Former Hardel Plywood Site
1210 West Bay Drive NW
Olympia, Washington

Feasibility Study

May 8, 2009

Prepared For: Hardel Mutual Plywood, Inc.

Prepared By:

GREYLOCK CONSULTING LLC

GC Project No. 0373

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1. INTRODUCTION

This report presents a Feasibility Study (FS) completed by Greylock Consulting LLC (Greylock) for the Former Hardel Plywood Site (Site) at 1210 West Bay Drive NW in Olympia, Washington (Figure 1). The FS was completed in compliance with the Washington State Department of Ecology (Ecology) Agreed Order No. DE-4108 (Scope of Work, Task 8).

A Remedial Investigation (RI) was previously completed at this site in 2007. Results from the RI are documented in a Draft Remedial Investigation Report prepared by Greylock (2007).

This FS focuses on remediation of soil and groundwater at the Site. Potential sediment issues are being deferred until Ecology determines the dioxin cleanup level for sediments in Budd Inlet. It is appropriate to separate the soil and groundwater issues from sediment due to the fact that these two issues are not related. Upland soil and groundwater are impacted by petroleum products approximately 240 feet from the shoreline. Separating soil and groundwater from potential sediment issues will allow cleanup of this site to move forward in an expeditious manner.

1.1 Purpose

This FS was prepared by Greylock to develop and evaluate cleanup action alternatives associated with soil and groundwater containing elevated petroleum hydrocarbons at the Site.

1.2 Report Organization

This report is divided into six major sections including:

- Section 1: Introduction – describes the purpose of the FS report and organization.
- Section 2: Supplemental Characterization - provides a summary of the additional soil borings performed at the site to delineate the Areas of Concern.
- Section 3: Preliminary Cleanup Levels and Points of Compliance - describes the cleanup levels and points of compliance used in this study.
- Section 4: Description of the Area of Concern for Soil and Groundwater – identifies the extent of contamination in soil and groundwater at this site.
- Section 5: Remedial Technologies – describes the different remedial technologies evaluated for this site.

- Section 6: Description of Remedial Alternatives – provides an outline of four possible remedial alternatives for this site.
- Section 7: Evaluation of Remedial Alternatives - provides an evaluation of the four remedial alternatives in accordance with MTCA guidelines.
- Section 8: Summary of Recommended Alternative - recommends a remedial alternative for the site.
- Section 9: Limitations
- Section 10: References

2. SUPPLEMENTAL CHARACTERIZATION

The RI completed in 2007 (Greylock, 2007) recommended that additional soil borings be installed to define the extent of soil above cleanup levels. On April 8, 2008 soil sampling and analyses were performed to address these data gaps. Eleven (11) supplemental soil borings were installed to depths ranging from 5 to 16 ft bgs using a Direct Push drill rig (Figure 2). Also, three (3) hand auger borings were installed, west of the concrete slab. Borings were continuously logged. Soil was sampled by driving a piston sampler into undisturbed soil ahead of the borehole bottom. Samples were collected at locations where evidence of petroleum was noted (i.e., odor and/or sheen).

Soil samples collected from borings were submitted to ESN Northwest Inc. of Olympia, Washington for analysis of Total Petroleum Hydrocarbons by NWTPHD-Dx. Soil analytical results are provided in Table 1. A comparison of soil analytical results with cleanup standards is provided in Figure 3. Boring logs from the supplemental investigation are provided in Appendix A. Laboratory analytical reports are provided in Appendix B.

Results from the supplemental soil sampling indicate that there are two distinct areas of soil contamination at this site:

1. Area of Contamination (AOC) No. 1: At the northwestern part of the site, soil in the vicinity of MW-1 contains elevated hydrocarbons (characterized as heavy oil) from depths of approximately 3 to 12 ft below ground surface (bgs).

2. AOC No. 2: At the southwestern part of the site, soil in the vicinity of MW-7 contains

elevated hydrocarbons (characterized as diesel) from depths of approximately 3 to 11 ft bgs. Within this area, PAHs above cleanup levels have been identified at some locations.

The approximate extent of AOC No. 1 and 2 are depicted graphically in Figure 4. Based on information from existing borings, the two areas do not appear to overlap.

3. PRELIMINARY CLEANUP LEVELS AND POINTS OF COMPLIANCE

This section develops and presents the rationale for preliminary cleanup levels and points of compliance. WAC 174-340-200 defines “cleanup level” as the concentration of a hazardous substance in soil, water, air, or sediment that is determined to be protective of human health and the environment under specified exposure conditions. A "point of compliance" means the point or points where cleanup levels shall be attained.

3.1 Remove Free Product

A proposed cleanup alternative is the removal of free product, as measured in monitoring wells. This cleanup alternative is appropriate to ensure source control and possible future migration of petroleum in groundwater.

3.2 Soil Cleanup Levels and Points of Compliance

The Hardel Site is currently zoned commercial-industrial. Surrounding properties are zoned commercial and residential. The appropriate cleanup levels for soils at this site are MTCA Method A for Unrestricted Land Uses and MTCA Method B where Method A levels are not available. Cleanup levels referenced in this FS come from Ecology's CLARC database (Ecology, 2008).

The point of compliance for soil is throughout the site for protection of groundwater and ambient air, and from the ground surface to a depth of 15 feet for soil for the protection of human health based on direct contact exposure.

3.3 Groundwater Cleanup Levels and Points of Compliance

The shallow aquifer at this site is approximately 3 to 4 feet below ground and discharges to Budd Inlet. The shallow aquifer is not a drinking water aquifer due to its proximity to marine waters.

The appropriate cleanup levels for groundwater at this site are Marine Chronic Surface Water Standards. Where these standards are not available, MTCA Method A drinking water standards have been used. Free phase hydrocarbon product is considered a continuing source and will require removal.

As defined under MTCA 173-340-720(8), the standard point of compliance for Site shallow groundwater is throughout the Site.

4. DESCRIPTION OF THE AREA OF CONCERN FOR SOIL AND GROUNDWATER

4.1 Area of Concern for Soil

This Site contains two discrete Areas of Concern (AOCs) for soil. Both areas are located along the eastern boundary of the site. AOC No. 1, located on the east-central portion of the site is characterized by elevated concentrations of heavy oil in soil (Figure 3). TPH concentrations range from 5,000 mg/kg at GB-8 to complete saturation at MW-1. AOC No. 1 is completely covered by concrete. The surface area of AOC No. 1 is approximately 11,600 sq ft. It contains approximately 5,200 cu yds of impacted soil.

AOC No. 2, located on the southeastern portion of the site is characterized by elevated concentrations of diesel in soil (Figure 3). Some elevated PAHs have also been detected in this area, but diesel is more widespread and thus is the primary contaminant that drives the cleanup of AOC No. 2. Diesel concentrations range from 3,200 mg/kg at GB-6 to 21,000 mg/kg at GB-20. AOC No. 2 is completely covered by concrete. The surface area of AOC No. 2 is approximately 16,800 sq ft. It contains approximately 6,100 cu yds of impacted soil.

4.2 Area of Concern for Groundwater

The Site contains two discrete AOCs for groundwater that are located within the two AOCs for soil. AOC No. 1 contains up to one foot of free phase hydrocarbon product at MW-1, measured as oil. AOC No. 2 contains dissolved diesel concentrations of 25,000 ug/L at MW-7. Wells downgradient of these two areas do not contain hydrocarbons above cleanup levels. It's possible that concrete footings in the subsurface may be acting as barriers for migration of hydrocarbons in groundwater. Since wells downgradient of MW-1 and MW-7 are not impacted

by hydrocarbons, it's likely that the area of impacted groundwater corresponds with the area of impacted soil.

5. REMEDIAL TECHNOLOGIES

This section describes in general the remedial technologies evaluated at this site.

5.1 Free Product Removal

Free product removal involves either active or passive removal of free phase hydrocarbon product from the water table. Removal can be achieved by active pumping or by passive product skimmers. Product is commonly removed using recovery wells, recovery trenches, or open excavations.

5.2 Natural Attenuation

Natural attenuation is a reduction in mass or concentration of a compound in groundwater over time or distance from the source of constituents of concern due to naturally occurring physical, chemical, and biological processes, such as; biodegradation, dispersion, dilution, adsorption, and volatilization.

Natural attenuation is a passive remedial technology that takes a significant amount of time. The effectiveness of natural attenuation at a specific site is determined by long-term groundwater monitoring.

5.3 *Insitu* Treatment

Insitu treatment of soil and groundwater involves active treatment using various media injected into the ground. Examples of treatment media include air, biological compounds, and chemical oxidation compounds. Treatment media is commonly introduced into the ground using direct push technology, injection wells, and/or injection trenches.

Insitu treatment is an active remedial technology that breaks down or destroys contaminants in place. The effectiveness of *insitu* treatment is often determined by the delivery method and the homogeneity of subsurface soils. Effectiveness of this method is reduced in heterogeneous soils.

5.4 *Exsitu* Treatment (Landfarming)

Exsitu treatment of soil involves excavation of soil and treatment above ground. An example of this is above-ground bioremediation or landfarming. Treatment media similar to the *insitu* treatment remedial technology may be used in above-ground soil treatment.

Exsitu treatment is often more effective than *insitu* treatment as heterogeneity of soil is not as significant of a limitation. The primary challenge with *exsitu* treatment involves finding available space to store soils during treatment and the control of storm water. Also, once soils are treated to the desired contaminant level, an end use needs to be identified.

5.5 Capping

Capping involves creating an isolation layer between the impacted media and possible human and/or environmental receptors. Caps are commonly constructed of low permeability soil, geotextile, asphalt, and/or concrete. In addition to creating an isolation layer, caps also minimize infiltration of storm water thus reducing the potential for contaminant migration. Caps require maintenance and institutional controls to ensure that the isolation layer is not breached.

5.6 Excavation and Offsite Disposal

Excavation and offsite disposal involves removal of impacted soils and disposal at a licensed landfill that is permitted to accept contaminated soils. This option can be accomplished with conventional construction equipment as long as soil contamination does not extend beyond the reach of a backhoe. This remedial alternative often takes the shortest amount of time to complete.

6. DESCRIPTION OF REMEDIAL ALTERNATIVES

6.1 Alternative 0 – No Action

This alternative would involve leaving the contaminated soil, groundwater, and free product in its current condition. Although existing chemical data suggest that contaminated groundwater has not migrated to Budd Inlet, there is a potential that it could migrate in the future. This alternative would not protect human health and the environment, and therefore will not be considered further.

6.2 Alternative 1 – Free Product Removal; Capping and Natural Attenuation

This alternative would involve:

- passive removal of free product from groundwater in AOC No. 1 using a product skimmer,
- maintaining the currently existing concrete cap, and
- natural attenuation of hydrocarbons in groundwater.

A new 4-inch diameter well would be installed near MW-1. A product skimmer would be installed in the well and monitored monthly. Product would be contained in a 55-gallon drum onsite and regularly removed and disposed offsite to a facility licensed to accept this material. Institutional controls would be put in place to ensure that the concrete cap is not breached. A covenant would be placed on the property which would restrict uses and activities in the impacted areas.

6.3 Alternative 2 - Free Product Removal; *Insitu* Treatment by Chemical Oxidation

This alternative would involve:

- passive removal of free product from groundwater in AOC No. 1 using a product skimmer, and
- *insitu* soil and groundwater treatment in AOCs No. 1 and No. 2 using direct push technology with Regenox, a chemical oxidation agent.

A new 4-inch diameter well would be installed near MW-1. A product skimmer would be installed in the well and checked monthly. Product would be contained in a 55-gallon drum onsite and regularly removed offsite and recycled.

Insitu soil treatment would be accomplished by injecting Regenox into the impacted soil in AOC No. 1 and 2. Injections would be spaced in a grid pattern, focusing on areas with the highest TPH concentrations. A minimum of 3 injections of Regenox would be completed within each AOC.

Following the completion of soil treatment, groundwater monitoring would be performed until four consecutive quarters of sampling confirm that groundwater cleanup levels are met.

Institutional controls would be put in place to ensure that workers who encounter contaminated soils in future excavations would be protected, and to ensure that excavated soils would be managed appropriately. A covenant would be placed on the property which would restrict uses and activities in the impacted areas.

6.4 Alternative 3 – Free Product Removal; On Site Bioremediation and Offsite Disposal of Unsuitable Materials

This alternative would involve:

- Active removal of free product from groundwater in AOC No. 1 by excavation and pumping.
- Excavation and onsite bioremediation (or landfarming) of geotechnically suitable soils in AOC No. 1 and No. 2. Geotechnically suitable soils are defined as sands and gravels.
- Excavation and offsite disposal of geotechnically unsuitable soils at a landfill permitted to accept contaminated soils. Geotechnically unsuitable soils are defined as silts, clays, and wood.

Concrete in the two AOC areas would be removed to enable the excavation of contaminated soils. Product would be removed from AOC No. 1, via active pumping of the excavation. Product and contaminated water would be disposed at a facility licensed to accept these materials. Recycling of product would occur, if possible.

A treatment area approximately 270 ft by 360 ft would be created on the northwestern part of the site. A bermed area, using clean fill would be constructed to manage storm water. Soil above cleanup levels would be excavated and placed within the bermed area. Structurally unsuitable soils would be disposed of offsite at a landfill permitted to accept soils containing hydrocarbons. Structurally suitable soils would be treated with nutrients such as nitrogen and phosphorus to break down hydrocarbons. Soil would be spread out and tilled at least once/month during the dry season. Soil would be covered with visqueen between tilling and during the wet season. It is estimated that it may take approximately 2 years to treat soils to cleanup levels using this technology. Once soils are remediated to cleanup levels, they would

be placed back on the site, above the elevation of the water table.

Following the completion of soil cleanup, groundwater monitoring would be performed until four consecutive quarters of sampling confirm that groundwater cleanup levels are met.

6.5 Alternative 4 – Free Product Removal; Excavation and Offsite Disposal of Contaminated Soils

This alternative would involve:

- active removal of free product from groundwater in AOC No. 1 by excavation and pumping,
- excavation, removal, and offsite disposal of contaminated soils to a landfill permitted to accept these materials.

Concrete in the two AOC areas would be removed to enable the excavation of contaminated soils. Product would be removed from AOC No. 1, via active pumping. Product and contaminated water would be disposed at a facility licensed to accept these materials. Recycling of product would occur, if possible.

Approximately 11,300 cubic yards of soil would be removed and disposed via truck to an off-site landfill permitted to accept petroleum-contaminated soils. Confirmation sampling of soil in the excavations would be performed, and groundwater monitoring would be performed until four consecutive quarters of sampling confirm that groundwater cleanup levels are met.

7. EVALUATION OF REMEDIAL ALTERNATIVES

Ecology identified the criteria that should be used to evaluate remediation alternatives within the Model Toxics Control Act (MTCA) regulation (WAC 173-340-360). The purpose of the evaluations is to identify the advantages and disadvantages of each alternative and thereby assist in the decision-making process. The specific criteria are all considered important, but they are grouped into two sets of criteria that are weighted differently in the decision-making process. These criteria are:

1. Threshold Requirements:

- Protect Human Health and the Environment;

- Comply with Cleanup Standards (WAC 173-340-700 through 173-340-760);
- Comply with Applicable State and Federal Laws (WAC 173-340-710); and
- Provide for Compliance Monitoring (WAC 173-340-410 and 173-340-720 through 173-340-760).

2. Other Requirements:

- Use Permanent Solutions to the Maximum Practical Extent.
- Provide for a Reasonable Restoration Time Frame
- Consider Public Concerns.

In addition to these criteria, the cleanup needs to be compatible with possible future site development and use. This was also considered during the evaluation of remedial alternatives.

A detailed evaluation of the Hardel site's remedial alternatives is provided in Table 2 and summarized below.

7.1 Overall Protection of Human Health and the Environment

This evaluation criterion assesses the degree to which existing risks are reduced, the time required to reduce risks at the facility and attain cleanup standards, on- and off-site risks resulting from implementing the alternative, and improvement of overall environmental quality.

All four alternatives would provide protection of human health and the environment. However, Alternatives 3 and 4 would accomplish this sooner than Alternatives 1 and 2.

7.2 Comply with Cleanup Standards

Ecology has established cleanup standards in the MTCA regulation. These standards are summarized in WAC 173-340-700 through 173-340-760. The site cleanup standards for soil and groundwater are listed in Table 3.

Alternatives 3 and 4 have a high probability of meeting cleanup standards throughout the site. Alternatives 1 and 2 would require conditional points of compliance.

7.3 Comply with Applicable State and Federal Laws

All cleanup actions conducted under MTCA must comply with applicable state and federal laws.

Legally applicable requirements include those cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations adopted under state or federal law that specifically address a hazardous substance, cleanup action, location or other circumstances at the site.

Alternatives 1 through 4 all comply with applicable state and federal laws.

7.4 Provide for Compliance Monitoring

Compliance monitoring refers to the collection, analysis, and reporting of environmental data to determine the short and long-term effectiveness of the cleanup action and whether protection is being achieved in accordance with the cleanup objectives. Compliance monitoring plans are developed in conjunction with the Cleanup Action Plan and typically involve standard field techniques and laboratory analytical methods.

Alternatives 1 through 4 include comprehensive compliance monitoring plans that fulfill the requirements of WAC 173-340-410.

7.5 Permanence

Permanence is the degree to which an alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including adequacy of the alternative in destroying the hazardous substances, reduction or elimination of hazardous substance releases and sources of releases, degree of irreversibility of waste treatment processes, and the characteristics and quantity of treatment residuals generated.

Alternative 4 has the highest degree of permanence and Alternative 1 has the lowest degree of permanence.

7.6 Cost

This criterion includes the cost of construction, long-term costs, and agency oversight costs that are cost recoverable. Long-term costs include operation and maintenance costs, equipment replacement costs, the cost of maintaining institutional controls, and compliance monitoring costs.

Approximate costs for each alternative are:

- Alternative 1: $395,000
- Alternative 2: $1,000,000
- Alternative 3: $1,535,000
- Alternative 4: $1,835,000

7.7 Long Term Effectiveness

This criterion assesses the degree of certainty that the alternative will be successful, reliability of the alternative during its operating time on the site, magnitude of the residual risk with the alternative in place, and the effectiveness of controls required to manage residual wastes.

The following types of cleanup actions, in descending order of preference, can be used to assess the relative degree of long-term effectiveness: reuse or recycling; destruction or detoxification; immobilization or solidification; on-site or off-site disposal in an engineered, lined, and monitored facility; on-site isolation or containment with attendant engineering controls; and institutional controls and monitoring.

Alternatives 3 and 4 have the highest level of long term effectiveness because all sources of contaminants will be either treated or removed from the site. Alternative 2 has a moderate level of long term effectiveness because some pockets of contaminated soil may remain in the subsurface even after treatment. Alternative 1 has a moderate level of long term effectiveness because it will take a long time for contaminants to naturally break down and attenuate.

7.8 Short Term Risks

This criterion assesses the risks to human health and the environment associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

Alternatives 1 and 2 are not expected to create any short term risks. Alternative 4 will create some short term dust impacts over a period of a few months, but these risks can be controlled with Best Management Practices (BMPs). Alternative 3 will create some short term dust impacts over a period of two years. These risks can also be controlled with BMPs.

7.9 Technical and Administrative Implementability

This criterion considers whether the alternative is technically possible including availability of necessary off-site facilities, services, and materials; administrative and regulatory requirements; scheduling; size; complexity; monitoring requirements; access for construction operations and monitoring; and integration with existing facility operations and other current or potential remedial actions.

Alternatives 1 and 4 are readily implementable. In Alternative 2, the presence of wood in the subsurface may complicate the ability to transmit the oxidation product evenly to the contaminants in the soil. In Alternative 3, the primary technical challenge will be management of storm water around the treatment cell.

7.10 Restoration Time Frame

This criterion evaluates the time expected for restoration to be complete. This time frame must be reasonable when the nine factors summarized in WAC 173-340-360(4)(b) are considered. In some instances where cleanup levels cannot be technically achieved, concentrations that are technically possible to achieve shall be met within a reasonable time frame considering the nine factors specified in WAC 173-340-360(4)(b).

Alternative 4 is expected to take three to four months for construction followed by 4 quarters of groundwater monitoring. Alternative 3 is expected to take approximately 2 years for treatment of soils followed by four quarters of groundwater monitoring. Alternative 2 is expected to take approximately 5 to 10 years for site restoration. Alternative 1 is expected to take greater than 10 years for site restoration.

7.11 Consideration of Public Concerns

This criterion addresses the public's concerns, if any, about the preferred alternative identified by Ecology. It will be addressed during the comment period for the Proposed Cleanup Action Plan.

Greylock believes that Alternative 4 will likely have the highest degree of public acceptance because the restoration time frame is the shortest and it has the highest degree of permanence.

8. SUMMARY OF RECOMMENDED ALTERNATIVE

The recommended remedial alternative is Alternative 4: Free Product Removal; Excavation and Offsite Disposal of Contaminated Soils.

MTCA specifies that, when selecting a cleanup action, preference shall be given to actions that are "permanent to the maximum extent practicable." This alternative requires the shortest amount of time for completion. It also provides the highest level of permanence. This alternative is readily implementable with conventional construction equipment.

Alternative 4 provides the highest level of protection to human health and the environment by removing all contaminated source material from the site and replacing it with clean material. Free product will be pumped from an excavation at the northern end of the site to a storage tank for disposal or recycling. Soil above cleanup levels will be removed from AOCs No. 1 and 2. Confirmation sampling will be performed to verify that all contaminated soil has been removed. Groundwater monitoring will be performed until four consecutive quarters of sampling confirm that groundwater cleanup levels are met.

9. LIMITATIONS

We have prepared this report for the exclusive use of Hardel Mutual Plywood and their authorized agents and regulatory agencies as part of their evaluation of remedial alternatives at the site. This report is not intended for use by others, and the information contained herein is not applicable to other sites. No one except Hardel Mutual Plywood and their authorized agents should rely on this report without first conferring with Greylock.

Greylock personnel performed this study in accordance with generally accepted standards of care that existed in the state of Washington at the time of this study. This report has been prepared in accordance with generally accepted professional practices in the area at this time. We make no other warranty, either expressed or implied.

This report is based on conditions that existed at the time the study was completed. The findings of this report may be affected by the passage of time or events such as a change in

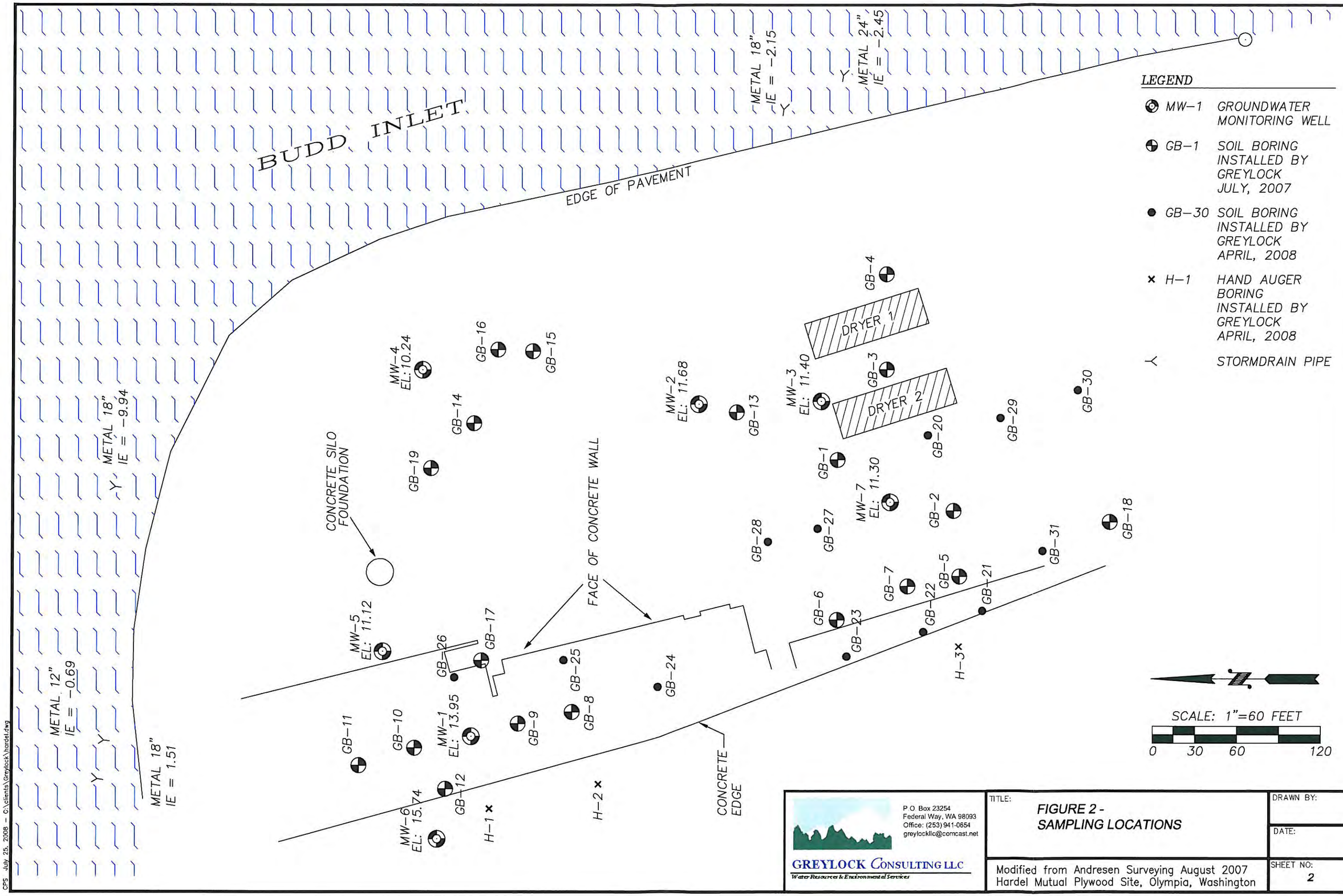
property use or occupancy, or by natural events, such as floods, earthquakes, or groundwater fluctuations.

10. REFERENCES

Ecology, 2008. *Cleanup Levels and Risk Calculations (CLARC) Washington State Department of Ecology*. 2008.

Greylock, 2007. *Draft Remedial Investigation. Former Hardel Plywood Site, 1210 NW West Bay Drive, Olympia, Washington.* December 17, 2007.

Figure 1. Vicinity Map



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TITLE: **FIGURE 2 - SAMPLING LOCATIONS**

Modified from Andresen Surveying August 2007
Hardel Mutual Plywood Site, Olympia, Washington

DRAWN BY:

DATE:

SHEET NO: 2

CPS July 25, 2008 -- C:\clients\Greylock\hardel.dwg

BUDD INLET

EDGE OF PAVEMENT

METAL 18"
IE = −2.15

METAL 24"
IE = −2.45

METAL 18"
IE = −9.94

METAL 12"
IE = −0.69

METAL 18"
IE = 1.51

CONCRETE SILO FOUNDATION

FACE OF CONCRETE WALL

CONCRETE EDGE

DRYER 1

DRYER 2

MW-1 MW-2 MW-3 MW-4 MW-5 MW-6 MW-7

GB-1 GB-2 GB-3 GB-4 GB-5 GB-6 GB-7 GB-8 GB-9 GB-10 GB-11 GB-12 GB-13 GB-14 GB-15 GB-16 GB-17 GB-18 GB-19 GB-20 GB-21 GB-22 GB-23 GB-24 GB-25 GB-26 GB-27 GB-28 GB-29 GB-30 GB-31

H-1 H-2 H-3

Heavy Oil

Diesel

Benzoapyrene
Chrysene
Napthalene
Benzo (k) fluoranthene

LEGEND

Chemical Exceedances Above MTCA Cleanup Levels in Soil Depth (feet below ground surface (ftbgs))

- 0–4 ftbgs
- 4–8 ftbgs
- 8–12 ftbgs
- 12–16 ftbgs

No Total Petroleum Hydrocarbon Exceedances in Soil Depth (ftbgs)

- 0–4 ftbgs
- 4–8 ftbgs
- 8–12 ftbgs
- 12–16 ftbgs

Blue box indicates sample was analyzed but the analyte(s) was not detected or was detected at concentrations less than applicable cleanup levels.

Red box indicates the analyte(s) was detected at a concentration greater than applicable cleanup levels.

Orange box indicates moderate to strong petroleum odor.

Clear box indicates no sample analyzed.

SCALE: 1"=60 FEET

0 30 60 120

CPS October 15, 2008 – C:\clients\Greylock\hardel2.dwg

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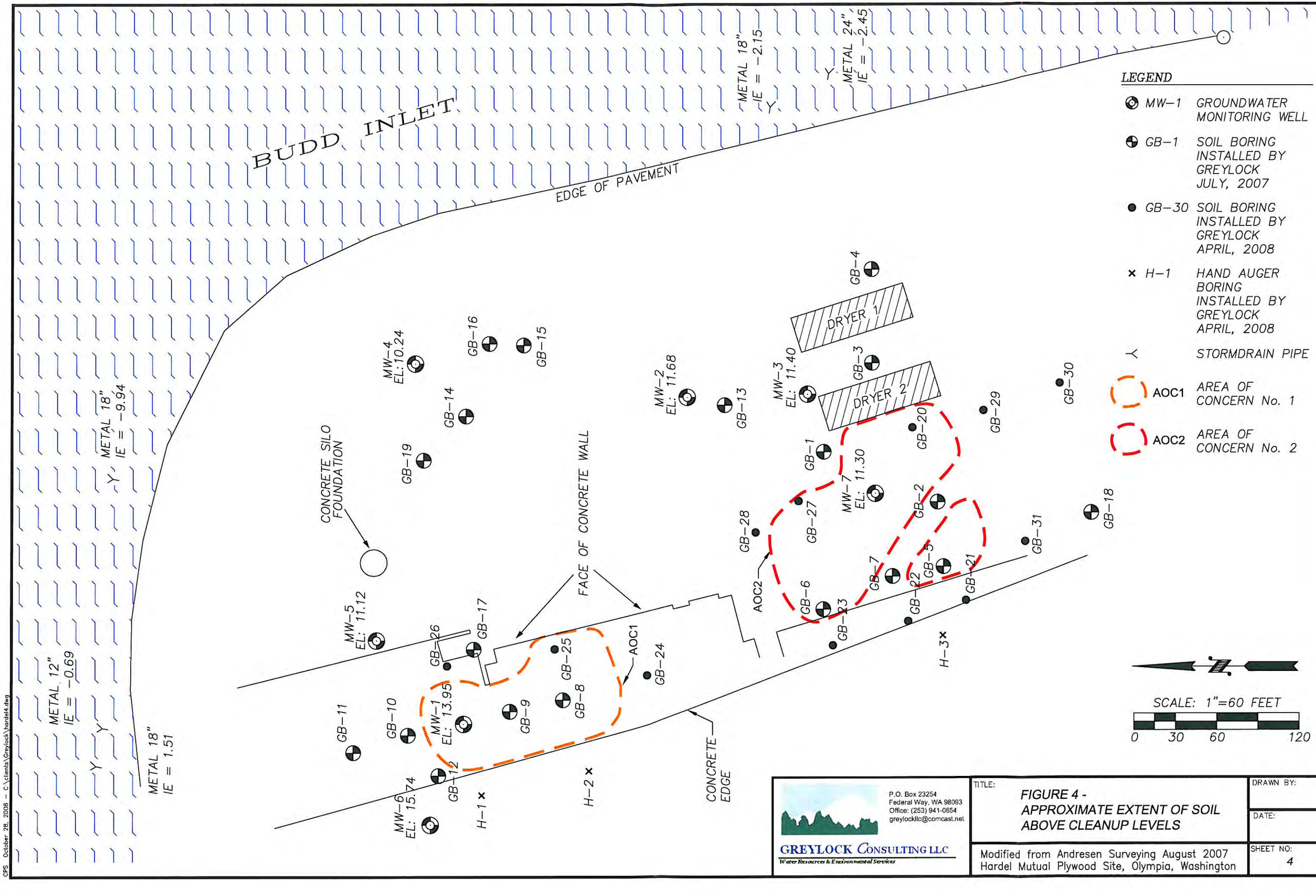
TITLE:
FIGURE 3 -
EXTENT OF HYDROCARBONS & PAHs IN SOIL

Modified from Andresen Surveying August 2007
Hardel Mutual Plywood Site, Olympia, Washington

DRAWN BY: CPS

DATE: 10/15/08

SHEET NO: 3



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TITLE:
FIGURE 4 -
APPROXIMATE EXTENT OF SOIL ABOVE CLEANUP LEVELS

Modified from Andresen Surveying August 2007
Hardel Mutual Plywood Site, Olympia, Washington

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DATE:

SHEET NO:
4

CPS October 28, 2008 – C:\clients\Greylock\hardel4.dwg

Table 1. Soil Chemistry, Hardel Olympia, April 8, 2008

Sample ID:			GB-20-5.5	GB-22-7	GB-24-5	GB-25-9	GB-26-5	GB-27-6	GB-29-5	GB-31-6
Date Sampled:			04/08/08	04/08/08	04/08/08	04/08/08	04/08/08	04/08/08	04/08/08	04/08/08
	MTCA Screening Criteria									
	Method A	Method B								
TPH in mg/kg										
Diesel/ Fuel Oil	2,000		**21,000**	ND	ND	ND	130	1400	ND	ND
Heavy Oil	2,000		ND	ND	ND	**19,000**	ND	ND	ND	ND
Mineral Oil	4,000		ND	ND	ND	ND	ND	ND	ND	ND

BOLD = Exceeds one or more of the Screening Criteria
ND = Not Detected

Table 2. Detailed Evaluation of Hardel Remedial Alternatives

Criteria	Alt. 1: Free Product Removal; Capping and Natural Attenuation with Engineering and Institutional Controls	Alt. 2: Free Product Removal; Insitu Treatment by Chemical Oxidation with Institutional Controls	Alt 3: Free Product Removal; Exsitu Bioremedation and Off-Site removal of unsuitable materials	Alt 4: Free Product Removal; Soil Excavation and Removal
Protection of Human Health and the Environment	This alternative protects human health by eliminating exposure routes. Following product removal, it reduces soil and groundwater toxicity over the very long-term using natural attenuation.	This alternative reduces soil and groundwater toxicity over the long-term, protecting human health and the environment.	This alternative protects human health and the environment by treating geotechnically suitable soils to cleanup levels. Geotechnically unsuitable soils would be removed and disposed offsite.	This alternative protects human health and the environment by removing soil above cleanup levels from the site and disposing of them in a permitted landfill.
Comply with Cleanup Standards	Moderate Probability if conditional points of compliance are accepted	Moderate Probability if conditional points of compliance are accepted	High Probability	High Probability
Comply with Laws	Yes	Yes	Yes	Yes
Provide for Compliance Monitoring	Yes	Yes	Yes	Yes
Compatibility with Future Site Development/Use.	Not very compatible as concrete and asphalt at the site would need to stay in place. Institutional controls would be required for the site.	Moderately compatible, however there is a potential for soils above cleanup levels to be encountered during future site development. Institutional controls would be required for the site.	Not compatible in the short term (< 2 years), but compatible in the long term (> 2 years) No institutional controls would be required.	Very compatible as all soil impacted with petroleum above cleanup levels would be removed. No institutional controls would be required.
Short-Term Effectiveness	No short-term adverse impacts are expected.	Insitu treatment will result in minimal impacts during injection of treatment compound.	Excavation will create minor short term dust impacts. However, this can be controlled with best management practices. Soil would be covered between treatments to minimize dust.	Excavation will create minor short term dust impacts. However, this can be controlled with best management practices.

(1) Conceptual Level Cost +/- 25%

Criteria	Free Product Removal; Capping and Natural Attenuation with Engineering and Institutional Controls	Free Product Removal; Insitu Treatment by Chemical Oxidation	Free Product Removal; Exsitu Bioremedation and Off-Site removal of unsuitable materials	Free Product Removal: Soil Excavation and Removal
Long-Term Effectiveness	This alternative effectively prevents human exposure over the long-term using engineering and institutional controls. Soil and groundwater toxicity will be reduced by natural attenuation over the very long term.	Chemical oxidation will remove the highest concentrations of petroleum in soil, however, it's possible that pockets of soil above cleanup levels will remain due to the heterogeneity of soils in the subsurface.	Long-term effectiveness is high as all sources of contaminants will be treated to cleanup levels or removed from the site.	Long-term effectiveness is high as all sources of contaminants will be removed from the site.
Permanent Reduction of Toxicity/ Mobility/ Volume	Natural attenuation will result in reduced in toxicity over the very long term.	Chemical oxidation will result in significantly reduced toxicity over the long term.	Exsitu bioremediation will permanently reduce the concentrations of hydrocarbons to below cleanup levels.	Excavation is a highly effective mean of eliminating the hydrocarbon source.
Technical and Administrative Implementability	A cap is effectively already in place at the site. Installation of a product recovery well near MW-1 is a readily implementable technology. Institutional controls are also easy to implement.	Insitu chemical oxidation is a demonstrated technology and can be implemented using direct push technology. The presence of wood in the subsurface may complicate the ability to transmit the oxidation product to contaminants in the soil.	Bioremediation of soils uses conventional construction equipment and readily available treatment products. The primary technical challenge with this approach will be management of storm water around the treatment cell.	Excavation uses conventional construction equipment. Some dewatering of clean, upgradient groundwater will be necessary to allow for excavation to 12 ft. Both excavation and dewatering are readily implementable.
Restoration Time Frame	Likely greater than 10 years.	Four to Six months for injection of product to the source areas, followed by 5 - 10 years of long-term monitoring.	Two to three years for treatment of soils, followed by 1 year of groundwater monitoring.	Three to four months, followed by 1 year of groundwater monitoring.

(1) Conceptual Level Cost +/- 25%

Criteria	Free Product Removal; Capping and Natural Attenuation with Engineering and Institutional Controls	Free Product Removal; Insitu Treatment by Chemical Oxidation	Free Product Removal; Exsitu Bioremedation and Off-Site removal of unsuitable materials	Free Product Removal: Soil Excavation and Removal
Community Acceptance	Moderate to Low due to the length of time required.	Moderate due to the presence of a treatment.	Moderate due to the presence of a treatment and short term dust impacts	High to Moderate due to short term traffic impacts.
Conceptual - Level Cost Estimate(1)	$395,000	$1,000,000	$1,535,000	$1,835,000

(1) Conceptual Level Cost +/- 25%

Table 3. Hardel Site Cleanup Levels

Soil	Site Cleanup Levels	
	Method A	Method B
TPH in mg/kg		
Diesel/ Fuel Oil	2,000	
Heavy Oil	2,000	
Semivolatiles in mg/kg		
Acenapthene		4,800
Anthracene		24,000
Benzo(a)anthracene		0.14
Benzo(a)pyrene	0.1	
Benzo(b)fluoranthene		0.14
Benzo(k)fluoranthene		0.14
Chrysene		0.14
Fluorene		3,200
Fluoranthene		3,200
Napthalene	5	
1-Methylnapthalene		24
2-Methylnapthalene		320
Pyrene		2400

Groundwater	Site Cleanup Levels	
	Method A	Marine Chronic
TPH in ug/L		
Diesel/ Fuel Oil	500	NR
Heavy Oil	500	NR
Mineral Oil	500	NR

NR = Not Researched

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood **Job #:** 0373 **Boring #:** GB-20

Location: 1210 West Bay Drive NW, Olympia, WA **Approximate Elevation:** Not Surveyed

Subcontractor/Equipment: ESN Northwest **Drilling Method:** Direct Push Probe

Date: 4/8/2008; 8:23 **Logged By:** S. Dudziak

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand Fine		Light Brown			Dry, Very little recovery
						Wet @ 4 ft; Moderate Petroleum Odor
5	Wood Fine					
	Sand Fine			1129	RGB5-5	
	Sand with Shells Fine			1138	RGB5-8	
10						
	Wood					
15						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood | **Job #:** 0373 | **Boring #:** GB-21

Location: 1210 West Bay Drive NW, Olympia, WA | **Approximate Elevation:** Not Surveyed

Subcontractor/Equipment: ESN Northwest | **Drilling Method:** Direct Push Probe

Date: 4/8/2008; 9:00 | **Logged By:** S. Dudziak

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand Fine		Light Brown			Dry
	Sand and Gravel		Light Brown	916	GB21-3.5	Wet @ 3.5 ft; No Odor
5						Refusal at 5 ft. Driller thinks he hit a log.
10						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-22
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 9:25	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	FILL: SAND + GRAVEL		Light Brown			
	Sand					Dry
			Light Brown			Wet @ 3.5; No Odor
5	Silty Sand					Strong odor @ 6 to 8 ft
			Gray	930	GB22-7	
	Peat and Wood		Black			
10	Wood					
	Sand and Gravel			944	GB22-11	No odor @ 11 ft
			Light Brown			
15						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-23
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 9:50	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand , fine		Light Brown			Dry
	Sand and Gravel		Gray			Wet @ 4; No Odor
5				954	GB23-5	
			Brown			No Odor
	Wood					
10			Brown			

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-24
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 10:11	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand , fine		Light Brown			Dry
	Sand and Gravel			1020	GB24-5	Wet @ 5; No Odor
5	Silty Sand		Gray			No Odor
	Wood					
10						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-25
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 10:23	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand , fine		Light Brown			Dry
	Sand		Light Brown			Wet @ 4; No Odor
5	CEMENT					Hit concrete
	Sand and Gravel		Dark Brown			No Odor
	Sand		Gray	1032	GB25-9	Slight unknown odor @ 9 ft; could be sulfide
10	Wood					

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LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-26
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 10:43	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand , fine		Brown			
	Sand , fine		Gray			Wet @ 4; No Odor, No Sheen
5				1048	GB26-5	
	Wood					
	Wood					Refusal at 8 ft; All Wood
10						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood | **Job #:** 0373 | **Boring #:** GB-27

Location: 1210 West Bay Drive NW, Olympia, WA | **Approximate Elevation:** Not Surveyed

Subcontractor/Equipment: ESN Northwest | **Drilling Method:** Direct Push Probe

Date: 4/8/2008; 11:20 | **Logged By:** S. Dudziak

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand and Gravel		Gray			Dry, No Odor
	Wood					Wood has slight to moderate petroleum odor/sheen @ 4 ft
5	Sand , fine		Dark Brown	1126	GB27-6	Sand has slight odor/sheen @ 6 ft
			Gray			
	Sand with Shells			1132	GB27-9	No Odor @ 8 ft
10	Wood					

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-28
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 11:35	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Gravelly Sand		Gray			
	Wood					No Odor, No Sheen
5	Sand with Shells		Gray	1139	GB28-6	No Odor, No Sheen

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LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-29
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 13:48	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand and Gravel		Light Brown			Dry, No Odor
	Sand		Gray			Wet @ 4.5 ft; No Odor, No Sheen
5				1355	GB29-5	
	Sand with Shells					
	Silt		Gray			
	Sand with Shells		Gray			
10						

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-30
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 14:04	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	CEMENT					
	Sand and Gravel		Light Brown			Dry, No Odor
	Sand		Gray			
				1415	GB30-5	Wet @ 4 ft; No Odor, No Sheen
5						
	Silt		Gray			
10	Sand with Shells		Gray			

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Water Resources & Environmental Services

LOG OF BOREHOLE

Project: Hardel Mutual Plywood	**Job #:** 0373	**Boring #:** GB-31
Location: 1210 West Bay Drive NW, Olympia, WA	**Approximate Elevation:** Not Surveyed	
Subcontractor/Equipment: ESN Northwest	**Drilling Method:** Direct Push Probe	
Date: 4/8/2008; 14:25	**Logged By:** S. Dudziak	

Depth (ft.)	Soil Description	Lithology	Color	Time	Sample Number	Comments
0	Sand and Gravel		Light Brown			Dry, No Odor
			Gray			
5	Sand					Wet @ 5 ft; Very slight odor @ 6 ft
				1429	GB31-6	
	Silt					
	Sand with Shells		Gray			
10			Gray			Refusal @ 13 ft

ESN NORTHWEST CHEMISTRY LABORATORY

HARDEL FS PROJECT
Olympia, Washington
Greylock Consulting, LLC

ESN Northwest
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(360) 459-4670 (360) 459-3432 Fax
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Analyses of Diesel & Oil (NWTPH-Dx/Dx Extended) in Soil

Sample Number	Date Analyzed	Surrogate Recovery (%)	Diesel (mg/kg)	Oil (mg/kg)	Mineral Oil (mg/kg)
Method Blank	4/10/2008	97	nd	nd	nd
GB20-5.5	4/10/2008	int	**21000**	nd	nd
GB22-7	4/10/2008	106	nd	nd	nd
GB24-5	4/10/2008	107	nd	nd	nd
GB24-5 Dup	4/10/2008	98	nd	nd	nd
GB25-9	4/10/2008	96	nd	**19000**	nd
GB26-5	4/10/2008	96	130	nd	nd
GB27-6	4/10/2008	int	**1400**	nd	nd
GB29-5	4/10/2008	99	nd	nd	nd
GB31-6	4/10/2008	96	nd	nd	nd
Method Detection Limits			20	40	40

"nd" Indicates not detected at the listed detection limits.
"int" Indicates that interference prevents determinatior

ACCEPTABLE RECOVERY LIMITS FOR SURROGATE : 65% TO 135%