City of Tacoma,
Department of Public Utilities, Light Division
Cowlitz River Project
FERC No. 2016

Settlement Agreement License Article 8, Fish Disease Management Plan

Status Report November 1, 2013 – October 31, 2018

1. INTRODUCTION

This status report is prepared in compliance with the requirements of the Federal Energy Regulatory Commission (FERC) Order Modifying and Approving Fisheries Disease Management Plan, Article 8, issued October 31 2008. The Order required the City of Tacoma, Department of Public Utilities, Light Division (Tacoma Power) to file a revised Fisheries Disease Management Plan or a status report by November 1, 2018.

1.1. PROJECT DESCRIPTION

The Cowlitz Project (FERC No. 2016) is Tacoma Power's largest electricity generating facility and is located on the Cowlitz River, Lewis County, Washington. The Project consists of two dams, the Mayfield Dam at river mile (RM) 52 and Mossyrock Dam, upstream at RM 65. In addition to the project generating electricity and providing flood control, Tacoma operates three major parks, manages approximately 14,000 acres of wildlife lands, and owns and funds operation of the Cowlitz Salmon Hatchery (RM 50) and the Cowlitz Trout Hatchery (RM 42). The Barrier Dam, associated with the Cowlitz Salmon Hatchery, is located at RM 49.5. The original 50-year license for the Cowlitz Project was issued on December 28, 1951. A new 35-year license was issued and became effective on July 18, 2003.

The Mayfield development completed in 1963 includes a 250-foot-high, 850-foot-long concrete arch and gravity dam that impound Mayfield Lake, which has a maximum surface area of 2,250 acres. In addition to the Cowlitz River, inflows from the Tilton River also contribute to Mayfield Lake, which supports public and private recreational facilities. An 854-foot-long power tunnel passes through the right abutment of the dam and terminates at a concrete forebay structure. Four penstocks continue from the forebay structure to the four generating units, which have an installed capacity of 162-megawatts (MW).

The Mossyrock development, completed in 1968, includes a 606-foot-high double curvature concrete arch dam that creates Riffe Lake, a 23-mile long, 11,830-acre reservoir with 52 miles of shoreline. Riffe Lake supports several parks and other recreational facilities. Three penstocks, varying in length from 248 to 285 feet, extend down to the powerhouse, which is adjacent to the base of the dam. The powerhouse contains two generating units with room for a third, and has a total installed capacity of 300 MW. Transmission lines link the Mossyrock and Mayfield developments.

1.2. FERC LICENSE

Article 8. Disease Management Plan

Within five (5) years of license issuance, the Licensee shall submit a Fisheries Disease Management Plan that defines an acceptable level of risk from Ceratomyxa shasta) and other diseases, and allows adult fish to be upstream of Barrier Dam. The Fisheries Disease Management Plan shall be designed to allow an appropriate level of pathogens. The plan shall include criteria for determining success or failure, as well as a review every five (5) years to see that the criteria for success are being met and a procedure and schedule for amending the plan if the criteria are not met. Plan amendments could include, but not be limited to: changes in the Fisheries and Hatchery Management Plan and changes to the hatchery water quality and/or quantity. The Licensee shall consult with fish pathology experts from the National Marine Fisheries Service, U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife and shall prepare the plan in collaboration with the Fisheries Technical Committee provided for in the August 2000 Settlement Agreement, or if the Settlement Agreement has become void, with the U.S. Fish and Wildlife Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife and Washington Department of Ecology (referred to as "the FTC or agencies"). When a draft plan has been prepared, it shall be provided to all affected agencies and Tribes for 30-day review and comment. The Licensee shall include with the final plan documentation of consultation and copies of comments and recommendations, and specific descriptions of how the final plan accommodates all comments and recommendations. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on Project-specific information. The Commission reserves the right to require changes to the plan. Upon Commission approval, the Licensee shall implement the plan, including any changes required by the Commission. Following Commission approval, the plan becomes a requirement of the license, enforceable by the Commission.

2. STATUS REPORT

Infectious Hematopoietic Necrosis Virus (IHNV)

In the Cowlitz River Basin IHNV has historically been detected in adult and juvenile winter and summer steelhead (*Oncorhynchus mykiss*). The virus has also been detected from both fall and spring Chinook adults. The virus poses a significant threat to juvenile steelhead reared at the Cowlitz Trout Hatchery. IHNV detections in juvenile fish during this reporting period are shown in Table 1. No IHNV detections have occurred at Cowlitz Trout Hatchery since 2009 (juvenile Summer Steelhead). Furthermore, no IHNV detections in juvenile fish occurred at the Cowlitz Salmon Hatchery during this reporting period.

Table 1: IHNV detections in juvenile fish at Cowlitz Trout Hatchery from 2013-2018.

Year	IHNV Detection	Species	Associated Loss[1]
2013	No Detection		
2014	No Detection		
2015	No Detection		
2016	No Detection		
2017	No Detection		
2018[2]	No Detection		

[1]Type of loss (epidemic or non-epidemic) experienced by the population at the time of viral detection.
[2]Results as of September, 2018.

IHNV Management Recommendations:

- Monitor prevalence of IHNV in smolts that have died while being collected and transported below the Barrier Dam and Cowlitz Falls Collection Facility. Monitor prevalence of IHNV in smolts that have perished while being held at the Mayfield Dam smolt collection facility, and from the Cowlitz Falls Fish Collection Facility (CFFCF) to the Stress Relief Ponds at the Cowlitz Salmon Hatchery.

- Do not use steelhead adults for nutrient enhancement purposes unless the viral status is known.

- Continue with the use of well water and treated river water as long as possible during the rearing cycle of steelhead at the Cowlitz Trout Hatcheries.

Bacterial Kidney Disease

Adult and juvenile spring Chinook have been monitored for the presence of *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease (BKD) using the Enzyme Linked Immunosorbant Assay (ELISA). Results of the last 5 years are presented in Table 2 for adult fish. Table 3 contains juvenile fish results for the last 6 years, including smolts tested in spring of 2018 before release. The relative increase is likely reflected by the inclusion of 30 fish sampled from a control pond not treated with Aquamycin that were observed to have clinical BKD.

Fish management agencies in the Pacific Northwest have agreed to a rating system based on ELISA Optical Density (OD) category values. The 4 OD categories are: below low; low; moderate; and high. Greater than 95% of the spring Chinook adults held for brood stock have had below low levels of BKD. Because the adult Chinook that pass upstream are a random sample, it is assumed that this percentage is a good representation of those adults. Since the pathogen is both horizontally and vertically transmitted, this level is reflected in the low levels of BKD in their progeny, which are reared at low densities and with good fish culture practices. Table 6 shows that the juveniles have been routinely released with low to undetectable levels of BKD detected by ELISA. It is also reflective of the amount of BKD shed by spring Chinook adults passed upstream of the Cowlitz Salmon hatchery.

Table 2. Results of ELISA measurement of *Renibacterium salmoninarum* from adult spring Chinook returning to the Cowlitz Salmon Hatchery from 2013 to 2017.

Year Sampled	2013	2014	2015	2016	2017
Total Number sampled	623	719	611	839	682
Below Low	561	706	606	788	647
Low	27	4	1	32	9
Moderate	4	2	2	14	3
High	31	7	2	5	23

Table 3. Results of ELISA measurement of Renibacterium salmoninarum from juvenile spring Chinook released from the Cowlitz Salmon Hatchery from 2013 to 2018.

Year Sampled	2013	2014	2015	2016	2017	2018
Total Number Sampled	121	172	-	48	20	86
Below Low	120	170	-	46	20	69
Low	0	1	-	1	0	6
Moderate	0	1	-	0	0	6
High	1	0	-	1	0	5

Past management involved monthly injections of adults with the macrolide antibiotic, erythromycin, at 100mg/kg and multiple erythromycin top-coated feedings to juvenile fish. However, both the injections and the prophylactic feeding of erythromycin were scaled back after further evaluation determined that a one time injection and feeding of erythromycin still maintained control of the disease. Current management of the pathogen at the hatchery level includes the use of injectable Draxxin® (Tulathromycin) at 50 mg/kg into spring Chinook adults 30-60 days prior to spawning. The change in drug was due to injectable erythromycin no longer being produced in the country. Furthermore, erythromycin mixed with feed is only used once per year. Typically the feed is first given to spring Chinook juveniles 5 to 6 months after hatching and it is administered for 21 days at a dose of 100 mg/kg, generally following the mass marking (fin clipping) process.

BKD Management Recommendations:

- Monitor the prevalence of BKD antigen and/or R. sal DNA in dead and morbid Chinook smolts from the upper Cowlitz drainages by sampling them as they are collected at the Mayfield Dam, the Cowlitz Falls Fish Facility, and/or the stress relief ponds at the Cowlitz Salmon Hatchery.

- Continue the use of feed mixed with erythromycin to coincide with the first findings of BKD in Chinook at the Cowlitz Salmon Hatchery. Erythromycin should be used 10 to 14 days prior to the averaged first detection of *R. salmoninarum* in juveniles, typically following mass marking.

- Continue the injection of Draxxin® or similar macrolide antibiotic to adult female Spring Chinook within 30-60 days of spawning to minimize the risk of vertical transmission to eggs.

- Explore new treatment methods and rearing strategies that will lower environmental stress and improve fish health to mitigate development of clinical BKD.

- Manage the spring Chinook based on the ELISA sampling results from the brood. Spawn up to 10 percent additional eggs for potential destruction based on ELISA BKD levels.

Ceratomyxa shasta (C. shasta)

To help determine the effects of upstream passage of adult fish, *C. shasta* prevalence has been periodically monitored in all stocks reared at the Cowlitz hatcheries in 1999 (HARZA and WDFW), 2009, and again in 2018. Those results are shown in Table 4. The detection of *C. shasta* in juvenile spring Chinook increased from 45% in 1999 to 98.3% in 2009, but decreased to 32.5% in 2018. In the past decade, a decrease in *C. shasta* prevalence was observed in all anadromous salmonid stocks at the Cowlitz Trout Hatchery and hypothesized to reflect an increase in the genotype specific for Chinook and a decrease in genotype lethal to steelhead. However, an increase in prevalence of *C. shasta* was observed in all stocks from the previous sampling period in 2009. This monitoring was done after an outage of the ozonation generator in October 2017, which could explain the increase in prevalence at Cowlitz Trout Hatchery prior to release. Past fish health examinations have noted *C. shasta* in steelhead prior to release, but formal monitoring efforts were not performed. Despite the high prevalence, no clinical signs were noted and mortality remained low during rearing. Continued monitoring of stocks prior to release is recommended to further monitor prevalence trends.

Table 4. The percent prevalence of *Ceratomyxa shasta* in juvenile fish stocks reared at the Cowlitz Salmon and Trout Hatcheries in 1999, 2009, and a subset of susceptible stocks prior to release in 2018 as determined by Polymerase Chain Reaction Assay (PCR).

	Year Sampled		
Species	**1999**	**2009**	**2018**
Spring Chinook	45.0 %	98.3 %	32.5%
Coho	3.3 %	0.0 %	-
Summer steelhead	95.0 %	68.0 %	91.7%
Winter steelhead	95.0 %	13.7 %	91.7%
Sea run cutthroat	93.0 %	6.7 %	98.3%

The amplification of the adult spores disseminating from the adult Chinook is not responsible alone for increased infection levels in stocks at the hatchery. The major flooding events that took place in the last decades changed riverbed substrate distribution, which provided better habitat for the alternate host, the polychaete *Manayunkia speciosa.* After polychaete habitat

studies in 2009 showed that the abundance was remarkably high in the silt collected in front of the salmon hatchery's intake, the recommendation was followed to dredge the intake in 2011 to remove the polychaete host near the intake and presumably decrease *C. shasta* spore density. That brood year of spring Chinook experienced its lowest mortality since dredging became regular practice (Table 5).

Table 5. Rearing mortality at Cowlitz Salmon Hatchery in juvenile spring Chinook salmon programs released from 2008 to 2018 ('06 BY to '17 BY).

Brood Year	2006	2007	2008	2009	2010	2011
Total percent loss	11.87%	9.49%	10.73%	18.82%	16.48%	7.64%
Brood Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017***
Total percent loss	5.10%	7.70%	6.03%	8.08%	3.53%	2.11%

*Currently rearing, mortality represents as of September 12, 2018.

Changes in total rearing mortalities may reflect changes to rearing, since the hatchery raceways were rebuilt in 2010. During construction it was necessary to rear at higher densities, which may have contributed to the increased mortality by increasing density and stress-related mortality. Therefore, further studies to determine the effect of dredging were initiated in 2017. A monitoring study to determine the effect dredging has on *C. shasta* spore density in the intake supply did not provide conclusive results on an immediate decrease in spores density when comparing before and after dredging in 2017 (Figure 1). However, there is a chance the removal of the polychaete has a long term effect on subsequent years regarding disruption of polychaete habitat and may reflect an overall decrease in spore density. A comparison of 2010 spore density estimates (before any dredging occurred) and 2017 (after dredging became normal practice) shows a decrease in overall spore density (Figure 2). Further study, perhaps comparing a year without dredging, may elucidate the effect dredging has on spore density in the subsequent year.

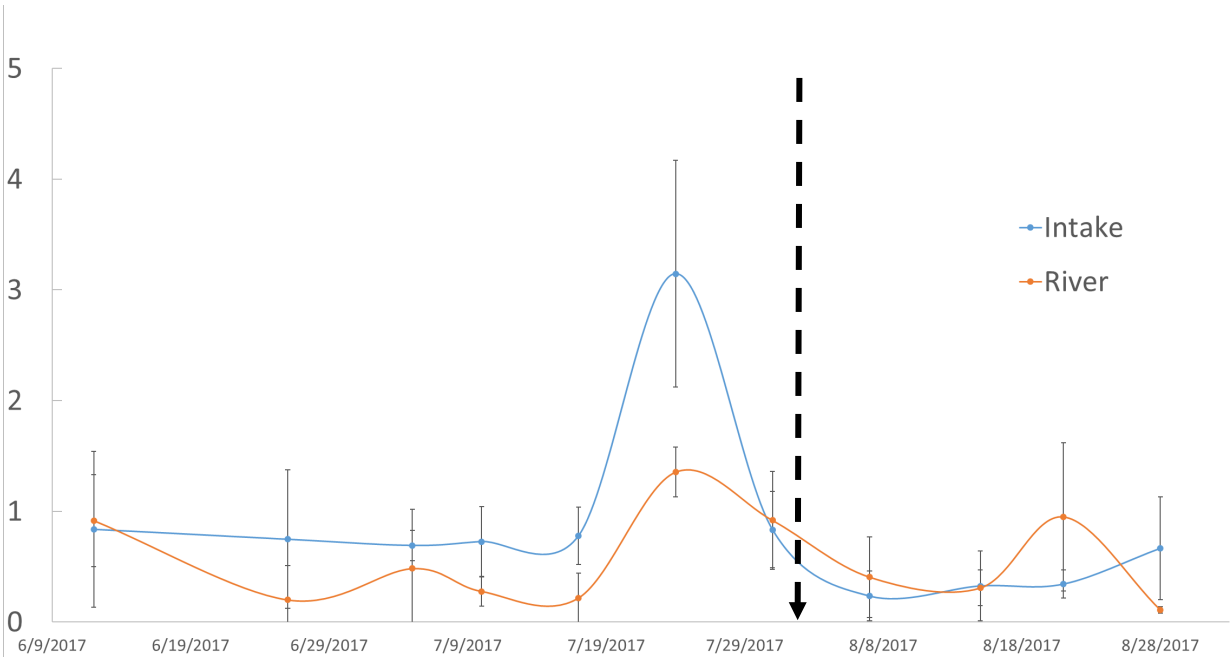

Figure 1. Spore density estimates (spores/liter) from qPCR for summer of 2017, with error bars representing standard deviation among triplicate samples. Dredging occurred on August 1, 2017, denoted by dashed arrow.

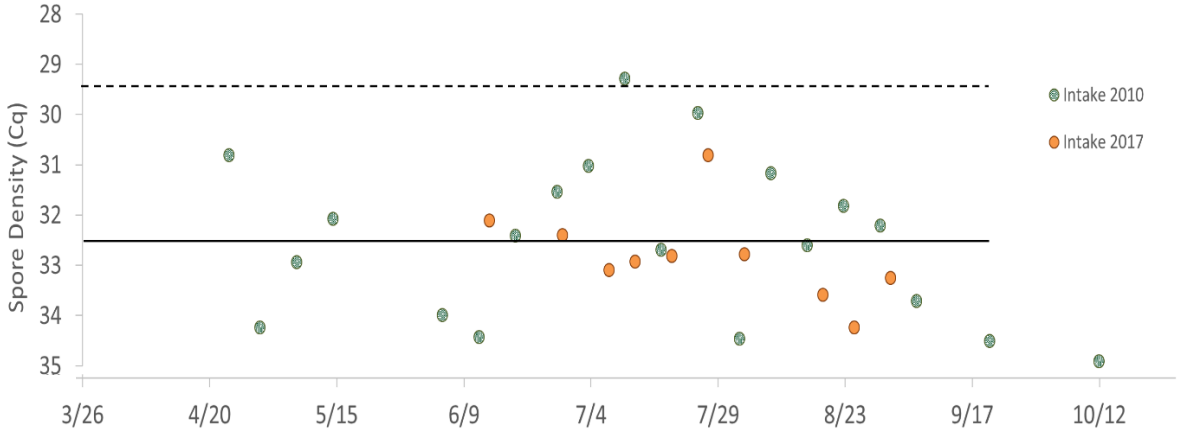

Figure 2. Comparison of spore density (estimated by Cq values from qPCR) at the hatchery intake from 2010 and 2017. The intake was first dredged in 2011. Standard estimates of 1 (solid) and 10 (dashed) spores/L are represented as horizontal lines.

The geographical distribution of this endoparasite was studied using sentinel fish exposures and it was found that *C. shasta* prevalence was highest near the intake to Cowlitz Salmon hatchery compared to sites above the barrier dam, indicating a lower risk of transmission in the upper Cowlitz River system. Further geographic testing for *C. shasta* was conducted in 2013 in a study to determine the best location for a net pen upstream of the hatchery (Table 6). In brief, sentinel fish were exposed to different sites in May 2013, then reared for 80 days to monitor for *C. shasta* related mortality and final prevalence. Control groups were represented by fish reared in hatchery on surface water and well water (negative control). Results again indicated sites upstream of Cowlitz Salmon Hatchery and Mayfield Dam have a low prevalence of the parasite

compared to high prevalence within the hatchery. Furthermore, an increased prevalence from May to June is seen when comparing any fall Chinook reared at the hatchery.

Table 6. Results of PCR analysis from fall Chinook exposed to different locations in the Cowlitz River in 2013 and 2018.

Geographic Location	Date Exposed	Date Sampled	Number *C. shasta* positive (% Prevalence)
2013			
Dock near Mossyrock Hatchery (Old net pen site)	May 13 – 20, 2013	July 8, 2013	4/52 (7.7%)
Dunn Canyon (New net pen site)	May 13 – 20, 2013	July 8, 2013	1/52 (1.9%)
Cowlitz Salmon Hatchery Intake (7d sentinel exposure)	May 13 – 20, 2013	July 8, 2013	15/56 (28.6%)
Cowlitz Salmon Hatchery – Pond 18	Surface water since February 2013	May 13, 2013	32/60 (53.3%)
Cowlitz Salmon Hatchery – Pond 18	Surface water since February 2013	June 11, 2013	60/60 (100%)
Negative Control	No exposure	July 8, 2013	0/100 (0%)
2018			
Mayfield Net Pen	Surface water since February 2018	June 1, 2018	3/60 (5.0%)
Rotary Screw Trap (downstream Cowlitz Salmon Hatchery)	Surface water since February 2018	July 1, 2018	17/19 (86.5%)

Hatchery origin fall Chinook sampled prior to release in June 2018 had a low prevalence of 5% after rearing for 4-8 weeks in the Mayfield Net Pen compared to a high prevalence of 89.5% in hatchery-origin fish collected downstream at the screw trap in July 2018 (Table 6). This could be attributed to differences in geographic location but also the temporal differences span a known period of increased spore density (Figure 2, 3) and parasite development within the host, which would also lead to increased prevalence between these groups.

Natural origin fall Chinook smolts opportunistically sampled during out-migration in 2015 from the Mayfield Dam smolt collection facility did not have *C. shasta* present. Smolts collected downstream at the rotary screw trap in 2018 had a 100% prevalence (Table 7). Further monitoring should focus on this passage to see if this pattern is reflected.

Table 7. Results of PCR analysis from natural-origin fall Chinook smolts collected from different locations in the Cowlitz River in 2015 and 2018. Number *C. shasta* positive (% prevalence).

	Year Sampled	
Geographic Location	**2015**	**2018**
Mayfield Dam Smolt Collection Facility	0/15 (0%)	-
Rotary Screw Trap (downstream from Cowlitz Salmon Hatchery)	-	19/19 (100%)

C. shasta Management Recommendations:

- Monitor prevalence of *C. shasta* in smolts that have died while being collected and transported below the Barrier Dam and Cowlitz Falls Collection Facility. Monitor prevalence in smolts that have perished while being held at the Mayfield Dam smolt collection facility and from the Cowlitz Falls Fish Facility (CFFF) to the Stress Relief Ponds at the Cowlitz Salmon Hatchery.
- Freeze spring Chinook carcasses used for nutrient enhancement to reduce parasite levels.
- As a precaution, mass mark hatchery fish that are susceptible to *C. shasta* during periods of lower water temperature.
- Continue with influent ozone disinfection at the Cowlitz Trout Hatchery.
- Continue dredging the Cowlitz Salmon Hatchery intake until it has been determined that dredging is not a factor in reducing losses of fish from *C. shasta*.
- Continue assessing the effects of intake dredging on the reduction of *C. shasta* spore density entering the hatchery water supply.
- Conduct longitudinal sampling in the Cowlitz watershed to determine where the *M. speciosa* polychaete host and/or *C. shasta* spores persist in high densities and how they compare to previous surveys.

Exotic Regulated Pathogens

All water supplies containing fish will be tested for the presence of the myxozoan parasite, *Myxobolus cerebralis*, at least once every three years if fish that are reared on that water supply are to be transferred to another watershed. This program will involve testing the most susceptible species on site Disease Management Plan, 2008; for the presence of *M. cerebralis* at a minimum of a 5% APPL every three years. The species selected for screening must have been exposed to the water supply a minimum of 1,800 degree-days (Centigrade) or six (6) months before testing (USFWS and AFS Blue Book 2004 or current edition). For the Cowlitz River, fish are not transferred out of the Cowlitz watershed unless it is a special circumstance. However, it is important to monitor and sample for the presence of *M. cerebralis*.

The sampling of steelhead smolts at the Cowlitz Trout Hatchery will provide a strong monitoring effort for *M. cerebralis*. Steelhead/rainbow trout (*Oncorhynchus mykiss*) are the most susceptible species reared at Cowlitz River hatcheries, but the steelhead generally are not exposed to untreated river water for the 1,800 degree-days or six (6) months. Still, due to their sensitivity, these are the best candidate for periodic surveillance within the Cowlitz system. Sixty fish will be tested prior to release every third year according to the Co-managers Salmonid Disease Policy. Fish reared in earthen ponds are the most likely to test positive for the parasite, so only fish from the acclimation lakes will be used in the monitoring effort. Sixty adult Chinook and 60 adult steelhead will be sampled for *M. cerebralis*. Unfortunately, turnover of WDFW fish health specialists during this reporting period has led to a delay in this schedulate monitoring, therefore, re-instatement of *M. cerebralis* should be conducted on these stocks prior to release starting with the current brood year 2018 stock.

***Myxobolus cerebralis* Recommendation:**

- Monitoring for *M. cerebralis* is recommended every third year and will be done prior to release in 2019.

Nutrient Enhancement

Criteria to be used that allow the least risk for nutrient enhancement:

- Freeze the carcasses to reduce IHNV levels. This also eliminates most parasites.
- Do not use fish with obvious clinical signs of disease (hemorrhage, ascites, lesions in internal organs, white patches on internal organs).
- Do not use steelhead unless viral results have detected no virus in that stock or sampled group.
- Do not use fish that have been injected with antibiotics within the required withdrawal period (avoids potential toxicity to wildlife).
- Do not use fish from other watersheds and do not export carcasses to other watersheds. If this is to occur, then the fish products are to be pasteurized before the transfer.

Consultation and Comments

Date	Agencies/ Committees	Participants	Type of Communication	Topics
September 25, 2018	Cowlitz Fisheries Technical Committee	Tacoma Power, WDFW, Yakima Nation, AR/TU, WDOE, USFWS	30-day Review distribution of draft annual report.	• Draft Annual Fish Disease Management Plan Status Report for review.