Condit Hydroelectric Project Decommissioning

FERC Project No. 2342

POST-RESERVOIR-DEWATERING ASSESSMENT REPORT

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Post-Reservoir-Dewatering Assessment Report

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1.0 Introduction

1.1 Project Description

PacifiCorp Energy owns and operates the Condit Hydroelectric Project, which was completed in 1913 on the White Salmon River in Skamania County and Klickitat County, Washington. In 1991, PacifiCorp Energy filed an application with the Federal Energy Regulatory Commission (FERC) for a new license authorizing the continued operation and maintenance of the project. PacifiCorp Energy evaluated the economic impacts of the FERC recommendations contained within the Final Environmental Impact Statement (FEIS) and determined that the mandatory conditions would render the project uneconomic to operate. After consultation with project stakeholders, the Condit Settlement Agreement was signed by PacifiCorp Energy and project stakeholders to resolve all issues in the proceeding for relicensing the project. The Condit Hydroelectric Project is currently being removed as outlined in the Project Removal Design Report dated March 15, 2011, 12 supporting management plans, the Washington Department of Ecology 401 Certification, the US Army Corps of Engineers 404 Permit, and the FERC Surrender Order.

A specific management plan was developed (Sediment Assessment, Stabilization, and Management Plan, PacifiCorp Energy, 2011) to address sediment stability and management issues that were expected to occur in the decommissioning process. This plan identified general goals and procedures for 1) performing a post-dewatering-assessment, 2) mapping the sediment which remains in the reservoir area, 3) estimating the quantity of sediment remaining in the reservoir area, 4) evaluating the stability of sediment slopes and banks in the reservoir area, 5) determining corrective actions as needed, and 6) evaluating fish passage through the former reservoir.

1.2 Regulatory Requirements

A section 404 permit was issued for this project (US Army Corps of Engineers, Regulatory Division, May 13, 2011). The 404 permit requires that the applicant (PacifiCorp Energy) implement the management plan (Sediment Assessment, Stabilization, and Management Plan, PacifiCorp Energy, 2011) as approved by the FERC.

A section 401 permit was issued for this project (Washington Department of Ecology, Water Quality Certification Order No. 8049, October 12, 2010). The 401 certification requires that the applicant (PacifiCorp Energy) implement the management plan (Sediment Assessment, Stabilization, and Management Plan, PacifiCorp Energy, 2011). The 401 certification establishes "Interim Limits" to assess and manage reservoir sediments, including 1) mapping the sediment which remains in the reservoir area, 2) estimating the quantity of sediment remaining in the reservoir area, 3) evaluating the stability of sediment slopes and banks in the reservoir area, 4) determining corrective actions as needed, and 5) evaluating fish passage through the former reservoir. The 401 certification also requires preparation of a report "that compares observed sediment transport dynamics and geomorphic response to assumptions and modeling results presented in the 2004 Sediment Behavior Analysis report (G&G Associates, 2004). This report is intended to satisfy this requirement.

The FERC has issued the Order Accepting Surrender of License, Authorizing Removal of Project Facilities, and Dismissing Application for New License [FERC, December 16, 2010 (FERC December 2010 SO)]; Order on Rehearing, Denying Stay, and Dismissing Extension of Time Request [FERC, April

21, 2011 (FERC April 2011 SO)]; and Order Modifying and Approving Sediment Assessment, Stabilization and Management Plan (FERC, May 12, 2011) for the project. The FERC April 2011 SO slightly modified Ordering Paragraph M of the FERC December 2010 SO regarding the Reservoir Sediment Assessment and Stabilization Plan. The FERC April 2011 SO required PacifiCorp Energy to submit a Sediment Assessment, Stabilization, and Management Plan in accordance with the 401 certification. The FERC Order Modifying and Approving Sediment Assessment, Stabilization, and Management Plan (FERC, May 12, 2011) incorporated elements of the Sediment Assessment, Stabilization, and Management Plan into their requirements. In December 2011, PacifiCorp Energy submitted a Preliminary Sediment Behavior Report to the Washington Department of Ecology for consultation. The preliminary report summarized the sediment conditions observed in the first 60 days post breach. After consulting with Washington Department of Ecology, the preliminary report was filed with the FERC on January 24, 2012.

This Post-Reservoir-Dewatering Assessment Report builds upon the Preliminary Sediment Behavior Report with the inclusion of LiDAR survey data that quantifies the sediments remaining in the reservoir area and a grading plan to stabilize the remaining sediments.

2.0 Post Reservoir Dewatering Sediment Behavior

2.1 Initial Response – the First 6 hours

The explosive charges were detonated at 12:08 PM on October 26, 2011. The drain tunnel was opened, sending a rush of water and sediment down the White Salmon River. A time-lapse video of the dam breach event created by an independent film maker can be seen at:

http://vimeo.com/31305629

It took just over one hour from the opening of the drain tunnel to evacuate all the standing water in the reservoir. During this same time period, the majority of sediment within the first 1,500-feet upstream of the dam (in the historic river canyon) flushed downstream. These fine-grained sediments in the lower part of the reservoir were estimated to be 15-30 feet thick. Given their unconsolidated and fully saturated condition, these sediments sluiced through the drain tunnel as a hyper-concentrated water flow. The historic basalt outcrops upstream of the dam that form a river canyon were exposed almost immediately. To view photographs of this reach please see Photo Points #6 and #9, in Appendix D.

Over the course of the next five hours reservoir sediments continued to mobilize, with erosion and mass wasting being the primary mechanisms. Many rotational failures of large sediment masses were observed, and as these sediments fell in to the free-flowing river they were entrained in the flow. The primary area of sediment mobilization on the afternoon of October 26, 2011, was between STA 0+00 (Condit dam) and STA 40+00 (4,000-feet upstream of the dam). Within this reach an active head-cut of approximately 40-feet height was slowly migrating upstream. As thick deposits of sediment lost lateral support, mass wasting of sediment on either side of the evolving river channel proceeded in a rapid fashion. The cover photograph of this report taken from Photo Point #9 shows the head-cut and mass wasting processes on the afternoon of October 26, 2011. Failure modes observed included: slumping, rotational failures, and vertical plane failures. High pore pressures in these sediments increased the instability. Water seeps appeared in many places showing drainage of the sediment layers. Tension cracks appeared on the surface of many sediment deposits.

2.2 Sediment Mobilization Upstream of the Dam

Sediments within the former reservoir area have continued to erode over the past three months. As was predicted, the rates of river channel erosion and mass wasting of sediment were quite high in the first two weeks post-breach. By the time of the LiDAR survey (58 days post breach) the rate of river bed elevation change within the reservoir area had decreased to a visually undetectable level, and large mass wasting events had ceased to occur. Smaller landslide movements of residual sediments were still occurring. Tributary drainage channels continued to erode through reservoir sediments during this time period. As sediment mobilization rates decreased, the turbidity measurements at the powerhouse also decreased, except during rainfall runoff events. Figure 1 indicates that baseline turbidity levels measured at the Powerhouse had dropped down to the range of 20-50 NTUs by early December.

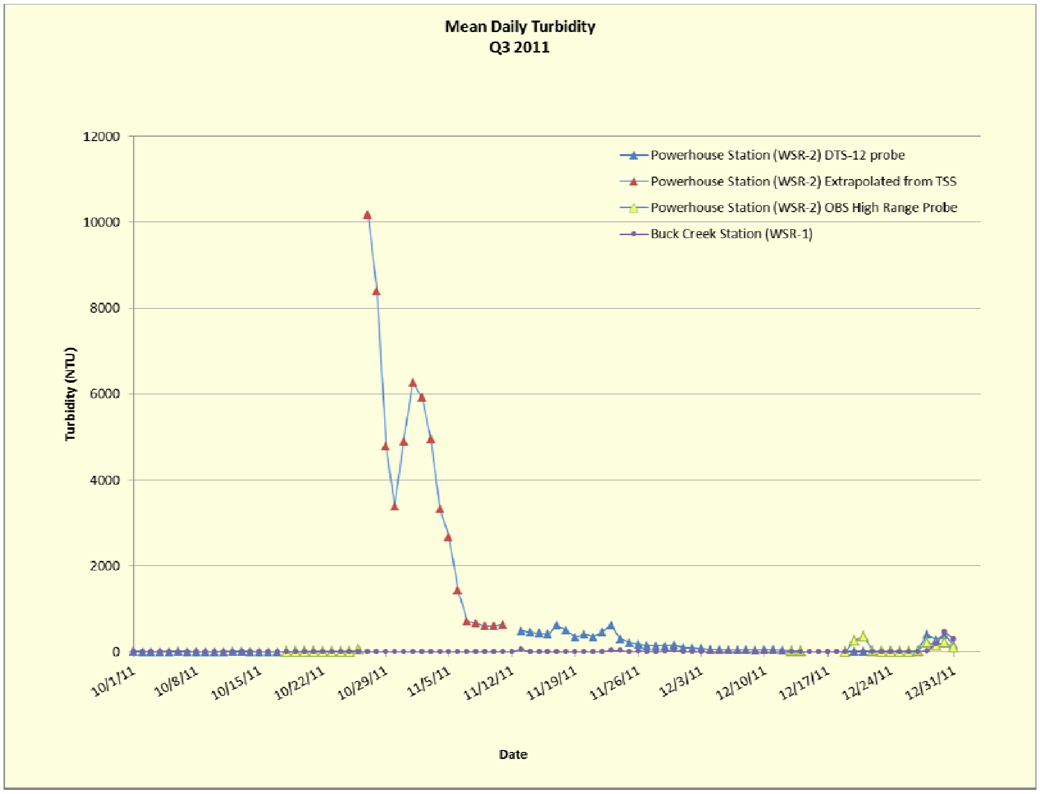

Figure 1. Mean daily turbidity values October through December 2011. (Figure 2.1-3, Water Quality Monitoring Quarterly Report, October to December 2011)

2.3 Sediment in the Canyon Reach Downstream of the Dam

Sediment concentrations in the White Salmon River were observed to be extremely high as predicted in the Sediment Behavior Analysis Report (G & G Associates, 2004). The initial flood wave had a high concentration of suspended sediments (primarily silt size material) which quickly exceeded the upper limits for detection in the turbidity probes installed in the river. The probes had an upper limit for detection of 4,000 Nephelometric Turbidity Units (NTUs). Manual collection of water and suspended sediment samples commenced immediately and continued for the following two weeks, until the concentrations came down enough to be detected by the 4,000 NTU turbidity probe. Suspended sediment samples collected manually were tested in the laboratory for Total Suspended Solids (TSS). Measured data points are shown in Figure 2. The TSS fraction of the total sediment load was significant, but observations suggest that a large amount of bedload sediment transport was occurring simultaneously. Bedload sampling was not performed during or after the breach event, so there is no quantitative means to estimate the peak concentration of total sediment load in the White Salmon River. Based on field observations, it is possible that the peak sediment load was in the range of 50,000 - 100,000 parts per million (PPM).

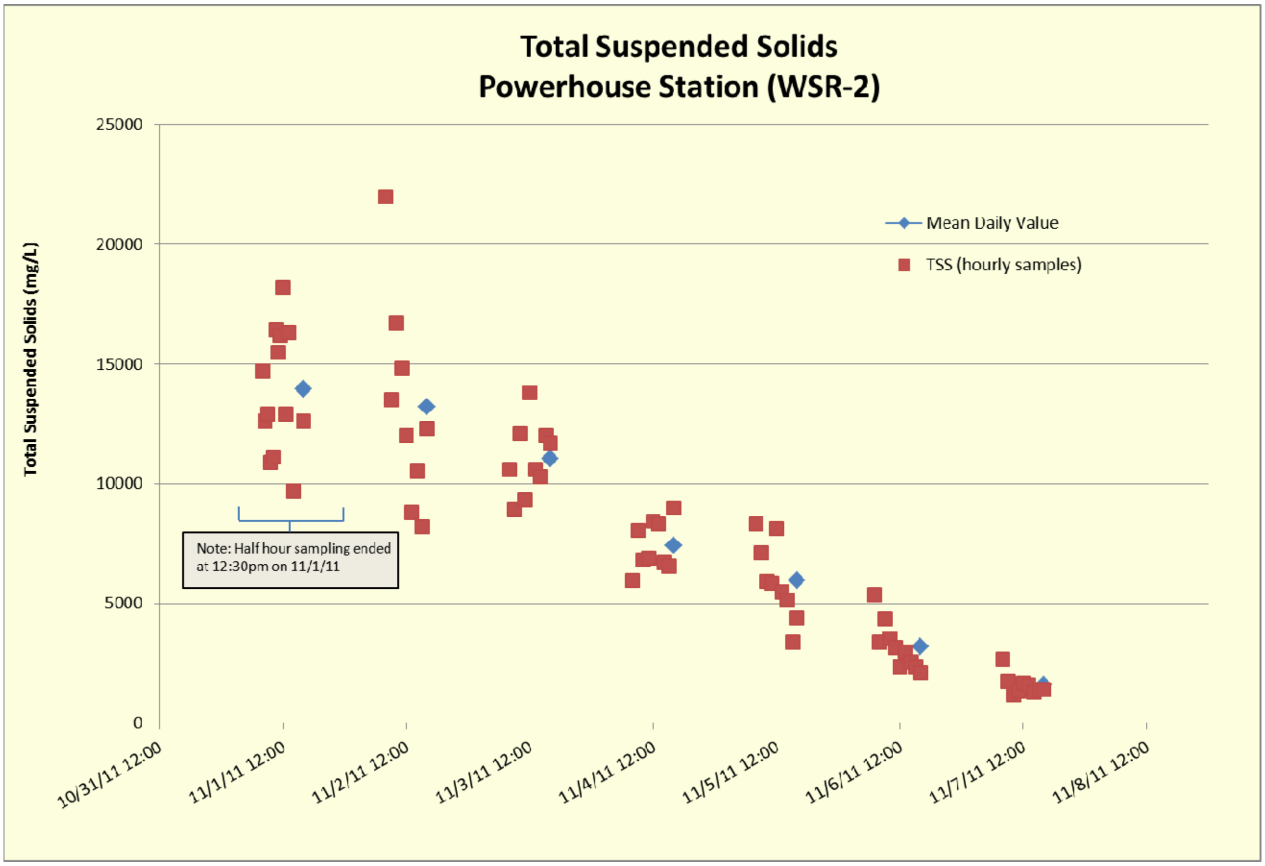

Figure 2. Total Suspended Solids for samples taken at the Powerhouse Station from October 26, 2011 to November 7, 2011.

Bedload concentrations certainly increased in the days after the breach event, as high volumes of sand-size particles were mobilized from the reservoir area. Field observations at the powerhouse showed the water surface rising daily for the first 10-11 days post breach. It is believed that this rise in water surface was due to a rising channel bed: sand-size sediments temporarily filling up the bottom of the channel. Anecdotal observations at a staff gage upstream of the reservoir suggest that water flow in the river did not change substantially during this 10-day period, remaining at around 700 cubic feet per second (CFS). Direct measurement of water surface (stage) has been recorded continuously at the USGS stream gage (USGS Gage No. 14123500) in the lower White Salmon River. Assuming the water flow in the river remained consistent during the first two weeks post breach (no rainfall events occurred), then the USGS stage data is analogous to the changes in river bed elevation from temporary sand deposits. During this two-week period, sediment supply to the canyon reach exceeded the sediment transport capacity of the river, allowing the excess sediments to be deposited in the riverbed. Beginning on approximately November 8, 2011, the sediment supply began to decrease, the sediment transport capacity of the river exceeded the supply, and channel bed elevations began to decrease (Figure 3). By approximately November 12, 2011, the river bed had returned to an elevation close to the pre-breach grade, and water stage readings stabilized.

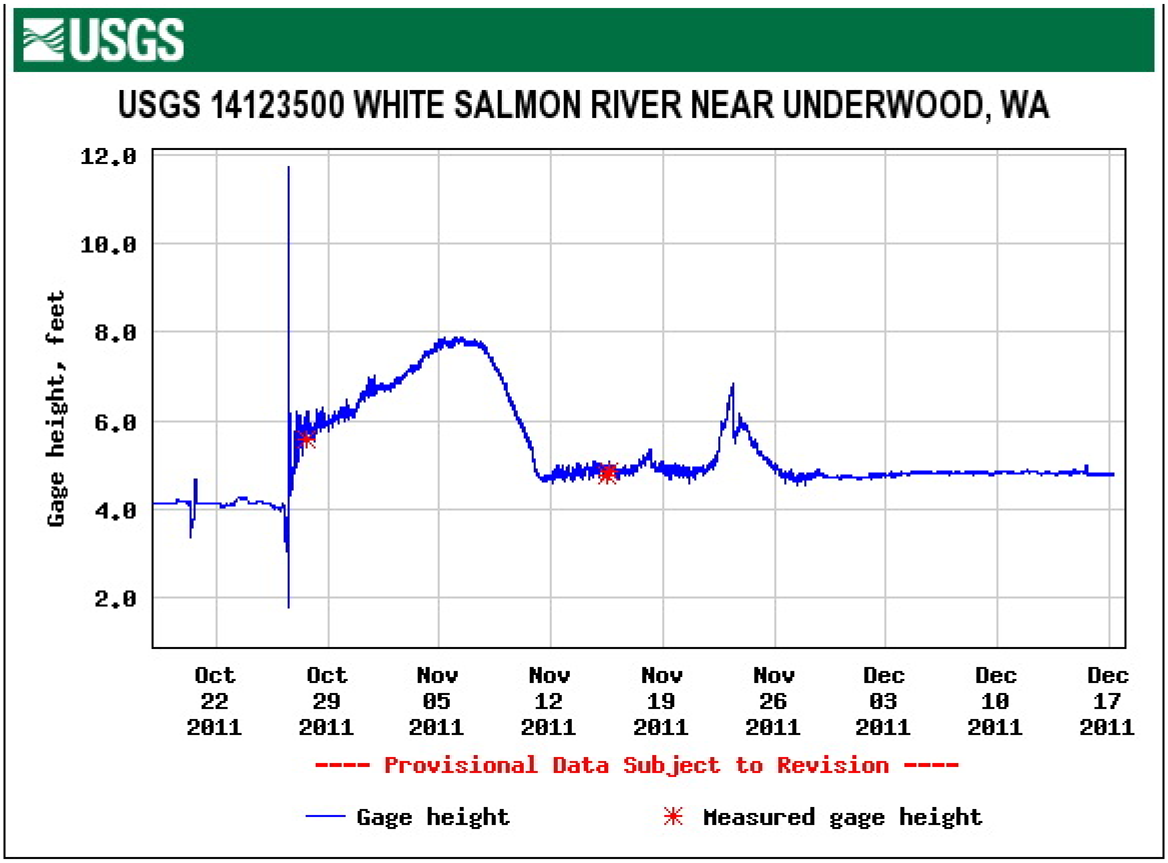

Figure 3. White Salmon River gage height at USGS Gage 14123500. Provisional Data from October 22, 2011 to December 17, 2011 Subject to Revision.

As the water levels dropped at the powerhouse, the level of temporary sediment filling of the channel bed could be seen. Photo 1 shows what is left of the temporary channel bed fill, with the sediment drape line on river right (view is looking downstream).

Photo 1. Downstream view of the White Salmon River at the powerhouse. Temporary bed sediment levels can be inferred from the deposition on river right. On river left the powerhouse tailrace is filled with sediment. Photo date December 7, 2011.

2.4 Sediment Influx to the Columbia River

The dam breach event had an estimated peak flow rate of approximately 14,000 CFS, somewhat larger than the pre-breach estimate discharge of 10,000 - 11,000 CFS. Flows throughout the first week had significant suspended sediment concentrations (see Section 2.5). On the afternoon of October 26, 2011, a plume of muddy water was visible flowing out of the White Salmon River mouth and into the Columbia River. Increases in turbidity measured at buoys anchored in the Columbia River showed the progression of turbid water westward from the White Salmon River. Figure 4 shows the head of the suspended sediment plume reaching Bonneville Dam approximately seven days after the breach. The turbidity data collected at the buoys shows a general pattern of dilution as the sediment plume moved down the Columbia River. Buoy No. 2 was at the mouth of the White Salmon River, and buoys Nos. 3, 4, and 5 were progressively further downstream. Buoy No. 1 was also in the Columbia River, but it was upstream of the White Salmon River confluence.

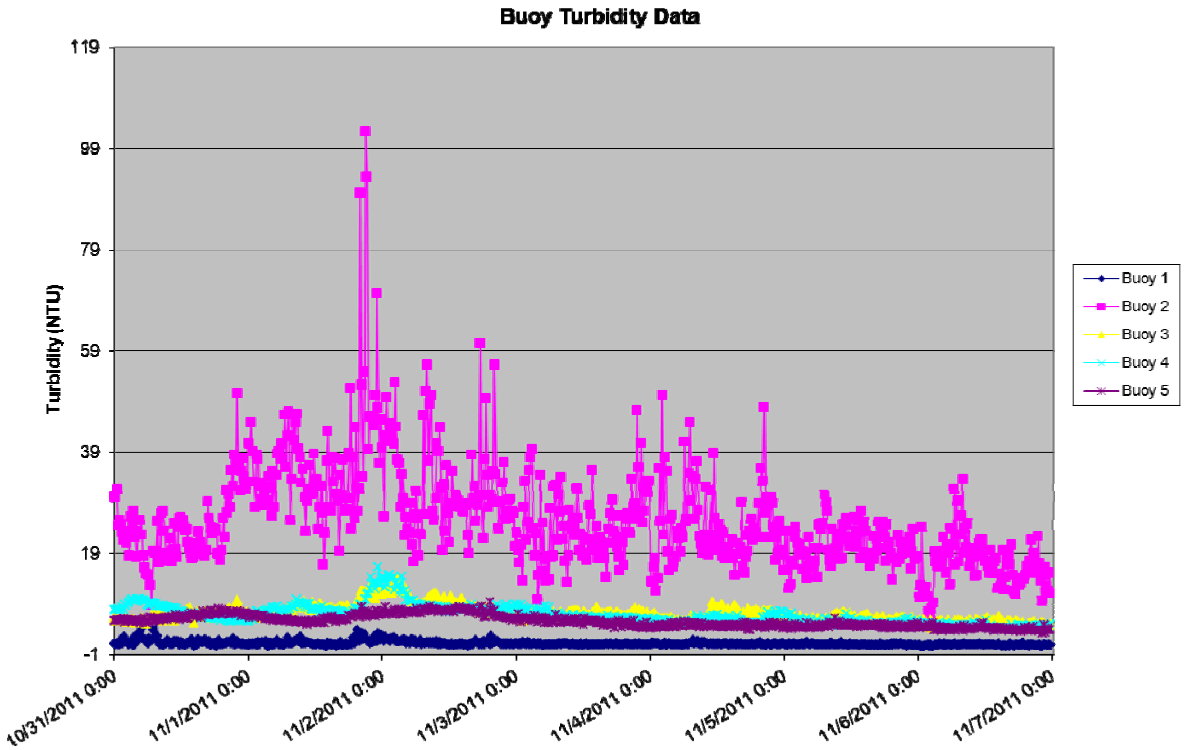

Figure 4. Columbia River turbidity data from five monitoring buoys.

Visible evidence of turbidity on the surface of the Columbia River was notably absent during the first four weeks post breach. It is believed that the majority of the sediment discharged to the Columbia River was sand-size particles, moving as fluid bed sediment. On breach day the USGS attempted to measure discharge from the White Salmon River under the railroad bridge at the confluence with the Columbia River. Verbal accounts say that this measurement effort was abandoned when it was determined that the majority of surface water was flowing in an upstream direction. This suggests a powerful current flowing along the bed of the White Salmon River out into the Columbia River, consistent with a high bedload concentration and a density greater than that of clear water.

Sand-size sediment accumulated at the "Underwood In-Lieu site" on the White Salmon River, just upstream of the Columbia River confluence. At this location the width of the White Salmon River doubles from the typical channel width upstream, and the gradient of the river is quickly reduced because of backwater effects from the Bonneville Pool. It took only a few days for the Underwood In-Lieu site to fill almost completely with sand, creating a wide and shallow flow of water and sediment across the new bed surface. Conversely, it took almost four weeks after the breach before sand deposits were visible on the surface of the Columbia River at the mouth of the White Salmon River (Photo 2). After three months time, the White Salmon has cut a new channel through the sediments at the Underwood In-Lieu site, but enough sediment still remains to make the former boat ramp unusable until some dredging work is completed.

Photo 2. Columbia River at the mouth of the White Salmon River on December 8, 2011. Sand bars visible.

Bathymetric surveys conducted in the Columbia River at the mouth of the White Salmon River in the first week post breach revealed approximately 433,000 cubic yards deposited. It is apparent that the bulk of the bedload sediment volume had taken weeks rather than days to reach the Columbia River. A limited number of sediment depth data points were collected on November 30, 2011. These data points and depth are shown on Photo 3, as is the commercial navigation channel (faint yellow line). The Coast Guard placed a lighted warning buoy at the outer extent off the sediment deposition area to warn mariners of the sandbar.

Photo 3. Depth to sediment surface measurements taken on November 30, 2011. Columbia River at the mouth of the White Salmon River. Note: photography is from an earlier date.

3.0 Remaining Sediments in the Former Reservoir Area

3.1 Sediment Stability Assessment

Lands beneath the former reservoir surface area are a mix of exposed rock outcrops, sediment deposits that are no longer eroding but which still have stability issues, side drainages that are eroding through reservoir sediment deposits, and a river channel which has down-cut within the reservoir area to an elevation and profile similar to the form which existed prior to the dam construction. Sheets A1, A2, and A3 in Appendix A provide a direct comparison of the LiDAR based topographic mapping from December 21, 2011, with the topographic map of the reservoir area prepared by Northwest Power Company in 1912. These sheets include annotations of the elevations from each topographic data set at selected locations, and the difference in elevation at these locations which can be interpreted as a reasonable estimate of the thickness of remaining sediment.

The stability of the remaining reservoir sediment has been evaluated using the LiDAR based topographic mapping from December 21, 2011, and field observations. Analysis of existing slope angles in the LiDAR topography has defined locations where a slope steeper than 30° exists. Sediment slopes steeper than 30° are presumed to be geotechnically unstable in the long term, whereas rock formations that exceed this slope angle are presumed to be stable. The extents of the mapped steep slopes are shown in Sheets B1, B2, and B3 in Appendix B. Steep slopes with a bedrock substrate have been identified with field observations, and have been separated in the sheets from steep slopes without evidence of underlying bedrock support.

Comparison of the LiDAR data with the 1912 topographic maps suggests that the river, within the reservoir area, has reached an elevation close to the pre-reservoir elevation. Other qualitative observations suggest that the river is nearing its pre-dam profile, including, 1) coarse size bed sediments observed throughout the former reservoir area, and 2) exposed tree stumps that are close to the observed water surface. In terms of lateral channel stability, the river has exposed rock or stumps along its sides for at least 60 percent of the reservoir length, leaving only a few locations where a new meander pattern could potentially develop. Comparison of the LiDAR data with the 1912 topographic maps (Sheets A1-A3) suggests that the river channel has re-occupied its former alignment in most locations.

3.2 Comparison of Estimated Sediment Quantities

The volume of sediment remaining in the reservoir area has been estimated by comparison of the recent LiDAR based topographic data with digitized topographic mapping from pre-reservoir surveys. The volume of sediment remaining in the reservoir is shown in the table below. The majority of sediment remaining in the reservoir area is found in five distinct Locations. These Locations are identified in Sheets B1, B2, and B3 and the sediment volume calculations have been separated into each of the five Locations. Figure 5 shows the total calculated remaining sediment volume is just over 921,600 cubic yards (CY). This calculated volume is higher than the Sediment Behavior Analysis Report (G&G Associates, 2004) where a residual volume of 200,000 to 700,000 cubic yards was estimated.

Condit Dam Decommissioning Project	
Volume of Sediment Remaining in the Reservoir Area	
Location	**Estimated**
	Volume
	(Cubic Yards)
Location 1	29,000
Location 2	176,000
Location 3	261,000
Location 4	277,000
Locations 5 & 6	337,000
Total Estimate Sediment Volume Remaining:	**921,600**

Figure 5. Estimated Remaining Reservoir Sediment Volumes based on December 21, 2011, survey.

3.3 Proposed Grading Plans for Sediment Management

The sediment management plan requires that sediments remaining in the reservoir area be stabilized. Stabilization will involve grading the sides of sediment deposits to a stable angle, revegetation of exposed sediment surfaces, and managing tributary streams so that they cannot saturate and erode the remaining sediment deposits.

The former reservoir reach of the White Salmon River runs through a relatively narrow valley with steep sideslopes. Sideslope angles in many locations are steep enough to indicate a bedrock substrate. The river's location is on the south side of the Mt. Adams geologic uplift, and the terrain through which the river runs is moderately steep. The rocky terrain with a moderately steep gradient has led to an incised river form with a limited meander pattern and only small, infrequent alluvial deposition zones. As the reservoir was drained, the sediments in the lower end of the reservoir eroded away quickly to expose a narrow gorge-like valley form with steep rock sideslopes. There is evidence of several geologically-recent basalt flows that have come down this river valley. These recent basalt flow deposits have been partially eroded by the river, and they appear at intermittent locations within the reservoir area. In the upper end of the reservoir the overall width from valley side to valley side is noticeably wider. Even so, there is only limited evidence of an active alluvial floodplain adjacent to the river channel. As the river has down-cut through the reservoir sediments, the river has establish a horizontal alignment which is very similar to the alignment shown in the 1912 pre-dam survey mapping completed by Northwestern Electric Company.

Sediments deposited in the reservoir at the upstream end are sand and gravel size material. The sediments in the middle sections of the reservoir are typically fine sand size particles, and the sediments in the lower section of the reservoir are typically silt size particles. As a result of the "lacustrine" depositional environment none of these sediments are well consolidated. The problem of poor consolidation (low density) becomes more pronounced as the sediment particle size decreases. Practically speaking, this means that the reservoir sediments do not hold water as well as might be expected, they do not support heavy equipment as well as the same soil particle size when properly compacted, and they are particularly vulnerable to erosion by flowing water.

In developing a grading plan for the reservoir sediments, several general parameters were considered:

1. Grade steep side slopes to a geotechnically stable slope of 2H:1V or flatter.
2. Control the location of side tributary channels by shaping small valleys for them to flow through. Grade these small valleys down to an elevation close to their pre-reservoir elevations. This will reduce the potential for future sediment erosion.
3. Stabilize all exposed soil surfaces with vegetation to control surface erosion.
4. If bedrock is encountered in the proposed slope grading, the slope grading will be field adjusted - no bedrock excavation is proposed.
5. Pre-reservoir stumps will remain in place. Where these stumps are currently exposed the land surface will not be changed. If stumps are encountered in the proposed slope grading, the slope grading will be field adjusted to work around them.
6. Create revegetation opportunities throughout the project including, low floodplains next to tributary drainages, low benches next to the White Salmon River for woody riparian vegetation re-establishment, flat benches in some locations, side slopes flatter than 2:1 in varying locations, and grading for the capture and management of surface runoff water near existing wetlands and in areas where wetlands might become established.
7. Bulldozers or other suitable earthmoving equipment will be used to smooth out the finished surface of remaining sediment. Bulldozers will track up and down soil slopes, creating surface indentations suitable for revegetation efforts. The weight of this machinery will provide compaction of the soil surface, which will reduce future erosion and soil permeability.

The proposed grading plan in the reservoir area has been divided in to the five distinct locations where the majority of the sediment remains, and a sixth location above Northwestern Lake Road. The proposed grading plan drawings can be found in Appendix C, Sheets C1-C4. Specific grading considerations for each location are discussed below.

Location 1 - This is the first area upstream of the dam, on river right. Steep rocky side slopes have been exposed on both sides of the river channel. No additional slope stabilization measures are proposed for these lower slopes, because of their bedrock substrate. Above the rocky gorge on river right there is a sloping bench where reservoir sediments have partially eroded in the past 3 months. The proposed grading plan shows this bench smoothed off at a 2H:1V or flatter slope, balancing cut and fill within that location. At the north end of Location 1 there are two tributary streams that come in on river right. Analysis of sideslopes in these tributary drainages indicates that the hill sideslopes before the reservoir were/are steeper than 2H:1V, that the remaining reservoir sediments are limited in thickness and extent, and that as they exist now the remaining sediments do not pose a large threat for mass wasting and instability. We expect that the remaining sediment will erode away in the next few years without the need for mechanical intervention. There is one "pillow" of sediment that is an exception to these general conclusions, and that pillow is shown on the grading plan on the river right side of Little Buck Creek. This location will be graded with a 2H:1V slope.

Location 2 - This is the first area upstream of the dam on river left. There is visual evidence of a basalt bench beneath the sediment deposit. This bench is located approximately one-half the vertical distance between the river bed and the top of the sediment deposit. The proposed grading of this location assumes that the basalt bench extends beneath the entire sediment deposit, and it assumes that the basalt surface will provide a limit to how much the side tributary streams (2) will be able to erode through the sediments over time. At each tributary stream the grading plan shows a simple alignment for the stream to drain to the White Salmon River. On either side of the stream alignment the proposed sediment grading cuts a small "valley" form creating a "floodplain" on either side of the stream. This creates an "opportunity zone" for riparian vegetation, and most importantly helps to control the extent of the erosion that may occur over the next few years, while riparian vegetation becomes established. The remaining areas within Location 2 have been left with their semi-flat reservoir deposition surface and with the edges graded with a 3H:1V typical sideslope.

Location 3 - This is the second area upstream of the dam on river right. There is no visual evidence of a basalt bench beneath the sediment deposit. The exact thickness of the sediments in Location 3 is not known, but could be as thick as 40 feet in some locations. For the middle section and the downstream section of this sediment deposit the grading plan includes three basic elements, 1) create a 12-foot wide bench parallel with the river channel and elevated above the water by 3-4 feet, 2) cut a backslope from the bench up to the top of the sediment deposit at a 2H:1V slope angle, and 3) leave the top surface of the reservoir sediment deposit in its existing (semi-flat) condition. The narrow bench next to the river provides an "opportunity zone" for the re-establishment of riparian vegetation next to the river channel. It also provides an erosion buffer, so that if the river did erode laterally it would not undercut the 2H:1V slope. The height of the bench is planned to match the height of an alluvial floodplain next to the river, consistent with the 1.5 year return frequency flow. The 2H:1V slope angle is considered geotechnically stable unless the soil becomes fully saturated, which will be avoided by effectively managing uphill water sources. The volume of soil that must be moved to achieve the 2H:1V slope angle is quite significant. Leaving a level bench on the top is believed to be a desirable feature by the adjacent cabin owners. At the upper end of this Location, Mill Creek is a perennial tributary stream flowing into the White Salmon. The proposed grading plan shows shaping the tributary sideslopes within the reservoir area to a 2H:1V slope angle. The historic bottom elevation of this stream is not known, but the proposed slope grading will result in a 20 foot wide creek bottom that is close to the predicted grade of the stream channel. If additional erosion does occur in the stream channel, that erosion should be limited to the creek bottom area. The creek bottom will be another "opportunity zone" for riparian vegetation.

Location 4 - This is the second major area upstream of the dam on river left where grading of reservoir sediment is proposed. There is no visual evidence of a basalt bench beneath the sediment deposit, although there is some evidence of rock at the toe of slope adjacent to the river. The exact thickness of the sediments in Location 4 is not known, but could be as thick as 30 feet in some locations. For all of this sediment deposit the grading plan includes the same three basic elements as were applied in Location 3: 1) a narrow bench (12 foot width) parallel with the river channel and elevated above the water by 3-4 feet, 2) a slope from the bench up to the top of the sediment deposit at a 2H:1V slope angle, and 3) leaving the top surface of the reservoir sediment deposit in its existing semi-flat condition. This location has a side tributary stream, and there is no assurance of a basalt layer to prevent downward erosion of the tributary channel through the sediment. The proposed grading anticipates this erosion by excavating a channel with a small "valley and floodplain" adjacent to it. This will limit the extent of additional erosion during the period of vegetation establishment.

Location 5 - This is the third area upstream of the dam on river right, and it includes Northwestern Park at its upstream end. This is a long, linear depositional landform. There is no visual evidence of a basalt bench beneath the sediment deposit, although the appearance of old tree stumps indicates the shape of the stable pre-reservoir landform in some locations. This location is in a wider section of the valley, as observed by the setbacks of the steeper valley side slopes. In general, 3H:1V side slopes can be graded down to the river channel without too much difficulty. There are several side slope areas where stumps are exposed, and these areas will remain “as-is”. This location has four small tributary streams that come in from the north, at least one of which is perennial. A low berm is proposed to prevent this tributary water from flowing directly in to the White Salmon River. This berm will trap surface runoff water in two of the larger areas where lake-fringe wetlands remain from the former reservoir. The berm extends to the south and would hold runoff water in a graded depression area where new wetlands could potentially be established. The graded depression area is intended to facilitate shallow flooding on an intermittent basis. To prevent erosion of the berm during larger runoff events exceeding the capacity of the graded depression area, a riser and drain pipe is anticipated to allow excess water to drain out to the White Salmon River. Location 5 includes a permanent boater take-out ramp just downstream of the Northwestern Lake Bridge. Because this location will be an active construction site for bridge stabilization work into the summer of 2012, a temporary boater take-out will be graded at a location approximately 300 feet further downstream, on the west bank of the river. This feature would remain as a permanent access point for anglers and other public use. Both the boater take-out and the general access point will be primitive earth ramps where boats must be carried up from the water; vehicular access is not planned.

Location 6 - This is the location upstream of Northwestern Park. Significant down cutting of the White Salmon River has occurred in this location, and in the tributary of Buck Creek. The White Salmon River channel bed has lowered approximately 17 feet since the draining of the reservoir. Buck Creek's channel bed has also cut down significantly, although not as far as the White Salmon River. Active river bank erosion and sloughing continues to occur at this writing (mid-February, 2012). Location 6 has the added complication of several cabins that were built close to the reservoir, and which are now close to an actively eroding river system. No cabins have been structurally compromised to date, but erosion-related risks have been identified at three cabin sites. The presence of the cabins limits the ability to apply the general slope stability measures being applied throughout the reservoir area. Until the river bed reaches a stable elevation, it is extremely difficult to determine what the appropriate bank stabilization measures should be. In addition, on river right at station 100+00, there is a log crib structure that emerged as sediment eroded. The log crib is assumed to have been constructed as a bridge abutment and was abandoned when a bridge in the vicinity of the current bridge was built. The logs in the crib are in sound physical condition and the crib is inhibiting erosion of the bank in the vicinity. The disposition of the log crib is under review. PacifiCorp Energy has adopted a pro-active management strategy for the next few months which includes: 1) sloping back river banks to a 2H:1V slope angle in the limited area where this is feasible, 2) removing hazard trees that might fall on a cabin, 3) monitoring the ongoing bank erosion and channel bed changes to assess risk to structures, and 4) continuing a dialogue with cabin owners regarding options for cabins near the river or creek banks.

Methods for moving reservoir sediments – The initial grading work that is underway in Locations 3 and 4 have shown that standard earthmoving equipment is difficult to use in this environment. The weight of the machinery has proved critical, as the sediments are so poorly consolidated that standard machinery gets stuck easily. The contractor has brought in excavators with wide track and a low ground pressure rating to overcome this challenge. These machines are not as efficient as a bulldozer to move the sediments. As the sediments dry out in spring, small dozers may be able to work more effectively. Rubber tire equipment is out of the question at this time. Almost all of the proposed grading will be accomplished with earthmoving machinery, albeit with smaller and lighter equipment than usual. There are several remote areas in the tributary drainages where soil conditions may not allow for equipment access. In these areas the contractor may elect to use hydraulic excavation techniques to obtain stable sediment slopes.

3.4 Schedule for Grading Activities

Grading operations have commenced in several locations to remove sediment from unstable areas and prepare those areas for hydroseeding and mulching within the spring germination window (Figure 6). Spring planting will help control surface erosion of the remaining sediments, control dust, and minimize noxious weed emergence.

Location	Start Date	Finish Date
1	March 26, 2012	April 6, 2012
2	March 1	March 16
3	February 6	February 29
4	February 6	February 24
5	March 1	March 23
6	TBD	TBD

Figure 6. Proposed grading schedule. Note: soil moisture has a significant impact on the ability to use heavy equipment on reservoir sediments. This schedule will be adjusted when soil moisture conditions force grading operations to be temporarily suspended.

3.5 Fish Passage Conditions

The White Salmon River has eroded down through the reservoir sediments to an elevation and channel alignment similar to the pre-reservoir condition, as defined by Northwest Power Company's pre-reservoir topographic survey. If there are any bedrock outcrops that create a "pour over" in the river bed, they have yet to emerge. The only impediment to fish passage at this point in time (three months post breach) is the cofferdam used for the original dam construction. This cofferdam was left in place when the reservoir was filled, and the wooden structure remained well preserved for 99 years. At present this cofferdam forms a weir across the river bottom, with an estimated 8 foot water drop on the downstream side. The cofferdam is now an effective barrier to upstream fish migration. The contractor is required to have this structure removed from the river no later than May 1, 2012. This will allow for upstream fish passage during the spring migration period.

3.6 Public Access and Safety Considerations

PacifiCorp Energy will continue to maintain public access closures for the dam site, the reservoir area and the canyon reach downstream of the dam during the spring and summer months of 2012 as deconstruction work continues. Northwestern Park remains open, but barricade fencing and warning signs ask the public to stay out of the river former reservoir area. Signage on the White Salmon River warning boaters to take out at Northwestern Park will remain in place, as will the boater safety warning posters located at the common boater put-in locations upstream. During the construction work at Northwestern Lake Bridge, boaters will use the temporary boater access ramp that will be graded approximately 300 ft downstream of the bridge. Once the construction work is completed, the permanent boater take-out location will be available just downstream of the bridge.

3.7 Sediment Changes Observed with Repeated Photography

Photographs of the changes in reservoir sediments were collected at 12 photo point locations. Photos were taken on breach day, on each of the following six days, and then weekly for a total of six weeks. These photo sequences show the evolution and erosion of sediments within the former reservoir area. Photo point locations (P1, P2, etc.) are shown in Figure 7. In some locations repeat photos were taken looking upstream and downstream. All of the photo sequences are provided in Appendix D. Each photo sequence in the appendix was continued until visible changes to the reservoir sediments were no longer evident. Data from Photo Point #8 had to be terminated when the soil at that location collapsed into the river. Data from Photo Point #12 commenced once the headcutting and erosion had moved upstream past Northwestern Lake Bridge.

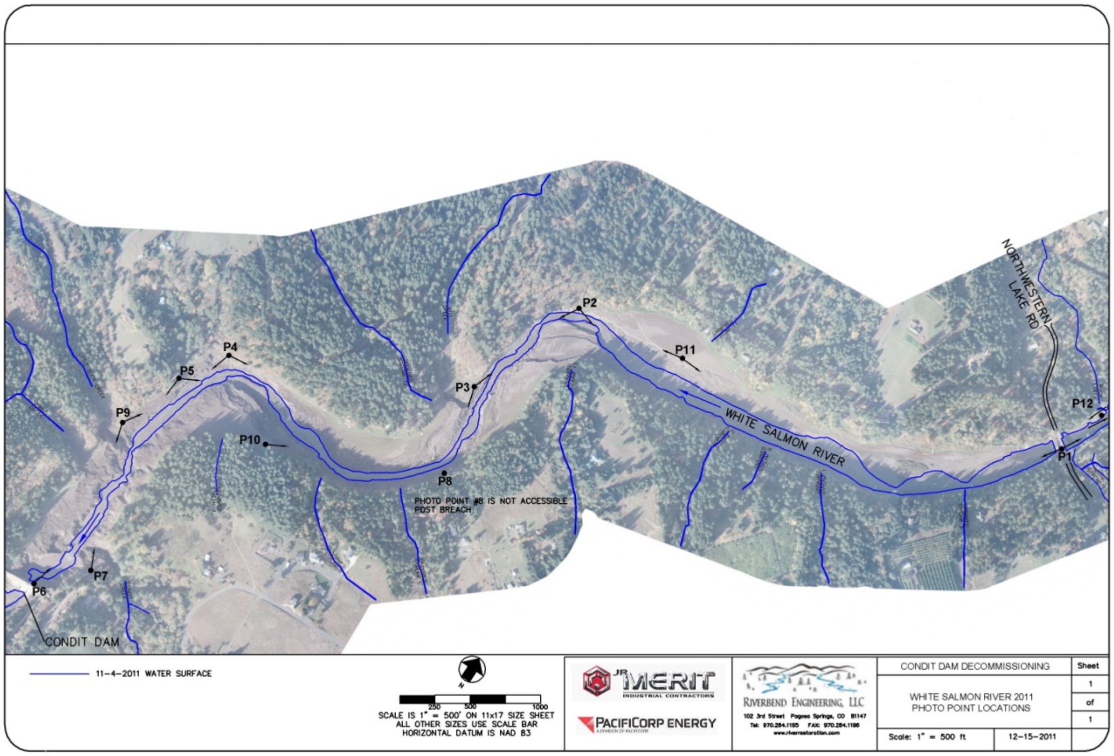

Figure 7. Photo point locations upstream of the Condit Dam.

Notes of field observations were taken at each photo point on a weekly basis. Summaries of the field notes are provided below in numerical order. All elevations, distances and heights described below are estimates made by a field geologist.

P1: *On 11/3/2011 riverbed cutting downstream from P1 ranged from 2 to 5 feet (ft) and upstream riverbed cutting was minimal. Increased riverbed cutting was observed on 11/10/2011 with maximum downstream bank height of approximately 8 ft. River width directly downstream from P1 had decreased by approximately 50 ft over the period 11/3/2011 to 11/10/2011. Minimal riverbed cutting was observed upstream from P1 on 11/10/2011. On 11/17/2011 down-cutting of approximately 3 to 5 feet was observed upstream from P1. On 11/30/2011 upstream and downstream riverbed cutting had increased to 10 feet upriver of P1 and 15 to 20 ft downriver of P1. Over this same period, the river path near the bridge had shifted to river right and the river throughout the reach exhibited increased meander. From 11/30/2011 to 12/8/2011 an additional 2 to 3 ft of riverbed cutting had occurred and river meander continued to increase.*

P2: *On 10/28/2011 the bank height was approximately 30 ft and increased to approximately 50 to 60 ft by 11/3/2011. Over this time period the river channel narrowed approximately 75 ft. From 11/10/2011 to 12/8/2011 the bank remained relatively stable with no visible mass wasting activity, other than grading of the river right bank by a trackhoe between 11/10/2011 and*

11/17/2011. From 11/10/2011 to 12/8/2011 approximately 2 to 4 feet of additional riverbed cutting was observed.

P3: *On 10/28/2011 the bank height ranged from 20 to 30 ft, increasing to 40 to 50 ft between 10/28/2001 and 11/32011. The river banks remained stable between 11/3/2011 and 11/10/2011 with minor mass wasting directly across from P3. Between 11/10/2011 and 11/17/2011 river bank slumping and loss of approximately 15 ft of bank across from P3 was observed. Upstream from P3 the river banks remained stable. From 11/17/2011 to 12/8/2011 riverbed down-cutting of 1 to 2 ft occurred. River banks remained relatively stable over this time.*

P4: *On 10/28/2011 left and right bank height ranged from 70 to 80 ft. From 10/28/2011 to 11/3/2011 there was 8 to 10 ft of riverbed down-cutting. Loss of approximately a 10 ft section of river right bank was observed upriver from P4 during this period. From 11/3/2011 to 11/10/2011 an additional 3 ft of riverbed down-cutting occurred. No visible riverbed or bank activity occurred between 11/10/2011 and 11/17/2011. From 11/17/2011 to 11/30/2011 there was loss of 2 to 8 ft of sediment deposits on river left, ranging from 2 to 5 ft in height. No significant changes were observed from 11/30/2011 to 12/8/2011 and river right and river left banks appeared stable.*

P5: *On 10/28/2011 left and right bank height ranged from 70 to 80 ft. From 10/28/2011 to 11/3/2011 there was approximately 8 ft of riverbed down-cutting. From 11/3/2011 to 11/10/2011 there was removal of sediment deposits near point across from P5 and approximately 3 to 4 ft of riverbed down-cutting. From 11/10/2011 to 12/8/2011 there were no significant changes observed and river right and river left banks appeared stable.*

P6 and P7: *On 10/28/2011 left and right bank height ranged from 70 to 80 ft. From 10/28/2011 to 11/10/2011 approximately 10 ft of riverbed down-cutting occurred. From 10/28/2011 and 11/10/2011 an additional 5 ft of riverbed down-cutting occurred below the coffer dam and 1 to 2 ft of riverbed down-cutting above the coffer dam. From 11/10/2011 to 12/8/2011 there was limited bed and bank activity, with the banks being relatively stable throughout the monitoring period.*

P8: *Photo point removed.*

P9: *On 11/3/2011 left and right bank height ranged from 70 to 80 ft. From 11/3/2011 to 11/10/2011 there was one to two ft of riverbed down-cutting and removal of 1 to 4 ft of sediment deposits on river right. From 11/10/2011 to 12/8/2011 there were no significant changes observed and river right and river left banks appeared stable.*

P10: *On 11/3/2011 riverbank height ranged from approximately 60 to 70 ft. From 11/3/2011 to 11/10/2011 there was approximately 3 ft of riverbed down-cutting. From 11/10/2011 to 11/17/2011 there was no significant change in bed cutting or bank conditions. From 11/17/2011* *to 11/30/2011 minor bank sloughing was observed across from P10 and approximately two feet of riverbed down-cutting had occurred. From 11/30/2011 to 12/8/2011 there were no significant changes observed and river left bank and point appeared stable.*

P11: *On 11/3/2011 a tiered bank existed on river right, totaling approximately 40 ft high. From 11/3/2011 to 11/17/2011 there was approximately 4 ft of riverbed down-cutting. Grading of the river right bank with a trackhoe occurred over this time period. From 11/17/2011 to 11/30/2011 there was removal of small sediment deposits on river left and 1 to 2 ft of additional riverbed down-cutting occurred. From 11/30/2011 to 12/8/2011 riverbed and banks were relatively stable with no significant changes observed.*

P12: *Photo point P12 was established on 11/10/2011 in response to active cutting observed upstream from P1. On 11/10/2011 riverbed cutting at this point was approximately 1 to 2 ft. By 11/17/2011 riverbed cutting had increased to approximately 4 ft, with no cutting observed approximately 100 ft upstream of P12. Between 11/17/2011 and 11/30/2011 P12 was lost due to the river cutting into the river right bank approximately 15 ft. During this period the bank height increased, ranging from 7 to 15 ft with bank height decreasing up river from P12. Down-cutting continued from 11/30/2011 to 12/8/2011 having increased by approximately 2 ft and increased river meandering.*

Powerhouse: *From 11/3/2011 to 11/10/2011 there was approximately 3 ft of down-cutting through riverbed sediment deposits and the river channel had narrowed by approximately 6 ft. From 11/10/2011 to 11/17/2011 approximately 3 ft of the sediment deposit on river right was removed. All sediment on river right was removed by 11/30/2011. No changes in conditions were observed from 11/30/2011 to 12/8/2011.*

4.0 Implementation and Documentation of Sediment Management Activities

4.1 Additional Photo Documentation

Within the former reservoir area photo documentation from the established photo points will be accomplished "before and after" the implementation of the grading plan. Photo documentation from these same photo points will be accomplished to monitor the revegetation efforts. This photo documentation will be included in the annual sediment monitoring reports.

4.2 LiDAR Surveys

LiDAR surveys are required by the “Sediment Assessment, Stabilization, and Management Plan” (PacifiCorp Energy, March 15, 2011) and by the FERC Surrender Order. The first LiDAR survey occurred on December 21, 2011. The results of this first LiDAR survey have been included in this report. A second LiDAR survey is planned for August, 2012, which should document the post grading topography of the (former) reservoir area. This LiDAR data will be included in the annual sediment monitoring report due to FERC by the end of September 2012. A third LiDAR survey is planned for August 2013, with results to be included in the annual sediment monitoring report due to FERC by the end of September 2013.

4.3 Annual Sediment Assessment Report

An annual sediment assessment report will be completed by the end of September 2012. That report will include data from the second LiDAR survey planned for August 2012. It will also include a narrative assessment of sediment stability, and sediment monitoring photos from the established photo monitoring points. Significant deviations from the grading plan will be documented.

5.0 References

Federal Energy Regulatory Commission (FERC), 2010, Order Accepting Surrender of License, Authorizing Removal of Project Facilities, and Dismissing Application for New License, Project Nos. 2342-005 & 2342-011, December 16, 2010.

FERC, 2011a, Order on Rehearing, Denying Stay, and Dismissing Extension of Time Request, Project No. 2342-021, April 21, 2011.

FERC, 2011b, Order Modifying and Approving Sediment Assessment, Stabilization, and Management Plan, Project No. 2342-025, May 11, 2011.

G&G Associates, 2004, Sediment Behavior Analysis Report

PacifiCorp Energy, 2011a, Project Removal Design Report, March 15, 2011.

PacifiCorp Energy, 2011b, Sediment Assessment, Stabilization, and Management Plan. March 15, 2011.

Washington Department of Ecology, 2010, Condit Dam Decommissioning Project 401 Water Quality Certification order No. 8049, October 12, 2010.

US Department of the Army, 2011, Section 404 Permit, Corps of Engineers Action No. NWP-2004-523, May 13, 2011.