2022 Upper Clark Fork River Basin Surface Water Monitoring Report

NRDP Contract 90022-TO 2.1

Prepared by the Clark Fork Coalition



<u>Abstract</u>

The purpose of this report is to present the results of seasonal water temperature and streamflow monitoring on the upper Clark Fork River and tributaries where existing data is lacking. Flow monitoring also occurred on in-stream flow projects to assist with monitoring related to restoration project development and implementation.

These flow studies assist in implementing projects identified in the Natural Resource Damage Program's *Final Upper Clark Fork River Basin Aquatic and Terrestrial Restoration Plans* (Restoration Plans), updated and approved February 2019. Group 1 Projects that may supply instream flows to the area of the Clark Fork River between Galen and Deer Lodge are the highest priority. Second in priority are Group 2 projects that supply flow to Priority 1 tributaries and third in priority are Group 3 projects that supply flow to Priority 2 tributaries. In the 2019 revision to the Restoration Plan it was determined that all projects in Group 1, Group 2, and Group 3 will be investigated at the same time.

The overarching goal of the project is to better understand summer streamflow and water temperature conditions in the Upper Clark Fork River Basin. The stretch of the mainstem of the Clark Fork River between Galen and Deer Lodge and tributaries that feed it face chronic dewatering issues and typically experience the lowest flows during periods of peak demand in late July and early August. The data collected for this task order is integral to the understanding of surface water and groundwater dynamics in the most dewatered portion of the upper Clark Fork Basin.

Introduction

In accordance NRDP Contract 90022-TO 2.1, for the 2022 field season the Clark Fork Coalition (CFC) managed 14 continuous flow and temperature monitoring sites described in Table 1. These locations have been monitored by the CFC for multiple seasons and provide valuable data on the severity of these dewatered systems. The CFC also performed synoptic flows studies and/or spot measurements in Mill Creek, Racetrack Creek and Cottonwood Creek. The purpose of the monitoring is to provide information that quantifies the impacts of low flows and high water temperatures on aquatic ecosystems in the upper Clark Fork Basin.

Upper Clark Fork River Basin Monitoring Sites			
Stream	Site		
Cottonwood Creek	Above Applegate Upper Diversion (Sherm Anderson's Corral Bridge)		
	Cottonwood Creek in Deer Lodge		
Clark Fork River	Galen Road		
	Below West Side Ditch @ Gem Back Road		
	Above Valiton Ditch		
	Valiton Ditch		
	Sager Lane		
Lost Creek	Below Beckstead Ditch		
Racetrack Creek	Outflow from Reservoir		
	Below Cement Ditch		
	Above Berg Diversion		
	Ted Beck's Bridge		
	Above Branch Ditch		
	Frontage Road		

Table 1- Locations of primary monitoring sites managed by the CFC in the upper Clark Fork Basin.

The individual monitoring sites are identified in the map (Figure 1). At each CFC monitoring site, a continuous data logger (HOBO) recorded both stream stage and water temperature data at 30 minute or 60 minute intervals. The primary purpose of these data collection efforts was to quantify the magnitude and timing of water conditions on the upper Clark Fork River and priority tributaries. Water temperature data was also collected to determine if water temperatures exceeded threshold levels considered sustainable for salmonids.

In addition to the continuously monitored sites described above, the CFC also recorded data at other potential project locations in the upper Clark Fork Basin (Table 2).

- 1. A synoptic flow study and spot measurements of discharge were conducted on Racetrack Creek to assist with understanding the reach scale impacts tied to the Racetrack Lake flow release.
- 2. Spot measurements occurred on Cottonwood Creek at 3 locations in order to monitor the Applegate instream flow project.
- 3. A spot measurement was taken on Mill Creek on 9/13/2022 to determine if call could be made to satisfy an existing instream flow water right.

This report provides a narrative of streamflow and water temperature conditions observed at each of monitoring sites funded by the NRDP, as well additional pertinent locations funded by the CBWTP. The monitoring sites are summarized in Table 1 above and are displayed in the map in Figure 1.

<u>Methods</u>

At each of the continuously monitored locations, streamflow and water temperature was manually measured every 2-4 weeks between June and September by CFC staff. These measurements were used to develop a rating curve for the continuous hydrographs. Individual flow measurements were tabulated using a Hach or Ott digital flow meter following standards established by the USGS (http://pubs.usgs.gov/wsp/ wsp2175/). To assure data reliability, the flow meters were calibrated monthly throughout the field season (and more frequently if needed). In accordance with the USGS measurement protocols, no individual velocity measurements in a stream cross section represented more than 10% of the total observed flow.

River stage and water temperature data was collected using data loggers that remotely recorded data at 30 or 60 minute intervals. Hobo data loggers were used at all sites during the 2022 field season.

River stage data from the HOBOs loggers was correlated to flow by developing a stage-discharge rating curve for each site. The rating curves were produced by plotting the flow measurement data against the river stage data and calculating a power function from the plotted data. Using the equation from the rating curves, river stage data was extrapolated to develop a continuous hydrograph for each site. Although the locations of monitoring sites typically remain the same from season to season, small changes to a stream's cross sectional geometry (caused by natural morphological processes) may significantly impact the accuracy of previous years rating curves. Because of this, new rating curves were generated at all of the sites for the 2022 data.

The hydrographs and thermographs contained in appendix A were constructed from the extrapolated flow data and water temperature recordings from the data loggers. Streamflow data represents daily averages; maximum daily water temperature represents the highest individual daily reading. Meteorological data was retrieved from the National Climatic Data Center (<u>https://www.ncdc.noaa.gov/</u> <u>climate-information</u>) and Montana Climate Office (<u>https://climate.umt.edu/</u>).

<u>Results</u>

Streamflow and water temperature graphs for the 2022 monitoring season are provided in Figures 3-14.

2022 marked the second consecutive year of below average streamflow conditions for most of the summer, despite snow water equivalent 101% of normal on May 1 for the Upper Clark Fork Basin according to the USDA/NRCS SNOTEL Report. Below average precipitation coupled with above average temperature from June to September contributed to some of longest periods of low streamflows the Upper Clark Fork has experienced since 2017 based on the Clark Fork River at Gem Back Road measurement site (Figure 6).

Analysis & Conclusions

Clark Fork River Figures 2 & 3

The Clark Fork River experienced below normal discharge in 2022, with the lowest flow of 15.87 CFS on August 19th occurred at Gem Back Road. Despite normal snowpack, below average precipitation in June and July and above average temperatures contributed to these unusually low streamflows in 2022. Flow remained below minimum targets (40 CFS at Galen and 90 CFS at Deer Lodge) at all monitoring locations on the mainstem from July 15th to August 15th, with the exception of the Clark Fork at Galen Road.

Water temperatures tracked consistently across the monitoring locations although there were significant differences in the magnitude of temperatures recorded (Figure 3). Temperatures at all locations peaked late July/early August and again in mid-August when thermal inputs were at a maximum. The maximum water temperature for 2022 was 25.81 degrees Celsius on July 28th at Sager Lane. Extremely high (31.88°C) and likely erroneous temperature readings were recorded in mid-August at Gem Back Road. This data was removed from the temperature graphs. Water temperatures were above 20 degrees Celsius for 60 days at the Sager Lane site (July 8th-September 7th). Water temperatures generally decreased after September 8th following a number of precipitation events, shorter days and cooler nights.

Racetrack Creek Figures 2, 7-10

During the 2022 field season, Racetrack Creek followed a flow pattern that was similar to other area streams. After a typical snowmelt driven runoff, natural flows on Racetrack Creek began a recession toward irrigation influenced baseflow levels in early July. 2022 marked the first year that Racetrack Lake storage water could be protected instream as a result of the issuance of the DNRC Change of Use Authorization for this water right held by the Clark Fork Coalition (CFC). Releases from Racetrack Lake started on July 27th and extending until August 20st. The CFC telemetry station at the outlet of the dam was activated on July 22nd to track outflows from the reservoir, which averaged around 13.5 CFS during the course of the release with 8.33 CFS allocated for instream flow. According to the Water Commissioner Record, there was 45 miner's inch (1.1 cfs) overflow, 450 miner's inch (11.25 cfs) for the creek and 45 miner's inch (1.1 cfs)" shrink for total release rate of 540 miner's inch or 13.5 CFS. Telemetry data from the Racetrack Lake Outflow site is not included in the report due to a possible shift in the rating curve, however outflows were actively monitored by the Racetrack Water Commissioner and CFC via a combination of flume readings and manual discharge measurements (Table 2). CFC also actively managed a second telemetry station at Racetrack Lake that monitored lake levels in order to track the volume remaining in the reservoir during the course of the release.

Flows below the Cement Ditch monitoring location persisted from 4 to 10 CFS from July 27th until Racetrack Lake reservoir releases ended around August 20th. The protectable instream flow right below the Cement Ditch is 7.5 CFS. The reason for reduced flows from August 5th-9th was the result of a measurement concern by the Water Commissioner and some of the water users, which was resolved by

the installation of a new flow monitoring site (staff gage) on August 9th immediately below the Cement Ditch. As a result of the concerns raised by the Water Commissioner and water users, instream flows were temporarily suspended between August 5th and August 9th.

Flows below the Cement Ditch generally remained depressed (less than 2 CFS) until September 21st when fall precipitation augmented flows on Racetrack Creek. Flows were also monitored immediately below Cement ditch (spot measurements), Above Berg Diversion, Above Branch Diversion and at the Frontage road as required by the Streamflow Monitoring Plan, DNRC Change of Use Authorization and the Water Management Plan.

A synoptic flow study was also performed on August 16th for the purpose of determining how much of the Racetrack Lake instream flow was being delivered through the entire protected reach (Figure 2). In summary, 2.5 CFS of flow was measured upstream of the Racetrack Creek confluence with the Clark Fork River of the total 8.33 CFS released from Racetrack Lake for instream flow. The diminishment in flow at the confluence is attributable to a combination of factors including the required 10% loss from the lake to the Cement ditch, natural streambed losses, a leaky headgate in the protected reach and the maintenance of pre-release irrigation levels under the Water Management Plan below the Cement Ditch.

Valiton Ditch at Headgate Figure 11

This is the fifth year of monitoring by the CFC on Valiton Ditch, which withdraws water from the Clark Fork River above Sager Lane and below Racetrack. The purpose of this effort was to better understand the magnitude of irrigation use at this location and assist with future planning and design for diversion improvements at this location. Diverted flows ranged from 2-4 CFS June 24th -August 24th and increased for the remainder of the irrigation season up to 10.8 CFS on September 20th. Reductions in diverted flows were apparent as a result of a split-season diversion reduction agreement among 2 of the 3 water users at this location between July 15th-September 6th. Surprisingly, the majority of the irrigation demand occurred in September and peaked on September 21st (10.88 CFS). During the month of September flows at Deer Lodge were below the minimum flow target of 90 CFS until September 17th when a series of precipitation events increased flows above the target for the remainder of the fall.

Cottonwood Creek Figures 13 and Table 2

Flows were monitored in Cottonwood Creek at three locations for the purposes of ensuring instream flow from the Applegate flow enhancement project were maintained. An instream flow authorization of 4.76 CFS is in place from May 16th to July 14th and 1.7 CFS from July 15th to September 15th. Flows in Cottonwood Creek remained in compliance with the DNRC Change of Use Authorization; with steady flow at both sites above 4.76 CFS until June 29th and flow remained above 1.7 CFS from July 15th-August 10th at Deer Lodge (below the lower Applegate diversion), although flows were below the 1.7 CFS value at times due to senior upstream irrigation uses. Spot measurements were also taken above and below the Applegate upper diversion after July 15th to ensure compliance, however upstream senior water right holders were utilizing all remaining flow.

Lost Creek (below Beckstead Ditch) Figure 14

Flow measurements below the Beckstead ditch on lower Lost Creek were conducted to ensure compliance with the Lampert Ranch split-season lease, which requires that 1.93 CFS be left instream from July 1st- August 31st of each year. Flows in excess of instream right were recorded at this location for the entire summer before steadily increasing starting August 20th through the remainder of the summer and fall.

Upper Clark Fork 2022 Monitoring Sites







Figure 1: Map of 2022 monitoring locations



Figure 2: Map of August 16, 2022 Racetrack Creek synoptic flow monitoring sites and discharge measurements



Figure 3: Upper Clark Fork River average daily hydrographs for the 2022 irrigation season.



Clark Fork River Max Daily Water Temps: 2022



Figure 4: Upper Clark Fork River maximum daily thermographs for the 2022 irrigation season. 20°C temperature threshold indicates the maximum temperature at which adverse effects to cutthroat and bull trout are minimized (Bear et al., 2007; Selong et al., 2001).





Figure 5: Upper Clark Fork River at Sager Lane average daily discharge 6-year comparison from 2017-2022.



Clark Fork River at Gem Back Road 6-Year Comparison



Figure 6: Upper Clark Fork River at Gem Back Road average daily discharge 6-year comparison from 2017-2022.



Figure 7: Racetrack Creek average daily hydrographs for the 2022 irrigation season.



Racetrack Creek Average Daily Discharges: July 27-August 20 2022



Figure 8: Racetrack Creek average daily hydrographs during the Racetrack Lake release from July 27-August 20.



Racetrack Creek Maximum Daily Temperatures: 2022



Figure 9: Racetrack Creek maximum daily thermographs for the 2022 irrigation season.

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Racetrack Creek Maximum Daily Temperatures: July 27-August 20 2022



Figure 10: Racetrack Creek maximum daily thermographs during the Racetrack Lake release from July 27-August 20.



Figure 11: Valiton Ditch average daily hydrograph for the 2022 irrigation season.



Cottonwood Creek Average Daily Discharge: 2022



Figure 12: Cottonwood Creek average daily hydrographs for the 2022 irrigation season.



Figure 13: Cottonwood Creek maximum daily thermographs for the 2022 irrigation season.



Lost Creek Daily Average Discharge and Max Temperatures: 2022



Figure 14: Lost Creek average daily hydrograph and maximum daily thermograph for the 2022 irrigation season.

2022 Manual Discharge Measurements

Location	Date	Time of Measurement	Discharge (cfs)
Racetrack Outflow from Reservoir	7/21/2022	5:30 PM	2.23
	8/18/2022	11:22 AM	14.20
Racetrack at Cement Ditch	8/9/2022	11:42 AM	5.90
	8/10/2022	2:09 PM	7.51
	8/11/2022	1:06 PM	9.22
	8/16/2022	12:10 PM	7.56
Racetrack at Edge Bridge	8/16/2022	1:00 PM	0.71
Racetrack at Yellowstone Trail	8/16/2022	12:22 PM	2.20
Racetrack below Waber Diversion (near confluence)	8/16/2022	3:00 PM	2.48
Mill Creek above Highway 1	9/13/2022	2:30 PM	2.72
Cottonwood Creek below Applegate Lower Diversion	7/25/2022	4:15 PM	0.25
	9/13/2022	10:30 AM	0.25

Table 2- Spot measurements for the 2022 irrigation season.