Water Quality Monitoring Plan (WQMP)

Henry M. Jackson Hydroelectric Project (FERC No. 2157)

Public Utility District No. 1 of Snohomish County

Everett, WA

May 2011

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Acronyms

°C	degrees Centigrade
°F	degrees Fahrenheit
7-DAD Max	7-day average of the daily maximum temperature
cfs	cubic feet per second
CWA	Federal Clean Water Act
datasonde	Hydrolab Series 5X DataSonde (or equivalent)
DO	dissolved oxygen
DQO	data quality objective
Ecology	Washington Department of Ecology
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
IT	Intake Tower
m	meter
mg/L	milligrams per liter
NTU	nephelometric turbidity units
ppm	parts per million
Project	Henry M. Jackson Hydroelectric Project
RM	River Mile
RPD	relative percent difference
SF	South Fork Sultan River
SM	Standard Method
SR-1	Spada Reservoir near outlet
TDG	total dissolved gas
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WC	Williamson Creek

1. Introduction

1.1. Purpose

This Water Quality Monitoring Plan (WQMP) describes monitoring procedures for select water quality parameters in the vicinity of the Henry M. Jackson Hydroelectric Project (Project) (No. P-2157). The Project is located on the Sultan River in Snohomish County, Washington, and is operated and maintained by the Public Utility District No. 1 of Snohomish County (District). The Project consists of a dam (Culmback Dam), an impoundment (Spada Lake Reservoir), a smaller diversion dam owned by the City of Everett, a powerhouse and associated equipment, and transmission facilities (Figure 1-1).

The District is in the process of seeking a new 45-year license for continued operation of the Project from the Federal Energy Regulatory Commission (FERC). The FERC is expected to issue a new license before the end of May 2011. To support issuance of the license from the FERC, Washington Department of Ecology (Ecology) issued a water quality certification, pursuant to Section 401 of the Clean Water Act (CWA, 33 U.S.C. § 1341) for operation of the Project under the new license. The District received the water quality certification from Ecology on October 18, 2010. The certification provides Ecology's confirmation that there is reasonable assurance the Project will meet applicable State water quality requirements.

As stipulated in Ecology's 401 Certification Order (October 18, 2010), the District will conduct monitoring of water quality conditions in the Sultan River and Spada Lake Reservoir in the vicinity of the Project to ensure continued protection and compliance with Washington State water quality standards currently codified in WAC 173-201A (401 Certification Order No. 7918; section 9.0 Monitoring and Reporting Requirements). The District's approach to this water quality monitoring is described in the following sections, including sites and parameters to be monitored, sampling frequency, sampling procedures and equipment, analytical methods, quality control procedures, and data assessment and reporting.

In October 2009, the District submitted to the FERC a comprehensive Settlement Agreement on behalf of itself, the National Marine Fisheries Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Park Service, Washington Department of Fish and Wildlife, Ecology, Tulalip Tribes of Washington, Snohomish County, City of Everett, City of Sultan, and American Whitewater. The purpose of the Settlement Agreement is to resolve among the signatories issues associated with issuance of the new license for the Project. The District requested that the FERC accept and incorporate all of the proposed license articles in the Settlement Agreement in the new license.

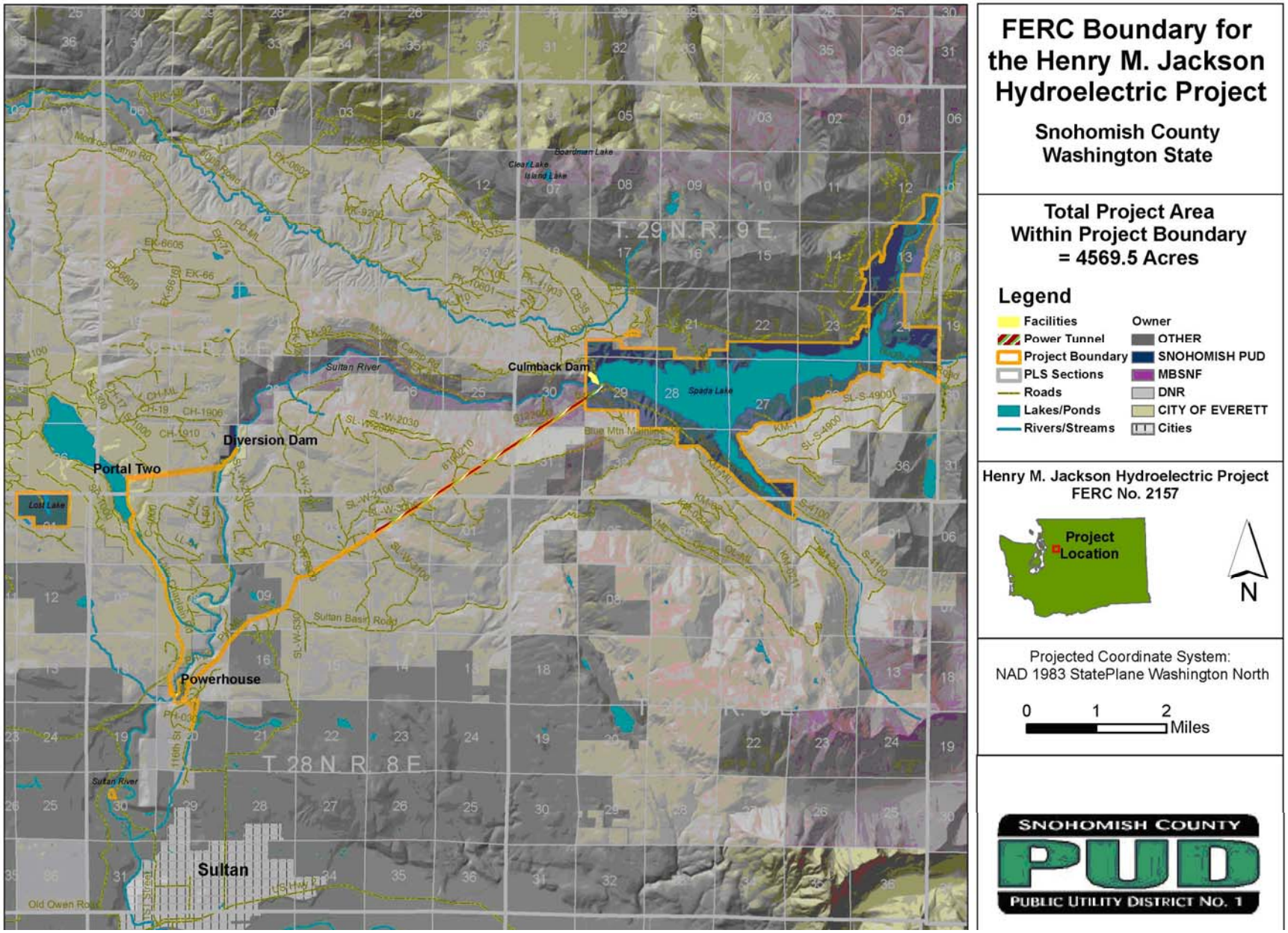

Figure 1-1. Map of the Henry M. Jackson Hydroelectric Project (FERC No. 2157) Vicinity.

Water License Article 1 (W-LA 1) of the Settlement Agreement specifies development and implementation of a Water Quality Plan (WQP)[1] to ensure compliance with Washington State water quality standards in the Sultan River as codified in WAC 173-201A (see Appendix 1). The Settlement Agreement specifies that, at a minimum, the WQP include the following components:

1. water quality protection measures related to Project construction or maintenance activities (includes Best Management Practices (BMPs) for in-water and upland construction and maintenance activities);
2. spill prevention and containment procedures;
3. procedures for application of herbicides, pesticides, fungicides, and disinfectants; and
4. a Water Quality Monitoring Plan (WQMP), which details compliance monitoring and reporting procedures for select water quality parameters (including, but not necessarily limited to, stream flow, water temperature, and turbidity).

Article W-LA 1 also specifies that the District will develop the WQP in consultation with Ecology, along with the Aquatic Resource Committee (ARC), and submit the WQP to the FERC for approval, within 180 days of issuance of the new FERC license. Upon the FERC's approval, the District will implement the WQP.

The District has developed a draft WQP that describes the measures and procedures for the first three components listed above (Snohomish County PUD 2010). This WQMP provides the fourth component listed above. This WQMP serves as a stand-alone document that is attached as Appendix A to the draft WQP (Snohomish County PUD). The WQMP is effective for the entire license term and is complementary to the numerous shorter duration water quality and biological monitoring efforts tied to specific license articles. The District developed this WQMP in consultation with the Aquatic Resource Committee (ARC); copies of consultation are included in Appendix 2. A complete tabular listing of the monitoring commitments tied to the license is presented in Appendix 3.

1.2. Background

The overall water quality in the Sultan River in the vicinity of the Project is very good. The Sultan River Basin is a remote watershed characterized by rugged forested terrain and high precipitation. These conditions result in surface waters that have diluted dissolved solids and ions content, and are generally free of pollutants or contaminants. The Sultan River Basin has been protected as the source of the City of Everett's municipal water supply since 1917. Protective measures include restrictions on the range of recreational and other activities that may occur in the Project area, which further limits the potential for anthropogenic effects on water quality.

The District completed a two-year Water Quality Parameter Study in March 2009 to obtain information on existing water quality conditions in the vicinity of the Project. This study

[1] The WQP is referred to as the Water Quality Protection Plan in W-LA 1. To standardize the language/terminology used in the 401 Water Quality Certification and W-LA1, this Plan will conform to the terminology used by Ecology in the 401 Water Quality Certification.

assessed 19 parameters at 13 sampling sites in the vicinity of the Project over the period April 2007 through March 2009. Results of the study, including descriptions of existing data and information on water quality conditions in the Project vicinity, are provided in the Water Quality Final Technical Report (CH2M HILL 2010). The Water Quality Final Technical Report is available online at the Project relicensing web site at: http://www.snopud.com/PowerSupply/hydro/jhprelicense/jhprdocrel/jhprstudyrpts.ashx?p=1480.

Results of the study confirm that water quality conditions in the vicinity of the Project are very good. Conditions in the vicinity of the Project conform to Washington State water quality standards throughout the year with few exceptions. The water quality sampling indicates that the trophic state of Spada Lake Reservoir is oligotrophic. In general, oligotrophic lakes have low nutrients, low algal biomass and productivity, and high water clarity.

Spada Lake Reservoir serves as the City of Everett's municipal water supply, supplying drinking water to approximately 80 percent of Snohomish County. Because of this use, access and activities are restricted to protect water quality in the watershed. Non-electric motorized boating, overnight camping, and body-contact activities, such as swimming, are not permitted in the reservoir. This source water is monitored according to Safe Drinking Water Act (SDWA) regulations, which ensures the continuing integrity of the water supply system. The City monitors Spada Lake Reservoir outflow at a sampling point on the Lake Chaplain pipeline. The on-going monitoring programs provide routine data on over 40 parameters, including physical characteristics, biological parameters, conventional parameters, cyanide, metals, and volatile and synthetic organics.

The District monitored water temperatures below the Diversion Dam as a condition of the 1983 Settlement Agreement with the Joint Agencies (FERC 1982, FERC 1983). Since 2004, the District also continuously monitored water temperature at eight additional locations throughout the Sultan River basin. The Water Quality Final Technical Report (CH2M HILL 2010) describes these data.

Ecology monitors water quality at the mouth of the Sultan River, near Sultan, Washington (Station 07E055). Water quality data have been collected at this site since 1960. The overview of the data for this station provided on Ecology's web site indicates that, "overall water quality at this station met or exceeded expectations and is of lowest concern" (http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?sta=07E055). No reaches in the Sultan River Basin are listed by Ecology as "water quality limited" under Section 303(d) of the CWA[2].

[2] Section 303(d) of the CWA requires Ecology to prepare a list of all surface waters in Washington for which beneficial uses (such as drinking, recreation, aquatic habitat, and industrial use) are impaired by pollutants. These are water quality limited lakes, rivers, and streams that fall short of state surface water quality standards. Waters placed on the 303(d) list require the preparation of Total Maximum Daily Loads (TMDLs). The TMDL provides a regulatory tool to establish the maximum amount of a pollutant that is allowed to be released into a waterbody so as not to impair uses of the water.

2. Monitoring Approach

The District's water quality monitoring will assess eight parameters at ten sampling sites in the Project vicinity. Water quality monitoring will include measurements of conventional parameters related to water chemistry at all ten sites and physical measurements of stream discharge at six of these sites. Monitoring of these parameters at these sites will allow the District to assess on-going trends in water quality conditions and compliance with applicable water quality standards (per WAC 173-201A-200 in Ecology 2006) in the Project area. In addition to the monitoring identified, the District will be conducting further monitoring of the resource as described in specific management plans (see Appendix 3).

2.1. Parameters to be Monitored

2.1.1. Water Chemistry

Specific water quality parameters to be monitored are listed in Table 2-1, including the key statistic to be used to describe the condition of the parameter. Also listed in Table 2-1 are the applicable standards and criteria for the Sultan River Basin for four of the parameters listed, including water temperature, dissolved oxygen, turbidity, and pH (per WAC 173-201A-200 in Ecology 2006).

In addition to the parameters listed in Table 2-1, standards are in effect for the Sultan River Basin for two other parameters: (1) total dissolved gas (TDG); and (2) fecal coliform organism levels for contact recreation (per WAC 173-201A-200 in Ecology 2006). However, TDG and fecal coliform are not included in the District's water quality monitoring as described in this WQMP. The District's recent two-year Water Quality Parameter Study established that: (1) current conditions of TDG and fecal coliform in the Project vicinity are well within (and therefore comply with) the applicable standards; and (2) Project facilities and operations do not affect these parameters (CH2M HILL 2010).

As stipulated in Ecology's 401 Certification Order (October 18, 2010), the District will implement and comply with Settlement Agreement proposed license articles requiring monitoring of instream flows (401 Certification Order No. 7918; section 5.2 Specific Conditions – Instream Flow and Flow-Habitat). To provide instream flows, releases of water by means other than the penstock and Powerhouse may occasionally be necessary during Powerhouse inspection or testing activities. These alternative releases from the base of Culmback Dam discharge immediately into a high gradient, boulder-strewn canyon reach. As such, it is highly unlikely that these releases would result in short term elevated TDG levels. As indicated in the 401 Certification Order, Ecology has determined that the benefits to biota of the required instream flow releases outweigh any potential effects of possible short-term elevated TDG levels. Although monitoring of TDG is not included in this WQMP, the 401 Certification Order stipulates that the District will apply to Ecology and WDFW for short-term modifications in advance of such releases, if anticipated (401 Certification Order No. 7918; section 5.3.2 Total Dissolved Gas). Any such releases will be described in annual reports by the District as stipulated in the 401 Certification Order (section 9.0, Monitoring and Reporting Requirements).

Table 2-1. Specific Parameters of Water Chemistry to be Monitored

Parameters	Unit	Key Statistic	Associated Standard
Water temperature (Continuous data)	^{o}C	7-day average of the maximum daily water temperature (7-DAD Max)	Criteria in WAC 173-201A-200 in Ecology (2006): 16^{o}C (core summer salmonid habitat) 17.5^{o}C (salmonid rearing and migration) When temperatures exceed the above levels (or within 0.3^{o}C) due to natural conditions, then cumulative human actions may not increase the 7-DAD Max by more than 0.3^{o}C. When the background condition of the water is cooler that the above levels, human actions may not increase the 7-DAD Max by more than 28/(T+7) (where "T" is unaffected background water temperature in ^{o}C). [3]
Water temperature (Vertical profile)	^{o}C	Individual sample values as measured	None. For purposes of this monitoring, profiles will be used to assess stratification in the lake.
Dissolved oxygen	mg/L	Individual sample values as measured	Criteria in WAC 173-201A-200 in Ecology (2006): 9.5 mg/L (core summer salmonid habitat) 6.5 mg/L (salmonid rearing and migration) When dissolved oxygen is lower than the above levels due to natural conditions, cumulative human actions may not decrease dissolved oxygen by more than 0.2 mg/L[4].
Dissolved oxygen (vertical profile)	mg/L	Individual sample values as measured	None. For purposes of this monitoring, profiles will be used to assess stratification in the lake.
Turbidity	NTU	Individual sample values as measured	Criteria in WAC 173-201A-200 in Ecology (2006): 5 NTU over background when background is 50 NTU or less, or a 10% increase when background is more than 50 NTU[5].
pH	pH units	Individual sample values as measured	Criteria in WAC 173-201A-200 in Ecology (2006): 6.5 to 8.5 pH units, with a human-caused variation within the above range of less than 0.5 units.
Secchi transparency	meters	Individual values as measured	None. For purposes of this monitoring, Secchi depth will be used to assess lake conditions, including photic zone depth.

[3] The two-year Water Quality Parameter Study (CH2M HILL 2010) demonstrated that temperatures in the Project area rarely exceed the criteria. However, if necessary (i.e., if and when temperature exceeds the criteria as indicated), "natural conditions" or "unaffected background" will be determined using data from the South Fork (SF) site, which represents a site upstream of, and unaffected by, the Project.

[4] The two-year Water Quality Parameter Study (CH2M HILL 2010) demonstrated that that dissolved oxygen in the Project area is rarely less than the criteria. However, if necessary (i.e., if and when dissolved oxygen is less than criteria), "natural conditions" will be determined using data from the South Fork (SF) site, which represents a site upstream of, and unaffected by, the Project. Alternatively, "natural conditions" will be determined by assuming 100% dissolved oxygen saturation of waters at ambient temperature conditions.

[5] Background turbidity will be determined using data from the South Fork (SF) site, which represents a site upstream of, and unaffected by, the Project.

2.1.2. Physical Measurements of Stream Discharge

Flow discharge measurement data is available at three U.S. Geological Survey (USGS) gaging stations that are currently in use in the Project vicinity (Table 2-2). These three gaging stations are well dispersed within the Project vicinity, and are specifically associated with water quality sampling sites as summarized in Table 2-2. Data from these stations will provide information if necessary to characterize flow conditions that occur during water quality sampling at these sites. Flow discharge measurement data will also be collected by the District at RM 16.1, RM 9.8, and RM 4.9 using on-site pressure transducers or equivalent instrumentation. Stage-discharge rating curves for these locations will be developed and maintained in accordance with Chapter A10, Discharge Ratings at Gaging Stations, Techniques of Water-Resources Investigations of the United States Geological Survey. Monitoring at the five locations downstream of Culmback Dam will be used to determine compliance with minimum flows (A-LA 9), downramping rates (A-LA 5), and process flows (A-LA 8) within the three discrete operational reaches.

Table 2-2. USGS Stream Gaging Stations in the Project Vicinity

Station Name	USGS Gage Number	River Mile [a]	Period of Record	Associated Water Quality Site
Stations Currently in Use				
South Fork Sultan River	12137290	18.2	1992 to present	SF
Sultan River below Diversion Dam	12137800	9.4	1983 to present	RM 9.6
Sultan River below Powerplant	12138160	4.5 [b]	1983 to present	RM 4.4

a: Official USGS location.
b: The official USGS location for this gage is RM 4.5; however, this gage is actually just downstream of the Powerhouse, which is located at RM 4.4.

2.1.3. Reservoir Water Level Elevation

Spada Lake Reservoir elevation data is collected at a point off the southeast corner of the power tunnel intake structure located approximately 250 feet upstream of the dam. The District has a nitrogen gas bubbler monitored in real time by its SCADA system year around.

2.2. Monitoring & Sampling Locations and Frequencies

The ten sampling sites are listed in Table 2-3 and their locations are shown in Figure 2-1. The sampling sites are located within six segments in the Project vicinity:

- South Fork Sultan River above entrance to Spada Lake Reservoir
- Spada Lake Reservoir at the Culmback Dam Intake Structure

- Sultan River from Culmback Dam to the Diversion Dam
- Sultan River from the Diversion Dam to the Powerhouse
- Sultan River downstream from the Powerhouse
- Skykomish River near the confluence with the Sultan River

Parameters and sampling frequency vary by sampling locations as summarized in Table 2-4. In general, the sampling sites are selected for their ability to represent conditions within these segments, and to ascertain potential effects of Project facilities and operations on water quality.

Water temperature, in stream reaches, will be monitored year-round for the term of the license[6]. The annual monitoring period for water temperature at SR-1 and the remaining parameters will be from May 1 to October 31. This period encompasses the months when potential water quality effects from Project operations would be most likely to occur. In addition, meteorological conditions may limit or prevent site access outside this period, particularly during winter (e.g., snow pack).

Table 2-3. List of Water Quality Monitoring Sites (and Associated Codes)

Sample Site	Associated Code
South Fork Tributary	SF
Spada Reservoir (near Log Boom)	SR-1
Sultan River below Culmback Dam	RM 16.1
Sultan River above Diversion Dam	RM 9.8
Sultan River below Diversion Dam	RM 9.6
Sultan River above Powerhouse	RM 4.9
Sultan River below Powerhouse (Tailrace)	RM 4.4
Sultan River near confluence	RM 0.2
Skykomish River upstream of Sultan River	RM 34.6[7]
Skykomish River downstream of Sultan River	RM 33.7

[6] Water temperature will be monitored at three additional locations (RM 14.3, RM 12.8, and RM 11.3) in the Sultan River in association with A-LA 3, Temperature Conditioning in Reach 3. The duration of this monitoring will be 3 to 5 years.

[7] Published RM values refer to the Skykomish River as an extension of the Snohomish River. The Skykomish and Snoqualmie rivers join together to form the Snohomish River at RM 20.5. The Sultan River is 13.9 miles upstream of this point of convergence.

Table 2-4. Parameters to be Monitored, Locations, and Sampling Frequency

Parameter	SF	SR-1	RM 16.1	RM 9.8	RM 9.6	RM 4.9	RM 4.4	RM 0.2	Skyko. RM 14.1	Skyko. RM 13.2	Frequency
Water temperature	•	•	•	•	•	•	•	•	•	•	Year-round .(hourly) in stream reaches. Monthly between May 1 and October 31 for lake profile.
Dissolved oxygen	•	•		•			•				May 1 to October 31. Monthly in stream reaches. Monthly for lake profile.
Turbidity	•	•		•			•				May 1 to October 31. Monthly in stream reaches. Monthly for lake profile.
pH	•	•		•			•				May 1 to October 31. Monthly in stream reaches. Monthly for lake profile.
Secchi transparency		•									May 1 to October 31. Monthly.
Flow discharge	•		•	•	•	•	•				Year-round. Daily.
Reservoir elevation		•									Year-round. Daily.

2.2.1. Descriptions of Sampling and Monitoring Locations

Major Tributary to Spada Lake (South Fork)

Monitoring will occur in the South Fork of the Sultan River, a main tributary to Spada Lake Reservoir, at a site located near the mouth of the tributary. The site is located above the high water level of the reservoir to ensure samples are representative of the tributary, without influence from the lake. The site is coded SF (South Fork), and corresponds to the same SF site sampled during the previous Water Quality Parameter Study (CH2M HILL 2010). Monitoring for water temperature and flow discharge will occur by USGS gaging station 12137290 (Table 2-2), and monitoring of dissolved oxygen, turbidity, and pH will occur at this site (Table 2-4).

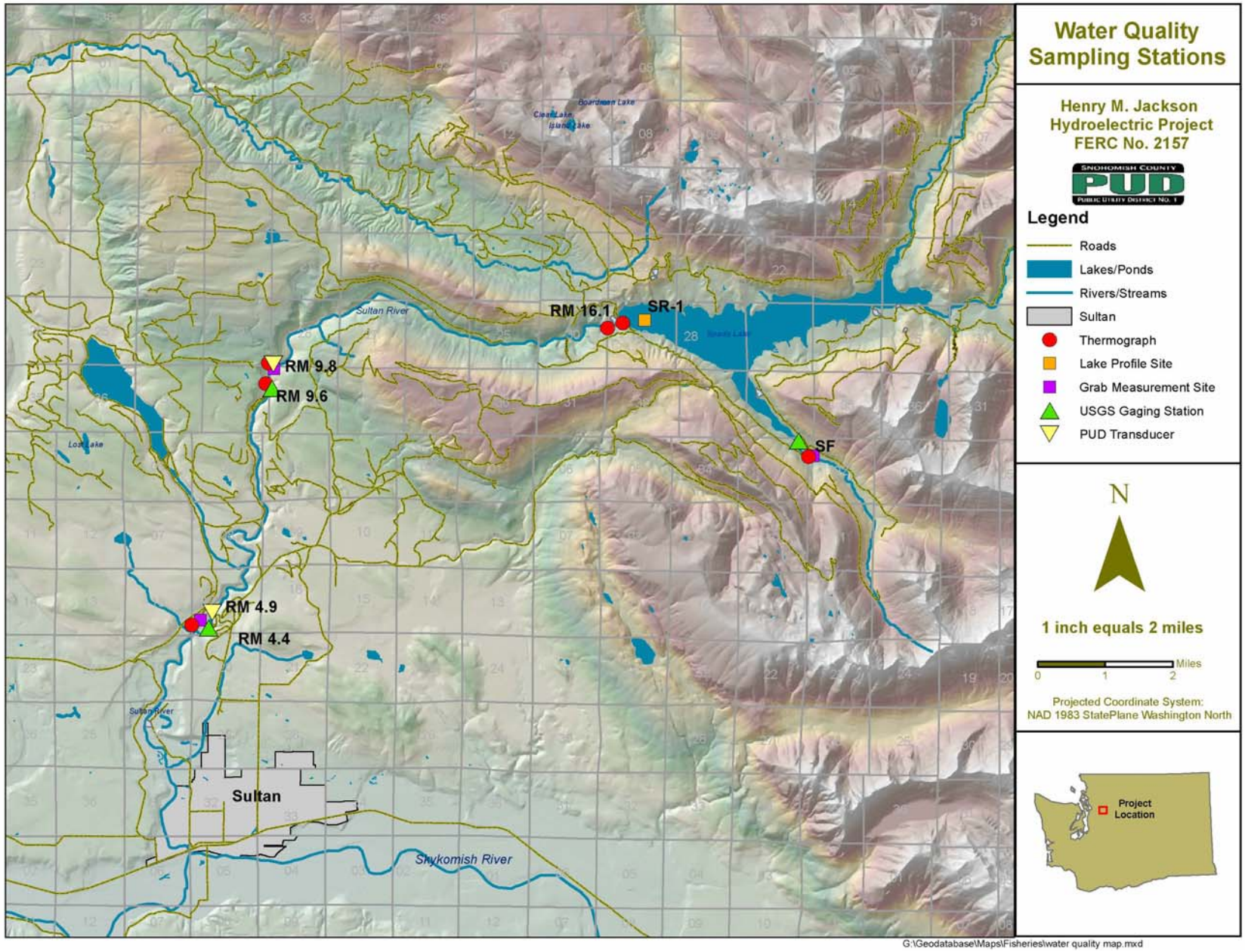

Figure 2-1. Map showing locations of Project water quality monitoring sites.

Spada Lake Reservoir

Spada Lake Reservoir monitoring will occur at a site near the outlet in the area of greatest water depth. This site is coded SR-1 (Spada Reservoir near outlet), and corresponds to the same SR-1 site sampled during the previous Water Quality Parameter Study (CH2M HILL 2010). At SR-1, profiling will occur for water temperature, dissolved oxygen, turbidity, and pH. Monitoring also will include measurements of Secchi transparency and reservoir elevation.

Sultan River from Culmback Dam to the Diversion Dam

This reach is a steep, narrow canyon. Monitoring will occur at two sites: one located just below Culmback Dam and the other just above the Diversion Dam. These sites are coded RM 16.1 and RM 9.8, respectively, and correspond to the sites with the same codes sampled during the previous Water Quality Parameter Study (CH2M HILL 2010). Selection of these sites was based on accessibility and safety, as well as reach representation. At RM 16.1, water temperature and flow discharge monitoring will occur. At RM 9.8, monitoring will occur for water temperature, dissolved oxygen, turbidity, and pH.

Sultan River from the Diversion Dam to the Powerhouse

Monitoring of water temperature and flow discharge will occur at one site located just below the Diversion Dam near the existing USGS gaging station 12137800. This site is coded RM 9.6, and corresponds to the site with the same code sampled during the previous Water Quality Parameter Study (CH2M HILL 2010).

Sultan River Downstream of the Powerhouse

Monitoring of water temperature and flow discharge will occur by USGS gaging station 12138160 (Table 2-2), and monitoring of dissolved oxygen, turbidity, and pH will occur at one site located in the tailrace of the Powerhouse. This site is coded RM 4.4 (tailrace), and corresponds to the site with the same code sampled during the previous Water Quality Parameter Study (CH2M HILL 2010).

2.2.2. Sampling Frequency

Continuous hourly measurements of water temperature will occur at sites SF, RM 16.1, RM 9.8, RM 9.6, and RM 4.4 from May 1 to October 31. Instream measurements of dissolved oxygen, turbidity, and pH will be taken monthly at sites SF, RM 9.8, and RM 4.4 from May 1 to October 31.

Spada Lake Reservoir (site SR-1) profiles of water temperature, dissolved oxygen, turbidity, and pH will be collected monthly from May 1 to October 31. Secchi depth measurements also will be obtained monthly at SR-1.

3. Monitoring and Analysis Procedures

3.1. Field Procedures

All in-situ measurements and field sampling procedures used for the monitoring will follow established protocols as described below.

3.1.1. Streamflow Monitoring

3.1.1.1 USGS

The collection, recording, and publishing of streamflow measurements of streamflow at South Fork, RM 9.6, and RM 4.4 will be conducted by the USGS following their established protocols as outlined in:

- Rantz, S.E. 1982. Geological Survey Water Supply Paper 2175, Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge.
- Kennedy, E.J. 1984. Techniques of Water-Resources Investigations of the United States Geological Survey, Chapter A10, Discharge Ratings at Gaging Stations.

3.1.1.2 District

The collection and recording of streamflow measurements at RM 9.8 and RM 4.9 will be conducted by the District following USGS protocols. The development of site specific rating curves will be based on routine measurements of stage and discharge. Intermittent measurements of both discharge at RM 16.1 and reservoir elevation will used to calibrate the manufacturers rating curves for valves used to release water into Reach 3.

3.1.2. Reservoir Sampling

For in-situ measurements in Spada Lake Reservoir of water temperature, dissolved oxygen, turbidity, and pH, vertical profiles will be measured using an in-situ datasonde (Hydrolab Series 5 DataSonde or equivalent). Measurements will be taken at vertical increments of 1 meter (m) in water depths less than 15 m, 2-m increments in water 15 to 30 m deep, 3-m increments in water 30 to 50 m deep, and 5-m increments in water more than 50 m deep. Measurements also will be made at 0.5 m below the surface and 2 m above the bottom. Depth in Spada Lake Reservoir will be measured by the datasonde.

Secchi transparency will be measured in Spada Lake Reservoir with a standard 20-cm Secchi disk. There will be two independent measurements taken until the difference between the paired measurements is no more than 0.5 m.

3.1.3. Riverine Sampling

Continuously-recording thermographs (Onset Water Temp Pro or equivalent) will be deployed at sites SF, RM 16.1, RM 9.8, RM 9.6, and RM 4.4 (Table 2-4). The thermographs will be located at a point where complete mixing is expected. The thermographs will be programmed to record water temperature on an hourly basis. The thermographs will be

calibrated and data downloaded approximately monthly according to the procedures described below in the Quality Control section.

Instream grab measurements of dissolved oxygen, turbidity, and pH will be obtained at sites SF, RM 9.8, and RM 4.4 (Table 2-4) using an in-situ datasonde (Hydrolab Series 5 DataSonde or equivalent). Measurements will be obtained below the water surface (at about 0.5 m deep), and where flow is sufficiently turbulent to provide representative mixed water conditions. The datasondes will be calibrated and data downloaded for each sampling event according to the procedures described below in the Quality Control section.

3.2. Analytical Methods and Quality Control

The analytical methods that will be used for in-situ measurements of water temperature, dissolved oxygen, turbidity, and pH come from the operation manuals for the instruments to be used. The operation manuals for the instruments provide further detail regarding procedures used for collecting data, equipment use, and calibration, inspection, and maintenance / replacement schedule of the instruments. The operation manuals will be kept in hardcopy and will be maintained by the District.

3.2.1. Datasondes (Hydrolab Series 5 or Equivalent)

Calibration, inspection, and maintenance of the datasondes (Hydrolab Series 5 or equivalent), and data collection methods using the datasondes will follow detailed procedures described in the manufacturer operations manuals (e.g., Hydrolab DS5X Manual; Hach Company 2006; available online at: http://www.hydrolab.com/pdf/S5_Manual.pdf). Calibration checks will be performed to document datasonde bias and performance to ensure the quality of the data. Calibration checks will be completed in advance of datasonde deployment and upon retrieval, according to the detailed procedures described in the manufacturer operations manuals (e.g., Hydrolab DS5X Manual; Hach Company 2006).

3.2.2. Onset Water Temp Pro (or Equivalent) Thermographs

Procedures used for calibration, inspection, and maintenance of the thermographs (Onset Water Temp Pro or equivalent), and data collections using the thermographs will follow manufacturer instructions. Prior to the initial deployment, a calibration check will be performed by comparing the thermographs with water temperature measurements using a liquid thermometer (accurate to 0.1°C) or laboratory-grade digital thermometer. During the pre-deployment check, any thermograph having a mean absolute value difference greater than 0.2°C shall be rejected until the problem is corrected and the instrument passes another calibration check.

Calibration also will be checked during routine field servicing of the thermographs. Calibration checks will be used to document bias and performance to assure the quality of the data. All thermographs will be serviced and data downloaded approximately monthly. Field checks of the thermographs will be done using a liquid thermometer or laboratory-grade digital thermometer.

3.3. Data Quality Assessment and Reporting

3.3.1. Data Quality Assessment

All monitoring data will be reviewed to determine if the data meets designated Data Quality Objectives (DQOs) for precision, accuracy and completeness. DQOs for measurement data (also known as data quality indicators) include targets for precision, accuracy, and completeness. The overall objective for analytical data is to ensure that data of known and acceptable quality are obtained.

Table 3-1 lists the specific DQOs by parameter, including targets for precision, accuracy, completeness, and reporting limits. These DQOs provide the basis for the field and data analysis procedures as described below.

Precision is a measure of the scatter of the data when more than one measurement is made of the same sample. Field precision will be measured by collecting field duplicate samples for each sampling event, and will be evaluated by the relative percent difference (RPD) between field duplicate measurements.

Accuracy describes how close the measurement is to its true or expected value. Field accuracy will be ensured by field instrument calibration according to the manufacturers' instructions and by using standards and chemicals that are current (prior to expiration dates), and by following proper field measurement protocols.

Completeness is the percentage of valid results obtained compared to the total number of samples taken for a parameter. An invalid measurement would be one that does not meet the sampling methods requirements and the other data quality objectives. Completeness is ideally 100 percent, but the actual completeness is typically less than 100 percent, depending on the nature of sampling conditions. Completeness targets of less than 100 percent account for potential adverse field conditions or equipment problems.

Table 3-1. Data Quality Objectives (DQOs) for the Water Quality Monitoring

Parameters	Unit	Precision (RPD)	Accuracy [8] (% Recovery)	Completeness (% Valid Results)	Reporting Limit
Water temperature	^{o}C	<10%	95-105%	>90%	0.1
Dissolved oxygen	mg/L	<20%	80-120%	>80%	0.1
Turbidity	NTU	<20%	80-120%	>80%	0.1
pH	pH units	<10%	90-110%	>90%	0.1
Secchi transparency	meters	<10%	NA	>90%	0.1

Calculations and determinations for precision, accuracy and completeness will be made following each monitoring event. All of the DQOs are expected to be met. However, any data that do not meet DQOs will be tagged for potential corrective actions. The corrective

[8] NA: Not applicable. Standards unavailable or accuracy will be ensured based on instrument calibration.

actions may include, but are not limited to, the following: (1) re-sampling and re-analysis; (2) evaluating and amending sampling and analytical procedures; (3) accepting data and acknowledging level of uncertainty or inaccuracy by flagging the data and providing an explanation for their qualification; and (3) rejecting data and providing an explanation for their disqualification.

The reporting limits contained in Table 3-1 represent what are considered the level of quantitation desired to assess monitoring data, including reporting relative to compliance with standards and objectives for this monitoring program (as discussed in section 3.3.2). These reporting limits also represent the significant-digit level to which data will be tabulated and reported.

3.3.2. Water Quality Monitoring Reports

Water quality monitoring reports will be completed annually. The annual reports will describe the status of scheduled monitoring activities, summarize data acquisition and quality, present tables and graphs of key statistics and their trends, discuss compliance with standards and objectives, and highlight violations, if any. The reports will include appendices of all accepted data, explanations for unaccepted data, and other explanatory information as appropriate. The annual reports (by calendar year) will be made available to agencies, tribes and interested stakeholders by April 30 of the year following collection of the data.

The annual reports also will fulfill monitoring and reporting requirements as stipulated in Ecology's 401 Certification Order (October 18, 2010). As described in the 401 Certification Order (section 9.0, Monitoring and Reporting Requirements), the report will include summaries of the water quality data, and will include sample dates, times, locations, and results. Compliance with state water quality standards will be discussed. The reports will be submitted to the hydropower certification manager at Ecology, Water Quality Program, Northwest Regional Office, and the FERC.

4. References

CH2M HILL. 2010. *Water Quality Final Technical Report. Henry M. Jackson Hydroelectric Project (FERC No. 2157) Water Quality Parameter Study (RSP 1)*. Prepared for Public Utility District No. 1 of Snohomish County. October 2010.

Federal Energy Regulatory Commission (FERC). 1982. In the Matter of: Public Utility District No. 1 of Snohomish County and City of Everett Project No. 2157. Uncontested Offer of Settlement – Joint Agencies. March 24, 1982.

Federal Energy Regulatory Commission (FERC). 1983. Public Utility District No. 1 of Snohomish County and City of Everett, Washington, Project Nos. 2157-001, 002, 003, 004, 005 and 2157-010. Order Approving Uncontested Settlements and Amending License. February 9, 1983.

Hach Company. 2006. User Manual. Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes (Catalog Number 003078HY). Edition 3. February 2006.

Public Utility District No. 1 of Snohomish County (Snohomish County PUD). 2010. *Water Quality Plan (WQP)*. Draft. December 2010.

Washington Department of Ecology (Ecology). 2006. *Water Quality Standards for Surface Waters of the State of Washington*. Chapter 173-201A WAC. Amended November 20, 2006. Washington State Department of Ecology. November 2006. Publication Number 06-10-091.

APPENDIX 1

Proposed License Article

W-LA 1: Water Quality Protection Plan

Within 180 days of issuance of the FERC License, the Licensee shall file with the Commission, for approval, a Water Quality Protection Plan (WQPP). This WQPP shall document how the Licensee will implement a program to ensure compliance with Washington State water quality standards (as codified in WAC 173-201A) in the Sultan River. At a minimum WQPP shall include following components:

(1) water quality protection measures related to Project construction or maintenance activities (includes Best Management Practices (BMPs) for in-water and upland construction and maintenance activities);
(2) spill prevention and containment procedures;
(3) procedures for application of herbicides, pesticides, fungicides, and disinfectants; and
(4) compliance monitoring and reporting procedures for select water quality parameters, such as stream flow, temperature, turbidity etc..

The WQPP shall follow the Guidelines for Preparing Quality Assurance Project Plans (QAPP) for Environmental Studies (July 2004 Ecology Publication Number 04-03-030) or its successor. The WQPP shall contain, at a minimum, a list of water quality parameter(s) to be monitored, a map of sampling locations, and descriptions of the purpose of the monitoring, sampling frequency, sample type or number of samples, sampling procedures and equipment, analytical methods, quality control procedures, data handling and data assessment procedures, and reporting protocols.

The Licensee shall prepare an annual report based on data collected. The Licensee shall review and update the WQPP as needed.

The Licensee shall allow a minimum of thirty (30) days for members of the Aquatic Resource Committee (ARC) to comment and make recommendations before submitting the WQPP to the Commission. When filing the WQPP with the Commission, the Licensee shall include documentation of consultation; copies of comments and recommendations; and specific descriptions of how comments and recommendations from the ARC are accommodated by the Licensee's plan. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons based upon Project-specific information.

Upon Commission's approval, the Licensee shall implement the WQPP.

The following is from the Settlement Agreement's Joint Explanatory Statement:

W. Article W-LA1: Water Quality Monitoring License Article

The water quality protection plan conditions outlined in W-LA 1 are similar to those proposed in the License Application (*see* Appendix B at 3). Within 180 days of issuance of the FERC License, the District will file with the Commission, for approval, a Water Quality Protection Plan ("WQPP"). This WQPP will document how the District will implement a program to ensure compliance with Washington State water quality standards (as codified

in WAC 173-201A) in the Sultan River. At a minimum the WQPP will include the following components:

1. water quality protection measures related to Project construction or maintenance activities (includes Best Management Practices ("BMPs") for in-water and upland construction and maintenance activities);
2. spill prevention and containment procedures;
3. procedures for application of herbicides, pesticides, fungicides, and disinfectants; and
4. compliance monitoring and reporting procedures for select water quality parameters, such as temperature and turbidity.

The WQPP will follow the Guidelines for Preparing Quality Assurance Project Plans ("QAPP") for Environmental Studies (July 2004 Ecology Publication Number 04-03-030) or its successor.

The District will prepare an annual report based on data collected. The District will review and update the WQPP as needed and provide the updated WQPP to Ecology.

Appendix 2

Documentation of Consultation

Presler, Dawn

From: Presler, Dawn
Sent: Monday, January 10, 2011 12:59 PM
To: 'Maynard, Chris (ECY)'; 'mkan461@ecy.wa.gov'
Cc: Binkley, Keith; Moore, Kim
Subject: Jackson Hydro (P2157) - DRAFT WQ and WQMP for review
Attachments: DRAFT_p2157_WQMP_Water_Quality_Monitoring_Plan.DOC; DRAFT_p2157 _Water_Quality_Plan.DOC

Monika and Chris,
Attached are the draft Water Quality and Water Quality Monitoring Plans per the Jackson Project's Settlement Agreement and 401. Keith will be in touch with you in a couple weeks to see if you have any initial questions/want to set up a meeting to discuss. We would like Ecology's review and approval of the Plans prior to sending it to the ARC for their review. Since we're hoping to do the Marsh Creek Slide fix this August (if license and permits received), we also need to make sure these Plans get reviewed and approved in a timely manner to support the Marsh Creek Slide fix as well.

Let me know if you have any questions.

Happy New Year!

Dawn Presler
Sr. Environmental Coordinator
Generation Resources

Snohomish County PUD No. 1
PO Box 1107 Everett, WA 98206-1107
Phone: 425-783-1709

Presler, Dawn

From: Binkley, Keith
Sent: Friday, February 25, 2011 4:08 PM
To: Maynard, Chris (ECY)
Cc: Presler, Dawn
Subject: Monitoring for Aquatic PM&E's - spreadsheet CM DOE.xls
Attachments: Monitoring for Aquatic PM&E's - spreadsheet CM DOE.xls

Hi Chris – Attached is a spreadsheet depiction of our global monitoring effort under the pending license for Jackson. My intent is to have this as an Appendix to the WQMP which I hope to send out to the ARC on Monday. Let me know what you think.

Meanwhile – have a good weekend!

Keith

Presler, Dawn

From: Presler, Dawn
Sent: Friday, March 04, 2011 12:47 PM
To: 'Deborah Knight'; 'okeefe@amwhitewater.org'; 'Jim Miller'; 'steven.m.fransen@noaa.gov'; 'Haas, Andy'; 'Abby Hook'; 'Tim_Romanski@fws.gov'; 'Loren Everest'; 'Maynard, Chris (ECY)'; 'Applegate, Brock A (DFW)'
Cc: 'mick.matheson@ci.sultan.wa.us'; 'jsklare@ci.everett.wa.us'; Binkley, Keith; Moore, Kim
Subject: ARC - draft Water Quality Monitoring Plan - for your review
Attachments: DRAFT_WQMP_Water_Quality_Monitoring_Plan_030411.DOC

Dear ARC,
Attached is the draft Water Quality Monitoring Plan. Please take the next 30-days to review and provide your comments to Keith and me by April 4. Contact Keith directly for any questions/clarifications on the WQM Plan at 425-783-1769 or KMBinkley@snopud.com .

Have a great weekend!

Dawn

From: Presler, Dawn
Sent: Thursday, February 17, 2011 12:14 PM
To: 'Deborah Knight'; 'okeefe@amwhitewater.org'; 'Jim Miller'; 'steven.m.fransen@noaa.gov'; 'Haas, Andy'; 'Abby Hook'; 'Tim_Romanski@fws.gov'; 'Loren Everest'; 'Maynard, Chris (ECY)'; 'Applegate, Brock A (DFW)'
Cc: 'mick.matheson@ci.sultan.wa.us'; 'jsklare@ci.everett.wa.us'; Binkley, Keith; Moore, Kim
Subject: ARC - draft Water Quality Plan - 3-week review

Per the ARC meeting yesterday, attached is the **draft Water Quality Plan** for your 3-week review. (The WQ Monitoring Plan will be provided in the next week after Keith addressed the Ecology's edits/comments.) Please provide your comments/edits, if any, on the WQ Plan back to me and Keith by Thursday March 10. If you need the full 30-days, please let us know. You can also contact Keith directly for any questions/clarifications at 425-783-1769 or KMBinkley@snopud.com .

Dawn

From: Presler, Dawn
Sent: Thursday, February 17, 2011 11:56 AM
To: 'Deborah Knight'; 'okeefe@amwhitewater.org'; 'Jim Miller'; 'steven.m.fransen@noaa.gov'; 'Haas, Andy'; 'Abby Hook'; 'Tim_Romanski@fws.gov'; 'Loren Everest'; 'Maynard, Chris (ECY)'; 'Applegate, Brock A (DFW)'
Cc: 'mick.matheson@ci.sultan.wa.us'; 'jsklare@ci.everett.wa.us'; Binkley, Keith; Moore, Kim
Subject: ARC Mtg 2/16 - draft meeting summary

Attached is the draft ARC meeting summary and attachments from our ARC meeting yesterday. Per the ARC Guidelines, please review and provide edits, if any, back to me by Thursday Feb 24.

Future Y2011 ARC Meetings are:

- April 13, 2011 (2nd Wednesday since Loren was unavailable the week of April 19)
- June 15, 2011
- August 17, 2011
- October 19, 2011

Dawn Presler
Sr. Environmental Coordinator
Generation Resources

Snohomish County PUD No. 1
PO Box 1107 Everett, WA 98206-1107
Phone: 425-783-1709

Presler, Dawn

From: Presler, Dawn
Sent: Thursday, June 09, 2011 12:01 PM
To: 'Steve Fransen'; 'Leonetti, Frank'; 'Abby Hook'; 'Tim_Romanski@fws.gov'; 'Loren Everest'; 'Maynard, Chris (ECY)'; 'Applegate, Brock A (DFW)'; 'okeefe@amwhitewater.org'; 'Jim Miller'; 'Deborah Knight'
Cc: Binkley, Keith; Moore, Kim
Subject: ARC - final review of plans
Attachments: FINAL_WQMP_Water_Quality_Monitoring_Plan.pdf; FINAL_Water_Quality_Plan.pdf; FINAL_SCELWD_Plan.pdf

Dear ARC Members:
Attached are the final plans to be filed with the FERC after the new license is issued as discussed at the April ARC meeting. Plans include: SCE/LWD, WQ, and WQM. DDVP will come in another email due to size of attachments.

SCE/LWD Plan – Keith updated per discussions at the last ARC meeting and specifically integrates suggestions from Brock and Abby. In addition, the revised version includes an updated map to reflect the relocation of one engineered log jam. We have also modified the naming convention for the ELJ's to be consistent with the plans being prepared by Herrera.

Please take the next week to review these final plans and provide comments, if any, back to me by June 17 COB. Otherwise, I will take your silence as concurrence with the attached plans and I will file them with the FERC for their approval after the new license is issued. Thanks everyone!

Dawn Presler
Sr. Environmental Coordinator
Generation Resources
(425) 783-1709
****
PUD No. 1 of Snohomish County
PO Box 1107
Everett, WA 98206-1107

APPENDIX 3

Table of License Monitoring Components

A-LA	Description	Purpose	Monitoring Components	Location	Timing	Frequency	Duration	Reporting	Comments
2	Marsh Creek Slide Modification and Monitoring	Document effectiveness	Annual escapement surveys to assess relative use in index areas upstream and downstream of the slide	Within four established index areas between RM 0.0 and 9.7 of the Sultan River	Spring and Fall	Annually	License Term	ARC, FERC	Redundant to A-LA 13 and A-LA 17
2	Marsh Creek Slide Modification and Monitoring	Document effectiveness	Post modification topographic surveys, if passage remains obstructed	Site specific evaluation at RM 7.5 (slide location) of the Sultan River	During summer, low-flow conditions	One time	N/A	ARC	
3	Temperature Conditioning in Reach 3	Document modified thermal regime	Longitudinal monitoring	Five total mainstem locations (RM 16.1, 14.3, 12.8, 11.3 and 9.8), one tributary location (Big Four Creek)	Year-round, hourly monitoring		Monitoring immediately downstream of Culmback Dam (near RM 16.1) and immediately upstream of Diversion Dam (near RM 9.8) will occur through term of new license, monitoring at the three remaining locations (RM 14.3, 12.8, and 11.3) will continue until correlations with permanent stations have been established	ARC, FERC within annual operations reports	Year-round monitoring at RM 16.1 and 9.8 for the license term is common with A-LA 17 and W-LA 1
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Periphyton	Five total mainstem locations (RM 16.1, 14.3, 12.8, 11.3 and 9.8)	Late August / early September	Once annually during Years 0 (baseline), 1, 3, and contingently 5		ARC, FERC	
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Chlorphyll A	Five total mainstem locations (RM 16.1, 14.3, 12.8, 11.3 and 9.8)	Late August / early September	Once annually during Years 0 (baseline), 1, 3, and contingently 5		ARC, FERC	
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Drift	Two mainstem locations (RM 14.3 and 12.8)	Early summer / late summer	Twice annually during Years 0 (baseline), 1, and 3		ARC, FERC	
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Benthic Macroinvertebrates	Five total mainstem locations (RM 16.1, 14.3, 12.8, 11.3 and 9.8)	Late August / early September	Once annually during Years 0 (baseline), 1, 3, and contingently 5		ARC, FERC	
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Fish, relative abundance	Two mainstem locations (RM 14.3 and 12.8)	Late summer	Once annually during Years 0 (baseline), 1, 3, and contingently 5		ARC, FERC	

A-LA	Description	Purpose	Monitoring Components	Location	Timing	Frequency	Duration	Reporting	Comments
3	Temperature Conditioning in Reach 3	Document community response to modified thermal regime	Fish growth, stable isotope analysis	Two mainstem locations (RM 14.3 and 12.8)	Late summer	Once annually during Years 0 (baseline), 1, and 3		ARC, FERC	
4	Whitewater Boating Flows	Document compliance with license terms	Flow conditions (magnitude and duration)	Compliance measured at USGS gages at PH and DDAM and PUD instrumentation at CD, U/S of DDAM, and U/S of PH	Per event		License term		
4	Whitewater Boating Flows		Number of users and skill level by location, run time		Per event		License term		
5	Downramping Rate Conditions	Document compliance with license terms	Rate of change in stage (elevation) at compliance point	Compliance measured at USGS gages at PH and DDAM	Ongoing, tied to routine operations		License term	Compliance reporting to FERC	
5	Downramping Rate Conditions	Document compliance with license terms	Rate of change in stage (elevation) at compliance point	Compliance measured at USGS gages at PH and DDAM	During process flow releases		License term	Compliance reporting to FERC	
5	Downramping Rate Conditions	Evaluation of connectivity	Rate of change in stage (elevation)	Site specific analysis at side channel locations	Prior to 1 year after completion of side channel enhancement projects			ARC, FERC	
6	Large Woody Debris	Document effectiveness	Evolution of structure (degradation, racking), change in localized hydraulics and habitat features at structure, fish use	Downstream of RM 2.7 at mainstem engineered log jam locations	summer, low-flow	Annually for the first 5 years after installation and then after each high flow > 4,100 cfs		ARC	
7	Side Channel PM&E Conditions	Document effectiveness	Flow connectivity with mainstem	Side Channels 1, 2, 3, and 4	summer, low-flow	Ongoing, surveys focused during summer months when near minimum flows			
7	Side Channel PM&E Conditions	Document effectiveness	Discharge (seasonal)	Side Channels 1, 2, 3, and 4	summer, low-flow	Ongoing, spot measurements over a range of flow conditions			
7	Side Channel PM&E Conditions	Document effectiveness	Fish use	Side Channels 1, 2, 3, and 4	summer, low-flow	Annual surveys during the first 5 years after construction			
7	Side Channel PM&E Conditions	Document effectiveness	Temperature	Side Channels 1, 2, 3, and 4	summer, low-flow	Ongoing, surveys focused during summer months when near minimum flows			
8	Process Flow Regime	Document compliance with license terms	Magnitude, duration, and timing of events,		Ongoing, constant, and continuous		License term	Compliance reporting to FERC	
8	Process Flow Regime	Document effectiveness	Physical monitoring consistent with and supplementary to A-LA 17 including permanent reference transects in each operational reach	Downstream of RM 2.7	Post high flow events during years 1 through 10. After channel forming flows for the remainder of the license.			Process Flow Effectiveness Report every ten (10) years	
9	Minimum Flows	Document compliance with license terms	Discharge	Compliance measured at USGS gages at PH and DDAM and PUD instrumentation at CD	Ongoing, tied to routine operations		License term	Compliance reporting to FERC	
10	Spada Lake Recreational Fishery	Monitor population trends	Use gill netting to collect data on relative abundance and structure of trout population	Consistent with past surveys	Summer / fall	Every 5 years, starting in 2012			

A-LA	Description	Purpose	Monitoring Components	Location	Timing	Frequency	Duration	Reporting	Comments
13	Diversion Dam Volitional Passage	Document passage effectiveness	Spawning surveys (relative utilization of index areas, including a Reach 3 Index Area)	Within four established index areas between RM 0.0 and 9.7 of the Sultan River plus a new index area to be established upstream of DDAM once passage is completed	Spring and Fall	Annually	License Term		Redundant with A-LA 2 and A-LA 17
14	Reservoir Operations	Document compliance with license terms	Reservoir elevation	Spada Reservoir	Ongoing, tied to routine operations		License term	Compliance reporting to FERC	
17	Fisheries and Habitat Monitoring Plan	Riverine Habitat	Habitat units, substrate composition, gradient, channel exposure, woody debris, bank stability, riparian vegetation content, and photo documentation	Focus on lower river, Reach 1	Post high flow events during years 1 through 10. After channel forming flows for the remainder of the license.		License term		
17	Fisheries and Habitat Monitoring Plan	Water Temperature	Basin wide monitoring	South Fork Sultan River, base of Culmback Dam, upstream and downstream of the Diversion Dam, upstream and downstream of the Powerhouse, at the confluence with the Skykomish River, and in the Skykomish River upstream and downstream of the Sultan River.	Year-round, hourly monitoring		License term	Redundant with W-LA 1	
17	Fisheries and Habitat Monitoring Plan	Spawner abundance, distribution, and timing	Surveys per current survey protocol	Four (five when passage occurs) established index areas downstream of CD	Spring and Fall	Annually	License Term	Annual Operations Report	Redundant with A-LA 2 and A-LA 13
17	Fisheries and Habitat Monitoring Plan	Juvenile production, distribution, and habitat utilization	A juvenile trapping operation will be employed	Lower river near RM 0.2	February through June	Annually for the first six years and then two out of every six years thereafter			