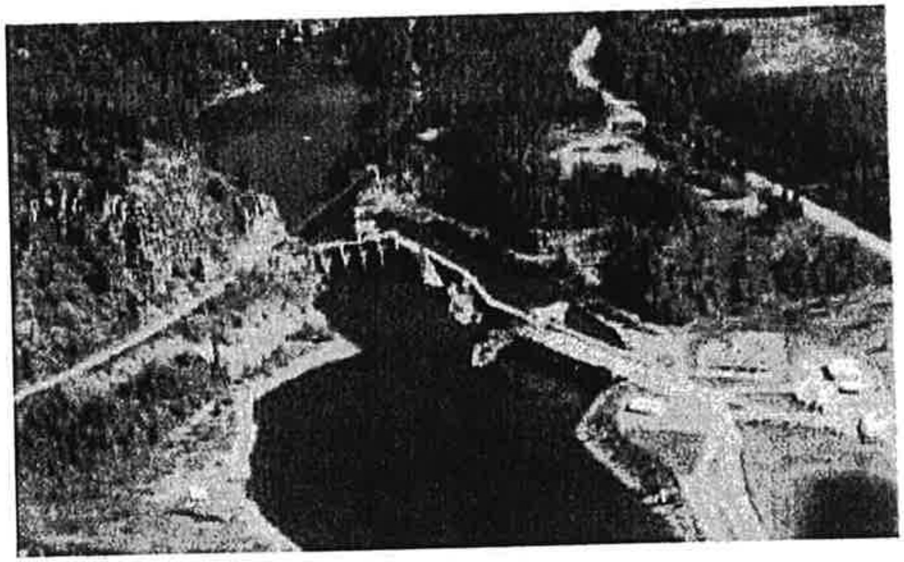
BOX CANYON HYDROELECTRIC PROJECT
FERC No. 2042

WATER QUALITY MONITORING PLAN



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1.0 INTRODUCTION

The Washington Department of Ecology (WDOE) issued a water quality certification in conformance with Section 401 of the Clean Water Act (33 USC §1341; FWPCA §401), for the Box Canyon Hydroelectric Project (FERC No. 2042), as an amended order dated February 21, 2003. As a condition of that certification, the Public Utility District No. 1 of Pend Oreille County (District) shall prepare a water quality monitoring plan within thirty days of the date FERC issues a new license for the Project. The FERC issued a new license for the Box Canyon Project on July 11, 2005. This plan is being submitted to the WDOE as part of the compliance with the WDOE Section 401 certification.

The Pend Oreille River originates from Lake Pend Oreille, which has the Clark Fork River as its primary tributary. The Pend Oreille-Clark Fork River watershed upstream of Box Canyon Dam encompasses 24,930 square miles in the states of Montana, Idaho, and Washington. The outflow of Lake Pend Oreille, Idaho's largest lake (1,153,000 acre-feet storage), is regulated by Albeni Falls Dam (River Mile [RM] 90.1 on the Pend Oreille River), which is managed by the U.S. Army Corps of Engineers (COE). All but 700 square miles (2.8%) of the total drainage area above Box Canyon Dam is above Albeni Falls Dam. There are 22 tributary streams to the Pend Oreille River between Albeni Falls Dam and Box Canyon Dam; most of these streams are small drainages for the surrounding mountain slopes and valley bottom. The largest tributary is Calispell Creek (RM 69.7) with a drainage area of about 68 square miles.

The Pend Oreille River between Albeni Falls Dam and Box Canyon Dam is referred to as the Box Canyon Reservoir (BCR). More than 97 percent of Box Canyon Dam's total drainage is upriver and under regulation by Albeni Falls Dam. Because there is relatively little inflow between Albeni Falls Dam and Box Canyon Dam, the flow passing the Project is essentially the same as the flow released from Albeni Falls Dam. The mean annual flow at Box Canyon Dam is 26,243 cfs. The average annual flood was 79,445 cfs between 1955 and 1995. The annual flood on the Pend Oreille River generally occurs during spring because of the melting snow pack.

The Box Canyon Hydroelectric Project consists of four turbines with a combined rated turbine capacity of 27,000 cfs, and the dam itself is comprised of spillgates consisting of four bays, each 40 feet wide. The total spillway capacity is 350,000 cfs. Between Box Canyon Dam and Cusick the maximum normal river water surface profile is defined by a flow of 68,000 cfs and a Box Canyon Dam headwater elevation that yields 2.0 feet of backwater at Albeni Falls Dam. The project is operated to not exceed a river water elevation of 2041.0 at the Cusick USGS gage for total river flows less than 88,000 cfs. Spill gates are completely open at 88,000 cfs and the river assumes a water surface profile equivalent to pre-project conditions. The downstream Boundary Hydroelectric Project is operated as a peaking facility and its reservoir water elevation (that is the tailwater for Box Canyon Dam) commonly varies 10 – 15 feet seasonally and approximately five feet daily. The backwater effect on Box Canyon Dam averages approximately 4 feet for flows of 20,000 to 30,000 cfs.

1.1 Water Quality Standards

The Washington State Water Quality Standards, set forth in Chapter 173-201A of the Washington Administrative Code, include designated beneficial uses, water body classifications, and numeric and narrative water quality criteria for surface waters of the state. A revised version of the standards was adopted in 2003 and is currently awaiting approval by U.S. EPA.

Under the new standards the mainstem Pend Oreille River is protected for "non-core salmon and trout."

Waters within Box Canyon Reservoir are Class A waters as defined in Chapter 173-201A of the Washington Administrative Code. Table 1 summarizes the standards for Class A water quality applicable to Box Canyon Reservoir.

Table 1. Summary of Washington Department of Ecology water quality standards

Parameter	Class A
Fecal Coliform	Not to exceed geometric mean of 100 col./100 ml, less than 10% of all samples exceeding 200 col./100 ml
Dissolved Oxygen	Must exceed 8.0 mg/l
Total Dissolved Gas	Not to exceed 110%[1]
Temperature	Special condition for Pend Oreille River[2,3]
PH	Within 6.5 - 8.5[4]
Turbidity	Not to exceed 5 NTU over background, or 10% over background of 50 NTU or more

[1] *Not applicable when discharge exceeds the 7 day 10 year frequency flood*
[2] *Special condition for this reach of the establishes 20•€ as maximum temperature*
[3] *Human activities shall not result in more than a 0.3°C increase when water temperatures naturally exceed this maximum criteria. Incremental temperature increase resulting from point source activities shall not exceed t=28/(T=7) where T=background temperature; maximum incremental increase for non-point sources is 2.8 C.*
[4] *Human caused variation must be ± 0.2 pH units.*

Both the new standards and the previous version contain a special condition for temperature:

> *Temperature shall not exceed a 1-day maximum (1-DMax) of 20.0°C due to human activities. When natural conditions exceed a 1-DMax of 20.0°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C; nor shall such temperature increases, at any time, exceed t=34/(T+9). ("T" represents the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.)*

The Kalispel Tribe has adopted water quality standards for waters within the Kalispel Indian Reservation (KIR), which U.S. EPA approved on June 24, 2004. This water quality monitoring plan only addresses conditions of the Washington State 401 Water Quality Certificate.

1.2 Historical Data Review

Ecology collects water quality monitoring data at the following locations in the Pend Oreille River:

- Pend Oreille River @ Metaline Falls, Station 62A090 (1949-50, 1959-62, 1994-95, 1998-present)
- Pend Oreille River @ Newport, Station 62A150 (1959-66, 1968, 1976, 1978-present)

The BCR is a cool-water mesotrophic system based on nutrient levels and temperature (maximum August daily temperature based on a two-year average from 1997 - 1998 of 73°F [22.75°C]). This average maximum daily temperature is slightly warmer than that reported by Falter et al. (1991). The difference is primarily attributable to the fact that more recent data are based on continuous monitoring as opposed to earlier instantaneous data, which do not fully account for diurnal variation. Water quality is good (Pelletier and Coots 1990; Bennet et al. 1990; Falter et al. 1991; EPA 1993). The reservoir is characteristic of a riverine environment. Annual mean reservoir flushing time during summer low flows is approximately 4.2 days and less during high water (Falter et al. 1991). The short flushing time and shallow depth do not allow vertical temperature stratification and the river is fully saturated for dissolved oxygen (D.O.), having an orthograde pattern (no difference top to bottom of water column).

The sloughs of Pend Oreille River are mesotrophic (moderate nutrients) to eutrophic (high nutrients) (Falter et al. 1991). The major sloughs weakly stratify in the spring; however, only Tiger Slough and Big Muddy sloughs are known to remain strongly stratified throughout the summer. Water quality among the sloughs is similar with the exception of Calispell and Trimble sloughs, which have soft water (low conductivity and total alkalinity).

The Box Canyon Reach of the Pend Oreille River is included on Washington State's 303(d) list for temperature, pH, total dissolved gas (TDG), exotic plants and Aldrin. Separate abatement plans are being submitted to the WDOE that address the 401 certification conditions for temperature, total dissolved gas pressure and non-native aquatic biota.

2.0 PURPOSE AND OBJECTIVES

The purpose of the Box Canyon Water Quality monitoring plan is to provide the WDOE with sufficient water quality data to demonstrate the Project's progress towards meeting and remaining in compliance with State water quality standards. The WDOE is in the process of developing TMDLs and associated implementation plans for bringing the Pend Oreille River into compliance with Washington State's standards for temperature, pH and total dissolved gas pressure. The study design of this monitoring plan is intended to support the development and implementation of those TMDL's.

Monitoring objectives include:

- Demonstrate continued Project compliance with state water quality standards. Monitoring will focus on water quality parameters that are known to not meet the State standards for waters within the Box Canyon Reach and Box Canyon Dam tailrace. Exceedences of numeric criteria for some parameters may not be attributable in entirety or in part to operation of the project. However, the monitoring data support the WDOE's implementation of the TMDLs.

- Document the progress towards and effectiveness of abatement measures to achieve project compliance with the water quality standard for total dissolved gas pressure not to exceed 110 percent saturation due to Project operation.

- Collect accurate and valid data using standard, approved water quality monitoring protocols so that all data will be valid and compatible with and comparable with data gathered on other water bodies within the State.

- Collect, analyze, and archive data in a manner that will support the identification of long-term water quality monitoring needs, if appropriate, and will ensure compatibility of data to the greatest extent feasible.

3.0 METHODS

This section describes field, laboratory and analytical methods for monitoring. Quality Control and quality assurance protocol are described separately.

3.1 Monitoring Parameters

Temperature, dissolved oxygen, pH and total dissolved gas will be monitored. If future 303(d) listings for the Box Canyon Reach include other parameters, those parameters will be added to the monitoring plan if Project operation is a contributing factor to an exceedence of a water quality standard. Similarly, if the implementation of TMDLs for pH, temperature or total dissolved gas requires monitoring of other water quality parameters, those parameters would be added. The methods listed are intended to be consistent with TMDLs affecting the Box Canyon reach. The methods will be modified upon concurrence by the WDOE if necessary to be consistent with future TMDLs.

3.2 Monitoring Locations

Temperature, dissolved oxygen and pH will be monitored at the Box Canyon Dam forebay (location shown in Figure 1).

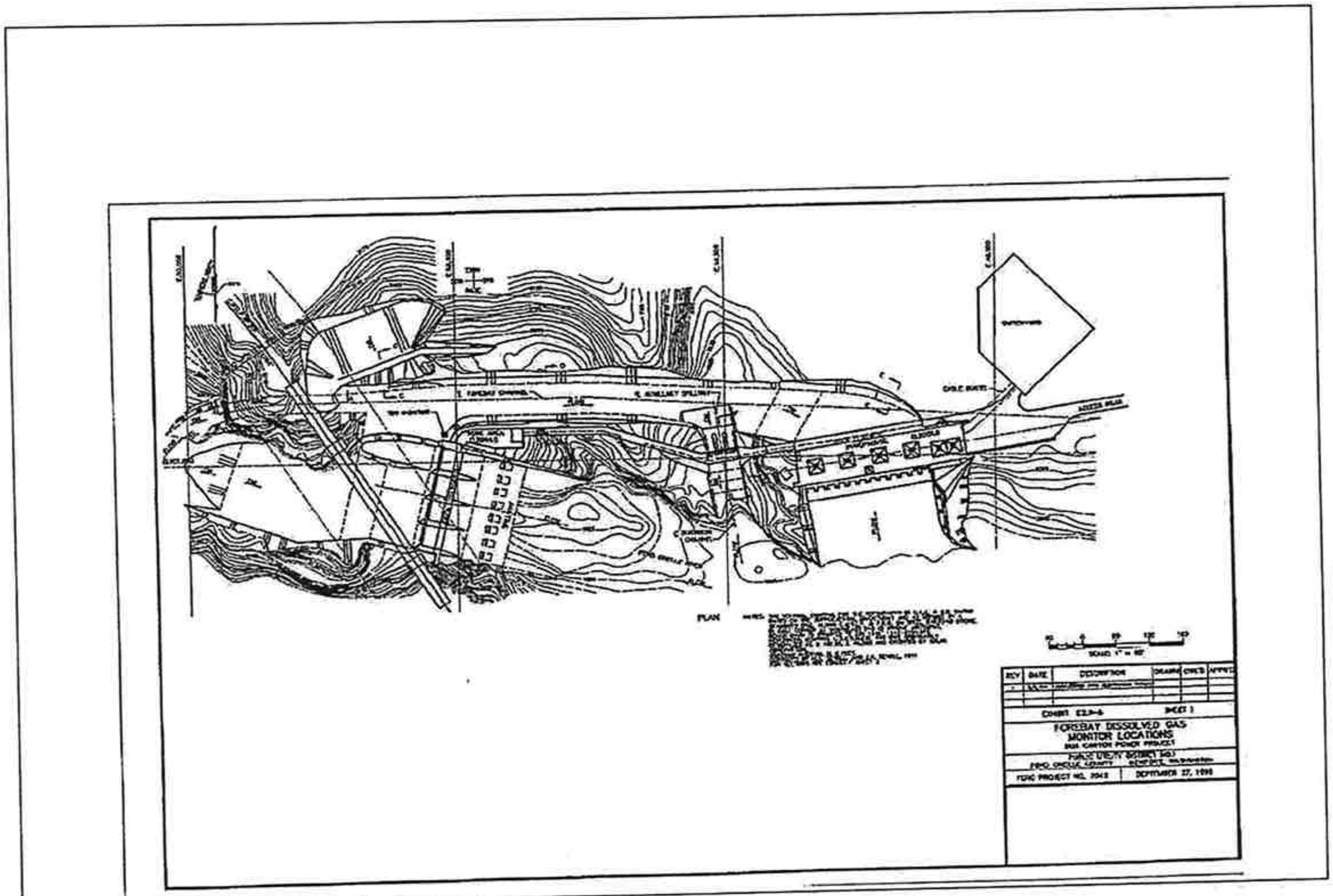

Figure 1. Monitoring location within Box Canyon forebay

During months when spill is not likely (mid-July through October), the forebay probe will be positioned at a depth of approximately 2 m below the typical water surface elevation. The probe will be located at a lower elevation during spill periods. This is necessary to ensure reliable total dissolved gas pressure data and maintain the probe within the water column when the spill gate crest elevations are lower. Monitoring locations for total dissolved gas are described below.

In the forebay of Box Canyon Dam, two pipes are attached to the forebay wall, in which the TDG probe can be deployed. The pipes were constructed so that water flows freely across the probe. When the project is operating at a forebay water surface elevation (WSEL) of 2,028 ft AMSL or greater, the TDG probe is deployed at an elevation of approximately 2,015 ft or about 15 ft below a typical operating water surface elevation in the forebay. As the flow increases above the turbine capacity, the forebay head elevation is lowered to maintain the required maximum operating water levels in the reservoir. The probe is placed in a pipe extending lower so that the probe is positioned at approximately 2,009 ft. This keeps the probe submerged except when the gates are almost fully open. However, at those infrequent times, the probe would no longer be below the minimum compensation depth (MSCD). It is desirable to keep the probe below the MSCD as this prevents the formation of gas bubbles on instrument tubing, which may cause erroneous readings. The MSCD can be approximated as 1 m water depth for every ten percent supersaturation.

TDG and associated parameters will be monitored downstream of Box Canyon Dam in the spillway flow at the location shown in Figure 2. A cable system has been installed that allows the Hydrolab monitoring instrument to be deployed approximately 100 ft out from the right bank at a submerged depth of approximately 17-20 ft dependent upon Boundary pool elevation.

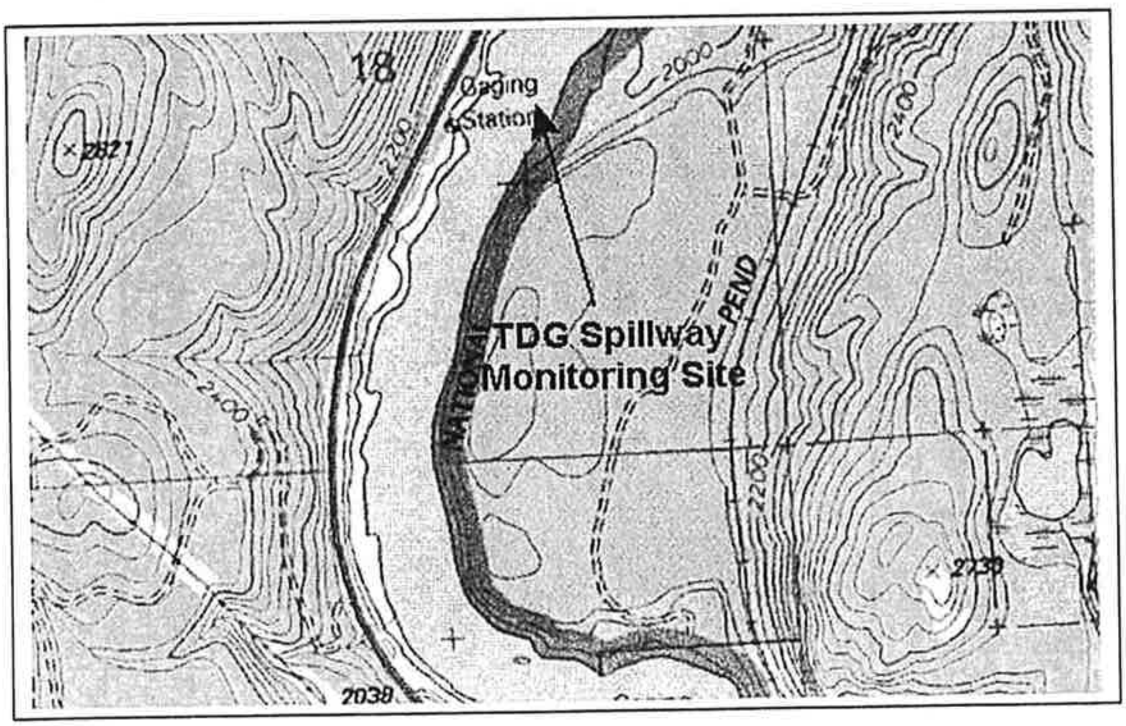

Figure 2. Box Canyon Dam spillway tailrace fixed station TDG monitor

As TDG abatement measures are implemented pursuant to the terms of the 401 certification (see TDG Abatement Plan), monitoring will occur at additional locations in the tailrace to document the effectiveness of the abatement measures. Fixed station monitoring within the turbine tailrace and bypass tailrace will commence during the first spill season upon completion of the spill bypass system. All four fixed monitoring stations (forebay, downstream spillway tailrace, turbine tailrace and bypass tailrace) will be operative during mid-April – mid-July or during periods of sustained spill, whichever is longer.

Monitoring shall continue until the Licensee has demonstrated compliance, to the satisfaction of WDOE, with the applicable TDG standard. Monitoring will occur during the spill season for a minimum of three years and inclusive of a range of flows up to 90,000 cfs. If the TMDL for TDG recommends longer-term TDG monitoring at Box Canyon Dam, then the District will participate in that monitoring effort.

Prior to the completion of the alternate bypass spillway, but subsequent to the installation of each turbine upgrade, short-term monitoring will be conducted within the turbine tailrace to demonstrate that the upgraded turbines are not contributing to elevated dissolved gas pressure. A hydrolab will be deployed in the tailrace of the upgraded turbine for a period of 3-5 days with data collected at 15-minute intervals. The deployment of this hydrolab will be scheduled to encompass a period when the upgraded turbine is operating at 90% or greater of its capacity. The short-term monitoring will also include periods when flow through the turbine is within the 0-25% range of turbine capacity to determine if air entrainment is occurring at these lower flows. It is not known if the tailrace flow patterns will allow monitoring to target the outflow from an individual turbine within the tailrace. A fixed station continuous monitor will be deployed in the turbine tailace year round if these short-term measurements indicate a significant increase in TDGP is occurring as water passes through the upgraded turbines. For the purpose of determining the need for year round continuous monitoring the following criteria will be applied.

- The difference between the turbine tailrace TDGP readings and concurrent TDGP readings in the forebay is greater than 6 mmHg for at least four consecutive hours; or
- The maximum difference averaged over a 1-hour period (four consecutive 15-minute readings) exceeds 14 mmHg, which is about the equivalent of 2% saturation for typical ambient barometric pressures.

If compliance with the 401 requirements for TDG standards has not been met with the completion of the spill bypass system, then the District will monitor TDG levels in the tailrace using a spatial pattern adequate to quantify lateral and longitudinal TDG gradients within the TDG mixing zone. This monitoring will be accomplished by supplementing the aforementioned fixed monitoring stations with additional temporary fixed stations capable of recording TDG data at 15-minute intervals. This supplemental grid monitoring will be implemented for a period up to two weeks when there is spill through the existing spill gates. Grid monitoring will be coordinated with operations to ensure the range of functional spill gate configurations is evaluated. The purpose of grid monitoring is to define the magnitude and extent of aquatic habitat not meeting the TDG standard due to Project-induced TDG. This information is necessary to support a Use Attainability Analysis (UAA) or to provide justification for site-specific TDG criteria.

Supplemental temperature monitoring sites will be added once WDOE completes the TMDL for temperature on the Box Canyon reach. The District will monitor temperature at up to four locations in the Box Canyon Reach specified by WDOE. These sites may be in the Box Canyon Reservoir or at the mouths of tributaries to the reservoir.

3.3 Monitoring Schedule

Monitoring will commence during the first season following issuance of the FERC license and approval of the monitoring plan by WDOE. The schedule may be subject to any permit requirements.

Monitoring at the two primary TDG stations in the forebay and tailrace (inclusive of all listed parameters) is scheduled for April 1 through mid-July, or ending earlier if an analysis of basin hydrology indicates that the spring season runoff is complete and spill has ended for the season. The schedule will be extended if spill is anticipated beyond mid-July. Continuous monitoring in the forebay (all parameters except TDG) will extend from April 1 through October 31 of each year. Temperature monitoring with thermographs will primarily focus on summer months. The schedule for temperature monitoring at sites other than the forebay is subject to the WDOE completing the TMDL, which will better define temperature monitoring needs. Table 2 summarizes the schedule for water quality monitoring.

The instruments used for continuous monitoring will be programmed to record water quality parameters at 15-minute intervals.

Temperature monitoring with thermographs will primarily focus on summer months. The schedule for temperature monitoring at sites other than the forebay is subject to the WDOE completing the TMDL, which will better define temperature monitoring needs. Table 2 summarizes the schedule for water quality monitoring.

Table 2. Schedule for water quality monitoring

Location	Start Date and Monitoring Period	Sample Frequency	Parameters	Comment
Box Canyon forebay	4/1 – 10/31[1]	Continuous 15-minute	TDG, Temperature, pH, DO, depth, barometric P	Hydrolab
Box Canyon spillway tailrace Fixed station	4/1 – 7/15[1]	Continuous 15-minute	TDG, Temperature, pH, DO, depth	Hydrolab; Dates will be adjusted to encompass spill period
Box Canyon turbine tailwater	Following each turbine upgrade	Short duration hourly	TDG, Temperature, pH, DO, depth	Hydrolab: Multiple 3-5 day monitoring periods with each turbine upgrade; continuous after all abatement complete
Auxiliary spillway tailwater	1st spill season after construction	Continuous 15-minute	TDG, Temperature, pH, DO, depth	Hydrolab
Downstream grid monitoring	Subsequent to all abatement measures if compliance not achieved in 10 years.			
Temperature	Completion of TMDL; May – October[2]	Hourly	Temperature	4 sites identified in coordination with WDOE

[1] The schedule will be modified to include periods of sustained spill that occur outside the stated monitoring period.
[2] The monitoring period will be adjusted to be consistent with the TMDL

3.4 Field Sampling Methods

A Hydrolab DataSonde or similar instrument will be used to measure water quality parameters. Instruments will be calibrated prior to each field visit according to the manufacturer's specifications. Instrument calibration procedures are summarized in Appendix A. Instruments will be calibrated prior to each deployment date and then at two-week intervals. At each servicing, competent personnel will check for and, if necessary, fix site problems (probes clogging, leaking membranes, instruments out of calibration, etc.) and recalibrate the instrument(s). A Winkler titration for dissolved oxygen will be performed at each calibration servicing and as part of any grab sampling. The probe will be re-calibrated if the result of the Winkler titration and probe reading differ by more than 0.2 mg/L.

During periods of spill at Box Canyon Dam, the instruments will be deployed at a depth equal to or slightly greater than the minimum compensation depth (approximately 5 m), which prevents erroneous readings due to gas bubbles forming on the TDG probe membrane. At other times, the instruments will be deployed at a depth of approximately 1 - 2 m. Surface grab samples will be measured at a depth of 1m.

Barometric pressure is necessary to compute the percent saturation relative to total dissolved gas pressure. A continuous recording instrument will be operated and maintained at Box Canyon

Dam to log atmospheric barometric pressure (mmHg) and air temperature (°C) during spill monitoring periods. A hand held digital barometer will be used as part of calibration procedures; typical instrument resolution 0.76 mm Hg with an accuracy ± 6mm Hg). Both barometric instruments will be compared to a mercury barometer at a regional NCDC climate station (Deer Park airport) prior to and at the end of the spill monitoring season. Adjustments to barometric pressure data will then be made if Measurement Quality Objectives (MQO's) for barometric pressure are not met (see Section 4.0 - Quality Control/Quality Assurance).

Monitoring of water temperature at the supplemental sites is intended to support implementation of the TMDL for temperature within the Box Canyon Reach. The methods will be consistent with the protocols yet to be defined in the Quality Assurance Project Plan (QAPP) for monitoring the effectiveness of the temperature TMDL. The QAPP will be developed by the Idaho Department of Environmental Quality (IDEQ), WDOE, Environmental Protection Agency (EPA) and the Kalispel Tribe working with the other members of the cooperative monitoring network including the District. Following is a description of anticipated temperature monitoring methods that is subject to modification to be consistent with the QAPP. Onset thermographs will be used for monitoring temperature at these sites. All thermographs will be serviced approximately once per every eight-week period. Servicing and downloading will occur at approximately four-week intervals during July through September to minimize the potential of data gaps due to instrument loss or malfunction. A calibration temperature measurement using a hand-held mercury thermometer will be recorded at each servicing. All thermographs will also be subject to a three-point calibration test prior to deployment and at the end of the study period. The Onset Corporation HOBO thermographs have an accuracy of ± 0.16°C and a resolution of 0.28°C. A calibration factor will be applied to data for any thermographs that are not within ±0.3°C of the standardized mercury thermometer used in laboratory calibration.

3.5 Analytical Methods

Data will be analyzed to determine if MQO's are met and any data not meeting MQO's will be noted. For water temperature data, daily maximum, minimum and mean values will be calculated as well as the 7-day average of the maximum daily water temperature. Dissolved oxygen data will be reported in units of mg/L as well as percent saturation. Daily maximum, minimum and mean values will be calculated for dissolved oxygen and pH. All data will be summarized monthly. Periods of exceedence of a water quality standard will be noted. Regression analysis with flow and water surface elevation as independent variables will be completed. Dependent variables include water temperature, dissolved oxygen and pH.

Total dissolved gas data will be reported as both total gas pressure and percent saturation. The calculation of percent saturation is dependent on barometric pressure, which will be first checked to insure MQO's for barometric pressure data are met. TDG data will be reported individually for the forebay and the tailrace as well as the difference between the two stations. TDG data will be plotted on the same chart as hourly total discharge and spill flow. As TDG abatement measures are implemented, the data will be analyzed in a manner to document the effectiveness of abatement measures. A narrative describing any monitoring concerns, instrument servicing dates and data quality concerns will be included in reports.

Thermograph data will be processed through a quality control/quality assurance (QA/QC) procedure. Data from time periods with anomalous patterns, or uncharacteristic spikes will be identified and discarded if data are not reasonable. Thermograph data will be compared to the field and laboratory instrument calibration records. Full documentation of QA/QC procedures, and reasons for not accepting any data, will be provided in the study report.

4.0 QUALITY CONTROL/QUALITY ASSURANCE

The Quality Control and Quality Assurance (QA/QC) plan is consistent with methods fully described in EPA 2002. Desired data accuracy is defined in Measurement Quality Objectives.

Clean sampling techniques will be applied throughout the sampling effort. Sample collection systems (Van Dorn sampler) will be triple rinsed with a portion of the sample water before filling for sample collection.

All personnel responsible for sample collecting and data analysis will be familiar with this study plan, including the quality control/quality assurance (QA/QC) protocol. A qualified scientist will be responsible for all phases of the study and for ensuring that other personnel are sufficiently trained.

Quality control in the field will be assured by accurate and thoroughly completed QA/QC forms for calibration. Calibration of field instrumentation for field measurements of dissolved oxygen, temperature and pH will be performed according to the manufacturer's instructions at each instrument servicing and each single sampling event. Where appropriate, a two-point calibration will be applied. Calibration procedures for the hydrolab are described in Appendix A

Measurement Quality Objectives (MQOs) answer the question of how accurate the measurements must be in order to get accurate data. The Environmental Protection Agency (EPA) defines MQOs as "acceptance criteria" for the quality attributes measured by project data quality indicators (EPA 2002). The MQOs are based on methods and the Data Quality Objectives, which guide how accurate data need to be in order to make correct decisions. MQOs include precision, bias and accuracy guidelines against which the laboratory and some field Quality Control results are compared. The MQOs for this study are reported in Table 3.

Precision is estimated as the standard deviation of the results of *n* replicate measurements. If more than one estimate of the standard deviation of a population is available, a pooled estimate may be calculated based on *m* pairs of duplicate results as:

$$sp = \sqrt{\frac{\sum D^{\wedge}2}{2m}}$$

where: s_p = pooled standard deviation
D = difference between two paired results

Precision is often reported as the Relative Standard Deviation (RSD) of the results of replicate measurements (WDOE 2001), which is calculated as a percentage of the mean by:

$$RSD = \frac{s}{\bar{x}} * 100$$

where: x = the mean of the replicate measurements

WDOE (2001) describes accuracy as a measure of the magnitude of the total error (E) and accuracy is a function of precision and bias such that

Accuracy = Bias + 2 * RSD when accuracy and bias are expressed as percentages of the true value and RSD is the percent relative standard deviation.

Typical instrument precision limits are also listed in Table 3. Precision limits are defined as the minimum value that there is 95% confidence that the instrument value is within one standard error of the actual value for a sample.

Table 3. Measurement Quality Objectives for Accuracy, Precision, Bias and Stated Reported Limits

Parameter	Maximum Laboratory Holding Time (Days)	Method	Accuracy	Precision	Bias	Reporting Limit	Expected Range
Water Temperature	NA	Onset Continuous	±0.18°C	0.025 °C[1]	0.05 °C[1]	0.01 C	0.1 – 25 C
Air Temperature	NA	Onset Continuous	±0.18 °C	0.025 °C[1]	0.05 °C[1]	0.01 C	-5 – 32 C
Barometric Pressure	NA	Digital instrument	±2 mm Hg	0.1 mm Hg	NA	1.0 mm Hg	695 – 725 mm Hg
Sample Depth	NA	Hydrolab-lake Topset rod-riv	±0.2 m	<5RSD	1%	0.1 m	< 32 m
Dissolved Oxygen4	NA	Modified Winkler/ Hydrolab	±0.4 mg/L	<5%RSD	1%	0.01 mg/L	7.5 – 12 mg/L
pH[2]	NA	Hydrolab	0.2 s.u.	0.05 s.u.	0.1 s.u.	0.01 s.u.	6.5 – 9 s.u.
Total Dissolved Gas Pressure[2]	NA	Hydrolab	±10mmHg@ 200mmHg	NA	NA	1.0 mmHg	95 – 140% sat.

EPA = Environmental Protection Agency
SM = Standard Methods for the Examination of Water and Wastewater, 19th Edition (APHA 1995)
[1] Based on manufacturer's reported calibration of instrument for Onset thermologgers; Hydrolab calibration precision acceptance is 0.3°C
[2] Based on calibration of check standards
[4] Based on comparison of instrument reading and Modified Winkler titration results

Quality control also applies to analytes measured in the field. Precision, the degree of agreement between replicate samples, will be measured at the time of instrument calibration. Accuracy of field instruments is also established at the time of calibration. An instrument is considered properly calibrated when the reading for a known standard meets the criteria established in Table 4. Instruments will be calibrated at each deployment and servicing according to the manufacturer's guidelines. Multiple point calibration procedures will be followed where applicable.

Table 4. Calibration Criteria for Field Measured Water Quality Parameters

Parameter	Temperature	Dissolved Oxygen	Conductivity
Instrument Precision (agreement between duplicate readings)	±0.35 °C	±0.3 Mg/L	±2% std. value
Instrument Accuracy (calibration agreement with a known standard)	±0.2 °C	±0.2 Mg/L	±7% std. value

Meeting the MQOs will be a measure of quality control. MQOs for field parameters will be reviewed concurrently with instrument calibration at the time of sample collection. The corrective action for not meeting the MQOs for field parameters will be recalibration of instruments. In the event that instruments cannot be properly calibrated to meet the MQOs, the data will be labeled as suspect. If data are compromised due to poor precision, the source of variability will be sought and corrective actions implemented. Possible corrective actions include: 1) modifying methods or instrumentation for field sampling, and 2) reevaluating the required precision, when it appears that the target cannot be met. Data failing to meet MQOs will be flagged. Methods will be reviewed to determine possible causes, which will be documented. Not meeting the MQOs does not necessarily mean that the data do not provide useful information. Interpretation of MQOs relative to Project results will be on a case-by-case basis for each parameter and will be fully discussed in reports.

5.0 COMPATIBILITY WITH LONG-TERM MONITORING

Full documentation of the methods, results and limitations of interpretation will be included in the study report. QA/QC procedures described in this study plan ensure the reliability of the data. An inherent challenge of long-term monitoring efforts is to adequately define monitoring objectives at the initiation of the monitoring program and to account for differences in data quality resulting from a continued evolution in the technology for assessing water quality.

6.0 DATA MANAGEMENT AND REPORTS

A report describing study methods, sampling locations, and results will be prepared annually. Data will be expressed in accordance with the WDOE approach to presenting water quality data. All raw data will be presented in an appendix, and digital copies of the data will be stored at District's office in Newport as well as provided to the WDOE and to FERC.

A draft of the annual report will be filed with the WDOE and FERC no later January 31, which describes monitoring and monitoring results for the previous field season. A final report will be filed within 60 days of comments received from the WDOE.

The monitoring plan will be reviewed and updated annually in advance of the following field season. Review and plan revisions are scheduled for February through March of each year with an annual monitoring plan filed with FERC and WDOE no later than May 1.

Within a monitoring season and prior to the subsequent report, upon written request, data will be made available to the WDOE, FERC and other agencies with regulatory authority for water quality for the Pend Oreille River. The District reserves the right to condition data as provisional that has not been subjected to complete QA/QC review.

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APPENDIX A

QA/QC and Calibration Procedures for Hydrolab DataSonde

CALIBRATION

Instrument calibration will be completed at the initiation and the conclusion of each sampling day. Calibration will also be completed during the course of sampling for any parameter that the results appear to be suspect or if a probe is replace or damaged. Upon completion of calibration, the instrument reported result for a known check standard (those used in calibration) will be re-tested. If the reported result does not meet the Measurement Quality Objectives, then the instrument will be re-calibrated until MQOs are met.

Total Dissolved Gas

1. Perform a two-point calibration. Determine local barometric pressure. A secondary source – i.e. common sensing unit that has been calibrated to an accurate barometer may be used.
2. Calibrate ambient pressure: barometric pressure = total dissolved gas pressure (Units = mm/Hg)
3. Set up TDG probe to pressure source (TDG membrane must be removed). Add 200 mm Hg of pressure. (Note: 200 mm Hg is equal to approximately 125% saturation). Calibrate if necessary.
4. Check for leaks. Dip probe into a solution of seltzer water. Readings should climb rapidly to 900-1000 mm Hg. If probe does not respond or responds slowly, there is a leak in the membrane. Membrane needs to be replaced.

Conductivity

1. For a two-point calibration, fill storage cup with distilled water. Allow to equilibrate, unit should be reading 0.
2. Use a known conductivity standard that is the range of the sampling water. Rinse with standard, then fill storage cup with standard, and allow to equilibrate. Enter calibration value in the calibration menu if necessary.

Dissolved Oxygen

1. Determine local barometric pressure. A secondary source – i.e. Common Sensing Unit that has been calibrated to an accurate barometer may be used.
2. Rinse dissolved oxygen probe.
3. Fill storage cup (Hydrolab should be inverted) to just below the O-ring of dissolved oxygen membrane.
4. Gently wipe any moisture on the dissolved oxygen membrane using KimWipes or Q-tips.
5. Put cap on storage cup and wait 5 minutes. This method of calibration is set-up so that the air surrounding the dissolved oxygen membrane is in a 100% humid environment and therefore will be in a 100% dissolved oxygen saturated environment.
6. After 5 minutes, enter in 100% dissolved oxygen saturation in the calibration menu, if necessary.
7. Additional calibration if necessary: confirm calibration (i.e. field tests) by using the Winkler method for dissolved oxygen. This will give you values in mg/L. Compare Winkler mg/L and Hydrolab mg/L. They should be within 0.3 mg/L or better.

pH

1. Replace reference electrode solution if necessary. Reference solution needs to be replaced every 2-4 weeks in the integrated pH probe, versus 2-3 months for the stand-alone electrode.
2. The top surface of the reference electrode contains a "teflon junction," which allows for the pH reference solution to escape. Do not handle by this teflon junction.
3. Stand-alone version: Remove the reference electrode probe. Rinse and re-fill with new pH reference solution. Fill almost to the top of the probe and gently re-place onto Hydrolab. The excess reference solution will leak out the sides and the top of the teflon junction. This probe does not thread – and will be slightly "loose" in comparison to the other probes.
4. Integrated version: Using a small philips screwdriver, remove teflon junction cap on reference electrode. Rinse and re-fill with new pH reference solution. Fill almost to the top of the probe and gently re-place onto Hydrolab. The excess reference solution will leak out the sides and the top of the teflon junction.
5. Depending upon local conditions, a 2-point calibration, rather than a 3-point calibration can be used.
6. Use pH=7, pH=10 for a 2-point, and pH=4, pH=7, and pH=10 for a 3-point calibration. (Note: changes in temperature will change pH by 0.01-0.10, see container for details).
7. Go to calibration menu. Starting with pH=7, submerge probes into buffer solution. Allow to equilibrate. Enter in calibration values (i.e. 4, 7 or 10), compensating for temperature as needed.
8. Rinse 1-2x prior to calibration with the appropriate buffer solution.

STORAGE/MAINTENANCE

Total Dissolved Gas

1. Gently clean dissolved gas membrane – rinse with water and scrub *softly* with a soft bristle tooth brush.
2. Gently wipe off excess water around probe. Replace probe with storage cap. TDG membrane needs to be stored dry!

3. Allow membrane to dry for 1-2 days and store in plastic container. For best results, replace with a clean dissolved gas membrane.

Conductivity

1. Gently clean conductivity probe with alcohol and Q-tips.

Dissolved Oxygen

Changing Membrane:

1. Position Hydrolab in a vice so that it is in a sturdy, upright position.
2. Remove O-ring and membrane. Rinse probe with distilled water. Fill probe with electrolyte solution, form a large meniscus on the probe.
3. Gently place dissolved oxygen membrane onto the top surface of the meniscus. Allow the membrane to gently fall over the probe so that no air bubbles are introduced into the solution. Handle membrane by the corners!
4. In one motion, fit the O-ring around the probe to keep the membrane in place. If done incorrectly, air bubbles will form under the surface of the membrane. If air bubbles form, re-do the procedure.
5. Allow membrane to sit on the Hydrolab for 24 hours before calibration. (Recommended by manufacturer--it is possible to do within 1-2 hours).

Cleaning:

1. Over long-term use, the gold ring surrounding the probe may need to be sanded. Also check the "cathode" – the probe may become oxidized (very black in color) and a new probe may need to be ordered.

Long-term storage:

1. Hydrolab recommends removing the electrolyte solution from the dissolved oxygen probe. Fill probe with distilled water and replace membrane.

pH

1. Clean bulb with alcohol and soft Q-tips. Do not use an abrasive scrubbing agent as you could scratch bulb.
2. pH probe needs to remain moist. Fill ¼ of storage cap with tap water (do not fill with distilled water!)

Slow probe response time is most likely due to a dirty or scratched pH probe or new reference electrode solution may be needed.