



15050 S.W. Koll Parkway, Suite L
Beaverton, OR
97006-6028

pl 503.644.9447
fl 503.643.1905
kleinfelder.com

TRANSMITTAL

Date: December 4, 2008
Project Number: 94175 / 7.1

To:

**Mr. Tim Hemstreet, P.E.
Senior Project Manager
PacifiCorp Energy Hydro Resources
825 N.E. Multnomah, Suite 1500
Portland, Oregon 97232**

Subject:

**Updated Evaluation of Mercury Bioaccumulation
Underwood In Lieu Fishing Access Site
Northwestern Lake – Condit Hydroelectric Project
FERC Project No. 2342
White Salmon, Washington**

We are sending the following:

Three copies of the above-referenced Updated Evaluation of Mercury Bioaccumulation for the Underwood In Lieu Fishing Access Site.

Remarks:

If you have any questions, please contact me at (503) 644-9447.

Thank you.

By:

A handwritten signature in blue ink that reads "Peter L. Stroud". The signature is written in a cursive, flowing style.

Peter L. Stroud, LEG
Principal Engineering Geologist



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Beaverton, OR
97006-6028

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fl 503.643.1905
kleinfelder.com

**UPDATED EVALUATION OF MERCURY
BIOACCUMULATION
UNDERWOOD IN LIEU FISHING ACCESS SITE
NORTHWESTERN LAKE
CONDIT HYDROELECTRIC PROJECT
FERC PROJECT No. 2342
WHITE SALMON, WASHINGTON
KLEINFELDER PROJECT NO. 94175 / 7.1**

December 4, 2008

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15050 S.W. Koll Parkway, Suite L
Beaverton, OR
97006-6028



December 4, 2008
Kleinfelder Project Number 94175 / 7.1

Mr. Tim Hemstreet, P.E.
Senior Project Manager
PacifiCorp Energy Hydro Resources
825 N.E. Multnomah, Suite 1500
Portland, Oregon 97232

**Subject: Updated Evaluation of Mercury Bioaccumulation
Underwood In Lieu Fishing Access Site
Northwestern Lake – Condit Hydroelectric Project
FERC Project No. 2342
White Salmon, Washington**

Dear Mr. Hemstreet:

We are pleased to present our Updated Evaluation of Mercury Bioaccumulation at the Underwood In Lieu Fishing Access Site. We trust the information contained in this report will meet your needs at this time.

We appreciate this opportunity to provide our services to you. Should you require additional information or have any questions regarding this report, please contact us at (503) 644-9447.

Sincerely,

KLEINFELDER WEST, INC.

Peter L. Stroud, LEG
Principal Engineering Geologist

TABLE OF CONTENTS

1.0 INTRODUCTION.....	1
2.0 BACKGROUND INFORMATION	3
2.1 PROPOSED ACTION.....	3
2.2 PROJECT DESCRIPTION	4
2.3 PREVIOUS INVESTIGATIONS.....	4
3.0 SITE EXPLORATION METHODOLOGY AND LOCATION	9
3.1 SUPPLEMENTAL SAMPLING AND ANALYSIS PLAN.....	9
3.2 SAMPLING DATE, LOCATION, AND FIELD DOCUMENTATION.....	9
3.3 SAMPLE TRANSPORT AND CHAIN-OF-CUSTODY PROCEDURES.....	10
4.0 CHEMICAL AND PHYSICAL ANALYSES RESULTS	11
4.1 CHEMICAL ANALYSES RESULTS	11
4.2 PHYSICAL PARAMETER ANALYSES RESULTS.....	12
4.3 COMPARISON OF FINDINGS TO NWRSEF SCREENING LEVELS	13
4.4 QUALITY ASSURANCE AND QUALITY CONTROL.....	13
5.0 MERCURY BIOACCUMULATION EVALUATION.....	15
5.1 FIRST PHASE OF LABORATORY ACTIVITY FOR BIOACCUMULATION EVALUATION	15
5.2 SECOND PHASE OF LABORATORY ACTIVITY FOR BIOACCUMULATION EVALUATION...	16
5.3 BIOACCUMULATION EVALUATION TEST RESULTS	16
6.0 SUMMARY AND CONCLUSIONS.....	19
7.0 REFERENCES.....	22
8.0 LIMITATIONS.....	24

TABLES

1. Sample Point Locations With Coordinates
2. Analytical Data for Mercury Distribution Analysis
3. Analytical Data for Mercury Background Evaluation
4. Soil Classification of Sediment Samples
5. Comparison of Bioaccumulation Analytical Results to Oregon Guidelines

FIGURES

1. Northwestern Lake Site Location Map
2. White Salmon River (Underwood In Lieu Fishing Site) Sample Location
3. Mercury Distribution in Sediment Sample Locations
4. Mercury Background Sample Locations

TABLE OF CONTENTS (Cont.)

APPENDICES

- A. Sampling and Analysis Plan
- B. Correspondence and Approval Letters
- C. Apex Labs and Columbia Analytical Services Chemical Laboratory Results
- D. Kleinfelder Physical Parameter Laboratory Results
- E. Northwestern Aquatic Sciences Report
- F. Brooks Rand Bioaccumulation Testing Analytical Report
- G. Mercury Demethylation Considerations for Condit Dam Sediments

1.0 INTRODUCTION

This report presents the results of an evaluation of mercury bioaccumulation from sediment collected at the Underwood In Lieu Fishing Access Site (ILFAS). The evaluation of this supplemental sample collected in May 2008 was performed to provide bioaccumulation information from a reference sample more representative of the fine sediment in Northwestern Lake than was obtained from background sampling conducted in June 2007. This information will enhance the understanding of the potential impacts of the open water release of sediments from Northwestern Lake following the proposed removal of the dam.

In December 2006, Kleinfelder, under contract to PacifiCorp Energy, collected sediment characterization samples from Northwestern Lake and reported the results in a *Sediment Sampling and Analysis Report* (March 2007). This investigation concluded that the average concentration of mercury in the fine silts impounded behind Condit dam that comprise the Lower Basin dredged material management unit (DMMU) is approximately 0.72 milligrams per kilogram (mg/kg). During this work, the maximum detected concentration of mercury in the sediments was 2.03 mg/kg in the surface sediment at a location (boring B-1) near the dam. Laboratory bio-assays conducted on the sediment collected during this field work indicated that the sediment had no adverse effect on the life cycles of test species.

The applicable current regulatory screening levels for mercury in fresh water sediments are found in the *Northwest Regional Sediment Evaluation Framework* (NWRSEF) (September, 2006) and are 0.28 mg/kg (lower screening level, SL1) and 0.75 mg/kg (upper screening level, SL2). The NWRSEF states, "The lower screening level (SL1) corresponds to a concentration below which adverse effects to benthic organisms would not be expected, and the upper screening level (SL2) corresponds to a concentration at which minor adverse effects may be observed in the more sensitive groups of benthic organisms."

Because mercury concentrations were found in excess of the upper screening level (SL2), the Regional Sediment Evaluation Team (RSET), composed of representatives of various state and federal regulatory agencies, requested that PacifiCorp Energy collect supplemental information to confirm the elevated mercury concentrations found in sediment near the dam at boring location B-1 in Northwestern Lake, establish the

bio-availability of mercury found in the sediments through bioaccumulation studies of fish, worms, and clams, and ascertain background sediment mercury concentrations in the local area.

The supplemental sampling and analysis was completed in July of 2007. However, sediments collected as a reference sample from the Little White Salmon River and used as part of the bioaccumulation study were determined to not be representatively similar to the White Salmon River sediments. Specifically, the Little White Salmon River sediments were composed of less than 70 percent fines, whereas the White Salmon River (and Northwestern Lake) sediments were typically 95 percent (or greater) fines. Based on this, RSET requested an additional bioaccumulation study be performed with sediment from the Underwood In Lieu Fishing Access Site, which is on the White Salmon River and was shown to include sediments that are similar to those collected from Northwestern Lake.

The data presented in this report are intended to further test the hypothesis presented in the *March 2007 Sediment Report* and the *November 2007 Supplemental Evaluation of Mercury in Sediments Report*, which suggested that the elevated concentrations of mercury encountered in the fine-grained sediments impounded in Northwestern Lake behind Condit dam are due to naturally occurring background concentrations of the native element. This hypothesis was developed based on the understanding that hydrothermal alteration associated with recent volcanic activity, such as that which has occurred with Mount St. Helens, is a known source of mercury. Additionally, there are no known anthropogenic sources of mercury within the White Salmon River basin and high background concentrations of mercury have been documented in water quality and sediment samples on the Washington side of the Columbia River from previous studies.

The information presented in this document is intended to satisfy the RSET and *NWRSEF* criteria. Included in this report for comparison are the data provided in the *November 2007 Evaluation of Mercury in Sediments Report*.

2.0 BACKGROUND INFORMATION

The following sections describe the project and sampling history, the site ranking criteria, and proposed dredging and sampling parameters.

2.1 PROPOSED ACTION

Northwestern Lake sediments are proposed to be released in an “open-water” fashion during the decommissioning of Condit dam. Since the construction of the dam and formation of the lake, the natural transport of sediments by the White Salmon River has been disrupted, and the sediments previously transported to the Columbia River are now deposited in the slack water of Northwestern Lake.

The removal of Condit dam would initiate the discharge of a portion of the impounded sediment into the lower White Salmon River, a tributary of the Columbia River. As the U.S. Army Corps of Engineers (USACOE) Portland District stated in a letter dated December 15, 2004, “Because the sediment will settle out within the river systems, the project would result in unconfined aquatic disposal of sediments into the Lower Columbia River system.” Unconfined aquatic disposal of sediments is regulated by the USACOE. The Regional Sediment Evaluation Team; composed of: the USACOE’s Seattle District, Portland District, Walla Walla District, and Northwestern Division; in collaboration with the U.S. Environmental Protection Agency (EPA) Region 10; Washington Department of Ecology (WDOE), Washington Department of Natural Resources (WDNR); Oregon Department of Environmental Quality (ODEQ); Idaho Department of Environmental Quality (IDEQ); National Marine Fisheries Service (NMFS); and the U.S. Fish and Wildlife Service (US F&WS); has developed a framework for evaluating sediments and the suitability of disposing those sediments in the Pacific Northwest. This framework is presented in the *Northwest Regional Sediment Evaluation Framework, Interim Final, September 2006*.

The sediments were physically and chemically characterized in 1994 and again in 2006/2007. In addition, information on the bioaccumulation of mercury was evaluated for fish, clams, and aquatic oligochaete worms. To assist with the continued evaluation of the bioaccumulation of mercury, Kleinfelder prepared a Sampling and Analysis Plan (SAP). The objective of this SAP was to detail the collection location, procedures, and analytical methods to be used to obtain the bioaccumulation data to supplement the

existing data presented in previous sediment characterization reports for the Condit Hydroelectric Project.

2.2 PROJECT DESCRIPTION

The Condit Hydroelectric Project is located along the White Salmon River above Washington State Highway 14 on the border between Klickitat and Skamania Counties, approximately 3.3-miles upstream from the confluence of the White Salmon and Columbia Rivers (Figure 1). The U.S. Geological Survey (USGS) topographic coordinates for the reservoir are Sections 2 and 3, Township 3 North, Range 10 East, Willamette Meridian (Sec. 2 and 3/T3N/R10E W.M.). The Condit Project includes a 125-foot high concrete dam across the White Salmon River that diverts water into a 5,100-foot long wood stave flowline. The wood stave flowline conveys water to a surge tank, where the water is diverted into two pipes (penstocks) for delivery to two turbine generators in the powerhouse downstream of the dam.

The Condit Project is owned and operated by PacifiCorp Energy and is regulated by the Federal Energy Regulatory Commission (FERC) as Project No. 2342. It has been in operation since construction was completed in 1913. The name of the reservoir behind the dam is Northwestern Lake. Northwestern Lake is approximately 1.8-miles long with a surface area of approximately 92 acres. The pool elevation listed on the USGS Northwestern Lake topographic map (1983 Edition) is 294 feet above mean sea level (msl). At the time of its construction, the depth of water in the reservoir ranged from approximately 15 to 110 feet. Since the construction of the dam, the reservoir has been collecting sediments brought in by the White Salmon River. As of 1990, the depth of water in the reservoir reportedly ranged from approximately 3 to 85 feet.

2.3 PREVIOUS INVESTIGATIONS

Bathymetric surveys of the reservoir were conducted by PacifiCorp Energy in 1990, 1997, and 2006. The sediments in Northwestern Lake, located behind Condit dam, were investigated by advancing ten borings for the collection of sediment and bedrock samples in 1994. The results of the 1994 investigation were presented in a report prepared by Squier Associates, entitled "*Condit Hydroelectric Project (FERC Project No. 2342), Northwestern Lake Sediment Characterization Study, White Salmon, Washington,*" dated April 29, 1994. The 1994 investigation was developed in general

accordance with the protocols of the Puget Sound Dredge Disposal Analysis (PSDDA) program.

The 1994 sediment characterization testing program consisted of both geotechnical and environmental testing. The geotechnical testing parameters included the following:

- soil classification
- moisture content
- grain-size analysis
- unit weight determination

The geotechnical testing indicated that the reservoir sediments consist mainly of fine-grained materials in the downstream deep pool area and granular materials in the upstream area. Located in the middle of the reservoir is a transition area where the upstream granular sediments have overridden the deep pool, fine-grained sediments.

The interpretation of the 1994 environmental testing results indicated that the metal concentrations were within expected background levels. However, remnant pesticides and herbicides were detected in the intermediate-aged sediments in the reservoir.

A second investigation of the sediments was conducted by Squier Associates in 1997. The results of that second investigation were presented in a report entitled, "*Additional Geotechnical Exploration and Laboratory Testing at the Condit Hydroelectric Project (Contract No. P018780)*" dated November 20, 1997.

In 1998, the cooperative interagency/intergovernmental team consisting of the USACOE, EPA Region 10, WDOE, WDNR, and ODEQ produced the Dredged Material Evaluation Framework, Lower Columbia River Management Area (DMEF). The DMEF established a tiered system for ranking the suitability of unconfined aquatic disposal of sediments at proposed dredging sites. The *DMEF* Tier I used existing information to conclude whether or not there is "enough information to determine if project meets exclusion ranking." Exclusionary ranking was a management area ranking that provided the least stringent characterization requirements. Projects from specific areas listed in the *DMEF* were awarded the exclusionary ranking. Northwestern Lake currently was not located in one of the listed zones for exclusionary ranking. The exclusionary criteria also included sediments that were to be used for beach enhancement and sediments whose

final placement would be the same substrate as their origin. The Northwestern Lake sediments did not meet either criterion.

Exclusionary ranking was also awarded to locations whose sediments had at least 80% sand retained on a number (No.) 230 sieve (i.e., less than 20% fines) and a total volatile solids (TVS) content of less than 5.0%. Mechanical sieve analysis of the sediments collected from the upstream portion of Northwestern Lake demonstrated that those sediments met the criterion of having less than 20% fines.

However, in order to determine if the 1994 data were suitable, the data were first compared to the framework of Tiers II and IIB. Consequently, it was concluded that the sediments from Northwestern Lake (as one discrete unit) did not meet the criteria for exclusionary ranking. It was further concluded that the low management area ranking was appropriate. The Northwestern Lake sediment source location met the following criteria for low management area ranking:

- Low concentrations of chemicals of concern (COC)
- Some locations of higher percentages of fines
- Few sources of potential contamination

The *DMEF* allowed for the creation of dredged material management units (DMMUs), which are subdivisions of a sediment-generating project site that represent sediments similar in nature. Based on this understanding, the Northwestern Lake sediments were segregated into two DMMUs: the lower basin sediments and the upstream gravels of the upper reservoir. The segregation into two DMMUs provided for one Low management area ranking of homogenous sediments (Lower Basin) and one area of exclusionary ranking (Upper Reservoir). The homogeneity of the sediments was supported by the 1994 mechanical sieve data. Based on the information presented in the *1994 Condit Study*, the lower basin included about 51% of the sediments (approximately 1,122,000 cubic yards).

The DMEF requirement for a homogeneous Low Management Area Ranking DMMU was one sample per 100,000 cubic yards. Accordingly, 12 samples were proposed to characterize the 1,122,000 cubic yards of sediment.

In December 2006, Kleinfelder (formerly Squier Associates and Squier | Kleinfelder) conducted additional sediment sampling in the lower basin of Northwestern Lake in

order to obtain current data on the chemical characterization of the fine-grained sediments. A total of 15 probes were advanced into the fine-grained sediments for the collection of 12 project and three quality control samples. The analytical results were compared to the screening levels provided in the USACOE's *Dredged Material Evaluation Framework, Lower Columbia River Management Area*, November 1998. The sampling and analysis plan developed for the 2006 phase of sediment sampling was approved by the USACOE in August 2006.

The data that were collected during implementation of the 2006 SAP were intended to satisfy the requirements of the USACOE in accordance with the applicable Tier IIB and Tier III testing guidelines as presented in the DMEF. However, the RSET introduced the Interim Final of the NWRSEF in September 2006. The NWRSEF provides more stringent fresh water screening criteria (compared to marine screening criteria) and divides the screening criterion into two discrete levels (SL1 and SL2). The mercury concentrations reported for four of the 12 project sediment samples and the three duplicate samples collected in December 2006 exceeded the SL2 criterion (0.75 mg/kg) for mercury.

Supplemental sediment sampling and analysis were performed in July of 2007 to confirm sediment mercury concentrations, establish mercury background levels, and assess bioaccumulation as requested by members of the RSET. Ten samples were collected from the Northwestern Lake and White Salmon River region. Sample results again indicated the presence of mercury in fine-grained surface sediments located near the dam, but at lower concentrations than previously found. Additional sediment was collected from Northwestern Lake and from a reference site on the Little White Salmon River (near the fish hatchery) to be used as part of the mercury bioaccumulation study. Clam and aquatic oligochaete worm tissue tested after laboratory exposure to Northwestern Lake sediments indicated that mercury was accumulating in aquatic worm tissue but not in clam tissues. Fish tissues collected from specimens captured in Northwestern Lake were also found to have accumulated mercury.

The reference sediment sample collected from the Little White Salmon River did not contain a similar percentage of fine-grained sediments as the sample from Northwestern Lake. Because the reference sample was not representative of fine sediments such as those contained in Northwestern Lake, the RSET requested that another bioaccumulation study be performed with sediment collected at the Underwood

In Lieu Fishing Access Site (Figure 2). Physical testing of sediment from the Underwood In Lieu Fishing Access Site demonstrated that sediment at that location was more characteristically similar to the sediment collected from Northwestern Lake.

3.0 SITE EXPLORATION METHODOLOGY AND LOCATION

The following sections discuss the methodologies and protocols used to complete the field portion of this project.

3.1 SUPPLEMENTAL SAMPLING AND ANALYSIS PLAN

Kleinfelder submitted a *Sampling and Analysis Plan for the Evaluation of Mercury Bioaccumulation at the In-Lieu Fishing Access Site (SSAP)* to PacifiCorp Energy on April 15, 2008 (April 2008 SSAP). A copy of the SSAP is included in Appendix A. After PacifiCorp Energy's review and approval, the *April 2008 SSAP* was submitted to RSET for review and approval. The objective of the *April 2008 SSAP* was to provide a systematic approach to collecting additional sediment characterization data that would supplement the existing data presented in the *November 2007 Supplemental Evaluation of Mercury in Sediments Report (2007 SEMSR)*. The data collected during implementation of the *April 2008 SSAP* are intended to satisfy the requirements of the RSET in accordance with the *NWRSEF*.

The Project Review Group (PRG) (consisting of a representative from Army Corps of Engineers, National Marine Fisheries Service, and Washington Department of Ecology) approved the *April 2008 SSAP* on May 9, 2008, in a transmittal to PacifiCorp Energy (Appendix B). The Washington Department of Fish and Wildlife provided a *Hydraulic Project Approval* on May 5, 2008, that authorized the sampling program to proceed at the Underwood In Lieu Fishing Access Site. A copy of the *Hydraulic Project Approval* is also included in Appendix B.

3.2 SAMPLING DATE, LOCATION, AND FIELD DOCUMENTATION

A team consisting of two Kleinfelder representatives conducted the field work to collect the sediment sample. The sediment sample was collected from the Underwood In Lieu Fishing Access Site on May 21, 2008. The sample collected at the Underwood In Lieu Fishing Access Site was labeled ILFAS-052108. The location of the sample point was determined with a Global Positioning System (GPS) unit with a minimum of three satellite points for reference. The coordinates of this sampling location and the other sampling locations from the Northwestern Lake sediment sampling characterization effort are included in Table 1. The sample collection location is shown in Figure 2.

The sediment sampling location was documented by a member of the Kleinfelder field team in the field notes, which were maintained during sampling operations. Included in the field notes was the following information:

- Names of the individuals onsite during sample collection
- Weather conditions
- Depth to top of sediments (mudline) at sampling station
- Date and time of collection of sample
- The sample identification number
- Physical sediment description, including general soil classification and observations for the presence of vegetation, debris, evidence of biological activity, and other distinguishing characteristics or features
- Any deviation from the approved sampling plan

The sediment sample for chemical analysis testing was immediately placed in properly labeled, laboratory-supplied glass jars with Teflon®-lined lids that were then placed on ice. Containers were filled as tightly as possible, eliminating obvious air pockets. With the cap liner's Teflon® side down, the cap was carefully placed on the opening of the container, displacing any excess material. A bulk sample for use in the exposure process of the bioaccumulation testing was placed into three clean, 5-gallon plastic buckets with clean lids.

The sampling containers were labeled with: the project name, sample identification, date, and time and referenced by entry into the field logs. New, disposable nitrile gloves were worn before the sample was collected and changed, as needed, during the collection of the sample as several containers were filled.

3.3 SAMPLE TRANSPORT AND CHAIN-OF-CUSTODY PROCEDURES

Following sample collection, the samples were packed on ice in coolers. A signed and dated chain-of-custody seal was placed on all coolers prior to removal from the site. The chain-of-custody records were maintained throughout all sampling activities and accompanied samples during shipment to the laboratory. Information tracked by the chain-of-custody records included: sample identification number, date and time of sample receipt, and analytical parameters requested.

4.0 CHEMICAL AND PHYSICAL ANALYSES RESULTS

Chemical and physical analyses of the sediment sample was conducted to determine the similarity of the reference sample collected at the Underwood In Lieu Fishing Access Site to the sediment samples collected from Northwestern Lake. The results of these analyses are presented and discussed below.

4.1 CHEMICAL ANALYSES RESULTS

A split of the sediment sample was delivered under chain-of-custody protocols to Apex Labs (Apex) in Tigard, Oregon, for chemical analysis. The project sample collected on May 21, 2008, was tested for the following:

- mercury concentrations by EPA Method 7471A
- total organic carbon (TOC) by American Society for Testing and Materials (ASTM) Method D 4129-98M.

The results of the chemical analyses are presented in Tables 2 and 3 along with the results from previously collected samples. Copies of the analytical reports provided by Apex are included in Appendix C. The results are summarized as follows:

- The mercury concentration from the sediment sample (ILFAS-052108) obtained from the In Lieu Fishing Access Site in May 2008 was 1.20 mg/kg.
- The mercury concentration in the sediment sample (SP5-071707) collected at this location in July 2007 was 0.72 mg/kg. Thus, the average of the mercury concentrations from sediment samples obtained from the In Lieu Site is 0.96 mg/kg.
- The sediment sample collected from Northwestern Lake in December 2006 (sample B1-72) contained 2.03 mg/kg mercury. The mercury concentrations reported for the seven supplemental samples collected from this same area in 2007 were all less than the concentration detected in sample B1-72. The average mercury concentration in the seven sediment samples collected in Northwestern Lake in July 2007 was 0.60 mg/kg (range 0.094 mg/kg to 0.881 mg/kg). When the sample from 2006 is included, the average concentration of mercury in surface sediment samples in the vicinity of the B1 sample location is 0.78 mg/kg. The mercury concentrations in the supplemental sediment samples appear to be more consistent with the average mercury concentrations derived from the data presented in the *March 2007 Sediment Report*.

- With an average concentration of 0.78 mg/kg at the B1 sample location, the average concentration of mercury in the 12 sample locations used to characterize sediments contained in the Lower Basin DMMU is 0.617 mg/kg.
- The mercury concentration in the sample collected from the In Lieu Site in May 2008 was almost twice the average concentration of mercury in the Lower Basin DMMU samples.
- At the Underwood In Lieu Fishing Access Site, the percentage of total solids was 67.6. Total solids in Northwestern Lake sediment samples collected in July 2007 ranged from 43.7 percent to 55.1 percent with an average of 50.4 percent (50.1 percent if the 2006 sample is included). Percent solids was not reported for the background sediment samples.

Total organic carbon (TOC) in the sample collected at the Underwood In Lieu Fishing Access Site in May 2008 was 1.20 percent. TOC in the samples collected in Northwestern Lake in July 2007 ranged from 0.86 percent (8,600 mg/kg) to 1.64 percent (16,400 mg/kg) with an average of 1.37 percent (13,700 mg/kg) or 1.33 percent if the 2006 sample is included. TOC in the sample collected from the In Lieu Site was similar to (slightly less than) the average TOC of the Northwestern Lake samples. TOC was not reported for the sediment samples collected for evaluation of background concentrations of mercury.

4.2 PHYSICAL PARAMETER ANALYSES RESULTS

A representative spilt of the sample from the In Lieu Site was delivered to Kleinfelder's soils testing lab in Beaverton, Oregon. The sample was analyzed for grain size determination using ASTM D422 and ASTM D2487 methods. The ASTM D422 analysis used the following sieve sizes: 5-inch; 2.5-inch; 1.25-inch; 0.63-inch; 0.31-inch; and numbers 5, 10, 18, 35, 60, 100, and 200. The fine-grained fraction (finer than No. 200 sieve) was classified using hydrometer analysis. Hydrogen peroxide was not used in the preparation for grain size analysis.

The results of the grain size analysis are provided in Appendix D and are summarized in Table 4. On the basis of the grain size analysis, Kleinfelder has classified the sediment in accordance with the Unified Soil Classification System, ASTM D 2487. The sediment classification is presented in Table 4. Note that the grain size composition of sediments from the locations sampled for background mercury levels are variable and

not uniformly consistent with the grain size composition of sediments from Northwestern Lake.

4.3 COMPARISON OF FINDINGS TO NWRSEF SCREENING LEVELS

The applicable, current regulatory screening levels for mercury in freshwater sediments are found in the NWRSEF. These screening levels include a lower screening level (SL1) of 0.28 mg/kg and an upper screening level (SL2) of 0.75 mg/kg. The sediment sample (B1-72) collected from Northwestern Lake in 2006 contained mercury at a concentration that exceeded the SL2 of 0.75 mg/kg, above which minor effects may be observed in more sensitive benthic organisms. Five of the seven samples collected to evaluate the distribution of mercury in Northwestern Lake sediments in the vicinity of the sample B1-72 exceeded the SL1 screening level of 0.28 mg/kg, which is a level below which adverse effects to benthic organisms would not be expected. Four of those five samples also exceeded the SL2 screening level. The average mercury concentration for the seven samples (NW1-071807 through NW7-071807) also exceeded the SL1 screening level, and the average including the sample collected in 2006 exceeded the SL2. The sample collected from the In Lieu Site in May 2008 also exceeded the SL1 and SL2 screening levels. The concentration of mercury in the previous sample collected from In Lieu Site in July 2007 exceeded the SL1 and was just below the SL2. Of the sediment samples collected to evaluate background mercury concentrations, only Mill Creek and In Lieu Site sediments contained mercury at levels that exceeded screening levels. The concentration of mercury in sediment taken from Mill Creek exceeded the SL1 but not the SL2.

4.4 QUALITY ASSURANCE AND QUALITY CONTROL

Samples submitted to Apex Labs were initially analyzed for TOC and mercury using EPA Methods SW9060A and 6020, respectively, although the submitted chain of custody specified using Method ASTMD 4129-98M for TOC and EPA Method 7471A for mercury. Once this discrepancy was discovered Apex Labs resubmitted the samples to Columbia Analytical Services (CAS) in Kelso, Washington for analysis by the appropriate methods. The additional time required for re-analysis resulted in an exceedance of the method hold times. The methods specify a hold time of 28 days, and the second set of tests were conducted 55 days after the hold time ended. The two mercury methods should produce comparable results, and the two test results are very similar. The mercury results were 1.14 mg/kg (Method 6020) and 1.20 mg/kg

(Method 7471). The TOC methods produce results in different unit measurements. The TOC results were 37.6 mg/kg (Method 9060) and 1.20 percent (Method 4129). CAS-Kelso has provided a Case Narrative for their package of laboratory results submitted for this set of analyses (Appendix C). No other anomalies or problems were noted.

Our QA review of the data indicates that the data are valid and, therefore, are acceptable for use in accomplishing the project objectives. Kleinfelder's QA/QC review included an evaluation of both the laboratory and field QA/QC procedures and results.

5.0 MERCURY BIOACCUMULATION EVALUATION

The State of Washington recognizes certain toxic substances in the environment as being bioaccumulative. Bioaccumulation is the process wherein a member of the biosphere takes in a substance quicker than it will excrete the same substance. This is a problem when the substance is toxic. The bioaccumulated toxic substance can also be passed along from one species (prey) to another species (predator). The larger the organism and the more active a carnivore an organism is, the greater the potential bioaccumulation. Mercury is a recognized bioaccumulative toxic substance.

To evaluate the bioavailability of mercury found in the sediments through invertebrate tissue analysis, bioaccumulation testing was conducted. Previous testing indicated the bioaccumulation of mercury in sediments collected from Northwestern Lake. The purpose of the bioaccumulation study for sediment collected from the In Lieu Site was to evaluate the bioavailability of background mercury in sediment similar to that of Northwestern Lake.

5.1 FIRST PHASE OF LABORATORY ACTIVITY FOR BIOACCUMULATION EVALUATION

Kleinfelder provided NW Aquatic Sciences of Newport, Oregon with 15 gallons of sediment obtained from the In Lieu Site. The sample was collected on May 21, 2008, and placed into clean, 5-gallon buckets dedicated to the bioaccumulation tests.

The reference sample location (ILFAS-052108) was selected because, based on field observations and laboratory testing, sediment at this location most closely resembled the sediment collected from the sample locations in Northwestern Lake that had mercury concentrations in excess of screening levels. A negative control sediment sample was collected by NW Aquatic personnel on May 21, 2008, from Beaver Creek, located about 8-miles south of Newport, Oregon. The negative control sample was press sieved through a 1.0 millimeter screen.

NW Aquatic conducted the exposure portion of the test using In Lieu Site test sediment and control sediments for a period of 28 days. During this 28 day period, oligochaete worm of the species *Lumbriculus* were exposed to the sediments. The exposures were conducted according to protocols based on EPA Method 100.3, EPA document 600/R-99-024, EPA document EPA-B-98-004 (the Inland Testing Manual), and ASTM E-1688-97a. Five sets of animals were used to provide the appropriate controls and replicates.

Specific details of the test procedures are presented in NW Aquatic's reports which are included in Appendix E.

5.2 SECOND PHASE OF LABORATORY ACTIVITY FOR BIOACCUMULATION EVALUATION

When the exposure period was completed, NW Aquatic provided the following sets of tissue samples to the Brooks Rand laboratory in Seattle, Washington:

- Five sets of tissue comprised of *Lumbriculus* that were exposed to the In Lieu Site sediments.
- Five sets of tissue comprised of *Lumbriculus* that were exposed to the control sediments.
- Five sets of tissue comprised of *Lumbriculus* that were not exposed to any sediments.

Brooks Rand laboratory composited each of the three groups of worms into three individual samples for analysis. One sample represented the tissue exposed to the In Lieu sediment that was collected at a single location; one sample represented the tissue exposed to the control sediment that was from a single location from Newport, Oregon; and one sample represented the tissue that was not exposed to any sediment. Brooks Rand personnel homogenized separately each of the three individual composited oligochaete worm samples. Homogenization blanks were also prepared at that time.

The samples were tested for mercury using an appendix to EPA Method 1631. Further information on the sample preparation is included in Brooks Rand's report, which is included in Appendix F. The results of Brooks Rand's mercury analysis is included in Appendix F and are summarized in Table 5.

5.3 BIOACCUMULATION EVALUATION TEST RESULTS

Mercury was detected in all oligochaete worm tissue samples including the homogenization blank. The level of mercury detected in the tissue of worms exposed to the Underwood In Lieu Fishing Access Site sediments was 0.186 mg/kg. The tissue of worms exposed to the Northwestern Lake sediments collected in June 2007 had an average concentration of 0.347 mg/kg of mercury. During bioaccumulation tests conducted on Underwood In Lieu Fishing Access Site sediments, mercury was detected in the pre-exposure worm tissue at 0.00133 mg/kg and in control worm tissue at 0.0106 mg/kg. During the previous bioaccumulation study of Northwestern Lake sediments

(collected in June 2007), mercury was detected in the pre-exposure worm tissue sample at an average of 0.00422 mg/kg and in control worm tissue at an average of 0.01312 mg/kg. The background level of mercury in the oligochaetes used in the bioaccumulation test appears to be approximately 0.003 mg/kg lower in the In Lieu Site study samples than in the Northwestern Lake samples, and the difference seems to be carried over into the controls. Controls from the In Lieu Site sediment bioaccumulation study also contained mercury at a level approximately 0.003 mg/kg less than the levels observed in controls in the study of the Northwestern Lake sediments.

The average concentration of mercury in oligochaetes exposed to sediments from Northwestern Lake was almost twice the concentration of mercury found in oligochaetes exposed to sediments from the Underwood In Lieu Fishing Access Site. The difference in the concentrations of mercury between pre-exposed worms and control worms in the two studies is not great enough to explain this difference. These findings suggest that although the concentration of mercury measured in sediment from the Underwood In Lieu Fishing Access Site appears to be slightly greater than the average concentration measured in the samples from Northwestern Lake, the mercury in Northwestern Lake sediments is more bioavailable to *Lumbriculus*. However, it should be noted that this comparison of mercury concentrations in sediment and mercury bioaccumulation in the oligochaetes is made on the basis of a single composite sample from the Underwood In Lieu Fishing Access Site. The use of a composite sample rather than a single individual sample allows greater confidence that the general concentration of mercury in the sediment at this location has been captured. However, the composite sample consists of a blend of individual subsamples and does not allow for an assessment of the variability in mercury concentrations in sediments at this location. Consequently, a single subsample containing a high concentration of mercury could raise the measured level of the entire composite sample.

The Oregon Department of Environmental Quality (DEQ), a co-member of the RSET with WDOE and others, has published its *Guidance for Assessing Bioaccumulative Chemicals of Concern in Sediment* (April 3, 2007). DEQ's guidance provides the following numerical criteria for mercury.

Acceptable Tissue Levels (ATLs):

- Humans General / recreational: 0.40 mg/kg
 Subsistence / Tribal: 0.049 mg/kg
- Mammals Individual: 0.12 mg/kg
 Population: 0.20 mg/kg
- Birds Individual: 0.074 mg/kg
 Eagle eggs: 0.18 mg/kg
 Population: 0.15 mg/kg
 Osprey eggs: 0.89 mg/kg

Freshwater Critical Tissue Level (CTL): 0.088 mg/kg

In bioaccumulation tests on sediments from both the Underwood In Lieu Fishing Access Site and Northwestern Lake (all samples), oligochaete worms (*Lumbriculus*) accumulated tissue levels of mercury that exceeded the Freshwater CTL. Assuming that indigenous oligochaetes will accumulate mercury to the same extent as the test organisms, this finding is a potential concern. Assuming that fish and other organisms in the aquatic food web will have greater concentrations of mercury than the indigenous oligochaetes, and assuming that indigenous oligochaetes will accumulate mercury to similar levels as the *Lumbriculus* worm used in the laboratory tests, one can make tentative comparisons to ATLs and CTLs for other organisms. For example, the concentration of mercury in the oligochaete worms exposed to the sediments from Underwood In Lieu Fishing Access Site exceed the Tribal and Subsistence Fishers Oregon ATL, the Oregon Avian Population and Individual ATLs, the Oregon Avian (Eagle) Egg ATL, and the Oregon Mammal Individual ATL. Individual and average concentrations of mercury in Northwestern Lake sediments collected in 2007 exceeded these same ATLs, plus the Oregon Mammal Population ATL. The oligochaete worm tissues from the pre-exposure sample, the control sample, and pre-exposed tissues did not exceed an Oregon ATL.

6.0 SUMMARY AND CONCLUSIONS

Previous sediment sampling and analysis for environmental and physical characteristics of sediments were conducted to provide information on the distribution and bioavailability of mercury in Northwestern Lake. Current sediment sampling and analysis were conducted to provide a comparison of the bioavailability of mercury in sediment from the Underwood In Lieu Fishing Access Site, which is similar, to the sediment found in Northwestern Lake. The following conclusions are based on the information presented in this report:

- Chemical analysis of sediments at the Underwood In Lieu Fishing Access Site (White Salmon River) indicate that mercury is present. The mercury concentration detected during the 2007 supplemental investigation was 0.72 mg/kg. The mercury concentration detected during the May 2008 sampling was 1.20 mg/kg.
- Chemical analysis of sediments in Northwestern Lake indicates that mercury is present. The mercury has consistently been detected in the sediments since the sediment evaluation began in 1994. Mercury concentrations detected in Northwestern Lake sediments during the 2007 supplemental investigation ranged from 0.094 mg/kg to 0.881 mg/kg. Including the supplemental samples collected in 2007, the average sediment mercury concentration concentration in the B1 sample location is 0.78 mg/kg, resulting in an average concentration of mercury in the 12 sample locations used to characterize sediments contained in the Lower Basin DMMU of 0.617 mg/kg. This average concentration exceeds the SL1 screening level of 0.28 mg/kg but is below the SL2 screening level of 0.75 mg/kg.
- Physical analysis of sediments at the Underwood In Lieu Fishing Access Site (White Salmon River) indicate they are similar to the sediments collected from Northwestern Lake. Sediments from Northwestern Lake are predominantly silt with variable concentrations of clay and trace sand. Sediments from the In Lieu Site had silt with clay and trace organics (May 2008 sample) and silt with trace sand (July 2007 sample).
- Mercury in background sediment collected from the In Lieu Site can bioaccumulate in worm tissue exposed to the sediment. Although the average concentration of mercury was slightly greater in sediment samples from the In Lieu Site than in samples from Northwestern Lake, the bioavailability of mercury in Northwestern

Lake sediments appears to be greater based on results of laboratory bioaccumulation tests with the aquatic oligochaete worm *Lumbriculus*. However, these comparisons were made on the basis of a limited number of samples, including only a single bioaccumulation test conducted on In Lieu Site sediments.

- As previously stated, mercury is a native element commonly found in rocks associated with Cascade Range volcanic activity. Numerous geologic publications discuss the presence of mercury in hydrothermally altered rocks, specifically argillic or fine grained rocks. Hydrothermally altered rocks are related to volcanic activity. The White Salmon River receives direct runoff from nearby Mount Adams, a Cascades Range volcano and from the Big Lava Bed Geologic Area located west of the White Salmon River. This might be the source of mercury found in the sediments.
- According to USGS Professional Paper 1270, background mercury concentrations are considered to be between 0.32 mg/kg and 2.0 mg/kg in the White Salmon River area. The mercury concentrations encountered in the 2007 sediment samples ranged from 0.014 mg/kg to 1.2 mg/kg. In 2006, the mercury concentrations ranged from 0.020 mg/kg to 2.030 mg/kg, and in 1994, the mercury concentrations ranged from less than 0.025 mg/kg to 1.1 mg/kg. The average mercury concentration in the fine grained sediments of Northwestern Lake sampled in 2007 is 0.6 mg/kg. This average increases to 0.7 mg/kg when the 2006 sample results are included in the average.

In summary, mercury is present in the fine-grained sediments impounded by Condit dam at levels that are within the range of background concentrations reported in the literature. Mercury is also present in locations that represent background locations that should be unaffected by sediments contained within Northwestern Lake, including the Underwood In Lieu Fishing Access Site. It is our opinion that the mercury at both locations arises from natural sources in the uplands drained by the White Salmon River. The mercury can be accumulated by the tested aquatic organisms and may bioaccumulate and possibly biomagnify in the food web. The current mercury concentrations in sediments at both the Underwood In Lieu Fishing Access Site and Northwestern Lake might pose a potential health risk for individuals or populations of humans and animals that ingest a diet consisting primarily of tissue obtained from these locations.

It is important to note that the form of mercury present and mercury cycling are affected by a number of factors such as flow that might differ between Northwestern Lake and the other sampling locations, which appear to be more representative of lotic (free-flowing water) rather than lentic (still water) conditions. Thus, bioavailability of mercury in sediments at Northwestern Lake might change after sediments are released from the impoundment into more lotic conditions.

Mercury in the environment is also constantly cycled and recycled (mercury cycling) through a biogeochemical cycle. The cycle has six major steps: degassing of mercury from rock, sediments, soils, or surface waters; movement in gaseous form through the atmosphere; deposition of mercury on land and surface waters; conversion of the element into insoluble mercury sulfide; precipitation or bioconversion into more volatile or soluble forms such as methylmercury; and reentry into the atmosphere or bioaccumulation in food chains. Therefore, mercury concentrations can also vary due to the dynamic nature of mercury cycling in the environment.

Biological and physical factors that can effect mercury concentrations and particularly methylation and demethylation of mercury are discussed in a technical memorandum in Appendix G. The literature review conducted to assess the rate of mercury demethylation after the sediments are released from Northwestern Lake indicate that there are a number of factors that control mercury methylation and demethylation. Unfortunately, there is not sufficient site-specific information regarding the reservoir sediments and downstream environments in the White Salmon and Columbia Rivers to determine whether, or at what rate, mercury in the sediments in Northwestern Lake will undergo demethylation or methylation following the removal of Condit dam.

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8.0 LIMITATIONS

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