lifting with arms and legs and not with back. Keep back straight while lifting.
		Take breaks if feeling faint or over exerted.
	Muscle strain injury	Use correct manual lifting methods.

	Noise	Wear hearing protection (ear muffs or plugs) if normal conversation levels are difficult to hear at 3 feet distance.
	Dust/vapors	Stay upwind or crosswind when possible. Implement air monitoring plan in HASP.
Soil Sampling	Handling contaminated materials / soils / groundwater	Stop work if hazardous conditions identified – reassess and take the necessary precautions.
		Wear appropriate PPE including face shield / safety glasses, dust masks or respirators, long sleeve shirts and pants.

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JOB SAFETY ANALYSIS

JSA #

Project Name:	Former Custom Plywood	Project No:	10654.000	Date:	2/25/08
Task:	Soil Sampling - Surface	Task Location:	Anacortes, WA		

For this Project and Task, this document is a Certification of Hazard Assessment

Completed by:	A. Bazin	Reviewed by:	T. Reinhardt
Notes:			

Task	**Hazard**	**Risk Control Method**
Mobilization To Site	Driving accidents	Reference Driving/Mobilization JSA
Set Up Work Site	Auto / public traffic	Notify attendant or site manager / owner of work activities and location.
		Work location to be barricaded off
		High visible clothing to be worn at all times while in operational areas
	Uneven or unstable ground	Visually examine site prior to entry.
Surface Soil Sampling		Stop work if hazardous conditions identified – reassess and take the necessary precautions.
		Wear appropriate PPE including face shield / safety glasses, dust masks or respirators, long sleeve shirts and pants.
	Slip, trip & fall	Keep work area tidy and clean – including the removal of excess cuttings.
		Keep work surfaces dry where possible
		Wear appropriate PPE including non-slip soles or rubber boots if working on wet or slick surfaces
		Stay aware of footing and do not run
	Heat / cold stress	Take regular breaks on hot days or if feeling faint or overexerted
		Consume adequate food / beverages (water / sports drink)
		Dress warmly for cold, wet conditions.
		If possible, adjust work schedule to avoid temperature extremes
	Biological hazards: insects, vegetation	Open enclosures slowly, do not put hands inside enclosures where view is obstructed
		Survey site for presence of biological hazards and maintain safe distance
	UV exposure	Wear correct PPE (neck to toe clothing & sun block, as needed)
	Lifting heavy equipment	Do not lift or move heavy equipment without assistance
		Use proper bending / lifting techniques by lifting with arms and legs and not with back. Keep back straight while lifting
		Take breaks if feeling faint or over exerted
	Muscle strain injury	Use correct manual lifting methods.
	Exposure to contaminated materials, soils or groundwater	Wear appropriate PPE including nitrile gloves, safety glasses and neck to toe clothing. Implement air monitoring plan per HASP

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JOB SAFETY ANALYSIS

JSA #

Project Name: custom plywood RIFS

Project No: 10654

Date: 2/22/08

Task: Van Veen Grab Sampling

Task Location:

Completed by: GSM

Reviewed by:

Notes:

Task	Hazard	Risk Control Method
Boat use	Misc.	Refer to: JSA Boat Trailer Towing and Use.dot
Moving the Van Veen Grab	Back injury	Use the boat winch whenever possible to lift heavy equipment. If this is not possible, ask someone to help you.
		Keep back straight to minimize strain when lifting.
	Foot injury	Wear steel toed boots when handling heavy items.
Running the Hydraulic Power Pack	Fire	Use caution in refueling to avoid fuel spills.
		Let engine cool before refueling.
		Smoking is prohibited when refueling.
		Have the dry chemical fire extinguisher readily available.
	Fuel Spill	Use oil spill kit to absorb the spill.
		If any fuel enters the water use the spill kit to contain the spill and promptly notify the oil spill response line at 1 (800) 424-8802.
	Noise	Wear hearing protectors when the power pack is running.
Raising the boat mast	Entanglement	Carefully monitor winch lines so they do not catch on anything.
		Wear your hard hat.
	Pinching	Have personnel move to center of deck away from the mast pivots and hydraulic cylinders.
Deconning the grab (gravity grab)	Pinching	Make sure the grab is stable before reaching inside to clean it.
	Splashing of soap and water	Wear eye protection and splash suit.
Deconning the grab (power grab)	Pinching	Engage safety valve before deconning the grab.
	Splashing of soap and water	Wear eye protection and splash suit.
Lifting the Van Veen Grab with the winch	Dropping heavy equipment	Do daily inspection of rigging. Do not use lifting equipment that is not in good operating condition.
		Do not lift the grab until the deck hand is prepared to guide it.
		Wear hard hat.
		Never walk under a lifted load.
		Avoid placing body parts between a heavy load and a fixed object.
	Entanglement	Check that winch lines are not caught on anything before lifting.
	Swinging heavy equipment	Check for wakes before lifting. Lift loads only when the boat is not expected to be rocking.
		Watch for boat wakes, alert other crew members if you see one.
		Never position your body between a fixed object and a swinging load.
		Position the lifting point directly over the grab so that it is lifted straight up.
		Lift slowly so that the deck hand can control the swing of the equipment.

		If a distraction occurs, the winch operator should stop all winch movement.
Arming the grab	Pinching	Coordinate arming the grab with winch operator.
		Never reach inside the grab after it is armed.
Lowering the Van Veen Grab into the water	Catching the edge of the boat	Lower the grab slowly so that the deck hand can guide the grab if necessary.
Lifting the Van Veen Grab out of the water	Hanging up on the deck	Watch that the Van Veen Grab does not catch under the edge of the deck.
		Have the boat hook handy so that you can guide the grab without having to lean over the side of the boat.
	Swinging	Set the Van Veen Grab on stand immediately after use so that it cannot swing if the boat rocks.
	Pinching	Do not place hands under the grab as it is being lowered onto the stand.
Contaminated Sediment	Chemical contamination	Decant water inside the grab over the bow of the boat rather than spilling it onto the deck.
		Promptly wash spilled sediment off of the deck.
		Do not overfill waste buckets.
		Waste sediment should be stored in an approved waste drum and properly labeled (if required).
		Always wear proper PPE (splash suit, gloves, eye protection).
	Splashing	If dumping waste sediment overboard, use caution to avoid splashing contaminatted sediment.
High pressure air (pneumatic grab only)	Unsecured air tanks	Air tanks must be secured at all times so that they do not roll or tip over.
	Air induced injury	Always bleed air pressure down before removing regulator from air cylinder.
		Never direct high pressure air onto your skin.
Lowering the boat mast	Pinching	Have personnel move to center of deck away from hinge and cylinders.
		Make sure the mast does not crush items on tables.
	Entanglement	Make sure winch line does not hang up on anything.
On the Job Accident	Minor Injury	Assess accident site to avoid further injury to victim or rescuers.
		Render first aid as necessary.
		Transport victim to local first aid facility for follow up treatment if necessary. The route to the nearest hospital should be included in the Project Health and Safety Plan.
		Fill out Incident Report Form as soon as possible.
	Serious Injury / Fatality	Assess accident site to avoid further injury to victim or rescuers.
		Call 911 to request Emergency Medical Services (EMS) or if access to the beach is difficult, USGS on VHF channel 16.
		Render first aid as necessary. Avoid moving the victim.
		Do not move any equipment that was involved in the accident except as necessary to facilitate rescue or to assure safety of other personnel.
		Contact Geomatrix Corporate H&S Manager Don Kubik (510) 368-6433.
		You must report the death, or probable death, of any employee, or the in-patient hospitalization of two or more employees within 8 hours to the Washington Department of Labor and Industries at 1 (800) 423-7233.

Geomatrix

JOB SAFETY ANALYSIS

JSA #

Project Name:	Former Custom Plywood	Project No:	10654.000	Date:	2/25/08
Task:	Well Development and Sampling	Task Location:	Anacortes, WA		

For this Project and Task, this document is a Certification of Hazard Assessment

Completed by:	A. Bazin	Reviewed by:	T. Reinhardt
Notes:			

Task	**Hazard**	**Risk Control Method**
Mobilization To Site	Driving accidents	Reference Driving/Mobilization JSA
Set Up Work Site	Auto / public traffic	Notify attendant or site manager / owner of work activities and location.
		Work location to be barricaded off.
		High visible clothing.
	UV exposure	Wear correct PPE (neck to toe clothing & sun block as needed)
Opening Well	Hand Scrapes/Injuries	Use appropriate type of wrench (socket), don't force, anticipate path of slipped tool and keep body path clear.
		Wear gloves
		Use pry bar to lift traffic box cover
	Insects and Spiders	Carefully inspect work area during site inspection to identify hazards
		Open enclosures slowly
		Don't place hands where you cannot see
	Pressurized well cap	Open well cap slowly
		Don't hold head over well when removing cap
	Vapors	Open well cap slowly
		Don't hold head over well when removing cap
		Test atmosphere in well box and well
Purging (pumping)	Back injuries	Bend with knees
		Lift objects properly (test weight first, no twist, bending knees)
		Get help to lift heavy objects
	Burns	Allow generator to cool before moving
	Splash hazards	Lower pump slowly down well
		Secure discharge hose to wastewater receptacle prior to starting pump.
		Wear appropriate PPE -- Safety glasses/Splash goggles, etc.
	Slip, Trip, and Falls	Clean up spill immediately
		Practice good housekeeping
		Properly coil hoses, cords, ext
		Make sure work area is solid and free of obstructions

Geomatrix

JOB SAFETY ANALYSIS

JSA #

Project Name:	Former Custom Plywood	Project No:	10654.000	Date:	2/25/08
Task:	Drilling, Sampling, Installation of MW	Task Location:	Anacortes, WA		

For this Project and Task, this document is a Certification of Hazard Assessment

Completed by:	A. Bazin	Reviewed by:	T. Reinhardt
Notes:			

Task	Hazard	Risk Control Method
Mobilization To Site	Driving accidents	Reference Driving/Mobilization JSA
Set Up Work Site	Auto / public traffic	Notify attendant or site manager / owner of work activities and location.
		Work location to be barricaded off
		High visible clothing to be worn at all times while in operational areas
	Uneven or unstable ground	Visually examine site prior to entry.
Soil Boring / Drilling		Set-up adequate exclusion zone – only trained, inducted and authorized personnel within this area
	Struck by, caught by	Stay clear of rotating auger / equipment – no hands, feet, loose clothes, or any body part to be near rotating equipment. Rotation to stop for sampling etc. Avoid exposure to burst hazard from pressurized hydraulic lines
	Impact by suspended loads	Do not walk under suspended loads
	Hearing damage from high noise levels	USE HEARING PROTECTION (EAR MUFFS OR EAR PLUGS) IF normal conversation difficult to hear at 3 feet
	Vapors and airborne particulates	MONITOR AIR CONCENTRATIONS per air monitoring plan
		Stop work if hazardous conditions identified – reassess and take the necessary precautions.
		Wear appropriate PPE including face shield / safety glasses, dust masks or respirators, long sleeve shirts and pants.
	Slip, trip & fall	Keep work area tidy and clean – remove excess cuttings.
		Keep work surfaces dry where possible
		Wear appropriate PPE including non-slip soles or rubber boots if working on wet or slick surfaces
	Slip, trip & fall	Stay aware of footing and do not run
	Heat / cold stress	Take regular breaks on hot days or if feeling faint or overexerted
		Consume adequate food / beverages (water / sports drink)
		If possible, adjust work schedule to avoid temperature extremes
	Hazard from Striking Underground Services	Call local 1-call utility locator at least 2 days in advance of field work.
		Augment 1-call with professional cable locator to locate and identify all services in potential drilling area.
		Develop and review checklist of all potential utilities serving site and structures, and positively locate them.
		Due diligence review of active and historic utility lines and subsurface structures with site representatives.
		Near suspected unlocated utilities, hand excavate or air knife to potential utility depth.
		Hand excavate or air knife to potential depth when within 2 feet of known utility lines.
		Inspect initial 3 feet of cuttings for utility bedding material .
	UV exposure	Wear correct PPE (neck to toe clothing & sun block, as needed)

	Lifting heavy equipment	Do not lift or move heavy equipment without assistance
		Use proper bending / lifting techniques by lifting with arms and legs and not with back. Keep back straight while lifting
		Take breaks if feeling faint or over-exerted
	Muscle strain injury	Use correct manual lifting methods.
		Driller to manage soil sampling.
Soil Sampling	Handling contaminated materials / soils / groundwater	Wear appropriate PPE including nitrile gloves, safety glasses and neck to toe clothing.
	Sharp sampling tools	Use correct tools for opening split spoon sampler / push tubes, don't use excessive force and keep body parts clear of tool path if it slips.
	Vapors and dusts	Monitor per air monitoring plan
		Work upwind of sampling area if possible
Monitoring well installation	Pinch points	Watch for pinch points when assembling and installing well pieces
	Slip, trip & fall	Keep work area tidy and clean –remove excess cuttings.
		Keep work surfaces dry where possible
		Wear appropriate PPE including non-slip rubber boots if working on wet or slick surfaces

ATTACHMENT C2

Hospital Location Map

Custom Plywood Site to Island Hospital

1.2 miles; 3 minutes

9:00 AM	0.0 mi	🟩 1 Depart 3507 Fidalgo Bay Rd, Anacortes, WA 98221 on 35th St (West) for 0.3 mi
9:00 AM	0.3 mi	Turn RIGHT (North) onto R Ave for 0.6 mi
9:02 AM	0.9 mi	Turn LEFT (West) onto 24th St for 0.3 mi
9:03 AM	1.2 mi	🟥 2 Arrive Island Hospital [1211 24th St, Anacortes WA 98221, (360) 293-3181]

APPENDIX D

Sanborn Maps and Facility “As Built” Sketch

8 Sheets.

1

SANBORN MAP COMPANY,

POPULATION
1000 IN WINTER. 1500 IN SUMMER.

PREVAILING WINDS N.W. IN SUMMER, S.W. IN WINTER
WATER FACILITIES SEE NOTE.
NO STEAM & NO HAND ENGINE
3 INDEPENDENT HOSE CART
HOOK & LADDER TRUCK

ANACORTES

SKAGIT COUNTY
WASH.
SEPTEMBER
1903
SCALE 50 FT. TO AN INCH
11 BROADWAY, NEW YORK.

NOTE:-

WATER FACILITIES: GRAVITY SYSTEM OWNED BY THE OREGON IMPROVEMENT CO. WATER FROM HEART LAKE LOCATED 2½ MILES S.W OF HOTEL VENDOME, CONVEYED THROUGH ABOUT 1½ MILES OF 12" WOODEN STAVE PIPE TO A RESERVOIR OF 335,700 GALS LOCATED ABOUT 1 MILE S. W. OF HOTEL VENDOME AT AN ELEV OF 220 FT. ABOVE TIDE WATER. WATER CONVEYED TO TOWN THROUGH 1 MILE OF 12" SPIRAL STEEL PIPE & THENCE THROUGH 6" & 8" DISTRIBUTING MAINS. ABOUT 3½ MILES OF MAINS. 7 HYD'S. PRESS. ABOUT 80 LBS PER SQ. INCH

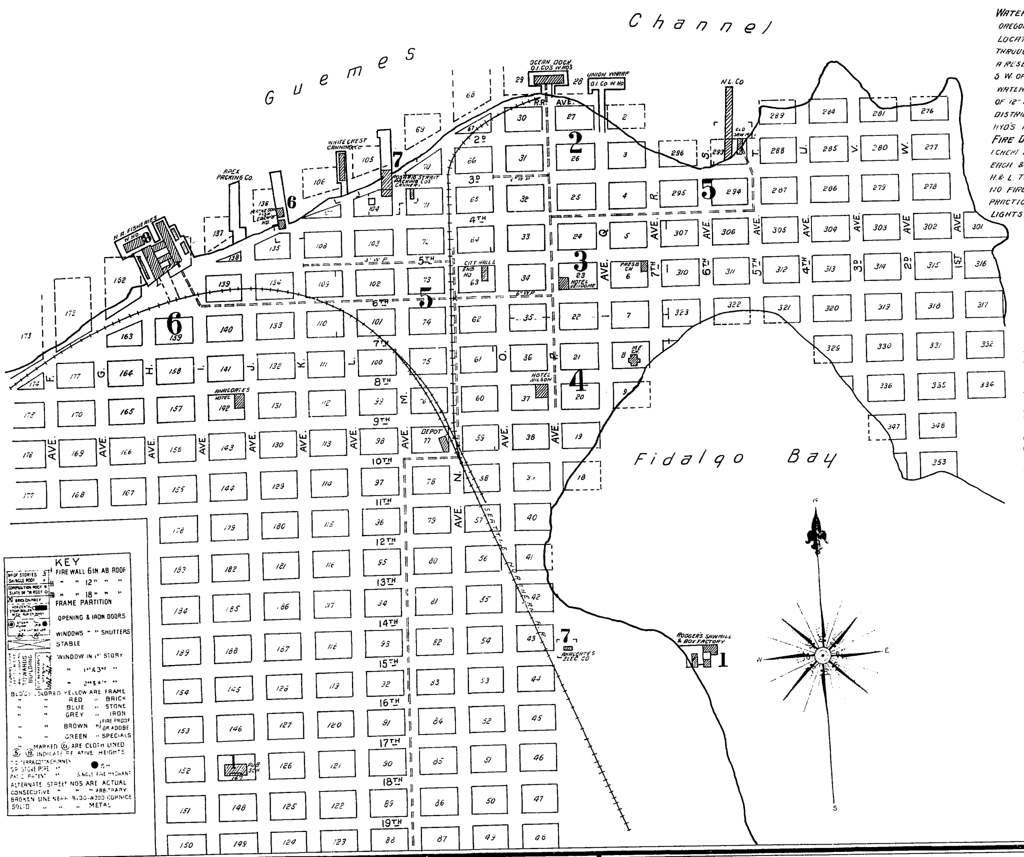
FIRE DEP'T: VOLUNTEER. NO HORSES. NO PAID MEN. 1 CHEM. ENG. 3 HOSE CARTS WITH 500 FT. OF COTTON HOSE EACH & 500' OF 2½" COTTON HOSE IN RESERVE. 1 PRESTON H. & L. TRUCK. 36 TIN BUCKETS.

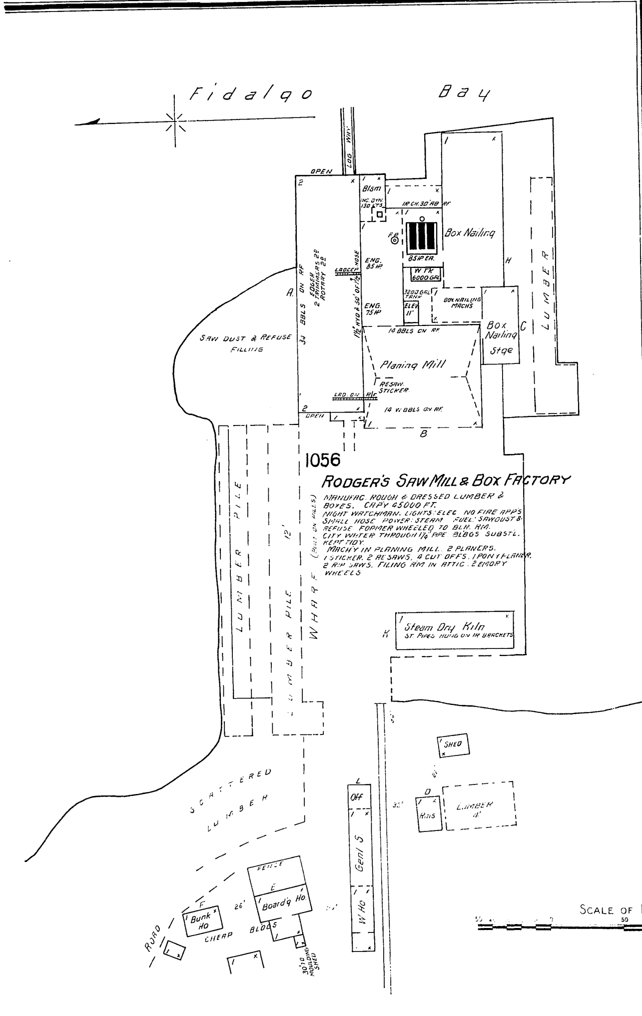
NO FIRE LIMITS. GRADE OF TOWN COV'D BY MAP PRACTICALLY LEVEL, EXCEPTING SHEET Nº 6

LIGHTS: ELEC.

INDEX.

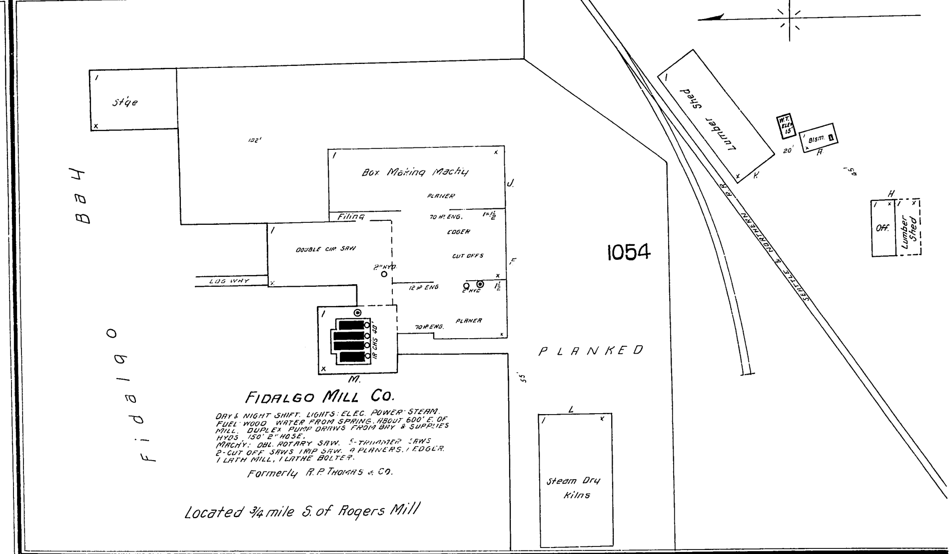
SPECIALS.





RODGER'S SAW MILL & BOX FACTORY

MANUFAC. ROUGH & DRESSED LUMBER & BOXES. CAP'Y 45000 FT.
NIGHT WATCHMAN. LIGHTS: ELEC. NO FIRE APP'S SMALL HOSE. POWER: STEAM. FUEL: SAWDUST & REFUSE FORMER WHEELED TO BLR. RM.
CITY WATER THROUGH 1¼" PIPE. BLDGS SUBSTL. KEPT TIDY.
MACH'Y IN PLANING MILL. 2 PLANERS. 1 STICKER. 2 RESAWS. 4 CUT OFFS. 1 PONY PLANER. 2 RIP SAWS. FILING RM IN ATTIC. 2 EMORY WHEELS



FIDALGO MILL CO.

DAY & NIGHT SHIFT. LIGHTS: ELEC. POWER: STEAM. FUEL: WOOD. WATER FROM SPRING, ABOUT 600' E. OF MILL. DUPLEX PUMP DRAWS FROM BAY & SUPPLIES HYDS. 150' 2" HOSE.
MACH'Y: DBL. ROTARY SAW. 5-TRIMMER SAWS. 2-CUT OFF SAWS. 1 RIP SAW. 4 PLANERS. 1 EDGER. 1 LATH MILL, 1 LATHE BOLTER.

Formerly R. P. Thomas & Co.

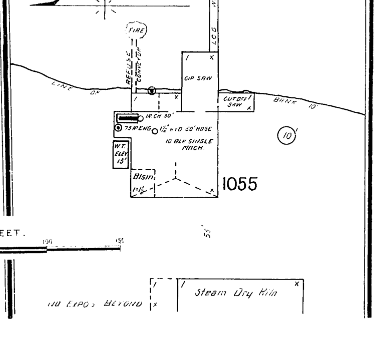
Located ¾ mile S. of Rogers Mill

ANACORTES SHINGLE MILL.

NIGHT WATCHMAN. LIGHTS: ELEC. 170' 1½" HOSE. WATER PUMPED FROM BAY BY ST. PUMP
CAP'Y 140,000

Fidalgo Bay

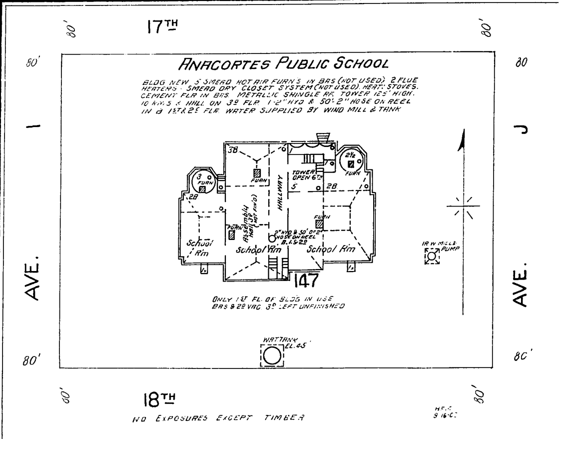
Located ½ mile S. of Rodgers Mill.



SCALE OF FEET.

ANACORTES PUBLIC SCHOOL

BLDG NEW. 5 SMEAD HOT AIR FURN'S IN BAS (NOT USED). 2 FLUE HEATERS - SMEAD DRY CLOSET SYSTEM (NOT USED). HEAT: STOVES. CEMENT FLR IN BAS. METALLIC SHINGLE RF. TOWER 125' HIGH. 10 RMS & HALL ON 3º FLR. 1-2" HYD & 50'-2" HOSE ON REEL IN @ 1ST & 2º FLR. WATER SUPPLIED BY WIND MILL & TANK



SANBORN MAP COMPANY.
POPULATION
6000
PREVAILING WINDS N.W. IN SUMMER S.W. IN WINTER
WATER FACILITIES SEE NOTE
NO STEAM & NO HAND ENGINE
4 INDEPENDENT HOSE CARTS
1 HOOK & LADDER TRUCK

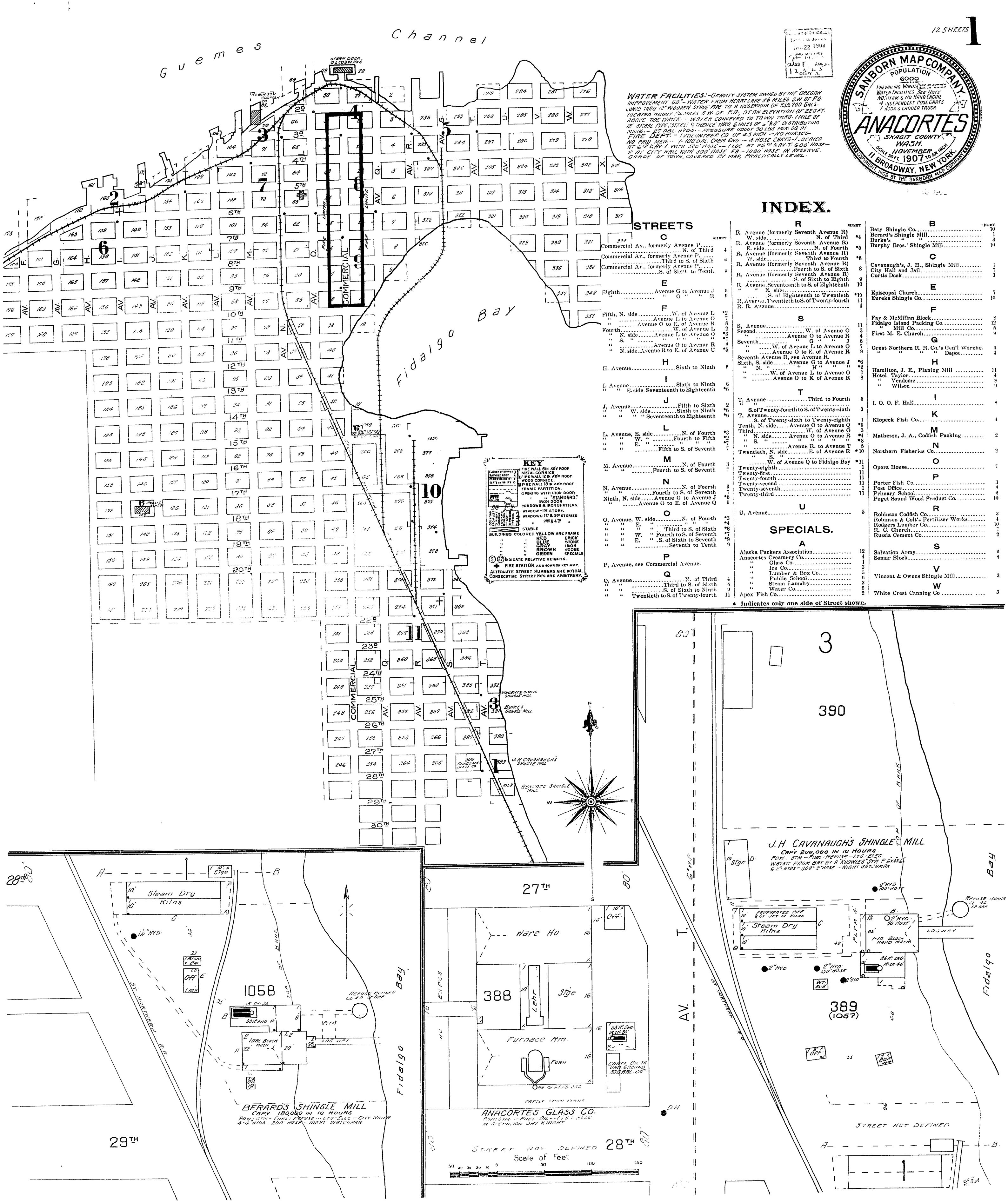
ANACORTES

SKAGIT COUNTY,
WASH.
NOVEMBER
1907
SCALE 50 FT. TO AN INCH
11 BROADWAY, NEW YORK.

WATER FACILITIES:- GRAVITY SYSTEM OWNED BY THE "OREGON IMPROVEMENT CO." - WATER FROM HEART LAKE 2½ MILES S.W. OF P.O. CONV'D THRO 12" WOODEN STAVE PIPE TO A RESERVOIR OF 855,700 GALS. LOCATED ABOUT 1¼ MILES S.W. OF P.O., AT AN ELEVATION OF 220 FT. ABOVE TIDE WATER. - WATER CONVEYED TO TOWN THRO. 1 MILE OF 12" SPIRAL PIPE (STEEL) & THENCE THRO. 6 MILES OF 6" & 8" DISTRIBUTING MAINS. - 27 DBL. HYDS. - PRESSURE ABOUT 90 LBS PER. SQ IN.

FIRE DEPT. - 1 VOLUNTEER CO. OF 45 MEN - NO HORSES - NO PAID MEN. - 1 - 100 GAL. CHEM ENG. - 4 HOSE CARTS - 1 LOCATED AT 6TH & AV. 1. WITH 500' HOSE - 1 LOC. AT 26TH & AV. T. 600' HOSE - 2 AT CITY HALL WITH 800' HOSE EA. - 1000' HOSE IN RESERVE.

GRADE OF TOWN, COVERED BY MAP, PRACTICALLY LEVEL.

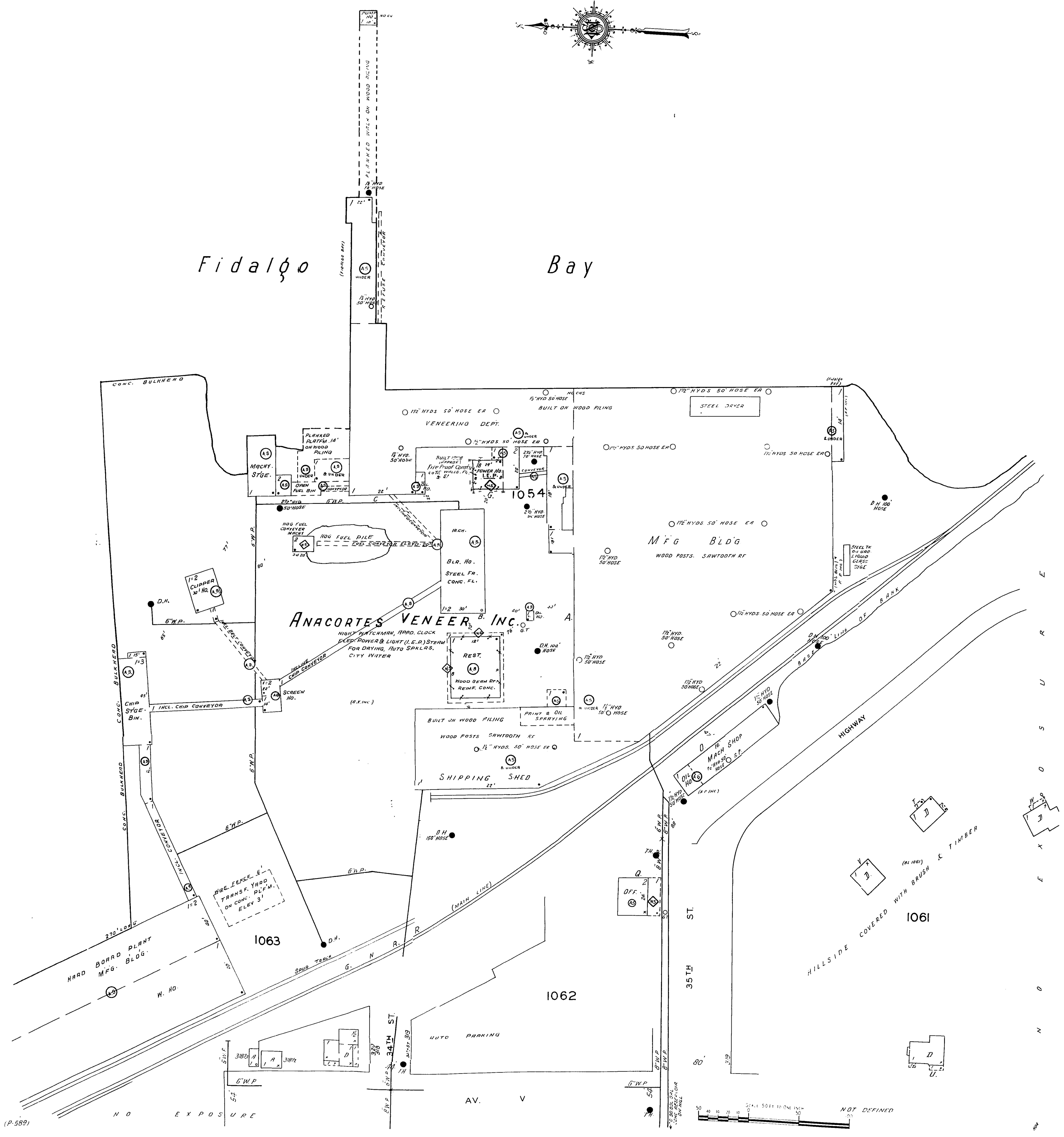


INDEX.

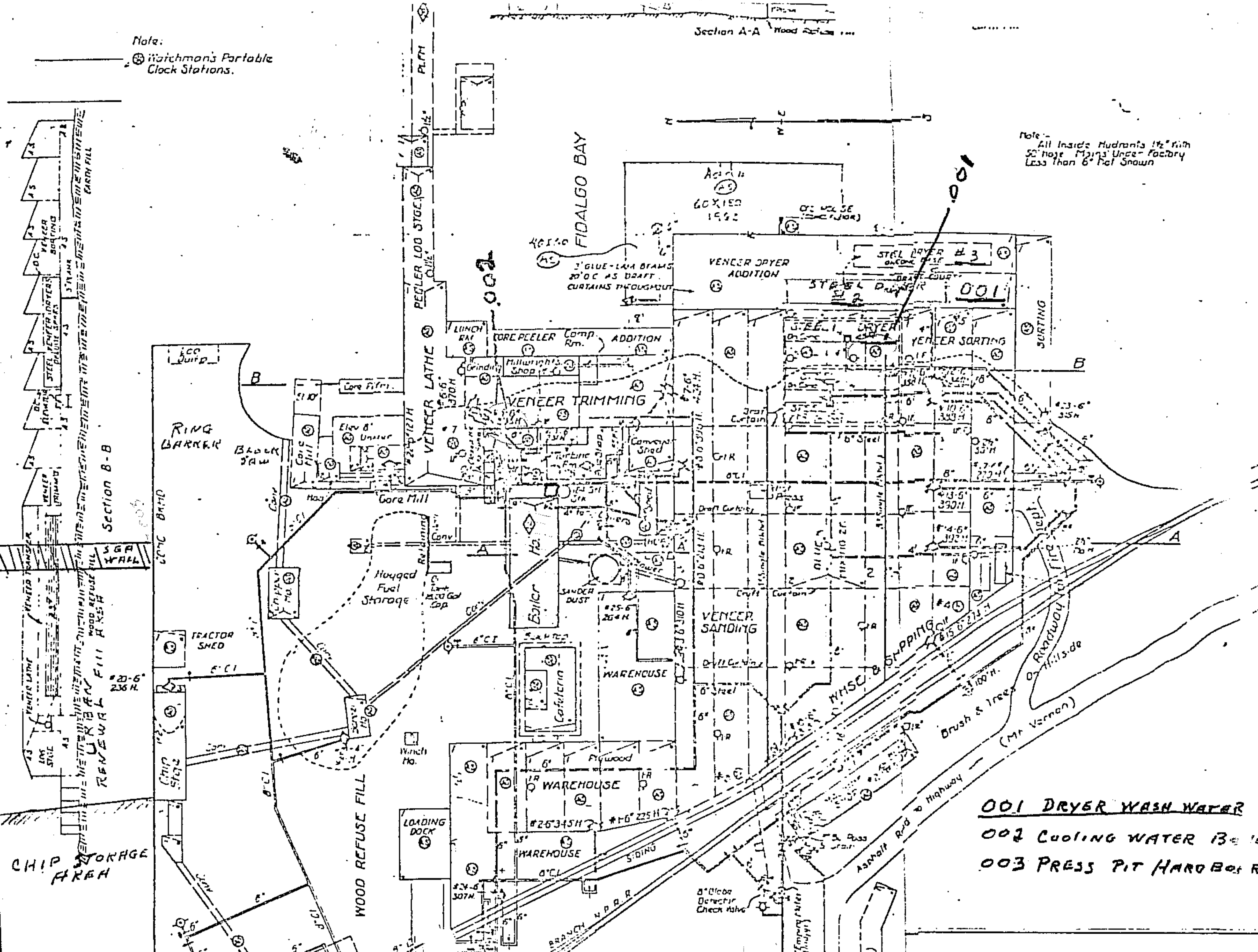
* Indicates only one side of Street shown.

OCT. 1925
ANACORTES
WASH.

NEW SHEET
MAR. 1940



(P-589)



001 DRYER WASH WATER

002 COOLING WATER Be

003 PRESS PIT /HARD Bo

APPENDIX E

Background Chromium Information

Background Calculations

Data	Loc Ref
22	PS50.3
22.6	PS20.3
22.6	PS160.3
25.1	SWRD2.6
26.7	SWRD2.3
32	SWRD2.3
35.3	PS10.3
45.2	SWRD2.7
163	SWRD2.5
235	PS250.3

Natural Background Soil Cr Calculation (mg/kg) for Anacortes Vicinity

MTCA*Stat* 3.0

Number of samples		Uncensored values	
Uncensored	10	Mean	62.95
Censored	0	Lognormal mean	59.60
TOTAL	10	Std. devn.	74.03
		Median	29.35
		Min.	22
		Max.	235

Lognormal distribution?		Normal distribution?	
r-squared is:	0.75	r-squared is:	0.61

Recommendations:

Use nonparametric method.

Distribution selection	Enter percentile	Value corresponding to that percentile is:
3	90	227.80
1 = Lognormal	50th	29.35
2 = Normal	4 X 50th	**117.40**
3 = Nonparametric method	Coefficient of Variation = N/A	

Soil cleanup levels for metals may be adjusted to no less than natural background concentrations, in accordance with WAC 173-340-740(5)(c). With the exception of chromium, statewide background metals concentrations were obtained from a state background soil metals study conducted by Ecology (1994) for comparison with Method A and Method B cleanup levels for the site. According to the Ecology study, background total chromium levels in Northern Skagit and Whatcom Counties are elevated compared to the rest of the state. Because elevated background levels of total chromium are expected, and because the site is located outside of the four main regional areas selected by Ecology for the calculation of soil background concentrations, a site-specific total chromium background concentration for the Anacortes area was calculated.

Plot Date: 05/28/08 - 3:20pm, Plotted by: astenberg
Drawing Path: S:\10654\013_Revised RIFS WP\, Drawing Name: Concorde_Samples_051308.dwg

CHROMIUM BACKGROUND SAMPLE LOCATIONS
Former Custom Plywood Mill
Anacortes, Washington

By: APS	Date: 05/28/08	Project No. 10654
Geomatrix		Figure 1