
Condit Hydroelectric Project Decommissioning FERC Project No. 2342

WOODY DEBRIS MANAGEMENT PLAN



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MARCH 15, 2011

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1 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. The project is regulated by the Federal Energy Regulatory Commission (FERC) as project number 2342. The project is located approximately 3.3-miles upstream from the confluence of the White Salmon and Columbia Rivers. Project facilities consist of a 125-foot high, 471-foot long concrete gravity diversion dam, an intake structure that directs water into a 13.5-foot diameter by 5,100-foot long wood stave flowline, and through a 40-foot diameter concrete surge tank. The flowline bifurcates inside the surge tank into two 9-foot diameter penstocks that supply water to the powerhouse. The powerhouse contains two double horizontal Francis turbines with an installed capacity of 14,700 kilowatts. The project creates a reservoir, Northwestern Lake, which extends 1.8-miles upstream of the dam and covers approximately 92 acres. The project area is shown in Figure 1-1.

1.2 BACKGROUND

In 1968, a new license was issued by the Federal Energy Regulatory Commission for a 25-year term, which expired on December 31, 1993. In 1991, PacifiCorp Energy filed an application with the FERC for a new license authorizing the continued operation and maintenance of the project. PacifiCorp Energy has since been operating the project pursuant to annual licenses, pending determination by the FERC on the status of PacifiCorp Energy's new license issuance. In 1996, the FERC issued a Final Environmental Impact Statement (FEIS) that analyzed the environmental and economic effects of various relicensing alternatives for the project. The FEIS included a recommendation to approve licensing with mandatory conditions, including provisions for establishing fish passage facilities at the project.

PacifiCorp Energy evaluated the economic impacts of the FERC recommendations contained within the FEIS and determined that the mandatory conditions would render the project uneconomic to operate. In 1997, PacifiCorp Energy requested a temporary abeyance of the relicensing procedure in order to investigate the feasibility of various removal alternatives in collaboration with project stakeholders. PacifiCorp Energy and project stakeholders then commissioned the consulting firm of R.W. Beck, Incorporated, to evaluate removal alternatives. In 1998, R.W. Beck, Incorporated, prepared a summary report of project removal engineering considerations that identified the preferred method and schedule for project removal as well as the expected costs and associated environmental and permit issues. In 1999, the Condit Settlement Agreement was signed by PacifiCorp Energy and project stakeholders. The settlement agreement provides for project removal upon the expiration of an extended license term in accordance with the preferred method identified in the R.W. Beck, Incorporated, summary report. The settlement agreement was amended in 2005 to extend the dates for project removal.



In 2002, the FERC prepared a Final Supplemental FEIS addressing project removal, which updated the 1996 FEIS and assessed the effects associated with approval and implementation of the Condit Settlement Agreement. In March 2007, Ecology issued the Final SEPA Supplemental Environmental Impact Statement (FSEIS) for the project.

In September 2002, the U.S. Fish and Wildlife Service issued a Biological Opinion finding no jeopardy to bull trout for ongoing project operations and implementation of the Condit Settlement Agreement. In October 2006, the National Marine Fisheries Services issued a Biological Opinion finding that the proposed dam removal action is not likely to jeopardize the continued existence of salmon and steelhead or destroy or adversely modify designated critical habitat.

1.3 PROJECT REMOVAL DESCRIPTION

PacifiCorp Energy proposes to remove the project in accordance with the amended Condit Settlement Agreement and the Project Removal Design Report. Prior to removing the dam, the City of White Salmon's water supply line that crosses the reservoir needs to be relocated and potential impacts to the Northwestern Lake Bridge which is owned by Klickitat County and is at the upper end of the reservoir need to be addressed.

The proposed method for dam removal involves clearing sediment and debris immediately upstream from the tunnel and then drilling and blasting a 12-foot by 18-foot drain tunnel in the base of the dam to within a few feet of the dam's face. During the month of October, sediment and debris immediately upstream from the dam will be cleared to form a pathway and then the remainder of the tunnel will be blasted to drain the reservoir and flush impounded sediments out of the reservoir as rapidly as possible. Following the final tunnel blast, the drain tunnel will discharge at a rate of 10,000 cubic feet-per-second – approximately 25 percent of the estimated peak discharge during the February 1996 flood event on the White Salmon River. This will drain the reservoir in approximately six hours. Rapid draining of the reservoir is expected to mobilize much of the estimated 2.3-million cubic yards of sediment that have accumulated behind the dam since its construction. Previous modeling has indicated that between 1.6 million to 2.2-million cubic yards of sediment will be discharged into the White Salmon River immediately following dam removal and over a number of years as successive high flow events mobilize overbank sediments.

Once the reservoir is drained, the dam will then be excavated and removed along with the flowline, surge tank, and penstocks. Concrete from the dam will either be buried onsite or removed from the site for recycling or disposal. The powerhouse will be left intact. The upstream cofferdam in the White Salmon River present from original dam construction will be removed from the river as soon as practicable after the breach. PacifiCorp Energy expects to complete the dam removal process within one year.

Following project removal, the irrigation water supply intake for the Mount Adams Orchard to the east of the dam will be reconfigured to accommodate a new intake.

Removal of Condit dam is expected to provide the following benefits:

- Anadromous salmonids will be provided access of up to 18 miles of White Salmon River mainstem and tributary habitats that have been inaccessible since the early 1900s. Restoration of natural runs of anadromous fish upstream of the project dam is consistent with the fishery management goals of the National Marine Fisheries Service, U.S. Fish and Wildlife Service, Washington Department of Fish and Wildlife, and the Yakama Nation.
- Dam removal offers the greatest potential for full utilization of anadromous fish habitat, including habitat inundated by Northwestern Lake, and therefore, full restoration of anadromous salmonids within the White Salmon River basin.
- Dam removal will benefit wildlife dependent upon anadromous fish in the area of the river reach upstream of river mile (RM) 3.3.
- Dam removal will provide increased whitewater recreation opportunities. Whitewater recreation is an important and popular use of the White Salmon River and provides income for the local area.

1.4 MANAGEMENT PLAN BACKGROUND

The Woody Debris Management Plan (WDMP) provides guidance for the monitoring, removal, disposal, or reuse of coarse wood material encountered during the dam removal process and following dam decommissioning as the river erodes existing reservoir sediments. The Woody Debris Management Plan encompasses existing channel segments below the dam to the Columbia River and future channel and floodplain surfaces currently submerged by the existing reservoir. These areas will be referred to as the project area in this document. The Plan is in effect for the 5-year monitoring period following dam breach.

1.5 REGULATORY AND OTHER REQUIREMENTS

There are several agency requirements and recommendations that relate to the Woody Debris Management Plan. These include project components included in the Settlement Agreement, FERC requirements set forth in the FSFEIS (2002), mitigation measures specified in Ecology's Final Supplemental Environmental Impact Statement (FSEIS), and terms and conditions set forth in the National Marine Fisheries Service Biological Opinion (NMFS, 2006). The applicable agency requirements and recommendations are summarized below.

1.5.1 Settlement Agreement

The Condit Settlement Agreement includes several measures intended to protect environmental resources during decommissioning activities. The measures that most directly apply to the Woody Debris Management Plan include the following:

- Implement a canyon debris and woody debris management plan during the removal of the dam
- Complete all in-water work by the following August to lessen adverse impacts on fish

The first item is addressed by this plan. With respect to the second item, some in-water work may be conducted after August if necessary to correct passage obstructions.

1.5.2 Federal Energy Regulatory Commission Final Supplemental Final Environmental Impact Statement (2002)

The Federal Energy Regulatory Commission requirements contained within the Final Supplemental Final Environmental Impact Statement include the following additional measures that apply to the Woody Debris Management Plan:

- Implement a plan to conduct a post-breaching assessment of reservoir sediment conditions. This should include a plan to map remaining reservoir sediments and to conduct geotechnical investigations. Within 120 days after breaching, an assessment report and plan for stabilizing the reservoir bed should be submitted for FERC review. The report should address fish passage and should specify proposed measures for removing sediment or debris that may impede passage. If blasting is proposed to dislodge sediment or woody debris, the report should include detailed plans, including location and timing of blasting activities.
- File detailed plans for Commission approval for proposed canyon and woody debris management.

These measures are addressed by the Sediment Assessment, Stabilization, and Management Plan and this plan.

1.5.3 Washington Department of Ecology FSEIS

The Washington Department of Ecology Final SEPA Supplemental Environmental Impact Statement (Ecology, 2007) recommends a number of mitigation measures in order to minimize the impact of decommissioning activities on aquatic habitat. The Department of Ecology specifies mitigation measures related to: 1) geology, soils, and sediment; and 2) aquatic resources. Those that apply to this plan are included below.

Geology, soils, and sediment mitigation measures

- The drain tunnel would be constructed with a slight bell shape with the largest diameter downstream to prevent large woody debris from clogging the tunnel.
- Removing unstable sediment and woody debris would improve downstream reservoir sediment transport within the predicted three- to five-year period and therefore not affect long-term water quality.

- The White Salmon River canyon below the dam will be surveyed to identify and dislodge woody debris that may be hindering fish passage. Removal of such blockage will facilitate downstream transport of sediment and the natural formation of riverbanks. Log jam removal will only be done in consultation with the fish management agencies.

Aquatic resources mitigation measures

- Dislodging unstable sediment and woody debris will help ensure that the reservoir sediment is transported downstream over the predicted three- to five-year period and will not affect long-term water quality, pool depths, or spawning gravels.
- If blasting is used to stabilize slopes or remove debris, it should be confined to daylight hours when salmonids are least likely to be actively moving. This will reduce the number of fish exposed to hydrostatic shock from blasting activities.

The mitigation measures listed above are addressed as part of this plan and the Sediment Assessment, Stabilization, and Management Plan. The first item listed will be addressed by the Project Removal Design Report.

1.5.4 National Marine Fisheries Service Biological Opinion (2006)

The National Marine Fisheries Service Biological Opinion (2006) specifies terms and conditions that relate to the Woody Debris Management Plan. The primary restrictions that apply include those related to heavy equipment use and protocols specified for obliterating and stabilizing any temporary access roads. Restrictions applied to heavy machinery use include provisions related to vehicle staging, cleaning, maintenance, refueling, and inspections for leaks. Heavy machinery used as part of Woody Debris Management Plan activities will be subject to the requirements outlined in the Spill Prevention, Control, and Countermeasures (SPCC) Plan.

The protocols to be followed for reporting are included in the Aquatic Resources Protection Plan. Components of this plan are designed to minimize overall impacts to aquatic resources by ensuring fish passage conditions are maintained.

1.5.5 Clean Water Act Section 401 Certification

Washington Department of Ecology issued the 401 Water Quality Certification on October 12, 2010.

1.5.6 Clean Water Act Section 404 Permit

The Section 404 Permit is pending as of the date of this plan.

1.5.7 Federal Energy Regulatory Commission Surrender Order

On December 16, 2010, the FERC issued an Order Accepting Surrender of License, Authorizing Removal of Project Facilities, and Dismissing Application for New License. On January 14, 2011, PacifiCorp Energy filed a Request for Clarification and Rehearing and Motion for Stay to the Commission. As of the date of this plan, FERC has yet to issue a final order on this matter.

1.6 PLAN OBJECTIVES

The primary purpose of the Woody Debris Management Plan is to provide guidance to evaluate when coarse woody debris causes jams that impede sediment flow, restrict fish passage, or present a public safety concern, and suggests methods to resolve those problems if they occur. The plan also establishes criteria for making quality woody debris resources available to the Washington Department of Fish and Wildlife or other organizations involved in stream restoration work. The plan addresses salvage and stockpiling protocols for this wood. This plan also provides alternatives for the disposition of wood that is not suitable for restoration use.

1.7 RELATIONSHIP WITH OTHER MANAGEMENT PLANS

Canyon wood material has the potential to influence the Sediment Assessment, Stabilization, and Management Plan; Revegetation and Wetlands Management Plan; and Aquatic Resources Protection Plan. The degree to which each can be influenced will depend on the volume and size of coarse wood buried within the reservoir sediments, which is currently unknown.

1.7.1 Sediment Assessment, Stabilization, and Management Plan

Log jams that become established within the canyon have the potential to influence sediment deposition upstream by reducing the local energy gradient. Depending on the vertical elevation of a log jam, the backwater influence could extend upstream enough to form a sediment wedge upstream of the log jam. If the jam is removed or decays over time, the sediment will be remobilized and continue downstream.

Wood also has the potential to influence reservoir sediments. Sediment exploration drilling logs indicate that approximately 75 percent of the accumulated reservoir sediment is comprised of fine-grained material that will rapidly erode and move downstream. Stored reservoir sediment will erode through mainstem incision, lateral erosion, and tributary drainage incision following dam removal and base level lowering. The speed at which this occurs will depend on intensity of precipitation and the duration of runoff events that occur soon after dam removal.

Coarse wood material may act to retard the rate of eroding bed and developing bank sediments as the river headcuts up through previously deposited reservoir sediment. The size and volume of buried wood may increase the length of time required to erode areas held together vertically and laterally by buried wood or wood jams. The degree to which this may occur cannot be predicted.

1.7.2 Revegetation and Wetlands Management Plan

Within the reservoir, large wood jams could influence the degree of lateral erosion and could prevent bank slopes from achieving a stable angle of repose at an expected slope of 30 degrees (1.73 horizontal to 1 vertical). This could influence revegetation efforts in areas where large jams occur within reservoir sediment.

Log jams will have no wetland influence within the canyon reach. Within the reservoir, it is possible but unlikely that large wood jams could influence wetland vegetation that may develop in a given area. Wood left within wetland areas of the former reservoir would contribute to the habitat complexity of the wetlands and may also serve to slow erosion from runoff.

The degree to which woody debris will affect revegetation and wetland development is unknown but any potential impacts are unlikely to be significant given the large land area that will be exposed when the reservoir is drained.

1.7.3 Aquatic Resources Protection Plan

Aquatic resources could be affected in areas where large wood may deposit or form log jams. Public safety and fish passage will be the primary concerns governing wood removal or modification in the project area. The degree to which woody debris will cause public safety or fish passage problems cannot be predicted. In general, where natural wood deposition occurs aquatic habitat improves. Therefore, removing wood deposits will only be done in areas where public safety or fish passage is a concern. In accordance with the Aquatic Resources Protection Plan, woody debris will be removed or dislodged if it is causing a fish passage obstruction. Wood that is not creating passage obstructions or safety concerns will be left in-place to provide fish habitat.

1.7.4 Historic Properties Management Plan

An archeological review will be conducted in the drained reservoir area prior to commencement with woody debris management activities.

1.7.5 Woody Debris Management Plan Effects on Other Components of Dam Removal

It is possible that wood material could influence reservoir dewatering and management of reservoir sediment. Both of these actions are addressed in their respective plans: the Project Removal Design Report and the Sediment Assessment, Stabilization, and Management Plan.

Reservoir drawdown will take place by excavating an approximately 12-foot high by 18-foot wide rectangular tunnel in the concrete dam with a proposed invert elevation of 174 feet. The tunnel will be created by drilling and blasting, as described in the Project Removal Design Report. The opening of this tunnel will rapidly drain the reservoir. It is during this initial phase of the operation that coarse wood material has a high probability of influencing dam removal operations by plugging the dewatering tunnel. It is possible

that jams may also form in the tunnel when wood is exposed and dislodged as the river cuts through the reservoir sediments, and also during the more active management of the reservoir sediments.

The Project Removal Design Report addresses the procedures for maintaining flow through the tunnel. It is proposed to use explosive charges to dislodge any jams that may form at the entrance or within the tunnel. This plan does not specifically address woody debris management in the immediate vicinity of the tunnel and dam because this is covered in the Project Removal Design Report.

After the reservoir has drained, flow in the White Salmon River will begin eroding vertically and laterally through existing reservoir sediments. The time required to erode the material will depend on river discharge during the months after dam removal. The location, size, and quantity of coarse wood material within the sediment are unknown. It is possible that buried wood may influence the progress of sediment erosion.

2 LARGE WOOD PROCESSES AND REMOVAL

Large wood plays an important ecological role in creating and maintaining habitat within rivers. The challenge within the project area will be to balance that role with human safety and fish passage concerns. Areas that may develop channel spanning log jams could easily create conditions hazardous to boaters who will likely float the lower river following dam removal. Confined, steep, narrow bedrock reaches of the canyon are also capable of creating log jams that might restrict upstream salmonid migration.

Wood that passes through the tunnel during deconstruction or enters the canyon area below the dam after breaching will follow one of four scenarios:

- Wood deposits creating lateral jams but not blocking the channel
- Wood deposits creating channel-spanning jams
- Wood deposits near the confluence of the White Salmon and Columbia Rivers (referred to as the embayment in this report)
- Fluvial transport to the Columbia River

Likely locations for wood accumulations have been mapped for the canyon reach below the dam to the Columbia River. Plan sheets that illustrate these locations are provided with this report and are shown in Plans 1 through 5 (Appendix A).

The degree to which log jams could develop that could create human hazards and fish passage obstruction will be greatly influenced by the size and volume of wood entering the canyon reach following dam removal. Since these factors cannot be predicted, this plan relies on professional judgment to identify areas that are narrow enough to create jams, and knowledge of the history of past jams on the river. Wood that does not create human hazards, slope stability concerns or impede fish passage will be left on the landscape. Following sediment stabilization efforts but prior to revegetation, PacifiCorp Energy will advise Ecology, WDFW, and Klickitat County of the opportunity to meet on site to review placement of woody materials prior to making them available to outside entities. This collaboration will be used to reinforce areas for monitoring plan focus.

2.1 PUBLIC SAFETY

Public boating use in the lower river is likely to increase following dam removal. Wood jams that result in a hazard to the boating public will need to be modified or removed to allow safe passage. After an initial period when the river will be closed to the public, and prior to opening the river to the public for recreational use, PacifiCorp Energy will monitor the passage and deposition of woody debris in the river and remove identified wood hazards. Once this is accomplished, PacifiCorp Energy's responsibility for active management of woody debris will be complete.

2.2 FISH PASSAGE

It is possible that large wood jams could form barriers to fish passage. In the mainstem, it is unlikely that a passage barrier will form that will not also create a boating hazard. Therefore, public safety issues will likely also determine elimination of wood that could result in a migration barrier. If a passage obstruction forms, that is not a boating hazard; guidelines presented in the Aquatic Resource Protection Plan will be used to determine if a barrier exists. Site conditions will determine the means of barrier correction according to the methods outlined in the Aquatics Resources Protection Plan. Barriers may also form at the downstream ends of tributaries flowing into the existing reservoir.

2.3 SEDIMENT ACCUMULATION

If log jams of sufficient size and persistence are formed downstream from the dam within the mainstem to engender the storage of sediment, it is probable that such log jams may also pose fish passage and safety issues. The removal of these obstructions will be guided by public safety and the Aquatic Resource Protection Plan. Sediment deposition within the mainstem may prove beneficial if it leads to stable bank formation. However if it has the potential to lead to continuing sediment delivery into the fluvial system, it should be professionally assessed and recommendations for stability presented.

3 EXISTING CONDITIONS

A field reconnaissance of the site below the dam was completed on November 20, 2007, to assess large, wood source areas; existing jam locations; potential wood retention areas; likely future jam locations; and access areas. The results of this survey are incorporated into the following sections of this plan.

Additionally, in February of 2008, a geophysical survey of a portion of Northwest Lake was conducted by Golder Associates (Golder Associates, 2008). Part of the intent of this investigation was the mapping of miscellaneous debris and large logs or trees immediately upstream of Condit dam for a distance of about 700 feet. This survey found that there is one zone in the surveyed area that was interpreted to contain large objects such as boulders, logs, trees, and associated root balls. The study did not quantify the amount of wood, and the area investigated included only a small portion of the reservoir, so the investigation provides limited information for estimating the possible volume of large woody debris that could flush out of the reservoir following the breaching of the dam.

3.1 LARGE WOODY DEBRIS SOURCES

Potential large wood sources within the canyon below the dam are limited to windthrow or slope failure that occurs along the steep canyon walls. Trees within the canyon are large but their ability to enter the channel is limited due to the bedrock nature of the channel boundary that prevents the erosion and undercutting of trees as would occur in an alluvial channel type. Slope failures and landslides within the canyon have occurred in the past but are not frequent events. Based on these observations, total wood loading potential from canyon sources is low.

Wood sources on the White Salmon River above the reservoir are also relatively limited due to similar conditions, as the river flows primarily within a steep bedrock canyon.

Wood that has accumulated within the reservoir since the dam was constructed will likely be the largest source of material during the term of active dam decommissioning. The volume of woody debris stored in the reservoir and its behavior is difficult to predict. It is possible that much of the wood stored in the reservoir will remain where it was deposited. This is primarily due to its reduced buoyancy caused by years of submergence and burial.

3.2 EXISTING JAM LOCATIONS

Although the survey indicated that existing wood sources are low, the potential for log jams to develop is high in areas where the canyon constricts. No existing log jams were observed below the dam during the field reconnaissance. One log spanning a bedrock constriction in the canyon was observed. This log could easily form a jam by collecting more wood behind it and is within a high risk zone for log jam development due to its narrow constriction. It is known that a jam has developed at this site before (personal communication with Brady Allen (USGS), November 2007). These factors make this a likely location for jam development in the future.

3.2.1 Wood and Sediment Retention

Wood and sediment retention is naturally low through the canyon reach. The slope, confinement, and expected natural sediment load following dam removal is conducive to sediment and wood transport. However, there are areas within the canyon that become constricted, enabling large wood to become trapped. In these areas sediment could be retained behind vertically high log jams that may develop.

3.3 LIKELY FUTURE JAM LOCATIONS

Likely wood accumulation and log jam risk zones are presented in the enclosed air photo map sheets (Plans 1 through 5, Appendix A). All high risk jam sites are associated with channel constrictions. Three higher risk sites are identified on Plans 1 and 2. All three sites are located in places where the bedrock canyon constricts, enhancing the risk wood will become lodged upstream of each constriction.

3.4 SITE ACCESS FOR MANAGEMENT ACTIVITIES

Access for management activities was determined during site reconnaissance. The depth and slope of the canyon make heavy equipment access difficult in most areas. Areas where site access is possible are illustrated on Plans 1 through 5 (Appendix A).

3.4.1 Reservoir Above the Dam

Access within the reservoir to remove wood or modify its location will be the same as those locations determined within the Sediment Assessment, Stabilization, and Management Plan and, depending upon site conditions following dam removal, other access areas that may be identified. Wood creating public hazards or limiting fish passage within the reservoir area will likely have to be removed or dislodged from above due to the expected development of high terraces and instability as fine reservoir sediments are eroded from the underlying bedrock canyon walls. Stability will be taken into account prior to movement of machinery into these areas.

3.4.2 Canyon Reach Below the Dam

The powerhouse and Big White Ponds facility are the only locations where access to the river with heavy equipment can occur within the canyon below the dam. Access is restricted by the steep vertical canyon walls along the remaining channel length below the dam. The entire canyon reach can be accessed by raft or on foot. Equipment access to the edge of the canyon is possible where the old Powerhouse Bridge crosses the White Salmon River approximately 700-feet downstream of the powerhouse. Access locations can be viewed in the enclosed air photo plan sheets (Appendix A).

3.4.3 Embayment and Columbia River

As the White Salmon River canyon enters the Columbia Gorge, the Bonneville Dam pool creates an embayment running approximately 6,000 feet into the former White Salmon River channel. The embayment depth limits the use of heavy equipment unless it is

placed on a barge. Small boat and barge access is possible from the Columbia River or from the boat launch at the Underwood In Lieu Site adjacent to the Burlington Northern Railroad and State Highway 14 Bridge at the mouth of the White Salmon River. At the location of the Underwood In Lieu Site, any accumulated woody debris may also require removal.

4 MONITORING/ADAPTIVE MANAGEMENT RECOMMENDATIONS

4.1 PRE-BREACH ACTIVITIES

4.1.1 Canyon Reach

JR Merit intends to remove any woody debris jams that exist in the canyon reach prior to the dam breach event. The purpose of removing woody debris jams is to facilitate the flushing of reservoir sediments during the breach event and in the months of reservoir sediment erosion that are predicted to follow. Based on a field inspection of the canyon reach conducted on February 2, 2011, there are presently no debris jams in the canyon reach that would impede sediment flushing. JR Merit will repeat these surveys in September 2011 (approximately 1 month prior to the breach event) to verify that this reach is "barrier free." In the event that a new jam has formed, the jam will be removed or broken apart such that it will not impede sediment flushing.

4.1.2 Reservoir Immediately Upstream of the Dam

JR Merit intends to remove large floating wood from the reservoir water surface prior to the breach event. In addition, a portion of the accumulated sediment in the reservoir within the first 75-feet upstream of the dam will be removed (Sediment Assessment, Stabilization, and Management Plan). Sediment removal will be accomplished with hydraulic dredging techniques, utilizing a floating barge. Within this 75-foot zone, JR Merit will attempt to locate and remove as much submerged large wood as possible. The proposed removal technique will utilize a clamshell type dredging apparatus. Large wood that is removed from the reservoir will be stockpiled near the existing boat ramp, next to the inflow point for Condit Creek.

4.1.3 Reservoir Between Graves Road and Northwestern Lake Road

Beginning in August, 2011 the lake level will be drawn down to elevation 285 for protection of the drain tunneling activities (Project Removal Design Report). At this surface elevation reservoir sediments will be exposed upstream of STA 45+00, except where the river channel is incised. Large wood that becomes exposed through this drawdown, as well as large wood that is exposed by the channel incision process, will be removed from the reservoir as soon as sediment stability allows for heavy equipment to cross those deposits. Large wood will be temporarily stockpiled in the vicinity of Graves Road, and in the vicinity of Northwestern Lake Park.

4.2 FREQUENCY OF POST-DAM REMOVAL RECONNAISSANCE

The Condit Hydroelectric Project Removal report (R.W. Beck, 1998) predicts that the sediments will be transported out of the reservoir in four primary stages. The proposed frequency of monitoring will reflect these predicted stages, but will be flexible enough to be adapted to changing conditions as needed. Results of the monitoring can be made available to the County. Prior to management actions resulting from the monitoring, PacifiCorp Energy will notify the County.

4.2.1 Stage One – Initial Dam Breach

The first stage follows the initial breaching of the dam and will result in the drawdown of the reservoir over a predicted period of six hours. It is within this time period that any exposed woody debris that has not been removed by the dredging operation immediately above the dam will mobilize and, either directly or as a result of blasting, will pass through the narrow tunnel in the base of the dam. During this initial time period there will likely also be the rapid erosion of some of the fine sediment deposited within the reservoir. Although the quantity of woody debris embedded in this sediment is unknown, for planning purposes it has been assumed that the volume of wood may be high. Thus the initial six hour high flow period will likely be the time when wood jams can be expected to rapidly form in the canyons downstream of the dam if the wood is long enough to become lodged between the constricted bedrock reaches identified in the attached drawings (Appendix A).

Monitoring

JR Merit will have mechanical extraction equipment and blasting materials ready to deploy in the event that the drain tunnel becomes plugged with large wood during the breach and initial drawdown period. Monitoring personnel will be located at strategic locations with views of the tunnel inlet, and any plugging of the drain tunnel with large wood should be rapidly evident. Mechanical extraction equipment at the drain tunnel mouth will consist of an aerial cable system with large grapples. This equipment will be able to grab large debris and trees and deposit them in the area of the existing dam parking lot.

Water levels in the canyons downstream of the dam are expected to be 5 to 10 feet above normal levels. The canyon reach downstream of the dam will be monitored during this period in order to identify the sites in which jams form and to determine appropriate removal techniques to apply when water levels drop. The focus will be on the specific areas identified as probable large wood jams or deposition locations.

As a safety measure the Washington State Route 14 Bridge and Burlington Northern Railroad Bridge at the confluence of the White Salmon and Columbia rivers will be monitored during this stage. Due to the neutral or negative buoyancy of the logs mobilized in this event, it is not anticipated that logs will be actively transported this far downstream. There is a slight possibility that existing trees within the riparian zone could be undermined by the water flows. Given that the anticipated flow of water in this event is 10,000 cubic feet-per-second and the 1996 flood resulted in flows of 45,000 cubic feet-per-second, it is unlikely that a significant number of new trees will be dislodged. However, the placement of monitors near the bridges, and the availability of on-call equipment capable of dislodging or removing trees are recommended as insurance for the unpredictable nature of this event.

4.2.2 Stage Two -- Immediately Post-reservoir Drawdown

The second stage is predicted to occur over a period of several days and is characterized by the erosion of much of the fine sediment deposited within the reservoir. The White

Salmon River flow will mobilize the sediments and cut down through the sediments to its historic channel alignment and grade. Wood that is exposed by this process will be transported down the White Salmon River and may be deposited in the newly exposed canyons above the dam. If it is allowed to pass through the tunnel, the wood may be deposited or form jams downstream of the dam. The tributaries that drain into the old reservoir will also be downcutting, and may be subject to blockage by the formation of wood jams.

Monitoring

JR Merit will continuously monitor the movement of sediment and large wood in the newly exposed bed of the reservoir. It is believed that the potential for blockage of the drain tunnel will remain high for several days post-breach. Therefore the emergency equipment and supplies for blockage removal will remain on standby alert for several days. There is less concern with large wood passing through the drain tunnel and then creating a logjam in the Canyon Reach, because the opening size of the drain tunnel is the smallest hydraulic constriction that water and large wood will encounter.

The jams will then be adaptively managed depending on the degree of public risk, unwanted sediment retention, or the potential to cause fish passage problems. Modifications or removal of jams creating problems will be completed as soon as it is safe and feasible to do so, or, in the case of jams that cause fish passage problems, prior to the fish migration period. The monitoring of the canyon reach will be conducted by a combination of methods. Personnel walking in from the flowline alignment will assess the location and scale of log jams that may have formed in the adjacent section of the river. A portion of the river downstream of the powerhouse will also be monitored from the old bridge location and from the Big White Ponds raceway location. In order to conduct a comprehensive survey of the river, a combination of foot and aerial surveys may be used to identify log jams, their locations, and necessary management actions.

Since the quantity of wood present in the reservoir sediments is unknown, the frequency of monitoring will depend on conditions observed in the field. This will apply to the newly exposed canyon upstream of the dam, the tributaries feeding into the reservoir, and the canyon areas downstream of the dam.

Weekly surveys of the river between the Washington State Route 14 Bridge and the upstream edge of the White Salmon River headcut (formed following dam breach) will be conducted during this period. The channel formation process of the tributaries feeding into the former reservoir area will be monitored at the same frequency.

Daily evaluations to inform if wood accumulations might jeopardize the highway and railroad bridge structures will be conducted.

4.2.3 Stage Three – Post-Reservoir Draining to Return of Pre-dam Conditions within the Existing Reservoir

It has been predicted that the time period between initial dam breaching and the return of the river channel through the reservoir to pre-dam conditions will be approximately one

year. During this period of time, the rapidity and extent of the erosion of the deposited sediments will vary with the seasonal flow volumes of the White Salmon River. Large woody debris will be exposed by the river, and depending on the relationship between flow and the size of the logs, may stay on-site or be mobilized downstream to a deposition zone suitable to its size and shape. Active management of the sediment slopes will also be conducted during this period, potentially exposing additional wood that would interact with the river or stay on-site depending on the distance to the channel edge. The removal of the coffer dam may also result in the addition of some timbers into the river system. Based on historical record, the coffer dam timbers are not expected to be treated wood.

Monitoring

Monitoring will be accomplished using a combination of methods depending on safety and accessibility. Between the time of dam breach and the establishment of stable remaining sediment deposits (estimated up to one year), JR Merit will monitor the reservoir bottom and the eroding river channel for large wood deposits. Large wood deposits will be removed as soon as practicable, given that the initial conditions of collapsing sediment deposits will make access to the river bottom unacceptably dangerous for a period of time. During this time period, JR Merit will maintain the equipment necessary for extracting large wood from the upstream entrance to the drain tunnel.

Woody debris that is inhibiting bank stabilization within the boundaries of the former reservoir will be identified and dislodged or removed. Sediment slopes will be monitored for stability according to the Sediment Assessment, Stabilization, and Management Plan. As soon after Stage Two is safe, the river will be assessed starting at the area immediately upstream of the dam location and proceeding upstream to the end of the project area to see if any large woody debris deposition is preventing the establishment of stable river banks.

The schedule of this monitoring will depend on several factors. The primary factor will be the determination of whether or not the area may be accessed safely. This will depend in part on the stability of the slopes above the canyon area. During high flow events monitoring may not be possible. As the river erodes down to historic grade, sediment removed will likely unearth bedrock escarpments that face the river making it impossible to access portions of the newly exposed canyon from the canyon floor. The necessity of monitoring downstream of the dam may be determined in part by the quantity of wood observed passing through the drainage tunnel at the base of the dam.

When monitoring is possible, the area will be visually assessed weekly from October through February then every other week through May. The monitoring will locate any exposed log jams that pose a safety hazard, impede fish passage, or restrict rapid reservoir erosion of fine sediment.

Woody debris that impedes the erosion of large volumes of reservoir sediments will be actively managed. This will be completed by dislodging or removing wood to a storage area. Wood in the storage area will be made available to agencies and organizations for

use in habitat restoration projects. Wood will be stored for up to one year following the decommissioning of the dam and be disposed if not utilized within this time. Also, once the designated storage area is full, additional wood will be recycled or disposed.

Specific fish passage surveys will be conducted according to the schedule outlined in the Aquatic Resources Protection Plan. The following section is taken directly from that plan:

Monitoring for fish passage will commence in April, in advance of the removal of the upstream 1912 cofferdam (to be removed by May) and prior to the beginning of the summer steelhead run. The cofferdam is expected to be a barrier to migrating fish (Ecology, 2007); and thus managing for passage elsewhere in the project area prior to its removal will have little benefit. Even if the cofferdam does not present a barrier or if it is removed sooner, restoring passage through the project area sooner than May will have limited benefit because of the adverse migration conditions that are expected to persist for the months following breaching as the river channel adjusts through the reservoir sediments. The only management of passage conditions that may occur prior to May are the activities related to reservoir sediment and wood management following breaching. These activities are discussed in the Sediment Assessment, Management, and Stabilization Plan and the Woody Debris Management Plan.

Following the initial passage survey in April, periodic surveys will be conducted once a month through September and after any high flow event that could potentially alter passage conditions (i.e., significant mobilization of sediment and wood). Beginning in October (one year following breaching), passage surveys will only be conducted following high flow events, in order to capture passage conditions that may have changed. Special surveys will be initiated in response to any reports of potential passage concerns. Surveys will be terminated once the site has stabilized such that decommissioning-related activities no longer present a significant risk to fish passage.

Schedule

The area downstream of the dam will also be visually assessed monthly to determine whether any large woody debris is posing any threat to public safety or fish passage. A series of weekly evaluations from October through March then every other week through May will inform if wood accumulations might jeopardize the highway and railroad bridge structures.

4.2.4 Stage Four – Extended Monitoring

Sand and gravel areas in the upper reaches of the reservoir may take additional time to erode. This process may be accelerated by the active management of these sediments. Woody debris that is exposed in this area will be transported down the river in a manner similar to that discussed above for Stage Three. The purpose of this monitoring stage is to ensure that woody debris from the reservoir does not create fish passage barriers or hazards to public safety. Procedures and processes for the long term stabilization of the sediments remaining in the bed of the former reservoir are detailed in the Sediment Assessment, Stabilization, and Management Plan. Once the remaining sediments are

judged to be geotechnically stable they will be seeded to permanent vegetative cover. Materials and methods for vegetative establishment are outlined in the Revegetation and Wetlands Management Plan.

Monitoring

As in Stage Three, fish passage evaluation will continue to be conducted as necessary prior to fish passage timing and immediately following major bank failures that contribute woody debris to the system or storm event with flows equal to or in excess of 2,000 cubic feet-per-second (10 percent exceedance flow). The monitoring will locate exposed log jams that may impede fish passage. This woody debris will be actively managed by either dislodging the jam or scheduling it for removal to a storage area to be recycled or utilized for habitat enhancement. Any wood dislodged will be observed to determine that it does not form additional fish passage barriers.

4.3 LARGE WOOD REMOVAL METHODS AND DISPOSAL

Wood removal and management activities will be coordinated with the local boating community and Washington State Fish and Wildlife to ensure these actions do not create additional public safety risks or impact aquatic resources.

Wood that is deemed a hazard to public safety and/or creates fish passage problems will be removed to allow passage. Wood jams that span the entire channel will present a public safety risk and will be modified or removed. Wood that enters segments of the low flow channel could be left, modified, or removed depending on the risk to the public. Wood that does not enter the low flow channel edge will be left alone since it will not pose a navigational hazard to recreational boaters, and it will not cause a safety or fish passage problem. During high flows, this type of wood will provide a velocity refuge for fish, and therefore will positively contribute to fish habitat.

Wood that is a minimum 18 inches in diameter and 20-feet long should be saved for habitat enhancement projects in the local area. Wood appropriate for salvage is that which can be handled by heavy equipment. A stockpile area will be created a short distance from the dam that will be used to store habitat wood until it can be mobilized to a project site. Wood will be stored for up to one year and will be disposed if not utilized within this time. Wood that is smaller than this may be piled and burned, chipped, or spread out within the adjacent forest floor or upper reaches of reservoir sediment considered for re-vegetation, marketed, recycled, sold for compost, or used as landfill. Log jam wood that is removed by hand tools or explosives in hard to access areas will not be salvaged.

4.3.1 Upstream of Tunnel and Reservoir

Prior to the blast that opens the final section of the drain tunnel; a barge-mounted clamshell crane upstream of the dam will excavate sediment and debris from the upstream face of the dam in the area where the tunnel will be opened. The crane will remove any excess woody debris and place it in the boat ramp area. It is unknown how much wood and what size will be encountered during this process.

It is possible that wood will find its way to the tunnel inlet between the time the reservoir is drawn down and final dam removal. This will most likely occur during the winter between project removal commencement and completion. Therefore, equipment or explosives that can remove debris from the tunnel entrance will be available as necessary through the duration of the decommissioning.

4.3.2 Canyon Reach

The canyon reach has limited heavy equipment access to remove or modify large wood that creates safety hazards or fish passage problems. Much of this work will require hand tools that are delivered to the site via raft. Roped access can also be used to gain access to portions of the lower river. Safety of entry (i.e., channel stability) and protection from fall hazards and water hazards will be necessary to address.

Once mobilized to a jam site, chainsaws, hand winches, and non-mechanical hand tools may be effective in loosening debris jams. Firmly established large wood jams may require removal using explosives. Once loosened, wood can be hand winched out of the channel or to a location downstream where it will be floated out during the next high flow. When possible, log jams will be removed or modified during low flows to reduce safety risks.

4.3.3 White Salmon River Embayment

Any wood transported during dam removal that does not accumulate within the canyon will be deposited in the embayment area created by the Bonneville Pool. It is not known how much wood may accumulate in the embayment following reservoir drawdown. The behavior of the reservoir wood that may enter the canyon will be different than wood entering the channel naturally. Reservoir wood will tend to be less buoyant (neutral) and have a tendency to deposit more readily than recently felled (buoyant) wood. Most of the wood coming out of the canyon will deposit where the fast flowing White Salmon River meets the backwater created by the Bonneville Dam in the northern most segment of the embayment.

If large volumes of wood are retained in the embayment, and create a hazard, it will be managed to minimize risks to the public and river navigation. Wood may be collected using a boat and log booms to create a debris raft. The wood could then be transported out to the Columbia River or removed at the Underwood In Lieu Site boat ramp near Highway 14. Wood may also be metered out to the Columbia River gradually or released during periods when it will pose less risk to navigational and recreational users.

If collected embayment wood is delivered to the Columbia River to float downstream, hazards to river navigation and recreational uses will be assessed and management actions will be developed and communicated according to the procedures established in the Public Safety and Traffic Control Plan.

4.4 POST DAM REMOVAL

4.4.1 Downstream of the Dam Site

It is inadvisable to place any large wood in the canyon reach below the dam site, primarily because of the hazards to recreational boating. Between the powerhouse and the Underwood In Lieu Site, located at the mouth of the White Salmon River, large wood deposits will be allowed to accumulate naturally over time. There are limited benefits to aquatic habitat that can be gained by the artificial placement of large wood jams in this reach of the river, particularly since those wood structures would need to be located at the river channel margins so as to prevent a new hazard for the boating public.

4.4.2 Upstream of the Dam Site

Once the reservoir sediments have become stable, and the final slopes have been graded, there may be some benefit to the placement of large wood structures along the margins of the White Salmon River or upland areas for wildlife benefit. Given fish passage and recreation river user impacts, no woody debris is planned to be placed in the river channel, only possibly the riparian and upland areas. The primary riparian benefits would include the trapping of sediment on floodplain surfaces adjacent to the active river channel, and the slowing of overbank floodwater from eroding newly graded riverine wetland areas before their riparian plants have become established. Secondary benefits would include micro-habitats along the riverine fringe, and visual affirmation of the natural river's process of wood accumulation. The optimal location for placement of large wood jams must be determined in association with the final grading plan for reservoir sediments, which will be developed after initial drawdown. Woody debris removal is limited to the extent necessary for public safety and sediment management as noted in the Surrender Order.

5 REFERENCES

- Federal Energy Regulatory Commission (FERC), 2002. Final Supplemental Final Environmental Impact Statement - Condit Hydroelectric Project, Washington (FERC Project No. 2342).
- Golder Associates, Incorporated, 2008. Geophysical Investigation at Condit Dam, Klickitat County, Washington.
- JR Merit and Riverbend Engineering, 2011. Woody Debris Management Plan Addendum, Prepared for PacifiCorp Energy. FERC Project No. 2342.
- Lower Columbia Fish Recovery Board (LCFRB), 2004. Lower Columbia Salmon and Steelhead Recovery and Fish & Wildlife Subbasin Plan.
- National Marine Fisheries Service (NMFS), 2006. Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Consultation. NMFS Northwest Region, Hydropower Division. NMFS Log Number 2002/00977. October 12.
- National Oceanic and Atmospheric Administration (NOAA), 2006. ESA Recovery Planning for Mid-Columbia River Steelhead in the Gorge Management Unit – Status of Planning Effort and Strategy for Completing Plans.
- PacifiCorp Energy, 2004. Project Description. Condit Hydroelectric Project. FERC Project No. 2342.
- R. W. Beck, Incorporated, 1998. Condit Hydroelectric Project Removal, Summary Report Engineering Considerations.
- Slavens, F., 2004. Western Pond Turtle Survey at Northwestern Lake Reservoir on the White Salmon River.
- Smith, C.T., LaGrange, A., Arden, W., Engle, R., and Olson, D., 2007. Genetic Analysis of Juvenile Chinook Salmon Collected in White Salmon River. US Fish & Wildlife Service, Laboratory report for FONS 13210-2006-062.
- U.S. Fish and Wildlife Service (USFWS), 2005. Reinitiation of Consultation on Bull Trout (*Salvelinus confluentus*) and Consultation on Bull Trout Critical Habitat for Condit Dam Removal and Dam Operation. FWS Reference 1-3-05-F-0059. Lacey, WA.
- Washington State Department of Ecology (Ecology), 2007. Condit Dam Removal Final SEPA Supplemental Environmental Impact Statement. Ecology Publication # 07-06-012.