M E M O R A N D U M

EUGENE WATER & ELECTRIC BOARD

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TO: Commissioners Brown, Carlson, Mital, Simpson and Helgeson

FROM: Mike McCann, Electric Generation Manager; Lisa McLaughlin, Environmental Supervisor

DATE: November 21, 2018

SUBJECT: Lower McKenzie River Water Temperature Study - 2018 Results

OBJECTIVE: Information Only

Issue

This memorandum presents water temperature data from 2018, the second year of a two-year study on river temperatures in the lower McKenzie River in proximity to EWEB's Leaburg and Walterville hydroelectric projects.

Background

On March 7, 2017, staff submitted a memorandum to the Board regarding the impacts of the Leaburg and Walterville hydroelectric projects on river temperatures in the lower McKenzie River. The March 7th memorandum entitled *Lower McKenzie River Water Temperature* contained background information on the temperature studies that had been conducted previously in support of the relicensing of the projects and the development of the Total Maximum Daily Loads (TMDLs) for the McKenzie River. Due to the lack of recent temperature data, staff recommended that EWEB initiate a two-year water temperature monitoring study in order to better understand temperature dynamics and the potential effect of the Leaburg and Walterville hydroelectric projects on water temperatures in the McKenzie River. In response to this staff recommendation, EWEB initiated a temperature study between May and October of 2017 and 2018. This memorandum provides a description of the study design, highlights some of the data that was generated in 2018, and compares the 2017 and 2018 results.

Methods and Project Description

On May 14, 2018, EWEB deployed 14 *Tidbit* temperature loggers at various locations within the project area. All of the loggers were retrieved on October 16th. The loggers were deployed upstream and downstream of EWEB facilities and were programmed to record temperature readings every half hour. Ten of the loggers were deemed to be the most critical in determining potential impacts to water temperature and are the subject of this analysis. Their location within the project area is depicted in Figure 1. In an effort to compare study results with previous DEQ modeling efforts, the average of seven consecutive daily maximum temperatures (7DADM) on a rolling basis was used for this analysis.

Leaburg Project

The Leaburg project features a 5-mile canal flowing between the diversion at Leaburg Dam at river mile (RM) 39, and the powerhouse, at RM 39. The 5.8 mile stretch of river between the diversion at Leaburg Dam and the Leaburg powerhouse tailrace is referred to as the Leaburg bypass reach.

In order to measure temperature impacts of the Leaburg Project, temperature loggers were placed at the top of the bypass reach below the dam (Logger 1), at the canal diversion (Logger 2), at the bottom of the bypass reach above the confluence with the tailrace (Logger 3), and in the tailrace below the powerhouse (Logger 4). Temperatures at the downstream locations were compared with their upstream counterparts to determine temperature variations in the canal and bypass reach. An additional logger (Logger 5) was placed at Deerhorn Bridge, approximately 2 miles downstream of the confluence of the Leaburg tailrace and the bypass, to measure if any potential temperature impacts were detectable below the mixing of the two flows.

Walterville Project

The Walterville project includes a 4.5-mile canal and a 2-mile tailrace canal that flows from the diversion at RM 28 and returns to the McKenzie River at RM 21. The 7.3-mile stretch of river between the Walterville Tailrace and the Walterville canal intake is referred to as the Walterville bypass reach.

To measure temperature impacts of the Walterville Project, temperature loggers were placed at the canal diversion (Logger 6), at the top of the bypass reach (Logger 7), in the tailrace above the barrier (Logger 8), and at the bottom of the bypass reach (Logger 9). Temperatures at the downstream locations were compared with their upstream counterparts to determine temperature variations in the canal and bypass reach. An additional logger (Logger 10) was placed at Bellinger Boat Ramp, approximately 2 miles downstream of the confluence of the tailrace and the bypass, to measure if any potential temperature impacts were detectable below the mixing of the two flows.

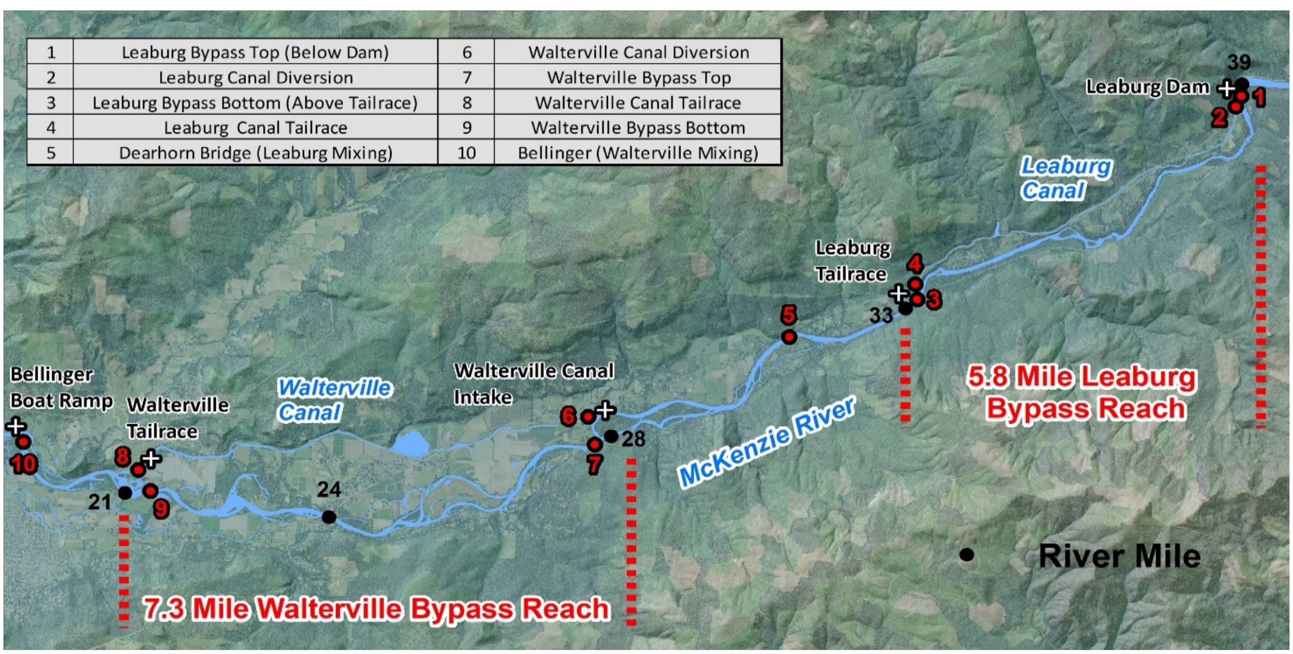

Figure 1. Locations of temperature loggers in the Leaburg-Walterville Project Area.

Results

Leaburg Project

In 2018, there was noticeable warming in the Leaburg bypass reach between the canal diversion and the tailrace reach (Figure 2). The maximum change was 0.9 °C and the median change was 0.4 °C. Although there was a slight period of warming, overall, cooling was observed at Deerhorn Bridge when compared to the downstream end of the Leaburg project.

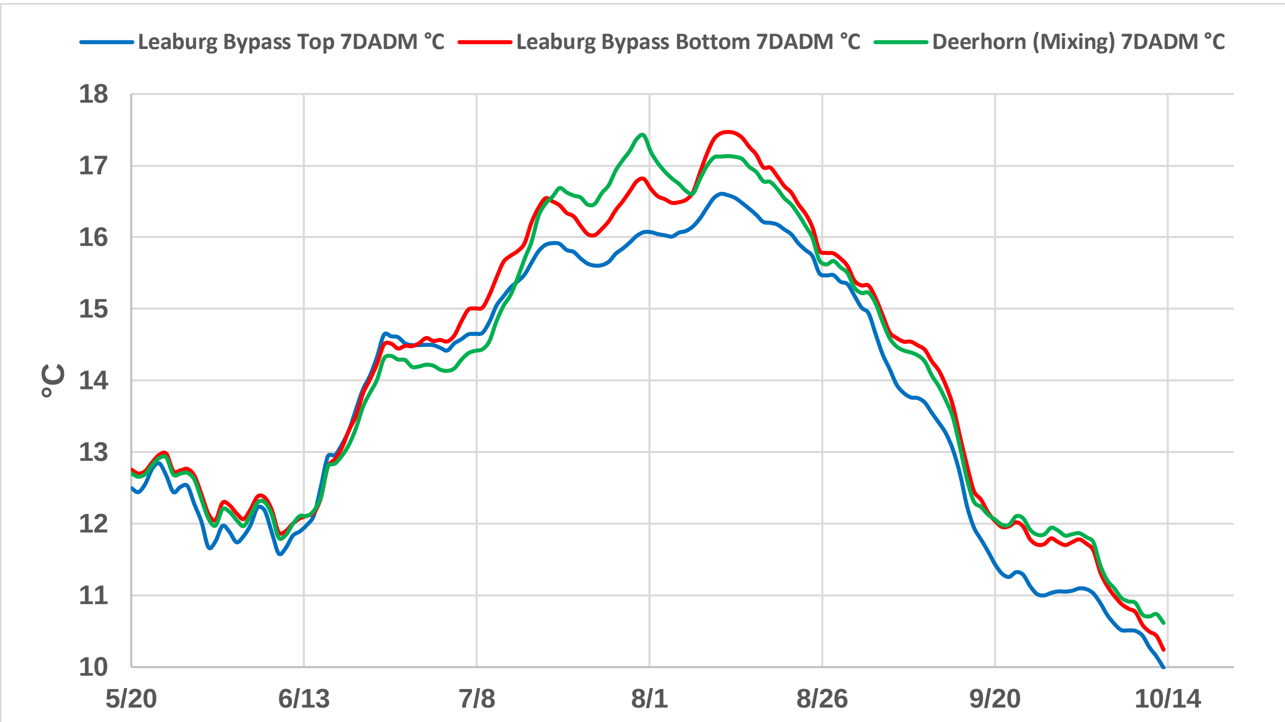

Figure 2. Comparison of temperatures (7DADM) at top of Leaburg bypass, bottom of Leaburg bypass, and Deerhorn Bridge.

Walterville Project

In 2018, there was noticeable warming in the Walterville bypass reach between the canal diversion and the tailrace. The Walterville bypass reach experienced a maximum of 2.3 °C warming during the study period and the median change was 1.3 °C (Figure 4). The river at Bellinger Boat Ramp experienced a maximum of 1.2 °C cooling and a median of 0.6 °C, when compared to the warming that occurred in the bypass reach (Figures 3).

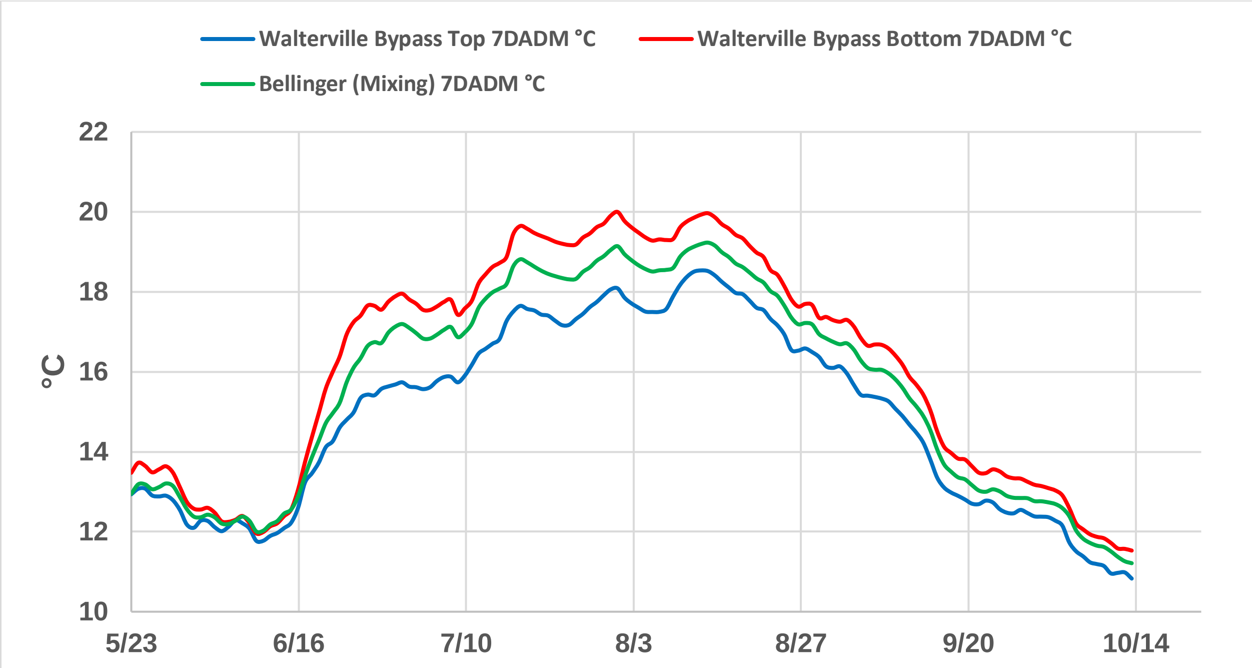

Figure 3. Comparison of temperatures (7DADM) at top of Walterville bypass, bottom of Walterville bypass and Bellinger Boat Ramp.

Discussion

The 2018 results are similar to the findings from the 2017 study with a few key differences. Unlike 2017 where there was negligible impact, the Leaburg Project appeared to have an overall warming impact in 2018, with a maximum warming of 0.9 °C and a median change of 0.4 °C. Like 2017, the Walterville bypass reach experienced warming in 2018, although less severe with a maximum of 2.3 °C and a median of 1.3 °C. The maximum and median for 2017 were 2.6 °C and 1.7 °C, respectively. Again, in 2018 there was cooling that occurred below the mixing of the canal and the bypass at Bellinger Boat Ramp, with a maximum of 1.2 °C. This is the result of the thermal moderating effects of the canal. Water diverted through the canal is exposed to less solar radiation because flow velocities are greater and the canals are deeper and narrower than the bypass reach. Conversely, the increase in water temperature in the bypass reach is due to the reduction in flow which can result in reduced heat capacity, lower stream velocities, and increased travel time. During the warm summer months, these factors allow for greater exposure to solar radiation heat loads and warmer temperatures in the bypass reach.

The results from this study are likely influenced by a combination of the operational, hydrological, and atmospheric conditions that occurred during the 2017 and 2018 study periods. The median daily maximum air temperature was 2 °C higher in 2017 than in 2018 during the study period. Even though air temperatures were on average warmer in 2017, the median daily water temperature was 0.9 °C warmer in study area in 2018. This is potentially due to the low water conditions that persisted throughout the study period in 2018. There was 21% more water flowing into the Leaburg-Walterville project area (USGS Vida gage) in 2017 than in 2018. The Leaburg and Walterville bypass reaches had roughly 12% more water in 2017 than in 2018. The comparatively low water conditions existed in the Walterville bypass reach despite the January 10, 2018 Record of Decision that states "In years with below median expected summer stream flows/snowpack, from May 20th through October 31st, EWEB will voluntarily adjust the power canal intake in order to maintain at least 10% more flow in the McKenzie bypass reach of the Walterville hydroelectric project than flows exiting the tailrace of the project". However, because of the intentional flow increase, there was more water during the late June through mid July period in 2018 than in 2017. This corresponds with the typical peak migration of spring Chinook through the bypass reach and likely improved passage around the tailrace barrier and through the return channel. The warming in the bypass is most readily observed when the reach recedes to just above the minimum flow of 1,000 cfs. This typically occurs in June after the project outage and occurred a week earlier in 2018 than in 2017.

The varying temperature effects in the two bypass reaches are due, in part, to the geomorphology of the reaches themselves. The Leaburg bypass reach is located in the middle McKenzie River Basin and is characterized by narrow, confined, and stable riffle pool morphology which results in higher stream velocities and decreased travel times as compared to the Walterville bypass reach. The Walterville bypass is located in the lower McKenzie Basin and the reach is characterized by wide shallow glides, an unconfined floodplain containing numerous off-channels habitats and side-channels, all of which contribute to reduced stream velocities, increased travel time and, therefore, an increased potential for warming. The geomorphic features precede project operations and have likely contributed to historical variances in the temperature regimes of the reaches.

Requested Board Action

None. This memorandum is provided for informational purposes only.