AVISTA CORPORATION

2017

LONG LAKE HED

TEMPERATURE MONITORING REPORT

WASHINGTON 401 CERTIFICATION, SECTION 5.5

Spokane River Hydroelectric Project
FERC Project No. 2545

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Table of Contents

List of Tables

List of Figures

List of Appendices

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
LLGEN	Long Lake generation plume 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), in 2015 (Golder and Mattax Solutions 2016), and in 2016 (Golder and Mattax Solutions 2017). This report summarizes temperature monitoring conducted for Long Lake HED during the 2017 calendar year.

2.0 MONITORING ACTIVITIES

2.1 2017 Monitoring Results

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 2018a, 2018b), Lake Spokane water quality (Tetra Tech 2018), Long Lake HED total dissolved gas (Avista 2018a), and Long Lake HED dissolved oxygen (Avista 2018b). 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), six stations within Lake Spokane, and one location in the Long Lake Dam Tailrace (Table 2-1 and Figure 2-1). 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.[1] 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 February 16, 2018.

2.2.1.2 Within Lake Spokane

In 2017, Avista monitored temperature and other water quality parameters through implementation of the Lake Spokane nutrient monitoring program, which it collaboratively implemented with Ecology in 2010 and 2011, and has solely implemented since 2012. The 2017 monitoring included one sampling event in May and October, and two sampling events per month in June through September. All sampling was completed in accordance with the Ecology-approved QAPP for Lake Spokane Nutrient Monitoring.[2] Sampling was conducted at the six Lake Spokane monitoring stations described in Table 2-1 and include:

- 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; and
- LL0, at approximately RM 32.66.

[1] The "water year" is defined as the 12-month period from October 1 to September 30 of the following year.
[2] 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).

2.2.2 Long Lake Dam Tailrace

In 2017, Avista monitored temperature at one location at the Long Lake HED: at a station 0.6 mile downstream of Long Lake Dam referred to as LLTR. All monitoring, including quality control protocols, was conducted in accordance with Avista's Total Dissolved Gas (TDG) Monitoring Plan (Golder Associates Inc 2010) and Detailed Dissolved Oxygen (DO) Phase II Feasibility and Implementation Plan (Avista 2010). Under this program, water temperature, total dissolved gas, 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 February 16, 2018 (Ecology 2018c).

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 (LLTR). 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; and
- 13.5°C between April 1 and May 31.

3.0 RESULTS

Results of the 2017 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

Water temperature was monitored at nine locations: Ecology's Spokane River at Nine Mile Bridge station (54A090), Ecology's Little Spokane River station (55B070), Avista's LL5, LL4, LL3, LL2, LL1, and LL0 stations, and Avista's LLTR station in the Long Lake Dam Tailrace.

3.1.1.1 Inflow Stations

Ecology's Spokane River at Nine Mile Bridge station (54A090) was monitored monthly from February through September, except for in the month of July. Reported water temperatures for this timeframe ranged from 2.6°C in February to 17.1°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 September. Water temperatures during this timeframe ranged from 4.1°C in March to 17.4°C in July (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 2017. The 2017 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

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 2017, and thermal stratification, as defined by greater than 1.0 °C/m, occurred on all sampling events from July 26 through September 13 (Table 3-3). The results indicate the thermocline was at a depth of 0.75 m on July 26 and September 13, and was at 1.5 m on August 9 and August 23 (Table 3-3).[3] Five LL5 temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.2°C on August 9. The high temperatures occurred only in the near surface water at 0.5 m on July 26, and down to 1 m on August 9 and August 23 (Table 3-3).

[3] 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.

LL4

Water 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 taken during July 12 through September 27 (Table 3-4). These results indicate the thermocline was at 4.5 m in July, 5.5 m in August and early September, and 2.5 m in late September. Twenty-six of the temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.9°C on August 9. The high temperatures occurred down to 4 m July through early September, and down to 5 m on August 9 (Table 3-4).

LL3

Water 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 ended within 1 m of the bottom. Vertical temperature profiles on July 12, August 9, and August 23 had maximum temperature change rates greater than 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 July to 5.5 m in August. Forty-two of the temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.9°C at 1 and 2 m of depth on August 9 (Table 3-5). Depths for the other greater than 20.0°C measurements were down to 2 m on June 21, down to 7 m on July 12 and August 9, down to 9 m on July 26, down to 6 m on August 23 and down to 5 m on September 13 (Table 3-5).

LL2

Water 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 during June 20 through September 12 sampling events (Table 3-6). The maximum temperature change rate was 1.0 °C/m on July 11, and was less than 1.0 °C/m for all remaining profiles. The thermocline was at a depth of 1.5 m on June 20, 6.5 m on July 11, 7.5 m on July 25, and remained at 5.5 m on August 8, August 22, and September 12. Forty temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.9°C down to 1 m on August 8. Depths for the other greater than 20.0°C measurements were down to 1 m on June 20, 7 m on July 11 and August 8, down to 8 m on July 25, down to 6 m August 22, and down to 5 m on September 12 (Table 3-6).

LL1

Water temperature measurements were taken at 0.5 m, 1-m intervals from 1 m to 10 m, then 3-m intervals from 12 m to 33 m. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for July 11 through August 22, and a temperature change rate of 1.0 °C/m occurred on June 20 and September 12 (Table 3-7). The thermocline depth was 1.5 m on June 20, 4.5 m in early July, 7.5 m late July, 5.5 m early August through late August, and extended to a depth of 6.5 m in early September. Forty-three temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.7°C in the top 1 m on August 8. The high temperatures occurred down to 1 m on June 20, down to 8 m on July 11, down to 9 m July 25, down to 7 m August 8, and down to 6 m August 22 through September 12 (Table 3-7).

LL0

Water 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. Temperature change rates of greater than 1.0 °C/m occurred in the vertical profiles for June 20 and July 11, August 8, August 22, and September 12, with a temperature change rate of exactly 1.0 °C/m occurring on July 25 (Table 3-8). Thirty-eight temperature measurements were greater than the 20.0°C Washington State criterion, and reached up to 24.5°C down to 3 m in depth on August 8. The high temperatures occurred down to 0.5 m on June 20, down to 7 m on July 11, July 25, and August 8, down to 6 m on August 22, and down to 5 m on September 12 (Table 3-8).

Lake Station Temperature Profile Comparisons

Comparison of the 2017 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 20.8°C in late June, 24.7°C in early July, 24.9°C in early August, and 21.1°C in early September. In late June, the three down-reservoir stations (LL2, LL1, and LL0) had very similar thermal stratification, while LL3 was nearly 1°C warmer in the uppermost 3 m (Figure 3-1). Late June surface temperatures at LL4 and LL5 were substantially cooler than those at the other sites and did not experience stratification. By late July, thermal stratification was well established and the epilmnion had temperatures reaching between 21.5°C and 24.2°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 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).

3.1.2 Long Lake Dam Tailrace

Long Lake Dam Tailrace data was collected at one location: LLTR. Water temperature data was collected in 15-minute intervals from March 10 through November 1 as part of Avista's Washington Total Dissolved Gas Monitoring Plan and the Detailed DO Phase II Feasibility and Implementation Plan (Figure 3-5).

LLTR

Daily maximum water temperatures ranged from 4.0°C on March 12 and 13 to 20.6°C on August 2 (Table 3-9). Temperatures of greater than the 20.0°C Washington State criterion occurred on twenty-one days from July 12 through August 11, ranging from 20.1 to 20.6 °C.

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 and 2017 (Avista 2014, 2015, 2016, and 2018c) and a Five Year Summary Report for the work completed from 2013 through 2016 (Avista 2017). In accordance with the DO WQAP, following completion of the 2017 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 2018 sampling program as identified in the Lake Spokane DO WQAP 2017 Annual Summary Report (Avista 2018c).

  These Annual 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', with the exception of the cold water fish habitat evaluation and 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** – Avista continued to evaluate cold water fish habitat in Lake Spokane. Based on a 16°C thermal standard and an 8.0 mg/L DO standard, water quality data within Lake Spokane 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.

    Interestingly, and as discussed in the Lake Spokane DO WQAP 2017 Annual Summary Report, preliminary results from Avista's multi-year fish population and habitat assessment for rainbow trout indicate rainbow trout in Lake Spokane are inhabiting the epilimnion during the summer months, frequently surpassing the 16°C temperature and 8.0 mg/l DO standards. This is based on results of tagged rainbow trout, tracked throughout the reservoir from early July through November of 2017. The second year of this study will be conducted during 2018. Avista anticipates the results of the multi-year fish population and habitat assessment will be available in 2019.

  - **Native Tree Plantings on Avista Shoreline Property** – Avista planted 200 native shrubs along Lake Spokane's shoreline on Avista-owned property, at the Muley Canyon boat-in-only campsite. The plantings consisted of dogwood, mock orange, service berry, and Oregon grape. Once mature, the trees will improve habitat and help reduce water temperature and along the lake's shoreline.

  - **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 12,568 native trees and shrubs have been planted on approximately 500 of the 656 acres. Avista continues to maintain and replace trees as needed.

- **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 is currently pursuing 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 2018 and will implement measures necessary to ensure its continued success.

- **Floating Treatment Wetland** - Avista is working with the Stevens County Conservation District (SCCD) to cost share the installation of a floating treatment wetland in Lake Spokane. The purpose of the floating treatment wetland is for water quality improvements including, reducing surface water temperatures, as well as potentially removing nutrients from the water column. Additionally, the floating treatment wetland has an educational component, allowing for a study to assess its impact on fish, as well as assess wetland vegetation survival rates. Avista and the SCCD anticipate the floating treatment wetland being installed during 2018.

- **Land Protection** - Avista previously identified approximately 215 acres of land that was used for grazing under lease from Washington State Department of Natural Resources (DNR). This land is located within the south half of Section 16 in Township 27 North, Rand 40 E.W. M. in Stevens County. Avista and State Parks pursued a lease for the 215 acres of land from DNR with the intent of changing the land use. DNR leased the property to State Parks in 2017 for public recreation, and therefore no longer allows grazing on this property.

  In addition, Avista owns over 1,000 acres of land, of which approximately 350 acres are located within 200 feet of the Lake Spokane shoreline in Spokane, Stevens, and Lincoln counties at the downstream end of the reservoir. This includes approximately 14-miles of Avista-owned shoreline that is managed in accordance with Avista's, FERC approved, Spokane River Project Land Use Management Plan (Avista 2016). For the most part this land is contiguous along the north and south shorelines and is managed primarily for conservation purposes. Specific details related to Avista's land use management activities are included in the Land Use Management Plan, a copy of which is available upon request. During 2014 Avista continued to protect this area and will pursue identifying the potential TP load that could be avoided by maintaining a

200-foot buffer along the Avista-owned lake shoreline. Avista will pursue the quantification of this activity along the wetland/restoration enhancements as the 200-foot buffer should create similar sediment-filtering effects.

- **Bulkhead Removal** - During 2012, Avista partnered with Ecology, the Spokane County Conservation District (SCD), and the Stevens County Conservation District (SCCD) 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[4].

  During 2017, 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 Tum Tum. Avista also worked with several Lake Spokane shoreline landowners in Spokane County to replace existing concrete, stacked rock, riprap, or other similar hardened bulkheads with natural shoreline materials or those that utilize bioengineered products that use native vegetation, when and where possible. Due to warm winter weather and high flows, a drawdown is not likely during the 2017/2018 season. As such, the bulkhead replacement projects will likely be targeted for winter 2018/2019.

- **Carp Population Reduction Program** – Avista implemented a large scale, multi-year common carp (*Cyprinus carpio*) removal effort on Lake Spokane in 2017. The removal effort was done in cooperation with WDFW, the Spokane Tribe of Indians, Ned Horner LLC, and the Idaho Cooperative Fishery Research Unit (U of I) and focused on testing locations and sampling methods to assess how and where to most effectively collect and remove carp. The effort was completed under a Scientific Collection Permit, issued by WDFW.

  In 2017, gill netting and boat electrofishing occurred over 3 weeks and resulted in over 1,200 carp being removed from the lake. This equates to 67.1 pounds of total phosphorus removed from Lake Spokane. This does not quantify the amount of phosphorus that will no longer be reactivated in the water column through bioturbation. The carp were weighed, measured, checked for sex and maturity, and a subset of carp had dorsal spines removed for aging analysis. All carp were removed from the water and taken the Greater Wenatchee Regional Landfill for disposal.

  Based on lessons learned from the 2017 sampling, Avista plans to remove carp again in 2018, placing gill nets in the sampling locations that had the greatest catch-per-unit-effort in 2017 sampling. Avista is also exploring the effectiveness of carp removal through an archery program. 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 Long Lake Dam spillway modifications for the TDG project in December 2016. The performance of the structural modifications and spillgate protocols were evaluated during 2017 and will be further evaluated during 2018. Water quality monitoring is also being conducted (2017 through 2018) in order to confirm the effectiveness of the spillway modifications and spillgate operations. Results of the 2017 water quality monitoring indicate TDG

[4] 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.

values downstream are frequently below incoming values, suggesting the spillway modification project has positively influenced TDG percent saturation downstream (Avista 2018a).

5.0 DISCUSSION

5.1 Lake Spokane

Temperature profile monitoring conducted during 2017 indicated that the 20.0°C Washington State criterion was exceeded within Lake Spokane at certain locations during late June through early September. The maximum temperature recorded at the lake sites was 20.8°C in late June, 24.7°C in early July, 24.9°C in early August, and 21.1°C in early September. Exceedances of 20.0°C occurred at four stations in late June, five stations in early July and early September, and all six lake stations in late July and August. Exceedances of 20.0°C within the lake occurred to depths of 2 m in June, 9 m in July, 7 m in August, and 6 m in September. 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 2017 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

The 20.0°C Washington State criterion was exceeded at LLTR on twenty-one days and reached a maximum temperature of 20.6°C (Table 3-9).

Monitoring results indicate the Spokane Tribe's 7-DADM criteria established for tribal waters were exceeded at LLTR from May 24 through May 31, and July 1 through the end of sampling on October 29 (Table 5-1, Figure 5-1). It is important to note the LLTR monitoring station, from which 2017 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 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 time periods. These conditions result in LLFB measurements that are much less consistent and reliable than those at LL0 to use as the upstream reference condition.

6.3 Summer Season, Lake Spokane Monitoring

In accordance with the DO WQAP, following completion of the 2017 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 2018 sampling program in the Lake Spokane DO WQAP 2017 Annual Summary Report (Avista 2018c). This modification includes gaining more information on core summer salmonid habitat in Lake Spokane. As such, the same lake stations will be monitored for *in situ* data only (including temperature) with the potential for additional monitoring stations incorporated into the existing current water quality program. 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.

7.0 REFERENCES

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TABLES

Table 2.1: Long Lake HED Temperature Monitoring Stations and Periods.

Monitoring Station	Location	NAD83 Decimal Degrees		2017 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	2/7/2017	9/12/2017
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	1/10/2017	9/12/2017
LL5	Long Lake sampling site 5, at RM 54.20	47.7985	117.5692	5/16/2017	10/19/2017
LL4	Long Lake sampling site 4, at RM 51.47	47.8137	117.6106	5/16/2017	10/19/2017
LL3	Long Lake sampling site 3, at RM 46.42	47.8641	117.6668	5/16/2017	10/19/2017
LL2	Long Lake sampling site 2, at RM 42.06	47.8636	117.7014	5/15/2017	10/18/2017
LL1	Long Lake sampling site 1, at RM 37.62	47.8305	117.7612	5/15/2017	10/18/2017
LL0	Long Lake sampling site 0, at RM 32.66	47.8339	117.8349	5/15/2017	10/18/2017
LLTR	On left downstream bank, at water pump house approximately 0.6 mile downstream from Long Lake Dam.	47.8375	117.8503	3/10/2017	11/1/2017
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	

Table 3.1: Spokane River at Nine Mile Bridge (54A090) Temperature Monitored in 2017.

Date	Maximum Daily Water Temperature (°C)
2/7/17 16:20	2.6
3/7/17 15:10	3.0
4/4/17 14:55	5.1
5/2/17 14:50	8.9
6/6/17 16:50	17.1
8/8/17 15:00	16.5
9/12/17 14:35	15.2

Notes:

On February 16, 2018, accessed preliminary data from Ecology's website: https://fortress.wa.gov/ecy/eimreporting/Eim/EIMSearchResults.aspx?ResultType=EIMTabs&LocationUserId=54A090&LocationUserIdSearchType=Contains&FieldActivityDateRangeBeginning=1%2f1%2f2017+12%3a00%3a00+AM&FieldActivityDateRangeEnding=12%2f31%2f2017+12%3a00%3a00+AM

The 20.0°C criterion was not exceeded at this monitoring location in 2017.

Table 3.2: Little Spokane River Upstream of Lake Spokane (55B070) Temperature Monitored in 2017.

Date	Maximum Daily Water Temperature (°C)
1/10/17 16:10	5.2
2/7/17 15:45	6.0
3/7/17 14:45	4.1
4/4/17 14:25	8.6
5/2/17 14:00	12.0
6/6/17 15:45	15.7
7/11/17 15:25	17.4
8/8/17 14:20	15.5
9/12/17 14:10	13.4

Notes:

On Fenruary 16, 2018, accessed preliminary data from Ecology's website: https://fortress.wa.gov/ecy/eimreporting/Eim/EIMSearchResults.aspx?ResultType=EIMTabs&LocationUserId=55B070&LocationUserIdSearchType=Contains&FieldActivityDateRangeBeginning=1%2f1%2f2017+12%3a00%3a00+AM&FieldActivityDateRangeEnding=12%2f31%2f2017+12%3a00%3a00+AM

The 20.0°C criterion was not exceeded at this monitoring location in 2017.

Table 3.3: LL5 Temperature Vertical Profiles in 2017.

Depth (meters)	Water Temperature (°C)									
	5/16/2017	6/6/2017	6/21/2017	7/12/2017	7/26/2017	8/9/2017	8/23/2017	9/13/2017	9/27/2017	10/19/2017
0.5	11.4	16.8	16.5	18.7	**21.5**	**24.2**	**22.0**	17.2	14.2	10.9
1.0	11.4	16.8	16.5	18.3	17.7	**24.0**	**21.8**	15.5	14.1	10.9
2.0	11.4	16.8	16.3	18.2	17.6	17.0	16.0	15.0	14.0	10.9
3.0	11.4	16.8	16.3	18.2	17.5	16.7	15.8	15.0	13.9	10.9
4.0	11.4	16.8	16.2	18.1	17.5	16.6	15.8	14.9	14.0	10.9
5.0	11.4	16.8	16.2	18.1	17.5	16.6	15.7	14.9	13.9	10.9
Max Change (°C/m)[1]	0.0	0.0	0.2	0.8	**7.6**	**7.0**	**5.8**	**3.4**	0.2	0.0
Depth of Max Change (m) [2, 3]	N/A	N/A	1.50	0.75	0.75	1.50	1.50	0.75	0.75	N/A

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)

Table 3.4: LL4 Temperature Vertical Profiles in 2017.

Depth (meters)	Water Temperature (°C)									
	5/16/2017	6/6/2017	6/21/2017	7/12/2017	7/26/2017	8/9/2017	8/23/2017	9/13/2017	9/27/2017	10/19/2017
0.5	11.4	17.0	17.5	**24.0**	**24.2**	**24.9**	**23.2**	**20.9**	16.9	10.8
1.0	11.4	17.0	17.3	**24.0**	**24.2**	**24.9**	**23.1**	**20.9**	16.8	10.8
2.0	11.4	16.9	17.3	**23.9**	**24.1**	**24.9**	**23.0**	**20.8**	16.6	10.8
3.0	11.4	16.8	17.2	**23.5**	**23.9**	**24.4**	**22.7**	**20.8**	15.1	10.8
4.0	11.4	16.8	17.2	**21.6**	**22.8**	**23.7**	**22.2**	**20.3**	14.4	10.8
5.0	11.4	16.8	17.2	19.2	19.1	**20.8**	19.4	18.4	14.2	10.8
6.0	11.4	16.8	17.2	19.0	17.9	17.2	16.4	15.5	14.2	10.8
7.0	11.4	16.8	17.2	19.0	17.8	17.2	16.2	15.5	14.2	10.7
8.0	11.4	16.8	17.2	18.9	17.9	17.1	16.1	15.5	14.2	10.7
Max Change (°C/m)[1]	0.0	0.1	0.4	**2.4**	**3.7**	**3.6**	**3.0**	**2.9**	**1.5**	0.1
Depth of Max Change (m)[2]	N/A	1.50	0.75	4.50	4.50	5.50	5.50	5.50	2.50	6.50

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.

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

Table 3.5: LL3 Temperature Vertical Profiles in 2017.

Depth (meters)	Water Temperature (°C)									
	5/16/2017	6/6/2017	6/21/2017	7/12/2017	7/26/2017	8/9/2017	8/23/2017	9/13/2017	9/27/2017	10/19/2017
0.5	11.3	16.9	**20.2**	**24.7**	**24.1**	**24.8**	**23.1**	**20.6**	17.1	12.9
1.0	11.3	16.9	**20.2**	**24.7**	**24.1**	**24.9**	**23.1**	**20.8**	17.2	12.9
2.0	11.3	16.8	**20.1**	**24.7**	**24.1**	**24.9**	**23.1**	**20.8**	17.2	12.9
3.0	11.3	16.8	20.0	**24.3**	**24.0**	**24.7**	**23.1**	**20.8**	17.1	12.9
4.0	11.3	16.8	19.2	**23.5**	**23.9**	**24.3**	**22.6**	**20.8**	17.1	12.9
5.0	11.3	16.8	19.0	**21.6**	**23.1**	**23.3**	**21.7**	**20.7**	17.0	12.9
6.0	11.3	16.8	18.8	**21.0**	**22.4**	**22.1**	**20.6**	19.9	16.9	12.4
7.0	11.3	16.7	18.7	**20.1**	**21.5**	**21.1**	19.8	19.1	16.8	12.2
8.0	11.3	16.7	18.2	19.7	**20.6**	20.0	19.0	18.6	16.7	12.1
9.0	11.3	16.7	17.7	19.4	**20.2**	19.6	18.7	18.2	16.5	11.8
10.0	11.3	16.7	17.3	19.2	19.3	19.3	18.5	17.3	16.3	11.6
12.0	11.3	16.7	17.2	19.0	18.7	18.3	17.8	16.8	15.2	11.3
15.0	11.3	16.6	17.1	18.1	18.7	17.8	16.8	16.1	14.3	11.0
18.0	11.3	16.5	16.8	17.4	18.6	17.7	16.6	15.9	14.2	10.9
18.5			16.6	17.4	18.6			15.9	14.2	10.9
19.0		16.5					16.6			
19.5	11.3					17.7				
Max Change (°C/m)[1]	0.0	0.1	0.8	**1.9**	0.9	**1.2**	**1.1**	0.9	0.6	0.5
Depth of Max Change (m)[2]	N/A	6.50	3.50	4.50	6.50	5.50	5.50	9.50	11.00	5.50

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.

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

Table 3.6: LL2 Temperature Vertical Profiles in 2017.

Depth (meters)	Water Temperature (°C)									
	5/15/2017	6/5/2017	6/20/2017	7/11/2017	7/25/2017	8/8/2017	8/22/2017	9/12/2017	9/26/2017	10/18/2017
0.5	11.6	18.0	**20.6**	**24.1**	**23.8**	**24.9**	**23.4**	**21.1**	17.4	13.1
1.0	11.2	17.8	**20.6**	**24.1**	**23.7**	**24.9**	**23.0**	**21.0**	17.3	13.1
2.0	11.2	17.4	19.0	**24.0**	**23.5**	**24.7**	**22.9**	**20.9**	17.2	13.0
3.0	11.1	17.4	18.6	**23.8**	**23.5**	**24.7**	**22.7**	**20.9**	17.1	13.0
4.0	11.1	17.3	18.5	**23.8**	**23.4**	**24.5**	**22.6**	**20.8**	17.1	13.0
5.0	11.1	17.1	18.2	**23.7**	**23.3**	**23.9**	**22.6**	**20.6**	17.0	13.0
6.0	11.1	17.1	17.7	**23.5**	**23.1**	**21.3**	**20.4**	19.3	17.0	13.0
7.0	11.0	17.1	17.6	**20.2**	**22.1**	**20.4**	19.4	18.6	16.9	13.0
8.0	11.0	17.0	17.5	19.8	**20.9**	19.8	19.0	18.0	16.7	13.0
9.0	11.0	17.0	17.1	19.6	20.0	19.2	18.7	17.9	16.5	13.0
10.0	11.0	17.0	16.8	19.4	19.5	19.0	18.6	17.6	16.4	12.9
12.0	11.0	17.0	15.9	18.9	19.0	18.5	18.2	17.3	16.1	12.9
15.0	10.9	16.9	15.7	18.3	18.6	18.5	17.9	16.9	15.3	12.5
18.0	10.8	16.9	15.4	17.9	18.2	18.3	17.5	16.5	14.0	11.3
21.0	10.8	16.8	15.4	17.3	17.8	18.3	17.3	15.8	13.7	11.3
24.0	10.8	16.6	15.3	16.9	17.4	17.9	17.0	15.4	13.6	11.1
25.0		16.6	15.3	16.6	17.0	17.3	17.0	15.3	13.6	
25.5	10.8									11.1
Max Change (°C/m)[1]	0.8	0.4	**1.6**	**3.3**	**1.2**	**2.6**	**2.2**	**1.3**	0.4	0.4
Depth of Max Change (m)[2]	0.75	1.50	1.50	6.50	7.50	5.50	5.50	5.50	16.50	16.5

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.

Table 3.7: LL1 Temperature Vertical Profiles in 2017.

Depth (meters)	Water Temperature (°C)									
	5/15/2017	6/5/2017	6/20/2017	7/11/2017	7/25/2017	8/8/2017	8/22/2017	9/12/2017	9/26/2017	10/18/2017
0.5	12.1	18.7	**20.8**	**23.5**	**23.6**	**24.7**	**23.0**	**21.1**	17.3	13.3
1.0	11.9	18.6	**20.4**	**23.5**	**23.3**	**24.7**	**23.1**	**21.0**	17.3	13.3
2.0	11.8	18.5	19.4	**23.3**	**23.1**	**24.6**	**22.8**	**21.0**	17.2	13.3
3.0	11.7	18.0	19.0	**23.3**	**23.1**	**24.6**	**22.6**	**21.0**	17.1	13.3
4.0	11.7	17.9	18.4	**23.2**	**23.1**	**24.5**	**22.5**	**20.8**	17.1	13.3
5.0	11.5	17.8	18.0	**22.0**	**23.0**	**23.4**	**22.4**	**20.8**	17.1	13.3
6.0	11.5	17.6	17.6	**21.4**	**23.0**	**21.6**	**20.9**	**20.5**	17.0	13.3
7.0	11.4	17.6	17.4	**20.5**	**22.4**	**20.3**	19.7	19.5	17.0	13.3
8.0	11.4	17.4	17.0	**20.2**	**21.2**	19.7	19.2	18.5	17.0	13.3
9.0	11.4	17.3	17.0	19.6	**20.1**	19.4	18.9	18.3	16.9	13.3
10.0	11.4	17.3	16.8	19.4	19.5	19.1	18.7	18.0	16.5	13.3
12.0	11.4	16.9	16.7	18.9	19.1	18.8	18.4	17.5	16.1	13.3
15.0	11.4	16.6	16.4	18.3	18.8	18.5	17.9	17.1	15.7	13.2
18.0	11.4	16.4	15.9	17.7	18.4	18.4	17.5	16.8	15.1	13.1
21.0	11.4	16.1	15.5	17.2	18.1	18.2	17.2	16.5	14.5	12.1
24.0	11.4	15.8	15.3	16.8	17.7	17.8	17.0	16.1	13.5	11.8
27.0	11.4	15.1	15.3	16.3	17.0	16.7	16.8	15.8	13.2	11.6
30.0	11.4	14.4	15.3	15.8	16.2	16.2	16.7	15.5	13.1	11.5
33.0	11.4	13.5	15.3	15.6	16.0	15.7	15.9	15.4	13.0	11.5
Max Change (°C/m)[1]	0.4	0.5	1.0	**1.2**	**1.2**	**1.8**	**1.5**	1.0	0.4	0.3
Depth of Max Change (m)[2]	0.75	2.50	1.50	4.50	7.50	5.50	5.50	6.50	9.50	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 2017.

Depth (meters)	Water Temperature (°C)									
	5/15/2017	6/5/2017	6/20/2017	7/11/2017	7/25/2017	8/8/2017	8/22/2017	9/12/2017	9/26/2017	10/18/2017
0.5	12.0	18.4	**20.4**	**23.4**	**22.6**	**24.5**	**22.3**	**20.7**	17.0	13.3
1.0	11.9	18.2	19.9	**23.4**	**22.6**	**24.5**	**22.3**	**20.7**	17.1	13.3
2.0	11.9	18.1	18.8	**23.3**	**22.5**	**24.5**	**22.2**	**20.7**	17.1	13.3
3.0	11.9	18.1	18.4	**21.2**	**22.4**	**24.5**	**22.2**	**20.7**	17.1	13.3
4.0	11.9	17.9	18.2	**20.7**	**22.3**	**23.6**	**22.2**	**20.7**	17.0	13.3
5.0	11.9	17.4	17.9	**20.5**	**22.3**	**22.4**	**21.7**	**20.6**	17.1	13.3
6.0	11.9	17.1	17.7	**20.2**	**21.3**	**21.0**	**20.4**	19.5	17.1	13.3
7.0	11.9	17.1	17.6	**20.1**	**20.4**	**20.1**	19.5	19.1	17.1	13.3
8.0	11.9	17.0	17.3	19.8	20.0	19.6	18.9	18.6	17.1	13.3
9.0	11.9	17.0	17.1	19.4	19.6	19.2	18.7	18.2	16.9	13.3
10.0	11.9	16.9	17.0	19.2	19.3	19.0	18.6	17.9	16.6	13.3
12.0	11.9	16.7	16.6	18.9	18.9	18.8	18.4	17.6	16.2	13.0
15.0	11.9	16.5	16.4	18.5	18.6	18.5	17.9	16.9	15.8	12.8
18.0	11.8	16.4	16.3	17.9	18.0	18.4	17.5	16.6	15.3	12.8
21.0	11.8	16.3	16.0	17.3	17.9	18.0	17.0	16.4	14.7	12.6
24.0	11.8	16.3	15.9	16.5	17.2	17.4	16.8	16.3	14.2	12.4
27.0	11.6	15.8	15.8	16.0	16.6	16.6	16.6	16.1	13.8	12.3
30.0	11.4	15.7	15.7	15.8	15.9	16.1	16.1	16.0	13.7	12.3
33.0	11.4	15.2	15.7	15.6	15.6	15.7	15.7	15.7	13.6	12.2
36.0	11.0	15.0	15.6	15.4	15.4	15.5	15.3	15.3	13.6	12.1
39.0	11.0	14.3	15.7	15.3	15.2	15.1	15.0	15.0	13.6	12.1
42.0	10.9	14.0	15.7	15.2	15.1	15.0	14.9	14.8	13.5	12.1
45.0	10.6	14.0	15.6	15.2	15.0	14.9	14.8	14.7	13.5	12.1
46.0	10.6									
46.5		13.9								
47.0			15.6	15.1	15.0	14.9	14.8	14.6	13.5	12.0
Max Change (°C/m)[1]	0.2	0.5	**1.1**	**2.1**	1.0	**1.4**	**1.3**	**1.1**	0.3	0.2
Depth of Max Change (m)[2]	0.75	4.50	1.50	2.50	5.50	5.50	5.50	5.50	9.50	11.00

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.

Table 3.9: LLTR Daily Maximum Temperature in 2017.

Day	Water Temperature (°C)								
	March	April	May	June	July	August	September	October	November
1	Not Monitored	5.4	9.4	15.8	18.6	20.0	18.5	15.6	11.4
2		5.4	9.7	16.0	18.5	**20.6**	18.7	15.7	Not Monitored
3		5.6	10.2	16.5	18.5	**20.4**	18.6	15.8	
4		5.7	10.3	16.7	19.2	**20.3**	18.8	15.7	
5		5.9	10.3	17.3	19.1	**20.3**	18.8	15.6	
6		5.9	10.3	17.1	19.1	**20.2**	18.5	15.4	
7		6.3	10.8	17.5	19.0	**20.2**	18.2	14.9	
8		6.4	11.1	17.5	19.5	**20.2**	18.3	14.5	
9		6.5	11.4	17.3	19.5	**20.1**	18.3	14.6	
10	4.1	6.5	11.6	17.3	19.6	**20.1**	18.0	14.4	
11	4.1	6.5	11.7	17.5	19.9	**20.1**	18.1	14.3	
12	4.0	6.4	11.7	17.2	**20.1**	20.0	18.1	13.9	
13	4.0	6.4	11.8	17.1	19.9	20.0	17.9	13.8	
14	4.5	6.7	11.8	17.0	**20.2**	19.8	18.4	13.6	
15	5.0	7.0	11.9	17.0	19.8	19.7	18.2	13.4	
16	5.0	7.4	11.7	17.1	19.6	19.9	18.0	13.5	
17	5.2	7.4	11.7	17.2	20.0	19.5	17.4	13.1	
18	5.3	7.5	11.6	17.0	20.0	19.6	17.4	12.9	
19	5.1	7.5	11.7	#NA	**20.5**	19.1	17.0	13.0	
20	4.6	7.5	11.9	16.7	20.0	19.2	17.0	12.7	
21	4.5	8.1	12.4	#NA	**20.1**	19.3	16.7	12.4	
22	4.3	8.3	12.8	16.9	**20.1**	19.2	16.6	12.4	
23	4.4	8.3	13.5	17.5	20.0	19.5	16.5	12.1	
24	4.5	8.4	13.5	17.6	20.0	19.2	16.7	12.1	
25	4.6	8.7	14.3	17.8	20.0	19.1	16.1	12.1	
26	4.5	8.8	14.5	17.9	**20.1**	19.1	16.1	11.9	
27	4.7	8.8	14.5	18.0	**20.3**	19.1	15.9	11.9	
28	4.7	9.2	14.6	18.1	**20.3**	18.9	16.0	11.8	
29	4.9	9.1	14.9	18.4	**20.3**	18.9	15.9	11.7	
30	5.0	9.0	15.5	18.8	**20.2**	18.7	15.7	11.6	
31	5.0		15.5		**20.2**	18.5		11.5	

Notes:

#NA= not enough days to calulate the daily maximum.
Shaded and bold values indicate an exceedance of the 20.0°C criterion.
Data collected as part of Avista's Washington Total Dissolved Gas Monitoring Plan and Detailed DO Phase II Feasibility and Implementation Plan.

Table 5.1: Comparison of LLTR 2017 Values to Spokane Tribe WQ Standards.

Day	Water Temperature (°C)								
	March	April	May	June	July	August	September	October	November
1	Not Monitored	5.3	9.6	15.8	**18.6**	**20.3**	**18.7**	**15.8**	#NA
2		5.4	9.7	16.2	**18.7**	**20.3**	**18.6**	**15.7**	Not Monitored
3		5.6	9.9	16.4	**18.8**	**20.3**	**18.6**	**15.6**	
4		5.7	10.2	16.7	**18.9**	**20.3**	**18.6**	**15.5**	
5		5.9	10.4	16.9	**19.0**	**20.3**	**18.6**	**15.3**	
6		6.0	10.6	17.1	**19.1**	**20.2**	**18.5**	**15.2**	
7		6.2	10.8	17.2	**19.3**	**20.2**	**18.4**	**15.0**	
8		6.3	11.0	17.4	**19.4**	**20.2**	**18.3**	**14.8**	
9		6.3	11.2	17.4	**19.5**	**20.1**	**18.2**	**14.6**	
10	#NA	6.4	11.4	17.4	**19.6**	**20.1**	**18.1**	**14.3**	
11	#NA	6.5	11.6	17.3	**19.8**	**20.1**	**18.2**	**14.2**	
12	#NA	6.6	11.7	17.2	**19.8**	**20.0**	**18.1**	**14.0**	
13	4.4	6.7	11.7	17.2	**19.9**	**19.9**	**18.1**	**13.8**	
14	4.5	6.8	11.7	17.2	**19.9**	**19.9**	**18.0**	**13.7**	
15	4.7	7.0	11.7	17.1	**19.9**	**19.8**	**17.9**	**13.5**	
16	4.9	7.1	11.7	#NA	**20.0**	**19.6**	**17.8**	**13.3**	
17	4.9	7.3	11.7	#NA	**20.0**	**19.5**	**17.6**	**13.2**	
18	4.9	7.5	11.8	#NA	**20.0**	**19.4**	**17.4**	**13.0**	
19	4.9	7.7	12.0	#NA	**20.0**	**19.4**	**17.2**	**12.9**	
20	4.8	7.8	12.2	#NA	**20.1**	**19.3**	**16.9**	**12.7**	
21	4.7	7.9	12.5	#NA	**20.1**	**19.3**	**16.8**	**12.5**	
22	4.6	8.1	12.9	#NA	**20.1**	**19.2**	**16.7**	**12.4**	
23	4.5	8.3	13.3	#NA	**20.0**	**19.2**	**16.5**	**12.2**	
24	4.5	8.5	**13.6**	#NA	**20.1**	**19.2**	**16.4**	**12.1**	
25	4.5	8.6	**13.9**	17.7	**20.1**	**19.1**	**16.3**	**12.0**	
26	4.6	8.8	**14.2**	17.9	**20.1**	**19.1**	**16.2**	**11.9**	
27	4.7	8.9	**14.5**	18.1	**20.1**	**19.0**	**16.1**	**11.9**	
28	4.8	9.0	**14.8**	18.2	**20.2**	**18.9**	**15.9**	**11.8**	
29	4.9	9.2	**15.0**	18.3	**20.2**	**18.8**	**15.8**	**11.7**	
30	5.0	9.4	**15.2**	18.4	**20.3**	**18.7**	**15.8**	#NA	
31	5.2		**15.5**		**20.3**	**18.7**		#NA	

Notes:

#NA= not enough days to calulate the 7-DADM
Shaded and bold values indicate an exceedance of the 20.0°C criterion.
Data collected as part of Avista's Washington Total Dissolved Gas Monitoring Plan and Detailed DO Phase II Feasibility and Implementation Plan.

FIGURES

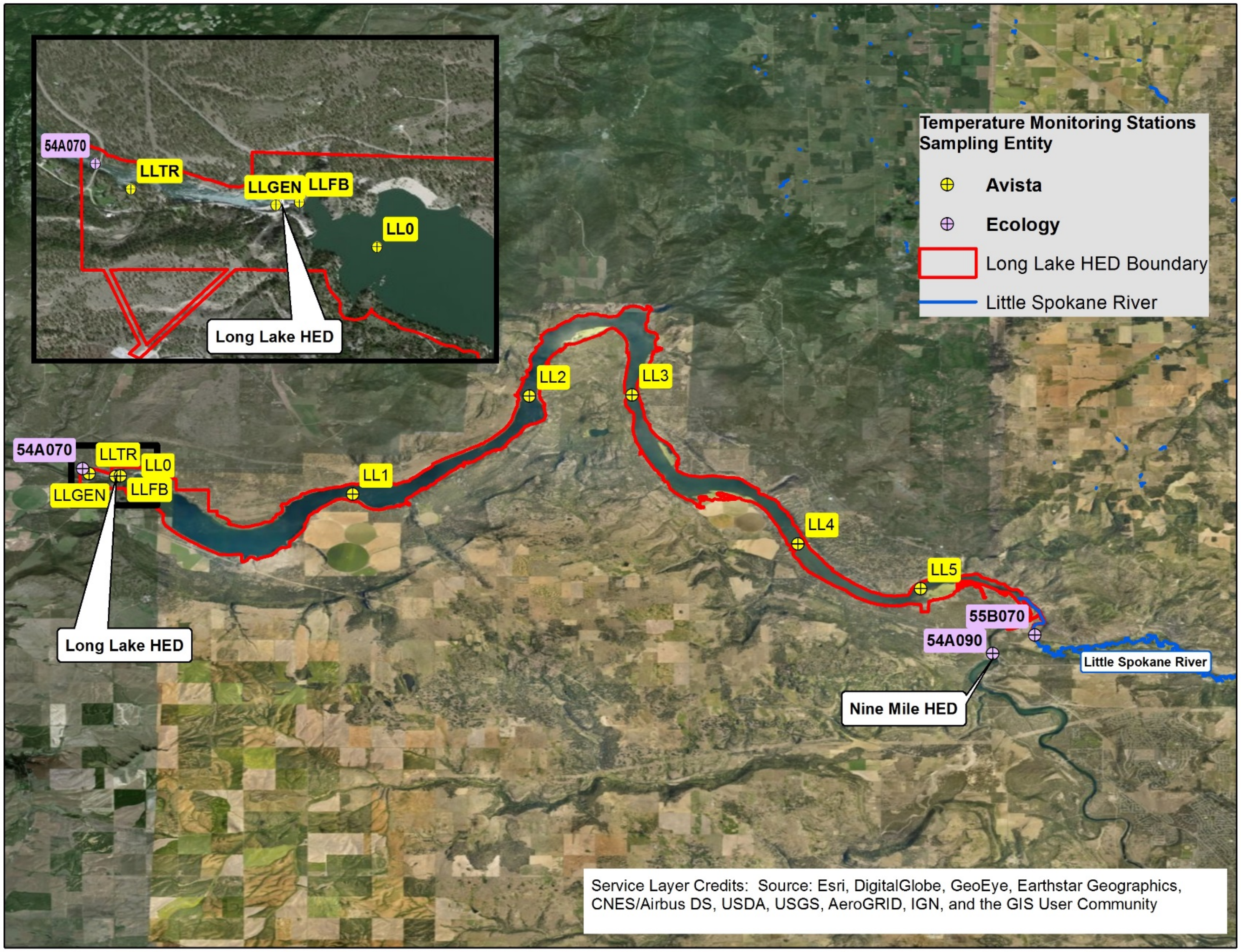

Figure 2-1: Long Lake HED 2017 Temperature Monitoring Stations.

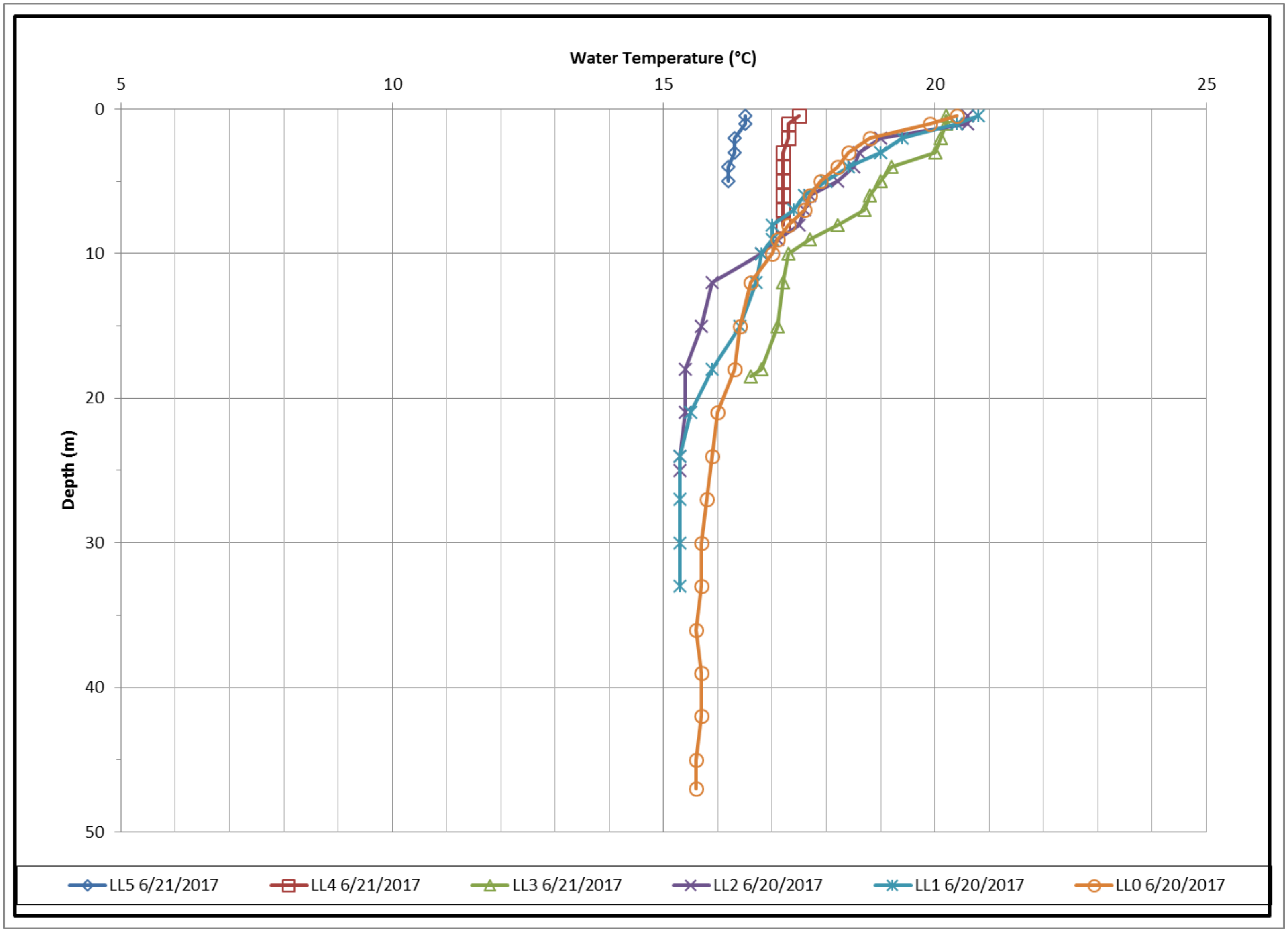

Figure 3-1: Lake Spokane Temperature Vertical Profiles, Late June 2017.

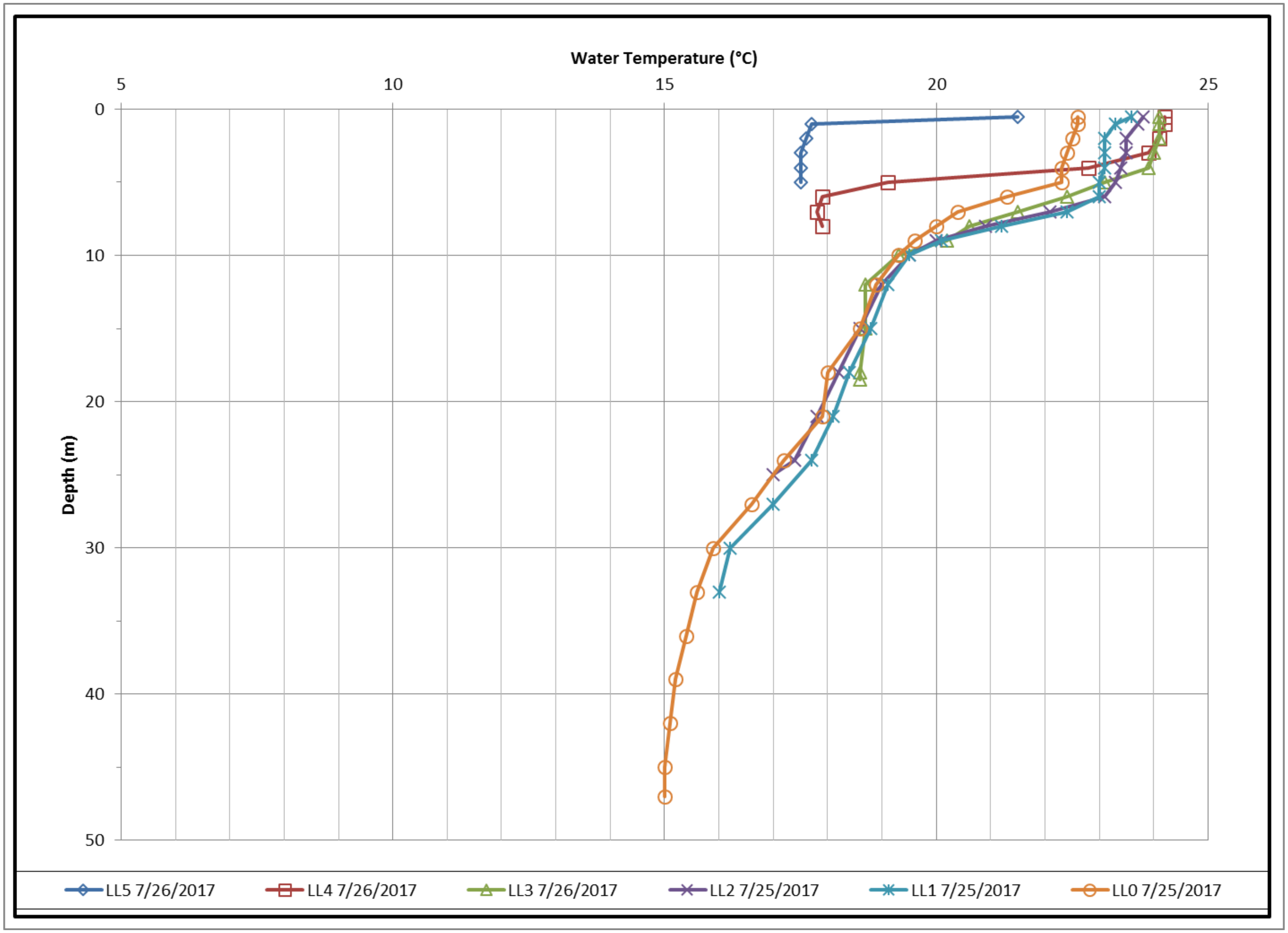

Figure 3-2: Lake Spokane Temperature Vertical Profiles, Late July 2017.

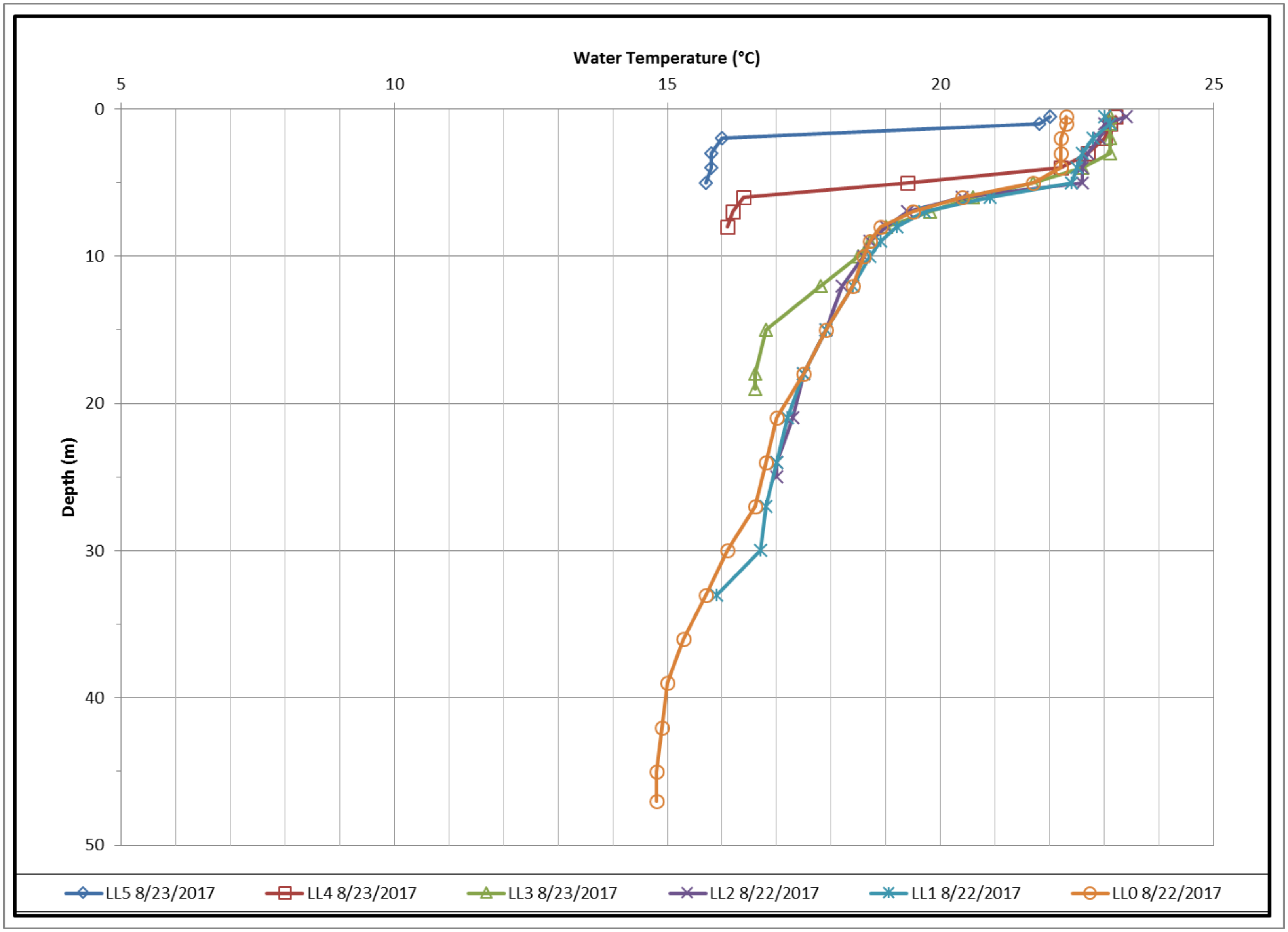

Figure 3-3: Lake Spokane Temperature Vertical Profiles, Late August 2017.

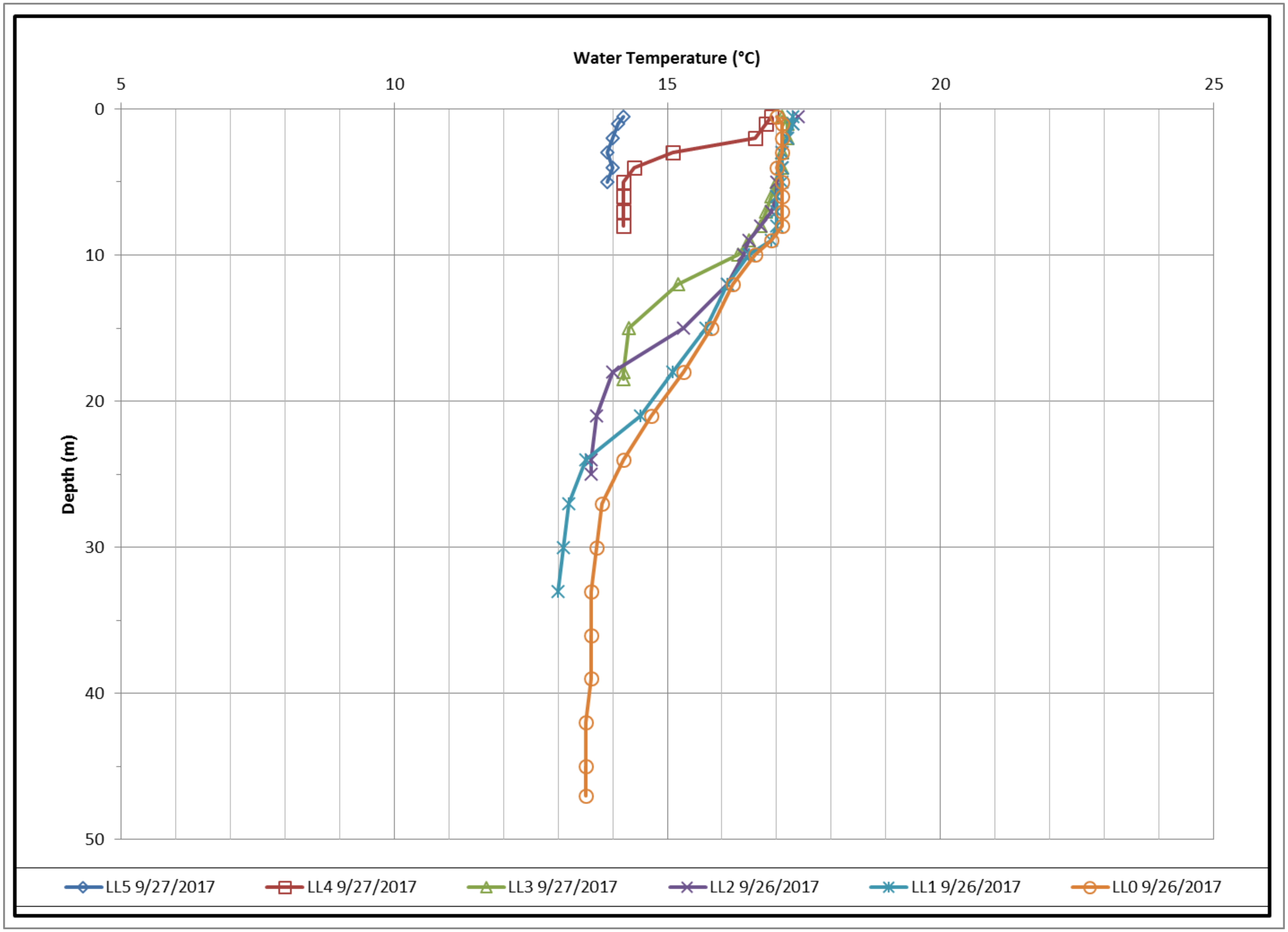

Figure 3-4: Lake Spokane Temperature Vertical Profiles, Late September 2017.

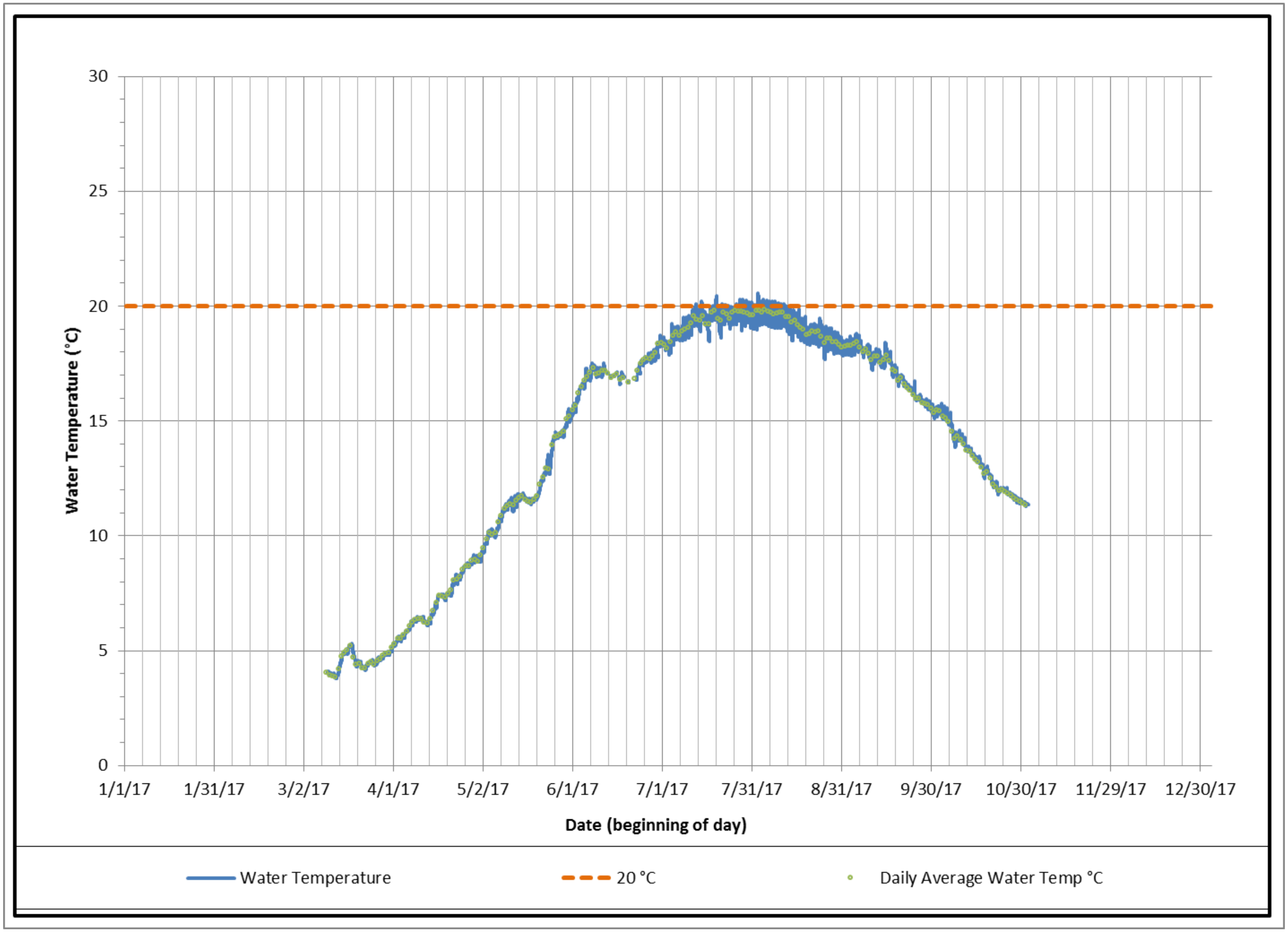

Figure 3-5: LLTR Temperature Time Series, 2017.

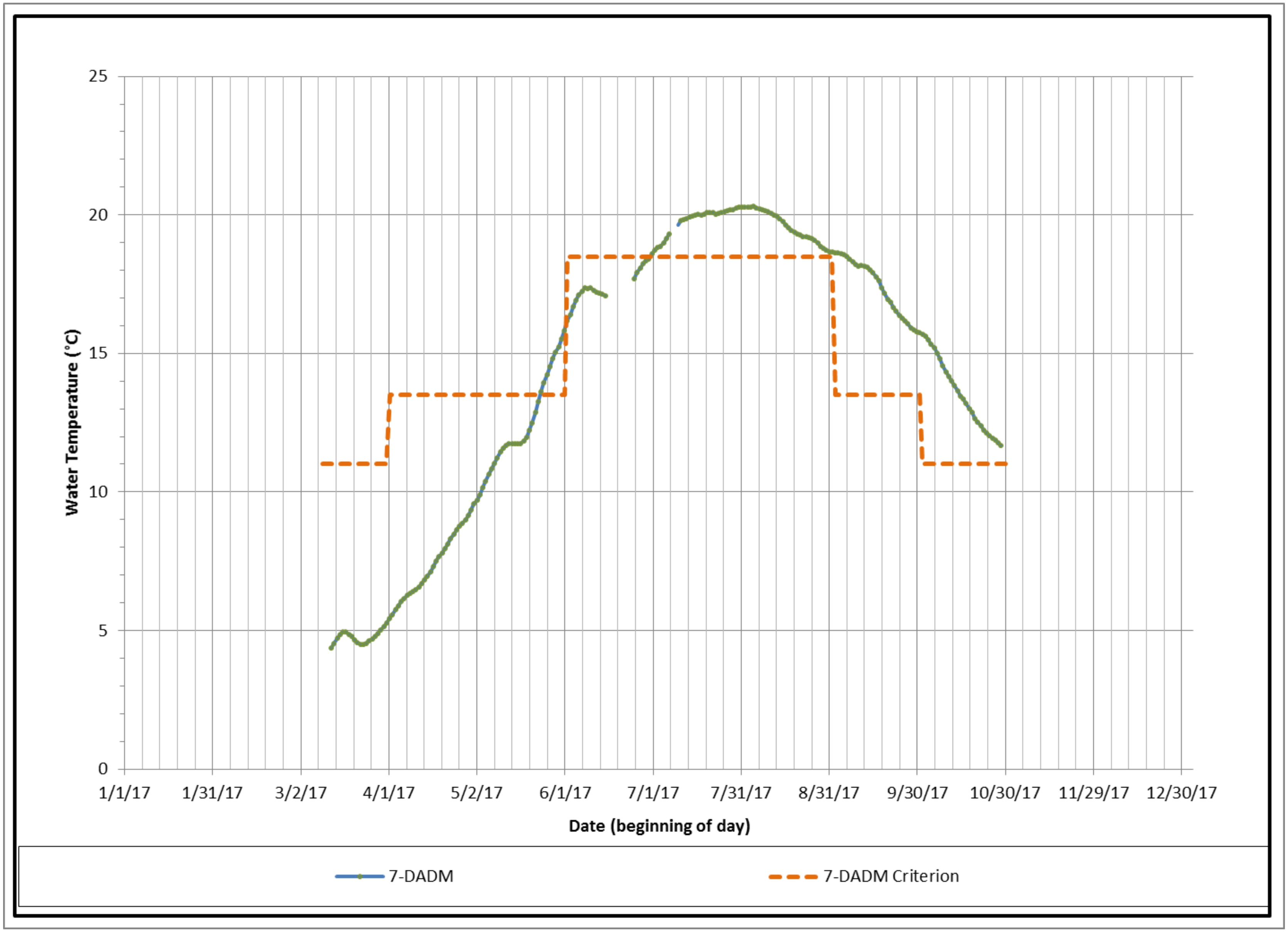

Figure 5-1: LLTR 7-DADM Time Series, 2017.

APPENDIX A

CONSULTATION RECORD

AVISTA

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

February 28, 2018

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
2017 Long Lake Hydroelectric Development Temperature Monitoring Report

Dear Pat:

I have enclosed the 2017 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 30, 2018**. This will allow us time to incorporate your comments and recommendations as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2018.

Please feel free to call me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Chris Moan
Fisheries Habitat Biologist

Enclosure (1)

cc: Chad Brown, Ecology
Brian Crossley, Spokane Tribe
Speed Fitzhugh, Avista
Meghan Lunney, Avista

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

March 30, 2018

Mr. Chris Moan
Fisheries Habitat Biologist
Avista Corporation
1411 East Mission Avenue, MSC-1
Spokane, WA 99220-3727

RE: Request for Ecology Review and Approval – *2017 Long Lake HED Temperature Monitoring Report*
Spokane River Hydroelectric Project, No. P-2545

Dear Mr. Moan:

The Department of Ecology (Ecology) has reviewed the *2017 Long Lake HED Temperature Monitoring Report* sent to Ecology on February 28, 2018. The report is a requirement in FERC License Appendix B, Section 5.5.B.

Ecology APPROVES the *2017 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,

Pat McGuire

Patrick McGuire
Eastern Region FERC License Coordinator
Water Quality Program

PDM:red
cc: Elvin "Speed" Fitzhugh, Avista
Meghan Lunney, Avista
Chad Atkins, Ecology

ECOLOGY COMMENTS AND AVISTA RESPONSES

Ecology Comment
Ecology approves the *2017 Long Lake HED Temperature Monitoring Report* as submitted.

Avista Response
Avista appreciates Ecology's review and approval of the *2017 Long Lake HED Temperature Monitoring Report.*

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

February 28, 2018

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
2017 Long Lake Hydroelectric Development Temperature Monitoring Report

Dear Brian:

I have enclosed the 2017 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 30, 2018**. This will allow us time to incorporate your comments as appropriate, and submit the Temperature Monitoring Report to FERC by April 15, 2018.

Please feel free to call me at (509) 495-4084 or Meghan Lunney at (509) 495-4643 if you have any questions about the Temperature Monitoring Report.

Sincerely,

Chris Moan
Fisheries Habitat Biologist

Enclosure (1)

cc: Patrick McGuire, Ecology
Speed Fitzhugh, Avista
Meghan Lunney, Avista

SPOKANE TRIBE COMMENTS AND AVISTA RESPONSES

Spokane Tribe Comment
The Spokane Tribe had no comments for the *2017 Long Lake HED Temperature Monitoring Report*.

Avista Response
Avista appreciates the Spokane Tribe's review of the *2017 Long Lake HED Temperature Report.*