PacifiCorp Energy

Ashton Hydroelectric Project FERC No. 2381

Low Impact Hydroelectric Institute Certification

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Water Quality Monitoring Report

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Table of Contents

Table of Figures

1.0 INTRODUCTION

PacifiCorp Energy applied to the Low Impact Hydro Institute (LIHI) to certify the Ashton Hydroelectric Project (FERC No. P-2381) for public benefit in 2009. The project is located on the Henry’s Fork of the Snake River in Fremont County, Idaho. Ashton Dam is part of the Ashton / St. Anthony Hydroelectric Project and is owned and operated by PacifiCorp Energy. The project received its certification based on a unanimous decision from the LIHI Governing Board in October, 2010 (LIHI Certificate #61). Certification was marked effective beginning on 31 December 2009 with an expiration date of 31 December 2014.

Due to a paucity of water quality data gathered since PacifiCorp Energy received its Water Quality Certificate in 1985, the Board stipulated that one of the conditions for LIHI certification would be for PacifiCorp to monitor water quality following rehabilitation of Ashton Dam. Rehabilitation was completed and the reservoir returned to its operating elevation in December of 2012.

Excerpt from Low Impact Hydro Certification Conditions:

> *2. The Project's Water Quality Certificate is dated 1985, and there is no quantitative data to document compliance with the quantitative water quality standards. However, the fisheries are very healthy below the dam, which in part, suggests that water quality in the waters downstream of the Project is good. As a result, LIHI requires the following second set of conditions:*
>
> *A. PacifiCorp shall provide LIHI, a copy of the same documents submitted to IDEQ, and on the same schedule, as required under the Water Quality Monitoring Plan of the Consent Order established with IDEQ;*
>
> *B. PacifiCorp shall provide LIHI a letter from IDEQ, attesting to PacifiCorp's compliance with requirements of the Consent Order, within 3 months of each filing made with IDEQ;*
>
> *C. Within two years of certification, documentation is submitted to LIHI showing agreement has been reached with IDEQ on a water quality testing regime, to be implemented at the conclusion of the Remediation project, demonstrating that quantitative water quality standards are being met for parameters potentially impacted by Project activities in the reservoir and downstream; and*
>
> *D. Not later than 18 months following completion of the Remediation Project, PacifiCorp shall submit to LIHI, the data showing that these quantitative water quality standards are indeed being met, with confirming letter from IDEQ.*

This report describes results of dissolved oxygen (DO) and temperature monitoring in Ashton Reservoir and in the Henry's Fork River upstream and downstream from the reservoir following rehabilitation. Because the Federal Energy Regulatory Commission requires the project to be operated in an instantaneous run-of-river mode that is controlled by a narrow reservoir elevation, turbidity monitoring was not necessary. Water quality monitoring began on January 30, 2013 and continued through 20 December 2013. The intent of this monitoring program was to collect data to establish baseline conditions for these parameters which insure compliance with current water quality standards set by the Idaho Department of Environmental Quality (IDEQ).

2.0 OBJECTIVES

The purpose of the proposed water quality study was to obtain detailed spatial and temporal data for two parameters: temperature and DO. Specific objectives for the study include:

1. Measure and report temperature and dissolved oxygen in the Henry's Fork above, below and in Ashton Reservoir after rehabilitation of the PacifiCorp Energy's Ashton Dam to ensure compliance with IDEQ standards.
2. Increase the temporal resolution of the parameters of concern relative to past baseline monitoring.
3. Increase the spatial resolution of the parameters of concern.

3.0 BACKGROUND

3.1 Beneficial Uses

Ashton Reservoir is located on the Henry's Fork River in southeastern Idaho within the Lower Henry's Fork subbasin (HUC No. 14040203) of the Upper Snake River Basin. Beneficial uses include coldwater aquatic life, salmonid spawning, primary contact recreation, and domestic water supply. IDEQ implemented an anti-degradation policy in 2011. The focus of the policy is to protect the existing quality of its waters. There are three tiers of designation; however, no stream is designated unless the State legislature designates a water body as Tier 3, which is the highest level of protection for "Outstanding Quality Waters" (IDEQ 2011).

3.2 Fishery

Fish species in the Henry's Fork within the project vicinity include rainbow trout (*Oncorhynchus mykiss),* mountain whitefish (*Prosopium williamsoni)*, brown trout (*Salmo trutta),* Yellowstone cutthroat trout *(O. clarki lewisi),* brook trout (*Salvelinus fontinalis*), speckled dace *(Rhynichthys osculus),* mottled sculpin *(Cottus bairdi),* Paiute sculpin *(Cottus beldingi),* redside shiner (*Richardsonius balteatus*), Utah chub *(Gila atraria),* Utah sucker *(Catostomus ardens),* and mountain sucker *(C. clatyrhynchus).* Attempts to list the Yellowstone cutthroat under the Endangered Species Act in recent years have not been successful, although this could change in the future. Currently, it is listed as Species of Concern by the US Fish and Wildlife Service and a Sensitive Species in Idaho.

The Henry's Fork is managed as a wild trout fishery from its mouth to Island Park Dam. It is considered to be one of the premier rainbow trout fisheries in Idaho and is renowned by anglers throughout the US (IDFG 2007). High densities of rainbow trout reside in the project vicinity as well as the much less abundant brown and brook trout (IDFG 2009).

4.0 RELEVANT WATER QUALITYSTANDARDS

4.1 Temperature

4.1.1 IDEQ Standards

According to the Idaho Surface Water Quality Standards set by the IDEQ (2008), temperature criteria vary by designated beneficial use classification. The Henry's Fork has been designated COLD/SS, meaning it is a cold body of water with salmonid spawning. As stated in section 250.02(b), the standard for cold water is:

> *Water temperatures of twenty-two (22) degrees C or less with a maximum daily average of no greater than nineteen (19) degrees C.*

During the salmonid spawning season(s) the standard for temperature becomes more restrictive, as indicated under section 250.02(f)(ii):

Water temperatures of thirteen (13) degrees C or less with a maximum daily average of no greater than nine (9) degrees C.

Spawning and incubation periods for rainbow and brown trout have been listed as 15 March to 15 July and 1 October 1 through 1 April, respectively, under the IDEQ *Water Body Assessment Guidance* manual (Grafe et al. 2002). However, salmonid spawning times may be adjusted for site specific conditions based on IDFG data or best professional judgment of the IDFG.

4.2 Dissolved Oxygen

4.2.1 IDEQ Standards

Under Section 250.02(f)(i)(2)(a), the DO criteria for salmonid spawning are:

One (1) day minimum of not less than six point zero (6.0) mg/l or ninety percent (90%) of saturation, whichever is greater.

5.0 METHODS

5.1 Henry's Fork River

Two sample sites were monitored in this study (Figure 1; Table 1). The site above Ashton Reservoir was located approximately 0.25 mile upstream from where US Highway 20 crosses the river. This site was located an additional 200m above previous sampling sites because of Ashton Reservoirs influence. Past monitoring was located downstream near the bridge because reservoir elevations were reduced during rehabilitation. The site below the reservoir was located about 0.5 mile downstream from Ashton Dam near Ora Bridge, which is the same location used during previous monitoring from 2010 to 2012. Both water quality monitoring sites were located on the west side of the river (Figure 1).

An Onset® HOBO© U26 sensor was installed to monitor temperature and DO at each river site to measure at 15-minute intervals throughout the study period. These sensors were installed to fulfill the requirements of the 24-hour monitoring for DO and expand the data set collected throughout the monitoring period. The sensors also recorded temperature for the entire study period. The sensors were housed in a perforated PVC cylinder to allow adequate inflow and were anchored offshore using 60lb cement blocks and chains. Data was downloaded from the logger monthly using an optic shuttle and HOBOware©.

Data was collected monthly at 30-second intervals for 10 minutes at both sites using an In-Situ Troll 9500© water quality probe throughout the study period. Probe specifications for DO and temperature are shown in Table 2.

5.2 Ashton Reservoir

A sample site was located in the reservoir area immediately upstream of Ashton Dam near the log boom across the reservoir and in the deepest part of the reservoir (Figure 1).

In Ashton Reservoir, vertical profiles of temperature and DO were collected once monthly for the period of May through October in 2013.These parameters were monitored using an In-Situ Troll 9500© water quality probe. Specifications of this probe for DO are shown in Table 2.

Table 1. The description of sample locations in the Henry's Fork River and Ashton Reservoir.

Site	Description	Parameters
HF-1	Henry's Fork above Reservoir, above Hwy 20 bridge	DO, Temp loggers
HF-2	Henry's Fork below reservoir, near Ora bridge	DO, Temp loggers
AR-1	Ashton Reservoir upstream of powerhouse	DO & Temp profiles

Table 2. Troll 9500 and Hobo U26 sensor specifications.

Meter	Parameter	Accuracy	Accuracy Range	Methodology
Troll 9500	Temperature, °C	±0.1 °C	-5 °C to 50 °C	EPA 170.1
Troll 9500	Dissolved oxygen, mg/L and % saturation	±0.1 mg/L, ±0.2 mg/L	0-8 mg/L, 8-20 mg/L	ASTM D888-05, Test Method C
Hobo U26	Temperature, °C	±0.1 °C	-5 °C to 40 °C	
Hobo U26	Dissolved oxygen, mg/L and % saturation	±0.2 mg/L, ±0.5 mg/L	0-8 mg/L, 8-20 mg/L	

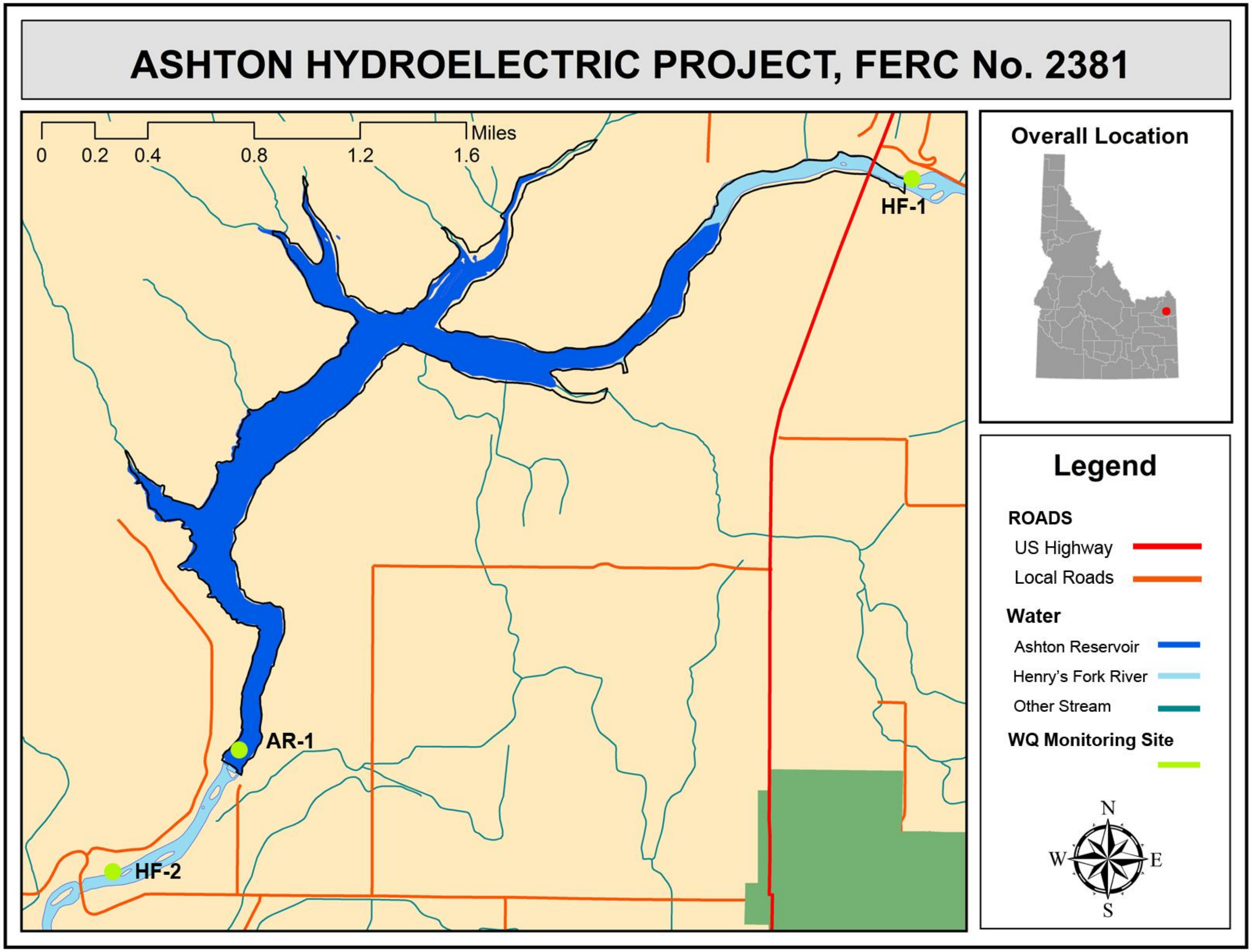

Figure 1. Approximate locations of monitoring sites above, below and in Ashton Reservoir.

6.0 RESULTS

6.1 Hydrology

Discharge can be an important factor in the interpretation of water quality data. Mean daily discharges for January 2010 through December 2013 were obtained from the US Geological Survey (USGS) National Water Information System (http://waterdata.usgs/id/nwis/) for the Henry's Fork at Ashton (USGS No. 13046000). This encompassed four separate periods when water quality data were collected. The gauge is located 1 mile downstream from Ashton Dam, or 0.2 mile below the Ora Bridge (Figure 1). All data for the 2014 water year (i.e., commencing on 1 October 2013) are considered preliminary by the USGS.

Ashton Reservoir releases exceeded 2,000 cfs for much of August 2010, but gradually diminished thereafter, becoming relatively stable at about 1,000 cfs until the 2011 runoff began in early May (Figure 2). Runoff in 2011 was characterized by: (1) a rapidly ascending limb, (2) a relatively brief but pronounced peak, and (3) an extended descending limb that did not reach a base flow condition until late July. Mean daily discharge peaked at 6,550 cfs on 8 June, which was among the highest levels recorded at this station since 1890 when record keeping began. The greatest peak of 8,140 cfs was observed in 1984. Mean annual peak flow over the period of record is about 4,020 cfs. By comparison, runoff in 2012 was much more typical of an average year with a peak of 3,700 cfs. In 2013, runoff was more typical of a dry year, peaking at just 1,900 cfs. Mid-summer irrigation demands had higher discharges than spring runoff in 2013.

Water quality monitoring in 2010 occurred during a period when flows declined gradually from about 1,760 cfs to 890 cfs. Monitoring in 2011, 2012 and 2013 encompassed pre-runoff, runoff, and post-runoff conditions (Figure 2).

6.2 Temperature

6.2.1 Henry's Fork Average Daily Temperature

Water temperature and other parameters were recorded at 15-minute intervals at both sites in the Henry's Fork in 2010 (24 August to 16 November 2010), 2011 (23 April to 15 November), and 2012 (6 February to 28 November) during the rehabilitation of Ashton Dam. Post-rehabilitation monitoring occurred in 2013 from 30 January to 20 December to evaluate conditions while the project was in operational mode.

Temporal patterns in average daily water temperatures at HF-1 and HF-2 for 2010 through 2013 are depicted in Figures 3 and 4. The patterns are similar between years, with average daily winter temperatures typically less than 3°C and dropping as low as 0°C by early December. Summer temperatures often reached 20 to 21°C in early July and then declined. Generally, temperatures rose gradually at both sites from late February, peaked in early July, and then declined more rapidly to winter temperature ranges by November. A more rapid autumn decline is due largely to ambient temperatures which tend to rise more slowly in the spring than they subside in the fall.

Average daily temperatures at each site were used to evaluate compliance with IDEQ criteria, with a 9°C standard from 1 October through 14 July and a 19°C standard from 15 July through 30 September. There was little difference between the sites during monitoring in 2013, although temperatures at HF-2 typically lagged behind HF-1 by 1 or 2 days (Figure 5). Daily average temperatures at HF-2 were slightly warmer than HF-1 throughout the summer months; however, those at HF-2 were typically within about 0.5°C of HF-1. The 9°C standard was exceeded at both sites in April and continued through early July. The 19°C standard was exceeded briefly at both sites before temperatures gradually declined; however, both sites exceeded the 9°C standard briefly when it went into effect on 1 October. Temperature at both sites then diminished quickly, and the standard was no longer exceeded at either site by 4 October.

Figures 6 and 7 show monthly diel patterns in temperature over a 48-hour period. Oscillations at HF-1 ranged from about 1 to 3ºC, with generally greater ranges occurring from spring to fall. HF-2 had a more muted fluctuation of typically 0-1°C which was reflected by lower daily maximum temperatures but higher nighttime temperatures.

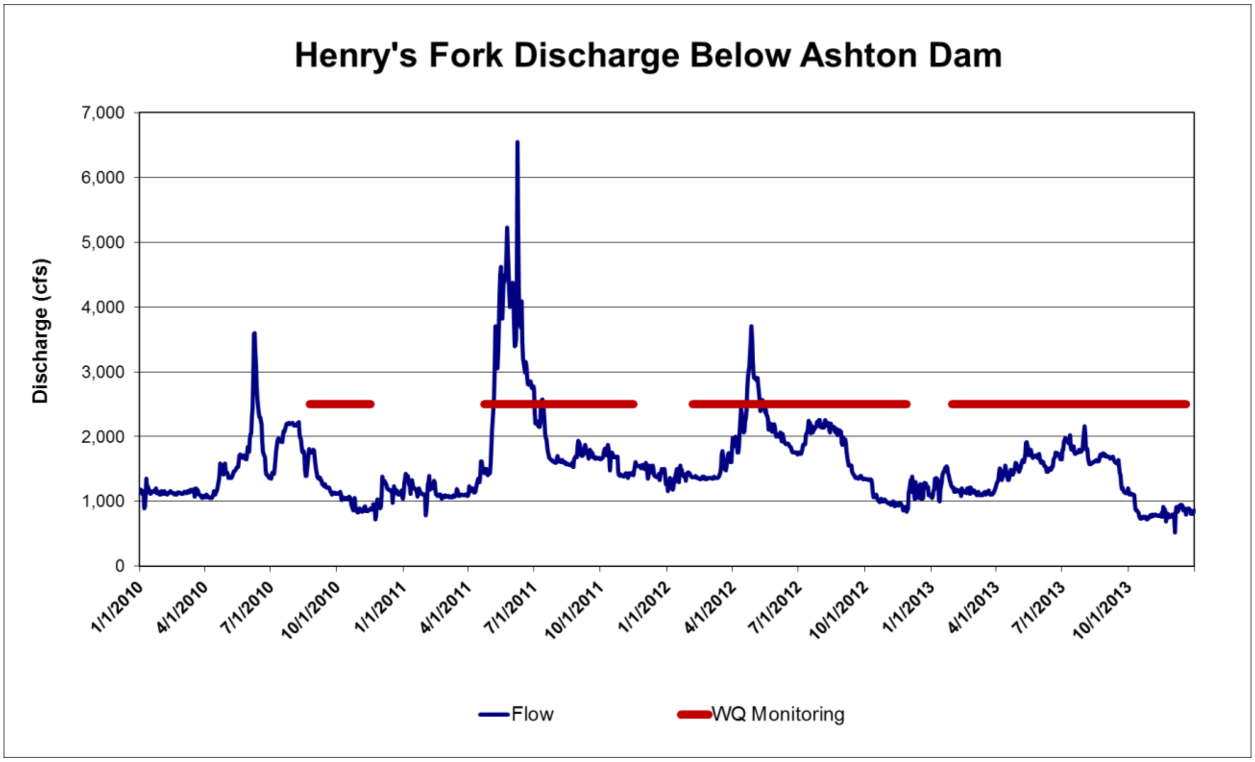

Figure 2. Discharge in the Henry's Fork below Ashton Dam as measured at USGS gauging station 13046000 in relation to the timing of water quality monitoring, 2010-13.

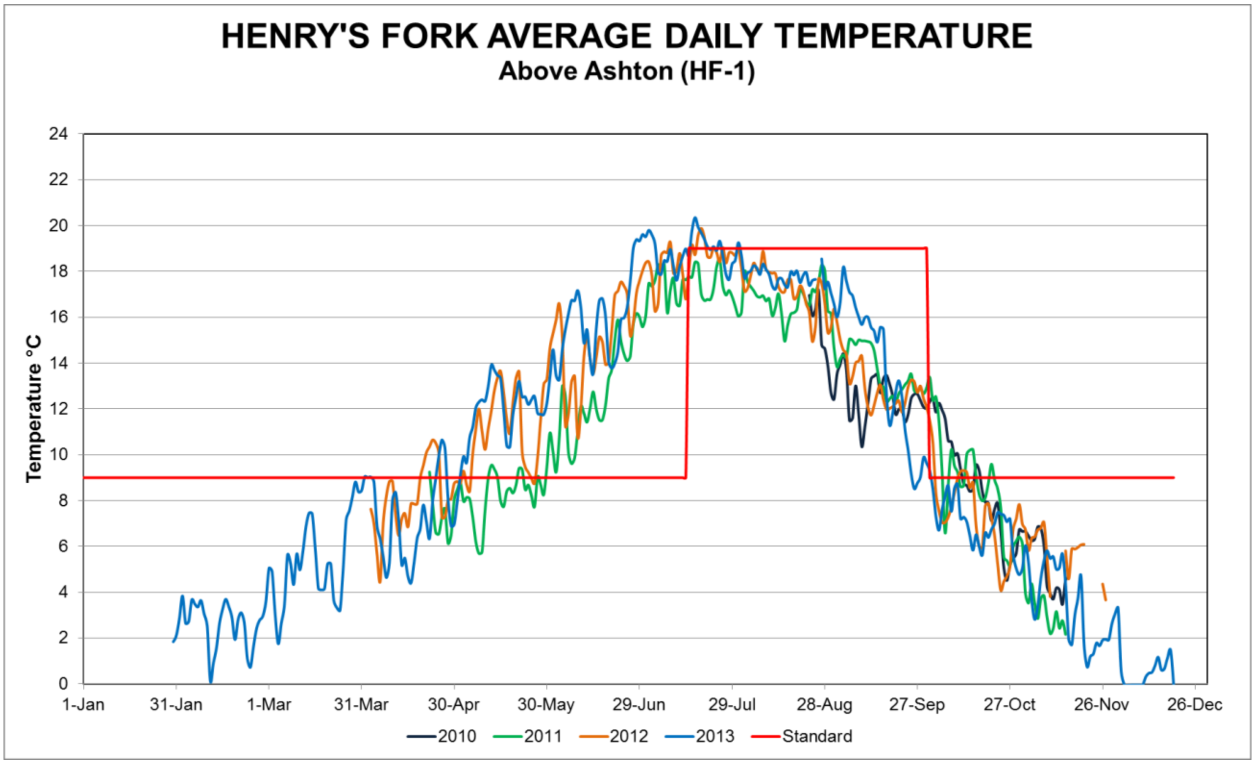

Figure 3. Average daily temperatures above Ashton Reservoir at HF-1 in relation to water quality standards, 2010-2013.

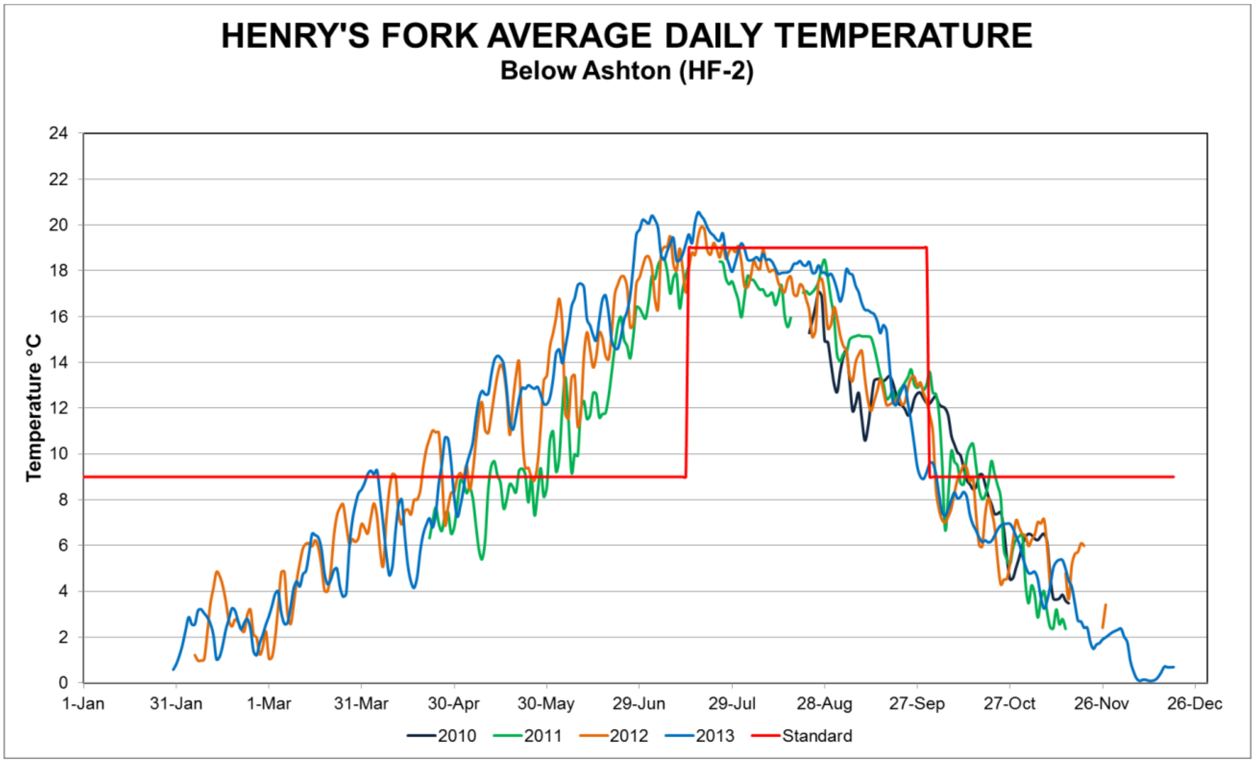

Figure 4. Average daily temperatures below Ashton Reservoir at HF-2 in relation to water quality standards, 2010-2013.

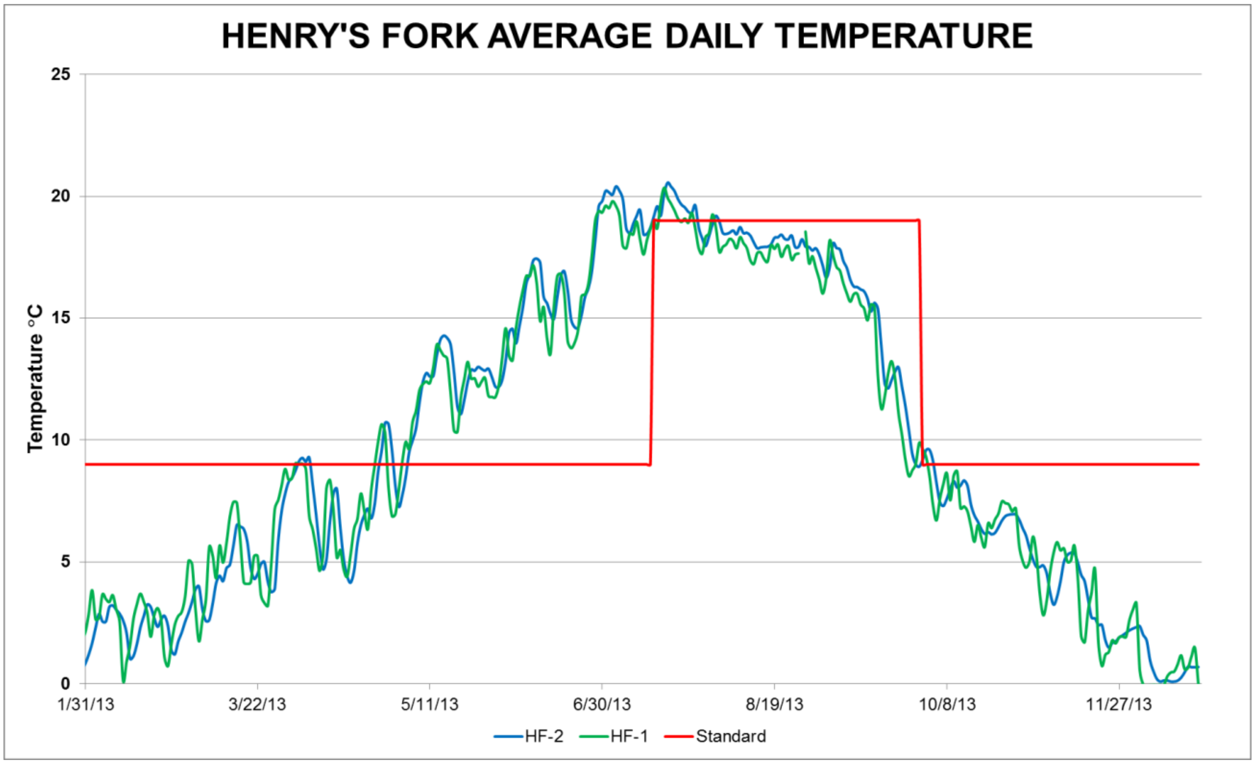

Figure 5. Average daily temperature in the Henry's Fork at sites above and below Ashton Reservoir, 2013.

6.2.2 Henry's Fork Maximum Daily Temperature

Maximum daily temperatures at each site were also determined to evaluate compliance with the 13°C standard from 1 October through 14 July and the 22°C standard from 15 July through 30 September. Temporal patterns at HF-1 and HF-2 for 2010 through 2013 are depicted in Figures 8 and 9. Patterns were similar between years, where maximum daily winter temperatures typically did not exceed 5°C with temperatures dropping as low as 1°C. Maximum summer temperatures can reach 22°C in July under extreme ambient temperatures.

Temperatures exceeded the water quality standard of 13°C from early May until the standard changes to 22°C at both sites. Typical daily variability was 4-6°C at HF-1 during the summer, but only 1-2°C at HF-2. Maximum daily temperature is influenced by Ashton Reservoir and reflects reservoir releases from an intake elevation of 5,147 ft.

Maximum daily temperatures in 2013 were similar to 2012. Temperatures at HF-1 exceeded standards on 28 April, while HF-2 exceeded standards on 10 May, this trend continued until the standard changed as shown in Figure 10. There were two instances where temperature exceeded the 22°C standard at HF-1, once on 29 June and again on 19 July. Throughout the monitoring period, temperatures at the two sites closely matched each other.

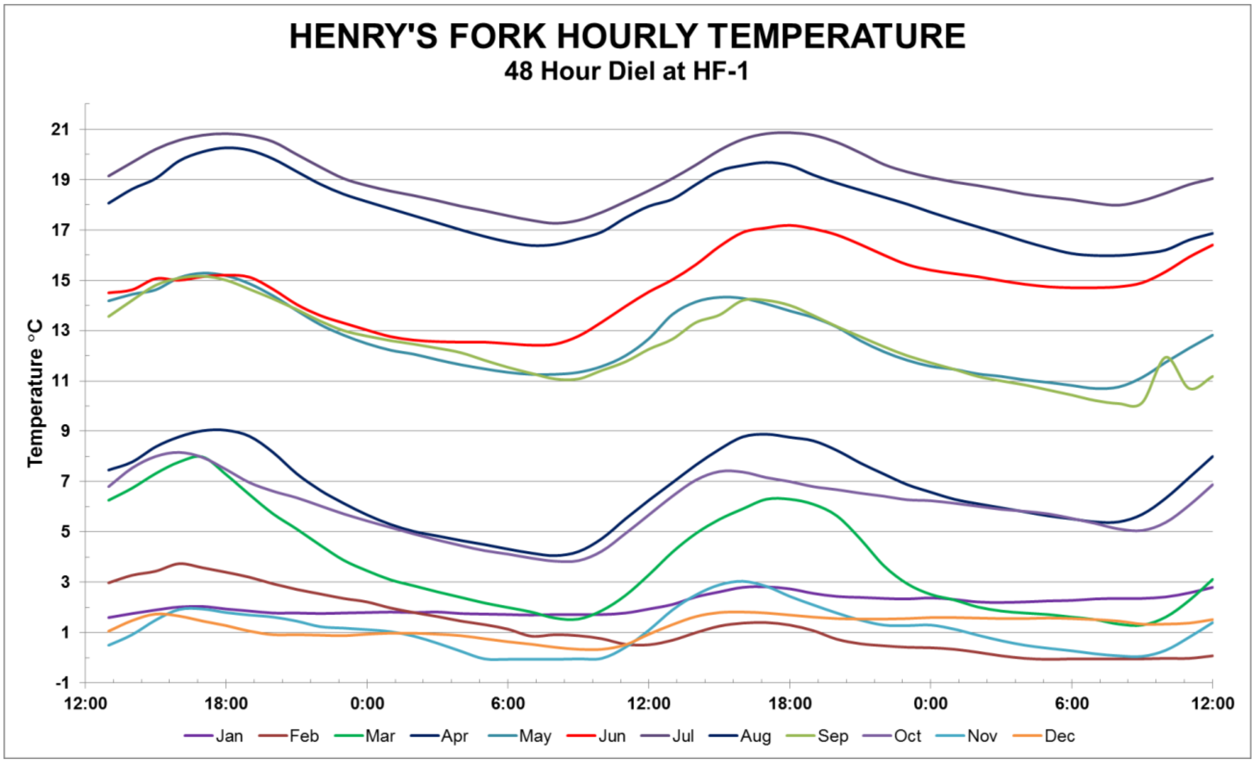

Figure 6. Temperatures over a 48-hour period by month in the Henry's Fork at HF-1, 2013.

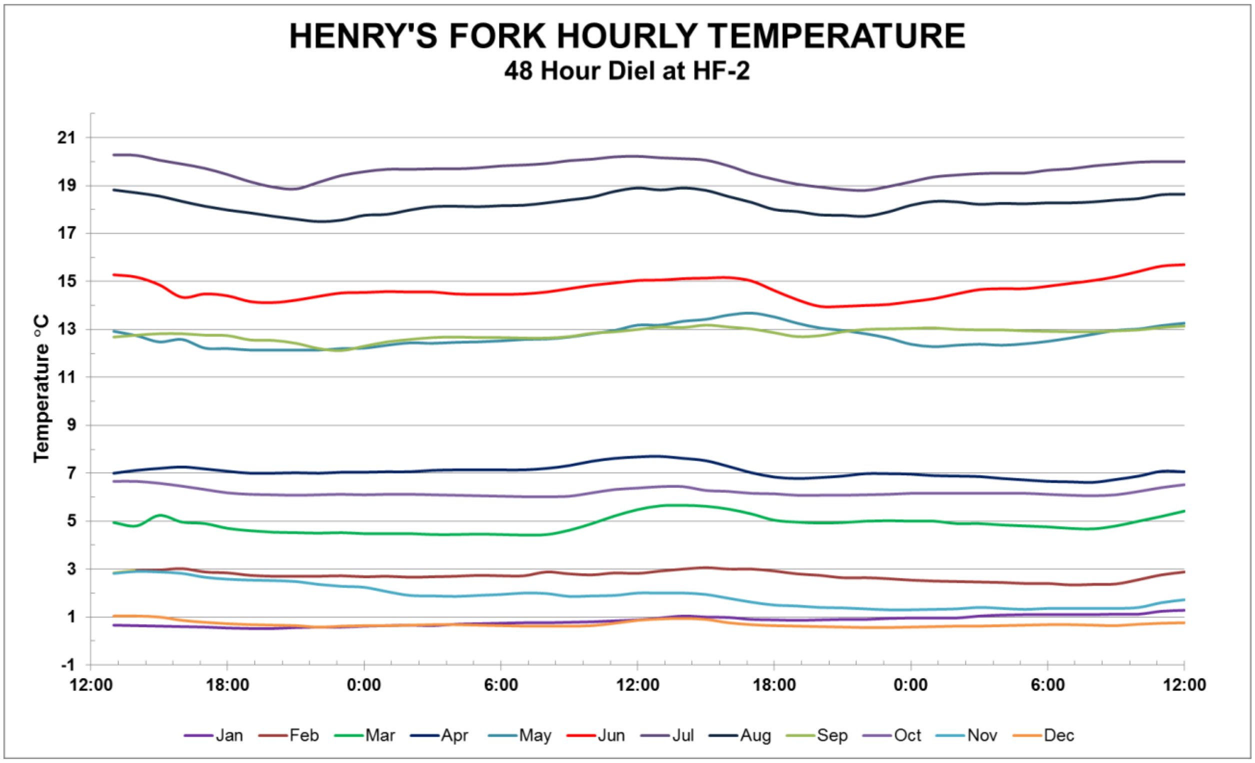

Figure 7. Temperatures over a 48-hour period by month in the Henry's Fork at HF-2, 2013.

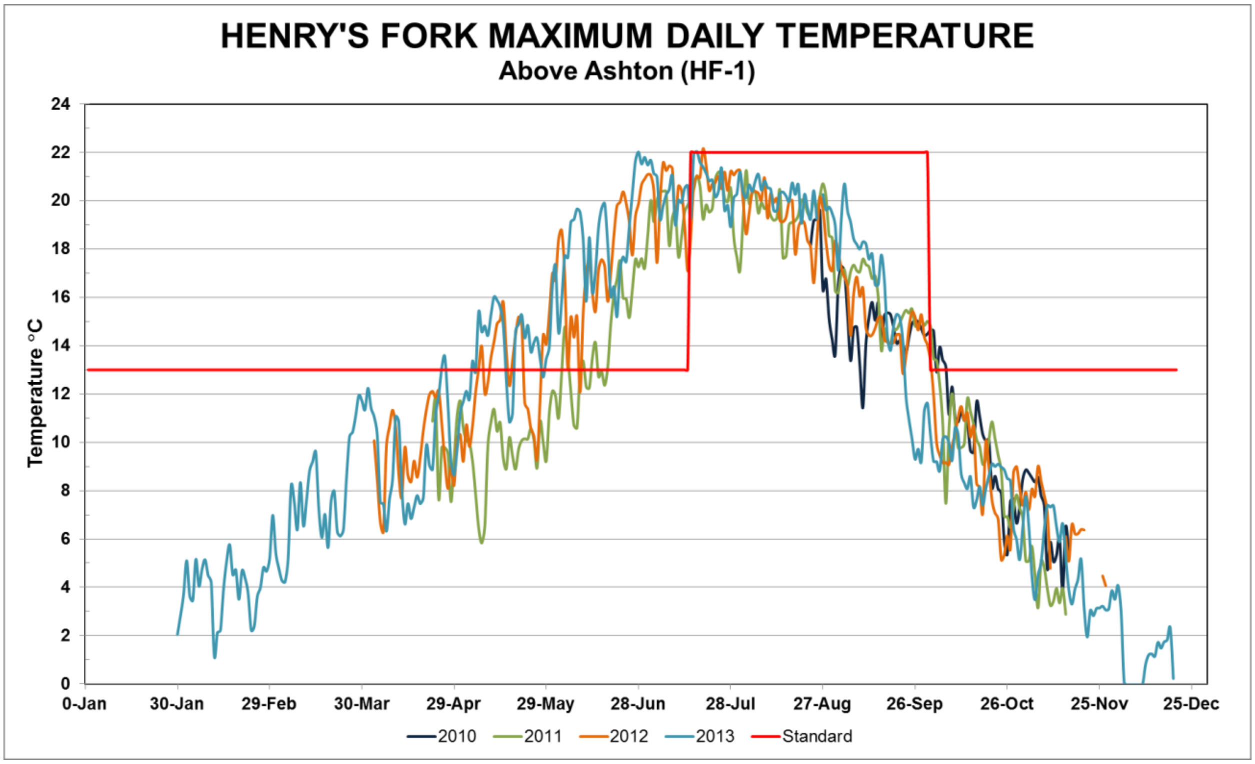

Figure 8. Maximum daily temperature for years 2010-2013 at HF-1.

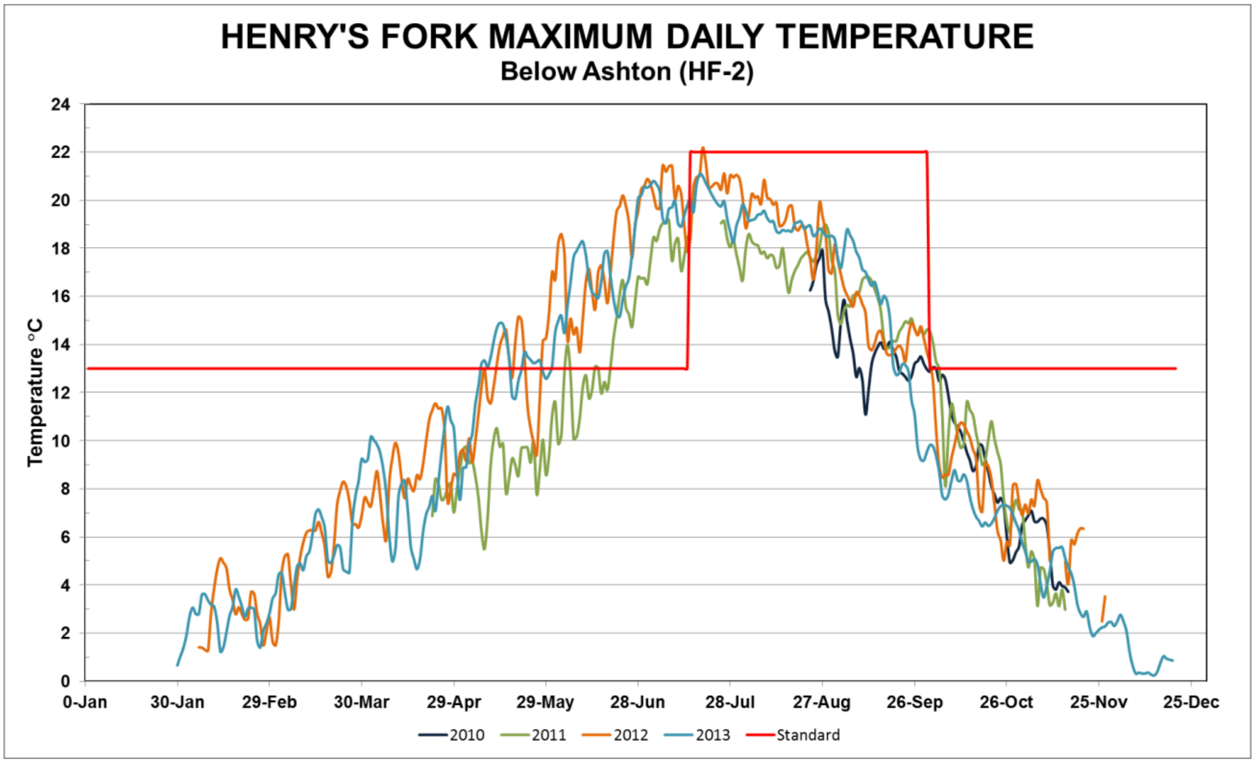

Figure 9. Maximum daily temperature for years 2010-2013 at HF-2.

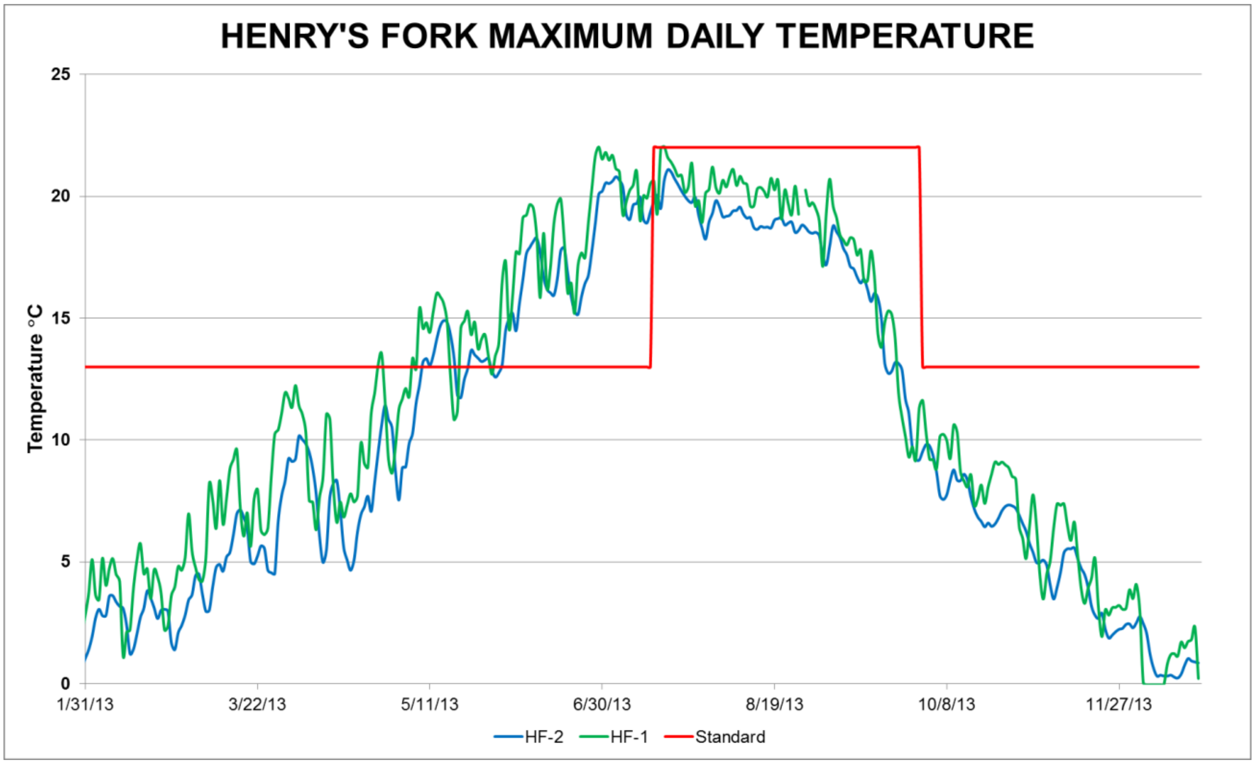

Figure 10. Maximum daily temperature in the Henry's Fork above and below Ashton Dam, 2013.

6.2.3 Ashton Reservoir

Ashton Reservoir was monitored monthly from May to October in 2013 (Figure 11). Reservoir profiles illustrate periods of both mixing and brief stratification. During May, Ashton Reservoir temperatures were uniform throughout the water column. By June the reservoir had stratified with a surface temperature of 19°C and a bottom temperature of 13°C. In July and August warmer water temperatures were observed at lower depths, with temperatures varying only a few degrees between the surface and bottom, reaching a maximum temperature of 17°C near the bottom. As the reservoir began to cool toward September, stratification was less pronounced, and by October the reservoir was again mixed throughout the water column.

Temperatures at HF-2 are influenced by Ashton Reservoir releases and can be distinguished by the slightly increased daily average from May to September (Figure 5) when the upper layer is warmed (Figure 11). Water is withdrawn from the reservoir at 5,147 msl, approximately 4m (13ft) below the surface when the reservoir is at full pool. This depth occurs approximately at the top of the hydroelectric plant intakes. During periods of excess flow, typically spring runoff, water has historically passed through surface spillway gates. A new tunnel was installed in 2011 during the rehabilitation of Ashton Dam whereby water can be withdrawn from a depth of 5,130 msl.

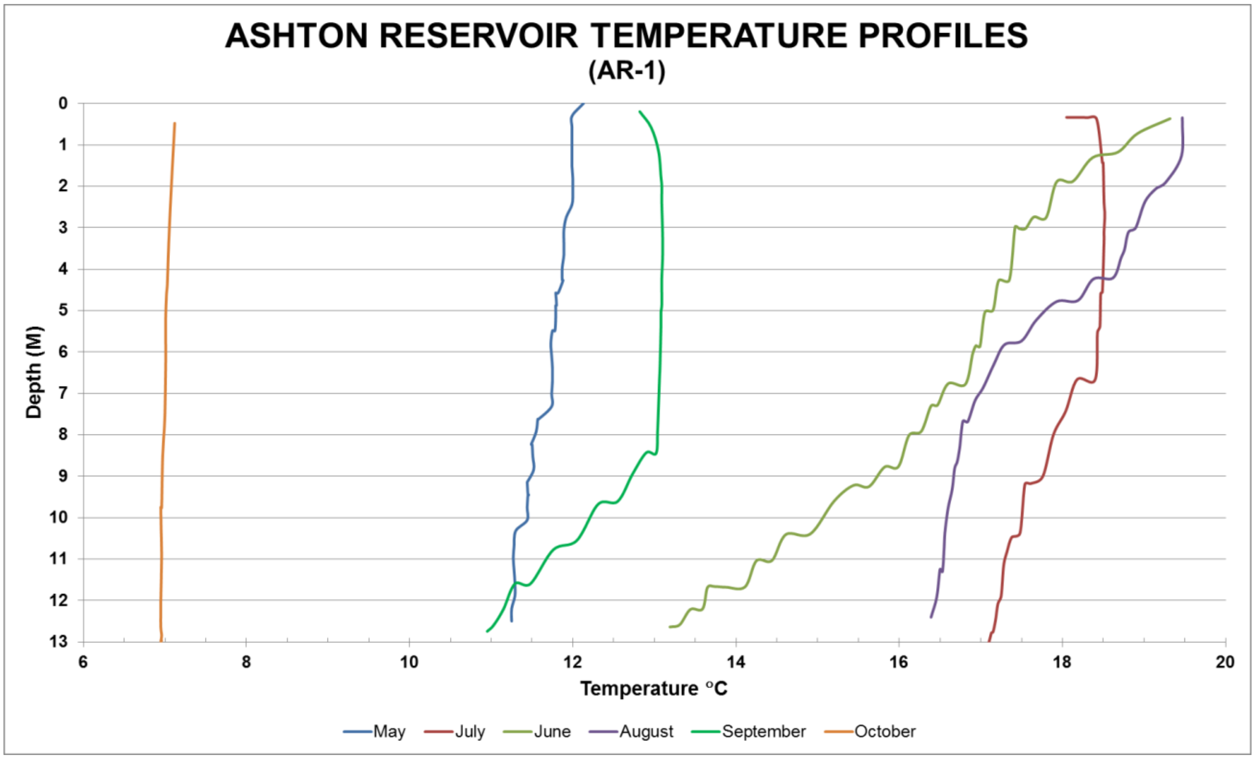

Figure 11. Temperature profiles in Ashton Reservoir (AR-1), 2013.

6.3 DISSOVLED OXYGEN

6.3.1 Henry's Fork

Daily minimum DO levels at the two river sites during all years are plotted in Figures 12 and 13. Post-rehabilitation oxygen concentrations in 2013 were similar to 2010 and 2011. Minimum concentrations remained above the Idaho instantaneous standard of 6 mg/L for the entire period, ranging between about 6 and 12 mg/L. Any DO levels which registered below the instantaneous standard were outliers attributed to probe stabilization issues or failure.

DO was similar at the two study sites in 2013 both with respect to ranges and temporal patterns (Figure 14). Concentrations varied between 6 mg/L and 12 mg/L throughout the year at each site. Winter marked the period of highest DO and summer the lowest. Instances when minimum DO concentrations fell below 6 mg/L were attributed to probe issues. These were typically one or perhaps several readings during a 24-hour period that recovered independently or after the probe was serviced.

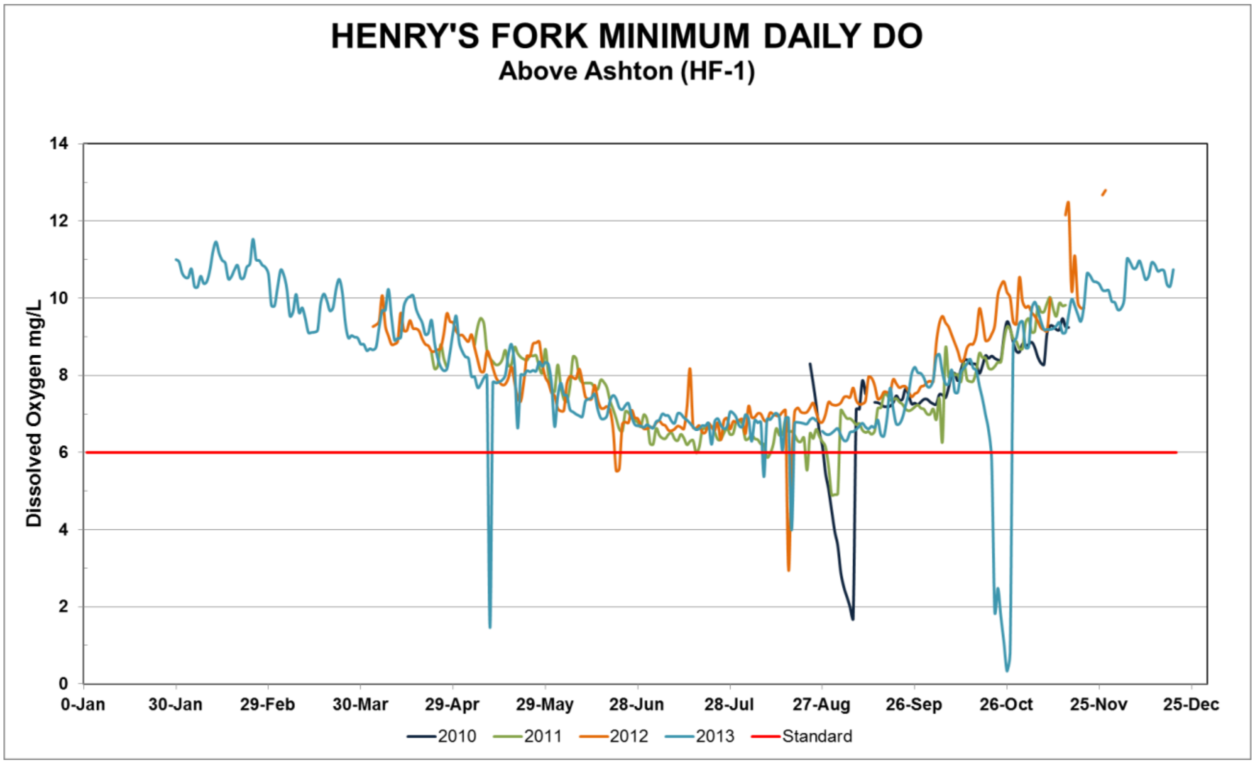

Figure 12. Minimum daily DO readings in the Henry's Fork at HF-1, 2010-2013.

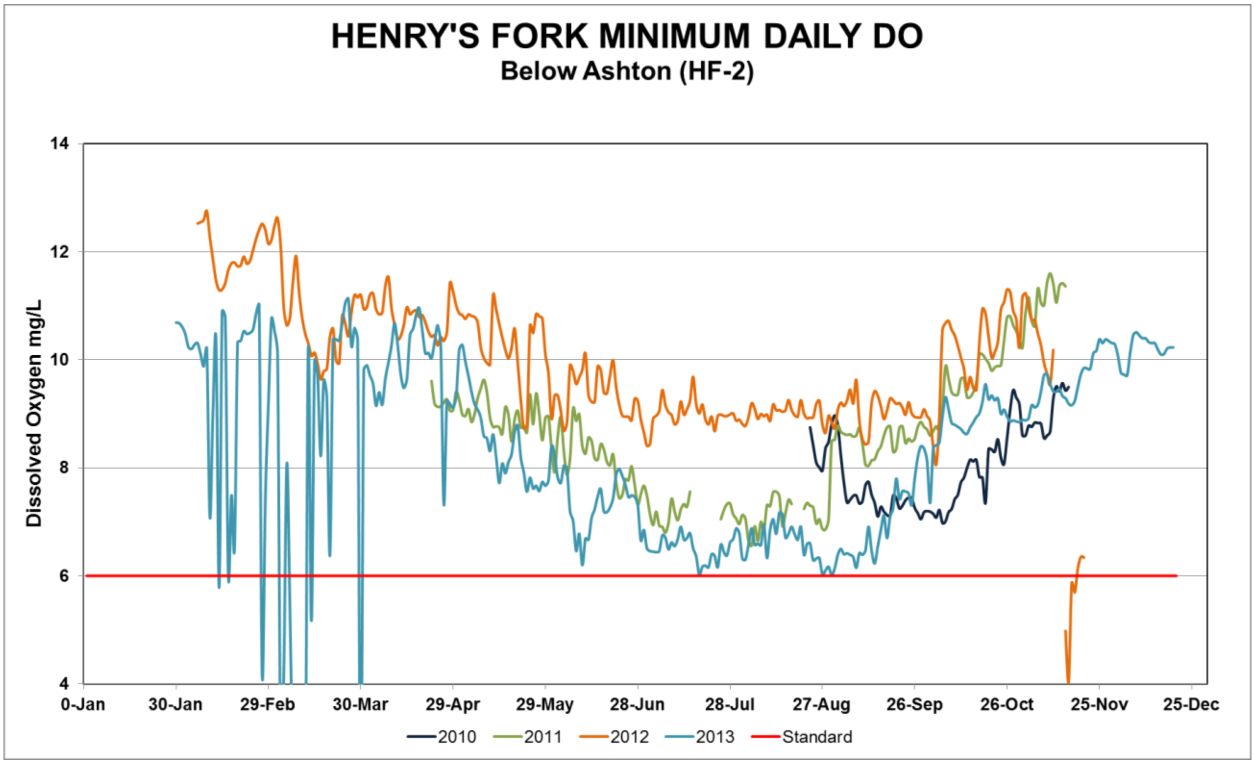

Figure 13. Minimum daily DO readings in the Henry's Fork at HF-2, 2010-2013.

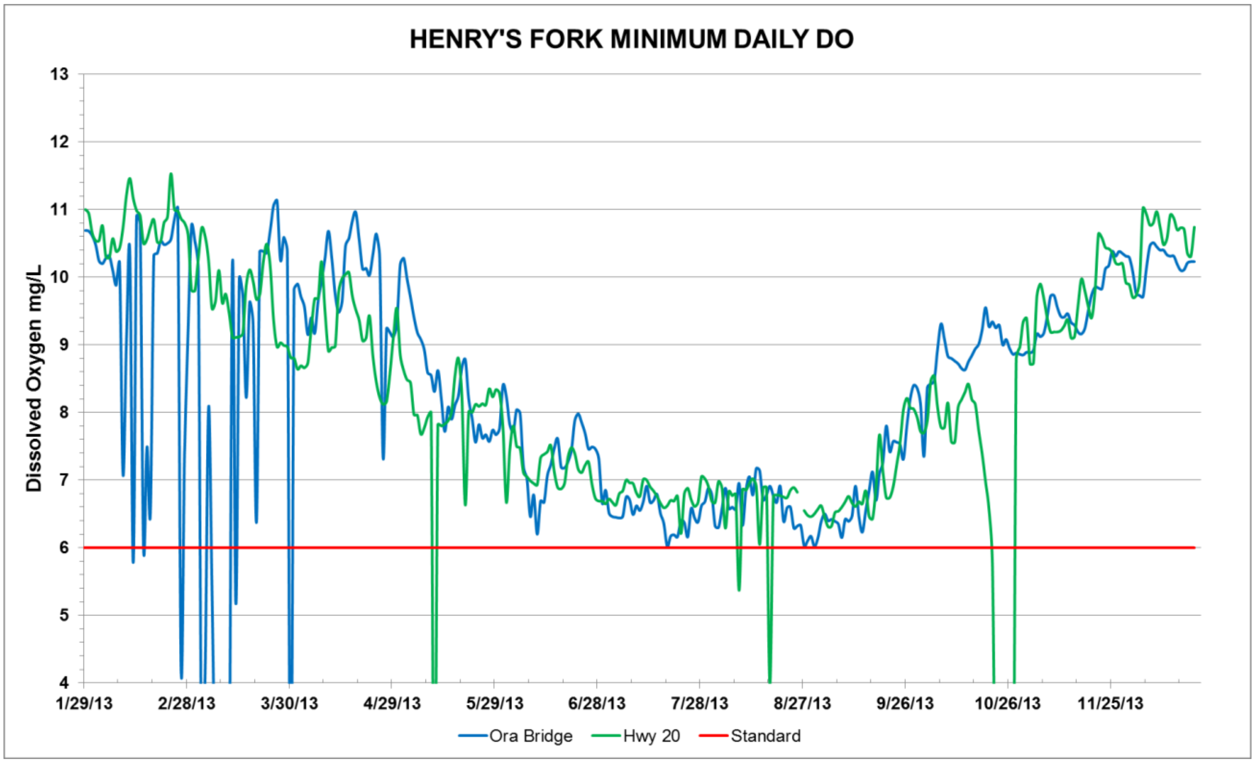

Figure 14. Minimum daily DO readings in the Henry's Fork above and below Ashton, 2013.

DO levels measured over 48-hour periods in 2013 are shown in Figures 15 and 16. The data demonstrated a cyclical pattern across all months at site HF-1 wherein DO rose from an early morning low to a midafternoon peak and declined thereafter to nighttime lows. Such a pattern reflects the cycle of benthic primary production (i.e., oxygen generation) by macrophytes, algae and other aquatic plants throughout the day. Minimum production occurs primarily during the spring and winter. The greatest disparities between daytime and nighttime DO levels were observed from late spring through fall, whereas winter fluctuations were dampened following the seasonal die-off of much of this flora. That diel pattern was often absent at site HF-2. There, it was evident only during June, July and August when primary production was at its annual peak. Pronounced diel patterns in DO at site HF-1 were likely influenced by the cumulative effect of benthic primary production from upstream lotic habitats. In contrast, site HF-2 is located not far downstream from Ashton Reservoir where there is no comparable source of benthic primary production to produce similar daily oxygen swings. Only during the summer was there apparently sufficient local plant biomass at HF-2 to elicit that pattern.

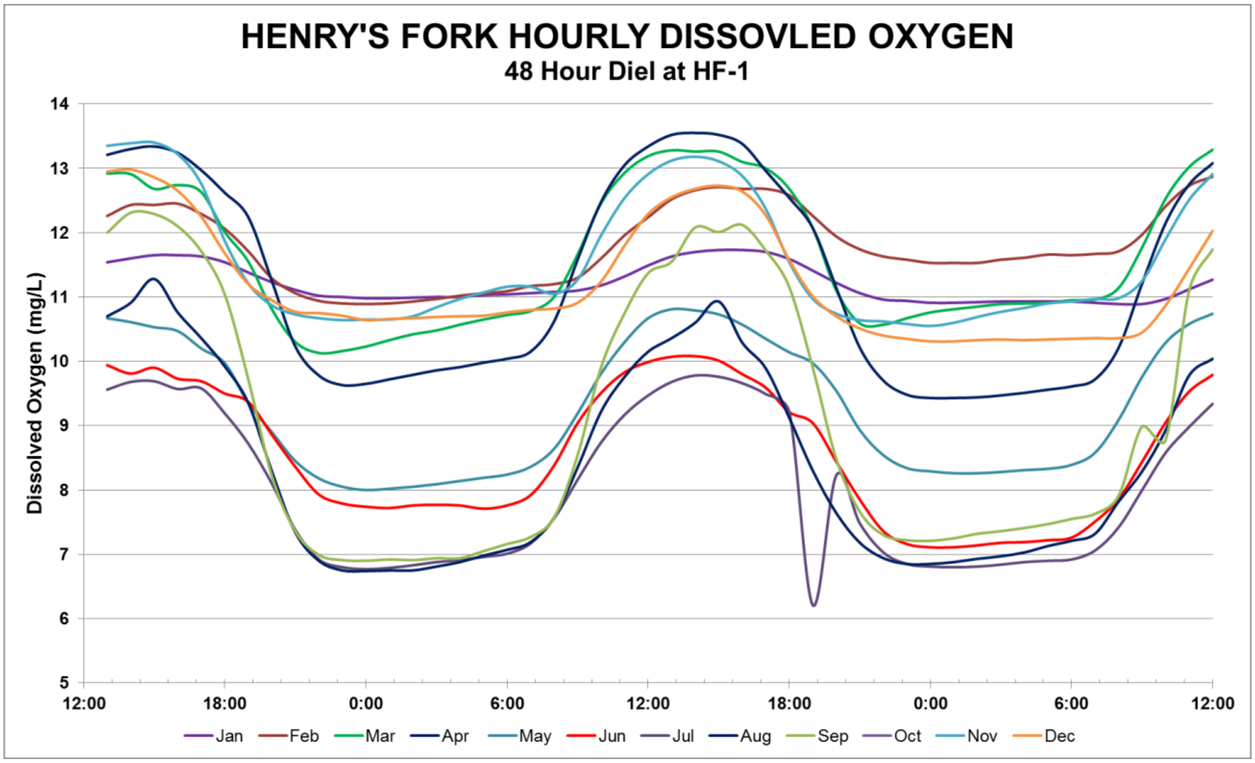

Figure 15. Monthly 48-hour diel of DO in the Henry's Fork above Ashton, 2013.

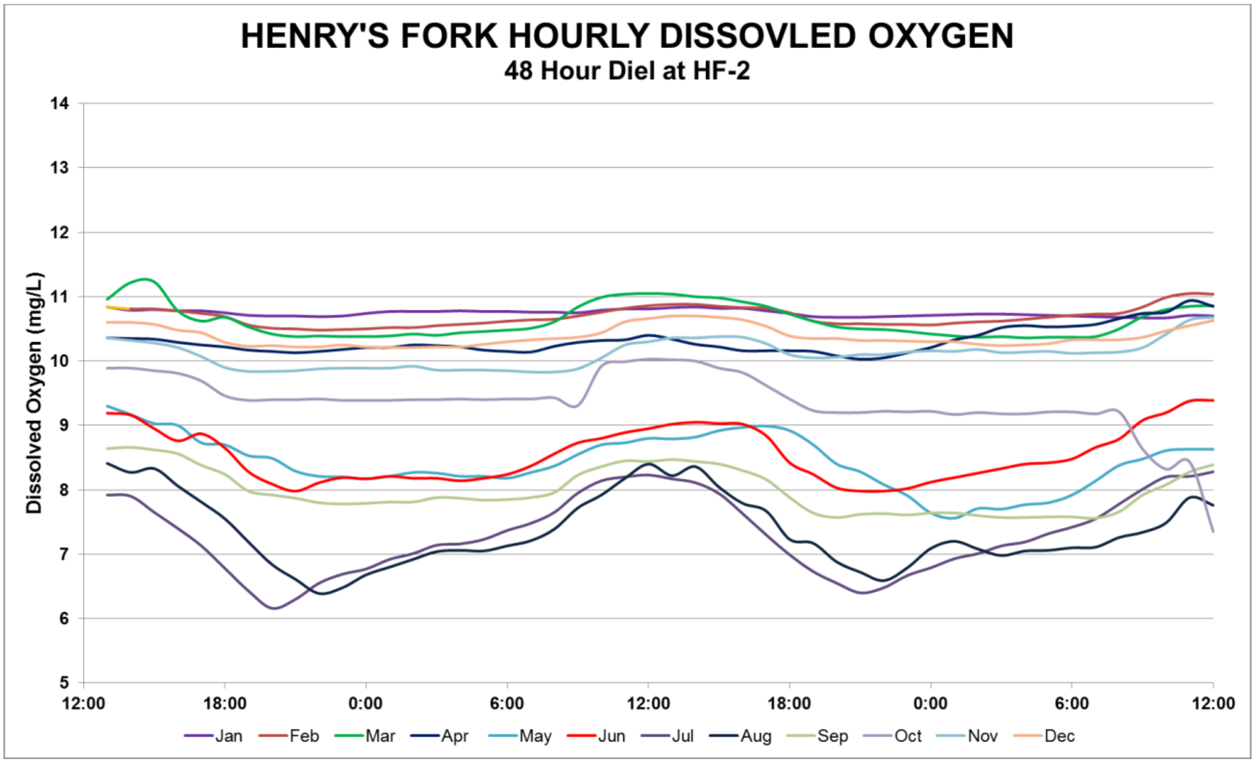

Figure 16. Monthly 48-hour diel for DO in the Henry's Fork below Ashton, 2013.

6.3.2 Ashton Reservoir

Relatively weak vertical stratification was observed from June through September, with the most pronounced condition seen in August (Figure 17). Even so, DO ranged only from about 7.5 mg/L at the surface to about 5 mg/L at 13m on the reservoir bottom. May and September showed relative uniformity in DO concentrations, reflecting spring and fall turnover conditions at those times, respectively.

Figure 17. Dissolved oxygen profile in Ashton Reservoir (AR-1), 2013.

7.0 SUMMARY

Seasonal and diel patterns in temperature and DO in the Henry's Fork below Ashton Dam during operations in 2013 were similar to those observed during its 3-year rehabilitation (2010-2012). Although there was some exceedance of Idaho temperature criteria, the same condition was also observed above the reservoir as it had been during past years, indicating this is a typical situation. DO levels both below and above the dam were similar on average and remained above the State standard of 6 mg/L. Diel variation in DO was evident above Ashton Reservoir, but was seen only during summer below the dam. Close proximity to the reservoir upstream appears to eliminate much of that diel variation which is likely more pronounced above the reservoir due to the cumulative contribution of benthic primary production from upstream river habitats.

Ashton Reservoir exhibited relatively weak stratification as judged by both temperature and DO. The only known previous limnological surveys also showed little to no stratification (IDFG 1986). Short reservoir retention time likely reduces the potential for stratification to occur.

8.0 REFERENCES

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