

PACIFIC LAMPREY MANAGEMENT PLAN
WELLS HYDROELECTRIC PROJECT
FERC PROJECT NO. 2149

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EXECUTIVE SUMMARY

The Pacific Lamprey Management Plan (PLMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP) will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification for the Wells Hydroelectric Project (Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Members of the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Indian Nation (Yakama), and Douglas.

The National Marine Fisheries Service (NMFS) was invited to participate in the development of Aquatic Resource Management Plans, but declined because its interests are currently satisfied by the measures within the HCP.

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey (*Lampetra tridentata*) resulting from the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several Pacific lamprey PMEs in support of the PLMP. The PMEs presented within the PLMP are designed to meet the following objectives:

Objective 1: Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey;

Objective 2: Identify and address any Project-related impacts on downstream passage and survival and rearing of juvenile Pacific lamprey;

Objective 3: Participate in the development of regional Pacific lamprey conservation activities.

The PLMP is intended to be compatible with other Pacific lamprey management plans in the Columbia River mainstem. Furthermore, the PLMP is intended to be supportive of the HCP, the critical research needs identified by the Columbia River Basin Technical Working Group, the Resident Fish Management Plan, Bull Trout Management Plan, and White Sturgeon Management Plan by continuing to monitor and address ongoing impacts, if any, on Pacific lamprey resulting from Project operations. The PLMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under Washington state water quality standards found at WAC 173-201A.

1.0 INTRODUCTION

The Pacific Lamprey Management Plan (PLMP) is one of six Aquatic Resource Management Plans contained within the Aquatic Settlement Agreement (Agreement). Collectively, these six Aquatic Resource Management Plans are critical to direct implementation of Protection, Mitigation, and Enhancement measures (PMEs) during the term of the new license and, together with the Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP), will function as the Water Quality Attainment Plan (WQAP) in support of the Clean Water Act Section 401 Water Quality Certification for the Wells Hydroelectric Project (Project).

To ensure active stakeholder participation and support, the Public Utility District No. 1 of Douglas County (Douglas) developed all of the resource management plans in close coordination with agency and tribal natural resource managers (Aquatic Settlement Work Group or Aquatic SWG). During the development of this plan, the Aquatic SWG focused on developing management priorities for resources potentially impacted by Project operations. Entities invited to participate in the Aquatic SWG include the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA), Washington Department of Ecology (Ecology), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (Colville), the Confederated Tribes and Bands of the Yakama Indian Nation (Yakama), and Douglas.

The PLMP will direct implementation of measures to protect against and mitigate for potential Project impacts on Pacific lamprey (*Lampetra tridentata*). To ensure active stakeholder involvement and support, Douglas developed this plan, along with the other aquatic management plans, in close coordination with the members of the Aquatic SWG.

The Aquatic SWG agrees on the need to develop a plan for the long-term management of Pacific lamprey in the Project. This management plan summarizes the relevant resource issues and background (Section 2), identifies the goal and objectives of the plan (Section 3), and describes the relevant PMEs (Section 4) for Pacific lamprey during the term of the new license.

2.0 BACKGROUND

2.1 Pacific Lamprey Biology

Pacific lamprey are present in most tributaries of the Columbia River and in the mainstem Columbia River during their migration stages. They have cultural, utilitarian and ecological significance in the basin, because Native Americans have historically harvested them for subsistence, ceremonial and medicinal purposes (Close et al. 2002). As an anadromous species, they also play an important role in the food web by contributing marine-derived nutrients to the basin and may act as a predatory buffer for juvenile salmon and steelhead. Little specific information is available on the life history or status of lamprey in the mid-Columbia River watersheds. They are known to occur in the Methow, Wenatchee and Entiat rivers (NMFS 2002) and recently have been captured during juvenile salmon and steelhead trapping operations in the Okanogan River.

In general, adults are parasitic on fish in the Pacific Ocean while ammocoetes (larvae) are filter feeders that inhabit the fine silt deposits in backwaters and quiet eddies of streams (Wydoski and Whitney 2003). Adults generally spawn in low-gradient stream reaches in the tail areas of pools and in riffles, over gravel substrates (Jackson et al. 1997). Adults die after spawning. After hatching, the ammocoetes burrow into soft substrate for an extended larval period filtering particulate matter from the water column (Meeuwig et al. 2002). The ammocoetes undergo a metamorphosis into macrophthalmia (outmigrating juvenile lamprey) between 3 and 7 years after hatching, and then migrate from their parent streams to the ocean (Close et al. 2002). Adults typically spend 1-4 years in the ocean before returning to freshwater tributaries to spawn.

Pacific lamprey populations of the Columbia River have generally declined in abundance over the last 40 years according to counts at dams on the lower Columbia and Snake rivers (Close et al. 2002). Starke and Dalen (1995) reported that adult lamprey counts at Bonneville Dam regularly exceeded 100,000 fish in the 1960s and more recently have ranged between 20,000 and 120,000 for the period 2000-2004 (DART - www.cqs.washington.edu/dart/adult.html).

In the mid-Columbia River Basin, adult lamprey count data at hydroelectric projects varies by site but is generally available for all projects since 1998 (with the exception of Wanapum Dam where data is only available for 2007). As is expected, the general trend for mid-Columbia River counts is relatively consistent with observations at Bonneville Dam from year to year (i.e., relatively high count years at Bonneville result in relatively high count years in the mid-Columbia River). It is important to note that the daily and seasonal time periods as well as the counting protocols may differ at each project. These differences may affect data reliability and need to be considered when examining and comparing these data. Table 2.1-1 provides a summary of adult lamprey passage data for mid-Columbia River hydroelectric facilities.

Table 2.1-1. Minimum, maximum, and average counts for adult Pacific lamprey at mid-Columbia River hydroelectric projects from 1998 to 2007.

	Priest Rapids	Wanapum*	Rock Island	Rocky Reach	Wells
Min	1,130	4,771	559	303	21
Max	6,593	4,771	5,074	2,583	1,417
Average	3,016	4,771	2,157	952	326

* Wanapum Dam counts are only available for 2007.

Close et al. (1995, 2002) identified several factors that may account for the decline in lamprey counts in the Columbia River Basin. This includes reduction in suitable spawning and rearing habitat from flow regulation and channelization and pollution, reductions of prey in the ocean, and juvenile and adult passage problems at dams. Mesa et al. (2003) found that adult Pacific lamprey had a mean critical swimming speed of approximately 85 cm/s which suggests that they may have difficulty negotiating fishways with high current velocities that were designed for salmon and steelhead passage.

The study of adult Pacific lamprey migration patterns past dams and through reservoirs in the lower Columbia River has provided the first data sets on lamprey passage timing, travel times, and passage success at hydroelectric projects (Vella et al. 2001; Ocker et al. 2001; Moser et al. 2002a; Moser et al. 2002b). These studies have shown that approximately 90% of the radio-

tagged lamprey released downstream of Bonneville Dam migrated back to the tailrace below Bonneville Dam; however, less than 50% of the lamprey which encountered a fishway entrance actually passed through the ladder exit at the dam (Nass et al. 2005).

Similar collection and passage efficiency results were observed at Rocky Reach, Wanapum, and Priest Rapids dams during tagging studies conducted at those projects (Nass et al. 2003; Stevenson et al. 2005).

Of the 125 radio-tagged lampreys released approximately 7 kilometers downstream of Rocky Reach Dam, 93.6% were detected at the project, and of those fish, 94.0% entered the fishway. Of the fish that entered the Rocky Reach fishway, 55.5% exited the ladder (Stevenson et al. 2005).

During studies at Wanapum and Priest Rapids dams, a total of 51 and 74 lamprey were radio-tagged and released downstream of Priest Rapid Dam in 2001 and 2002, respectively. Over the two years of study, the proportion of fish that approached the fishway that exited the ladders was 30% and 70% at Priest Rapids and 100% and 51% at Wanapum Dam in 2001 and 2002, respectively (Nass et al. 2003).

Two recent reviews of Pacific lamprey (Hillman and Miller 2000; Golder Associates Ltd. 2003) in the mid-Columbia River have indicated that little specific information is available regarding their population status (Stevenson et al. 2005).

2.2 Status of Pacific Lamprey

In January 2003, the USFWS received a petition from 11 environmental groups seeking the listing of four lamprey species (Pacific lamprey, river lamprey, western brook lamprey, and Kern brook lamprey). The petition cited population declines and said lampreys are threatened by artificial barriers to upstream and downstream migration, de-watering and habitat degradation among other threats. In response to the petition, the USFWS conducted an initial review to determine whether an emergency listing was warranted and decided in March 2003 that such a situation did not exist.

In an agreement stemming from a lawsuit filed by the petitioners in response to the initial finding, the USFWS committed to the issuance of a 90-day finding on the petition by December 20, 2004. Again, the USFWS announced that the petition seeking a listing of the four lamprey species did not contain enough information to warrant further review and the agency was not going to place the lamprey species on the Endangered Species list. For Pacific lamprey, the petitioners provided information showing a drop in range and numbers, but did not provide information describing how the regional portion of the species' petitioned range, or any smaller portion, is appropriate for listing under the Endangered Species Act (ESA). The agency did however decide it will continue to work with others on efforts to gather information related to the conservation of lamprey and their habitats.

2.3 Monitoring and Studies of Outmigrating Juvenile Lamprey (Macrophthalmia)

Little information in the mid-Columbia River basin exists with regard to the outmigration timing and abundance of juvenile Pacific lamprey. Upstream of the Project, recent juvenile salmonid trapping operations by WDFW and the Colville Tribe have provided preliminary information on the presence of juvenile lamprey outmigrants in both the Methow and Okanogan rivers. This information represents incidental captures of juvenile lamprey, and may not be reflective of actual abundance or population trends. In the Okanogan River, information is available for 2006 and 2007 where 220 and 24 juvenile lamprey were observed, respectively, during spring trapping operations. In the Methow River watershed, information is available for two sites; the Twisp and Methow rivers. At the Twisp River site, no juvenile lamprey have been observed since data has been collected (2005). At the Methow River site, for the years 2004-2007, 89, 84, 831, and 37 juvenile lamprey were observed, respectively, in trapping operations that typically last from April to November with peaks generally occurring in the spring. Data collection from these activities is likely to continue and provide information on juvenile Pacific lamprey as they begin their outmigration through the Columbia River hydrosystem towards the Pacific Ocean.

Although there is a growing body of information on adult Pacific lamprey and their interactions at hydroelectric projects, relatively little information exists describing the effects of hydroelectric plant operations on outmigrating juvenile lamprey (macrophthalmia). Recent juvenile lamprey studies at hydroelectric projects have addressed testing for lamprey macrophthalmia survival through juvenile bypass facilities (Bleich and Moursund 2006), impingement at intake diversion screens (Moursund et al. 2000 and 2003), validation of existing screening criteria (Ostrand 2005), and responses of juvenile Pacific lamprey to simulated turbine passage environments (Moursund et al. 2001; INL 2006). Results of other studies targeting predaceous birds and fish suggest that juvenile lamprey may compose a significant proportion of the diets of these predators (Poe et al. 1991; Merrell 1959).

A review of the recent body of work addressing juvenile lamprey at hydroelectric facilities concludes that there is a current lack of methods and tools to effectively quantify the level of survival for juvenile lamprey migrating through hydroelectric facilities. Furthermore, no studies exist that assign a level of survival attributed to a project's operations. This is due to the lack of miniaturized active tag technologies to overcome two study limitations. Macrophthalmia (juvenile outmigrating lamprey) are relatively small in size and unique in body shape and they tend to migrate low in the water column resulting in the rapid attenuation of active tag signal strength. In an effort to develop a tagging protocol, the Bonneville Power Administration (BPA) funded Oregon State University (OSU) to identify and develop tag technologies for lamprey macrophthalmia. Recent reports on this developmental effort have concluded that the smallest currently available radio-tag was still too large for implantation in the body cavity of a juvenile lamprey (Schreck et al. 2000). Additionally, external application was not effective as animals removed tags within the first week and fish performance was affected. This report also concluded that internal implantation of Passive Integrated Transponder (PIT) tags was the most viable option for tagging juvenile lamprey although this method included severe limitations such as the limited range of detection systems and the ability to tag only the largest outmigrating juvenile lamprey (Schreck et al. 2000).

2.4 Project Adult Pacific Lamprey Counts and Passage Timing

Returning adult Pacific lamprey have been counted at Wells Dam since 1998. Between the years of 1998 and 2007, the number of lamprey passing Wells Dam annually has averaged 326 fish and ranged from 21 fish in 2006 to 1,417 fish in 2003 (Table 2.3-1). In addition to the overriding condition that Pacific lamprey numbers are declining in the Columbia River system, the relatively small number of adult lamprey observed at Wells Dam may be attributed to fact that the Project is the last of nine passable dams on the mainstem Columbia River and the fact that the Project is over 500 miles upstream from the Pacific Ocean and the bioenergetic expenditure for a relatively poor swimming species such as Pacific lamprey is likely great.

Adult lamprey pass Wells Dam from early July until late November with peak passage times between mid-August and late October (Figures 2.4-1 and 2.4-2). In all years since counting was initiated, Pacific lamprey counts at the east fish ladder were greater than at the west fish ladder except for 2007. It is important to note that historically, counting protocols were designed to assess adult salmonids and did not necessarily conform to lamprey migration behavior (Moser and Close 2003). Traditional counting times for salmon did not coincide with lamprey passage activity which occurs primarily at night; the erratic swimming behavior of adult lamprey also makes them inherently difficult to count (Moser and Close 2003). Beamish (1980) also noted that lamprey overwinter in freshwater for one year prior to spawning. Consequently, lamprey counted in one year may actually have entered the system in the previous year (Moser and Close 2003) which confounds annual returns back into the Columbia River Basin. In addition to salmonid-specific counting protocols, adult fishway facilities have been constructed specifically for passage of salmonids. Recent research has identified areas such as picketed lead structures downstream of fish count windows that adult lamprey may access to bypass count stations and avoid being enumerated (LGL 2008). It is unknown to what degree lamprey behavior and methodological and structural concerns are reflected in Columbia River lamprey passage data. However, it is important to consider such caveats when examining historic lamprey count data at Columbia River dams including Wells Dam.

Table 2.4-1 Adult Pacific lamprey counts at Wells Dam for east and west fish ladders, 1998-2007.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
East	174	47	96	153	226	724	263	151	13	17
West	169	26	59	106	117	694	140	64	8	18
Total	343	73	155	259	343	1418	403	215	21	35

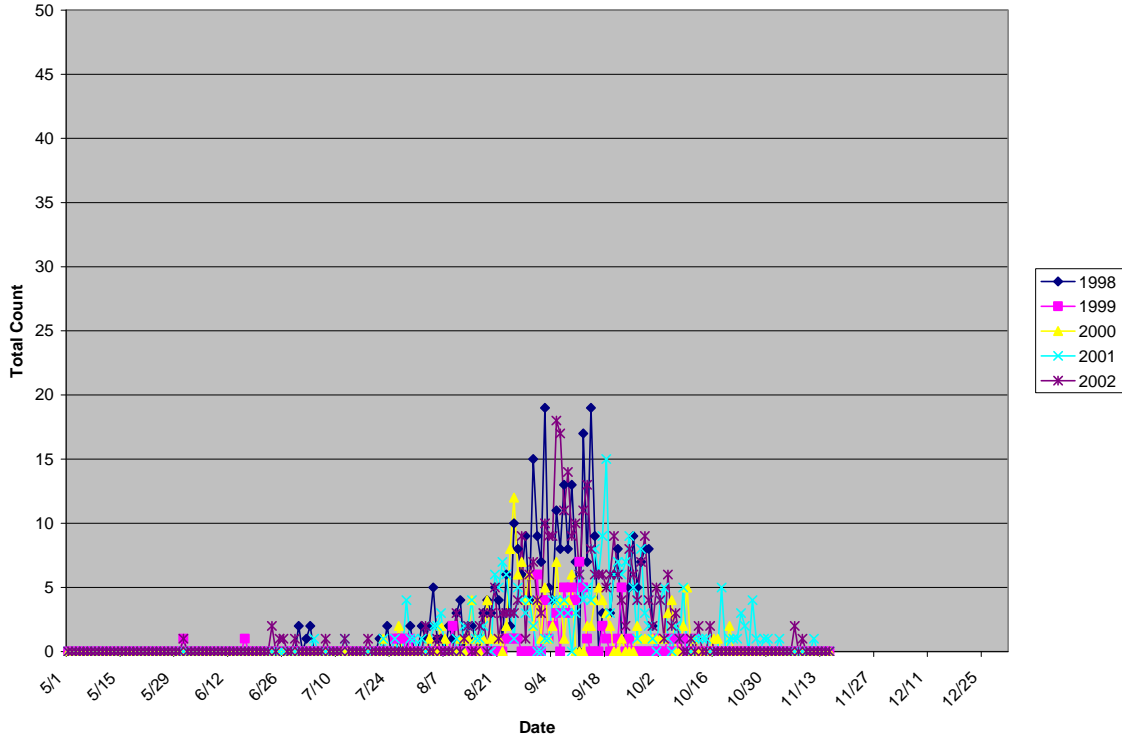


Figure 2.4-1 Daily counts of adult Pacific lamprey at Wells Dam during the fish counting season, 1998-2002.

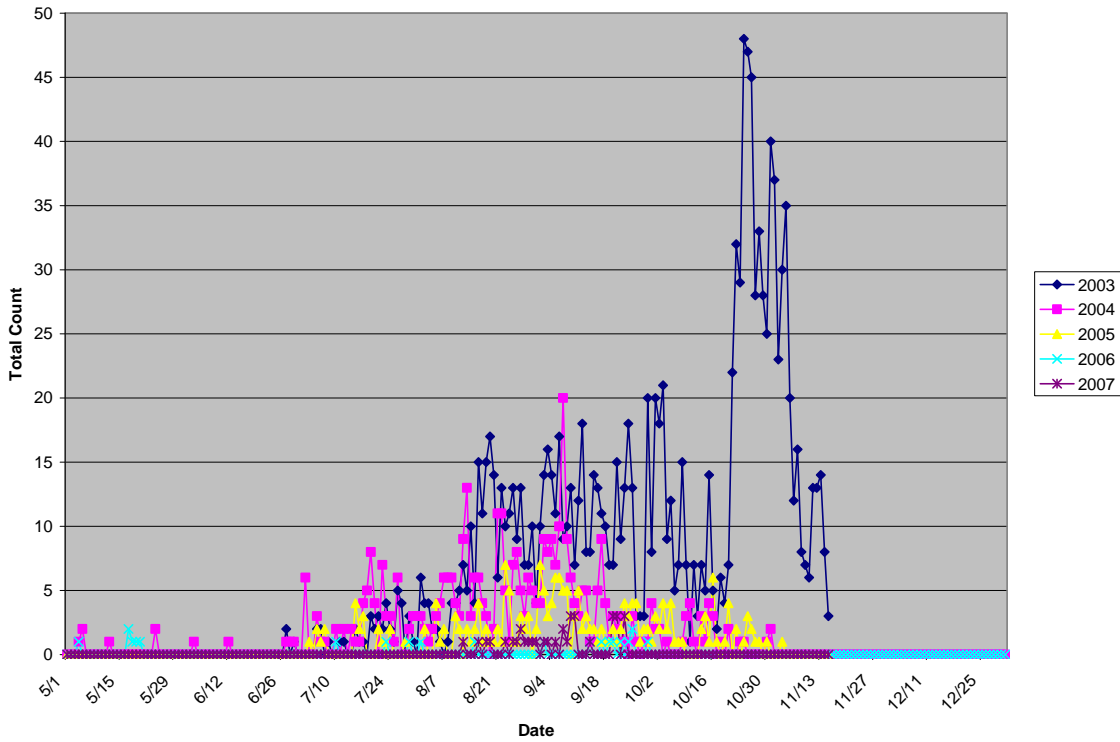


Figure 2.4-2 Daily counts of adult Pacific lamprey at Wells Dam during the fish counting season, 2003-2007.

2.5 Project Pacific Lamprey Studies

Until recently, relatively little information was available on Pacific lamprey in the mid-Columbia River Basin. However, with increased interest in the species coupled with a petition for listing under the ESA (Section 2.2), Douglas has initiated studies to address Pacific lamprey passage and migratory behavior in the Project consistent with currently available technology.

2.5.1 2001-2003 Project Pacific Lamprey Study

In 2004, Douglas contracted with LGL Limited to conduct a lamprey radio-telemetry study at Wells Dam in coordination with Chelan PUD, which was conducting a similar study at Rocky Reach Dam. A total of 150 lamprey were radio-tagged and released at or below Rocky Reach Dam. The radio-tags used in this study had an expected operational life of 45 days (Nass et al. 2005). It is important to note that as a result of the lamprey release site being located over 50 miles downstream of Wells Dam, the value of the study results for the Project was limited by the relatively small numbers of tagged fish detected upstream at Wells (n=18) and the fact that many of the radio-tags detected at Wells Dam were within days of exceeding their expected battery life.

The 2004 study at Wells Dam was implemented through a combination of fixed-station monitoring at the dam and fixed-stations at tributary mouths. Collectively, these monitoring sites were used to determine migration and passage characteristics of lamprey entering the Project Area. Of the 150 adult lamprey released at or below Rocky Reach in 2004, 18 (12% of 150) were detected in the Wells Dam tailrace, and ten (56% of 18) of these were observed at an entrance to the fishways at Wells Dam. A total of 3 radio-tagged lamprey passed Wells Dam prior to expiration of the tags, resulting in a Fishway Efficiency estimate of 30% (3 of 10) for the study period. A single lamprey was detected upstream of Wells Dam at the mouth of the Methow River (Nass et al. 2005).

For lamprey that passed the dam, the majority (92%) of Project Passage time was spent in the tailrace. Median time required to pass through the fishway was 0.3 d and accounted for 8% of the Project Passage time (Nass et al. 2005).

Although the 2004 study at Wells Dam provided preliminary passage and behavioral information for migrating adult lamprey, the limited observations due to the small sample size (n=18) were insufficient in addressing the objectives of the 2004 study.

2.5.2 2007-2008 Project Pacific Lamprey Study

In 2007, Douglas contracted with LGL Limited to conduct a second lamprey radio-telemetry study at Wells Dam. The study was scheduled to occur from early August through November and utilized tags that had 87 days of battery life. A total of 21 adult lamprey were tagged and released for the purpose of this study. However, due to very low adult lamprey returns to Wells Dam in 2007 (n=35) and low trapping efficiency, only 6 adult Pacific lamprey were captured at Wells Dam during trapping activities (August 14 to October 3). Therefore, 15 additional adult lamprey were collected at Rocky Reach Dam, transported to Wells Dam, tagged and released. The project was continued in 2008 to obtain additional information.

A comprehensive report was produced in February of 2009 containing the results from the two-year radio-telemetry behavior studies (Robichaud et al. 2009). Results indicated that the “greatest impediment to successful passage of adult lamprey at Wells Dam appears to be the conditions at the fishway entrance, probably related to water velocities that limit swimming and attachment capabilities.” An equally significant impediment to successful passage of adult lamprey at Wells Dam in 2008 was the installation of perforated plates on the floor of the weir orifices in an effort to increase trapping efficiency. Robichaud et al. further recommended the following:

- Implement a reduction in fishway head differential to reduce entrance velocities to levels within the swimming capabilities of Pacific lamprey (0.8 to 2.1 m/s). These proposed flow reductions should be restricted to hours of peak lamprey activity (i.e., nighttime) and within their primary migratory period at Wells Dam (August-September).
- Remove perforated plates from orifice floors at the current trapping locations and discontinue trapping efforts at Wells Dam.
- Consider using monitoring tools that are less intrusive, do not require the collection of fish from the ladders at Wells Dam, and minimize the surgical implantation of tags in fish that are nearing their physiological limits.

2.5.3 2009 Pacific Lamprey Ladder Modification Study

In response to Robichaud et al. (2009), Douglas PUD, in consultation with the Aquatic SWG, prepared a plan to implement and evaluate measures to enhance passage of adult Pacific lamprey at Wells Dam (Murauskas and Johnson, 2009). These measures, originally scheduled for year two after license issuance (2013), were designed to determine whether temporary velocity reductions at the fishway entrances would enhance the attraction and relative entrance success of adult lamprey at Wells Dam. Three alternative entrance flow velocities (i.e., existing high, moderate, and low) will be assessed using Dual-frequency Identification Sonar (DIDSON) in a randomized block design during the fall of 2009. The goal is to identify optimal hydraulic conditions conducive to entry of adult lampreys into the fishways at Wells Dam.

3.0 GOALS AND OBJECTIVES

The goal of the PLMP is to implement measures to monitor and address impacts, if any, on Pacific lamprey resulting from the Project during the term of the new license. Douglas, in collaboration with the Aquatic SWG, has agreed to implement several Pacific lamprey PME in support of the PLMP. The PMEs presented within the PLMP are designed to meet the following objectives:

Objective 1: Identify and address any adverse Project-related impacts on passage of adult Pacific lamprey;

Objective 2: Identify and address any Project-related impacts on downstream passage and survival, and rearing of juvenile Pacific lamprey;

Objective 3: Participate in the development of regional Pacific lamprey conservation activities.

The PLMP is intended to be compatible with other Pacific lamprey management plans in the Columbia River mainstem. Furthermore, the PLMP is intended to be supportive of the HCP, the critical research needs identified by the Columbia River Basin Technical Working Group, the Resident Fish Management Plan, Bull Trout Management Plan, and White Sturgeon Management Plan by continuing to monitor and address ongoing impacts, if any, on Pacific lamprey resulting from Project operations. The PLMP is intended to be not inconsistent with other management strategies of federal, state and tribal natural resource management agencies and supportive of designated uses for aquatic life under Washington state water quality standards found at WAC 173-201A.

The schedule for implementation of specific measures within the PLMP is based on the best information available at the time the Plan was developed. As new information becomes available, implementation of each activity may be adjusted through consultation with the Aquatic SWG.

4.0 PROTECTION, MITIGATION AND ENHANCEMENT MEASURES

Douglas, in consultation with the Aquatic SWG, will implement PME for Pacific lamprey in the Project consistent with the goals and objectives identified in Section 3.0. The measures proposed in this section are intended to serve as PMEs for Pacific lamprey throughout the new license term.

4.1 Adult Pacific Lamprey Passage (Objective 1)

4.1.1 Upstream Fishway Operations Criteria

Douglas shall operate the upstream fishways at Wells Dam in accordance with criteria outlined in the HCP. Based upon information collected from activities conducted in Sections 4.1.3 - 4.1.7, Douglas, in consultation with the Aquatic SWG and the HCP Coordinating Committee, may evaluate various operational and structural modifications to the upstream fishways (e.g., reduction in fishway flows at night) for the benefit of Pacific lamprey passing upstream through Wells Dam during the new license term. If requested, the Aquatic SWG shall develop an Operations Study Plan (OS Plan) that specifically identifies all operational modifications to be evaluated, the proposed monitoring strategy, implementation timeline and criteria for success. The plan shall include a component to evaluate the effects of lamprey modifications on salmon. Upon completion of the evaluation, the Aquatic SWG, in consultation with the HCP Coordinating Committee, will determine whether the proposed modifications should be made permanent, removed, or modified.

4.1.2 Salvage Activities During Ladder Maintenance Dewatering

Douglas shall continue to implement the Adult Fish Passage Plan and associated Adult Ladder Dewatering Plan as required by the HCP. These plans include practices and procedures utilized during fishway dewatering operations to minimize fish presence in the fish ladders and then once dewatered directs Douglas staff to remove stranded fish and safely place them back into the

Columbia River. All fish species, including Pacific lamprey that are encountered during dewatering operations are salvaged consistent with the protocol identified in the HCP. Any adult lamprey that are captured during salvage activities will be released upstream of Wells Dam, unless otherwise determined by the Aquatic SWG. Douglas will coordinate salvage activities with the Aquatic SWG and allow for member participation. Douglas will provide a summary of salvage activities in the annual report.

4.1.3 Upstream Fishway Counts and Alternative Passage Routes

Douglas shall continue to conduct annual adult fish passage monitoring in the Wells Dam fishways using the most current technology available, to count and provide information on upstream migrating adult Pacific lamprey 24-hours per day during the adult fishway monitoring season (May 1- November 15). Based upon information collected from activities conducted in Sections 4.1.6 - 4.1.7, Douglas, in consultation with the Aquatic SWG, may choose to address the use of alternative upstream passage routes around Wells Dam fishway counting stations by adult Pacific lamprey. Potential measures to improve counting accuracy, following consultation and approval of the Aquatic SWG, may include, but may not be limited to, the development of a correction factor based upon data collected during passage evaluations (Sections 4.1.6 and 4.1.7) or utilization of an alternative passage route as a counting facility for adult Pacific lamprey.

4.1.4 Upstream Passage Improvement Literature Review

If additional passage improvement measures are deemed necessary by the Aquatic SWG, then within six months after this determination, Douglas, in consultation with the Aquatic SWG, shall complete a literature review on the effectiveness of upstream passage measures (i.e., lamprey passage systems, plating over diffuser grating, modifications to orifices, rounding sharp edges, fishway operational changes, etc.) implemented at other Columbia and Snake river hydroelectric facilities. The literature review will be conducted in support of activities identified in Section 4.1.5 to help in the selection of reasonable measures that may be implemented to improve adult lamprey passage at Wells Dam.

4.1.5 Fishway Modifications to Improve Upstream Passage

If additional passage improvement measures are deemed necessary by the Aquatic SWG, based upon the results of studies conducted at Wells Dam, then within one year or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify, design and implement any reasonable upstream passage modifications (structural and/or operational). Passage measures will be designed to improve passage performance by providing safe, effective, and volitional passage for Pacific lamprey through the Wells Dam fishways without negatively impacting the passage performance of adult anadromous salmonids. The following components shall be included in these passage measures:

- Fishway Inspection: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall conduct a fishway inspection with the Aquatic SWG and regional lamprey passage experts to identify and prioritize measures to improve adult lamprey passage and enumeration at Wells

Dam. Additional ladder inspections will be conducted at the request of the Aquatic SWG, consistent with winter ladder dewatering operations.

- Entrance Efficiency: Within one year of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall develop a Lamprey Entrance Efficiency Plan (LEE Plan) for evaluating operational and physical ladder entrance modifications intended to create an environment at the fishway entrances that are conducive to adult lamprey passage without significantly impacting the passage of adult salmonids. These improvements shall be evaluated until compliance, as described below, is attained.
- Diffuser Gratings: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, diffuser gratings within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.
- Transition Zones: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, transition zones within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.
- Ladder Traps and Exit Pools: Within five years of license issuance or as soon as practicable following consultation with the Aquatic SWG, Douglas shall identify and address, if needed, lamprey ladder traps and exit pools within fishways at Wells Dam that adversely affect passage of adult Pacific lamprey.

Douglas shall exhibit steady progress, as agreed to by the Aquatic SWG, towards improving adult lamprey passage until performance at Wells Dam is determined to be similar to other mid-Columbia River hydroelectric dams, or until scientifically rigorous standards and evaluation techniques are established by the Lamprey Technical Workgroup, or its successor, and adopted regionally. The Aquatic SWG will then evaluate, and if applicable and appropriate, adopt these standards for use at Wells Dam. If compliance is achieved, Douglas shall only be required to implement activities pursuant to Section 4.1.7 (Periodic Monitoring) for adult Pacific lamprey passage.

4.1.6 Adult Pacific Lamprey Upstream Passage Evaluation

Should upstream passage measures be implemented under Section 4.1.5, then within one year following the implementation of such measures, Douglas, in consultation with the Aquatic SWG, shall conduct a one-year study to monitor the effectiveness of such measures on upstream passage performance of adult Pacific lamprey through Wells Dam. If monitoring results indicate that passage rates at Wells Dam are not similar to passage rates at other mid-Columbia River dams or within standards as described in Section 4.1.5, Douglas, in consultation with the Aquatic SWG, shall develop and implement additional measures to improve upstream Pacific lamprey passage. Measures described in Sections 4.1.5 and 4.1.6 may be repeated, as necessary, until adult passage through Wells Dam is similar to passage rates at other mid-Columbia River hydroelectric dams or within standards as described in Section 4.1.5.

4.1.7 Periodic Monitoring

Once adult Pacific lamprey upstream passage rates at Wells Dam are similar to rates at other mid-Columbia River dams or within standards as described in Section 4.1.5, Douglas, in consultation with the Aquatic SWG, shall periodically monitor adult Pacific lamprey passage performance through Wells Dam fishways to verify the effectiveness of passage improvement measures. Specifically, every ten years after compliance has been achieved, or as determined by the Aquatic SWG, Douglas shall implement a one-year study to verify the effectiveness of the adult fish ladders with respect to adult lamprey passage. If results of the monitoring program confirm the effectiveness of adult lamprey passage measures and the results indicate that passage rates are still in compliance, then no additional measures are needed. If the results indicate that adult upstream passage rates are out of compliance, then the upstream passage study will be replicated to confirm the results. If the results after two years of study both indicate that passage rates have not been maintained, Douglas, in consultation with the Aquatic SWG, shall develop and implement measures to improve upstream Pacific lamprey passage, if any (see Section 4.1.5).

4.2 Juvenile Pacific Lamprey Downstream Passage and Survival and Rearing (Objective 2)

4.2.1 Downstream Bypass Operations Criteria

Douglas is required to operate the downstream bypass system at Wells Dam in accordance with criteria outlined in the HCP.

4.2.2 Salvage Activities During Ladder Maintenance Dewatering

Douglas shall continue to conduct salvage activities as required by the HCP's Adult Fish Passage Plan during fishway dewatering operations. All fish species, including Pacific lamprey that are encountered during dewatering operations shall be salvaged consistent with the protocol identified in the HCP. Any juvenile Pacific lamprey that are captured during salvage activities will be released downstream of Wells Dam. Douglas will coordinate salvage activities with the Aquatic SWG and allow for member participation. Douglas will provide a summary of salvage activities in the annual report.

4.2.3 Juvenile Pacific Lamprey Passage and Survival Literature Review

Beginning in year five and every five years thereafter during the new license, Douglas, in consultation with the Aquatic SWG, shall conduct a literature review to summarize available technical information related to juvenile lamprey passage and survival through Columbia and Snake river hydroelectric facilities. This information will be used to assess the feasibility of conducting activities identified in Section 4.2.4.

4.2.4 Juvenile Pacific Lamprey Downstream Passage and Survival Evaluation

Based upon the current state of the science regarding tag technology and methodologies for Pacific lamprey macrophthalmia (Section 2.3), coupled with the challenges of obtaining

macrophthalmia in sufficient numbers within the Project to meet sample size requirements for a statistically rigorous study, a juvenile downstream passage and survival evaluation is not feasible at this time.

During the term of the new license, if tag technology and methodologies are developed and field tested and a sufficient source of macrophthalmia in or upstream of the Project are identified to ensure that a field study will yield statistically rigorous and unbiased results, Douglas, in consultation with the Aquatic SWG, shall implement a one-year juvenile Pacific lamprey downstream passage and survival study.

If statistically valid study results indicate that Project operations have a significant negative impact on the Pacific lamprey population above the Wells Dam, Douglas, in consultation with the Aquatic SWG, shall identify and implement scientifically rigorous and regionally accepted measures (e.g., translocation, artificial production or habitat enhancement), if any, or additional studies to address such impacts. If operational changes are needed to improve passage survival of juvenile lamprey migrants, then those changes need to be coordinate with the HCP Coordinating Committee.

4.2.5 Juvenile Pacific Lamprey Habitat Evaluation

Within three years of the effective date of the new license, Douglas shall implement a one-year study to examine presence and relative abundance of juvenile Pacific lamprey in habitat areas within the Project that may be affected by Project operations. As part of this measure, Douglas shall identify areas of potential juvenile Pacific lamprey habitat for future evaluation. Sampling of these areas will assess presence/absence and relative abundance. Any sampling methodologies used in support of this activity will require coordination with the HCP Coordinating Committee and regulatory approval of the federal and state agencies.

4.3 Participate in Regional Pacific Lamprey Conservation Activities (Objective 3)

4.3.1 Regional Lamprey Working Groups

Douglas shall participate in Pacific lamprey work groups in order to support regional conservation efforts (e.g., the Pacific Lamprey Technical Work Group and the USFWS Lamprey Conservation Initiative). Activities may include but are not limited to information exchanges with other entities, meeting attendance, and coordination of Douglas' Pacific lamprey activities with other entities conducting lamprey research in the mid-Columbia River. Activities may also include conducting PLMP research within the Project, and sharing that information with other entities.

4.4 Reporting

Douglas will provide an annual report to the Aquatic SWG summarizing the previous year's activities and proposed activities for the following year undertaken in accordance with the PLMP. The report will document all Pacific lamprey activities conducted within the Project and describe activities proposed for the following year. Furthermore, any decisions, statements of agreement, evaluations, or changes made pursuant to this PLMP will be included in the annual report. If significant activity was not conducted in a given year, Douglas will prepare a memorandum providing an explanation of the circumstances in lieu of the annual report.

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