AVISTA CORPORATION

2012

LONG LAKE

TOTAL DISSOLVED GAS

MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.4(D)

Spokane River Hydroelectric Project
FERC Project No. 2545

Prepared By:
Golder Associates Inc.
Redmond, WA

April 10, 2013

[Page intentionally left blank]

Table of Contents

1.0 INTRODUCTION 1
2.0 LONG LAKE HED 2
2.1 Objectives 2
2.2 Monitoring Period 2
2.3 Methods 2
2.3.1 Equipment and Calibration 2
2.3.2 Station Facilities 3
2.3.3 Spot Measurements 3
2.3.4 Data Collection and Processing 4
2.3.5 Monitoring Difficulties 4
2.4 Results 5
2.4.1 Discharge 5
2.4.2 Water Temperature 5
2.4.3 Barometric Pressure 5
2.4.4 Total Dissolved Gas 5
2.4.5 Dissolved Oxygen 6
2.5 Discussion 6
3.0 REFERENCES 7

List of Tables

Table 2-1 Long Lake Dam TDG Monitoring Stations
Table 2-2 Summary of Continuous Monitoring Results
Table 2-3 LLTRSP1 Spot Measurement Results
Table 2-4 Summary of Exceedances of TDG Criterion when Total Discharge was Less Than or Equal to Ecology-Specified 7Q10 in 2011

List of Figures

Figure 2-1 Long Lake Dam Long-Term Water Quality Monitoring Locations
Figure 2-2 Water Temperature and HED Operations
Figure 2-3 Total Dissolved Gas Pressure, Barometric Pressure, and HED Operations
Figure 2-4 Total Dissolved Gas Percent of Saturation and HED Operations
Figure 2-5 Dissolved Oxygen Concentration and HED Operations

List of Appendices

Appendix A Data Quality Analysis
Appendix B Consultation Record

List of Acronyms and Abbreviations

% saturation	percent of saturation
°C	degrees Celsius
7Q10	7-day average flow with a 10-year return period
amsl	above mean sea level
Avista	Avista Corporation
BAR	barometric pressure
cfs	cubic feet per second
DO	dissolved oxygen
DQO	data quality objective(s)
Ecology	Washington State Department of Ecology
FERC	Federal Energy Regulatory Commission
ft	feet
Golder	Golder Associates Inc.
HED	hydroelectric development
m	meter(s)
mg/L	milligrams per liter
mm Hg	millimeters mercury (pressure)
MQO	measurement quality objective
MS5	Hydrolab® MS5 Multiprobe®
LLGEN	monitoring station at Long Lake HED Unit 4 generation plume
LLFB	monitoring station at Long Lake forebay
LLTR	monitoring station at Long Lake tailrace
LLTRSP1	monitoring station across the river from LLTR
LLGEN_Spot	monitoring station between Long Lake powerhouse and LLTR
PDT	Pacific Daylight Time
PME	protection, mitigation, and enhancement measure
Project	Avista's Spokane River Project
RMSE	root mean squared error
TDG	total dissolved gas, as pressure
TDG%	total dissolved gas, as percent of saturation
TDG WQAP	TDG Water Quality Attainment Plan
Tribe	Spokane Tribe
WQC	Amended section 401 water quality certification

1.0 INTRODUCTION

Avista Corporation (Avista) recognizes the need to address potential negative effects of total dissolved gas (TDG) production caused by water spilling through the Long Lake Dam spillway, and as a result proposed a protection, mitigation, and enhancement measure (PME) as part of its Spokane River Project (Project) license application to the Federal Energy Regulatory Commission (FERC) (Avista 2005). This PME, referred to as SRP-WQ-1 "Total Dissolved Gas Control and Mitigation Program", has the overall goal of reducing the Project's production of elevated TDG levels to the extent necessary for compliance with applicable water quality standards.

The Washington State Department of Ecology (Ecology) issued and amended a 401 water quality certification (WQC) for Avista's four Spokane River Project hydroelectric developments (HEDs) that are located in Washington (Ecology 2009). The WQC addresses the Upper Falls, Monroe Street, Nine Mile, and Long Lake HEDs. Section 5.4 of the WQC includes Avista's requirements to address the HEDs' effects on TDG.

On June 18, 2009, FERC issued a license for the Spokane River Project (FERC 2009). Article 401(a) of this license required Avista to file the TDG monitoring plan required by WQC section 5.4(A) and the Long Lake Dam TDG Water Quality Attainment Plan (TDG WQAP) required by WQC section 5.4(D) for Ecology and FERC approval prior to implementation.

Avista consulted with Ecology and the Spokane Tribe (Tribe) in preparation of the TDG monitoring plan, which addresses TDG associated with spills from the Long Lake and Nine Mile HEDs (Golder 2010a). Ecology approved this plan on March 17, 2010, and Avista filed this Ecology-approved plan with the FERC on March 26, 2010. Avista then filed the TDG WQAP (Golder 2010b), which includes sections of the Washington TDG Monitoring Plan that pertain to the Long Lake HED, to Ecology and FERC for approval, on June 8, 2010 and July 16, 2010, respectively. On July 9, 2010 Ecology approved the TDG WQAP and FERC approved both the monitoring plan and the TDG WQAP on December 14, 2010.

Avista began implementing the TDG monitoring plan associated with Long Lake Dam in 2010; the results of which are summarized in the 2010 Washington TDG Monitoring Report (Golder 2011). The 2011 TDG monitoring for Long Lake Dam is documented in the 2011 Long Lake Dam TDG Monitoring Report (Golder 2012). This report discusses TDG monitoring conducted for Long Lake Dam during the 2012 high-flow season.

2.0 LONG LAKE HED

2.1 Objectives

The overall objectives of the Long Lake HED TDG Monitoring Plan, developed as part of the Washington TDG Monitoring Plan, are to:

- Collect data to test the efficacy of using selected operational measures to reduce gas production by Long Lake Dam spillway(s)
- Collect data for modeling the effectiveness of using selected structural measures to reduce gas production by Long Lake Dam spillway(s)
- Test the effectiveness of selected operational and structural TDG abatement measures for Long Lake HED
- Confirm that Long Lake Dam does not cause exceedances of the TDG standard after implementation of selected operational and/or structural measures

2.2 Monitoring Period

The 2012 monitoring period for this study was from April 20 to July 13. Use of the Long Lake Dam spillways had begun before initiation of the 2012 TDG monitoring season and extended into July 6.

2.3 Methods

Water quality parameters that were recorded include TDG (millimeters mercury [mm Hg]), dissolved oxygen (DO) concentration (milligrams per Liter [mg/L]), and water temperature (°C). Water depth (meters) was also recorded and used in conjunction with water temperature to evaluate whether and when the water quality monitoring instruments emerged from the water and when they were above the minimum TDG compensation depth.

2.3.1 Equipment and Calibration

Hydrolab® MS5 Multiprobe® (MS5) instruments with TDG, optical DO, temperature, and depth sensors were used. Each MS5 deployed for extended periods[1] was connected to an external alternating current power source throughout the entire monitoring period with the goal of reducing potential issues associated with low or no power supply from the internal battery.

Solinst® barologgers were used to determine local barometric pressure (BAR). One barologger was deployed at the Long Lake pump house for the entire monitoring season. As an additional quality assurance measure, resulting site-specific barometric pressures were compared to corresponding values for the Spokane International Airport. Spokane International Airport station sea-level daily ranges for barometric pressure were downloaded from www.wunderground.com[2] and adjusted by subtracting

[1] AC power was not connected to MS5s used during spot measurements.
[2] On each site visit day, Spokane, WA KGEG barometric pressure data were downloaded from the History & Almanac section of http://www.wunderground.com/cgi-bin/findweather/getForecast?query=99219&sp=MKGEG.

37.05 mm Hg to account for the altitude of the Long Lake HED tailrace (1,365 feet above mean sea level [ft amsl]).

A MS5 equipped with a short power/data cable and a laptop computer were used as a portable TDG meter to obtain spot measurements at long-term and short-term TDG monitoring stations.

Monitoring equipment was calibrated according to the manufacturer's instructions prior to deployment and on periodic site visits. All instruments used were factory calibrated before the 2012 monitoring season. Pre-deployment field verification included synchronizing the clocks, comparing the MS5s' TDG pressure value with the silastic membrane removed to the ambient barometric pressure, confirming the MS5s' patency of the TDG silastic membrane, and testing the barologgers to confirm that the recorded values were similar and comparable to the Spokane International Airport.

During service periods, each MS5 was retrieved and the pull time recorded. Each service session included verification of logging status and downloading the data to a portable field computer. The Solinst® barologgers also were downloaded during these service periods. Patency of the original TDG membrane was confirmed by observing a rapid increase in TDG pressure while pressurizing the sensor with soda water. Depth, temperature, and DO sensors were calibrated according to the manufacturer's instructions.

2.3.2 Station Facilities

Permanent water quality monitoring facilities are constructed at three locations associated with Long Lake HED: 1) 0.6 mile downstream of the Long Lake Dam referred to as LLTR, 2) in the Long Lake HED Unit 4 generation plume referred to as LLGEN, and 3) in the Long Lake HED forebay referred to as LLFB (Table 2-1; Figure 2-1). In 2012, the incoming TDG was monitored at LLGEN until June 28 and then at LLFB for the remainder of the TDG monitoring period.

The permanent stations consist of a length of 4-inch-diameter pipe stilling-well (standpipe), which is sealed at the pipe's submerged end to prevent the MS5 from falling out of the pipe. Each standpipe has ½-inch-diameter perforations along its sides and a hole at the bottom to provide water exchange between the interior and exterior of the pipe and limit accumulation of sediment and debris in the bottom of the pipe. Each standpipe's top end is protected by an enclosed box containing AC power and data communication equipment.

2.3.3 Spot Measurements

Spot measurement of TDG, water temperature, and DO were made at each of the TDG monitoring stations being operated during the site visits which were done at approximately two-to-three week intervals. Spot measurements also were taken across the river from LLTR, at LLTRSP1 (Table 2-1).

2.3.4 Data Collection and Processing

Parameters monitored at 15-minute log intervals with the instruments described above included:

- Barometric pressure (mm Hg)
- Air Temperature (°C)
- Depth (m)
- TDG (mm Hg)
- Dissolved Oxygen (mg/L)
- Water Temperature (°C)

In addition, TDG percent of saturation (TDG%) was computed based on measurements, as:

- TDG% = TDG in mm Hg / Barometric pressure in mm Hg x 100

Data downloaded to the laptop computer were transferred to an office server and were checked for errors using Microsoft Excel®. Erroneous data were identified, assigned data quality codes, and removed from the final data set.

Long Lake HED operational logs were provided by Avista for the entire TDG monitoring period of April 20 to July 13, 2012. These logs provide the HED's hourly discharges as generation and spill along with total discharge.

2.3.5 Monitoring Difficulties

Monitoring difficulties during the 2012 TDG monitoring season centered around MS5s deployed at the LLGEN monitoring station. Even though the MS5 had been programmed correctly, MS5 #48765 had data gaps during the April 20 to May 13 deployment. These gaps started out as frequent power loss along with late probe turn on and progressed into overall low battery voltage of less than 7 volts. On May 13, the internal batteries were replaced, but valid measurements occurred for less than one day after redeployment. On May 24, a small piece of plastic was found in the battery compartment, so a different MS5 (#48764) was deployed in the LLGEN stilling well. This MS5 recorded the data between the May 24 to June 6 site visits, but did not record data on several periods between June 9 and June 17. On June 28, MS5 #48764 was retrieved from the long-term monitoring station and prepared for shipping to Hach for maintenance. Although the cause of the data recording failures discussed above is not totally resolved from available evidence, it may have been caused by erratic voltage provided by the AC backup system. To minimize the reoccurrence of a similar event, Avista has implemented a Standard Operating Procedure to maintain the backup AC power supply to the MS5 at this location and other long-term monitoring stations, recognizing however that the backup power supply may be interrupted during maintenance on non-scheduled events.

2.4 Results

Results of the 2012 TDG monitoring season data collection activities are presented below. The TDG monitoring season consisted of the period from April 20 to July 13, 2012. Since the MS5 at LLGEN needed to be moved to LLFB for the DO monitoring season, which started July 1, data were collected at LLGEN from April 20 to June 28, and from LLFB from June 28 to July 13. MS5s and barologgers were set up to record data for a maximum of approximately 8,100 consecutive 15-minute periods (referred to as "continuous" data in this report) from April 20 to July 13 (Table 2-2). The barologger deployed at LLTR provided local barometric pressure for 99 percent of the continuous monitoring period. TDG data were successfully obtained for 100 percent of the continuous monitoring periods at both LLTR and LLFB, although the monitoring difficulties described above limited TDG data for LLGEN to 62 percent of the continuous monitoring periods. Spot measurements were collected on April 20, May 13, June 6, June 28, and July 13, when long-term deployment or download of instruments was conducted (Table 2-3). Results of continuous and spot measurements are displayed in Figures 2-2 through 2-5.

2.4.1 Discharge

Combined Long Lake HED generation and spill discharge for the April 20 to July 13 monitoring period ranged from approximately 60 to approximately 37,100 cubic feet per second (cfs). With the exception of 10 hours, Long Lake HED generation was at full capacity from April 20 to July 8 (Figure 2-2). Spills at Long Lake Dam reached a maximum of approximately 30,600 cfs resulting in a total river discharge (generation plus spill discharge) of approximately 37,000 cfs on April 27, 2012.

2.4.2 Water Temperature

Water temperature in the tailrace (LLTR) increased from approximately 7°C in late April to approximately 18°C in mid-July (Figure 2-2). Maximum temperatures were 18.5°C at LLTR. Maximum temperature at LLGEN was 15.4°C with the last measurement made on June 28. In contrast, temperature measured at LLFB between June 28 and July 13 reached a maximum of 23.5°C and was more variable. Corresponding measurements at the two long-term TDG monitoring stations (LLTR and LLGEN) were within 1°C of one another, and LLTR temperature tended to be slightly warmer than LLGEN during spill periods (Figure 2-2).

2.4.3 Barometric Pressure

Site-specific barometric pressures ranged from 709 to 734 mm Hg based on the Solonist® barologger deployed at LLTR (Figure 2-3).

2.4.4 Total Dissolved Gas

TDG pressure for LLTR was greater than corresponding values for LLGEN and LLFB during most of the spill period (Figure 2-3). Comparison of spot values for LLTRSP1 and continuous monitoring data for

LLTR, which is across the river, closely coincided except on June 6 when the total hourly discharge was nearly 18,300 (cfs) with the hourly spill at nearly 11,800 cfs.

TDG% for all three continuous TDG monitoring stations exceeded 110 percent of saturation throughout most of the monitoring period until early July when use of the spillgates ceased for the season.

The range of TDG% computed was 110 to 123 percent of saturation for LLGEN, 107 to 118 percent of saturation for LLFB, and 107 to 143 percent of saturation for LLTR (Figure 2-4).[3] LLTR TDG% was greater than all corresponding LLGEN TDG% values and was greater than 33 percent of LLFB TDG% values.

The 110 percent of saturation TDG criterion is not applicable when stream discharge exceeds the 7Q10, which Ecology (2009) specified as 32,000 cfs for the Spokane River at Long Lake Dam and Nine Mile Dam. During the 2012 TDG monitoring study, maximum total discharge (spill plus turbine discharge) was 37,050 cfs, and the Ecology-designated 7Q10 was exceeded for 216 hours (approximately 9 days) in late April to early May (Figure 2-4). Table 2-4 provides the specific periods with TDG% of greater than the 110 percent of saturation criterion when total discharge was less than the Ecology-specified 7Q10.

2.4.5 Dissolved Oxygen

Measured DO concentrations were 9.5 to 13.2 mg/L for LLGEN, 8.0 to 11.4 mg/L for LLFB, and 9.1 to 15.0 mg/L for LLTR (Figure 2-5). Greatest DO concentrations occurred near the beginning of the monitoring period when temperature was near its lowest causing potential solubility for oxygen to be greatest.

2.5 Discussion

Consistent with historic measurements (Golder 2003, 2004, 2011, 2012) and expectations, TDG was typically greater at LLTR than at LLGEN and LLFB, and generally followed the pattern of spill flows. Comparison of the TDG% and spill discharges for 2012 indicate TDG% at LLTR were greater than at LLGEN and exceeded the 110 percent criterion for all 4,159 TDG% data pairs.

[3] The depths for all LLFB continuous TDG measurements were below the compensation depth, although depths for LLGEN and LLTR TDG measurements were less than the compensation depth 1.0 percent of the time and 0.5 percent of the time, respectively. Depths for all these measurements were within 0.2 foot of the compensation depth.

3.0 REFERENCES

Avista Corporation (Avista). 2005. Spokane River Hydroelectric Project, FERC Project No. 2545, Application for New License, Major Project – Existing Dam, Volume II: Applicant-Prepared Preliminary Draft Environmental Assessment. Avista Corporation, Spokane, Washington. July 2005.

Federal Energy Regulatory Commission (FERC). 2009. Project Nos. 2545-091, 12606-000, Order Issuing New License and Approving Annual Charges for Use of Reservation Lands. Issued June 18. 167 pp.

Golder (Golder Associates Inc.). 2010a. Washington Total Dissolved Gas Monitoring Plan. Prepared for Avista Corporation. March 26.

Golder (Golder Associates Inc.). 2010b. Long Lake Dam Total Dissolved Gas Water Quality Attainment Plan. Prepared for Avista Corporation. July 9.

Golder (Golder Associates Inc.). 2011. 2010 Washington Total Dissolved Gas Monitoring Report. Prepared for Avista Corporation. January 21.

Golder (Golder Associates Inc.). 2012. 2011 Long Lake Dam Total Dissolved Gas Monitoring Report. Prepared for Avista Corporation. February 16.

Golder (Golder Associates Ltd.). 2003. Total Dissolved Gas Pressure (TDG) Monitoring on the Spokane River 2003 Data Report. Prepared for Avista Corporation, Spokane, WA. Prepared by Golder Associates Ltd., Castlegar, B.C. October 2003. Golder Report No. 033-1363CD: 40 p. + 1 CD Appendix.

Golder (Golder Associates Ltd.). 2004. Total Dissolved Gas Pressure (TDG) Monitoring on the Spokane River 2004 Final Data Report. Data on CD. Prepared for Avista Corporation, Spokane, WA. Prepared by Golder Associates Ltd., Castlegar, B.C. September 2004. Golder Report No. 033-1363C2004F: 55 p. + 1 Appendix + plates.

Washington State Department of Ecology (Ecology). 2009. 401 Certification-Order Spokane River Hydroelectric Project, Certification-Order No. 5492, FERC License No. 2545, As amended May 8, 2009 by Order 6702. Prepared by Eastern Regional Office Water Quality Program staff, Spokane, WA. May 8.

TABLES

Table 2-1: Long Lake Dam TDG Monitoring Stations

Station Code	Description	Latitude / Longitude (NAD83)	Monitoring Type
LLFB	Long Lake Forebay between Unit 3 and 4 intakes near centerline of intake (elevation 1499 feet)	47°37'48" / 117°31'47"	Long-term for DO monitoring season starting June 28
LLGEN	Long Lake HED Unit 4 generation plume	47°37'48" / 117°31'47"	Long-term until June 28
LLTR	On left downstream bank, at a water pump house approximately 0.6 mile downstream from Long Lake dam	47°37'48"/ 117°31'47"	Long-term
LLTRSP1	On right downstream bank, across river from LLTR station	47° 50'19" / 117° 51'02"	Spot during spillway use

Table 2-2: Summary of Continuous Monitoring Results

Parameter	LLGEN			LLFB			LLTR		
	Minimum	Maximum	Count	Minimum	Maximum	Count	Minimum	Maximum	Count
Date/Time (PDT)	4/20/2012 14:15	6/28/2012 11:00	6,612	6/28/2012 13:30	7/13/2012 13:15	1,442	4/20/2012 10:00	7/13/2012 11:15	8,070
Water Temperature (°C)	6.6	15.4	4,086	15.8	23.5	1,441	6.7	18.5	8,057
DO (mg/L)	9.5	13.2	3,787	8.0	11.4	1,441	9.1	15.0	8,057
BAR (mm Hg)	Used LLTR BAR			Used LLTR BAR			709	734	7,952
TDG (mm Hg)	795	875	4,078	764	842	1,438	777	1,035	8,048
TDG (% saturation)[1]	110.3	122.6	4,066	106.6	117.5	1,438	107.3	142.7	7,936

Notes:

1. TDG (% saturation) calculated using site-specific barometric pressure (BAR) data collected at LLTR and corrected for altitude.

Table 2-3: LLTRSP1 Spot Measurement Results

Date Time (PDT)	Water Temperature (°C)	DO (mg/L)	TDG (mm Hg)	LLTR BAR (mm Hg)	TDG (% of saturation)
4/20/2012 15:30	6.7	14.6	936	725	129.1
5/13/2012 14:30	8.0	14.8	952	Not recorded[1]	N/A
6/6/2012 15:15	13.9	10.8	857	724	118.4
6/28/2012 17:00	15.8	10.5	837	721	116.1
7/13/2012 12:30	18.3	10.1	794	722	110.0

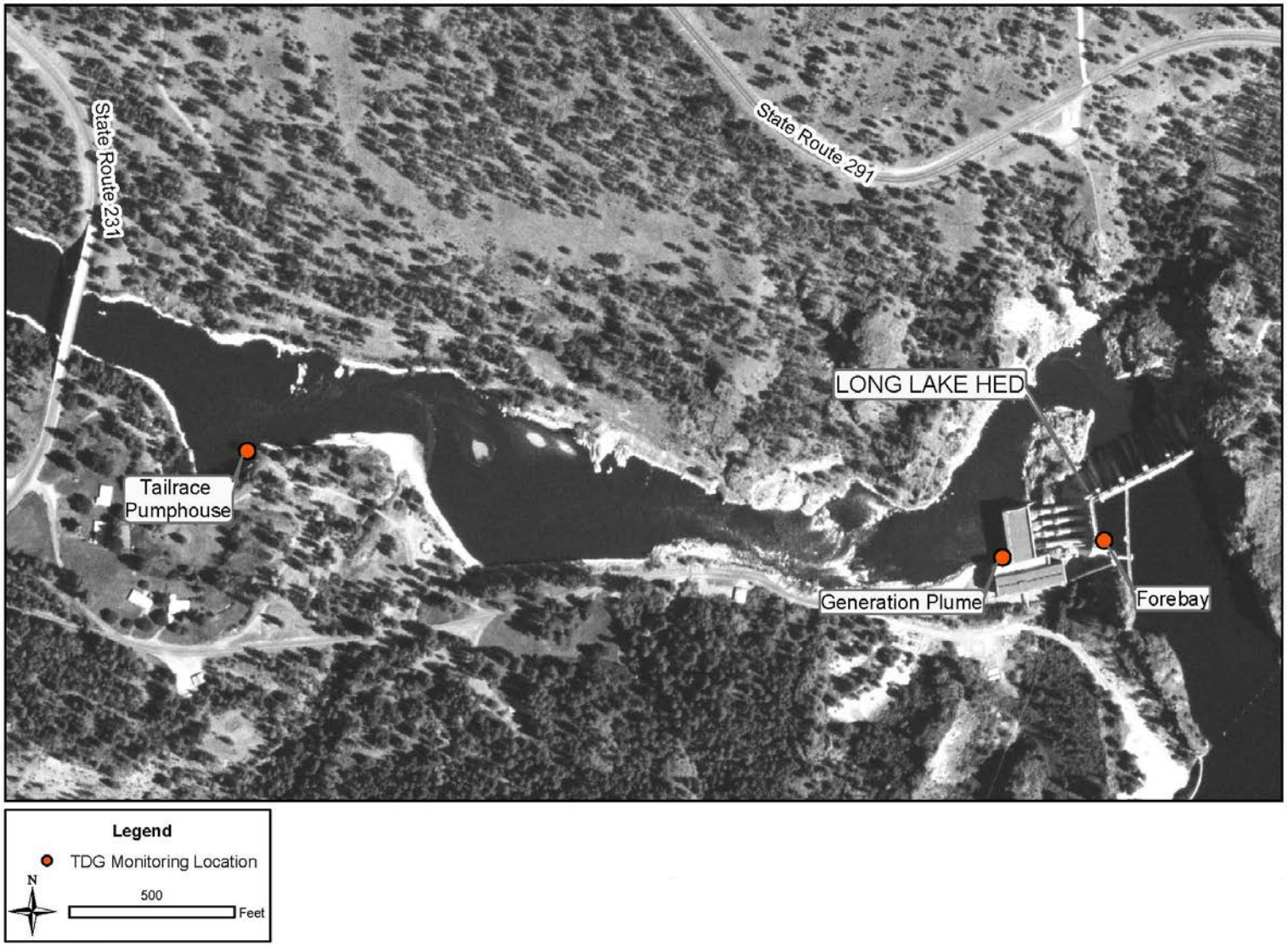
Notes:
1. Barologger was being serviced simultaneously.

Table 2-4: Summary of Exceedances of TDG Criterion when Total Discharge was Less Than or Equal to Ecology-Specified 7Q10 in 2012

	LLTR	LLGEN	LLFB
# of records that exceeded 110% of saturation	7,206	4,066	1,127
total # of records	7,936	4,066	1,438
Periods when TDG exceeded 110% of saturation (PDT)[1,2,3]	4/20/2012 10:30 to 7/5/2012 19:45	4/20/2012 14:45 to 4/21/2012 2:00	6/28/2012 13:00 to 7/7/2012 7:30
	7/10/2012 15:30 to 7/10/2012 15:45	4/21/2012 2:30 to 4/21/2012 5:30	7/7/2012 8:00 to 7/7/2012 16:00
	7/11/2012 20:15	4/21/2012 6:00 to 4/21/2012 8:45	7/7/2012 16:45 to 7/7/2012 18:30
	7/13/2012 11:00 to 7/13/2012 11:15	4/21/2012 9:15 to 5/5/2012 1:15	7/7/2012 20:30
		5/24/2012 15:45 to 6/6/2012 9:00	7/7/2012 21:30
		6/6/2012 10:45 to 6/9/2012 14:15	7/7/2012 22:00 to 7/8/2012 2:00
		6/10/2012 20:15	7/8/2012 8:30 to 7/8/2012 15:45
		6/10/2012 23:45	7/8/2012 16:15 to 7/8/2012 16:30
		6/11/2012 2:45	7/9/2012 9:30 to 7/9/2012 9:45
		6/11/2012 6:30	7/9/2012 14:45 to 7/9/2012 15:15
		6/11/2012 20:15	7/9/2012 15:45 to 7/9/2012 16:00
		6/12/2012 8:15	7/9/2012 17:00
		6/14/2012 19:30 to 6/14/2012 22:30	7/10/2012 10:15
		6/14/2012 23:00 to 6/15/2012 4:00	7/10/2012 11:15
		6/15/2012 4:45 to 6/16/2012 13:45	7/10/2012 12:30 to 7/11/2012 0:15
		6/17/2012 5:00 to 6/28/2012 11:00	7/11/2012 10:15 to 7/12/2012 0:00
			7/12/2012 10:30 to 7/12/2012 17:45
			7/12/2012 18:15 to 7/13/2012 1:45
			7/13/2012 7:00 to 7/13/2012 13:15

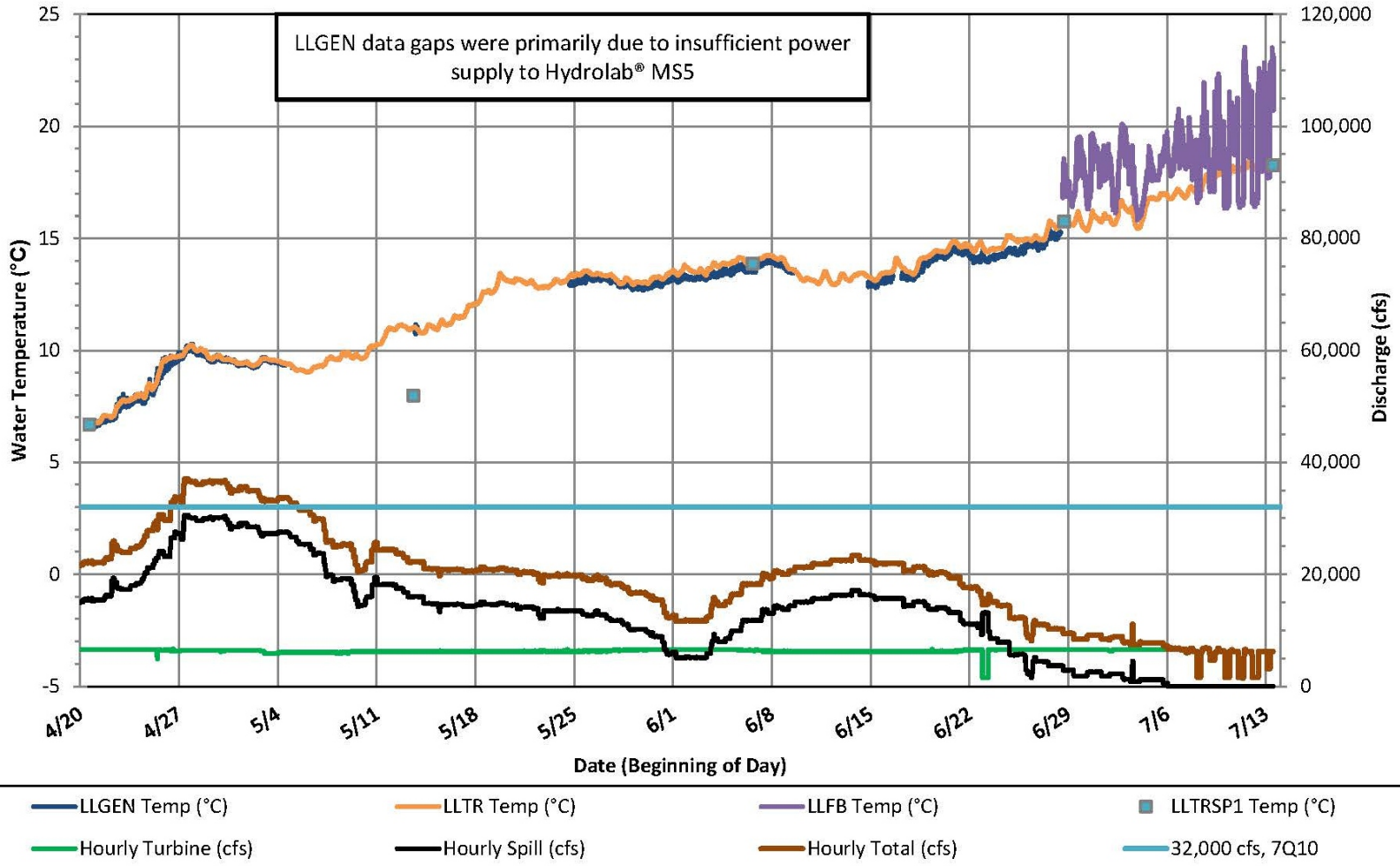
Notes:
1. Flow exceeded the 7Q10 from 4/26/2012 10:00 to 5/5/2012 10:45 with exception of one hour.
2. Refer to Figure 2-4 and Appendix A for data gaps.
3. During the LLGEN 4/21 9:15 to 5/5 01:15 period, data gaps occurred on ten days in this period.

FIGURES



Source: Avista

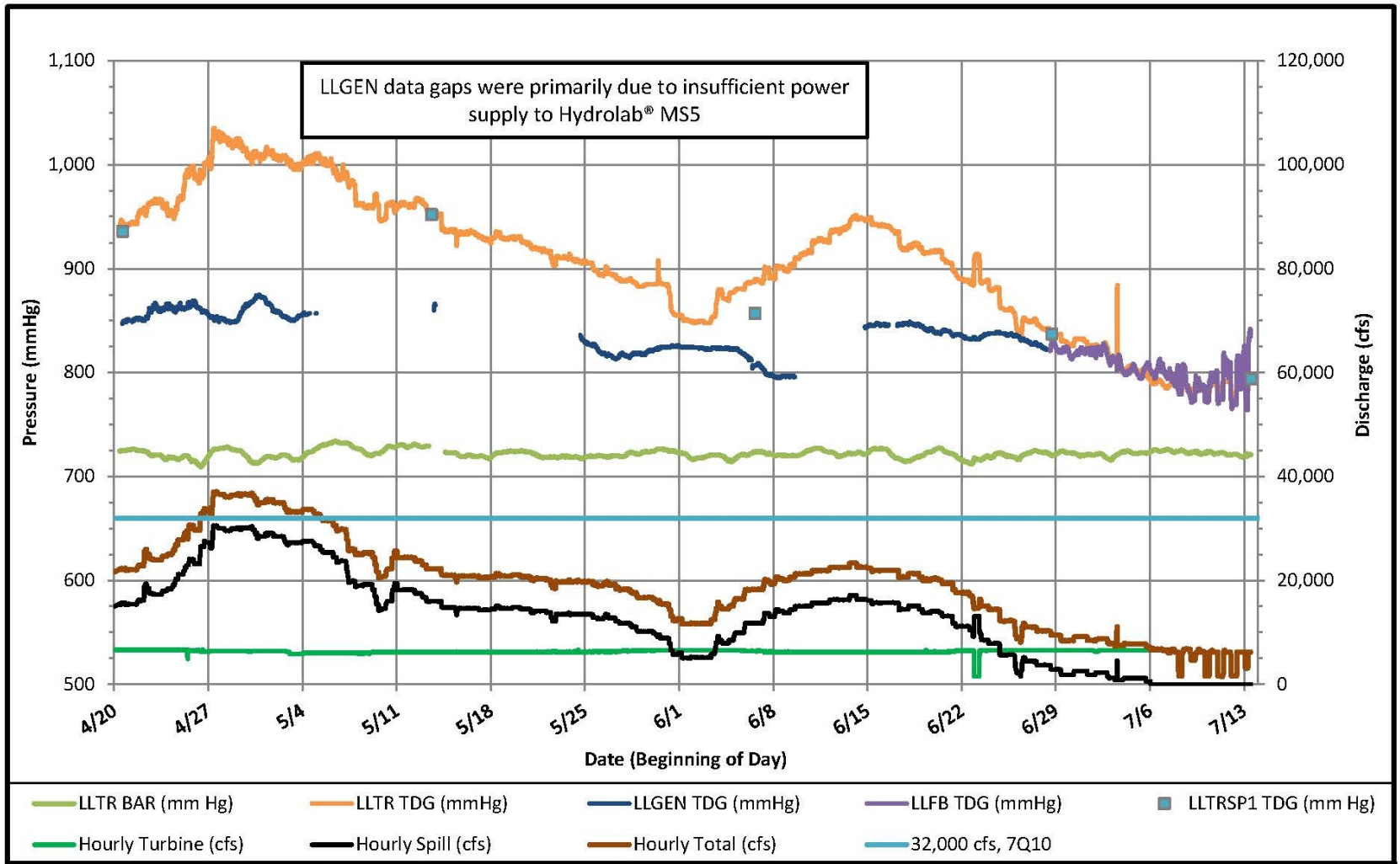
Figure 2-1: Long Lake Dam Long-Term Water Quality Monitoring Locations



Golder Associates

Title	Water Temperature and HED Operations		
Project Name	LL TDG Monitoring	Project No.	073-93081-05.411
Client Name	Avista	Date	February 26, 2013

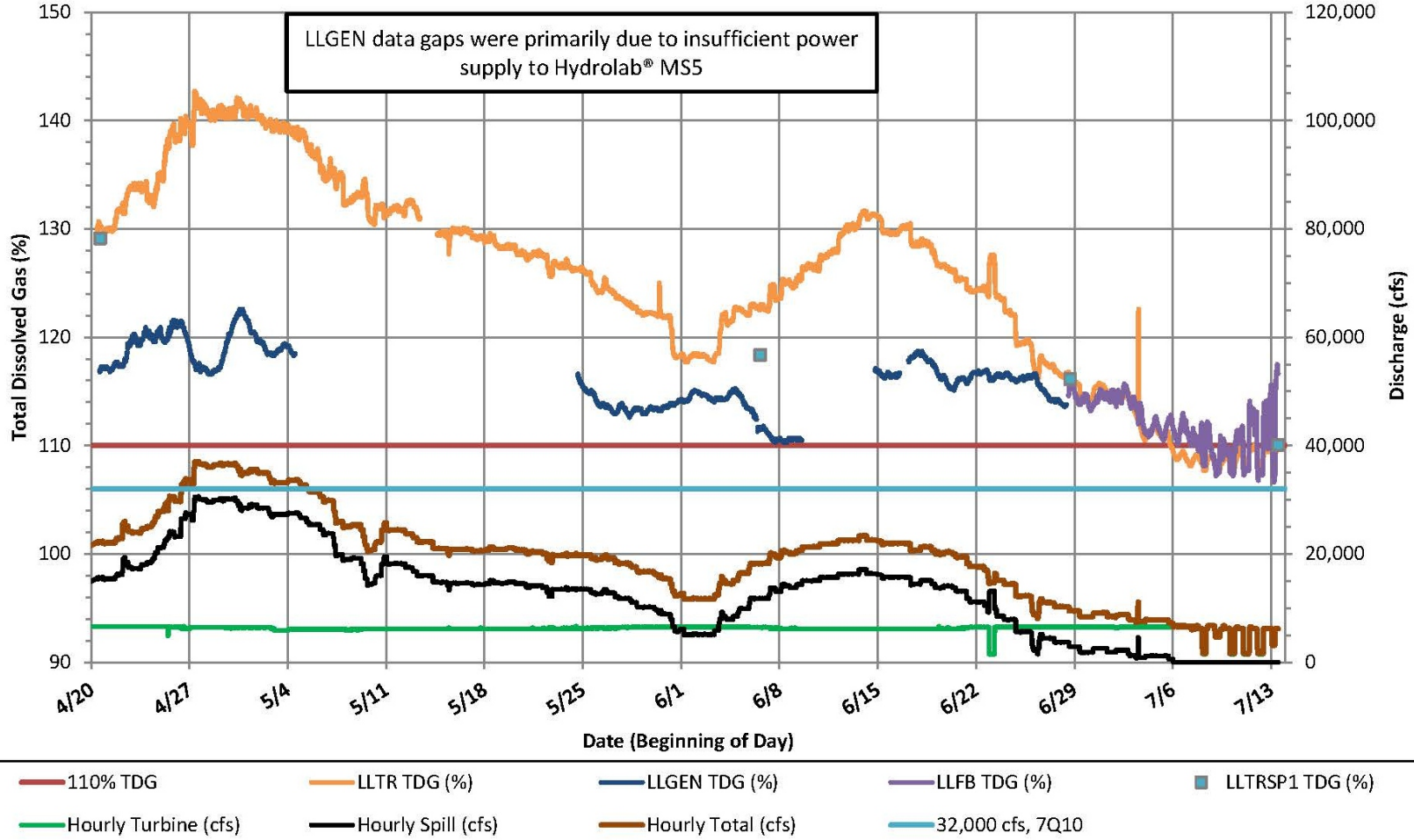
FIGURE 2-2



Golder Associates

Title	Total Dissolved Gas Pressure, Barometric Pressure, and HED Operations		
Project Name	LL TDG Monitoring	Project No.	073-93081-05.411
Client Name	Avista	Date	February 26, 2013

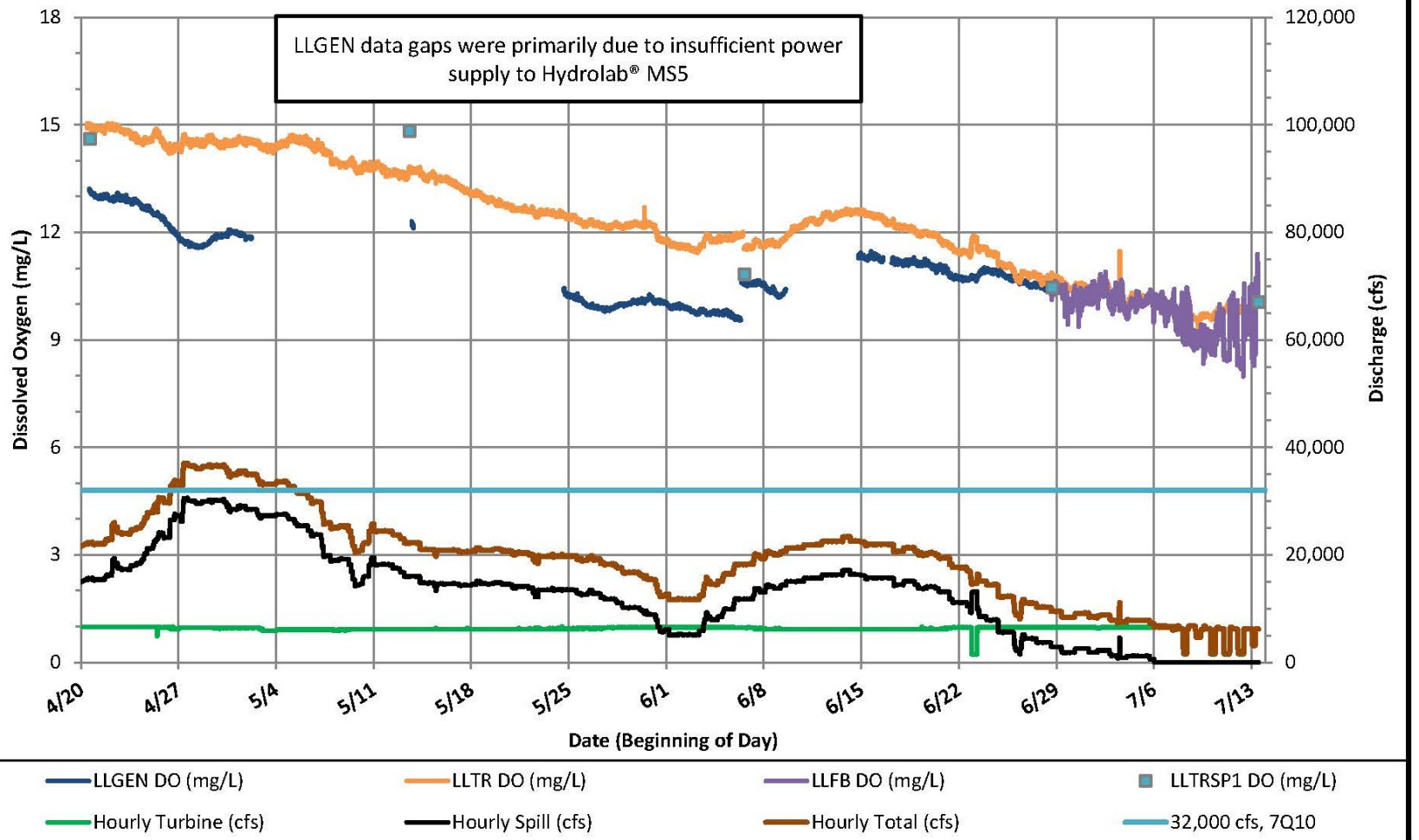
FIGURE 2-3



Golder Associates

Title	Total Dissolved Gas Percent of Saturation and HED Operations		
Project Name	LL TDG Monitoring	Project No.	073-93081-05.411
Client Name	Avista	Date	February 26, 2013

FIGURE 2-4



Golder Associates

Title	Dissolved Oxygen Concentration and HED Operations		
Project Name	LL TDG Monitoring	Project No.	073-93081-05.411
Client Name	Avista	Date	February 26, 2013

FIGURE 2-5

APPENDIX A
DATA QUALITY ANALYSIS

DATA QUALITY SUMMARY

Data Quality Objectives (DQOs) and Measurement Quality Objectives (MQOs) are the quantitative and qualitative terms used to specify how good the data need to be to meet the project's specific monitoring objectives. DQOs for measurement data, also referred to as data quality indicators, include measurement range, accuracy, precision, representativeness, completeness, and comparability. The range, accuracy, and resolution for each measured parameter are provided in Table A-1.

Table A-1: Range, Accuracy and Resolution of Parameters Recorded

Instrument and Parameter	Range	Accuracy	Resolution
MS5 Total Dissolved Gas	400 to 1300 mm Hg	±0.1 % of span	1.0 mm Hg
MS5 Dissolved Oxygen	0 to 30 mg/L	± 0.01 mg/L for 0 to 8 mg/L ± 0.02 mg/L for >8mg/L	0.01 mg/L
MS5 Temperature	-5 to 50°C	±0.10°C	0.01°C
MS5 Depth (0-25 meters)	0 to 25 meters	±0.05 meter	0.01 meter
Barologger Relative Barometric Pressure	1.5 meter of water	± 0.1 cm of water	0.002% of full scale
Barologger Temperature	-10 to 40°C	± 0.05°C	0.003°C

Notes: Sources: Hach MS5 User Manual and Solinist Levelogger User Guide [4]

MQOs are the performance or acceptance thresholds or goals for the project's data, based primarily on the data quality indicators precision, bias, and sensitivity. Table A-2 presents MQOs selected during preparation of the Washington TDG Monitoring Plan along with the same MQO for DO as used for the Long Lake HED tailrace DO monitoring plan. The meter-specific root mean squared error (RMSE) of the calibration corrections applied after each calibration, and an overall RMSE for all meters compared to MQOs are shown in Table A-3.

Table A-2: Measurement Quality Objectives (MQOs)

Parameter	MQOs
Barometric Pressure	2 mm Hg
Temperature	0.5ºC
Total Pressure	1% (5 to 8 mm Hg)
TDG%	1%
Dissolved Oxygen	0.5 mg/L

[4] Hach Corporation. 2006. Hydrolab DS5X, DS5, and MS5 Water Quality Multiprobes User Manual. February 2006, Edition 3. Catalog Number 003078HY and Solinist. 2010. Levelogger Series (Levelogger Gold, Barologger Gold, Levelogger Junior, LTC Levelogger Junior and Rainlogger) User Guide - Software Version 3.4.0. August 17, 2010.

Table A-3: Difference Between RMSE and MQOs by MS5

Part 1: Barometric Pressure (BAR), Total Pressure, and Total Dissolved Gas (TDG)

Meter IDs and Locations	RMSE[1]				MQO			RMSE - MQO			
	BAR[2] (mm Hg)	Total Pressure[3] (mm Hg)	TDG-cal[4] (%)	TDG-spot[5] (%)	BAR (mm Hg)	Total Pressure (%)	TDG (%)	BAR (mm Hg)	Total Pressure (%)	TDG-cal (%)	TDG-spot (%)
48762 (LLTRSP1 Spot; 4/20, 6/6)	1.58	0.22	0.22	1.00	2	1	1	-0.42	-0.78	-0.78	0.00
48763 (LLFB 6/28 - 7/13)	2.00	0.28	0.28	N/A	2	1	1	0.00	-0.72	-0.72	N/A
48764 (LLGEN 5/24-6/28 LLTRSP1 Spot; 4/20, 5/13, 7/13)	0.71	0.10	0.10	1.00	2	1	1	-1.29	-0.90	-0.90	0.00
48765 (LLGEN 4/20 - 5/25)	3.81	0.52	0.52	N/A	2	1	1	1.81	-0.48	-0.48	N/A
60375 (LLTRSP1 Spot 6/28)	2.00	0.28	0.28	1.00	2	1	1	0.00	-0.72	-0.72	0.00
60376 (LLTR 4/20 - 7/13)	1.79	0.25	0.25	N/A	2	1	1	-0.21	-0.75	-0.75	N/A
Overall RMSE	2.13	0.29	0.29	1.00	2	1	1	0.13	-0.71	-0.71	0.00

Notes:
Shaded values indicate exceedance of MQO.
[1] RMSE calculated for each meter during calibration checks and spot measurements from multiple meters.
[2] RMSE calculated from BAR measured during calibration compared to the TDG in air uncorrected reading.
[3] RMSE calculated as the difference in TDG in air uncorrected measured during calibration minus the BAR, then divided by the TDG and multiplied by 100%.
[4] RMSE calculated as TDG in air uncorrected measured during calibrations divided by the BAR and multiplied by 100%.
[5] RMSE calculated as the measured TDG in air uncorrected divided by the group average measured TDG.
N/A - Not available, measurement not taken.

Root mean squared error (RMSE) = $\sqrt{\frac{\sum_{i=1}^{n}(x_{1,i}-x_{2,i})^2}{n}}$.

Table A-3 (Continued): Difference Between RMSE and MQOs by MS5,

Part 2: Temperature and Dissolved Oxygen (DO)

Meter IDs and Locations	RMSE				MQO		RMSE - MQO			
	Temperature[1]		DO[2]				Temperature[1]		DO[2]	
	Calibration (°C)	Spot (°C)	Calibration (mg/L)	Spot (mg/L)	Temp (°C)	DO (mg/L)	Calibration (°C)	Spot (°C)	Calibration (mg/L)	Spot (mg/L)
48762 (LLTRSP1 Spot; 4/20, 6/6)	0.08	0.00	0.45	0.03	0.5	0.5	-0.42	-0.50	-0.05	-0.48
48763 (LLFB 6/28 - 7/13)	0.06	N/A	0.58	N/A	0.5	0.5	-0.44	N/A	0.08	N/A
48764 (LLGEN 5/25-6/28 LLTRSP1 Spot; 4/20, 5/13, 7/13)	0.04	0.00	0.15	0.03	0.5	0.5	-0.46	-0.50	-0.35	-0.48
48765 (LLGEN 4/20 - 5/25)	0.26	N/A	0.30	N/A	0.5	0.5	-0.24	N/A	-0.20	N/A
60375 (LLTRSP1 Spot 6/28)	0.17	0.01	0.23	0.18	0.5	0.5	-0.33	-0.49	-0.27	-0.33
60376 (LLTR 4/20 - 7/13)	0.17	N/A	0.31	N/A	0.5	0.5	-0.33	N/A	-0.19	N/A
Overall RMSE	0.16	0.01	0.34	0.13	0.5	0.5	-0.34	-0.49	-0.16	-0.38

Notes:
Shaded values indicate exceedance of MQO.
[1] For Calibration, RMSE calculated from the difference between the meter and calibration thermometer at all calibration checks. Spot differences are differences between measured values from group average.
[2] Calibration RMSE as difference of the pre-calibration measurement and calculated 100% saturation. Spot RMSE calculated as difference between measured values from group average.
N/A - Not available, measurement not taken

Root mean squared error (RMSE) = $\sqrt{\frac{\sum_{i=1}^{n}(x_{1,i}-x_{2,i})^2}{n}}$.

Measurement Range

The measurement range, range of reliable readings of an instrument or measuring device, specified by the manufacturer is displayed in Table A-1 for each measured parameter. Maintenance of field sampling equipment was conducted in a manner consistent with the corresponding manufacturer's recommendations to provide reliable readings within each instrument's reported measurement range.

Bias

TDG meters, like other field monitoring instruments, are subject to bias due to systematic errors introduced by calibration, equipment hardware or software functioning, or field methods. Bias was generally minimized by following standard protocols for calibration and maintenance, and by following field protocols for stabilization of meter readings.

Precision

Precision refers to the degree of variability in replicate measurements. Instrument precision was evaluated through the calibration and maintenance activities. MQOs for total pressure and TDG% were met for all meters, although one of the six MS5s did not meet MQOs for barometric pressure (Table A-3).

All six MS5s met the 0.5°C water temperature MQO both for pre-calibration and paired spot measurements, and the 0.5 mg/L DO MQO with paired spot measurements. The MS5 deployed at LLFB from June 28 to July 13 did not meet the DO MQO during the pre-calibration test on July 13. Discharge data were obtained from Avista, which uses a well-established monitoring program. Golder reviewed the variability of discharge data to determine whether it was appropriate based on expected values. All discharge data were deemed acceptable.

Accuracy

Accuracy is a measure of confidence that describes how close a measurement is to its "true" value, or the combination of high precision and low bias. Throughout this seasonal TDG monitoring study, the MS5s underwent verification procedures. All differences between TDG pressure, DO, temperature, depth, and barometric pressure were recorded and these differences were discussed in the previous section.

Representativeness

Representativeness qualitatively reflects the extent to which sample data represent a characteristic of actual environmental conditions. For this project, representativeness was addressed through proper design of the sampling program to ensure that the monitoring locations were properly located and sufficient data were collected to characterize TDG at that location.

Comparability

Comparability is the degree to which data can be compared directly to previously collected data. Comparability was achieved by consistently monitoring the same downstream long-term monitoring station (LLTR) monitored in the past, monitoring in the LLGEN stilling well that also was a TDG monitoring station in 2009 and 2010, and conducting spot measurements at the same location across the river from LLTR as in past years.

Completeness

Completeness is the comparison between the quantity of data planned to be collected and how much usable data was actually collected, expressed as a percentage (Table A-4). The TDG data collection period consisted of approximately 8,100 15-minute periods at LLTR, with shorter period at both LLGEN and LLFB. Data completeness was at least 98 percent for all parameters at both LLFB and LLTR. Completeness of all parameters for LLGEN was between 57 and 62 percent. The primarily reason for data gaps at LLGEN appears to be due to external power issues at this monitoring site.

Table A-5 summarizes the number of specific DQCodes applied to LLFB and LLTR data.

Table A-4: Project Completeness

	LLGEN		LLFB		LLTR	
	Count	**Completeness (%)**	**Count**	**Completeness (%)**	**Count**	**Completeness (%)**
Monitoring Period	6,612	--	1,442	--	8,070	--
Water Temperature (°C)	4,086	62%	1,441	100%	8,057	100%
DO (mg/L)	3,787	57%	1,441	100%	8,057	100%
BAR (mm Hg)	Used LLTR BAR		Used LLTR BAR		7,952	99%
TDG (mm Hg)	4,078	62%	1,438	100%	8,048	100%
TDG (% saturation)	4,066	61%	1,438	100%	7,936	98%

Table A-5: Number of Specific DQCodes during Monitoring Period

DQ Code	DQ Code Description	LLGEN					LLFB					LLTR						
		Temp (°C)	TDG (mm Hg)	Depth (meters)	DO (mg/L)	Batt (volts)	Temp (°C)	TDG (mm Hg)	Depth (meters)	DO (mg/L)	Batt (volts)	Temp (°C)	TDG (mm Hg)	Depth (meters)	DO (mg/L)	Batt (volts)	Level (m H2O)	ATemp (°C)
999	Instrument logging data before deployment at monitoring station	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
997	Equilibrating after deployment	1	9	0	0	0	0	3	0	0	0	0	9	0	0	0	0	0
996	No data reported by instrument even though programmed correctly	2,452	2,453	2,453	2,453	2,452	0	0	0	0	0	0	0	0	0	0	0	0
995	No instrument deployed	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	113	113
994	Parameter not monitored during the monitoring period	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
993	Out of water for calibration/servicing	14	14	14	14	3	0	0	0	0	0	13	13	13	13	13	0	0
992	Moved instrument; it is not at standard station or is out of water	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
889	Power loss/ late probe turn on	59	58	58	118	118	0	0	0	0	0	0	0	0	0	0	0	0
888	Power loss	0	0	0	29	25	0	0	0	0	0	0	0	0	0	0	0	0
303	Unrealistic DO value, suspect erratic or low voltage	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0
102	Between "minimum operating voltage" (<9 volts) and 7 volts, and other data do not appear reliable	0	0	0	6	4	0	0	0	0	0	0	0	0	0	0	0	0
101	Less than "minimum operating voltage" (<7 volts) and other data do not appear reliable	0	0	0	201	184	0	0	0	0	0	0	0	0	0	0	0	0
-101	Less than "minimum operating voltage" (<7 volts), but other data appear reliable	379	379	379	179	197	0	0	0	0	0	0	0	0	0	0	0	0
-102	Between "minimum operating voltage" (<9 volts) and 7 volts, but other data appear reliable	1,197	1,197	1,197	1,191	1,193	0	0	0	0	0	0	0	0	0	0	0	0
-887	Late probe turn on, but data appear reliable	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
-888	Power loss, but data appear reliable	206	206	206	177	181	0	0	0	0	0	0	0	0	0	0	0	0
-889	Power loss/ late probe turn on, but data appear reliable	81	81	81	21	21	0	0	0	0	0	0	0	0	0	0	0	0
-1002	Corresponds with spot measurement	0	0	0	0	0	0	0	0	0	0	5	5	5	5	5	0	0
-1003	Corresponds with spot measurement at nearby station	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	0	0
-1010	Less than "minimum operating voltage" (<7 volts) after conversion from %Left, but other data appear reliable	0	0	0	0	1,082	0	0	0	0	0	0	0	0	0	0	0	0
-1020	Between "minimum operating voltage" (<9 volts) and 7 volts after conversion from %Left, but other data appear reliable	0	0	0	0	147	0	0	0	0	0	0	0	0	0	0	0	0
0	No data qualifiers	2,220	2,212	2,221	2,216	994	1,440	1,437	1,440	1,440	1,440	8,048	8,039	8,048	8,048	8,048	7,952	7,952
	Monitoring Period[1]	6,612	6,612	6,612	6,612	6,612	1,440	1,440	1,440	1,440	1,440	8,070	8,070	8,070	8,070	8,070	8,070	8,070

Notes:
1. Monitoring periods consisted of 4/20/2012 10:00 to 7/13/2012 11:15 for LLTR, 4/20/2012 14:15 to 6/28/2012 11:00 for LLFB, and 6/28/2012 13:30 to 7/13/2012 13:15 for LLGEN.

APPENDIX B

CONSULTATION RECORD

February 28, 2013

Ms. Marcie Mangold, Water Quality Program
Washington Department of Ecology
Eastern Region Office
4601 N Monroe Street
Spokane, WA 99205-1295

RE: Federal Energy Regulatory Commission's Spokane River Hydroelectric Project License, Appendix B, Sections 5.4 and 5.6, TDG and DO Reporting Requirements

Dear Ms. Mangold:

Ordering Paragraph E of the Spokane River Hydroelectric Project License (Federal Energy Regulatory Commission Project No. 2545) incorporated the Washington Department of Ecology (Ecology) Certification Conditions under Section 401 of the Federal Clean Water Act Water Quality Certification (Certification) as Appendix B of the License. In accordance with Section 5.4 and Section 5.6 of the Certification, Avista submits the following reports for your review and comment.

Section 5.4: Total Dissolved Gas
There are three components related to Total Dissolved Gas in this filing, which include the following:

1. *2012 Long Lake Total Dissolved Gas Monitoring Report, Golder Associates, February 2013.* As required by the Total Dissolved Gas (TDG) Water Quality Attainment Plan (WQAP) and the Washington TDG Monitoring Plan, this enclosed report provides the results of monitoring TDG at Avista's Long Lake Hydroelectric Development (HED) during 2012. Avista proposes to continue implementing the same monitoring plan at the Long Lake HED in 2013.

2. *Long Lake Hydroelectric Development (HED) Total Dissolved Gas Abatement Phase III Feasibility Study, Draft Report, NHC, November 19, 2012.* The Phase III Feasibility Study documents the progress of building the physical model and hydraulic testing of using deflectors on the modeled Long Lake Dam spillway. Additionally, the Phase III Feasibility Study documents the detailed physical scale modeling of the Long Lake HED and the development and implementation of the various model scenarios that were tested to reduce TDG, based on the findings of Phase II studies. It also includes estimated TDG performance, construction cost estimates, and preliminary geotechnical analysis of the various alternatives that were tested. Specifics related to TDG performance and construction costs are discussed in the Summary and Conclusions section of the Phase III Feasibility Study.

   Based on the results of the study, Avista has determined that the best alternative to mitigate for TDG produced by the Long Lake HED is a modified Alternative 1 (Spill Bay 7-8 Deflectors), that includes substantial rock removal from the rock outcropping below the two spill bays, and additional deflectors on spill bays 3-6. The deflectors will help eliminate the plunging flow that causes the high TDG levels and the rock removal will allow the spill bay 7 and 8 deflectors to develop a skimming flow in the same manner that the deflectors do for spill bays 3-6.

1411 East Mission Avenue
PO Box 3727
Spokane, Washington 99220-3727

800.227.9187
www.avistautilities.com

3. *Revised Long Lake HED TDG Compliance Schedule.* The July 9, 2010 Long Lake Dam TDG WQAP included a compliance schedule to address TDG production at Long Lake Dam. During the modeling process it was determined that additional unplanned alternatives needed to be assessed to thoroughly evaluate their potential to reduce TDG production. This required us to extend the compliance schedule by up to two years and allowed us to modify Alternative 1, which we believe will have the best TDG reduction performance. With this, we have revised the compliance schedule, which still has us completing the project within 10 years (2020) of both Ecology and Federal Energy Regulatory Commission (FERC) approval of the TDG WQAP. We have enclosed the revised compliance schedule for Ecology's approval.

In accordance with the Ecology letter dated February 17, 2012, Avista did not conduct TDG monitoring at its Nine Mile HED during 2012. As indicated in the Ecology Letter, Avista will resume monitoring TDG the first season following the removal of sediment in front of the sediment bypass intake and the replacement of turbine units 1 and 2. This will ensure Nine Mile HED is operating under normal Project operations prior to resuming TDG monitoring.

Section 5.6: Dissolved Oxygen
This is the second annual monitoring report required under the FERC approved Dissolved Oxygen (DO) Feasibility and Implementation Plan. This report illustrates the seasonal changes in DO immediately downstream of the dam during the low flow period of the year and summarizes the use of draft tube aeration to boost DO levels in the river. In addition to the aeration equipment installed on turbine units 3 and 4 during 2011, Avista installed aeration equipment on turbine units 1 and 2 during June of 2012. Besides providing a full season of DO data below the dam, the report details the success of the aeration system. Avista plans to continue with the aeration program in 2013.

With this, Avista is submitting the 2012 Long Lake Total Dissolved Gas Monitoring Report, the Long Lake Hydroelectric Development (HED) Total Dissolved Gas Abatement Phase III Feasibility Study, the Revised Long Lake HED TDG Compliance Schedule, and the 2012 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report for Ecology's review and approval. We would like to receive any comments or recommendations that you may have by March 28, 2013, which will allow us time to file the attachments with FERC by April 15, 2013.

Please feel free to contact me at (509) 495-4998 if you have any questions or wish to discuss the reports. We would also like to meet with you, at your convenience, to discuss our recommendations related to the Phase III Feasibility Study.

Sincerely,

Speed Fitzhugh

Elvin "Speed" Fitzhugh
Spokane River License Manager

Enclosures (4)

cc: Chad Brown, Ecology
Brian Crossley, Spokane Tribe

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
4601 N Monroe Street • Spokane, Washington 99205-1295 • (509)329-3400

March 19, 2013

Mr. Elvin "Speed" Fitzhugh
Spokane River License Manager
Avista Corporation
1411 East Mission Ave., MSC-1
Spokane, WA 99220-3727

RE: Request for Comments – Spokane River Hydroelectric Project No. 2545
2012 Long Lake Dam Total Dissolved Gas Monitoring Report,
Long Lake Hydroelectric Development TDG Abatement Phase III Feasibility Study,
Revised Long Lake HED TDG Compliance Schedule, and 2012 Long Lake HED Tailrace
Dissolved Oxygen Monitoring Report – Washington 401 Certification, Section 5.4(D) and 5.6(B)

Dear Mr. Fitzhugh:

The Department of Ecology (Ecology) has reviewed the following documents emailed to us on February 28, 2013 and would like to provide the comments detailed below:

1. *2012 Long Lake Total Dissolved Gas Monitoring Report, Golder Associates, February 2013*

   We recognize that monitoring difficulties often occur due to power failure and approve the standard operating procedure that has been developed to maintain backup AC power supply to the monitoring station. If difficulties continue to occur due to power loss, another alternative may need to be considered.

   Although the data showed that total dissolved gas (TDG) exceeded the 110% water quality standard in the tailrace for all data 4,159 data pairs, Ecology acknowledges that while you are actively working on your compliance schedule identified in your TDG abatement plan, you are in compliance with your 401 water quality certification.

2. *Long Lake Hydroelectric Development (HED) Total Dissolved Gas Abatement Phase III Feasibility Study, Draft Report, NHC, November 19, 2012*

   In reviewing the feasibility study, the construction costs, geotechnical analysis and estimated TDG performance using Alternative 1, appear to be the best choice. Ecology agrees with Avista's determination that Alternative 1 is the best alternative to mitigate for TDG produced by Long Lake HED.

3. *Revised Long Lake HED TDG Compliance Schedule*

   Prior to completion of the physical model, Ecology was aware that the eight year compliance schedule that was developed in the TDG water quality attainment plan (WQAP) would need to be adjusted to accommodate for the physical model testing and monitoring. The 401 Certification did allow for a 10 year compliance schedule to achieve water quality standards for TDG at Long Lake HED.

Ecology supports the extension of the eight year compliance schedule in the original TDG WQAP to a 10 year compliance schedule. The additional two years will allow for adequate monitoring and adaptive management of the newly engineered deflectors. We fully understand that this lapse in schedule is due to the complex challenges, including but not limited to physical constraints associated with the tailrace, of reducing TDG at Long Lake HED and agree that the additional modeling and/or assessment efforts are appropriate.

We request that the new compliance schedule be added to the future TDG annual reports with a section discussing progress towards meeting the dates within the compliance schedule.

4. *2012 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report*

The data presented in the report were very helpful in portraying the entire picture, especially Table 2-5, *Summary of Exceedances of DO Criterion at LLTR During Generation*. We recommend that you continue to use this reporting format in future annual reports.

We recognize that it is a delicate balancing act maintaining water quality compliance with DO and TDG concentrations with the effects of temperature. Ecology approves the methods used for maximizing your efficiency in maintaining higher DO concentrations and lower TDG concentrations in the Long Lake HED tailrace and look forward to the continued success in refining these methods.

We thank you for the opportunity to comment. Please contact me by phone at (509) 329-3450 or by email at dman461@ecy.wa.gov if you have any further questions.

Sincerely,

D. Marcie Mangold

D. Marcie Mangold
Water Quality Program

DMM:dw
cc: Brian Crossley, Spokane Tribe of Indians
Meghan Lunney, Avista
David Knight, Ecology/WQP

ECOLOGY COMMENTS AND AVISTA RESPONSES

These comments and responses pertain specifically to the 2012 Long Lake Total Dissolved Gas Monitoring Report.

Ecology Comment
Ecology requested that the new compliance schedule be added to future total dissolved gas monitoring reports with a section discussing progress towards meeting the dates within the compliance schedule.

Avista Response
Avista will incorporate the new compliance schedule in all future total dissolved gas monitoring reports for the Long Lake Hydroelectric Development and will also provide a summary of progress made with respect to the compliance schedule.

February 28, 2013

Brian Crossley
Spokane Tribe of Indians
P.O. Box 480
Wellpinit, WA 99040

RE: Federal Energy Regulatory Commission's Spokane River Hydroelectric Project License, Appendix B, Sections 5.4 and 5.6, TDG and DO Reporting Requirements

Dear Mr. Crossley:

Ordering Paragraph E of the Spokane River Hydroelectric Project License (Federal Energy Regulatory Commission Project No. 2545) incorporated the Washington Department of Ecology (Ecology) Certification Conditions under Section 401 of the Federal Clean Water Act Water Quality Certification (Certification) as Appendix B of the License. In accordance with Section 5.4 and Section 5.6 of the Certification, and per the October 2008 Settlement Agreement between Avista and the Tribe, Avista submits the following reports for your review and comment.

Section 5.4: Total Dissolved Gas
There are three components related to Total Dissolved Gas in this filing, which include the following:

1. *2012 Long Lake Total Dissolved Gas Monitoring Report, Golder Associates, February 2013.* As required by the Total Dissolved Gas (TDG) Water Quality Attainment Plan (WQAP) and the Washington TDG Monitoring Plan, this enclosed report provides the results of monitoring TDG at Avista's Long Lake Hydroelectric Development (HED) during 2012. Avista proposes to continue implementing the same monitoring plan at the Long Lake HED in 2013.

2. *Long Lake Hydroelectric Development (HED) Total Dissolved Gas Abatement Phase III Feasibility Study, Draft Report, NHC, November 19, 2012.* The Phase III Feasibility Study documents the progress of building the physical model and hydraulic testing of using deflectors on the modeled Long Lake Dam spillway. Additionally, the Phase III Feasibility Study documents the detailed physical scale modeling of the Long Lake HED and the development and implementation of the various model scenarios that were tested to reduce TDG, based on the findings of Phase II studies. It also includes estimated TDG performance, construction cost estimates, and preliminary geotechnical analysis of the various alternatives that were tested. Specifics related to TDG performance and construction costs are discussed in the Summary and Conclusions section of the Phase III Feasibility Study.

   Based on the results of the study, Avista has determined that the best alternative to mitigate for TDG produced by the Long Lake HED is a modified Alternative 1 (Spill Bay 7-8 Deflectors), that includes substantial rock removal from the rock outcropping below the two spill bays, and additional deflectors on spill bays 3-6. The deflectors will help eliminate the plunging flow that causes the high TDG levels and the rock removal will allow the spill bay 7 and 8 deflectors to develop a skimming flow in the same manner that the deflectors do for spill bays 3-6.

1411 East Mission Avenue
PO Box 3727
Spokane, Washington 99220-3727

800.227.9187
www.avistautilities.com

3. *Revised Long Lake HED TDG Compliance Schedule.* The July 9, 2010 Long Lake Dam TDG WQAP included a compliance schedule to address TDG production at Long Lake Dam. During the modeling process it was determined that additional unplanned alternatives needed to be assessed to thoroughly evaluate their potential to reduce TDG production. This required us to extend the compliance schedule by up to two years and allowed us to modify Alternative 1, which we believe will have the best TDG reduction performance. With this, we have revised the compliance schedule, which still has us completing the project within 10 years (2020) of both Ecology and Federal Energy Regulatory Commission (FERC) approval of the TDG WQAP. We have enclosed the revised compliance schedule for Ecology's approval.

In accordance with the Ecology letter dated February 17, 2012, Avista did not conduct TDG monitoring at its Nine Mile HED during 2012. As indicated in the Ecology Letter, Avista will resume monitoring TDG the first season following the removal of sediment in front of the sediment bypass intake and the replacement of turbine units 1 and 2. This will ensure Nine Mile HED is operating under normal Project operations prior to resuming TDG monitoring.

Section 5.6: Dissolved Oxygen

This is the second annual monitoring report required under the FERC approved Dissolved Oxygen (DO) Feasibility and Implementation Plan. This report illustrates the seasonal changes in DO immediately downstream of the dam during the low flow period of the year and summarizes the use of draft tube aeration to boost DO levels in the river. In addition to the aeration equipment installed on turbine units 3 and 4 during 2011, Avista installed aeration equipment on turbine units 1 and 2 during June of 2012. Besides providing a full season of DO data below the dam, the report details the success of the aeration system. Avista plans to continue with the aeration program in 2013.

With this, Avista is submitting the 2012 Long Lake Total Dissolved Gas Monitoring Report, the Long Lake Hydroelectric Development (HED) Total Dissolved Gas Abatement Phase III Feasibility Study, the Revised Long Lake HED TDG Compliance Schedule, and the 2012 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report for your review. We would like to receive any comments that you may have by March 28, 2013, which will allow us time to file the attachments with FERC by April 15, 2013.

Please feel free to contact me at (509) 495-4998 if you have any questions or wish to discuss the reports. We would also like to meet with you, at your convenience, to discuss our recommendations related to the Phase III Feasibility Study.

Sincerely,

Speed Fitzhugh

Elvin "Speed" Fitzhugh
Spokane River License Manager

Enclosures (4)

cc: Marcie Mangold, Ecology

Lunney, Meghan

From: Brian Crossley [crossley@SpokaneTribe.com]
Sent: Tuesday, April 09, 2013 12:44 PM
To: Lunney, Meghan
Cc: Casey Flanagan
Subject: RE: 2012 Long Lake HED Temperature Monitoring Report

Casey Flanagan and I have reviewed the annual monitoring reports for TDG, Temperature and TDG-sorry about the delay. A couple of comments: Casey did notice better dissolved oxygen in our water quality data collected down at the Bible Camp. There appears to be some attenuation of dissolved oxygen even when the turbines are not turning. The only other item concerning temperature is if you have given thought to whether there is an increase in temperature from aerating by the draft tube method and if so; could that be reduced by providing a cooler air source?

We did notice that for TDG; sampling started on April 20th when TDG was already above 110%; any reason for this? I also noticed on Figure 2-4 (TDG report) that there are several 3% drops in LLGEN TDG and did not see a reason for these drops other than they were right before the data didn't meet DQO's.

From: Lunney, Meghan [Meghan.Lunney@avistacorp.com]
Sent: Thursday, February 28, 2013 1:10 PM
To: Brian Crossley
Cc: Mangold, Marcie (ECY); Fitzhugh, Speed (Elvin); Goloborodko, Yelena
Subject: 2012 Long Lake HED Temperature Monitoring Report

Brian,
Attached is the 2012 Long Lake HED Temperature Monitoring Report (Temperature Monitoring Report) which was completed in accordance with the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan, required by the Spokane River Hydroelectric Project License (License) Appendix B, Section 5.5.B of the Washington Department of Ecology Section 401 Water Quality Certification.

Per the October 2008 Settlement Agreement between Avista and the Spokane Tribe, we request your review and comment by **March 28, 2013**. This will allow us time to incorporate your comments and recommendations as appropriate, and submit the Temperature Monitoring Report to FERC by **April 15, 2013**. In addition to this e-mail, I am also mailing you a hard copy.

Please give me a call at 509-495-4643 if you have any questions.

Thanks!

Meghan Lunney
Aquatic Resource Specialist
Avista Utilities
(509) 495-4643

SPOKANE TRIBE COMMENTS AND AVISTA RESPONSES

These following comments and responses pertain specifically to the 2012 Long Lake Total Dissolved Gas Monitoring Report.

Spokane Tribe Comment
The Spokane Tribe commented that they noticed TDG sampling started on April 20th when TDG was already above 110%, and asked if there was any reason for this.

Avista Response
On April 20, 2012 flows were at 22,104 cubic feet per second (cfs) which is 10,000 cfs lower than the 7Q10 flows (32,000 cfs) for the Long Lake HED. Avista deployed the TDG monitoring equipment on April 20th to assess TDG levels at flows which were well below the 7Q10 flows. Following April 20th, Avista continued the TDG monitoring through the remainder of the spill season, which included the 7Q10 flows, in accordance with the 401 Certification and license.

Spokane Tribe Comment
The Spokane Tribe noticed on Figure 2-4 (TDG report) that there are several 3% drops in LLGEN TDG and did not see a reason for these drops other than they were right before the data didn't meet DQO's.

Avista Response:
The drop in the LLGEN TDG data was due to our MS5 backup AC power supply dropping off line. As indicated in Section 2.3.5 of the report, we plan to minimize the reoccurrence of a similar event. To do so, Avista has implemented a Standard Operating Procedure to maintain backup AC power supplies to the monitoring equipment, including the LLGEN station.

Lunney, Meghan

From: Fitzhugh, Speed (Elvin)
Sent: Tuesday, April 09, 2013 12:37 PM
To: Brian Crossley
Cc: Billy Joe Kieffer; Ted Knight; Lunney, Meghan
Subject: RE: Long Lake TDG abatement

Brian,
Thank you your review and comment that Modified Alternative 1, the one with the two lips that you are referring to, will provide us with operational flexibility to reduce TDG produced by the dam.
Thanks again for your help, we greatly appreciate it.
Speed

From: Brian Crossley [mailto:crossley@SpokaneTribe.com]
Sent: Tuesday, April 09, 2013 12:30 PM
To: Fitzhugh, Speed (Elvin)
Cc: Billy Joe Kieffer; Ted Knight
Subject: Long Lake TDG abatement

Speed, I appreciate Avista including the Tribe in its review of the alternatives and modeling of TDG abatement at Long Lake Dam. I feel that Avista has included numerous alternatives in its modeling to the extent that an extended modeling duration was needed. This increased effort to look at various alternatives not in the original plans necessitates moving the construction and completion timeline as well. After reviewing the various alternatives and viewing the physical model I feel that constructing 2 lips on the spillway will give Avista operational flexibility in reducing TDG production.

Brian Crossley
Water & Fish Program Manager
STI Dept of Natural Resources