AVISTA CORPORATION

2016

LONG LAKE HED

TEMPERATURE MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.5

Spokane River Hydroelectric Project
FERC Project No. 2545

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List of Acronyms and Abbreviations

7-DADM	7-day average daily maximum temperature
°C	degrees Celsius
°C/m	degrees Celsius per meter
Avista	Avista Corporation
Certification	Section 401 water quality certification
DNR	Washington State Department of Natural Resources
DO	dissolved oxygen
Ecology	Washington State Department of Ecology
DO WQAP	Dissolved Oxygen Water Quality Attainment Plan
FERC	Federal Energy Regulatory Commission
Golder	Golder Associates Inc.
HED	hydroelectric development
LLFB	Long Lake Forebay monitoring station
LLTR	Long Lake HED tailwater monitoring station
m	meter(s)
MS5	Hydrolab® MS5 Multiprobe®
Project	Spokane River Project
QAPP	Quality Assurance Project Plan
RM	River mile
SCCD	Stevens County Conservation District
Spokane Tribe	Spokane Tribe of Indians
TDG	total dissolved gas
Temperature WQAP	Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area
WQM QAPP	Water Quality Monitoring and Quality Assurance Project Plan

1.0 INTRODUCTION

On June 18, 2009, the Federal Energy Regulatory Commission (FERC) issued a new license for the Spokane River Project (Project), FERC Project No. 2545 (FERC 2009a), which incorporated the Washington Department of Ecology (Ecology) Section 401 Water Quality Certification (Certification; Ecology 2009). In accordance with Section 5.10 and 5.5 of the Certification, Avista Corporation (Avista) developed the Water Quality Monitoring and Quality Assurance Project Plan (WQM QAPP; Avista 2009) and the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan (Temperature WQAP; Avista 2011) in consultation with Ecology and the Spokane Tribe of Indians (Spokane Tribe). Avista filed the Ecology-approved WQM QAPP with FERC on August 13, 2009 and FERC approved it with modification on September 17, 2009 (FERC 2009b). Avista filed the Ecology-approved Temperature WQAP with FERC on January 26, 2011. On May 10, 2011, FERC (2011) issued an order approving and amending the 2009 WQM QAPP, pursuant to Article 401(A)(12) of the license.

As part of the Temperature WQAP, Avista is required to provide an annual summary report of the available temperature water quality monitoring results to Ecology by March 1 on an annual basis. Previous reports summarized Long Lake Hydroelectric Development (HED) temperature data collected in 2010 and 2011 (Golder 2012), in 2012 (Golder 2013), in 2013 (Golder 2014), in 2014 (Golder 2015), and in 2015 (Golder and Mattax Solutions 2016). This report summarizes temperature monitoring conducted for Long Lake HED during the 2016 calendar year.

2.0 MONITORING ACTIVITIES

2.1 Objectives

The overall objectives of the Temperature WQAP Monitoring Report are to:

- Document monitoring periods
- Summarize temperature monitoring results
- Document compliance with the applicable water quality standards
- Describe any proposed changes to the Temperature WQAP and WQM QAPP

In addition to the above objectives we have included information pertaining to the Spokane Tribe's water quality standards in regards to waters downstream of the Project.

2.2 Monitoring Locations and Periods

Water temperature data that are included in annual summary reports are from a number of water quality monitoring programs as described in the Temperature WQAP (Avista 2011). This report presents temperatures obtained as a component of monitoring programs focused on Spokane River water quality

(Ecology 2017a, 2017b), Lake Spokane water quality (Ecology 2017c), and Long Lake HED tailwater dissolved oxygen (Golder and Mattax Solutions 2017). Additional temperature data related to studies outside the scope of the Temperature WQAP are available upon request.

2.2.1 Lake Spokane

Temperature monitoring was conducted at two river stations upstream of Lake Spokane (inflow stations) and six stations within Lake Spokane (Table 2-1 and Figure 2-1).[1] These monitoring efforts are described in more detail below.

2.2.1.1 Inflow Stations

Ecology has monitored temperature along with other water quality parameters in the Spokane River and Little Spokane River a short distance upstream of its confluence with Lake Spokane. This was done under Ecology's River and Stream Water Quality Ambient Monitoring Program, which monitors by water year.[2] Ecology's sampling effort at these two stations was conducted in accordance with the Stream Ambient Monitoring QAPP (Ecology 2003). Preliminary data for the Spokane River at Nine Mile Bridge station (54A090) and Little Spokane River near Mouth station (55B070) located on the Little Spokane River at River Mile (RM) 1.1 were accessed on January 17, 2017.

2.2.1.2 Within Lake Spokane

In 2016, Avista monitored temperature and other water quality parameters through implementation of the Lake Spokane nutrient monitoring program, which it had collaboratively implemented with Ecology in 2010 and 2011, and solely implemented since 2012. This monitoring program included one sampling event in May and October, and two sampling events per month, in June through September, in order to provide baseline data. All sampling was completed in accordance with the Ecology-approved QAPP for Lake Spokane Nutrient Monitoring.[3] Sampling was conducted at the six Lake Spokane monitoring stations described in Table 2-1 and from upstream to downstream are:

- LL5, at approximately RM 54.20
- LL4, at approximately RM 51.47
- LL3, at approximately RM 46.42
- LL2, at approximately RM 42.06
- LL1, at approximately RM 37.62

[1] No measurements were made at the forebay just above Long Lake Dam (LLFB) during 2016.
[2] The "water year" is defined as the 12-month period from October 1 to September 30 of the following year.
[3] The current QAPP (Ecology 2010) as supplemented by its addendum (Lunney and Plotnikoff 2012), which was approved by Ecology on July 16, 2012 (Ross 2012).

- LL0, at approximately RM 32.66

2.2.2 Long Lake Dam Tailrace

Avista monitored temperature at the Long Lake Dam (LLTR), a station located 0.6 mile downstream of Long Lake Dam. All monitoring, including quality control protocols, was conducted in accordance with Avista's Detailed Dissolved Oxygen (DO) Phase II Feasibility and Implementation Plan (Avista 2010). Under this program, water temperature, total dissolved gas (TDG), and DO concentrations were monitored with Hydrolab® MS5 Multiprobe® (MS5) instruments.

In the past, Ecology has conducted monitoring at Station 54A070, which is located below Long Lake Dam. Ecology ceased monitoring at this station in 2010, and hence no new temperature data were available when Ecology's database was accessed on January 17, 2017 (Ecology 2017d, 2017e).

2.3 Temperature Numeric Criteria

The Washington state numeric temperature criterion that applies to Lake Spokane and the Long Lake HED tailrace (WAC 173-201A-602, WRIA 54 Notes 1, 2, and 3) limits 1-day maximum temperature to no more than 20.0 degrees Celsius (°C) due to human activities. In addition, water temperature shall not be increased by greater than 0.3°C when natural conditions exceed 20.0°C.

The numeric temperature criteria for the Spokane Tribe, whose reservation is located downstream of the Project, are applicable from the upstream Spokane Indian Reservation boundary (approximately RM 32.7) to the mouth of the Spokane River (RM 0). For reference, the upstream boundary of the Spokane Indian Reservation is located approximately 1.2 miles downstream of Long Lake Dam and approximately 0.6 miles downstream of the Avista and Ecology monitoring stations located below the dam. The Spokane River temperature criteria are the Class A 7-day average daily maximum temperature (7-DADM) criteria. The 7-DADM is calculated as the arithmetic average of seven consecutive measures of daily maximum temperatures, with the 7-DADM for any individual day calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days before and the three days after that date. The maximum allowable limit (7-DADM) for the Spokane River varies throughout the year as described below (Spokane Tribe 2003).

- 18.5°C between June 1 and August 31
- 13.5°C between September 1 and September 30
- 11°C between October 1 and March 31
- 13.5°C between April 1 and May 31

3.0 RESULTS

Results of the 2016 temperature monitoring are discussed by monitoring location, along with a comparison to the 20.0°C Washington State water quality criterion.

In addition, the discussion in Section 5.0 presents a comparison of the temperature results for the monitoring location below Long Lake Dam with the corresponding Spokane Tribe water quality criteria.

3.1.1 Lake Spokane

Lake Spokane water temperature was monitored at eight locations: Ecology's Spokane River at Nine Mile Bridge station (54A090), Ecology's Little Spokane River station (55B070), and Avista's LL5, LL4, LL3, LL2, LL1, and LL0 stations.

3.1.1.1 Inflow Stations

Ecology's Spokane River at Nine Mile Bridge station (54A090) was monitored monthly from January through September. Reported water temperatures for this timeframe ranged from 4.6°C in February to 18.5°C in June (Table 3-1). All monitored water temperatures were less than the 20.0°C Washington State criterion.

Ecology's Little Spokane River station, 55B070, was monitored monthly from January through November. Water temperatures during this timeframe ranged from 5.1°C in February to 17.5°C in June (Table 3-2). All monitored water temperatures were less than the 20.0°C Washington State criterion.

3.1.1.2 Within Lake Spokane

Vertical profiles of water temperatures were monitored at the six Lake Spokane sampling stations in 2016. The 2016 monitoring frequency was once in May; twice in the months of June, July, August, and September; and once in October. Results for each of the six lake stations are described below in order from upstream to downstream.

LL5

LL5 water temperature measurements were conducted near the surface at 0.5 meter (m), and at 1-m intervals from 1 to 5 m below the water surface. Temperature varied more than 1.0°C throughout the water column for four of the ten vertical profiles measured in 2016, and thermal stratification, as defined by greater than 1.0 °C/m, occurred on July 20 through September 7 (Table 3-3). The results indicate the thermocline was at a depth of 0.75 m on July 20, and was at 1.5 m between August 11 and September 7 (Table 3-3).[4]

[4] Thermocline depths are presented as the mid-point between depths of temperature measurements with the greatest change in temperature per meter that exceeds 1.0 °C/m.

Five LL5 temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 21.9°C on August 25. The high temperatures occurred only in the near surface water at 0.5 m on July 20, and down to 1 m on August 11 and August 25 (Table 3-3).

LL4

LL4 temperature measurements were taken at 0.5 m and at 1-m intervals from 1 m below the water surface to within 1 m of the bottom. The maximum temperature change rate was greater than 1.0 °C/m for the vertical temperature profiles from June 22 through September 20 (Table 3-4), but had virtually no stratification in May, early June, or October. These results indicate the thermocline was at 2.5 m on June 22, and between 4.5 m and 5.5 m in early July through late September. Twenty-two of the temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 22.4°C on July 20. The high temperatures occurred down to 3 m on July 6, and down to 5 m on July 20 through August 25 (Table 3-4).

LL3

LL3 temperature measurements were taken at 0.5 m, at 1-m intervals from 1 m to 10 m, at 3-m intervals from 12 m to 18 m, and within 1 m of the bottom. Vertical temperature profiles for June 8, and July 6 through August 25 had maximum temperature change rates greater than 1.0 °C/m, and May 18 had a maximum temperature change rate of 1.0 °C/m. All remaining periods had temperature change rates less than 1.0 °C/m (Table 3-5). The thermocline depth ranged from 4.5 m in early June, to 8.5 m in late July and late August. Forty-three of the temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 22.6°C on August 11. The high temperatures occurred down to 4 m on June 8, 6 m on July 6 and September 7, and 7 m on the July 20 through August 25 (Table 3-5).

LL2

LL2 temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, 3-m intervals from 12 m to 24 m, and within 1 m of the bottom. Vertical temperature profiles had maximum temperature change rates greater than 1.0 °C/m on June 7, and between July 5 and August 24 (Table 3-6). The maximum temperature change rate was 1.0 °C/m on September 6, and was less than 1.0 °C/m for all remaining profiles. The thermocline was at a depth of 2.5 m on June 7, 8.5 m on July 5, and remained at 6.5 to 7.5 m from July 19 to August 24. Forty-three temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 22.8°C on August 10. The high temperatures occurred down to 2 m on June 7, and to 8 m on July 5. Depths for the other greater than 20.0°C measurements were down to 6 m on August 10; and down to 7 m on July 19, August 24 and September 6 (Table 3-6).

LL1

LL1 temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, 3-m intervals from 12 m to 30 m, and within 1 m of the bottom. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for June 7, and July 19 through August 24, and a temperature change rate of 1.0 °C/m occurred on September 6 (Table 3-7). The thermocline depth was 2.5 m on June 7, 6.5 m in late July and early August, and extended to a depth of 7.5 m in late August. Thirty-four temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 23.4°C on June 7. The high temperatures occurred down to 2 m on June 7; down to 6 m on July 19; and down to 7 m on July 5, August 10, and August 24 (Table 3-7).

LL0

LL0 temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, and at 3-m intervals from 12 m to 45 m, and within 1 m of the bottom. Only three of the LL0 vertical temperature profiles had maximum temperature change rates greater than 1.0 °C/m indicating thermal stratification was less persistent at LL0 than the other five lake monitoring stations. Twenty-five temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 22.5°C on August 10. The high temperatures occurred down to 1 m on June 7, down to 5 m on July 19, down to 7 m on August 10, and down to 8 m on August 24 (Table 3-8).

Lake Station Temperature Profile Comparisons

Comparison of the 2016 temperature profiles for the six sampling stations during late June, July, August, and September are displayed in Figures 3-1 through 3-4, respectively. The maximum monthly temperatures reached 23.4°C in early June, 22.4°C in late July, 22.8°C in early August, and 20.2°C in early September. In late June, very similar thermal stratification occurred at the three down-reservoir stations (LL2, LL1, and LL0), and water was approximately 1°C warmer in the uppermost 7 m at LL3, and 1 m at LL4 (Figure 3-1). Late June inflow (LL5) temperatures were approximately 16°C, which was substantially cooler than the other sites. By late July, thermal stratification was well established and the epilmnion had temperatures reaching between 20.5°C and 22.4°C at the five down-reservoir stations (i.e., LL4-LL0), while the reservoir's riverine zone (LL5) temperature only exceeded 20.0°C at a depth of 0.5 m (Figure 3-2). In late August, all stations still exceeded 20.0°C in the epilimnion (Figure 3-3). By late September, cooling had occurred in the epilimnion, and none of the six stations were greater than 20.0°C (Figure 3-4). In addition, cooling had occurred throughout the rest of the reservoir's upper 30 m of the water column.

3.1.2 Long Lake Dam Tailrace

Long Lake Dam tailrace (LLTR) water temperature data were collected in 15-minute intervals from July 1 through October 31 as part of the Detailed DO Phase II Feasibility and Implementation Plan (Figure 3-5). Daily maximum water temperatures ranged from 12.1°C on October 31 to 20.3°C on August 19 (Table 3-9). Temperatures of greater than the 20.0°C Washington State criterion occurred on two days, August 5 and 19.

Data for Ecology's Spokane River at Long Lake station (54A070) were not collected during 2016.

4.0 SCHEDULE

Avista has prepared, obtained approval for, and implemented the Temperature WQAP and WQM QAPP, as well as other plans to address Lake Spokane temperatures, nutrients, and DO. Avista will continue to coordinate implementation of measures to improve water quality with the ultimate goal of meeting the water quality standard which consists of a numeric and narrative component. The list below summarizes plans that are currently being implemented along with Avista's planned actions towards this goal.

- **WQM QAPP** - Prepared WQM QAPP (Avista 2009) in consultation with Ecology and the Spokane Tribe. Approval of this plan was obtained from Ecology on August 13, 2009 and from FERC with modifications on September 17, 2009 (FERC 2009b).
- **Temperature WQAP** - Prepared the Temperature WQAP (Avista 2011) in consultation with Ecology and the Spokane Tribe. Approval of this plan was obtained from Ecology on January 25, 2011 and from FERC (2011) on May 10, 2011 in an order approving and amending the 2009 WQM QAPP, pursuant to Article 401(A)(12). Avista will continue to provide annual reports summarizing water temperature data for the Long Lake HED in accordance to the approved Temperature WQAP and WQ QAPP and WQM QAPP.
- **Lake Spokane DO WQAP** – Avista prepared the Lake Spokane DO WQAP (Avista and Golder 2012), which discussed nine feasible potential measures to improve DO conditions. Upon receiving FERC approval (December 19, 2012), Avista began implementing the DO WQAP and has submitted Annual Reports for the work completed in 2013 through 2015 (Avista 2014, 2015, and 2016) and a Five Year Summary Report (Avista 2017). In accordance with the DO WQAP, following completion of the 2016 nutrient monitoring season, Avista and Ecology evaluated the results and success of monitoring baseline nutrient conditions in Lake Spokane. In order to gain a better understanding of core summer salmonid habitat in Lake Spokane, Avista proposes to modify the 2017 and 2018 sampling program as identified in the Lake Spokane DO WQAP Five Year Report.

  The Annual and Five Year Reports provide a summary of the baseline monitoring, implementation activities, effectiveness of the implementation activities, and proposed actions of the upcoming year. The implementation activities are summarized as follows, and with the exception of the native tree plantings on Avista's shoreline property, goals for these potential reasonable and feasible measures are primarily related to improving DO in the lake.

- **Cold Water Fish Habitat Evaluation** – As a continuation of the 2013 efforts, Avista continued to evaluate cold water fish habitat in Lake Spokane. Preliminary analysis suggests that rainbow trout are likely inhabiting cooler water in the metalimnion and upper portions of the hypolimnion. In addition, the habitat volumes for temperature and DO together, as well as separately, suggest that temperature is restricting habitat more than DO.

  As discussed in the Lake Spokane DO WQAP Five Year Report (Section 2.3, Monitoring Recommendations), Avista plans to initiate a multi-year fish population and habitat assessment for rainbow trout in Lake Spokane in 2017.

- **Native Tree Plantings on Avista Shoreline Property** - Avista and the Stevens County Conservation District planted 13,625 ponderosa pines along Lake Spokane's northern shoreline on Avista-owned property in April 2016. The trees were planted along a very steep slope and once mature, the trees will help reduce localized water temperature and are expected to help stabilize and enhance shoreline habitat.

- **Hangman Creek Basin Shoreline Stabilization and Agricultural Practices** - Avista continues to track plans and progress addressing erosion control in the Hangman Creek Basin by participating in meetings, including the Spokane Conservation District's Hangman Creek Bi-State Watershed Project and Ecology's Spokane River and Lake Spokane DO TMDL Advisory Committee meetings.

- **Upper Hangman Creek Wetland Restoration -** Avista and the Coeur d'Alene Tribe have acquired approximately 656 acres of farmland with straightened creek beds on upper Hangman Creek through implementation of one of Avista's Spokane River License Wetland Mitigation requirements. Site-specific wetland management plans are updated annually for these properties and include establishing long-term, self-sustaining native emergent, scrub-shrub and/or forested wetlands, riparian habitat and associated uplands, through preservation, restoration and enhancement activities. Since 2013, approximately 8,000 native trees and shrubs have been planted on approximately 500 of the 656 acres.

- **Wetland Restoration/Enhancement** - Avista acquired a 109-acre parcel on the Little Spokane River, the Sacheen Springs property, to fulfill its 42.51-acre wetland mitigation requirement identified in Section 5.3.G of the Certification. This property includes over one-half mile of frontage along the West Branch of the Little Spokane River and contains a highly valuable wetland complex with approximately 59 acres of emergent, scrub-shrub and forested wetlands and approximately 50 acres of adjacent upland forested buffer. Several seeps, springs, perennial and annual creeks are also found on the property. The property was purchased "in fee" and Avista will pursue a conservation easement in order to protect the property in perpetuity. Avista completed a detailed site-specific wetland management plan and began implementing it upon its approval by Ecology and FERC in 2014. In 2014, 2015, and 2016 herbicide application was completed to control terrestrial invasive weeds, and to improve the overall biodiversity and function of the wetland complex.

- **Little Spokane Wetland & Shoreline Restoration** - As part of Nine Mile HED's Rehabilitation Program, Avista partnered with the Washington State Parks and Recreation Commission to complete a wetland and shoreline restoration project on four acres within the Little Spokane Natural Area Preserve. The Natural Area Preserve is a popular location for recreation; however, two invasive weed species (yellow flag iris and purple loosestrife) have severely impacted large sections of the river and adjacent shoreline. The mitigation project included herbicide treatments, large woody debris placement, and planting of 400 trees and shrubs (black cottonwoods, quaking aspens, chokecherry and red osier dogwood). Avista will continue to monitor the wetland and shoreline restoration project in 2017 and will implement measures necessary to ensure its continued success.

- **Floating Treatment Wetland** - Avista worked with the Stevens County Conservation District (SCCD) to cost share the installation of a floating treatment wetland in Lake Spokane. The goals for the floating treatment wetland were wave attenuation outside a community swim area along with potential TP removal. Unfortunately, the Homeowner Association declined to participate in the project following the SCCD's award for the grant. The SCCD and Avista subsequently found a new potential location for the floating treatment wetland in the downstream portion of Lake Spokane adjacent to Avista owned shoreline and plan to move ahead with the permitting process.

- **Land Protection** - Avista has identified approximately 215 acres of land that is currently used for grazing under lease from the Washington State Department of Natural Resources (DNR). This land is located within the south half of Section 16 in Township 27 North, Range 40 East in Stevens County. Avista and State Parks are pursuing a lease for the 215 acres from DNR with the intent of changing the land use.

  In addition, Avista owns more than 1,000 acres of land, of which 350 acres are located within 200 feet of the Lake Spokane shoreline at the downstream end of the reservoir. During 2016 Avista continued to protect these lands, which also serve as a buffer adjacent to other undeveloped Avista land.

- **Bulkhead Removal** - During 2012, Avista partnered with Ecology, the Spokane County Conservation District, and the Stevens County Conservation District through an Ecology grant to identify two to five homeowners and encourage them to convert their bulkheads to more naturalized shorelines. Progress to date includes the removal of an approximate 90-foot-long bulkhead located at the Staggs parcel in Spokane County and replacement of the bulkhead with a more naturalized shoreline[5].

  During 2016, Avista continued to work with the SCCD to plan and permit a design for an additional bulkhead removal project on an Avista-owned shoreline parcel located in TumTum. The project would consist of replacing an approximate 90-foot-long bulkhead with native rocks and vegetation to provide a more naturalized shoreline. The final permit required for this project was issued in December 2016. Given the project has to take place when the lake is drawndown, we anticipate this project will be conducted during the winter of 2017-2018.

- **Carp Population Reduction Program** – During 2016, Avista planned to assess the effectiveness of electrofishing and using gill nets to capture carp during spring spawning when they are concentrated in shallow areas. This effort was a cooperative project between Avista, WDFW, and the Idaho Cooperative Fishery Research Unit and was to take place over a two-week timeframe. Implementation of the project was initiated on June 13; however, the warmer than normal temperatures experienced during the spring of 2016 combined with a lack of significant runoff triggered carp spawning earlier than has been historically observed. In addition, these weather conditions led to earlier excessive aquatic weed growth than in a normal growth season. As a result of these conditions, Avista and its partners were unable to remove carp as planned.

  In 2017, Avista plans to assess the effectiveness of using gill nets during the winter to remove carp from the vicinity of the Sportsman's Paradise area of Lake Spokane, and utilize electrofishing and gill nets to remove carp during spring spawning when they are

[5] A time-lapse video produced by the Staggs features the bulkhead removal project is available for viewing at the following website: http://www.youtube.com/watch?v=luT0RZShJoY.

concentrated in shallow areas. Avista is also considering exploring the effectiveness of carp removal through archery. Avista is coordinating these efforts with WDFW and has obtained a scientific collection permit to implement these activities.

- **Long Lake HED Turbine Aeration and Tailrace DO Monitoring** – Avista will continue to refine implementation of turbine aeration that was initiated in 2010, based on real-time water quality measurements that are monitored 0.6 miles downstream of Long Lake Dam from July 1 through October 30. Avista also will continue to coordinate results with the DO TMDL efforts, and evaluate the need for additional DO enhancement measures in accordance with the FERC-approved schedule (FERC 2010).
- **Long Lake Dam Spillway Modification Project for TDG Abatement and Monitoring** – Avista completed construction of the spillway modifications for the Long Lake Dam TDG project in December 2016. The performance of the structural modifications will be tested and a new spillgate protocol will be developed in 2017 and 2018. In 2017 through 2018, Avista will also conduct monitoring to confirm the effectiveness of the spillway modifications and spillgate operations and prepare annual monitoring reports.

5.0 DISCUSSION

5.1 Lake Spokane

Temperature profile monitoring conducted during 2016 indicated that the 20.0°C Washington State criterion was exceeded within Lake Spokane during June, July, August, and September. The maximum temperature recorded at the lake sites was 23.4°C in June, 22.8°C in August, 22.4°C in July, and 20.2°C in September. Exceedances of 20.0°C occurred at all six lake stations in July and August, four stations in June, and two stations in September. Exceedances of 20.0°C within the lake occurred to depths of 8 m in July and August, 7 m in September, and 4 m in June. Measurements at both the Spokane River at Nine Mile Bridge station and Little Spokane River station did not exceed the 20.0°C criterion.

The exceedances reported for Lake Spokane during 2016 are indicative of the natural stratification process typical of eastern Washington and northern Idaho lakes during the summer season. Avista, however, is continuing to pursue reasonable and feasible mitigation measures in accordance with its Ecology-approved Temperature WQAP and Lake Spokane DO WQAP that may have positive localized effects on temperature within the lake.

5.2 Long Lake Dam Tailrace

During 2016, temperature measurements at the Avista monitoring station LLTR, located downstream of the Long Lake Dam, exceeded the 20.0°C Washington State criterion on two days in August (Table 3-9). The maximum of these temperatures was 20.3°C, which occurred on August 19.

Monitoring results indicate that except for two days at the end of August, the Spokane Tribe's 7-DADM criteria established for tribal waters were exceeded July 19 through October 28 (Table 5-1, Figure 5-1). It is important to note the LLTR monitoring station from which 2016 temperature data were collected is located approximately 0.6 miles upstream from the reservation boundary where the Tribe's criteria is applicable.

As part of a non-License Agreement, Avista provides the Spokane Tribe with funds to complete water quality improvements to help address temperature exceedances along with other water quality improvement needs downstream of the Project. To date, the Spokane Tribe has planted trees and completed stream stabilization efforts in the Chamokane Creek watershed to reduce surface water temperatures. Avista and the Spokane Tribe will continue working together in the future to improve water quality within the reservation. These projects relate to DO, TDG, and temperature within the reservation.

6.0 PROPOSED CHANGES TO THE TEMPERATURE WQAP AND WQM QAPP

6.1 Spring Season Monitoring

Given completion of the Long Lake Dam Spillway Modification construction in 2016, Avista plans to monitor TDG at LLTR and LLGEN during the high-flow season (typically March/April through June) in 2017 and 2018.

6.2 Summer Season, Tailrace Monitoring

As approved by Ecology in 2015, Avista will monitor summer critical season water quality at the LLTR station, but not at LLFB because the complex hydraulic dynamics near the forebay intake cause substantial temperature variability near the dam over short timeperiods. These conditions result in LLFB measurements that are much less consistent and reliable than those at LL0.

6.3 Summer Season, Lake Spokane Monitoring

In accordance with the DO WQAP, following completion of the 2016 nutrient monitoring season, Avista and Ecology evaluated the results and success of monitoring baseline nutrient conditions in Lake Spokane. In order to gain a better understanding of core summer salmonid habitat in Lake Spokane, Avista proposed to modify the 2017 and 2018 sampling program. This modification's effect on temperature data would result in data collection from the six lake sites along with additional sites at the same frequency as in 2016. We anticipate the results of this monitoring will be incorporated into the CE-QUAL-W2 model as a means to extrapolate the point data to characterize the entire reservoir.

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TABLES

Table 2-1: Long Lake HED Temperature Monitoring Stations and Periods

Monitoring Station	Location	NAD83 Decimal Degrees		2016 Monitoring Year	
		Latitude	Longitude	Start	End
54A090	Spokane River at Nine mile Bridge approximately 0.2 miles downstream of Nine Mile Dam, at river mile (RM) 58	47.7767	117.5448	1/5/2016	9/13/2016
55B070	On the Little Spokane River approximately 1.5 miles upstream from its confluence with Lake Spokane, at RM 1.1	47.7829	117.5305	1/5/2016	11/15/2016
LL5	Long Lake sampling site 5, at RM 54.20	47.7985	117.5692	5/18/2016	10/13/2016
LL4	Long Lake sampling site 4, at RM 51.47	47.8137	117.6106	5/18/2016	10/13/2016
LL3	Long Lake sampling site 3, at RM 46.42	47.8641	117.6668	5/18/2016	10/13/2016
LL2	Long Lake sampling site 2, at RM 42.06	47.8636	117.7014	5/17/2016	10/12/2016
LL1	Long Lake sampling site 1, at RM 37.62	47.8305	117.7612	5/17/2016	10/12/2016
LL0	Long Lake sampling site 0, at RM 32.66	47.8339	117.8349	5/17/2016	10/12/2016
LLFB	Long Lake Forebay between Unit 3 and 4 intakes.	47.8367	117.8397	Not Available	
LLTR	On left downstream bank, at water pump house approximately 0.6 mile downstream from Long Lake Dam.	47.8375	117.8503	7/1/2016	10/31/2016
54A070	Approximately 0.6 mile downstream of Long Lake Dam, at the Highway 231 Bridge and RM 33.3.	47.8391	117.8525	Not Available	

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Table 3-1: Spokane River at Nine Mile Bridge (54A090) Temperature Monitored in 2016

Date	Maximum Daily Water Temperature (°C)
1/5/16 15:00	4.9
2/2/16 14:25	4.6
3/8/16 14:15	5.2
4/5/16 13:55	7.3
5/3/16 13:50	15.6
6/7/16 14:50	18.5
7/19/16 16:02	16.3
8/9/16 15:50	15.2
9/13/16 15:00	13.8

Notes:

On January 17, 2017, accessed preliminary data from Ecology's website: https://fortress.wa.gov/ecy/eap/riverwq/station.asp?theyear=&tab=prelim_data&scrolly=559&wria=54&sta=54A090&docextension=.xls&docextension=.xls

The 20.0°C criterion was not exceeded at this monitoring location in 2016.

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Table 3-2: Little Spokane River Upstream of Lake Spokane (55B070) Temperature Monitored in 2016

Date	Maximum Daily Water Temperature (°C)
1/5/16 14:25	5.7
2/2/16 13:50	5.1
3/8/16 13:45	7.2
4/5/16 14:25	10.3
5/3/16 13:23	14.4
6/7/16 14:20	17.5
7/19/16 15:32	14.0
8/9/16 15:00	13.5
9/13/16 14:20	12.1
10/4/16 14:55	10.3
11/15/16 14:00	9.8

Notes:

On January 17, 2016, accessed preliminary data from Ecology's website: https://fortress.wa.gov/ecy/eap/riverwq/station.asp?theyear=&tab=prelim_data&scrolly=undefined&wria=55&sta=first

The 20.0°C criterion was not exceeded at this monitoring location in 2016.

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Table 3-3: LL5 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/18/2016	6/8/2016	6/22/2016	7/6/2016	7/20/2016	8/11/2016	8/25/2016	9/7/2016	9/20/2016	10/13/2016
0.5	14.9	18.2	16.1	17.1	**20.8**	**21.7**	**21.9**	17.6	13.5	11.5
1.0	14.8	18.1	15.9	16.9	19.4	**21.2**	**21.4**	17.3	13.5	11.5
2.0	14.8	18.1	15.8	16.8	16.6	17.0	17.5	13.7	13.4	11.5
3.0	14.8	18.0	15.8	16.8	16.5	15.3	15.8	13.4	13.4	11.4
4.0	14.8	18.0	15.7	16.8	16.5	15.4	15.7	13.4	13.4	11.4
5.0	14.8	18.0	15.8	16.8	16.5	15.3	15.6	13.4	13.4	
Max Change (°C/m)[1]	0.2	0.2	0.4	0.4	**2.8**	**4.2**	**3.9**	**3.6**	0.1	0.1
Depth of Max Change (m)[2, 3]	0.75	0.75	0.75	0.75	0.75	1.50	1.50	1.50	1.50	2.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals. Bold values are >1.0°C per meter depth.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

3. N/A = not applicable (dates with 0.0°C max change)

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Table 3-4: LL4 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/18/2016	6/8/2016	6/22/2016	7/6/2016	7/20/2016	8/11/2016	8/25/2016	9/7/2016	9/20/2016	10/13/2016
0.5	15.2	19.2	19.7	**21.5**	**22.4**	**22.3**	**22.2**	19.6	17.3	11.8
1.0	15.0	19.2	19.6	**21.5**	**22.4**	**22.3**	**22.3**	19.6	17.3	11.8
2.0	14.9	19.2	19.5	**21.4**	**22.3**	**22.2**	**22.2**	19.7	17.3	11.8
3.0	14.9	19.1	18.2	**21.0**	**22.1**	**22.2**	**22.1**	19.7	17.2	11.8
4.0	14.9	19.1	17.5	19.7	**21.9**	**21.8**	**22.0**	19.6	16.5	11.7
5.0	14.9	19.1	17.3	17.4	**20.2**	**20.5**	**20.7**	17.8	14.1	11.7
6.0	14.9	19.0	17.3	17.3	17.4	15.8	16.2	14.2	14.1	11.7
7.0	14.9	18.7	17.3	17.3	17.4	15.7	16.1	14.0	14.1	11.7
7.5										11.6
8.0	14.9	18.4	17.2	17.3	17.4	15.7	16.1	13.9	14.1	
Max Change (°C/m)[1]	0.4	0.3	**1.3**	**2.3**	**2.8**	**4.7**	**4.5**	**3.6**	**2.4**	0.2
Depth of Max Change (m)[2]	0.75	6.50	2.50	4.50	5.50	5.50	5.50	5.50	4.50	7.25

Notes:

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

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Table 3-5: LL3 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/18/2016	6/8/2016	6/22/2016	7/6/2016	7/20/2016	8/11/2016	8/25/2016	9/7/2016	9/20/2016	10/13/2016
0.5	17.7	**22.3**	19.5	**21.7**	**21.8**	**22.6**	**22.1**	**20.2**	17.8	14.4
1.0	17.6	**22.3**	19.4	**21.7**	**21.8**	**22.6**	**22.1**	**20.2**	17.8	14.4
2.0	17.4	**22.3**	19.4	**21.6**	**21.7**	**22.6**	**22.1**	**20.2**	17.8	14.4
3.0	17.1	**21.7**	19.4	**21.6**	**21.7**	**22.6**	**22.0**	**20.2**	17.8	14.4
4.0	16.1	**20.6**	19.3	**21.6**	**21.6**	**22.5**	**22.0**	**20.2**	17.8	14.4
5.0	15.8	19.3	19.3	**21.1**	**21.4**	**22.5**	**21.8**	**20.2**	17.8	14.4
6.0	15.6	18.8	19.2	**20.8**	**21.3**	**21.5**	**21.0**	**20.2**	17.8	14.4
7.0	15.1	18.7	19.0	19.3	**20.9**	**20.1**	**20.4**	19.7	17.8	13.8
8.0	14.5	18.3	18.4	18.7	19.9	19.0	20.0	19.1	17.8	13.7
9.0	14.3	18.3	18.3	18.7	18.8	18.5	18.5	18.3	17.8	13.6
10.0	14.2	18.0	18.1	18.4	18.2	18.1	17.8	17.7	17.7	13.4
12.0	14.0	17.6	17.3	17.2	17.7	17.2	17.4	17.1	17.3	13.0
15.0	13.9	16.0	16.6	16.5	17.4	16.7	17.1	15.6	15.9	12.9
18.0	13.4	15.2	16.4	16.3	16.9	16.5	16.9	15.4	14.5	12.5
18.5	13.4	15.2	16.4	16.3						12.5
19.5					16.8	16.4	16.9	15.3	14.5	
Max Change (°C/m)[1]	1.0	**1.3**	0.6	**1.5**	**1.1**	**1.4**	**1.5**	0.8	0.5	0.6
Depth of Max Change (m)[2]	3.50	4.50	7.50	6.50	8.50	6.50	8.50	8.50	13.50	6.50

Notes:

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-6: LL2 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/17/2016	6/7/2016	6/21/2016	7/5/2016	7/19/2016	8/10/2016	8/24/2016	9/6/2016	9/19/2016	10/12/2016
0.5	17.6	**22.7**	19.2	**21.6**	**22.0**	**22.8**	**22.0**	**20.2**	18.0	15.2
1.0	17.4	**22.4**	19.2	**21.5**	**21.8**	**22.7**	**22.0**	**20.2**	18.0	15.1
2.0	16.8	**21.4**	19.1	**21.3**	**21.7**	**22.5**	**22.0**	**20.2**	17.9	15.1
3.0	16.3	19.8	18.8	**21.2**	**21.5**	**22.4**	**21.9**	**20.2**	17.9	15.0
4.0	15.7	18.3	18.8	**21.2**	**21.4**	**22.4**	**21.8**	**20.2**	17.9	15.0
5.0	15.5	17.9	18.8	**21.1**	**21.4**	**22.3**	**21.6**	**20.2**	17.9	15.0
6.0	15.4	17.7	18.4	**21.1**	**21.3**	**21.1**	**21.4**	**20.2**	17.9	15.0
7.0	15.3	17.5	18.2	**21.1**	**20.7**	19.6	**20.7**	**20.2**	17.8	15.0
8.0	15.2	17.4	18.1	**21.0**	19.2	18.9	19.4	19.2	17.8	15.0
9.0	15.1	17.3	18.0	19.3	18.4	18.5	18.2	18.4	17.8	14.9
10.0	15.0	16.9	17.8	18.9	18.0	18.1	18.0	17.8	17.8	14.9
12.0	14.5	16.2	17.0	18.1	17.8	17.8	17.6	17.6	17.7	14.9
15.0	14.4	15.7	16.1	16.9	17.2	17.5	17.3	17.0	16.3	14.0
18.0	14.1	14.9	15.9	16.4	16.9	17.2	17.0	16.5	15.1	13.6
21.0	14.0	14.7	15.8	16.0	16.6	17.0	16.8	16.2	14.6	13.4
24.0	13.8	14.4	15.7	15.8	16.5	16.5	16.5	16.0	14.6	13.4
24.5										13.4
25.0	13.8	14.4	15.7	15.8	16.5	16.2	16.5	16.0	14.6	
Max Change (°C/m)[1]	0.6	**1.6**	0.4	**1.7**	**1.5**	**1.5**	**1.3**	1.0	0.5	0.3
Depth of Max Change (m)[2]	3.50	2.50	5.50	8.50	7.50	6.50	7.50	7.50	13.50	13.5

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

3. nr = not reported

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Table 3-7: LL1 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/17/2016	6/7/2016	6/21/2016	7/5/2016	7/19/2016	8/10/2016	8/24/2016	9/6/2016	9/19/2016	10/12/2016
0.5	17.5	**23.4**	19.3	**20.6**	**22.0**	**22.4**	**22.0**	19.9	18.0	15.0
1.0	17.3	**23.0**	19.4	**20.5**	**21.8**	**22.3**	**21.9**	19.9	17.9	15.0
2.0	16.9	**21.1**	19.0	**20.5**	**21.7**	**22.2**	**21.9**	19.9	17.9	15.0
3.0	16.9	18.8	18.8	**20.4**	**21.6**	**22.2**	**21.7**	19.9	17.8	15.0
4.0	16.3	18.4	18.7	**20.4**	**21.6**	**22.2**	**21.6**	19.9	17.8	14.9
5.0	16.0	18.0	18.4	**20.3**	**21.5**	**22.1**	**21.5**	19.9	17.8	14.9
6.0	16.0	17.7	18.2	**20.2**	**20.8**	**21.8**	**21.5**	19.9	17.8	14.9
7.0	15.7	17.5	18.1	**20.2**	19.1	**20.4**	**21.4**	19.8	17.8	14.9
8.0	15.6	17.3	18.0	19.8	18.6	19.3	20.0	18.8	17.7	14.9
9.0	15.4	17.1	17.9	18.9	18.2	18.7	19.0	17.9	17.7	14.9
10.0	15.4	16.9	17.7	18.2	17.9	18.4	18.6	17.6	17.7	14.9
12.0	15.2	16.4	17.1	17.6	17.4	17.9	17.9	17.3	17.0	14.8
15.0	14.8	15.8	16.6	17.1	16.8	17.4	17.4	17.0	16.2	14.5
18.0	14.6	15.1	15.9	16.7	16.7	17.1	17.1	16.9	15.8	14.2
21.0	14.4	14.7	15.8	16.2	16.5	16.8	16.8	16.7	15.4	13.7
24.0	14.2	14.5	15.7	16.0	16.3	16.6	16.6	16.5	15.2	13.2
27.0	13.6	14.4	15.7	15.5	15.6	16.2	16.2	16.4	14.8	13.0
30.0	12.8	14.3	15.0	15.2	15.1	15.7	15.8	16.1	14.7	13.0
31.0										13.0
33.0	12.6	14.1	14.6	14.9	15.0	15.1	15.4	15.3	14.7	
Max Change (°C/m)[1]	0.6	**2.3**	0.4	0.9	**1.7**	**1.4**	**1.4**	1.0	0.4	0.2
Depth of Max Change (m)[2]	3.50	2.50	1.50	8.50	6.50	6.50	7.50	7.50	11.00	19.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Table 3-8: LL0 Temperature Vertical Profiles in 2016

Depth (meters)	Water Temperature (°C)									
	5/17/2016	6/7/2016	6/21/2016	7/5/2016	7/19/2016	8/10/2016	8/24/2016	9/6/2016	9/19/2016	10/12/2016
0.5	17.2	**21.8**	19.0	19.8	**21.0**	**22.5**	**21.5**	19.5	17.8	14.7
1.0	17.0	**21.6**	19.0	19.8	**20.8**	**22.4**	**21.5**	19.5	17.9	14.7
2.0	16.8	20.0	18.9	19.7	**20.7**	**22.3**	**21.5**	19.5	17.8	14.7
3.0	16.4	18.9	18.6	19.7	**20.6**	**22.3**	**21.5**	19.5	17.8	14.7
4.0	16.0	18.1	18.6	19.6	**20.6**	**22.3**	**21.4**	19.5	17.8	14.7
5.0	15.7	17.6	18.4	19.6	**20.3**	**22.3**	**21.4**	19.5	17.7	14.7
6.0	15.6	17.3	18.3	19.5	19.8	**22.3**	**21.3**	19.5	17.5	14.8
7.0	15.4	17.0	18.1	19.5	19.1	**20.6**	**21.0**	18.7	17.1	14.7
8.0	15.3	16.6	17.9	19.1	18.7	19.3	**20.3**	18.0	16.9	14.7
9.0	15.3	16.5	17.9	18.6	18.3	18.6	19.0	17.6	16.9	14.7
10.0	15.3	16.4	17.8	18.0	17.9	18.1	18.3	17.4	16.8	14.7
12.0	15.1	16.2	17.1	17.6	17.3	17.7	17.7	17.2	16.6	14.7
15.0	15.0	15.8	16.4	17.0	16.8	17.3	17.3	17.0	16.3	14.5
18.0	14.8	15.2	16.1	16.7	16.6	17.0	17.0	16.8	16.0	14.4
21.0	14.6	14.8	15.8	16.2	16.3	16.7	16.7	16.6	15.6	14.0
24.0	14.3	14.7	15.2	15.9	16.1	16.5	16.4	16.5	15.5	13.4
27.0	14.2	14.5	14.9	15.6	15.8	16.1	15.9	16.2	15.2	13.3
30.0	13.4	14.4	14.7	15.2	15.2	15.5	15.6	15.8	15.1	13.2
33.0	12.8	14.3	14.5	14.6	14.8	14.9	15.1	15.3	15.0	13.2
36.0	12.5	14.1	14.3	14.4	14.4	14.4	14.5	14.6	14.8	13.2
39.0	12.2	14.0	14.0	14.0	14.0	13.9	13.9	14.0	14.4	13.1
42.0	12.0	13.9	13.8	13.7	13.7	13.7	13.7	13.7	13.7	13.1
45.0	12.0	13.8	13.7	13.5	13.5	13.6	13.5	13.5	13.5	13.1
46.5					13.4					
47.0	11.9	13.8	13.6	13.4		13.4	13.4	13.5	13.4	
Max Change (°C/m)[1]	0.4	**1.6**	0.4	0.6	0.7	**1.7**	**1.3**	0.8	0.4	0.2
Depth of Max Change (m)[2]	2.50	1.50	11.00	9.50	6.50	6.50	8.50	6.50	6.50	22.50

Notes:

Data from field duplicates are averaged.

Shaded and bold values indicate an exceedance of the 20.0°C criterion.

1. The change in °C per meter of depth was calculated for each pair of adjacent measurement intervals in the table. This value represents the maximum value of the calculated change in °C per one meter of depth for each pair of adjacent measurement intervals. Bold values are >1.0°C per meter depth.

2. Depth of Max Change (m) = the shallowest depth where the greatest temperature gradient occurs.

Golder Associates

Mattax Solutions LLC

Table 3-9: LLTR Daily Maximum Temperature in 2016

Day	June	July	August	September	October	November
1	Not Monitored	18.0	19.3	18.4	16.0	Not Monitored
2		18.4	19.5	18.1	15.9	
3		18.2	19.1	18.2	15.9	
4		17.8	19.5	18.3	15.9	
5		18.4	**20.1**	17.9	15.7	
6		18.5	19.5	17.8	15.5	
7		18.4	19.4	17.7	15.5	
8		18.2	19.4	17.6	15.0	
9		18.5	19.0	17.6	15.0	
10		18.2	19.0	17.6	14.8	
11		18.2	19.0	17.5	14.6	
12		18.4	18.9	17.9	14.5	
13		18.3	18.7	17.9	14.4	
14		18.3	18.9	17.7	14.3	
15		18.1	18.8	17.4	14.0	
16		18.4	18.7	17.4	14.0	
17		18.5	18.9	17.0	13.8	
18		18.5	18.7	16.7	13.5	
19		18.3	**20.3**	16.8	13.3	
20		18.6	19.6	16.5	13.3	
21		18.7	19.2	16.5	13.1	
22		18.8	18.4	16.9	13.0	
23		18.6	18.8	16.6	12.9	
24		18.8	19.1	16.1	12.8	
25		18.8	19.0	16.2	12.7	
26		19.5	18.7	16.2	12.7	
27		19.0	18.6	16.2	12.5	
28		19.0	18.7	16.1	12.4	
29		19.1	18.6	16.1	12.3	
30		19.0	18.5	16.2	12.2	
31		18.8	18.5	---	12.1	

Notes:
--- = not applicable
Shaded and bold values indicate an exceedance of the 20.0°C criterion.
Data collected as part of Avista's Washington Detailed DO Phase II Feasibility and Implementation Plan.

Golder Associates
Mattax Solutions LLC

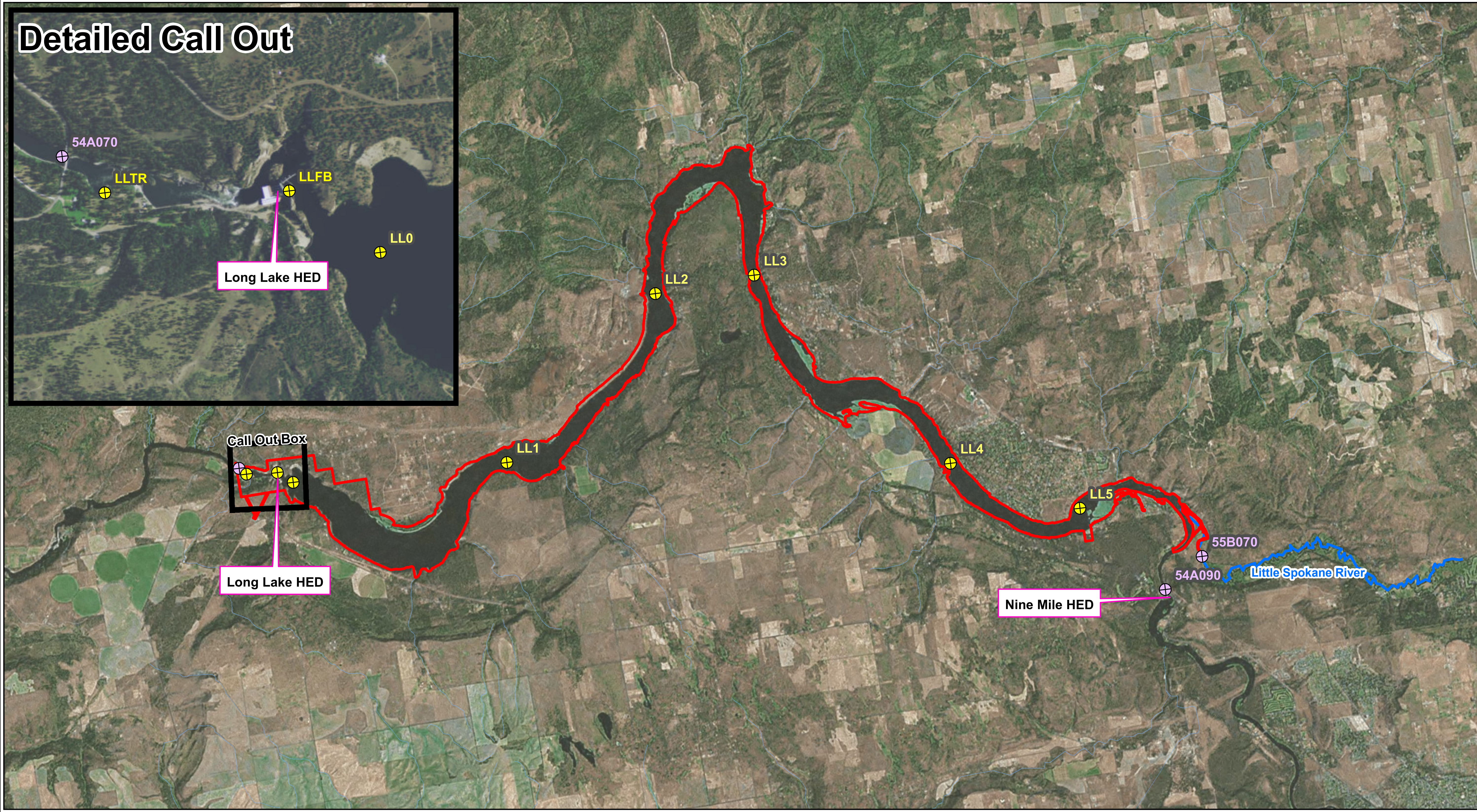
Table 5-1: Comparison of LLTR 2016 Values to Tribe WQ Standards

Day	July	August	September	October
1	N/A	**19.2**	**18.4**	**16.0**
2	N/A	**19.3**	**18.3**	**16.0**
3	N/A	**19.4**	**18.2**	**15.9**
4	18.2	**19.5**	**18.1**	**15.8**
5	18.3	**19.5**	**17.9**	**15.6**
6	18.3	**19.4**	**17.9**	**15.5**
7	18.3	**19.4**	**17.8**	**15.3**
8	18.3	**19.3**	**17.7**	**15.2**
9	18.3	**19.2**	**17.7**	**15.0**
10	18.3	**19.1**	**17.7**	**14.8**
11	18.3	**19.0**	**17.7**	**14.7**
12	18.3	**18.9**	**17.7**	**14.5**
13	18.3	**18.9**	**17.6**	**14.4**
14	18.3	**18.8**	**17.5**	**14.2**
15	18.4	**18.8**	**17.4**	**14.1**
16	18.3	**19.0**	**17.3**	**13.9**
17	18.4	**19.1**	**17.1**	**13.7**
18	18.4	**19.2**	**16.9**	**13.6**
19	**18.5**	**19.1**	**16.8**	**13.4**
20	**18.6**	**19.1**	**16.7**	**13.3**
21	**18.6**	**19.2**	**16.6**	**13.1**
22	**18.7**	**19.2**	**16.5**	**13.0**
23	**18.8**	**19.0**	**16.4**	**12.9**
24	**18.9**	**18.8**	**16.4**	**12.8**
25	**18.9**	**18.8**	**16.3**	**12.7**
26	**19.0**	**18.8**	**16.2**	**12.6**
27	**19.0**	**18.7**	**16.2**	**12.5**
28	**19.0**	**18.7**	**16.1**	**12.4**
29	**19.1**	**18.6**	**16.1**	N/A
30	**19.1**	18.5	**16.1**	N/A
31	**19.1**	18.4	---	N/A

Notes:
N/A = not enough days to calculate the 7-DADM
Shaded and bold values indicate an exceedance of the Tribe's 7-DADM Criteria.
Data collected as part of Avista's Washington Detailed DO Phase II Feasibility and Implementation Plan.

Golder Associates
Mattax Solutions LLC

FIGURES



LEGEND

- Long Lake HED Boundary
- Little Spokane River

Temperature Monitoring Stations

Sampling Entity

- Avista
- Ecology

0 1 2
Miles

Map Projection:
NAD 1983 StatePlane Washington
North FIPS 4601 Feet

Source:
ESRI (Aerial Imagery, Little Spokane River),
Avista (Avista HED), Golder Associates (Long Lake Boundary,
Tempurature Monitoring Locations)

N

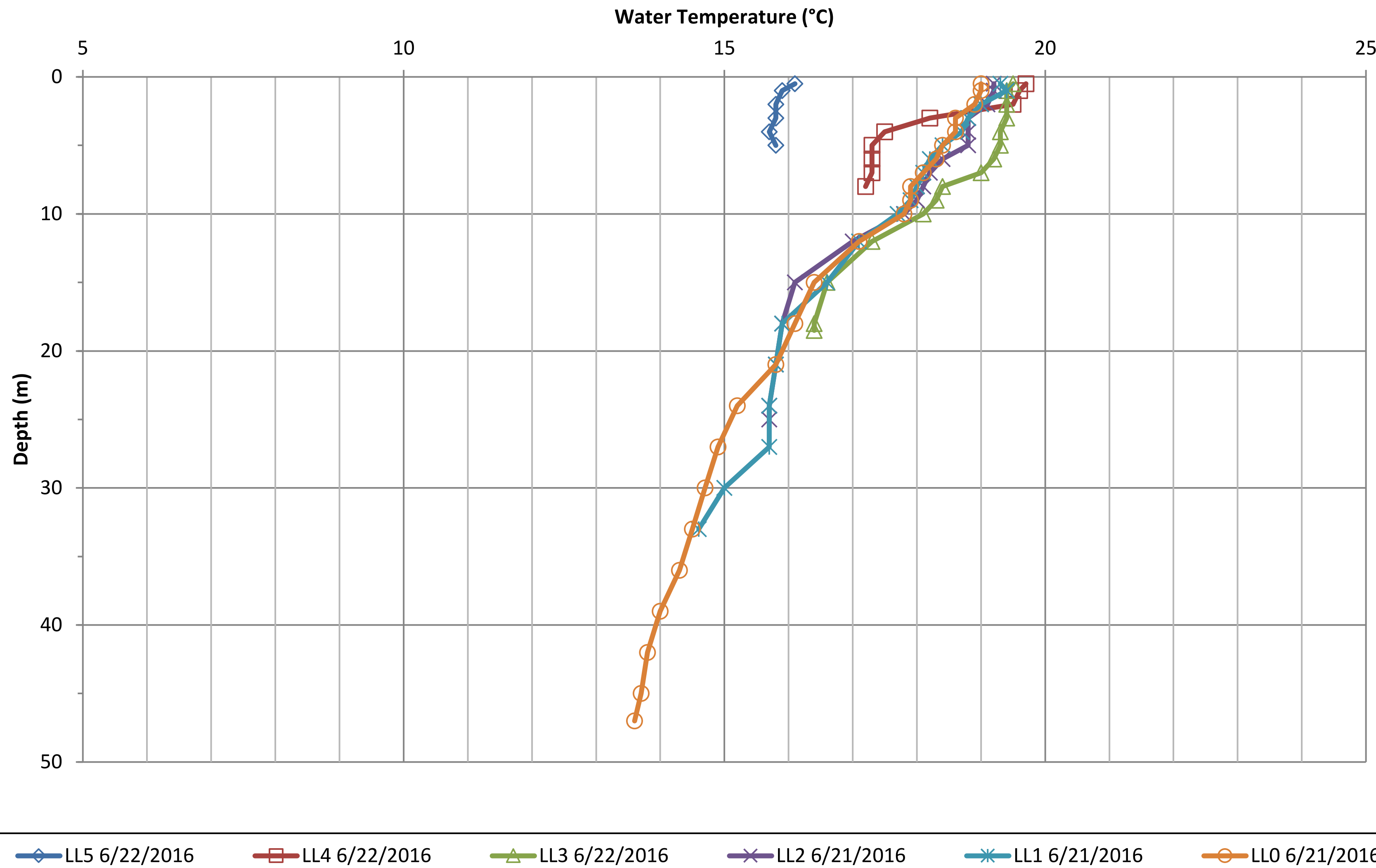
This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

FIGURE **2-1**

Long Lake HED 2016
Temperature Monitoring Stations

Path: G:\Avista\Long_Lake\99_PROJECTS\07393081_18\02_PRODUCTION\MXD\FIGURES\RevA\07393081_18_F2_1_RevALakeSpokane_Temp_Monitoring_Sites Fig_2_1.mxd

Golder Associates
Mattax Solutions LLC

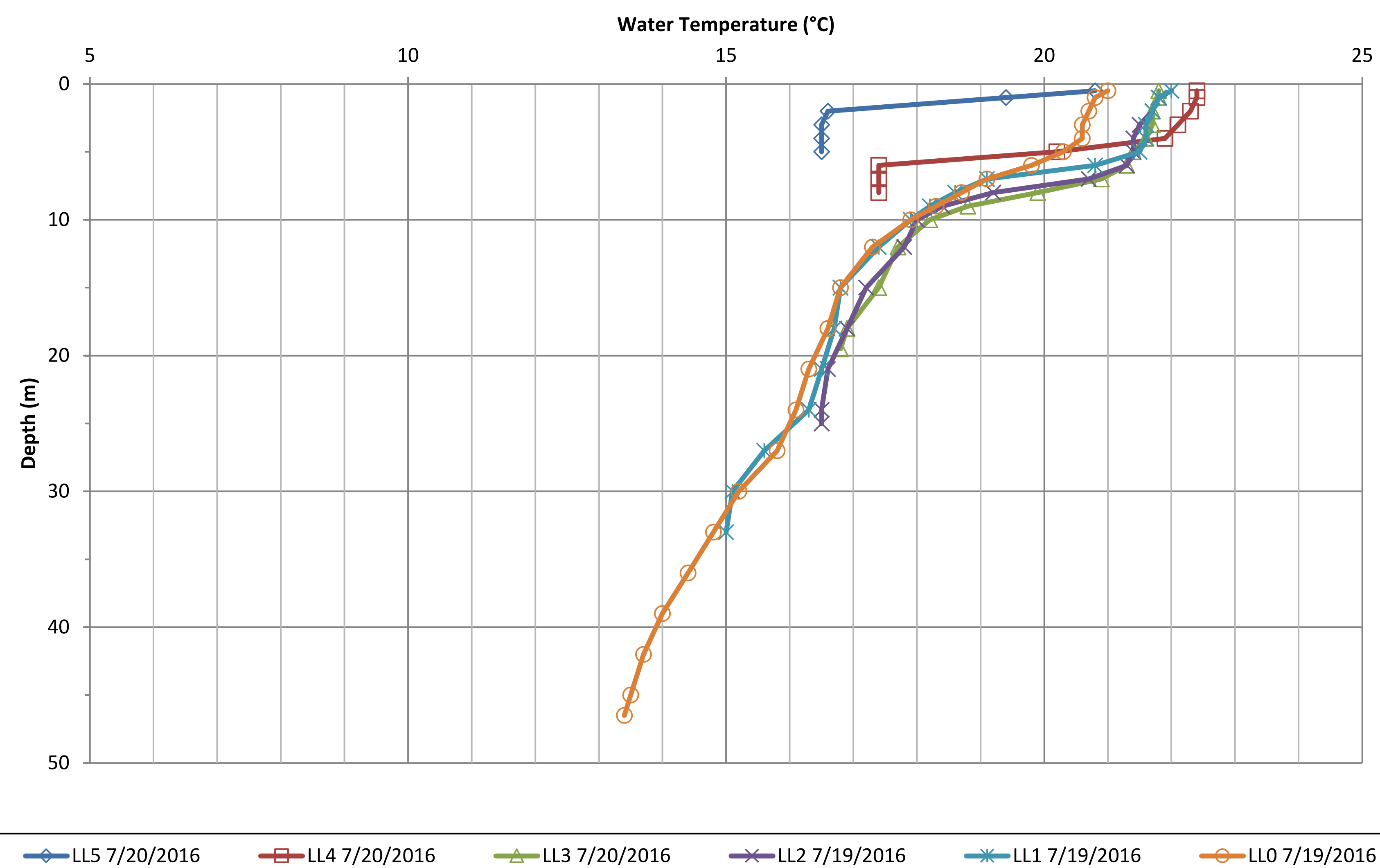


Golder Associates

Mattax Solutions LLC

Title	Lake Spokane Temperature Vertical Profiles, Late June 2016
Project Name	LL HED Temp Monitoring Report
Project No.	073-93081-18
Client Name	Avista
Date	4/12/2017

FIGURE 3-1

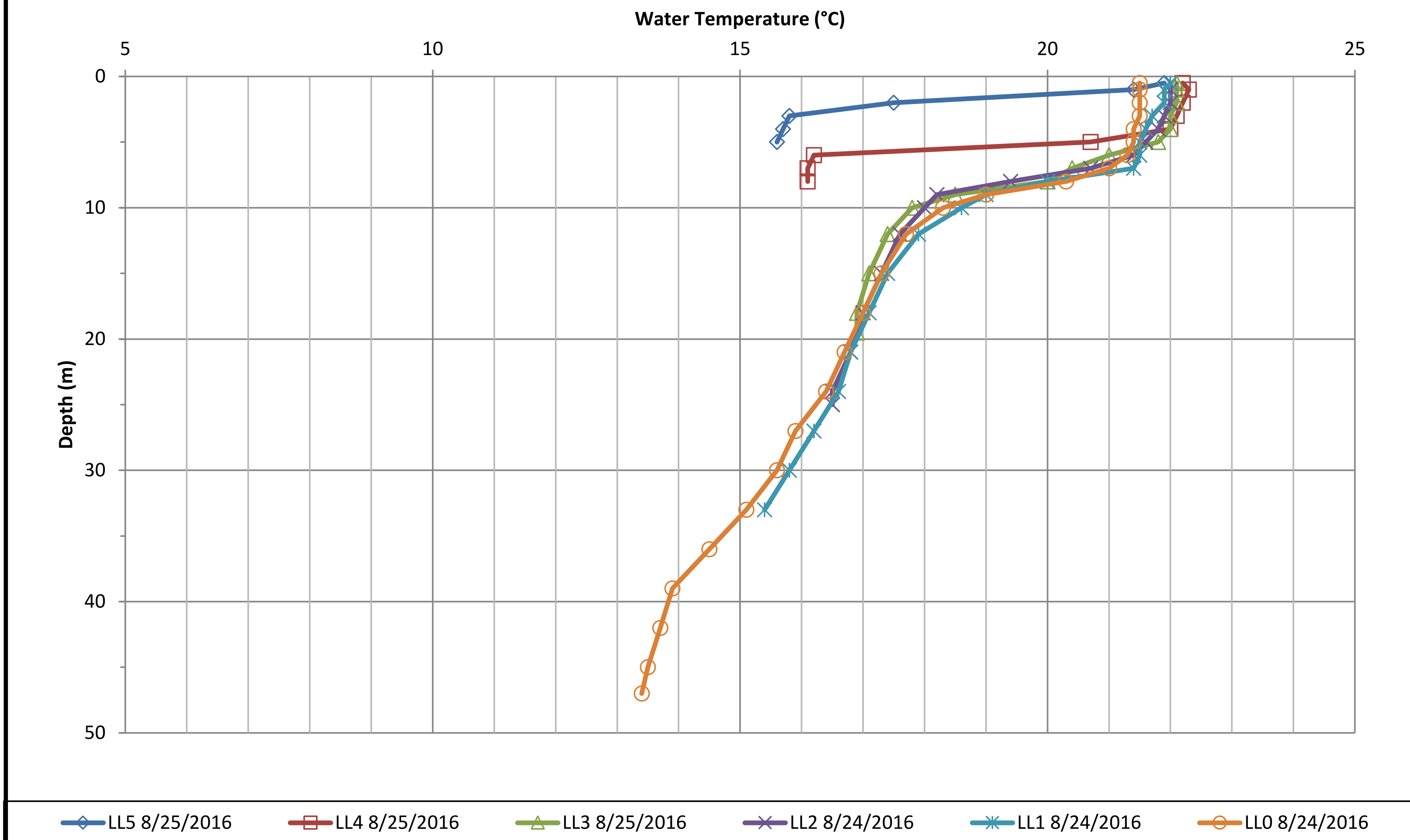


Golder Associates

Mattax Solutions LLC

Title	Lake Spokane Temperature Vertical Profiles, Late July 2016		
Project Name	LL HED Temp Monitoring Report	Project No.	073-93081-18
Client Name	Avista	Date	4/12/2017

FIGURE 3-2

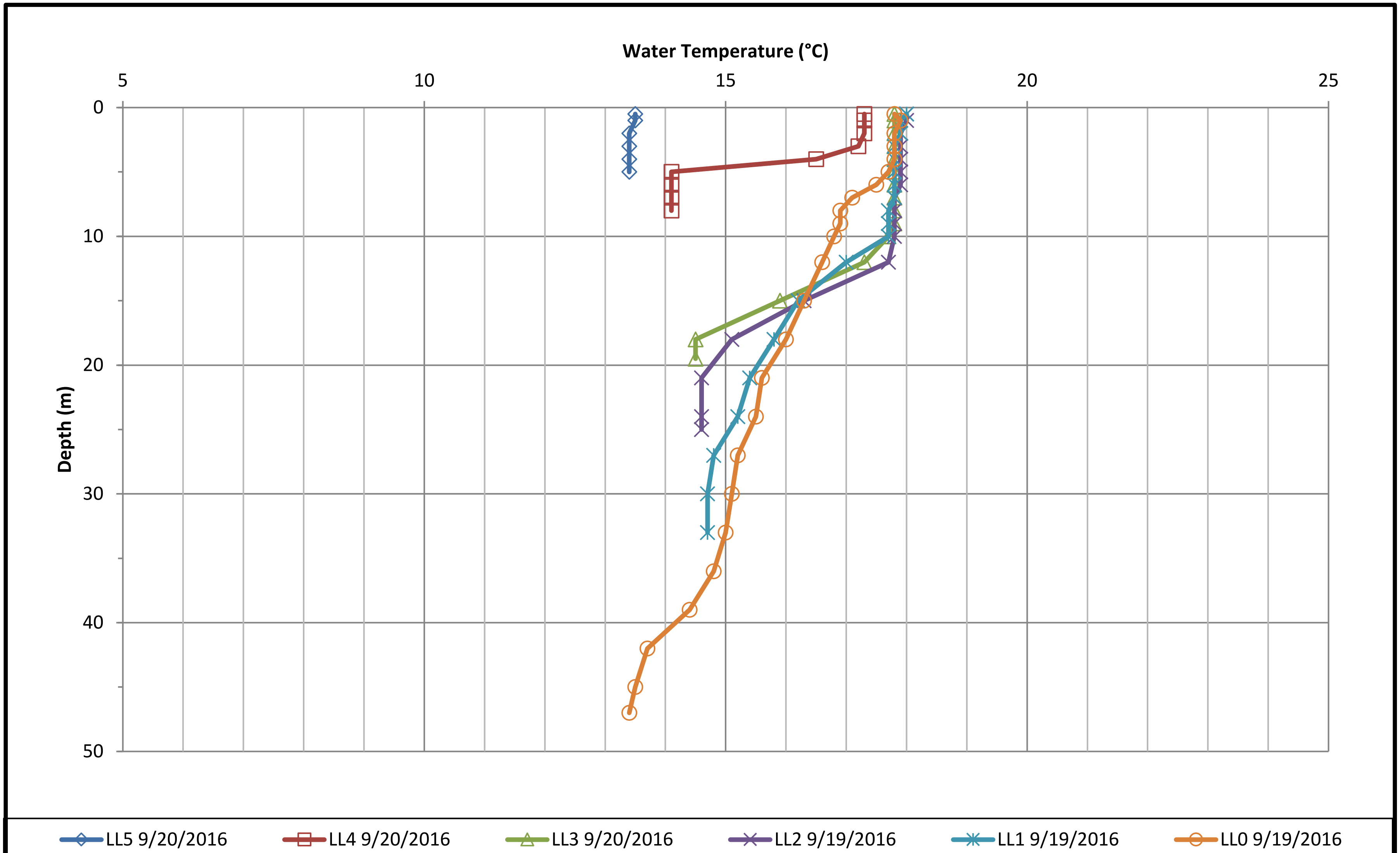


Golder Associates

Mattax Solutions LLC

Title	Lake Spokane Temperature Vertical Profiles, Late August 2016		
Project Name	LL HED Temp Monitoring Report	Project No.	073-93081-18
Client Name	Avista	Date	4/12/2017

FIGURE 3-3

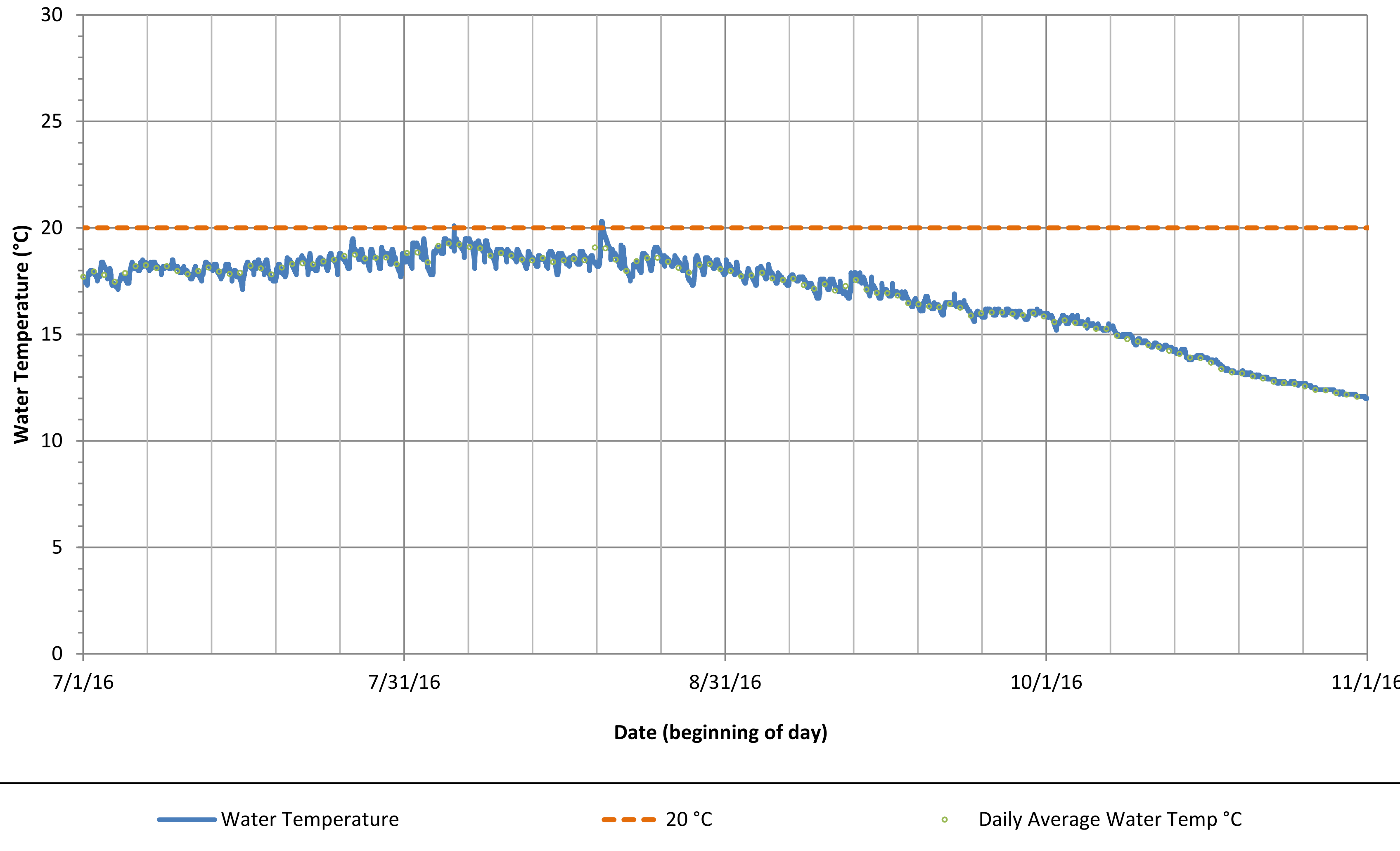


Golder Associates

Mattax Solutions LLC

Title	Lake Spokane Temperature Vertical Profiles, Late September 2016
Project Name	LL HED Temp Monitoring Report
Project No.	073-93081-18
Client Name	Avista
Date	4/12/2017

FIGURE 3-4

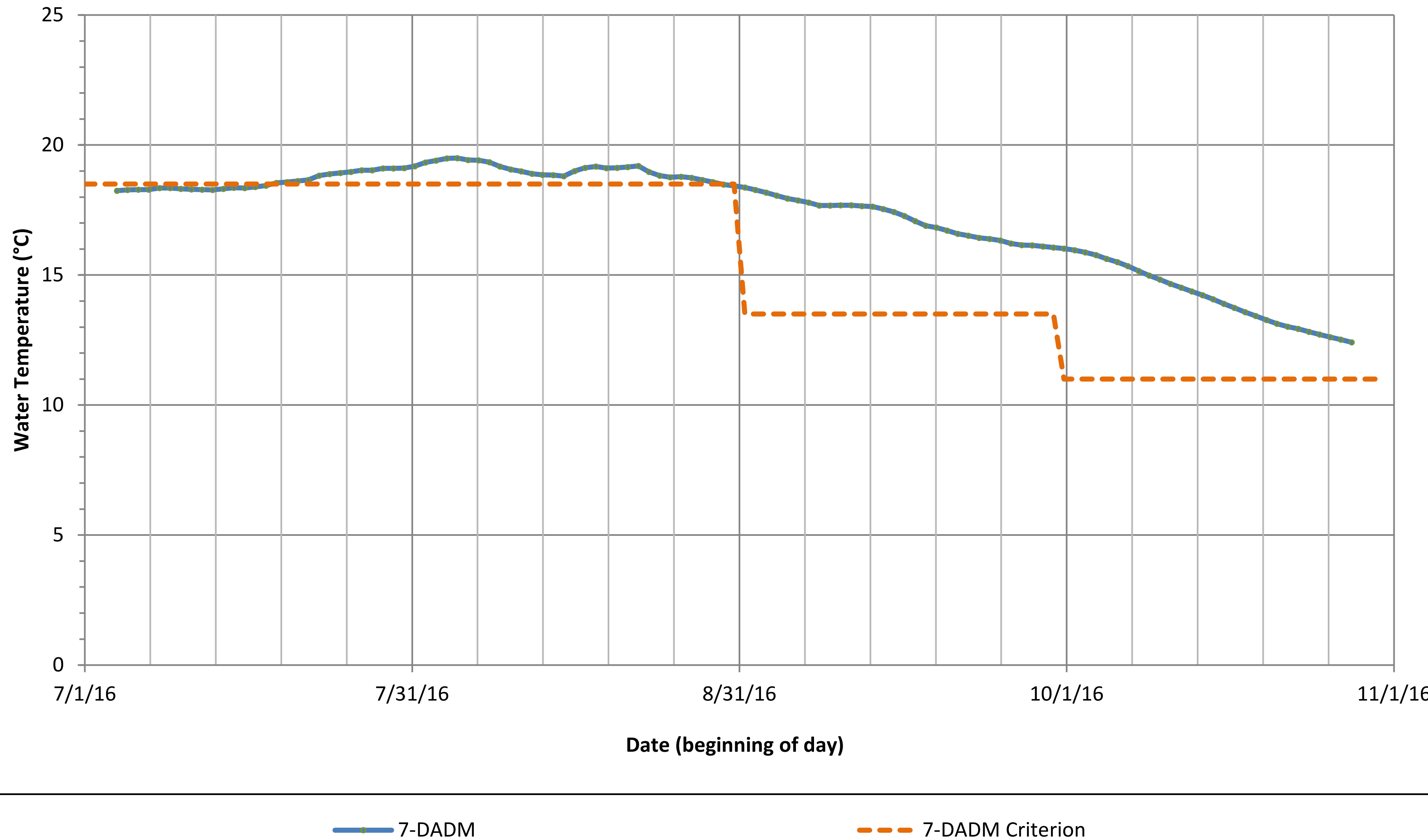


Golder Associates

Mattax Solutions LLC

Title	LLTR Temperature Time Series, 2016		
Project Name	LL HED Temp Monitoring Report	Project No.	073-93081-18
Client Name	Avista	Date	4/12/2017

FIGURE 3-5



Golder Associates / Mattax Solutions LLC	Title: LLTR 7-DADM Time Series, 2016		
	Project Name: LL HED Temp Monitoring Report	Project No. 073-93081-18	FIGURE 5-1
	Client Name: Avista	Date: 4/12/2017	

APPENDIX A

CONSULTATION RECORD

AVISTA
1411 East Mission Avenue
PO Box 3727
Spokane, WA 99220-3727

February 28, 2017

Patrick McGuire, Water Quality Program
Washington Department of Ecology
Eastern Regional Office
4601 N Monroe Street
Spokane, WA 99205-1295

**Subject: Spokane River Hydroelectric Project, FERC Project No. 2545
2016 Long Lake Hydroelectric Development Temperature Monitoring Report**

Dear Pat:

I have enclosed the 2016 Long Lake Hydroelectric Development Temperature Monitoring Report (Temperature Monitoring Report) for your review and approval. The Temperature Monitoring Report was completed in accordance with the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan, which was required by the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License Appendix B, Section 5.5.B.

We request your review and approval by **March 31, 2017**. This will allow us time to incorporate your comments and recommendations as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2017.

Please feel free to call me at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Meghan Lunney
Aquatic Resource Specialist

Enclosure (1)

cc: Chad Brown, Ecology
Brian Crossley, Spokane Tribe
Speed Fitzhugh, Avista
Chris Moan, Avista

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

March 31, 2017

Ms. Meghan Lunney
Aquatic Resource Specialist
Avista Corporation
1411 East Mission Avenue, MSC-1
Spokane, WA 99220-3727

RE: Request for Ecology Review and Approval – *2016 Long Lake HED Temperature Monitoring Report.* Spokane River Hydroelectric Project, No. P-2545

Dear Ms. Lunney:

The Department of Ecology (Ecology) has reviewed the *2016 Long Lake HED Temperature Monitoring Report* sent to Ecology on February 28, 2017. The report is a requirement in FERC License Appendix B, Section 5.5.B.

Ecology APPROVES the *2016 Long Lake HED Temperature Monitoring Report* as submitted.

Please contact me at (509) 329-3567 or pmcg461@ecy.wa.gov if you have any questions.

Sincerely,

Patrick McGuire
Eastern Region FERC License Coordinator
Water Quality Program

PDM:jab

cc: Elvin "Speed" Fitzhugh, Avista

ECOLOGY COMMENTS AND AVISTA RESPONSES

Ecology Comment
Ecology reviewed and approved the 2016 Long Lake HED Temperature Monitoring Report as submitted.

Avista Response
Avista appreciates Ecology's review and approval of the 2016 Long Lake HED Temperature Monitoring Report.

AVISTA
1411 East Mission Avenue
PO Box 3727
Spokane, WA 99220-3727

February 28, 2017

Brian Crossley
Water and Fish Program Manager
Spokane Tribe Natural Resources
P.O. Box 480
Wellpinit, WA 99040

Subject: Spokane River Hydroelectric Project, FERC Project No. 2545
2016 Long Lake Hydroelectric Development Temperature Monitoring Report

Dear Brian:

I have enclosed the 2016 Long Lake Hydroelectric Development Temperature Monitoring Report (Temperature Monitoring Report) for your review and approval. The Temperature Monitoring Report was completed in accordance with the Long Lake Dam Reservoir and Tailrace Temperature Water Quality Attainment Plan, which was required by the Federal Energy Regulatory Commission (FERC) Spokane River Hydroelectric Project License Appendix B, Section 5.5.B.

Per the October 2008 Settlement Agreement between Avista and the Spokane Tribe, we would like to receive any comments that you may have on the Temperature Monitoring Report by **March 31, 2017**. This will allow us time to incorporate your comments as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2017.

Please feel free to call me at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Meghan Lunney
Aquatic Resource Specialist

Enclosure (1)

cc: Patrick McGuire, Ecology
Speed Fitzhugh, Avista
Chris Moan, Avista

Spokane Tribal Natural Resources
P.O. Box 480 ● Wellpinit, WA 99040 ● (509) 626 - 4400 ● fax 258 - 9600

3/28/2016

Meghan Lunney
1411 East Mission Avenue
PO Box 3727 MSC-25
Spokane WA 99220

Dear Megan:

I have reviewed the 2016 dissolved oxygen/total dissolved gas and temperature monitoring reports with the assistance of Casey Flanagan, Water & Fish Project Manager. These reports focus on Long Lake Dam and its effects on dissolved oxygen, total dissolved gas and temperature. In 2016 the spill deflectors were installed on Long Lake Dam and we are anxious to evaluate their effectiveness in reducing total dissolved gas. The dissolved oxygen mitigation continues to improve below the dam evident by lower dissolved gas spikes and higher levels of dissolved oxygen during power generation. However, as noted in 2015, low flows in the Spokane River can create issues with aeration and may become more common.

We noticed a brief time period around September 20th that showed some of the lowest dissolved oxygen levels at a time when temperature was declining and Units 1 and 2 were operating and were interested in discussing possible causes and remedies.

Sincerely,

Brian Crossley
Water & Fish Program Manager
crossley@spokanetribe.com

cc: Patrick McGuire, Dept. of Ecology
BJ Kieffer, Director Dept. of Natural Resources
Danny Kieffer, Tribal Council

SPOKANE TRIBE COMMENTS AND AVISTA RESPONSES

Spokane Tribe Comment
We noticed a brief time period around September 20th that showed some of the lowest dissolved oxygen levels at a time when temperature was declining and Units 1 and 2 were operating and were interested in discussing possible causes and remedies.

Avista Response
Avista concurs with the Tribe that river temperatures below Long Lake HED were declining in late September. Avista's response to the DO portion of the question is included in the 2016 Long Lake HED Tailrace Dissolved Oxygen Monitoring Report's Appendix B Response to Comments.