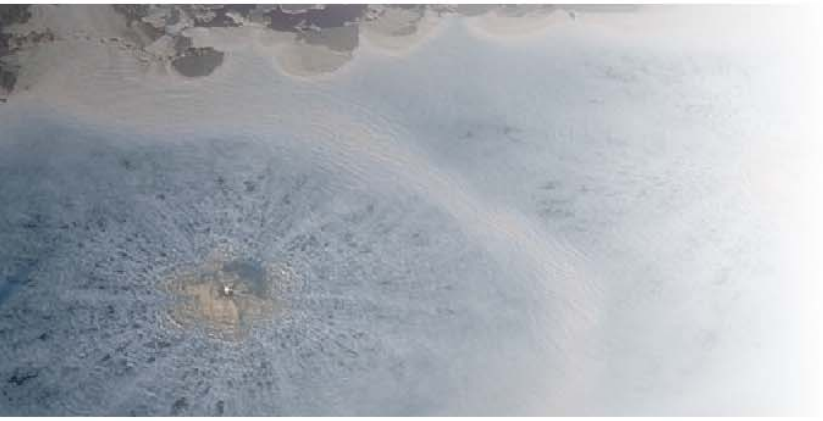

Final Site Investigation Report
Loon Lake
Loon Lake, Washington

Prepared for
Washington State
Department of Natural Resources

January 23, 2009
17453-00

HARTCROWSER

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EXECUTIVE SUMMARY

Sediment cores and surface grab samples were visually examined to determine the presence or absence of wood waste. Only minor visible identifiable bark, wood chips, or sawdust was present in the samples collected. Large amounts of organic-like material were present in both the cores and surface grab samples. Some portions of this material could be visually identified as decomposing leaves, roots, and stems, though other material present was too decomposed to identify as other than organic plant material.

Chemical results for sediment samples indicate high levels of nutrients (organic nitrogen and phosphorus) at concentrations within the range typically associated with diatoms, other phytoplankton and aquatic vegetation.

Microscopic examination of samples indicated that the samples contained decomposing leaves, roots, and stems with no apparent sawdust or wood waste. Microscopic examination of samples revealed that diatoms and other phytoplankton comprised 50 to 60 percent of the sample volume.

Comparisons between samples collected close to the historical sawmills, and background samples from the opposite, western shore, indicate little difference between the areas. The organic surface material was visually similar, down to the microscopic level. The chemistry and density separation results comparing the site locations and background samples were also similar showing little variability. Similarities between visual microscopic characteristics, chemistry, and density separation results indicate that there is no difference between organic material from areas potentially impacted with wood waste and reference areas unlikely to be impacted with wood waste.

Comparison of sediment samples near historical sawmills and background samples showed no significant difference in chemical concentrations and analyte ratios. This indicates that there is no discernable difference in visual, physical, or chemical properties between areas near the former sawmills and background locations unlikely to have been impacted by wood waste. The source of organic-rich sediment “muck” appears to be decayed aquatic vegetation, diatoms, and other phytoplankton.

1.0 INTRODUCTION

This report presents the results of the sediment investigation performed for the Washington State Department of Natural Resources (DNR) at Loon Lake, located north of Spokane, Washington (Figure 1). The overall project objective for the Loon Lake investigation was to assess whether there were sediment impacts from historical sawmill operations adjacent to the lake (Figure 2). Specific tasks conducted included:

- Collecting, analyzing, and characterizing sediment from areas adjacent to former sawmills located on the northeast part of the lake;
- Collecting, analyzing, and characterizing sediment from background areas on the lake distant from historical sawmill operations for comparison purposes; and
- Determining the presence or absence of wood waste in the sediment based on visual and chemical characteristics.

The sediment characterization program was performed in accordance with the April 9, 2008, DNR-approved Sampling and Analysis Plan (SAP) prepared for this project (Hart Crowser 2008).

2.0 SITE BACKGROUND AND HISTORY

Much of the historical and site background information described below was provided in the DNR Draft Loon Lake Sediment Study – Phase I Report (DNR 2007).

Loon Lake is an approximately 1,100-acre lake, approximately 2,382 feet in elevation with an average depth of 46 feet and a maximum depth of 100 feet. The lake has several unnamed intermittent streams as inflow and one outlet on the northwest corner of the lake. As a result, the lake has no continuous inflow of new water and stratifies during the dry months when inflow is minimal. During years of normal precipitation, the lake receives large groundwater inputs from the regional aquifer to reach full pool level. It has been noted that Loon Lake and Deer Lake, approximately 3 miles northeast of Loon Lake, are hydraulically connected. Outflow from the lake, as well as infiltration to its deep-water aquifer, form the headwaters of the Colville River.

Sawmill Operations

Several sawmills were located on or near Loon Lake. Sawmills floated timber from the cutting operations in the Deer Creek area (northeast of the town of Lake Side) on a tramway to sawmills located on the shoreline of the lake (Figure 2). Historical research indicated that most sawmill operations concluded in the mid-1920s to the mid-1930s.

Ice Production

Because of the quality of the water in Loon Lake, ice production became a profitable business in the area. Ice houses were located around the lake including the northeastern shoreline where sawmills and towns were located. The Great Northern Railroad Company reportedly operated an ice block collection and storage venture on the northeastern lakeshore between 1905 and 1916. The railroad shipped the ice for use in its cold storage facilities located in Spokane County. Other firms continued ice production until the mid-1950s when electric refrigeration became widespread. Sawdust from the nearby mills was reportedly used to insulate ice during storage and shipping up until the time the mills ceased operation in the mid-1930s.

Sawdust and Wood Waste

Based on historical photographs provided by DNR, it is known that sawmills typically burned sawdust, wood debris by-products, or waste in "hog fuel burners" to provide power for mill operations. In addition, sawdust was used as insulation for ice transport and storage. Based on this information, it is thought that much of the sawdust generated in sawmills may have been used rather than disposed of as a waste.

Lake Levels

Lake levels have decreased steadily since its recorded history as a result of a combination of human controls and drought. Water levels were lowered through the creation of irrigation canals and raised through the construction of control structures at the outlet. The first records of the lake level were from 1889 when a local rancher decided to cut a channel leading from the north end of the lake, lowering the lake level approximately 3 feet. This started what would be a lengthy controversy regarding the water level in Loon Lake. In 1973, the Washington State Supreme Court ruled that the 1950 Steven's County Superior Court decision, which established the maximum lake level at 2,382 feet, made the lake unavailable for additional water appropriations.

Lake water level has been dropping naturally over the past 5 years due to drought conditions in the Colville Drainage Basin.

Water Quality

Loon Lake is a deep, dimictic lake (water column mixes twice a year) with relatively good surface water quality. The lake thermally stratifies from around June through October, with warm surface waters (~20 °C) above a depth of around 25 feet and cool, dense bottom waters (~8 °C) below a depth around 40 feet. Total phosphorus levels (~10 µg P/L) and chlorophyll levels (<2 µg/L) are low and water transparency is high (Secchi depth ~20 to 25 feet). Based solely on dissolved nutrient levels, phytoplankton levels in the water column, and water clarity, the lake would be classified as oligotrophic (Ecology 1973 and 1980).

The lake exhibits hypoxia (dissolved oxygen levels below ~5 mg/L) in bottom waters after the onset of thermal stratification. For example, data from 1971 showed that waters at a depth of 50 feet had 2.5 mg/L of dissolved oxygen in late July and 1.5 mg/L of dissolved oxygen in mid-September. Summer oxygen data from the late 1990s showed hypoxic bottom waters below a depth of around 40 feet. Because of bottom-water hypoxia, a characteristic of eutrophic lakes, Loon Lake is generally classified as oligo-mesotrophic (intermediate between oligotrophic and eutrophic).

Bottom-water anoxia leads to the release of nutrients from deep, anaerobic sediments and a stimulation of phytoplankton activity upon water column overturn in the fall when these nutrients mix into the photic zone. Anoxia is also likely impacting biota by not providing a well oxygenated cold water refuge for fish and zooplankton during the summer. It is unclear why the lake has such good surface water quality but poor bottom water quality. This could be a legacy of historical nutrient pollution to the lake or the natural result of decaying aquatic vegetation with resulting build-up of organic matter in deep sediments over decades.

Nutrient Inputs and Sewage Treatment

Water quality studies (Ecology 1973 and 1980) indicated that eutrophication (decreased dissolved oxygen levels and increased nutrient levels) of Loon Lake was being accelerated by the introduction of nutrients (nitrogen and phosphorus) to the lake, possibly the result of seepage from private on-site sewage disposal systems surrounding the lake. In addition, the arrival of fruit orchards into the area in the 1910s with a subsequent increase in agricultural fertilizer runoff into the lake may have also altered the lake's water chemistry. As a result of increased nutrient loading, concentrations of algae increased

subsequently reducing water clarity. In addition, aquatic vegetation and noxious weeds became established in the lake. As vegetation dies back in the fall and sinks to the lake bottom and decays, it forms an organic rich "muck" and nutrients bound up in the vegetation are released and recycled through the water column.

The Loon Lake sewer district was established in 1981 to install sewer facilities to protect water quality of the lake. Between 1983 and 1986, a septic tank pumping program was installed to serve a majority of residences around the lake and, in 1986, the district sewage treatment system began operation (Esvelt 1998). A private sewer system (septic) still serves the Granite Point area on the southeast portion of Loon Lake.

3.0 SEDIMENT SAMPLING AND ANALYSIS

3.1 Sample and Survey Location Control

Twenty-one sediment core samples and nine surface sediment grab samples were collected from Loon Lake near the locations of the former sawmills (Figure 3). Of the samples collected from Loon Lake, four core samples (LL-04, LL-06, LL-08, and LL-20) and six grab samples (LL-05, LL-06, LL-07, LL-09, LL-14, and LL-20) were analyzed. Four core samples and three grab samples were collected from the west side of Loon Lake at locations unlikely to be impacted from historical sawmill operations (Figure 3). Of the background samples collected from Loon Lake, two core samples (LLBG-01and LLBG-02) and three surface grab sample (LLBG-01 Grab, LLBG-03, and LLBG-04 Grab) were analyzed. These sediment samples were collected between September 8 and 11, 2008.

Actual sample locations were modified from locations proposed in the SAP based on observations of organic material in the cores and input from the community. The majority of sample locations were moved closer to shore than initially proposed, under the assumption that wood waste would be present closer to the historical sawmill operations located near the northeastern corner of the lake (Figure 2). Core and grab sample location LL-20 was advanced in the area where local residents had reported suspected wood waste. Core and grab sample location LL-21 was selected to attempt to define the outer boundary of possible wood waste.

Target and actual sampling locations are presented in Table 1.

3.2 Sediment Sampling

3.2.1 Sediment Core Samples

Piston cores (3-inch-diameter) or vibracores (4-inch-diameter) were collected from 21 locations in the vicinity of the former sawmills (Figure 3) and from four reference locations (Figure 3). Piston cores were the preferred method of sediment collection to obtain good recovery of very soft sediment. At locations where the piston core method met refusal, vibracore samples were collected. Samples were collected to a depth of up to 8 feet. Cores were collected using clear rigid Lexan tubes, and were examined and evaluated in the field. Each core was photographed, and representative photographs are provided in Appendix E. Visual observations and sediment descriptions are summarized in Table 2.

Sample volume for chemical analyses was collected from selected cores extruded and homogenized aboard the vessel. Sample LL-04 was collected from approximately 5- to 7-foot depth, within an organic material layer. Sample LL-06 was collected from 5- to 7-foot depth, in a fibrous organic material layer. Sample LL-08 was collected from 3.2- to 4.7-foot depth, within the organic material layer immediately above a silty sand layer. Sample LL-20 was collected from 4- to 5.7-foot depth, within a fibrous organic layer.

3.2.2 Surface Sediment Grab Samples

A hydraulically powered vanVeen grab sampler was used to collect surface samples at five locations (LL-05 Grab, LL-06 Grab, LL-20 Grab, LLBG-01 Grab, and LLBG-03) selected for chemistry and potential bioassay testing (Figures 2 and 3). Due to mechanical problems with the powered sampler, an Ekman mechanical hand grab sampler was used to collect samples at three locations (LL-07 Grab, LL-09 Grab, and LL-14 Grab). Samples were collected from the upper 10 cm, and volume from multiple grabs was combined and homogenized.

Upon retrieval of the sediment grab and core samples, the acceptability of each grab and core was assessed relative to the criteria established in the SAP Sediment descriptions are summarized in Table 2.

3.2.3 Sediment Testing

After sample collection, sample containers were placed in a cooled ice chest for transport to the analytical laboratory under chain of custody procedures described in the SAP (Hart Crowser 2008). Samples were analyzed for total organic carbon (TOC), total sulfide, total solids, total volatile solids (TVS), total

Kjeldahl nitrogen (TKN), nitrate, nitrite, phosphorus, and biological oxygen demand (BOD). Selected samples were analyzed for grain size. Analytical Resources, Inc. (ARI) in Tukwila, WA, performed the sediment chemical and conventional analysis.

Wet sieving was initially attempted in the field to match grain size between site and reference test sediment. Attempts were made based on the procedure described in the SAP. However, due to the overall fine-grained nature of the lake bed sediments and the high volume of organic plant material and phytoplankton (up to 100 percent) in the samples, reference samples were selected based on similar sediment grain size and visual appearance at locations deemed unlikely to be affected by potential wood waste.

Samples were collected and submitted to Dr. Mark Beutel at Washington State University. Dr. Beutel took photomicrographs (photographs taken through a microscope to see sediment details) and conducted density separation tests to estimate the amount of wood and plant material following the procedure described in the SAP (Hart Crowser 2008). Dr. Beutel's findings are presented in Appendix C.

Microscopic evaluation and identification of the types and relative amounts of organic material present in the samples was performed by Hart Crowser biologists following the procedure described in the SAP (Hart Crowser 2008). The results of these efforts are presented in Appendix D.

Sample volumes were also collected for bioassay toxicity testing and Microtox ® testing to assess potential toxicity to benthic organisms due to wood waste. However, visual observations in the field and subsequent microscopic observations and chemical analysis indicated that little or no wood waste was present in the samples. Therefore, bioassay toxicity testing and Microtox® were not conducted on the samples.

4.0 SEDIMENT PHYSICAL CHARACTERISTICS

4.1 Field Observations

Visual descriptions of the core samples were recorded in the field and are documented in core logs presented in Appendix A. Visual descriptions of the sediment grab samples are summarized and presented in Table 2. Specific attention was paid to any material or layers that appeared to be potential wood waste.

Except for LLBG-03, the cores had a surface layer consisting of very soft to soft, wet, soft, light brown to brown Peat with a high organic content, which appeared to be composed of decaying aquatic plant material. Cores at most locations had 3 to 7 feet of Peat with a high organic content overlying a harder substrate (silty Sand or sandy Silt). The core collected from LLBG-03 consisted of soft, black, sandy Silt with moderate organic content.

The core and surface grab sample from LLBG-03 had significant visual differences from other locations in the lake. As described in Section 5.0, chemical results from this location also differed from other reference locations in the lake. Sample LLBG-03 consisted of coarser material (sandy silt) with little aquatic vegetation. In addition, sample LLBG-03 was located in a small cove, in deeper waters (30 foot water depth) than the majority of the locations sampled (approximately 3 to 24 feet). Therefore, LLBG-03 was not used as a reference location.

Surface grab sediments were comparable to the observed surface layer in the corresponding cores sediments. No visual signs of sawdust, wood debris, or wood waste were observed in surface grab or core samples; however, quantities of aquatic plant material, included decayed leaves, stems, and roots, were present in surface grab and core samples. One piece of bark was identified in core LL-09, and a wood stick about 1/4 inch in diameter was identified in core LL-20. In both instances, the material appeared to come from terrestrial runoff, not historical sawmill activities.

4.2 Density Separation

Samples were submitted to Dr. Mark Beutel of Washington State University for density separation to estimate the percentage of vegetation, followed by microscopic examination to determine whether wood waste was present. Density separation is based on the fact that wood debris and vegetation will float on the dense, hydrophobic solvent trichloroethylene (TCE), while sediment will sink. This allows for a qualitative estimation of the total amount of wood waste, aquatic vegetation, and other materials less dense than TCE in a sample. The less dense material is filtered, dried, weighed, and then examined microscopically.

The percent of separated material in each sample was quantified as the weight of air-dried and separated material divided by the total weight of air-dried sediment. Results of the density separation evaluation are presented in Appendix C.

Visual inspection of density-separated material from the samples evaluated showed that all samples appeared fairly similar. Microscopic evaluation of the wet sediments showed high levels of organic material. No obvious wood waste or sawdust was observed, though some material showed linear morphology characteristic of wood lignin or plant cellulose.

Visual inspection of the reference samples showed that LLBG-02 and LLBG-03 were very different in appearance and texture from the other reference samples and the subsurface and grab samples. LLBG-02 was very watery and light brown, while LLBG-03 was sandy and blackish, and both samples appeared to not have much aquatic plant material. This was in contrast to LLBG-01 and LLBG-04, which, similar to the subsurface and grab samples, had visible pieces of aquatic plants include roots and small seed pods. In general, the surface sediment grab samples were more watery than the more cohesive subsurface samples core samples. No sawdust or wood waste was identifiable in any sample. Visual inspection of sediments showed that all samples (excluding LLBG-02 and -03) contained plant organic matter, and most of the separated material consisted of this plant matter. In addition, microscopic and visual inspection of separated material did not yield substantial differences in appearance between subsurface samples, background samples, and surface grab samples. The percentage of separated material was not substantially different between subsurface samples (range of 2.5 to 31.8 percent with an average of 11.7 percent), background samples (5.2 to 20.5 percent excluding LLBG-02 and -03), and surface grab samples (2.1 to 32.4 percent with an average of 11.8 percent).

4.3 Microscopic Evaluation

Microscopic evaluation to identify types of vegetation present in samples was performed by Hart Crowser biologists. The complete report is presented in Appendix D.

Each sample was examined upon opening for surface characteristics and mobile fauna before a brief stirring to homogenize. After homogenization a 2.0 ml subsample was taken using a clean glass pipette and placed into a small petri dish at which point 2.0 ml of deionized water was added to create a loose slurry. From this mixture, two slides per sample were prepared to be viewed under a compound microscope.

Slides were generally surveyed using the 100x magnification and 400x magnification was used to examine individual particles of interest. Two slides from each sample were prepared and examined looking for general evidence of sawdust particles and bacterial load that may be associated with the decay of large amounts of cellulose material.

Examination of the samples indicated greater than 50 percent diatoms and the presence of marsh vegetation including milfoil and bulrushes. In addition, a whitish gelatinous material, which appeared to consist of diatom skeletons, was present in background and site sediment samples. Overall, the samples appeared to be typical of a low energy aquatic system with presence of emergent shoreline or marsh vegetation. There were a few particles noted that could be cellulose material potentially derived from sawdust. This distinction is based on the small cell structure typical of wood rather than large, flat cell structure associated with emergent plant structures. However, these possible wood particles were only a very minor portion of the sample. No differences in appearance or apparent composition were noted among surface grab sediment samples and deeper core samples collected near the vicinity of the former sawmills and background samples collected from the western side of the lake.

4.4 Grain Size

Grain size distribution was determined for each sample following PSEP protocols. Sediment was fine-grained and consisted primarily of silt and clay. Grain size results are summarized in Table 3.

5.0 SEDIMENT ANALYTICAL RESULTS

Chemical concentrations and analyte ratios from areas located near historical saw mills and from reference areas unlikely to be impacted by potential wood waste were compared to assess whether there were chemical differences in the upper, biologically active zone. Samples from organic-rich "muck" layers were analyzed from select sediment cores to establish chemical signatures potentially indicative of wood waste.

Samples were collected from four reference locations (Figure 4). As discussed earlier, LLBG-03 was not deemed an appropriate reference location since its characteristics did not match samples collected from other reference locations.

Discussions of analytical results are presented below and tabulated laboratory results are presented in Table 3.

5.1 Total Solids

Total solids results are used to correct sample results to a dry-weight basis. The preserved total solids is a total solids measurement obtained from the sample container for sulfide analysis, which is preserved with a chemical agent.

Samples contained high water content typical of fine-grained, organic-rich sediment. Total solids concentrations ranged from 5.4 to 13.7 percent.

5.2 Total Organic Carbon

TOC is a measure of the total amount of organic matter in a sample and includes wood, aquatic vegetation, bacteria, algae, diatoms, and other phytoplankton. Samples were very organic-rich as expected from their "mucky" appearance. Carbon content ranged from 12.7 to 24.6 percent in reference samples (excluding LLBG-03) and ranged from 6.38 to 28.4 percent in samples collected from the vicinity of the former sawmills. As discussed previously, grain size and physical appearance and chemical results for sample LLBG-03 were different from other reference samples collected; therefore, LLBG-03 results are not appropriate for comparison to other locations.

5.3 Total Volatile Solids

Total volatile solids (TVS) is a measurement of sample weight loss at elevated temperature and is used as an indicator of wood, aquatic vegetation, algae, plankton, and other non-refractory organic matter.

TVS concentrations in reference samples ranged from 13.3 to 58.2 percent. Excluding results for sample LLBG-03, TVS reference sample concentrations ranged from 32.2 to 58.2 percent.

TVS concentrations in samples collected from the vicinity of the former sawmills were comparable to reference area concentrations ranging from 28.0 to 51.2 percent, essentially the same range measured in reference locations unlikely to have been impacted by sawmill operations.

5.4 Biological Oxygen Demand

Biological oxygen demand (BOD) measures the oxygen consumed by microbial degradation of organic material over a 5-day period. BOD results were non-detected in the samples analyzed. However, laboratory reporting limits were elevated due to the low percent solids content of samples and the small sample size used (based on the organic-rich nature of the sediment).

The laboratory provided estimated results (below the reporting limit) for samples where oxygen depletion and residual oxygen concentrations at the end of the test did not meet method criteria but where BOD could still be estimated. These results are included in Table 3 and qualified as estimated (J). The BOD spreadsheet calculations are included in Appendix B.

The low oxygen depletion rates indicate that even though samples appear to be organic-rich, the organic matter is not rapidly degraded, which would be expected for cellulose or lignin from aquatic plants or wood.

5.5 Nitrogen

Nitrate and nitrite, water soluble forms of nitrogen often associated with fertilizer or sewage, were non-detect in reference location samples and samples collected in the vicinity of the former sawmills. Since these forms of nitrogen are water soluble, they would not be expected to be present in sediment samples.

Total Kjeldahl nitrogen (TKN) measures ammonia and organic nitrogen compounds and is often indicative of biological (sewage, plant, or animal sources) nitrogen. With the exception of location LLBG-03, TKN in reference samples ranged from 12,200 to 24,900 mg N/kg, with the highest concentration detected in surface sample LLBG-02 Grab. The TKN concentration in sample LLBG-03 was 6,100 mg/kg, the lowest concentration detected in the samples analyzed.

TKN concentrations in samples collected from the vicinity of the former sawmills were comparable to reference locations and range from 11,700 to 19,300 mg N/kg, with the highest concentration detected in sample LL-06.

To determine whether the sediment nitrogen source was associated with wood waste, aquatic vegetation, or some other source, total nitrogen concentrations were TVS-normalized by dividing the total nitrogen concentration by the TVS concentration. This normalization process accounts or corrects for varying concentrations of organic matter present in individual sediment samples.

Direct comparisons can be made between sediment TVS-normalized nitrogen concentrations and the nitrogen content of wood, aquatic vegetation, phytoplankton, and other organic nitrogen sources since the TVS for these potential sources of nitrogen is almost 100 percent (slightly less due to small amounts of ash).

The TVS-normalized total nitrogen content (Table 4 and Figure 5) is relatively consistent among the samples suggesting a common nitrogen source. TVS-normalized nitrogen content is essentially the same at all locations, ranging from 3.6 to 4.6 percent in reference samples and ranging from 3.6 to 4.8 percent in samples collected from the vicinity of the former sawmills.

For comparison, total nitrogen content in conifer heartwood ranges from 0.045 to 0.227 percent with an average concentration of 0.098 percent (Table 5 and

Figure 5). Ponderosa pine, historically the predominant species in the Loon Lake area, has a nitrogen content of only 0.052 percent.

Nitrogen content in aquatic plants and phytoplankton is typically higher than those in wood. Concentrations in milfoil are reported to range from 1.48 to 2.81 percent (Nichols and Keeney 1973). Diatoms and other phytoplankton have reported nitrogen content ranging from 4 to 9 percent (Reynolds 1984).

Nitrogen content (TVS-normalized) in Loon Lake samples is higher than concentrations associated with wood and aquatic vegetation (milfoil) but within the range reported for diatoms and phytoplankton (Figure 5). This finding suggests that diatoms and phytoplankton are the source of the "muck" in the lake and that wood waste has not significantly impacted lake sediment. This result is also consistent with results of the microscopic evaluations described in Sections 4.2 and 4.3 and Appendices C and D.

5.6 Phosphorus

Phosphorus, similar to nitrogen, is often associated with fertilizer, sewage, and detergents/cleaners and is also in plants and living organisms, though typically at lower concentrations than nitrogen.

Reference location phosphorus concentrations ranged from 398 to 547 mg/kg. The phosphorus concentration in sample LLBG-03, which was not used as a reference location, was 1,070 mg/kg, the highest concentration detected in all samples.

Phosphorus concentrations in samples collected from the vicinity of the former sawmills were comparable to reference locations with concentrations ranging from 234 to 598 mg/kg, with the highest concentration detected in the surface sediment sample collected at location LL-14.

As for nitrogen, direct comparisons can be also be made between sediment TVS-normalized phosphorus concentrations and the phosphorus content of wood, aquatic vegetation, phytoplankton, and other organic phosphorus sources.

With the exception of LLBG-03, TVS-normalized phosphorus concentrations were similar (Table 4 and Figure 6), ranging from 0.09 to 0.12 percent in reference samples and 0.05 to 0.18 percent in samples collected from the vicinity of the former sawmills again suggesting little or no difference in chemical characteristics.

Phosphorus content in aquatic plants and phytoplankton is typically higher than those in wood, ranging from 0.3 to 0.43 percent in milfoil (Nichols and Keeney 1973) and 0.03 to 0.8 percent in diatoms and other phytoplankton (Reynolds 1984). For comparison, ponderosa pine typically contains only about 0.001 percent phosphorus (J.P. Kaye et al, 2005).

Similar to TVS-normalized nitrogen results, phosphorus content (TVS-normalized) in Loon Lake samples is also within the range reported for diatoms and phytoplankton (Figure 6). This finding provides additional supporting evidence that diatoms and phytoplankton, and not wood waste, are responsible for the "muck" present in the lake sediment.

5.7 Sulfide

Sulfide is an indicator of anaerobic (low oxygen) sediment conditions. Elevated sulfide concentrations are usually associated with microbial degradation of organic-rich sediment.

Excluding results for sample LLBG-03, sulfide was not detected in reference area samples. The sulfide concentration in sample LLBG-03 was 555 mg/kg, the highest concentration detected in the samples analyzed.

Sulfide was detected in only five of ten samples collected from the vicinity of the former sawmills. Detected sulfide concentrations ranged from 14.2 to 87.3 mg/kg with the highest concentration in the surface sediment sample collected from location LL-05.

5.8 Data Quality Review

Overall, the data for this project are acceptable for use, as qualified. No results were rejected as a result of the QA/QC review; therefore, data for this project are 100 percent complete. Results for a few analytes were qualified as estimated concentrations based on minor exceedances of quality control criteria. A detailed chemical data quality review and laboratory certificates of analysis are presented in Appendix B.

6.0 RESULTS AND CONCLUSIONS

Sediment cores and surface grab samples were visually examined to determine the presence or absence of wood waste. Only minor visible identifiable bark, wood chips, or sawdust was present in the samples collected. Large amounts of organic-like material were present in both the cores and surface grab samples.

Some portions of this material could be visually identified as decomposing leaves, roots, and stems, though other material present was too decomposed to identify as other than organic plant material.

Chemical results for sediment samples indicate high levels of nutrients (organic nitrogen and phosphorus) in concentrations greater than those typically associated with wood. Nutrient concentrations were within the range typically associated with diatoms and other phytoplankton.

Density separation of the sediment material collected from near historical sawmills and reference areas showed little variability, implying that the material is similar from both areas of the lake.

Microscopic examination of samples indicated that the samples contained decomposing leaves, roots, and stems with no apparent sawdust or wood waste. Microscopic examination of samples revealed that diatoms and other phytoplankton comprised 50 to 60 percent of the sample volume.

Comparisons between samples collected close to the historical sawmills, and background samples from the opposite, western shore, indicate little difference between the areas. The organic surface material was visually similar, down to the microscopic level. The chemistry and density separation results comparing the site locations and background samples were also similar showing little variability. Similarities between visual microscopic characteristics, chemistry, and density separation results indicate that there is no difference between organic material from areas potentially impacted with wood waste and reference areas unlikely to be impacted with wood waste.

Comparison of sediment samples near historical sawmills and background samples showed no significant difference in chemical concentrations and analyte ratios. This indicates that there is no discernable difference in visual, physical, or chemical properties between areas near the former sawmills and background locations unlikely to have been impacted by wood waste. The source of organic-rich sediment “muck” appears to be decayed aquatic vegetation, diatoms, and other phytoplankton.

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8.0 LIMITATIONS

Work for this project was performed, and this report prepared, in general accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of the Washington State Department of Natural Resources for specific application to the referenced property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

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Table 1 - Sample Location Coordinates

			Proposed		Actual	
Sample ID	**Date**	**Time**	**Northing**	**Easting**	**Northing**	**Easting**
LL-01	9/10/2008	9:05	1006065.0	2344167.2	1006250.4	2344205.4
LL-02	9/10/2008	9:25	1005772.0	2344661.4	1005813.1	2344798.6
LL-03	9/8/2008	13:55	1005385.3	2345198.6	1005395.4	2345203.8
LL-04	9/10/2008	10:50	1005504.8	2344124.9	1005324.0	2344435.3
LL-05	9/10/2008	11:50	1005207.0	2344643.3	1004749.8	2344528.7
LL-06	9/10/2008	12:15	1004843.1	2344263.0	1004640.4	2343843.3
LL-07	9/8/2008	15:35	1004783.8	2344854.5	1004778.8	2344949.1
LL-08	9/8/2008	11:52	1004272.8	2344593.5	1004267.4	2344591.9
LL-09	9/8/2008	14:50	1003937.0	2344981.7	1004000.7	2345029.3
LL-10	9/8/2008	16:40	1003551.2	2344806.1	1003522.3	2344785.2
LL-11	9/8/2008	14:15	1003504.0	2345445.8	1003528.0	2345495.0
LL-12	9/9/2008	9:10	1003065.1	2344937.4	1003084.5	2344942.3
LL-13	9/9/2008	9:35	1002888.8	2345559.7	1002854.9	2345589.1
LL-14	9/9/2008	10:40	1003055.6	2346220.2	1003084.3	2346228.4
LL-15	9/9/2008	11:30	1002317.4	2347029.6	1002429.9	2347093.4
LL-16	9/9/2008	13:25	1001549.7	2347622.1	1001609.3	2347723.6
LL-17	9/9/2008	13:55	1000375.9	2348116.0	1000334.3	2348100.2
LL-18	9/9/2008	14:30	999560.4	2347514.1	999554.1	2347663.3
LL-19	9/9/2008	15:25	998303.0	2348058.1	998343.8	2348032.8
LL-20	9/10/2008	10:00	TBD	TBD	1005701.7	2345040.9
LL-21	9/10/2008	14:40	TBD	TBD	1004525.0	2343615.0
LLBG-01	9/10/2008	12:45	1004928.0	2339458.1	1004991.5	2339292.6
LLBG-02	9/10/2008	16:00	1001093.4	2340842.4	1004525.6	2343622.2
LLBG-03	9/10/2008	17:00	1000251.0	2343197.5	1000192.0	2343256.7
LLBG-04	9/9/2008	15:45	997248.0	2345508.5	997313.0	2345301.5

Coordinates are Washington State Plane South NAD83

Table 2 - Sediment Grab Sample Descriptions

Sample Number	Collection Date	Visual Sediment Description	Comments
LL-05 GRAB	9/11/2008	Saturated, very soft to soft, light brown PEAT (PT) with high organic content.	van Veen power grab. Combined two grabs for chemistry, physical properties, and bioassay.
LL-06 GRAB	9/11/2008	Saturated, very soft to soft, light brown PEAT (PT) with high organic content.	van Veen power grab. Combined two grabs for chemistry, physical properties, and bioassay. Water plants.
LL-07 GRAB	9/11/2008	Saturated, very soft, light gray-brown PEAT (PT) with high organic content.	Ekman van Veen. Combined four grabs for chemistry, physical properties, and bioassay. Water plants, swimming organisms at surface.
LL-08	9/11/2008	Saturated, very soft, light brown PEAT (PT) with high organic content.	van Veen power grab. Did not collect sample for analysis due to water plants, and low recovery.
LL-09 GRAB	9/11/2008	Saturated, very soft, light brown PEAT (PT) with high organic content.	Ekman van Veen. Combined four grabs for chemistry, physical properties, and bioassay. Water plants, swimming organisms at surface.
LL-14 GRAB	9/11/2008	Saturated, very soft, light brown PEAT (PT) with high organic content.	Ekman van Veen. Combined three grabs for chemistry, physical properties, and bioassay. Water plants, swimming organisms at surface.
LL-19	9/11/2008	Saturated, dense, light brown, clayey SILT (ML).	Ekman van Veen. Did not sample for analysis due to water plants, and low recovery.
LL-20 GRAB	9/11/2008	Saturated, very soft to soft, light brown, PEAT (PT) with high organic content.	van Veen power grab. Combined two grabs for chemistry, physical properties, and bioassay.
LL-21	9/11/2008	Saturated, very soft to soft, light brown PEAT (PT) with high organic content.	van Veen power grab. Did not collect sample for analysis due to water plants, and low recovery.
LLBG-01 GRAB	9/11/2008	Saturated, very soft to soft, light brown PEAT (PT) with high organic content.	van Veen power grab. One grab for grain size and bioassay. Water plants.
LLBG-03	9/10/2008	Saturated, soft, black, sandy SILT (OL) with moderate organic content.	van Veen power grab. One grab for chemistry, and physical properties.
LLBG-04 GRAB	9/10/2008	Saturated, very soft to soft, light brown PEAT (PT) with high organic content.	van Veen power grab. Combined two grabs for chemistry, physical properties, and bioassay. Water plants.

Table 3 - Analytical Results for Loon Lake Sediment Samples

Sample ID	LL-04	LL-05 GRAB	LL-06	LL-06 GRAB	LL-07 GRAB	LL-08	LL-09 GRAB	LL-14 GRAB
Sampling Date	9/10/08	9/11/08	9/10/08	9/11/08	9/11/08	9/8/08	9/11/08	9/11/08
Depth below Mudlines	5 to 7.25 ft	0 to 10 cm	5 to 7.05 ft	0 to 10 cm	0 to 10 cm	3 to 4.7 ft	0 to 10 cm	0 to 10 cm
Conventionals in mg/kg								
Biological Oxygen Demand	9420 U	10100 U	6820 U	1673 J	3154 J	5340 U	787 J	140 J
Sulfide	14.5 U	83.7	10.7 U	36.3	14.3 U	9.56 U	14.2	38.4
Total Phosphorus	335	404	348	553	519	251	564	598
Nitrate + Nitrite (NO3+NO2)	1.81 U	8.37 U	1.12 U	1.67 U	4.38 U	0.94 U	7.27 U	5.97 U
Total Kjeldahl Nitrogen	18500	16700	19300	18500	11700	17000	15800	15100
Conventionals in %								
Preserved Total Solids	6.6	6.1	9.1	5.9	6.8	10.3	7.2	9.2
Total Organic Carbon	28.4	18.8	15.7	23.6	11.3	15.5	9.76	15.3
Total Solids	5.4	5.8	8	5.5	10.2	9.6	6.5	7.7
Total Volatile Solids	51.18	43.48	40.5	49.39	28.03	39.52	39.9	32.52
Grain Size in %								
8-9 Phi Clay			8			8.3		
9-10 Phi Clay			5			6.3		
> 10 Phi Clay			8.2			10.2		
Very Fine Silt			6.9			9.1		
Fine Silt			10.7			7.4		
Medium Silt			4.4			3		
Coarse Silt			0.1 U			0.6		
Total Fines	40.8	28.5	43.1	36.6	23.3	45	25.2	14
Very Fine Sand	2.4	6.7	5.1	5.1	11.5	4.1	6	8.3
Fine Sand	4.3	8.2	6.4	7.2	14.5	5.1	8.7	13.6
Medium Sand	7.4	10.4	7.7	11.2	9.5	6.7	12.6	9.8
Coarse Sand	13.1	15.9	11	16.4	13.8	9.8	20.7	15.1
Very Coarse Sand	20.4	20.5	15.1	17.8	21.4	14.7	21.9	22.7
Gravel	11.6	9.7	11.6	5.8	6.1	14.7	4.9	16.4

Table 3 - Analytical Results for Loon Lake Sediment Samples

Sample ID	LL-20	LL-20 GRAB	LLBG-01	LLBG-01 GRAB	LLBG-02	LLBG-03	LLBG-04 GRAB
Sampling Date	9/10/08	9/11/08	9/10/08	9/11/08	9/10/08	9/10/08	9/10/08
Depth below Mudlines	4 to 5.7 ft	0 to 10 cm	0 to 0.5 ft	0 to 10 cm	0 to 0.5 ft	0 to 10 cm	0 to 10 cm
Conventionals in mg/kg							
Biological Oxygen Demand	3470 U	1220 J	5260 U		20800 U	1594 J	5910 U
Sulfide	7.11 U	26.7	15.3 U		25.8 U	555	7.35 U
Total Phosphorus	234	510	401		547	1070	398
Nitrate + Nitrite (NO3+NO2)	3.64 U	6.56 U	5.99 U		3.19 U	5.51 U	5.11 U
Total Kjeldahl Nitrogen	11900	14700	14100		24900	6100	12200
Conventionals in %							
Preserved Total Solids	13.7	11.2	6.6		4.3	16.6	13.1
Total Organic Carbon	8.08	6.38	16.7		24.6	5.31	12.7
Total Solids	13.1	7.6	7.5		2.7	16.4	8.9
Total Volatile Solids	30.73	30.66	39.41		58.22	13.27	32.21
Grain Size in %							
8-9 Phi Clay	6.4						6.4
9-10 Phi Clay	4.4						3.7
> 10 Phi Clay	6						5.9
Very Fine Silt	7.6						9.8
Fine Silt	8.1						9.9
Medium Silt	5.4						7.9
Coarse Silt	1.9						0.5
Total Fines	39.7	38.7		22.8			44.1
Very Fine Sand	7.2	6.9		6.7			4.7
Fine Sand	7.1	8.6		8.3			5
Medium Sand	7.9	10.6		7.8			6.2
Coarse Sand	10.4	13.2		16.1			8.7
Very Coarse Sand	13.4	14.8		23.6			14
Gravel	14.4	7.1		14.7			17.4

U = Not detected at the reporting limit indicated.
J = Estimated value.
Blank indicates sample not analyzed for specific analyte.

Table 4 - TVS-Normalized Nitrogen and Phosphorus Concentrations in Sediment Samples

Sample **Number**	**TVS Concentration**	**Nitrogen Concentration (TVS Normalized)**	**Phosphorus Concentration (TVS Normalized)**
LLBG-01	39.4%	3.58%	0.10%
LLBG-02	58.2%	4.28%	0.09%
LLBG-03	13.3%	4.59%	0.83%
LLBG-04	32.2%	3.79%	0.12%
LL-04	51.2%	3.61%	0.06%
LL-05 GRAB	43.5%	3.84%	0.09%
LL-06	40.5%	4.77%	0.10%
LL-06 GRAB	49.4%	3.74%	0.10%
LL-07 GRAB	28.0%	4.18%	0.18%
LL-08	39.5%	4.30%	0.05%
LL-09 GRAB	39.9%	3.96%	0.15%
LL-14 GRAB	32.5%	4.65%	0.18%
LL-20	30.7%	3.88%	0.07%
LL-20 GRAB	30.7%	4.79%	0.16%

Table 5 - Measured Nitrogen Levels in Wood

Type of Wood	Percent Nitrogen
Douglas fir	0.051
Douglas fir	0.1
Loblolly pine	0.068
Monterey Pine (inner sapwood)	0.09
Monterey Pine (outer sapwood)	0.148
lodgepole pine	0.071
Shortleaf pine	0.13
Slash pine	0.05
Sugar pine	0.124
Western white pine	0.113
Longleaf pine	0.038
Ponderosa pine	0.052
White pine	0.087
White fir	0.045
Red fir	0.227
Red cedar	0.139
Engleman spruce	0.118
Western larch	0.18
California incense cedar	0.097
Redwood	0.06
Redwood	0.1
Cypress	0.057
Eastern hemlock	0.106
Western hemlock	0.1
Average	0.098

From Veverka et al., 1993

Source: Base map prepared from Microsoft Streets and Trips 2005.

0 3000 6000
Scale in Feet

N

Loon Lake
Loon Lake, Washington

Vicinity Map

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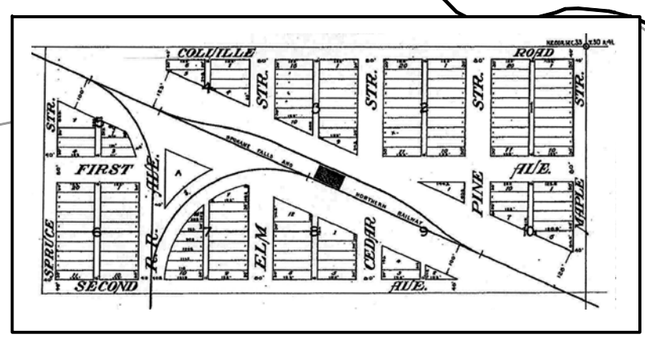
Figure
1

EAL 12/19/08 1745300-001.dwg

Colville Road
Cedar Street
Pine Street
Maple Street
Garden Spot Road
Highway 292
See Inset 1
Neil Road
Morgan Road
Mackinaw Avenue
Evan Road
Highway 395
North Shore Drive
North Shore Lane
Park Lane
State Road
Loon Lake
Sunset Bay Road
Lynn Road
Sunset Drive
See Inset 2



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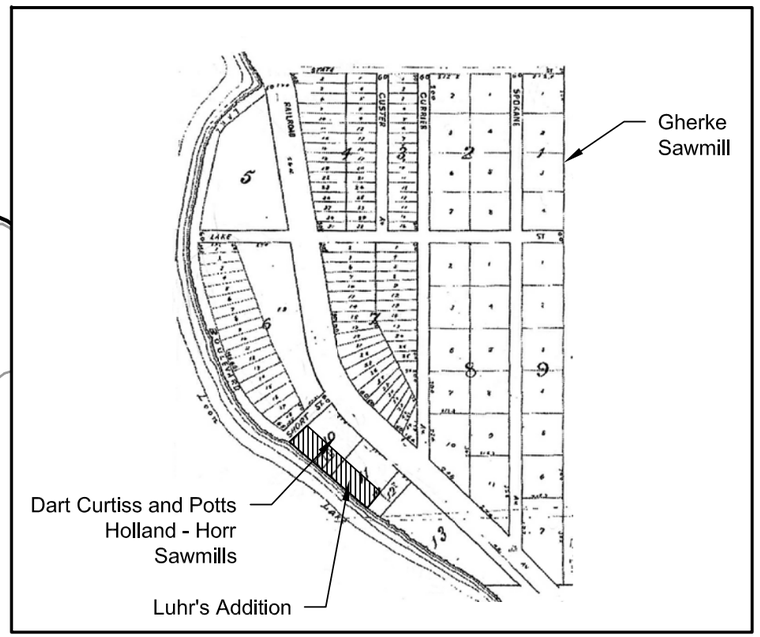

Inset 2

0 600 1200
Scale in Feet

N

Loon Lake
Loon Lake, Washington

Historical Features Map

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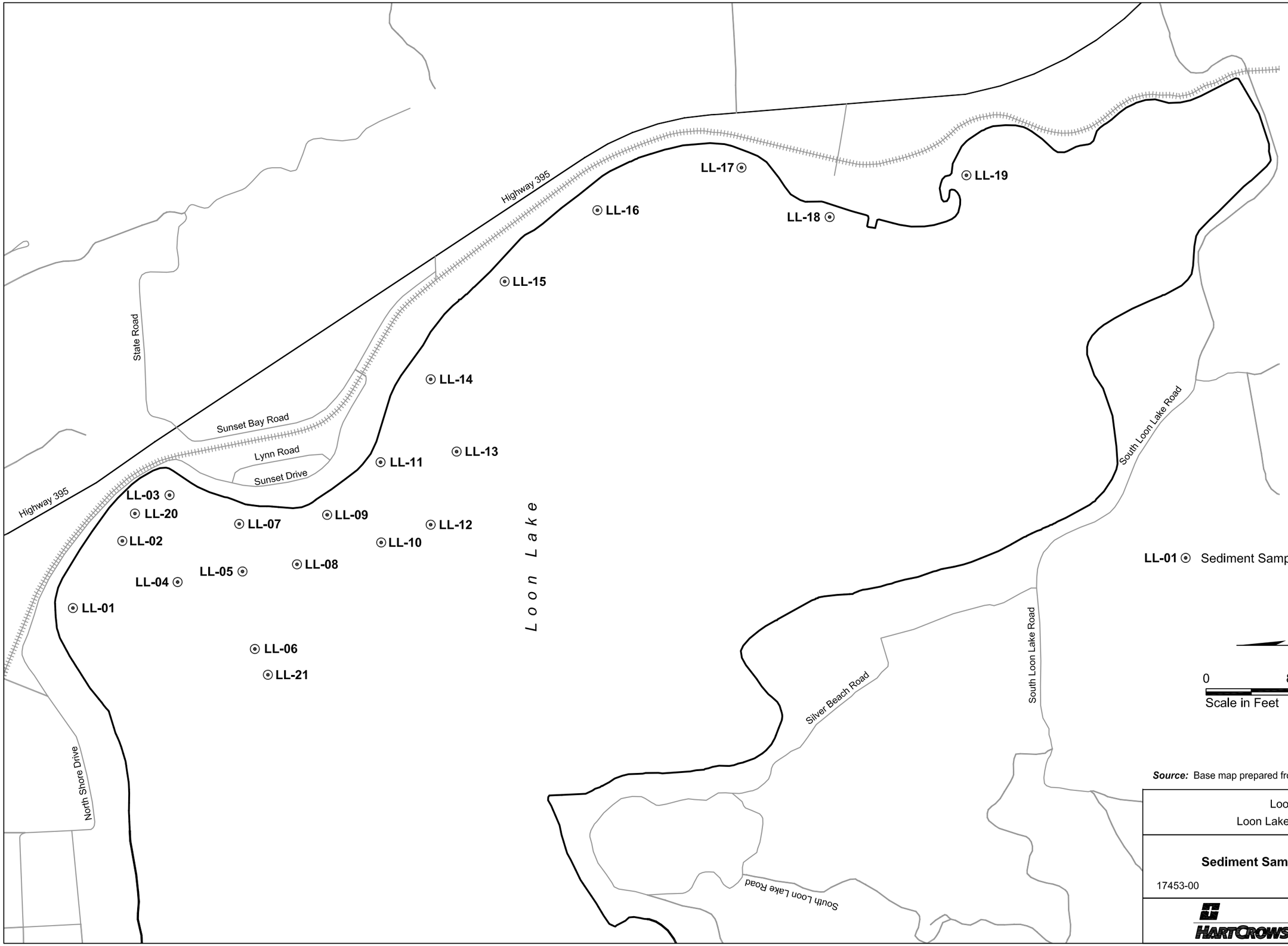
Figure
2

Source: Base map prepared from drawings provided by DNR 2008.

EAL 12/19/08 1745300-002.dwg



Source: Base map prepared from drawings provided by DNR 2008.

Loon Lake
Loon Lake, Washington

Sediment Sample Location Map

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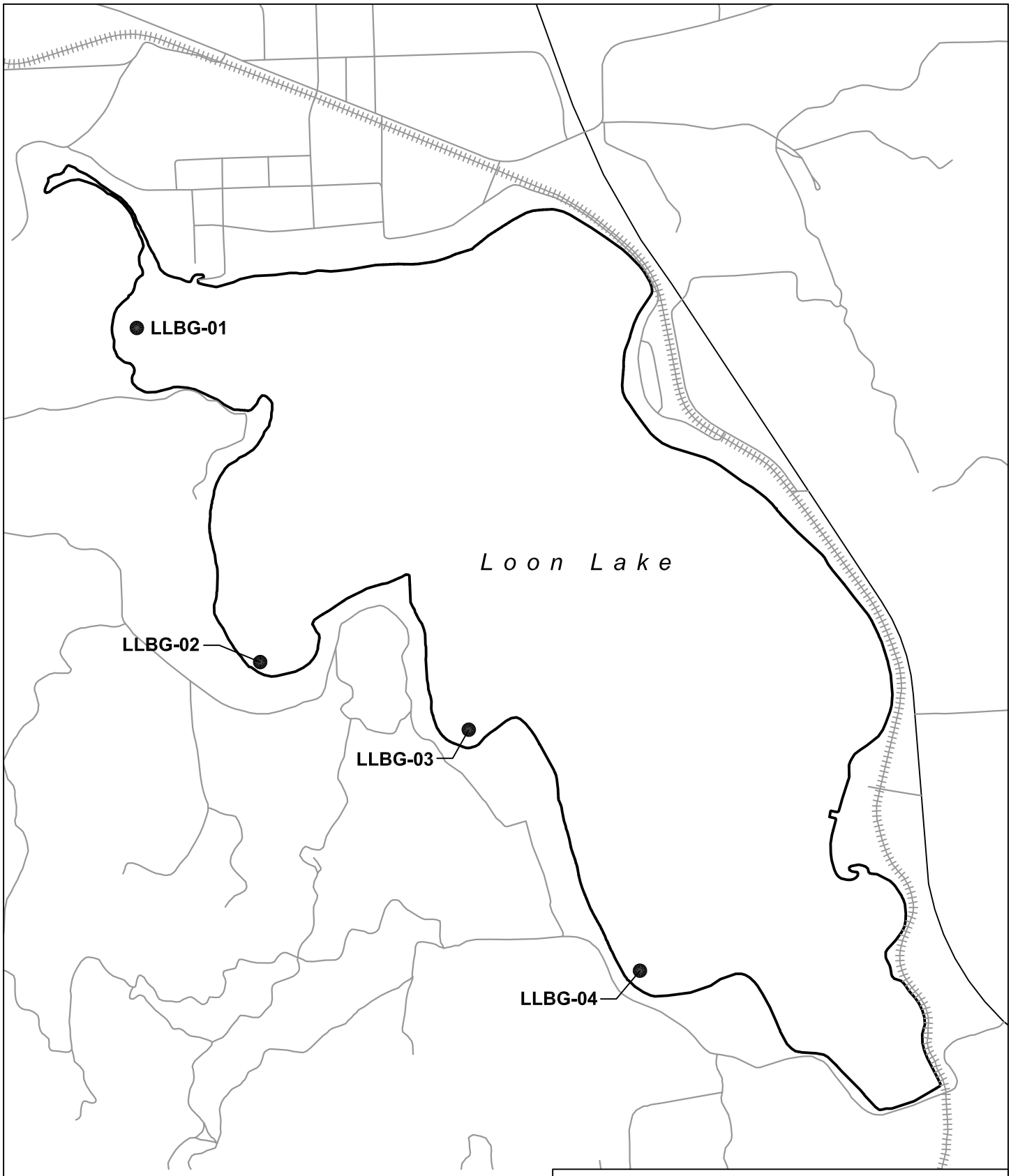
Figure
3

EAL 12/19/08 1745300-005.dwg



Source: Base map prepared from drawings provided by DNR 2008.

LLBG-03 ● Reference Sediment Sample Location

0 1600 3200
Scale in Feet

N

Loon Lake
Loon Lake, Washington

Reference Sediment Sample Location Map

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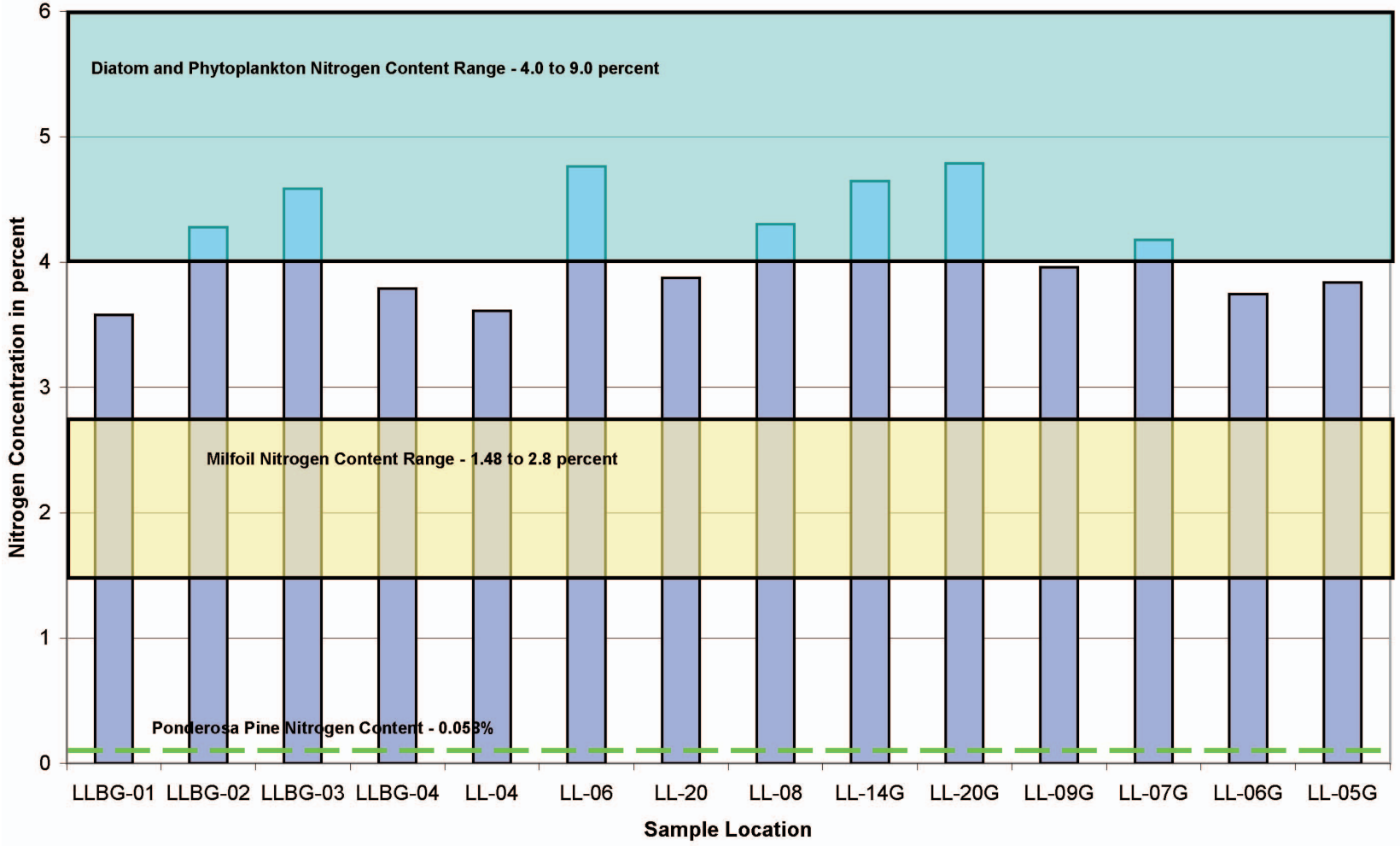
Figure
4

EAL 12/19/08 1745300-004.dwg

EAL 01/19/09 1745300-AA.cdr



Loon Lake
Loon Lake, Washington

Sediment TVS-Normalized Nitrogen Concentration

17453-00

1/09

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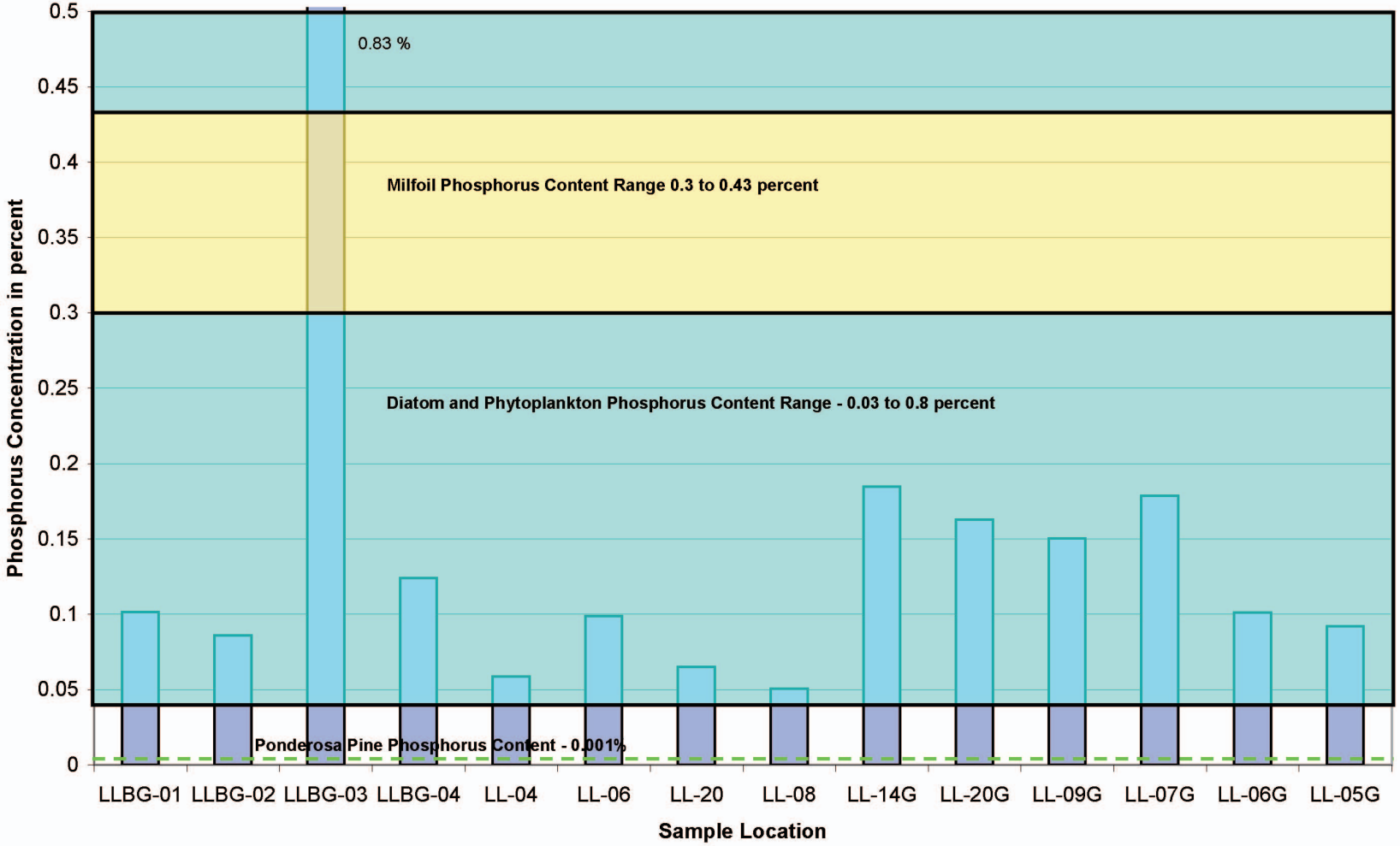
Figure 5

EAL 01/19/09 1745300-AB.cdr



Loon Lake
Loon Lake, Washington

Sediment TVS-Normalized Phosphorus Concentration

17453-00

1/09

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Figure 6

APPENDIX A
PISTON CORE AND VIBRACORE LOGS

Key to Exploration Logs

Sample Description

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

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

Density/Consistency

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

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

Sampling Test Symbols

- 1.5" I.D. Split Spoon
- Grab (Jar)
- 3.0" I.D. Split Spoon
- Shelby Tube (Pushed)
- Bag
- Cuttings
- Core Run

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE)	GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE)	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE)	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Laboratory Test Symbols

GS	Grain Size Classification
CN	Consolidation
UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
QU	Unconfined Compression
DS	Direct Shear
K	Permeability
PP	Pocket Penetrometer Approximate Compressive Strength in TSF
TV	Torvane Approximate Shear Strength in TSF
CBR	California Bearing Ratio
MD	Moisture Density Relationship
AL	Atterberg Limits

Water Content in Percent
Liquid Limit
Natural
Plastic Limit

PID	Photoionization Detector Reading
CA	Chemical Analysis
DT	In Situ Density in PCF

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key

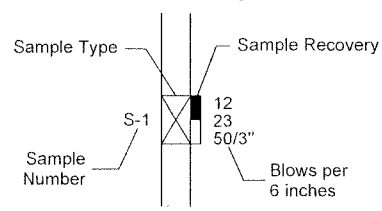

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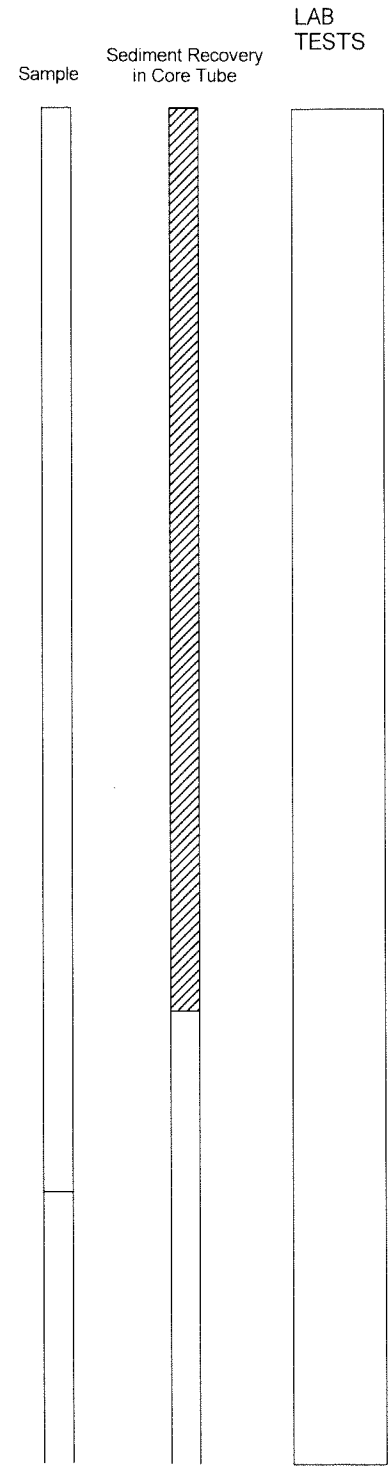
Figure A-1

Piston Core Log LL-01

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 6.8 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1006250.4
Easting: 2344205.4
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, air bubbles, sulfide-like odor, degraded plant material, decomposing leaves, roots, pebbles, and no evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet. Drive Length: 8 feet; Recovery Length: 6.65 feet. Date/Time: 09/10/08 9:05	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/16/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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17453-00 9/08

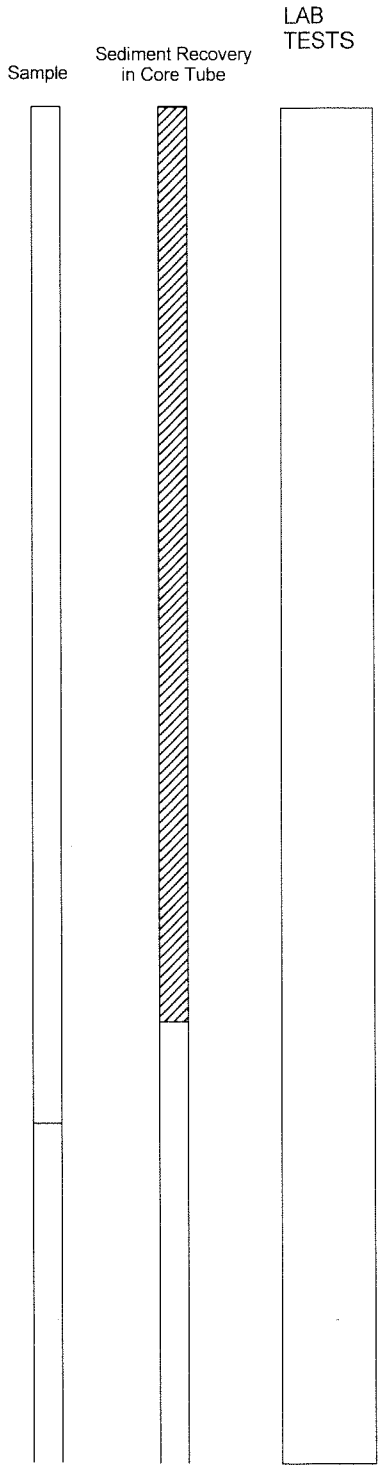
Figure A-2

Piston Core Log LL-02

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 4.9 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1005813.1
Easting: 2344798.6
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, air bubbles, sulfide-like odor, degraded plant material, decomposing leaves, roots, and no evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 6.75 feet. Date/Time: 09/10/08 9:25	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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17453-00 9/08

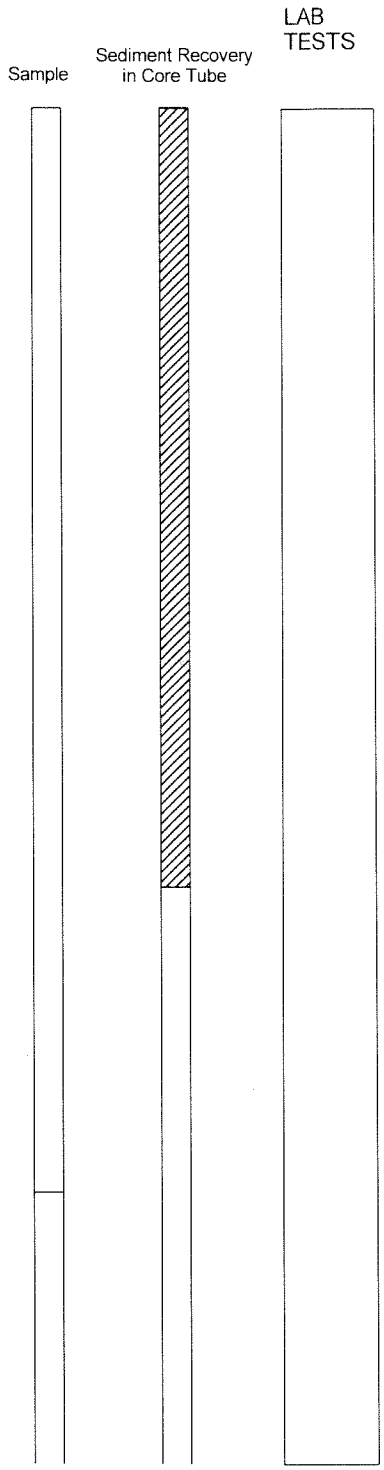
Figure A-3

Vibracore Log LL-03

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 2.7 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1005395.4
Easting: 2345203.8
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light gray-brown PEAT with abundunt organic material, large air bubble at 3.5 feet, no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
SM		(Loose), wet, green-gray, silty SAND with some organic material.	
GW		(Dense), wet, gray-white, sandy GRAVEL (well graded). Cobbles (4-inch).	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet. Drive Length: 8 feet; Recovery Length: 5.75 feet. Date/Time: 09/8/08 13:55	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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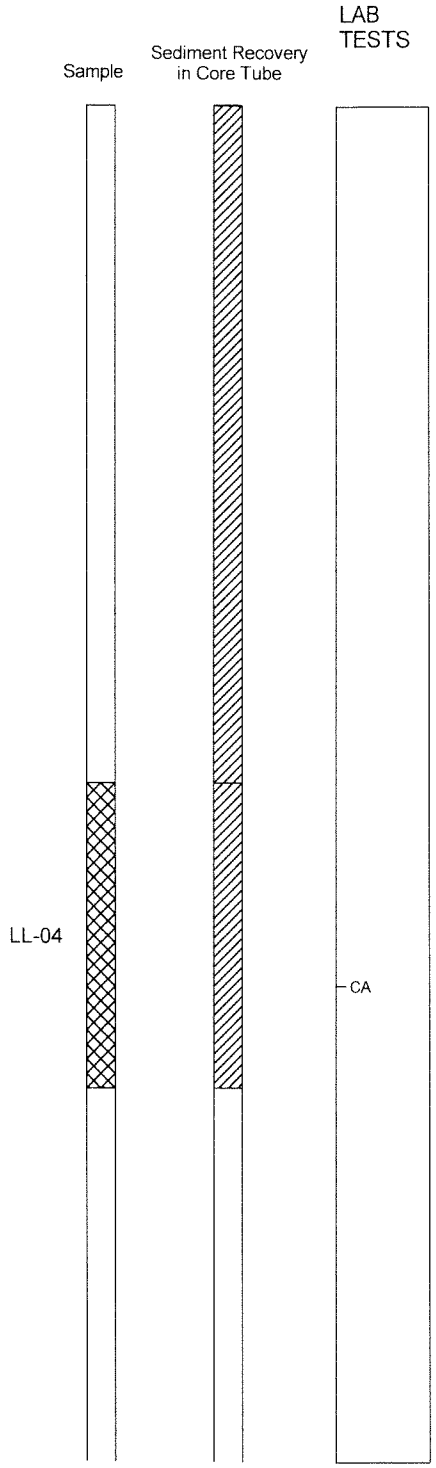
Figure A-4

Piston Core Log LL-04

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 4.9 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1005323.9
Easting: 2344435.3
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content and sulfide-like odor, fibrous material, decaying organic matter, air bubbles throughout, no organisms, and no evident wood debris (sawdust, wood chips).	0
		Darker brown organic material.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet.	
		Drive Length: 7.5 feet; Recovery Length: 7.25 feet.	
		Date/Time: 09/10/08 10:50	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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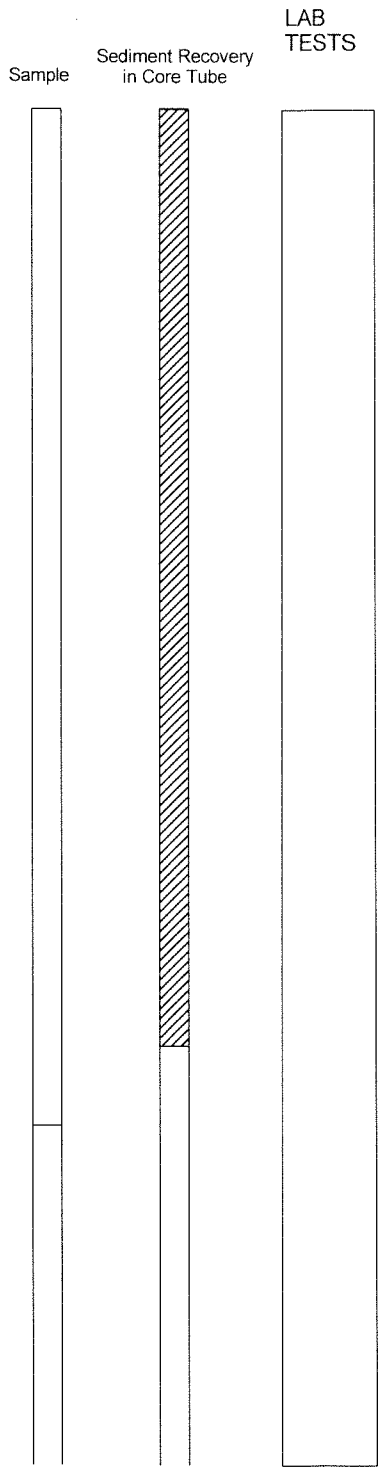
Figure A-5

Piston Core Log LL-05

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.8 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004749.8
Easting: 2344528.7
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content and sulfide-like odor, air bubbles throughout, fibrous pulp material, roots, stems, and no evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 6.9 feet. Date/Time: 09/10/08 11:50	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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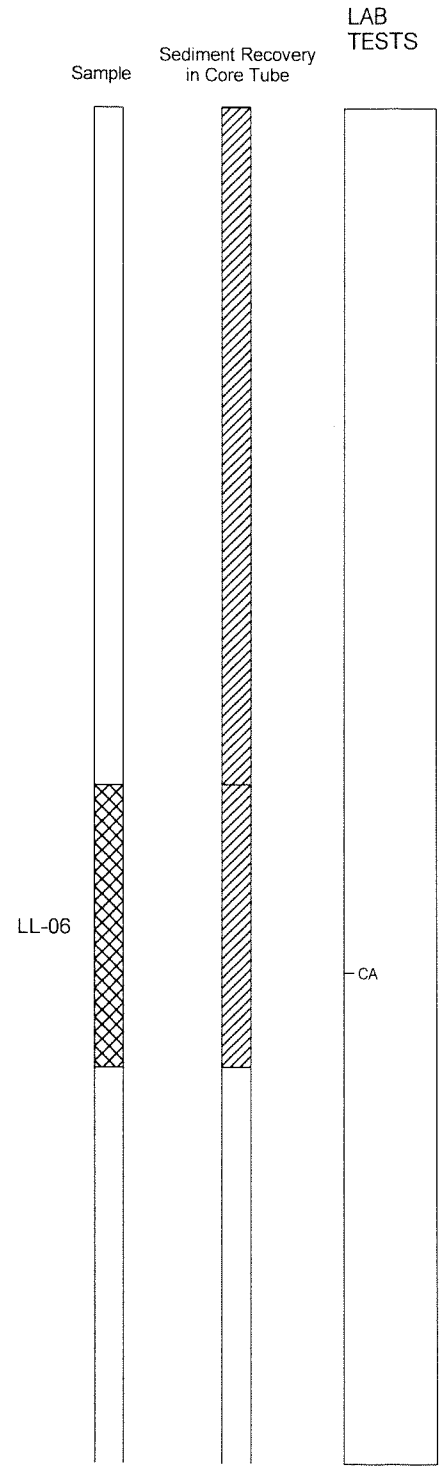
Figure A-6

Piston Core Log LL-06

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 8.1 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004640.4
Easting: 2343843.3
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, decaying leaves, roots, and stems, air bubbles throughout, and no evident wood debris (sawdust, wood chips).	0
		Grades to a red-brown, fibrous material, high organic content.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 7.05 feet. Date/Time: 09/10/08 12:15	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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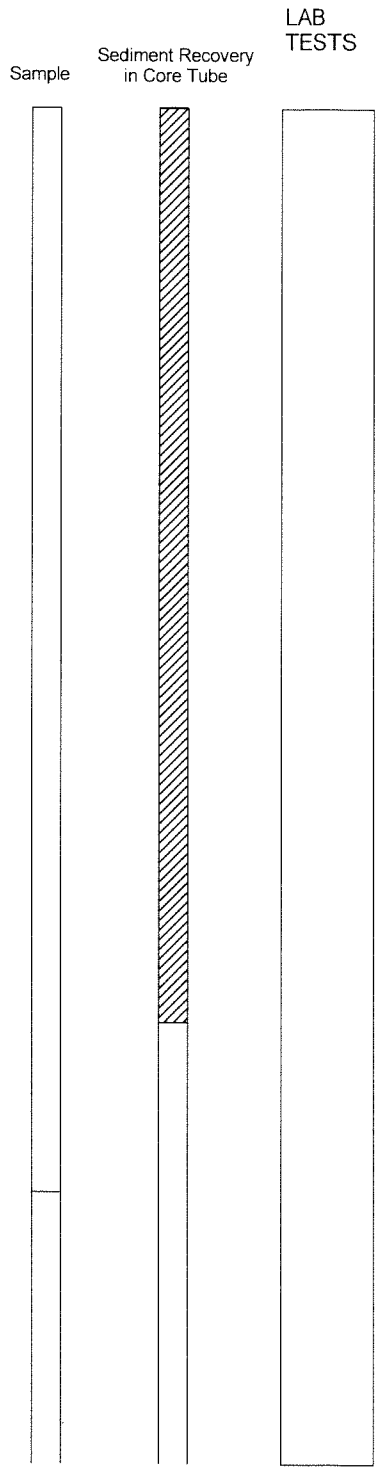
Figure A-7

Piston Core Log LL-07

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.5 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004778.8
Easting: 2344949.1
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light gray-brown PEAT with high organic content, air bubbles, and sulfide-like odor, root and leaf fragments (highly decomposed), and no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
		Grades to light brown.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet. Drive Length: 8 feet; Recovery Length: 6.75 feet. Date/Time: 09/8/08 15:35	10



VIBROCORE LOG 174530OPP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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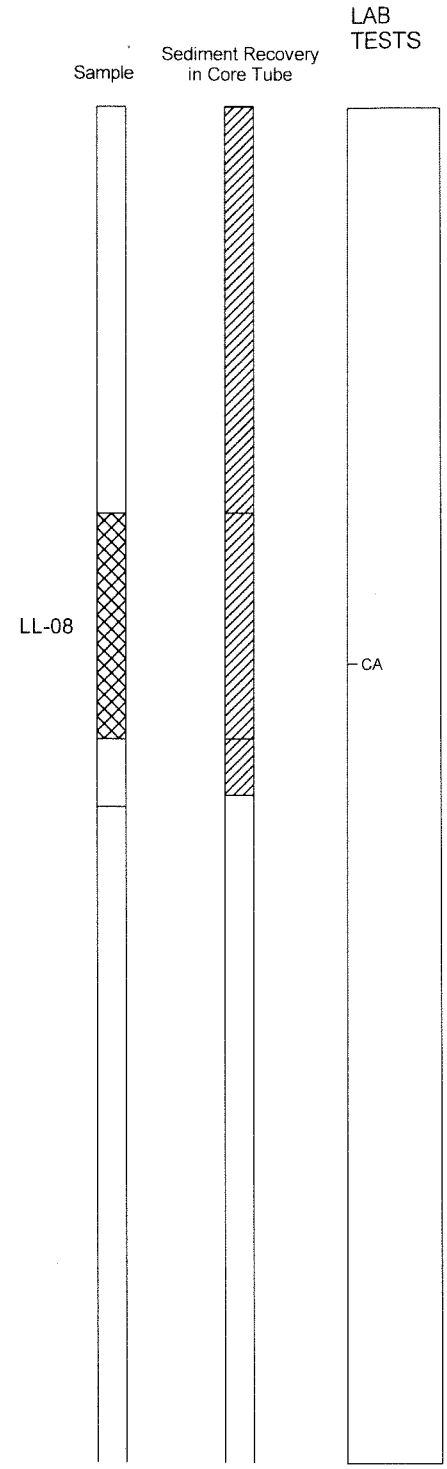
Figure A-8

Piston Core Log LL-08

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 4.9 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004267.4
Easting: 2344591.9
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light brown, silty, highly organic PEAT, with sulfur-like odor, air pockets, fibrous root structures, and no evident wood debris (sawdust, wood chips).	0
SM		(Loose), wet, light gray-white, silty SAND with no odor and no organic material.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 5.2 Feet.	
		Drive Length: 5.2 feet; Recovery Length: 5.1 feet.	
		Date/Time: 09/8/08 11:52	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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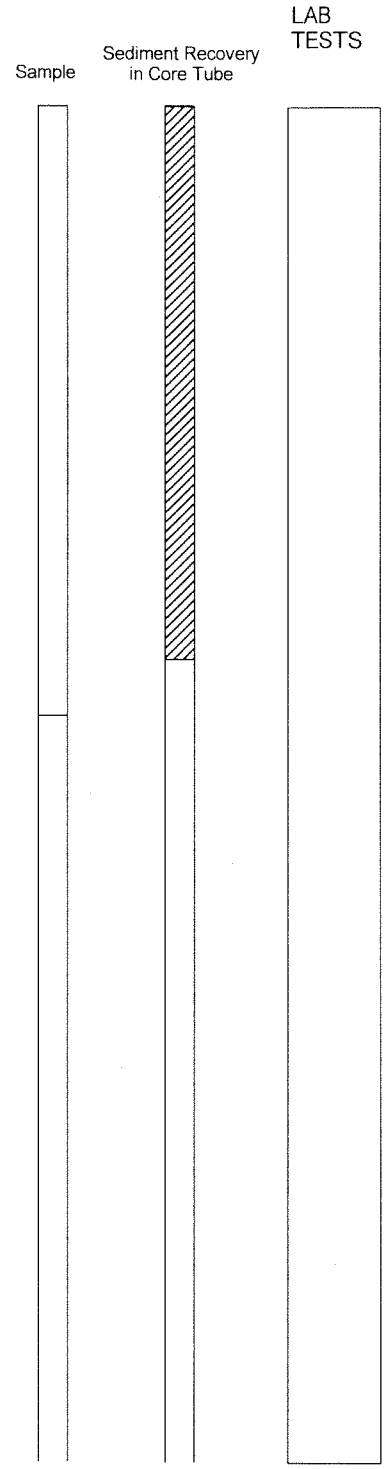
Figure A-9

Piston Core Log LL-09

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.1 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004000.7
Easting: 2345029.3
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, brown, slightly silty PEAT with high content of plant material, one piece of bark, sulfide-like odor, silt lenses, and air bubbles, and no evident wood debris (sawdust, woodchips). Benthic organisms (1-mm) swimming at top of sample.	0
SM		(Loose), wet, gray, silty SAND with organic material. Grades to gray SAND.	
GW		(Dense), wet, gray-white, sandy GRAVEL (well-graded).	
		Bottom of Sediment in Core Tube. Clayey SAND layer in core shoe.	
		Bottom of Core Tube at 4.5 Feet.	
		Drive Length: 4.5 feet; Recovery Length: 4.05 feet.	5
		Date/Time: 09/8/08 14:50	
			10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
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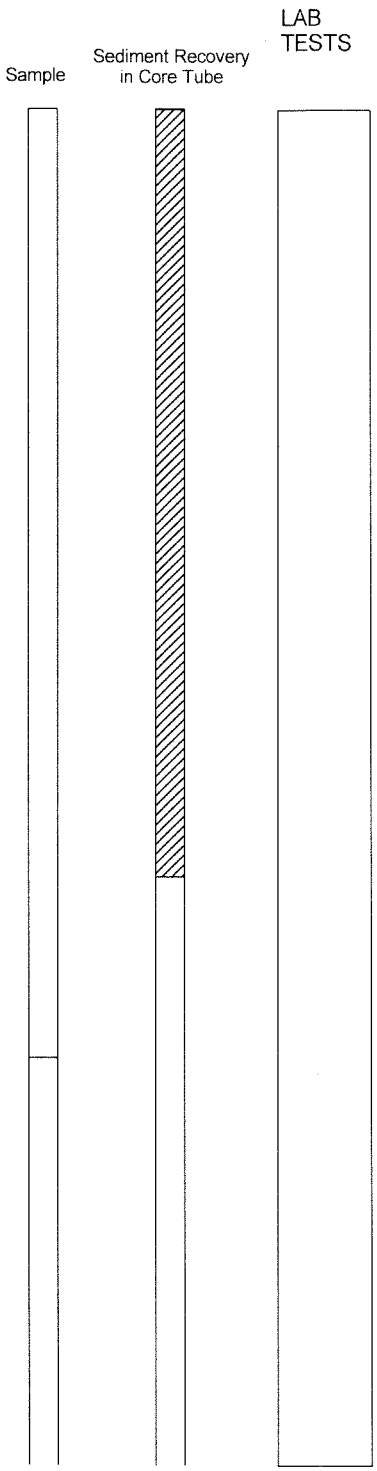
Figure A-10

Piston Core Log LL-10

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 10.2 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1003522.3
Easting: 2344785.2
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light gray to brown PEAT with abundant organic material, decomposed leaf and root fragments, sulfide-like odor, no evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.0 Feet. Drive Length: 7 feet; Recovery Length: 5.7 feet. Date/Time: 09/8/08 16:40	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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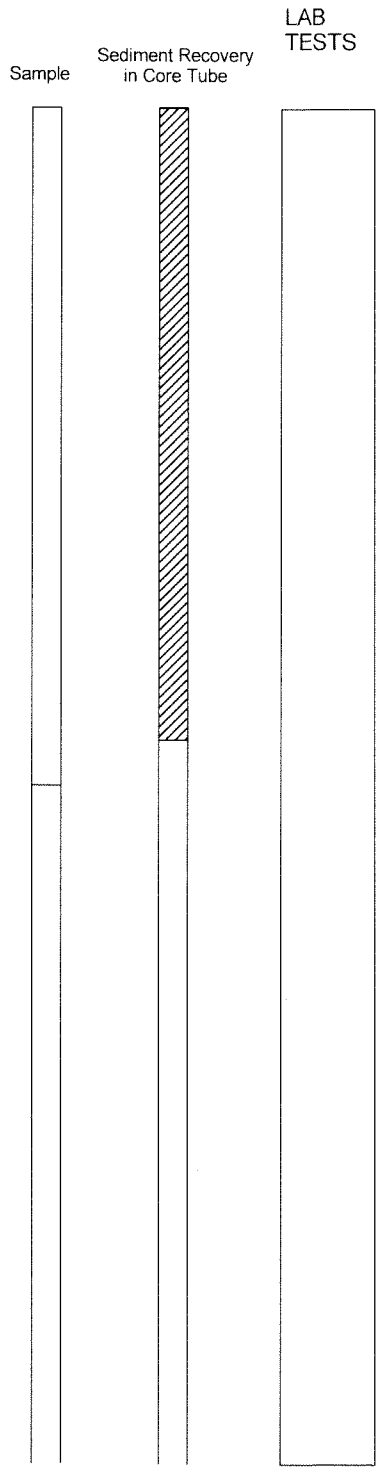
Figure A-11

Vibracore Log LL-11

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.6 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1003527.9
Easting: 2345495
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, brown PEAT with high organic content, and leaf and root fragments.	0
SM		(Loose), wet, gray, silty SAND with organic material grading to wet, gray, coarse SAND with no organic material.	
GW		(Dense), wet, gray-white, sandy GRAVEL, well-graded with 4-inch cobbles.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 5.0 Feet.	5
		Drive Length: 5 feet; Recovery Length: 4.65 feet.	
		Date/Time: 09/8/08 14:15	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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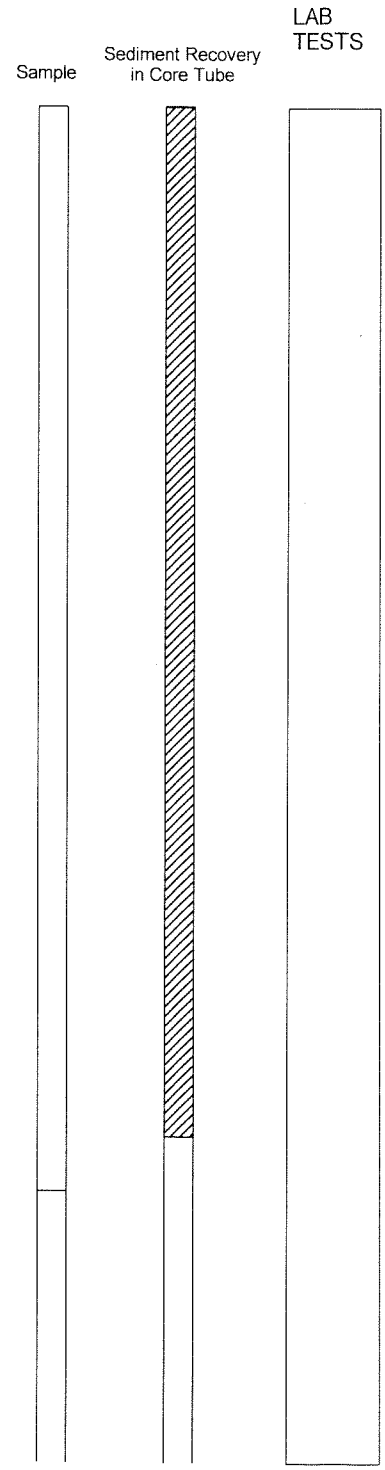
Figure A-12

Vibracore Log LL-12

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 24.4 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1003084.6
Easting: 2344942.3
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light brown PEAT with high organic content, sulfide-like odor, no organisms, and no evident wood debris (sawdust, wood chips).	0
CL		(Stiff), wet, light gray, silty CLAY.	
PT		(Soft), wet, light tan PEAT with high organic content and sulfide-like odor. Grades to light brown. Grades to light tan.	
SW		(Dense), wet, gray-white, gravelly, coarse SAND with no organic material, 2-inch gravels, and Clay/Silt lenses.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet.	
		Drive Length: 8 feet; Recovery Length: 7.6 feet.	
		Date/Time: 09/9/08 9:10	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

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

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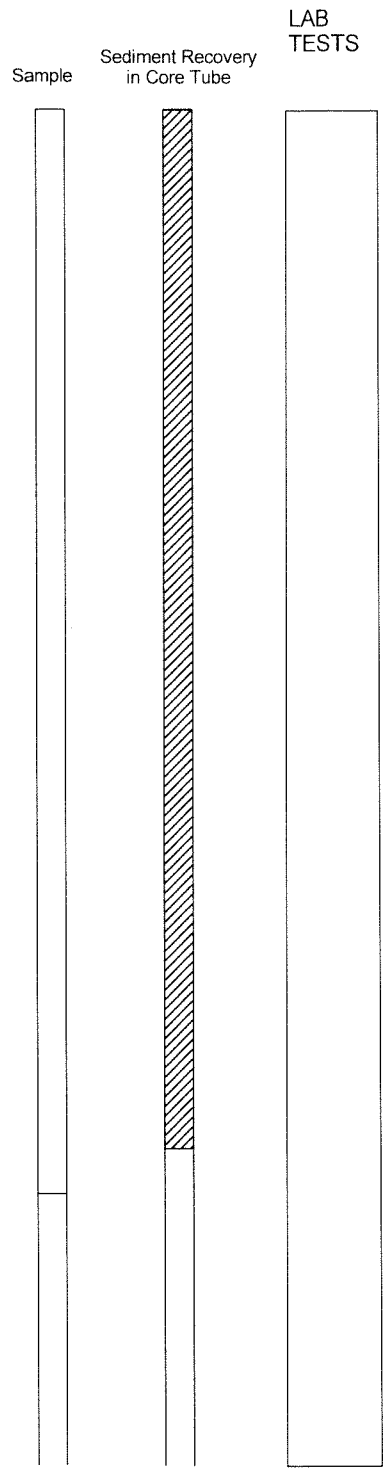
Figure A-13

Vibracore Log LL-13

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 21.5 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1002854.9
Easting: 2345589.1
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light brown PEAT with high organic content, no organisms, and no evident wood debris (sawdust, wood chips).	0
ML		(Slightly stiff), wet, light gray, clayey SILT with organic material and high plasticity.	
PT		(Soft), wet, light brown PEAT with high organic content, no evident wood debris (sawdust, wood chips), and lenses of silty, fine SAND.	5
OH		(Loose), wet, gray, silty CLAY, high plasticity and organic content.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet. Drive Length: 8 feet; Recovery Length: 7.7 feet. Date/Time: 09/9/08 9:35	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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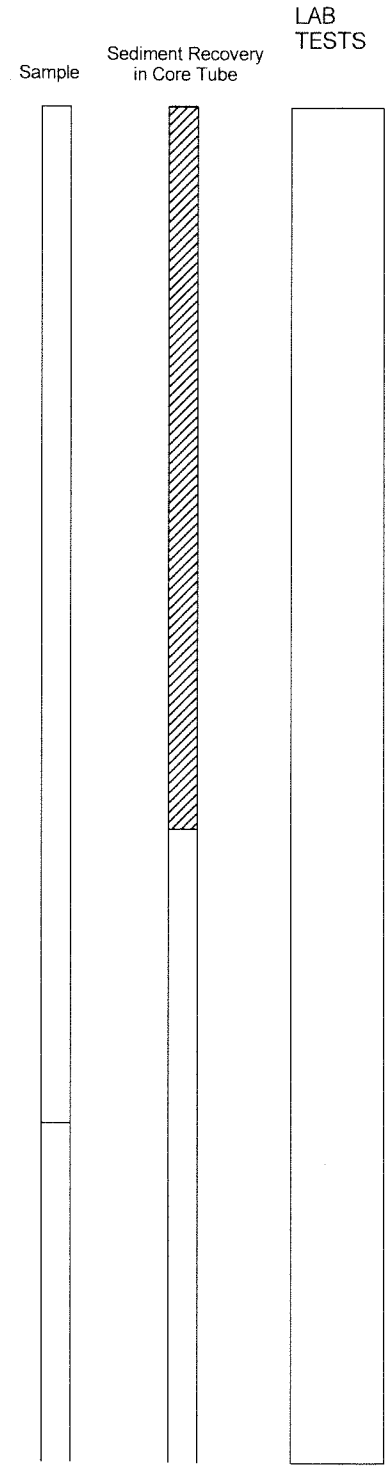
Figure A-14

Vibracore Log LL-14

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.7 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1003084.3
Easting: 2346228.4
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft), wet, light brown PEAT with high organic content and sulfide-like odor, no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
ML		(Stiff), wet, light gray, clayey SILT with a lens of green, fine Sand.	5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 5.3 feet. Date/Time: 09/9/08 10:40	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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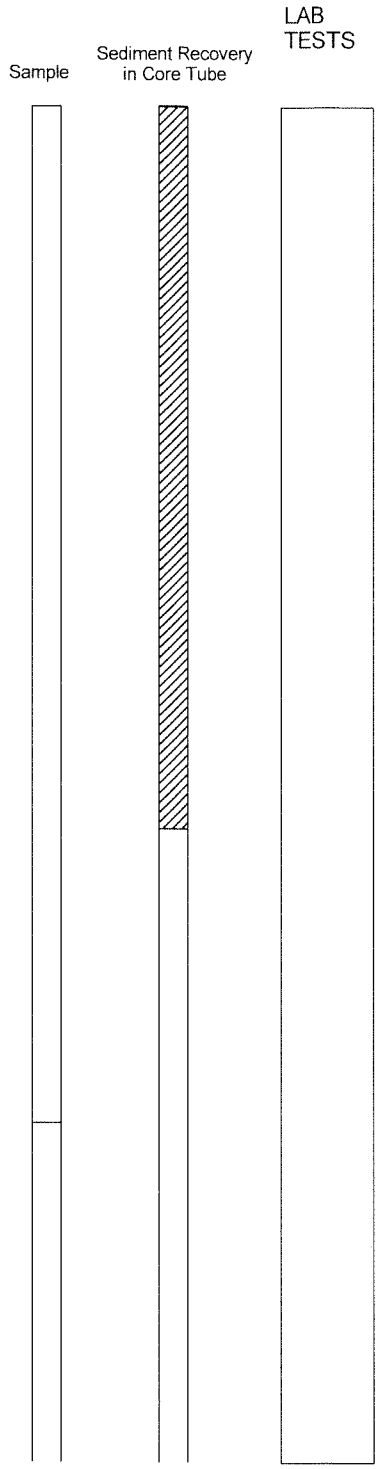
Figure A-15

Vibracore Log LL-15

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 4.3 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1002429.9
Easting: 2347093.4
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, and no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
			5
ML		Clayey, sandy SILT.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet.	
		Drive Length: 7.5 feet; Recovery Length: 5.35 feet.	
		Date/Time: 09/9/08 11:30	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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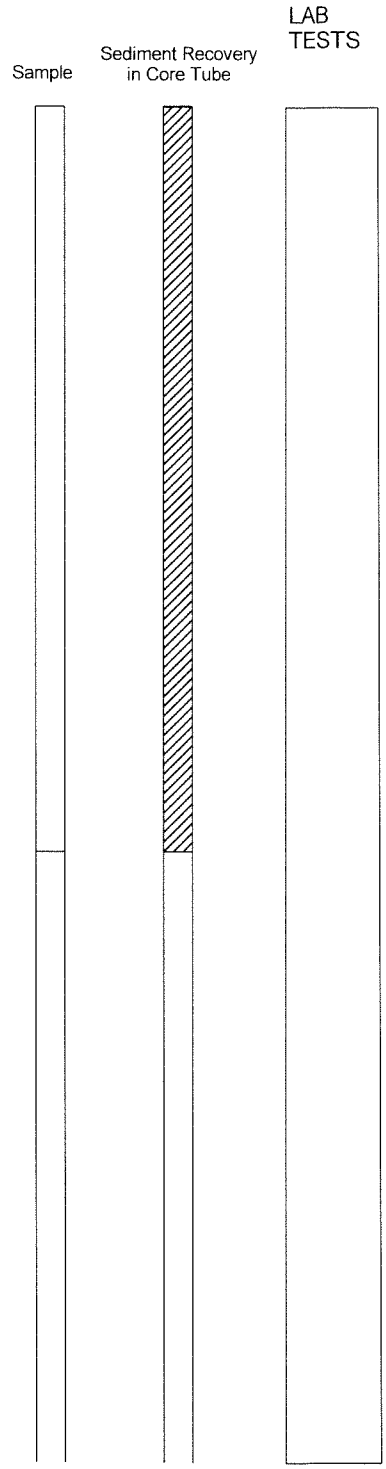
Figure A-16

Piston Core Log LL-16

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 5 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1001609.3
Easting: 2347723.6
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, decaying organic material (stems, leaves, roots), and no evident wood debris (sawdust, wood chips).	0
			5
ML		(Stiff), wet, light gray, clayey SILT with no organic material.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 5.5 Feet.	
		Drive Length: 5.5 feet; Recovery Length: 5.45 feet.	
		Date/Time: 09/9/08 13:25	
			10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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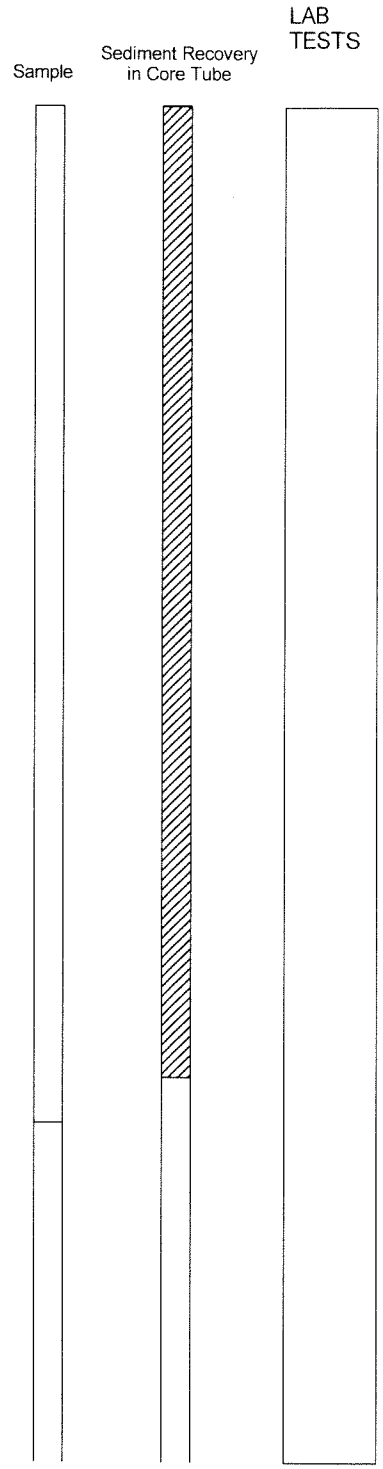
Figure A-17

Vibracore Log LL-17

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 3.3 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1000334.3
Easting: 2348100.2
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, PEAT with high organic content, sulfide-like odor, and no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
ML		(Soft), wet, medium gray, sandy SILT with lenses of coarse Sand.	
ML		(Stiff), wet, light gray, sandy SILT with lenses of silty Clay (medium plasticity).	5
SM		(Dense), wet, light tan, slightly gravelly, silty SAND.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet.	
		Drive Length: 7.5 feet; Recovery Length: 7.2 feet.	
		Date/Time: 09/9/08 13:55	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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17453-00 9/08

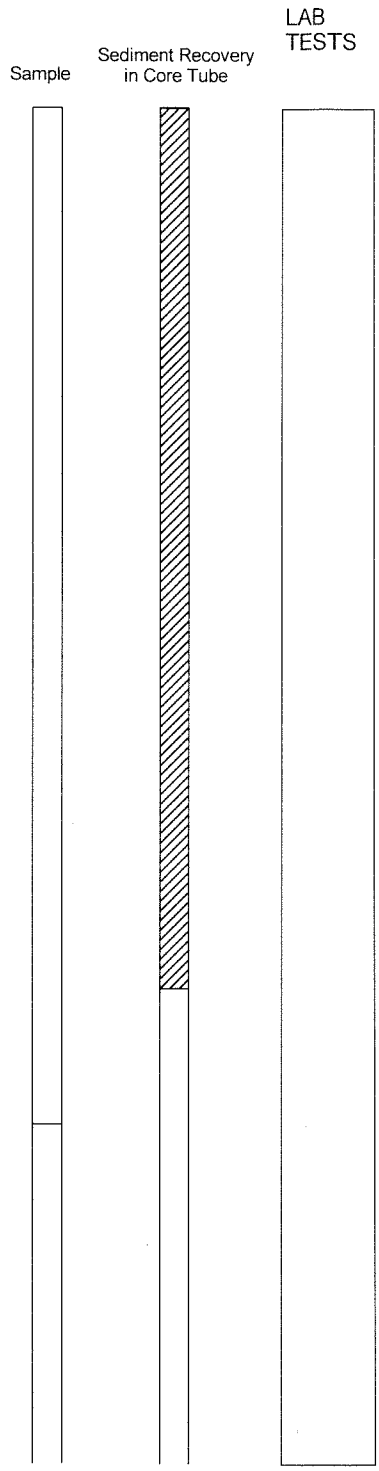
Figure A-18

Vibracore Log LL-18

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 5.9 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 999554.1
Easting: 2347663.3
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, air bubbles, and no evident wood debris (sawdust, wood chips).	0
ML		(Stiff), wet, light gray-tan, clayey SILT with organic material.	
SM		(Dense), wet, light gray-white, silty, coarse SAND.	5
GP		Sandy GRAVEL up to 2 inches with 4-inch cobbles.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 6.5 feet. Date/Time: 09/9/08 14:30	10



VIBROCORE LOG 174530PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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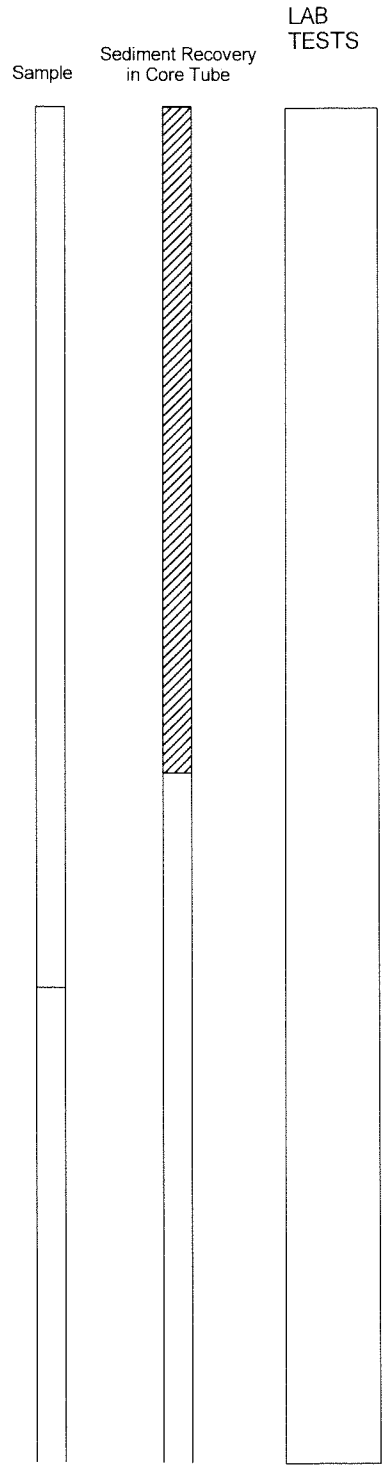
Figure A-19

Vibracore Log LL-19

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 23.8 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 998343.8
Easting: 2348032.8
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Soft), wet PEAT.	0
ML		Benthic organisms (1-mm) swimming at top of sample.	
		(Stiff), wet, light brown, clayey SILT.	
OL		(Soft), wet, light brown, organic SILT.	
PT		(Stiff), wet, medium brown, well-compacted PEAT with high content of organic material, sulfide-like odor, and no evident wood debris (sawdust, wood chips).	
SM		(Dense), wet, light to dark gray, slightly gravelly, silty SAND.	
		Bottom of Sediment in Core Tube.	5
		Bottom of Core Tube at 6.5 Feet. Drive Length: 6.5 feet; Recovery Length: 4.9 feet. Date/Time: 09/9/08 15:25	10



VIBROCORE LOG 174530PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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17453-00 9/08

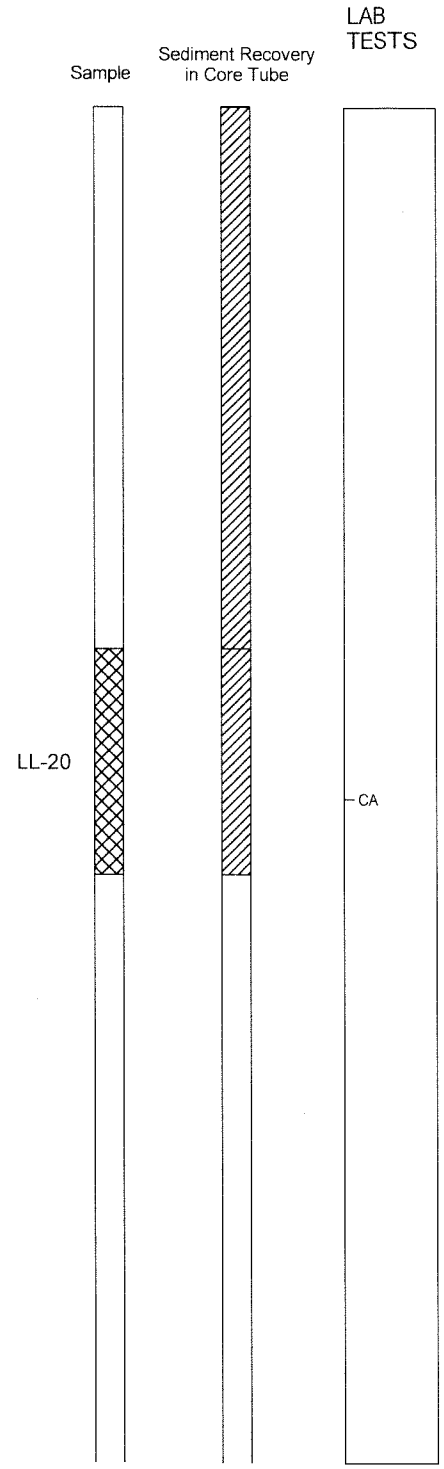
Figure A-20

Piston Core Log LL-20

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 2.8 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1005701.7
Easting: 2345040.9
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, air bubbles, 2-foot wood stick (1/4-inch diameter), and fibrous material, highly degraded.	0
			5
SM		Dense, wet, light tan, sandy SILT.	
		Bottom of Sediment in Core Tube. Bottom of Core Tube at 5.7 Feet.	
		Drive Length: 5.7 feet; Recovery Length: 5.7 feet.	
		Date/Time: 09/10/08 10:00	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-21

Vibracore Log LL-21

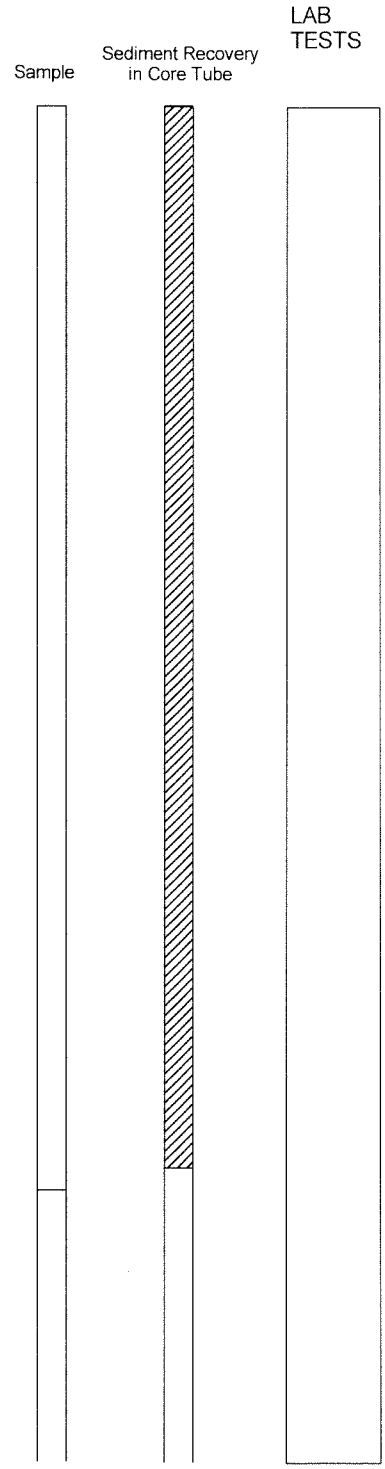
Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 23.8 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 1004525
Easting: 2343615
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, fibrous material with decaying stems and leaves, and no evident wood debris (sawdust, wood chips).	0
SM		(Dense), wet, light tan, sandy SILT with organic material.	
PT		(Stiff), wet, medium brown PEAT with high organic content and sulfide-lide odor, fibrous material with roots, stems, leaves, layers of darker brown PEAT.	5
OL		(Medium stiff to stiff), wet, brown to light brown to tan, highly organic CLAY with low plasticity, and sulfur-like odor.	
SM		(Dense), wet, gray-white, silty SAND.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 8.0 Feet.	10

Drive Length: 8 feet; Recovery Length: 7.8 feet.

Date/Time: 09/10/08 14:40



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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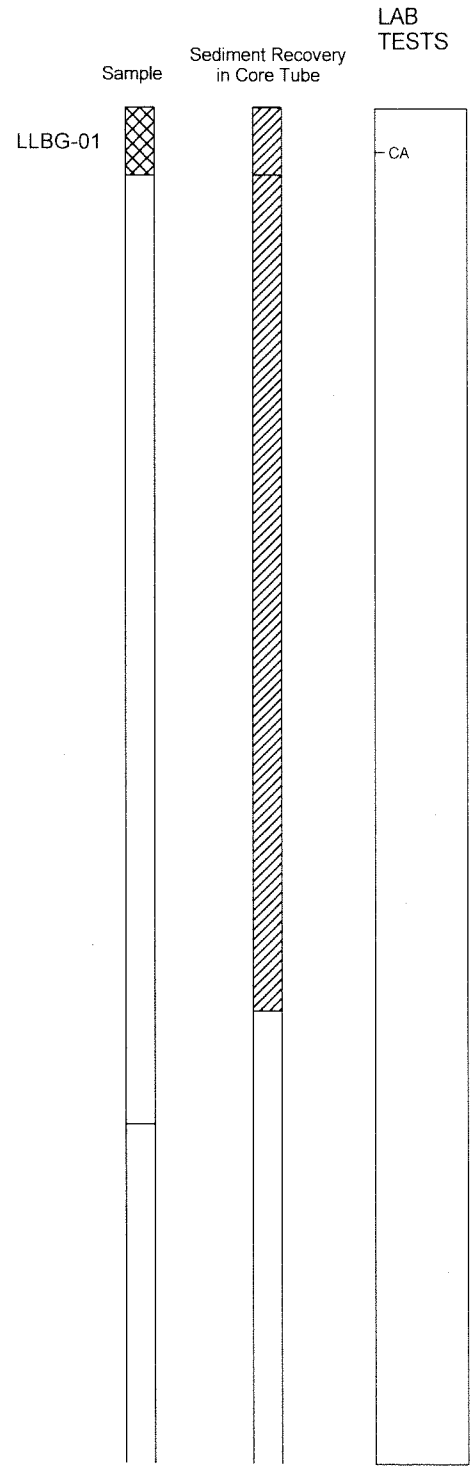
Figure A-22

Piston Core Log LLBG-01

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 5.35 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004991.5
Easting: 2339292.6
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, air bubbles, fibrous, decaying leaves, stems, and roots, and no evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 6.7 feet. Date/Time: 09/10/08 12:45	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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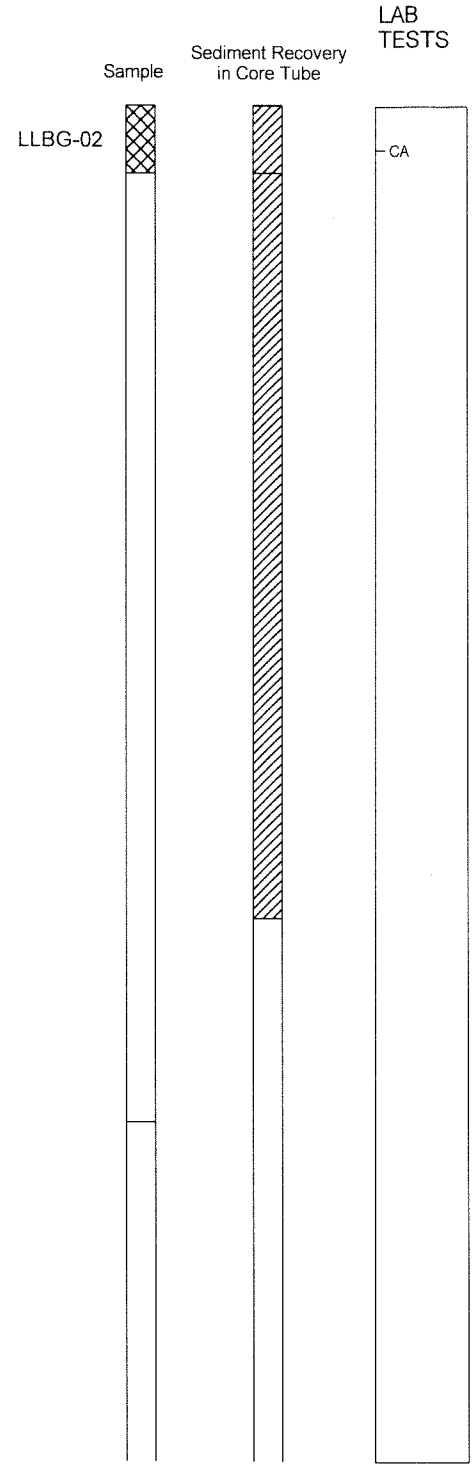
Figure A-23

Piston Core Log LLBG-02

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 15.5 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1004525.6
Easting: 2343622.2
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content, sulfide-like odor, fibrous material, decaying plant stems, leaves, and roots, and air bubbles, and evident wood debris (sawdust, wood chips).	0
			5
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 7.5 Feet. Drive Length: 7.5 feet; Recovery Length: 6.0 feet. Date/Time: 09/10/08 16:00	10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-24

Piston Core Log LLBG-03

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 30 Feet

Type of Sample: Piston Core
Core Diameter: 3 inches
Northing: 1000191.9
Easting: 2343256.7
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet	Sample	Sediment Recovery in Core Tube	LAB TESTS
OL		(Soft), wet, sandy SILT with moderate organic content, black mica fines at surface, with slight plasticity, and no evident wood debris (sawdust, wood chips).	0			
		Bottom of Sediment in Core Tube.				
		Bottom of Core Tube at 3.0 Feet. Drive Length: 3.0 feet; Recovery Length: 2.0 feet. Date/Time: 09/10/08 16:55	5 10			

VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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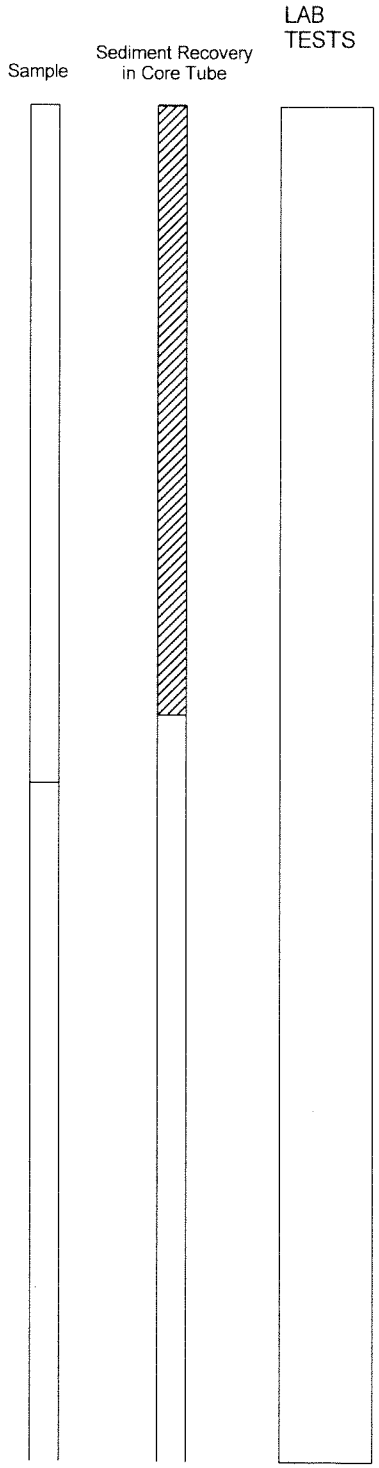
Figure A-25

Vibracore Log LLBG-04

Location: See Figure 2.
Mudline Elevation in Feet (MLLW): NA Feet
Water Depth in Feet: 5.1 Feet

Type of Sample: Vibracore
Core Diameter: 4 inches
Northing: 997312.9
Easting: 2345301.5
Logged By: C. Rust Reviewed By: G. Both

USCS Class	Graphic Log	Soil Descriptions	Depth in Feet
PT		(Very soft to soft), wet, light brown PEAT with high organic content and sulfide-like odor and no evident wood debris (sawdust, wood chips). Benthic organisms (1-mm) swimming at top of sample.	0
ML		(Stiff), wet, light tan, clayey SILT.	
		Bottom of Sediment in Core Tube.	
		Bottom of Core Tube at 5.0 Feet.	5
		Drive Length: 5 feet; Recovery Length: 4.5 feet.	
		Date/Time: 09/9/08 15:45	
			10



VIBROCORE LOG 1745300PP.GPJ HC_CORP.GDT 12/23/08

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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Figure A-26

APPENDIX B
CHEMICAL DATA QUALITY REVIEW AND CERTIFICATES OF ANALYSIS

APPENDIX B
CHEMICAL DATA QUALITY REVIEW AND CERTIFICATES OF ANALYSIS

Chemical Data Quality Review

One sediment sample was collected from Loon Lake on September 8, 2008. Seven sediment samples were collected from Loon Lake on September 10, 2008. Six sediment samples were collected from Loon Lake on September 11, 2008. The samples were submitted to Analytical Resources, Inc. (ARI) for analysis. The samples were analyzed for total organic carbon (TOC), sulfide, grain size, total solids, total preserved solids, total volatile solids (TVS), nitrate and nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, and biological oxygen demand (BOD). Sample volume for bioassays and Microtox were also collected, but the tests were not performed. The laboratory reported results as Sample Delivery Group (SDG) NP00.

Quality assurance/quality control (QA/QC) reviews of laboratory procedures were performed on an ongoing basis by the laboratory. Hart Crowser performed the data review, using laboratory quality control results summary sheets and raw data, as required, to ensure they met data quality objectives for the project. Data review followed the format outlined in the National Functional Guidelines for Inorganic Data Review (EPA 2004) modified to include specific criteria of the individual analytical methods. The following criteria were evaluated in the standard data quality review process:

- Holding times;
- Method blanks;
- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries;
- Laboratory duplicate relative percent differences (RPDs); and
- Reporting limits.

The data were determined to be acceptable for use, as qualified. Full laboratory results are presented at the end of this appendix. Results of the data reviews, organized by analysis class, follow.

Total Solids and Total Preserved Solids

Total solids and total preserved solids were determined following EPA Method 160.3 modified. Reported detection limits were acceptable. The samples were prepared within the holding time limits of 14 days. No target analytes were

detected in laboratory blanks. The RPD between replicate measurements met quality control limits.

Total Volatile Solids (TVS)

Total volatile solids were determined following EPA Method 160.4. The samples were prepared within holding time limits of 7 days. Reported detection limits were acceptable. No target analytes were detected in laboratory blanks. The RPD between replicate measurements met quality control limits.

Nitrate and Nitrite

The samples were extracted using 2N KCl. Nitrate and nitrite were then determined following EPA Method 353.2. The samples were prepared and analyzed within holding time limits of 28 days. Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. No target analytes were detected in laboratory blanks. MS and SRM recoveries were within QC limits. The sample and duplicate were non-detect at the reporting limit. RPD results, therefore, were not applicable.

Total Kjeldahl Nitrogen (TKN)

TKN was determined following EPA Method 351.4. The samples were prepared and analyzed within holding time limits of 28 days. Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. No target analytes were detected in laboratory blanks. LCS and MS recoveries were within QC limits. The RPD between replicate measurements met quality control limits. The Standard Reference Material (SRM) recovery was within QC limits.

Total Phosphorus

Total phosphorus was determined following EPA Method 365.2. The samples were prepared and analyzed within holding time limits of 28 days. Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. MS and SRM recoveries met QC limits.

Total phosphorus was detected in the method blank above the reporting limit. The samples had concentrations of total phosphorus greater than 5 times the amount present in the blank, and no corrective action was taken.

The RPD between replicate measurements exceeded 50 percent. The results for sample LLBG-01 were qualified as estimated (J).

Total Sulfide

Total sulfide was determined following EPA Method 376.2. The samples were prepared and analyzed within holding time limits of 7 days. Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. No target analytes were detected in laboratory blanks. LCS and MS recoveries were within QC limits. The sample and duplicate were non-detect at the reporting limit. RPD results were not applicable.

Biological Oxygen Demand (BOD)

BOD was determined following EPA Method 405.1. The samples were prepared within holding time limits of 7 days. No target analytes were detected in laboratory blanks. LCS recovery was within QC limits.

Reporting limits were elevated as no sample dilution passed the dissolved oxygen depletion criteria of at least 2 mg/L. However, review of the laboratory data indicated that some estimated BOD results were available. These results are reported in the associated table and qualified as estimated (J).

Total Organic Carbon (TOC)

TOC was determined following Plumb (1981). The samples were prepared and analyzed within holding time limits of 28 days. Reported detection limits and analytical results were adjusted for moisture content and any required dilution factors. No target analytes were detected in laboratory blanks. LCS, MS, and SRM recoveries were within QC limits. The RPD between replicate measurements met quality control limits.

J:\Jobs\1745300\Final Loon Lake Investigation Report.doc

CERTIFICATES OF ANALYSIS
ANALYTICAL RESOURCES, INC.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

December 13, 2008

Mr. Roger McGinnis
Hart Crowser, Inc.
1700 Westlake Avenue North Suite 200
Seattle, WA 98109-3056

RE: Project: LOON LAKE, 17453
ARI Job No: NP00

Dear Mr. McGinnis:

Please find enclosed the original Chain-of-Custody record, sample receipt documentation, and the final data package for the samples from the project referenced above.

The samples were analyzed for TOC, Grain Size, BOD, Total Sulfide, Total Phosphorus, Nitrite plus Nitrate, TVS, TS and Total Kjeldahl, as requested.

Sample receipt and details of these analyses are discussed in the Case Narrative.

An electronic copy of this data package and the supporting data will remain on file with ARI. If you have any questions or require additional information, please contact me at your convenience.

Respectfully,
ANALYTICAL RESOURCES, INC.

Kelly Bottem
Client Services Manager
206-695-6211
kellyb@arilabs.com
www.arilabs.com

Enclosures

cc: files NP00

Chain of Custody
Documentation

prepared
for

HART CROWSER, INC.

Project: LOON LAKE, 17453-00

ARI JOB NO: NP00

prepared
by

Analytical Resources, Inc.

Sample Custody Record NPØØ

1 of 2

Samples Shipped to: ARI

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB 17453-00 LAB NUMBER

PROJECT NAME LOON LAKE

HART CROWSER CONTACT R. McGINNIS, A. CONRAD, C. RUST

SAMPLED BY: AMC/CFR

REQUESTED ANALYSIS

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	MICROTOX	TOC	TOTAL SOLIDS	TVS	TKN	NO_2 + NO_3	PHOSPHORUS	GRAIN SIZE	TOTAL SULFIDE	BOD				NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	LLBG-01		9/10/08	1350	SED	X	X	X	X	X	X	X		X	X				4	
	LLBG-02		9/10/08	1600	SED		X	X	X	X	X	X		X	X				~~4~~ 3	
	LLBG-03		9/10/08	1640	SED	X													4	
	LLBG-04	GRAB	9/10/08	1740	SED	X							X						5	
	LL-04		9/10/08	1120	SED														4	
	LL-06		9/10/08	1215	SED														4	
	LL-20		9/10/08	1050	SED														4	
	LL-08		9/8/08	1500	SED														4	
	LL-14	GRAB	9/11/08	1600	SED	X													5	
	LL-20	GRAB	9/11/08	1130	SED	X													5	
	LL-09	GRAB	9/11/08	1810	SED	X													5	TOTAL SULFIDE NEEDS PRESERVING
	LL-07	GRAB	9/11/08	1700	SED	X													5	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/12/08	SIGNATURE	9/12/08
PRINT NAME Sonia Fernandez	TIME	PRINT NAME Jonathon Walter	TIME
COMPANY Hart Crowser, Inc.	1755	COMPANY ARI	1755

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS: FREEZE EXTRA SAMPLE VOLUME

52 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☐YES ☐NO ☐N/A
GOOD CONDITION ☐YES ☐NO
TEMPERATURE
SHIPMENT METHOD: ☐HAND ☐COURIER ☐OVERNIGHT

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No. for Other Contract Requirements

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☒ STANDARD
☐ 72 HOURS OTHER

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

Sample Custody Record

2 of 2

Samples Shipped to: ARI

HARTCROWSER

Hart Crowser, Inc.
1910 Fairview Avenue East
Seattle, Washington 98102-3699
Phone: 206-324-9530 FAX: 206-328-5581

JOB 17453-00 LAB NUMBER

PROJECT NAME LOON LAKE

HART CROWSER CONTACT R. McGINNIS

A. CONRAD, C. RUST

SAMPLED BY: AMC/CFR/SF

LAB NO.	SAMPLE ID	DESCRIPTION	DATE	TIME	MATRIX	MICROTOX	TOC	TOTAL SOLIDS	TVS	TKN	NO_3+NO_3	PHOSPHORUS	GRAIN SIZE	TOTAL SULFIDES	BOD				NO. OF CONTAINERS	OBSERVATIONS/COMMENTS/ COMPOSITING INSTRUCTIONS
	~~LL-19 GRAB~~		~~9/11/08~~	~~1600~~	~~SED~~															
	LL-06-01 GRAB		9/11/08	0917	SED								X						1	
	LL-06 GRAB		9/11/08	1013	SED	X	X	X	X	X	X	X	X	X	X				5	
	LL-05 GRAB		9/11/08	1100	SED	X	X	X	X	X	X	X	X	X	X				5	

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE	9/12/08	SIGNATURE	9/12/08
PRINT NAME Sonia Fernandez	TIME	PRINT NAME Jonathan Walter	TIME
COMPANY Hart Crowser	1755	COMPANY ARI	1755

RELINQUISHED BY	DATE	RECEIVED BY	DATE
SIGNATURE		SIGNATURE	
PRINT NAME	TIME	PRINT NAME	TIME
COMPANY		COMPANY	

SPECIAL SHIPMENT HANDLING OR STORAGE REQUIREMENTS:
FREEZE EXTRA SAMPLE VOLUME

11 TOTAL NUMBER OF CONTAINERS

SAMPLE RECEIPT INFORMATION
CUSTODY SEALS: ☐YES ☐NO ☐N/A
GOOD CONDITION ☐YES ☐NO
TEMPERATURE
SHIPMENT METHOD: ☐HAND ☐COURIER ☐OVERNIGHT

COOLER NO.: STORAGE LOCATION:

See Lab Work Order No.
for Other Contract Requirements

TURNAROUND TIME:
☐ 24 HOURS ☐ 1 WEEK
☐ 48 HOURS ☒ STANDARD
☐ 72 HOURS OTHER

White and Yellow Copies to Lab Pink to Project Manager Lab to Return White Copy to Hart Crowser Gold to Sample Custodian

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Cooler Receipt Form

ARI Client: Hart Crowser
COC No:
Assigned ARI Job No: NPØØ

Project Name: Loon Lake
Delivered by: hand
Tracking No: —

Preliminary Examination Phase:

Were intact, properly signed and dated custody seals attached to the outside of to cooler? YES (NO)
Were custody papers included with the cooler? ..... (YES) NO
Were custody papers properly filled out (ink, signed, etc.) ..... (YES) NO
Record cooler temperature (recommended 2.0-6.0 °C for chemistry ..... 6.6, 3, 0, 4.6 °C

Cooler Accepted by: JW Date: 9/12/08 Time: 1755

Complete custody forms and attach all shipping documents

Log-In Phase:

Was a temperature blank included in the cooler? ..... YES (NO)
What kind of packing material was used? ..... Bw
Was sufficient ice used (if appropriate)? ..... (YES) NO
Were all bottles sealed in individual plastic bags? ..... (YES) NO
Did all bottle arrive in good condition (unbroken)? ..... (YES) NO
Were all bottle labels complete and legible? ..... (YES) NO
Did all bottle labels and tags agree with custody papers? ..... (YES) NO
Were all bottles used correct for the requested analyses? ..... (YES) NO
Do any of the analyses (bottles) require preservation? (attach preservation checklist) ..... YES (NO)
Were all VOC vials free of air bubbles? ..... (NA) YES NO
Was sufficient amount of sample sent in each bottle? ..... (YES) NO

Samples Logged by: [signature] Date: 9/15/08 Time: 0830

***** Notify Project Manager of discrepancies or concerns *****

Explain discrepancies or negative responses:

By: Date:

Case Narrative

prepared
for

HART CROWSER, INC.

Project: LOON LAKE, 17453-00

ARI JOB NO: NP00

prepared
by

Analytical Resources, Inc.

Case Narrative
Hart Crowser
LOON LAKE, 17453-00
ARI Job: NP00
December 13, 2008

Sample Receipt

Analytical Resources Inc. (ARI) accepted fifteen sediment samples in good condition on September 12, 2008 under the ARI job referenced above. The cooler temperatures measured by IR thermometer following ARI SOP were between 3.0 and 6.6°C and the samples were well iced. For more details regarding sample receipt, please refer to the Cooer Receipt Form.

Conventional Parameters:

All samples were prepared and analyzed within the method recommended holding times.

Method Blank (s): The total phosphorus method blank contained total phosphorus. All associated sample concentrations were greater then twenty times the concentration found in the method blank, therefore no further corrective action was taken. All other method blanks were free of contamination.

MS/ MSD(s): Are in control.

Replicate(s): The sample duplicate RPD for total phosphorus on sample LLBG-01 is outside of the +/- control limit. The phosphorus matrix spike recoveries and all other sample replicate RPD/RSDs were within control limits. No other corrective action was taken.

LCS(s): All LCS percent recoveries were within control limits.

SRM(s): All SRM percent recoveries were within control limits.

Geotechnical Parameters:

A laboratory-specific Case Narrative follows.

Analytical Resources, Incorporated
Analytical Chemists and Consultants

Client: Hart Crowser, Inc.	Project No.: NP00
Client Project: 17453-00 Loon Lake	

Case Narrative

1. Fourteen samples were submitted for grain size analysis according to PSEP methodology.
2. The samples were run in a single batch, and a sample from another job was chosen for triplicate analysis. The triplicate data is reported on the QA summary.
3. Over half the samples did not contain the required 5 grams of fines in the pipette portion of the analysis. Our balance has a capacity of about 200 g (by 0.0001) and a sample that would give 5 g of fines could not be split and stay within the capacity of the balance.
4. All of the samples contained woody or other organic matter, which may have broken down during the sieving process, affecting grain size analysis.
5. The data is provided in summary tables and plots.
6. There were no other noted anomalies in this project.

Approved by: _____ Date: Dec. 12, 2008
Lead Technician

4611 South 134th Place, Suite 100 • Tukwila WA 98168 • **206-695-6200** • **206-695-6201** fax

Geotechnical Data

SM Sample matrix was not appropriate for the requested analysis. This normally refers to samples contaminated with an organic product that interferes with the sieving process and/or moisture content, porosity and saturation calculations

SS Sample did not contain the proportion of "fines" required to perform the pipette portion of the grain size analysis

W Weight of sample in some pipette aliquots was below the level required for accurate weighing

F Samples were frozen prior to particle size determination

Data Summary Package

prepared
for

HART CROWSER, INC.

Project: LOON LAKE, 17453-00

ARI JOB NO: NP00

prepared
by

Analytical Resources, Inc.

GENERAL CHEMISTRY

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LLBG-01
ARI ID: 08-23795 NP00A

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	7.50	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	6.60	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	39.41	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	5.99	< 5.99	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	735	14,100	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	21.3	401	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	15.3	< 15.3	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	5,260	< 5,260	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.212	16.7	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MP
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LLBG-02
ARI ID: 08-23796 NP00B

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	2.70	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	4.30	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	58.22	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	3.19	< 3.19	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	2,140	24,900	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	135	547	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	25.8	< 25.8	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	20,800	< 20,800	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.210	24.6	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LLBG-03
ARI ID: 08-23797 NP00C

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	16.40	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	16.60	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	13.27	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	5.51	< 5.51	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	295	6,100	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	69.7	1,070	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	119	555	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	2,970	< 2,970	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	5.31	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LLBG-04 GRAB
ARI ID: 08-23798 NP00D

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	8.90	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	13.10	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	32.21	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	5.11	< 5.11	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	688	12,200	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	19.1	398	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	7.35	< 7.35	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	5,910	< 5,910	U
Total Organic Carbon	10/18/08 101808#1	Plumb,1981	Percent	0.020	12.7	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LL-04
ARI ID: 08-23799 NP00E

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	5.40	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	6.60	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	51.18	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	1.81	< 1.81	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	1,010	18,500	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	47.8	335	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	14.5	< 14.5	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	9,420	< 9,420	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.186	28.4	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LL-06
ARI ID: 08-23800 NP00F

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	8.00	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	9.10	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	40.50	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	1.12	< 1.12	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	687	19,300	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	21.7	348	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	10.7	< 10.7	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	6,820	< 6,820	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	15.7	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Client ID: LL-20
ARI ID: 08-23801 NP00G

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	13.10	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	13.70	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	30.73	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	3.64	< 3.64	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	387	11,900	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	21.8	234	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	7.11	< 7.11	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	3,470	< 3,470	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	8.08	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/08/08
Date Received: 09/12/08

Client ID: LL-08
ARI ID: 08-23802 NP00H

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	9.60	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	10.30	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	39.52	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	0.94	< 0.94	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	643	17,000	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	29.8	251	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	9.56	< 9.56	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	5,340	< 5,340	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	15.5	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-14 GRAB
ARI ID: 08-23803 NP00I

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	7.70	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	9.20	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	32.52	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	5.97	< 5.97	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	744	15,100	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	30.6	598	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	10.7	38.4	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	6,660	< 6,660	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	15.3	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-20 GRAB
ARI ID: 08-23804 NP00J

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	7.60	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	11.20	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	30.66	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	6.56	< 6.56	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	873	14,700	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	26.3	510	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	8.44	26.7	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	7,660	< 7,660	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	6.38	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-09 GRAB
ARI ID: 08-23805 NP00K

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/16/08 091608#1	EPA 160.3	Percent	0.01	6.50	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	7.20	
Total Volatile Solids	09/16/08 091608#1	EPA 160.4	Percent	0.01	39.90	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	7.27	< 7.27	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	974	15,800	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	24.1	564	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	13.1	14.2	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	6,640	< 6,640	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	9.76	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-07 GRAB
ARI ID: 08-23806 NP00L

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	10.20	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	6.80	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	28.03	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	4.38	< 4.38	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	429	11,700	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	12.7	519	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	14.3	< 14.3	U
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	3,770	< 3,770	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.020	11.3	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-06 GRAB
ARI ID: 08-23808 NP00N

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	5.50	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	5.90	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	49.39	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	1.67	< 1.67	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	770	18,500	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	28.5	553	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	16.5	36.3	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	7,320	< 7,320	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.202	23.6	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

SAMPLE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/11/08
Date Received: 09/12/08

Client ID: LL-05 GRAB
ARI ID: 08-23809 NP00O

Analyte	Date	Method	Units	RL	Sample	
Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	5.80	
Preserved Total Solids	09/15/08 091508#1	EPA 160.3	Percent	0.01	6.10	
Total Volatile Solids	09/15/08 091508#1	EPA 160.4	Percent	0.01	43.48	
Nitrate + Nitrite (NO3+NO2)	09/16/08 091608#1	EPA 353.2	mg-N/kg	8.37	< 8.37	U
Total Kjeldahl Nitrogen	09/26/08 092608#1	EPA 351.4	mg-N/kg	1,010	16,700	
Total Phosphorus	09/16/08 091608#1	EPA 365.2	mg/kg	23.0	404	
Sulfide	09/15/08 091508#1	EPA 376.2	mg/kg	16.0	83.7	
Biological Oxygen Demand	09/15/08	EPA 405.1	mg/kg	10,100	< 10,100	U
Total Organic Carbon	10/20/08 102008#1	Plumb,1981	Percent	0.200	18.8	

RL Analytical reporting limit
U Undetected at reported detection limit

NO2+NO3 determined on 2N KCl extracts.

METHOD BLANK RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: NA
Date Received: NA

Analyte	Date	Units	Blank
Total Solids	09/15/08	Percent	< 0.01 U
	09/15/08		< 0.01 U
	09/15/08		< 0.01 U
	09/16/08		< 0.01 U
Preserved Total Solids	09/15/08	Percent	< 0.01 U
Total Volatile Solids	09/15/08	Percent	< 0.01 U
	09/16/08		< 0.01 U
Nitrate + Nitrite (NO3+NO2)	09/16/08	mg-N/kg	< 0.10 U
Total Kjeldahl Nitrogen	09/26/08	mg-N/kg	< 75.0 U
Total Phosphorus	09/16/08	mg/kg	4.80
Sulfide	09/15/08	mg/kg	< 1.00 U
Biological Oxygen Demand	09/15/08	mg/kg	< 2.00 U
	09/15/08		< 2.00 U
Total Organic Carbon	10/18/08	Percent	< 0.020 U
	10/20/08		< 0.020 U

LAB CONTROL RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: NA
Date Received: NA

Analyte	Date	Units	LCS	Spike Added	Recovery
Total Kjeldahl Nitrogen	09/26/08	mg-N/kg	4.4	5.0	88.0%
Sulfide	09/15/08	mg/kg	141	136	103.8%
Biological Oxygen Deman	09/15/08	mg/kg	181	198	91.4%
	09/15/08		160	198	80.8%
Total Organic Carbon	10/18/08	Percent	0.492	0.500	98.4%
	10/20/08		0.463	0.500	92.6%

STANDARD REFERENCE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: MB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: NA
Date Received: NA

Analyte/SRM ID	Date	Units	SRM	True Value	Recovery
Nitrate + Nitrite (NO3+NO2) ERA #20034	09/16/08	mg-N/kg	95.5	100	95.5%
Total Kjeldahl Nitrogen ERA #02065	09/26/08	mg-N/kg	9.7	10.0	97.0%
Total Phosphorus ERA #35064.1	09/16/08	mg/kg	4.64	5.00	92.8%
	09/16/08		39.0	50.0	78.0%
Total Organic Carbon NIST #8704	10/18/08	Percent	3.58	3.35	106.9%
	10/20/08		3.09	3.35	92.2%

REPLICATE RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized:
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Analyte	Date	Units	Sample	Replicate(s)	RPD/RSD
ARI ID: NP00A Client ID: LLBG-01					
Total Solids	09/15/08	Percent	7.50	7.40 7.40	0.8%
Total Volatile Solids	09/15/08	Percent	39.41	40.53 39.36	1.7%
Nitrate + Nitrite (NO3+NO2)	09/16/08	mg-N/kg	< 5.99	< 6.63 < 6.35	NA
Total Kjeldahl Nitrogen	09/26/08	mg-N/kg	14,100	14,400	2.1%
Total Phosphorus	09/16/08	mg/kg	401	182	75.1%
Total Organic Carbon	10/20/08	Percent	16.7	16.8 14.5	8.1%
ARI ID: NP00B Client ID: LLBG-02					
Preserved Total Solids	09/15/08	Percent	4.30	4.30 4.20	1.4%
Sulfide	09/15/08	mg/kg	< 25.8	< 23.3	NA
ARI ID: NP00K Client ID: LL-09 GRAB					
Total Solids	09/16/08	Percent	6.50	6.50 6.60	0.9%
Total Volatile Solids	09/16/08	Percent	39.90	39.94 40.93	1.4%

MS/MSD RESULTS-CONVENTIONALS
NP00-Hart Crowser, Inc.

ANALYTICAL RESOURCES INCORPORATED

Matrix: Sediment
Data Release Authorized: NB
Reported: 11/10/08

Project: Loon Lake
Event: 17453-00
Date Sampled: 09/10/08
Date Received: 09/12/08

Analyte	Date	Units	Sample	Spike	Spike Added	Recovery
ARI ID: NP00A Client ID: LLBG-01						
Nitrate + Nitrite (NO3+NO2)	09/16/08	mg-N/kg	< 5.99	1,070	1,250	85.9%
Total Kjeldahl Nitrogen	09/26/08	mg-N/kg	14,100	26,100	14,100	85.0%
Total Phosphorus	09/16/08	mg/kg	401	19,700	25,600	75.3%
Total Organic Carbon	10/20/08	Percent	16.7	30.4	13.1	105.0%
ARI ID: NP00B Client ID: LLBG-02						
Sulfide	09/15/08	mg/kg	< 25.8	2,950	3,050	96.7%

Sediment Biochemical Oxygen Demand (5-day BOD)

*BOD (mg/kg dry wt) = (Corr Deplete * bottle volume) / (grams sediment * %solids)*

Analyst: MAP
Start date 9/15/08 14:45
Pull date *09/20/08* elapsed (days)
Stop date

Reagents

Seed Source: 200802-1-0414-44

Nutrients	HACH Pillow Lot A8135
FeCl3	
Phosphate Buffer	
MgSO4	
CaCl2	

Sugar Check Solution
Source: in house (150 mg each/liter)
(2%, 300 mg/L Glucose Glutamic acid)
BOD = **198** ± 30.5 mg/L

CALIBRATION

	TEMP	ZERO	CAL	Barometric Pressure (mbar)
DAY 0	22.9	0.02	8.65	1020
DAY 5	22.6	0.01	8.71	1021

SAMPLE NUMBER	pH	BOTTLE NUMBER	SAMPLE VOLUME (mL)	DO (mg/L) Initial	DO (mg/L) 5-day	DEPLETE (mg/L)	SEED CORRECT	CORR DEPLETE	DILUTION FACTOR	BOD (mg/l)	Avg BOD (mg/l)	Corrected for pre-dilution
Pre-dilution factor												
DILUTION WATER	Initial°C		300	**OK**					*initial DO saturation should be*		*u factor*	DOsat
(DI + nutrients)	22.2	20C		8.50	9.21	-0.71	*doi*		*8.63*	*OK*	*1.74*	8.63
		13NE		8.62	9.41	-0.79	*8.56*		*8.68*	*OK*	*1.74*	8.68
SEED CONTROL 1			5	**OK**			*mg/L/mL*	*mg/L/mL*				
		49		8.32	7.38	0.94	0.181				Seed Correction	mL seed per sample
		13		8.54	7.67	0.87	*range*					
SEED CONTROL 2			10	**OK**			*mg/L/mL*	*mg/L/mL*	average =	0.266	**0.80**	**3**
		55		8.48	5.77	2.71	0.266	0.271				
		326		8.58	5.97	2.61	*OK !*	0.261				
SUGAR CHECK			6	**OK**							**181**	91.3%
2% Glucose / Glutamic acid		16		8.63	3.90	4.73	0.80	3.93	50.0	197	*OK!*	
Conc (mg/L) =	198	28		8.56	4.46	4.10	0.80	3.30	50.0	165		
Method Blank			300								**blank check**	
Entry of Dilution Water Data				8.50	9.21	-0.71		-0.71	1.0	-0.71	*-0.75*	
Pre-dilution factor =	1			8.62	9.41	-0.79		-0.79	1.0	-0.79	*OK*	

SAMPLE NUMBER	BOTTLE NUMBER	SAMPLE WEIGHT (grams)	DO (mg/L) Initial	DO (mg/L) 5-day	DEPLETE (mg/L)	SEED CORRECT	CORR DEPLETE	Bottle Volume (mL)	5-day BOD (mg/kg)	Evaluation	Avg BOD mg/kg
NP00 A2	09-01	0.18	8.56	8.28	0.28	0.80	-0.52	300	-11,511	depletion <2	< 3163
% Solids = 8%	09-02	0.67	8.56	8.53	0.03	0.80	-0.77	300	-4,585	depletion <2	all <2mg/L
LLBG-01	09-03	1.52	8.56	8.19	0.37	0.80	-0.43	300	-1,126	depletion <2	
IDOD	*09-04*	*0.71*	*8.56*	8.66	-0.10			*300*	*< 5634*	*IDOD <1*	
NP00 B2	09-05	0.26	8.56	8.28	0.28	0.80	-0.52	300	-22,137	depletion <2	< 12482
% Solids = 3%	09-06	0.58	8.56	8.47	0.09	0.80	-0.71	300	-13,563	depletion <2	all <2mg/L
LLBG-02	09-07	1.07	8.56	8.57	-0.01	0.80	-0.81	300	-8,390	depletion <2	
IDOD	*09-08*	*0.53*	*8.56*	8.75	-0.19			*300*	*< 20964*	*IDOD <1*	

SAMPLE NUMBER	% Solids =	BOTTLE NUMBER	SAMPLE WEIGHT (grams)	DO (mg/L) Initial	DO (mg/L) 5-day	DEPLETE (mg/L)	SEED CORRECT	CORR DEPLETE	Bottle Volume (mL)	5-day BOD (mg/kg)	Evaluation	Avg BOD mg/kg
NP00 C2		09-09	0.13	8.56	9.01	-0.45	0.80	-1.25	300	-17,561	depletion <2	< 1788
	% Solids = 16%	09-10	0.50	8.56	8.36	0.20	0.80	-0.60	300	-2,188	depletion <2	all <2mg/L
LLBG-03		09-11	1.23	8.56	6.69	1.87	0.80	1.07	300	**1,594**	depletion <2	
	IDOD	*09-12*	*0.46*	*8.56*	8.61	-0.05			*300*	*< 3977*	*IDOD <1*	
NP00 D2		09-13	0.09	8.56	8.43	0.13	0.80	-0.67	300	-25,019	depletion <2	< 3554
	% Solids = 9%	09-14	0.58	8.56	8.22	0.34	0.80	-0.46	300	-2,662	depletion <2	all <2mg/L
LLBG-04 grab		09-15	1.14	8.56	8.03	0.53	0.80	-0.27	300	-792	depletion <2	
	IDOD	*09-16*	*0.50*	*8.56*	8.79	-0.23			*300*	*< 6742*	*IDOD <1*	
NP00 E2		09-17	0.11	8.56	8.24	0.32	0.80	-0.48	300	-24,141	depletion <2	< 5659
	% Solids = 5%	09-18	0.47	8.56	8.50	0.06	0.80	-0.74	300	-8,723	depletion <2	all <2mg/L
LL-04		09-19	1.18	8.56	8.47	0.09	0.80	-0.71	300	-3,333	depletion <2	
	IDOD	*09-20*	*0.57*	*8.56*	8.76	-0.20			*300*	*< 9747*	*IDOD <1*	
NP00 F2		09-21	0.10	8.56	8.37	0.19	0.80	-0.61	300	-22,800	depletion <2	< 4098
	% Solids = 8%	09-22	0.51	8.56	8.46	0.10	0.80	-0.70	300	-5,132	depletion <2	all <2mg/L
LL-06		09-23	1.10	8.56	8.32	0.24	0.80	-0.56	300	-1,902	depletion <2	
	IDOD	*09-24*	*0.83*	*8.56*	8.77	-0.21			*300*	*< 4518*	*IDOD <1*	
NP00 G2		1	0.21	8.56	8.20	0.36	0.80	-0.44	300	-4,776	depletion <2	< 2085
	% Solids = 13%	31	0.46	8.56	8.46	0.10	0.80	-0.70	300	-3,475	depletion <2	all <2mg/L
LL-20		44	1.32	8.56	8.13	0.43	0.80	-0.37	300	-638	depletion <2	
	IDOD	*333*	*0.76*	*8.56*	9.01	-0.45			*300*	*< 3013*	*IDOD <1*	
NP00 H2		10	0.18	8.56	8.18	0.38	0.80	-0.42	300	-7,257	depletion <2	< 3210
	% Solids = 10%	15	0.51	8.56	8.20	0.36	0.80	-0.44	300	-2,684	depletion <2	all <2mg/L
LL-08		110	1.17	8.56	8.17	0.39	0.80	-0.41	300	-1,090	depletion <2	
	IDOD	*316*	*1.01*	*8.56*	8.60	-0.04			*300*	*< 3094*	*IDOD <1*	
NP00 I2		11	0.23	8.56	8.10	0.46	0.80	-0.34	300	-5,726	depletion <2	< 4003
	% Solids = 8%	18	0.63	8.56	7.97	0.59	0.80	-0.21	300	-1,286	depletion <2	all <2mg/L
LL-14 grab		118	1.17	8.56	7.72	0.84	0.80	0.04	300	**140**	depletion <2	
	IDOD	*315*	*0.66*	*8.56*	8.46	0.10			*300*	*< 5903*	*IDOD <1*	

SAMPLE NUMBER	% Solids =	BOTTLE NUMBER	SAMPLE WEIGHT (grams)	DO (mg/L) Initial	DO (mg/L) 5-day	DEPLETE (mg/L)	SEED CORRECT	CORR DEPLETE	Bottle Volume (mL)	5-day BOD (mg/kg)	Evaluation	Avg BOD mg/kg
NP00 J2		5	0.12	8.56	7.84	0.72	0.80	-0.08	300	-2,566	depletion <2	< 4607
	% Solids = 8%	9	0.50	8.56	7.58	0.98	0.80	0.18	300	**1,437**	depletion <2	all <2mg/L
LL-20 grab		36	1.03	8.56	7.50	1.06	0.80	0.26	300	**1,004**	depletion <2	
	IDOD	*44*	*0.63*	*8.56*	8.46	0.10			*300*	*< 6266*	*IDOD <1*	
NP00 K2		72	0.23	8.56	8.03	0.53	0.80	-0.27	300	-3,427	depletion <2	< 2543
	% Solids = 10%	111K	0.59	8.56	7.77	0.79	0.80	-0.01	300	-40	depletion <2	all <2mg/L
LL-09 grab		321	1.39	8.56	7.39	1.17	0.80	0.37	300	**787**	depletion <2	
	IDOD	*330*	*0.89*	*8.56*	8.48	0.08			*300*	*< 3305*	*IDOD <1*	
NP00 L2		10	0.26	8.56	7.92	0.64	0.80	-0.16	300	-3,315	depletion <2	< 4203
	% Solids = 6%	25	0.80	8.56	7.68	0.88	0.80	0.08	300	559	depletion <2	all <2mg/L
LL-07 grab		35	1.56	8.56	6.86	1.70	0.80	0.90	300	**3,154**	depletion <2	
	IDOD	*40*	*1.66*	*8.56*	8.43	0.13			*300*	*< 3286*	*IDOD <1*	
NP00 N2		7	0.17	8.56	7.93	0.63	0.80	-0.17	300	-5,112	depletion <2	< 4173
	% Solids = 6%	16	0.61	8.56	8.01	0.55	0.80	-0.25	300	-2,103	depletion <2	all <2mg/L
LL-06 grab		48	1.49	8.56	7.28	1.28	0.80	0.48	300	**1,673**	depletion <2	
	IDOD	*322*	*1.35*	*8.56*	8.54	0.02			*300*	*< 3831*	*IDOD <1*	

GEOTECH

Hart Crowser, Inc.
17453-00 Loon Lake

Apparent Grain Size Distribution Summary
Percent Finer Than Indicated Size

Sample No.	Gravel			Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Silt				Clay	
Phi Size	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
Sieve Size (microns)	3/8"	#4	#10 (2000)	#18 (1000)	#35 (500)	#60 (250)	#120 (125)	#230 (62)	31.00	15.60	7.80	3.90	2.00	1.00
RCB157-102408	100.0	80.3	68.1	55.9	41.2	26.7	19.1	15.2	12.3	8.5	5.0	2.5	1.5	0.6
RCB157-102408	100.0	79.4	67.3	55.8	41.2	27.1	19.7	15.8	12.2	8.6	5.0	2.6	1.4	0.6
RCB157-102408	100.0	82.7	71.4	59.7	43.6	27.5	18.8	14.3	13.4	9.1	5.1	2.7	1.5	0.7
LLBG-04 GRAB	100.0	100.0	82.6	68.6	59.9	53.7	48.8	44.1	43.6	35.7	25.8	16.0	9.6	5.9
LL-04	100.0	100.0	88.4	68.0	54.9	47.5	43.2	40.8	NA	NA	NA	NA	NA	NA
LL-06	100.0	100.0	88.4	73.3	62.3	54.6	48.2	43.1	43.1	38.8	28.1	21.1	13.1	8.2
LL-20	100.0	100.0	85.6	72.2	61.8	53.9	46.8	39.7	37.8	32.3	24.3	16.7	10.4	6.0
LL-08	100.0	100.0	85.3	70.6	60.8	54.2	49.1	45.0	44.3	41.3	33.9	24.9	16.6	10.2
LL-14 GRAB	100.0	100.0	83.6	60.8	45.7	35.9	22.4	14.0	NA	NA	NA	NA	NA	NA
LL-20 GRAB	100.0	100.0	92.9	78.0	64.9	54.2	45.6	38.7	NA	NA	NA	NA	NA	NA
LL-09 GRAB	100.0	100.0	95.1	73.2	52.5	39.9	31.2	25.2	NA	NA	NA	NA	NA	NA
LL-07 GRAB	100.0	100.0	93.9	72.6	58.8	49.3	34.7	23.3	NA	NA	NA	NA	NA	NA
LLBG-01 GRAB	100.0	100.0	85.3	61.7	45.7	37.8	29.5	22.8	NA	NA	NA	NA	NA	NA
LL-06 GRAB	100.0	96.1	94.2	76.4	60.0	48.8	41.6	36.6	NA	NA	NA	NA	NA	NA
LL-05 GRAB	100.0	100.0	90.3	69.7	53.8	43.4	35.2	28.5	NA	NA	NA	NA	NA	NA

Notes to the Testing:

1. Organic matter was not removed prior to testing, thus the reported values are the "apparent" grain size distribution. See narrative for discussion of the testing.

NP00

Hart Crowser, Inc.
17453-00 Loon Lake

Apparent Grain Size Distribution Summary
Percent Retained in Each Size Fraction

Sample No.	Gravel	Very Coarse Sand	Coarse Sand	Medium Sand	Fine Sand	Very Fine Sand	Coarse Silt	Medium Silt	Fine Silt	Very Fine Silt	Clay			Total Fines
Phi Size	> -1	-1 to 0	0 to 1	1 to 2	2 to 3	3 to 4	4 to 5	5 to 6	6 to 7	7 to 8	8 to 9	9 to 10	< 10	<4
Sieve Size (microns)	> #10 (2000)	10 to 18 (2000-1000)	18-35 (1000-500)	35-60 (500-250)	60-120 (250-125)	120-230 (125-62)	62.5-31.0	31.0-15.6	15.6-7.8	7.8-3.9	3.9-2.0	2.0-1.0	<1.0	<230 (<62)
RCB157-102408	31.9	12.2	14.7	14.4	7.6	3.9	2.9	3.8	3.5	2.5	1.1	0.8	0.6	15.2
RCB157-102408	32.7	11.5	14.6	14.0	7.5	3.9	3.6	3.6	3.6	2.4	1.2	0.8	0.6	15.8
RCB157-102408	28.6	11.7	16.1	16.1	8.7	4.4	0.9	4.3	4.0	2.4	1.2	0.8	0.7	14.3
LLBG-04 GRAB	17.4	14.0	8.7	6.2	5.0	4.7	0.5	7.9	9.9	9.8	6.4	3.7	5.9	44.1
LL-04	11.6	20.4	13.1	7.4	4.3	2.4	NA	NA	NA	NA	NA	NA	NA	40.8
LL-06	11.6	15.1	11.0	7.7	6.4	5.1	0.0	4.4	10.7	6.9	8.0	5.0	8.2	43.1
LL-20	14.4	13.4	10.4	7.9	7.1	7.2	1.9	5.4	8.1	7.6	6.4	4.4	6.0	39.7
LL-08	14.7	14.7	9.8	6.7	5.1	4.1	0.6	3.0	7.4	9.1	8.3	6.3	10.2	45.0
LL-14 GRAB	16.4	22.7	15.1	9.8	13.6	8.3	NA	NA	NA	NA	NA	NA	NA	14.0
LL-20 GRAB	7.1	14.8	13.2	10.6	8.6	6.9	NA	NA	NA	NA	NA	NA	NA	38.7
LL-09 GRAB	4.9	21.9	20.7	12.6	8.7	6.0	NA	NA	NA	NA	NA	NA	NA	25.2
LL-07 GRAB	6.1	21.4	13.8	9.5	14.5	11.5	NA	NA	NA	NA	NA	NA	NA	23.3
LLBG-01 GRAB	14.7	23.6	16.1	7.8	8.3	6.7	NA	NA	NA	NA	NA	NA	NA	22.8
LL-06 GRAB	5.8	17.8	16.4	11.2	7.2	5.1	NA	NA	NA	NA	NA	NA	NA	36.6
LL-05 GRAB	9.7	20.5	15.9	10.4	8.2	6.7	NA	NA	NA	NA	NA	NA	NA	28.5

Notes to the Testing:
1. Organic matter was not removed prior to testing, thus the reported values are the "apparent" grain size distribution. See narrative for discussion of the testing.

NP00

QA SUMMARY

Client:	Hart Crowser, Inc.	Project No.:	17453-00 Loon Lake
ARI Trip. Sample ID:	NW34C	Batch No.:	NP00-1
Client Trip. Sample ID:	RCB157-102408	Page:	1 of 1

Relative Standard Deviation, By Phi Size

Sample ID	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
RCB157-10240	100.0	80.3	68.1	55.9	41.2	26.7	19.1	15.2	12.3	8.5	5.0	2.5	1.5	0.6
RCB157-10240	100.0	79.4	67.3	55.8	41.2	27.1	19.7	15.8	12.2	8.6	5.0	2.6	1.4	0.6
RCB157-10240	100.0	82.7	71.4	59.7	43.6	27.5	18.8	14.3	13.4	9.1	5.1	2.7	1.5	0.7
AVE	NA	80.80	68.90	57.10	41.98	27.11	19.18	15.10	12.62	8.74	5.02	2.60	1.46	0.64
STDEV	NA	1.75	2.16	2.23	1.41	0.38	0.45	0.74	0.66	0.32	0.04	0.07	0.04	0.03
%RSD	NA	2.16	3.14	3.91	3.36	1.40	2.36	4.90	5.21	3.68	0.74	2.75	2.52	4.73

The Triplicate Applies To The Following Samples

Client ID	Date Sampled	Date Extracted	Date Complete	QA Ratio (95-105)	Data Qualifiers	Pipette Portion (5.0-25.0g)
RCB157-102408	10/24/2008	11/21/2008	12/10/2008	95.1	W	10.4
RCB157-102408	10/24/2008	11/21/2008	12/10/2008	101.1		10.9
RCB157-102408	10/24/2008	11/21/2008	12/10/2008	97.0		9.4
LLBG-04 GRAB	9/12/2008	11/21/2008	12/10/2008	99.3		5.7
LL-04	9/12/2008	11/21/2008	12/10/2008	98.1	SS	1.2
LL-06	9/12/2008	11/21/2008	12/10/2008	99.6		5.2
LL-20	9/12/2008	11/21/2008	12/10/2008	100.7		6.6
LL-08	9/12/2008	11/21/2008	12/10/2008	98.9		6.2
LL-14 GRAB	9/12/2008	11/21/2008	12/10/2008	97.1	SS	0.8
LL-20 GRAB	9/12/2008	11/21/2008	12/10/2008	98.1	SS	2.4
LL-09 GRAB	9/12/2008	11/21/2008	12/10/2008	98.2	SS	1.4
LL-07 GRAB	9/12/2008	11/21/2008	12/10/2008	102.0	SS	2.0
LLBG-01 GRAB	9/12/2008	11/21/2008	12/10/2008	96.5	SS	1.0
LL-06 GRAB	9/12/2008	11/21/2008	12/10/2008	99.2	SS	1.6
LL-05 GRAB	9/12/2008	11/21/2008	12/10/2008	103.0	SS	1.1

* ARI Internal QA limits = 95-105%

Notes to the Testing:

1. Organic matter was not removed prior to testing, thus the reported values are the "apparent" grain size distribution. See narrative for discussion of the testing.

APPENDIX C
EVALUATION FOR WOOD DEBRIS IN LOON LAKE SEDIMENTS
DR. MARC BEUTEL

APPENDIX D
SEDIMENT MICROSCOPIC EVALUATION
LOON LAKE SEDIMENT SAMPLES

APPENDIX D
SEDIMENT MICROSCOPIC EVALUATION
LOON LAKE SEDIMENT SAMPLES

Introduction

Loon Lake is an approximately 1,100-acre lake located in Stevens County in northeastern Washington State. Known for its water clarity, the lake provides habitat for many aquatic and water-dependent species. Historically, the northeastern shore of the lake was the location of a succession of sawmills and ice production plants operating in the area from the late 1800s to the mid-1900s. Served by the railroad line, the old town site was also located in this area of the lake and the current Town of Loon Lake developed around the sawmills.

In recent years, large quantities of organic muddy debris have been perceived to be accumulating on the bottom of the lake, affecting its water clarity. Local residents suspect that the debris may result from accumulations of sawdust and sawmill debris related to the former sawmill operations. Pursuant to this line of investigation, several sediment samples from Loon Lake were characterized biologically by an experienced biologist using light microscopy. Particular attention was given to identify historically deposited wood waste, if present, and to assess any associated alterations to the micro-scale ecology of the sediments.

Sample Investigation

Methods

Fourteen samples of sediment from the Loon Lake investigation were delivered to the Pentec office of Hart Crowser, of which seven were examined using light microscopy. The samples were refrigerated until they could be examined. Of the seven samples, two (background sample LL-BG-04 and site sample LL-20) were deemed of high importance based on resident input. The remaining five samples were selected to be representative of sediment collected from the lake. Each sample was examined upon opening for surface characteristics and mobile fauna before a brief stirring to homogenize. After homogenization a 2.0 ml subsample was taken using a clean glass pipette and placed into a small petri dish at which point 2.0 ml of deionized water was added to create a loose slurry, which was examined using a dissecting microscope under 50x magnification to view macro-scale features. In addition, two slides per sample were prepared to

be viewed under an Olympus BH2 compound microscope to examine individual particles.

Features of interest were generally surveyed using the 100x magnification and 400x magnification use used to examine individual particles of interest. From these two levels of examination evidence of sawdust particles and bacterial load that might be associated with the decay of large amounts of cellulose material could easily be detected.

Observations

Background Samples

This group of samples includes sediment collected in areas that are assumed to be unaltered by sawmill impacts and serve as reference or "background" samples indicative of no direct point source impacts. This includes samples LL-BG-01, LL-BG-02, and LL-BG-04. Surficial examination of the samples revealed a fairly uniform consistency with a moderate amount of organic detritus derive d from emergent marsh vegetation and submerged aquatic vegetation as well as terrestrial plant inputs (Photos 1 and 2). No redox layer or hydrogen sulfide had developed in the sample container since collection of the sample. Generally the sediment appeared typical of organic-rich lake sediment.

Under magnification (100x), it was very clear that a majority of the sediment was composed of diatom frustules (Photos 3 and 4). For a given field of view, over 50 percent of the observable particles were diatoms of some form. Diatoms ranged from chain forming to large raphid forms most of which would be considered benthic in nature. Motile flagellates were the only highly mobile organisms noted, but only made up a small proportion of the sample. Pine pollen was also noted (Photo 5) though it made up a very minor fraction of the overall particle load.

There was little evidence of sawdust or bacterial colonies. There were possibly some bacteria colonies detected (Photo 4), but were a very minor portion of any given field of view.

Potential Wood Waste Area Samples

This group included grab samples from areas suspected to have been impacted by wood milling and log storage. This includes samples LL-04, LL-05, LL-06, and

LL-20. Surficial examination of the samples revealed a varied consistency with a high degree of organic detritus. Given the general appearance and composition of the organic detritus, it seemed likely to have originated from emergent marsh vegetation in the vicinity. No obvious large sawdust particles were noted in the detritus (Photos 6 and 7). As with the background samples, no redox layer or hydrogen sulfide had developed in the sample container since collection of the sample. Generally the sediment seemed indicative of sediment taken near a marsh setting and/or some other highly productive/depositional environment associated with emergent vegetation. There were several mobile invertebrates noted on the surface of the sample including isopods and ostracods.

Under magnification, it was very clear that large portion of the sediment was composed of diatom frustules (Photos 8, 9, and 10) with a marginally higher concentration than the background samples. . Diatom diversity was very high with pennate, chain forming, and large raphid forms, most of which would be considered benthic. Motile flagellates and rotifers were noted throughout the sample as well as several gastrotrichs (Photo 11). Pine pollen was also noted in all survey samples (Photo 12) though it made up a minor fraction of the particle load. There were a few particles noted that could be cellulose material potentially derived from sawdust (Photo 13). This distinction is based on the small cell structure typical of wood rather than large, flat cell structure associated with emergent plant structures (Photo 14). However, these possible wood particles were only a very minor portion of the sample.

Conclusions

From the observations based on these samples, there appears to be a thriving benthic diatom community capable of sustaining the base of a moderate aquatic foodweb along with the phytoplankton community. The sediments seemed typical of a low energy aquatic system that is mostly depositional in nature. There was organic detritus noted, but this detritus was likely generated locally through emergent shoreline or marsh vegetation and possibly submerged aquatic vegetation. There was very little incidence of noticeable bacterial colonies and no record of filamentous bacteria in these samples. Based on the samples examined, there seems to be little or no sawdust or wood waste debris in these sediments. The few wood particles that were observed may have been generated as part of the natural detrital flux from terrestrial sources.

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Photo 1 Typical sediment components from background samples including detritus derived from terrestrial and emergent marsh sources.

Photo 2 Typical sediment components from background samples including detritus derived from submerged aquatic sources.

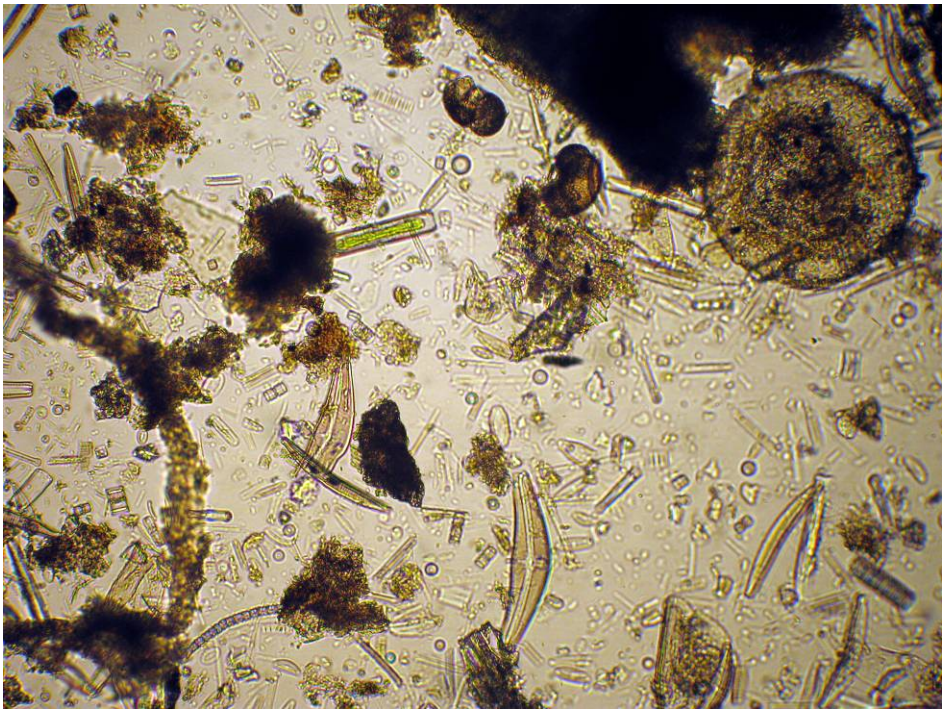

Photo 3 Typical diatom compliment for sample LL-BG-04.

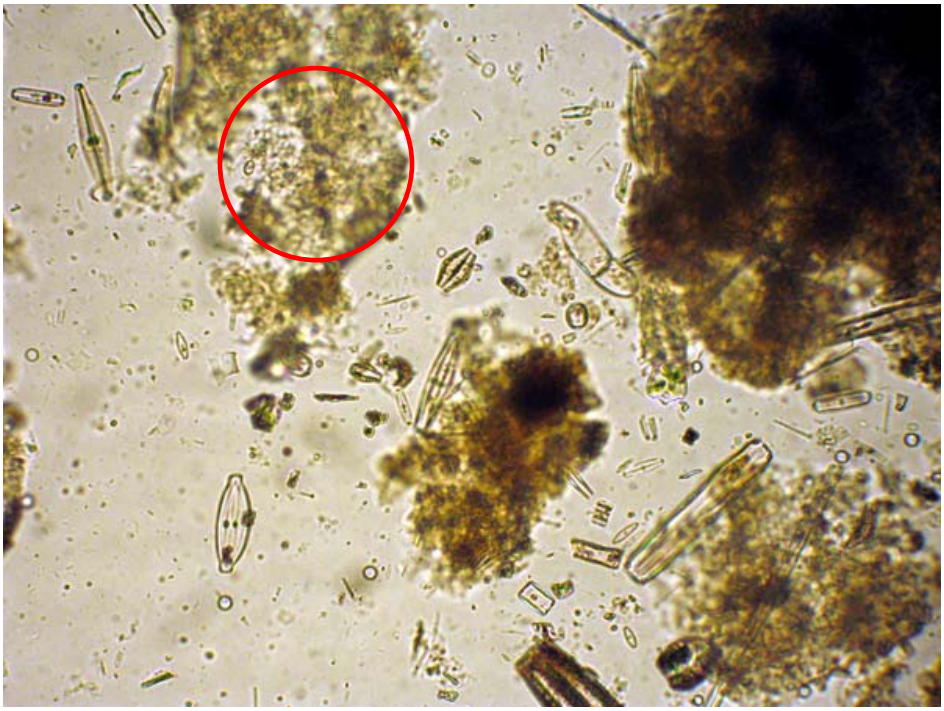

Photo 4 Typical diatom compliment for sample LL-BG-02 with possible bacterial colony (circled portion).

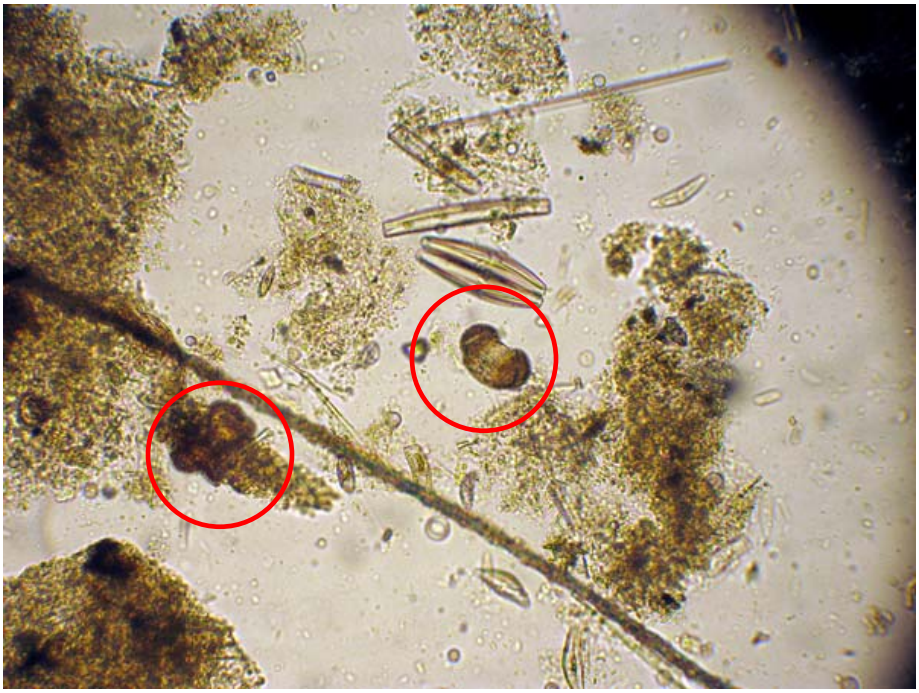

Photo 5 Pine pollen in sample LL-BG-02 (circled portions).

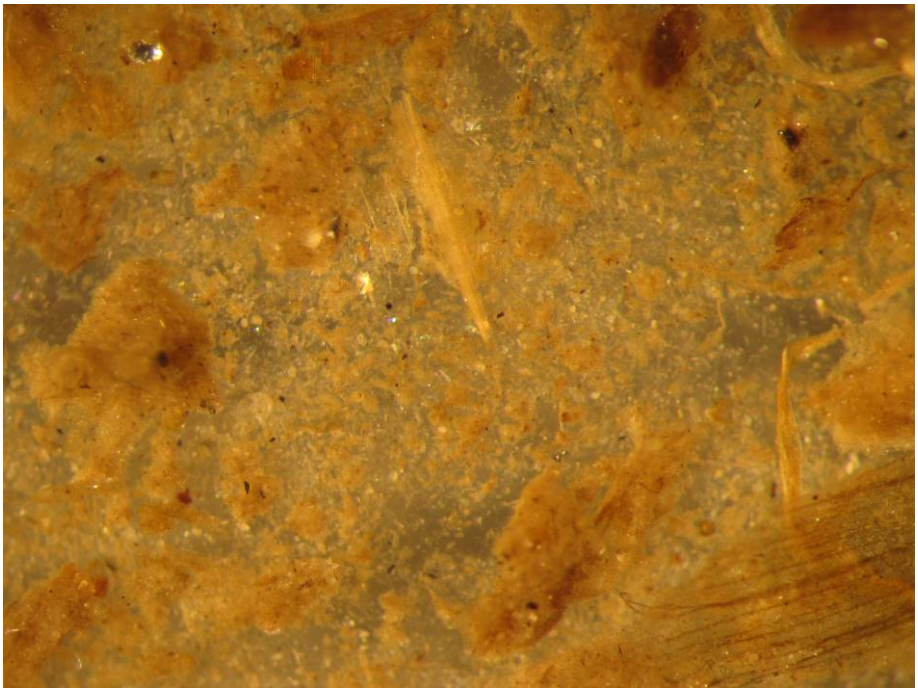

Photo 6 Typical sediment components from wood waste survey samples.

Photo 7 Typical sediment components from wood waste survey samples including detritus derived from emergent marsh sources.

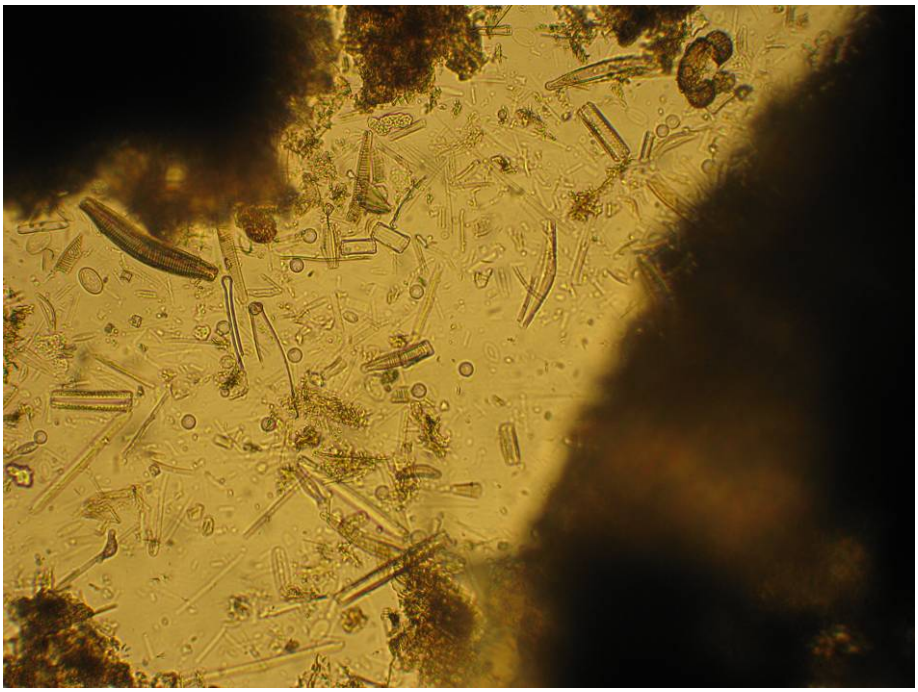

Photo 8 Typical diatom compliment for sample LL-04

Photo 9 Typical diatom compliment for sample LL-05

Photo 10 Typical diatom compliment for sample LL-20

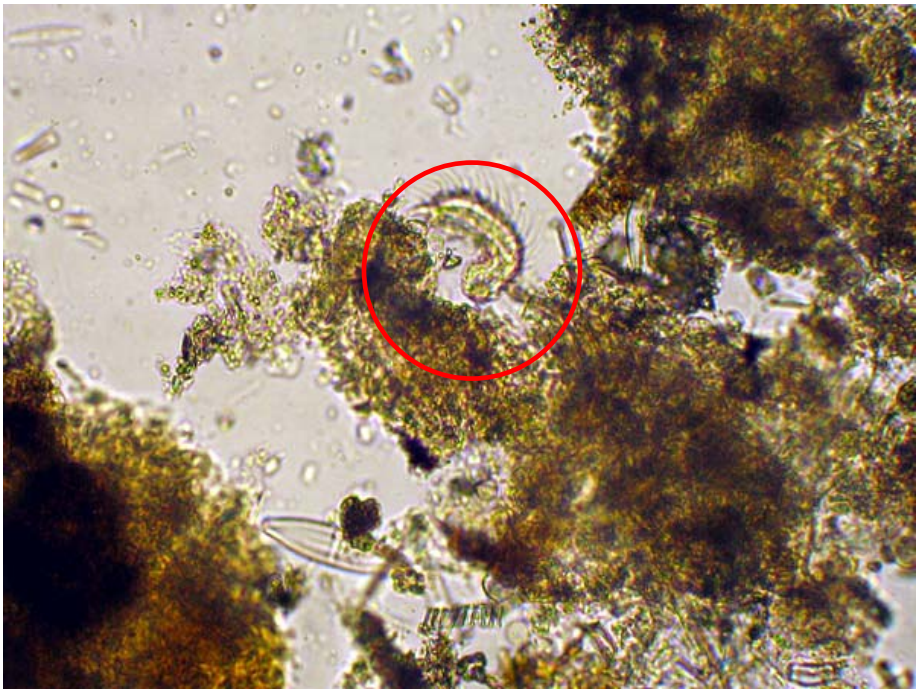

Photo 11 Gastrotrich (circled) observed feeding in sample LL-05

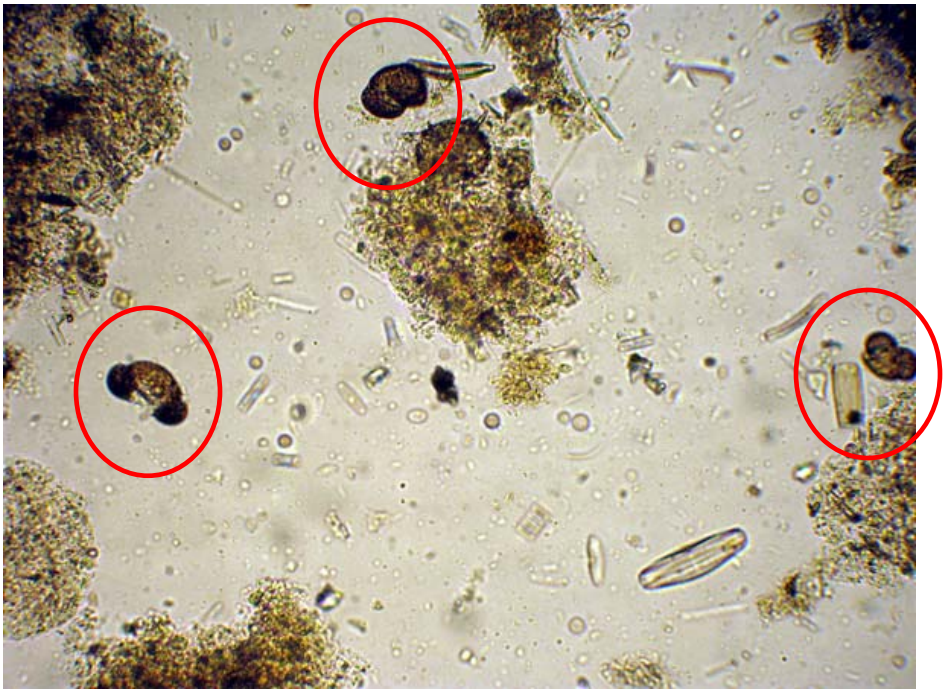

Photo 12 Pine pollen in sample LL-05 (circled portions)

Photo 13 Cellulose material (circled portion) possibly from sawdust. Note dense, small cell structure.

Photo 14 Cellulose material (circled portion) most likely from emergent vegetation. Note thin, flat cells.

APPENDIX E
PISTON AND VIBRACORE PHOTOGRAPHS
LOON LAKE, WASHINGTON

Photo 1: Piston Core LL-20, very soft to soft, wet, light brown Peat with a high organic content.

Photo 2: Piston Core LL-04, Peat with a high organic content.

Photo 3: Vibracore LL-03 sample within clear Lexan core tube.