

Project Name | Weather Station Monitoring Program**Date** | 2/22/2024**To / Contact info** | BCWD Board of Managers**Cc / Contact info** | Karen Kill, District Administrator**From / Contact info** | Mike Majeski, Conservation Biologist**Regarding** | 2023 Weather Summary

Background

The BCWD Weather Station Monitoring Program was initiated in the spring of 2011 and has been in operation since 2012. Each season the weather station is installed on top of the vegetated berm at the Stillwater Public Works Facility and collects the following data: precipitation, air temperature, relative humidity, dew point, solar radiation, wind speed, gust speed, and wind direction. The weather station is programmed to collect data from spring through fall of each season and is removed during the winter months. This information is being collected to support a variety of District programs such as hydrologic and hydraulic model upgrades and calibration (which require 15-minute precipitation data), thermal modeling efforts, and other projects including the Settlers Glen iron-enhanced sand filter, THPP, and the Biological Monitoring Program. The weather station data is also routinely shared with the Washington Conservation District (WCD).

The objective of this memorandum is to summarize temperature and precipitation data recorded in 2023 and how the data relates to water temperatures in Brown's Creek, particularly in the Brown's Creek gorge where coolwater and coldwater-dependent species occur including rainbow darter, brown trout, and several macroinvertebrates that have specific thermal and dissolved oxygen requirements to survive.

2023 Weather Summary

The BCWD weather station was installed at the Stillwater Public Works Facility (latitude: 45°03'49.86", longitude: 92°51'21.05") on March 27, 2023 and was removed on November 6, 2023. During this timeframe, a total of 24.30" of precipitation was recorded, including seven rain events exceeding 1.0" (Figure 1). Above average monthly precipitation occurred in April (+0.60", total of 3.47"), September (+2.48", total of 6.06") and October (+2.11", total of 4.71"). However, for the third consecutive year, a significant drought occurred during most of the growing season, with the greatest precipitation departures from normal occurring in June (-3.28", total of 1.48"), August (-2.83", total of 2.09"), May (-2.06", total of 1.52"), and July (-0.52", total of 4.17"). Notable dry periods over the course of the monitoring season included: May 15-May 31 (0.28" in 17 days), June 3-June 24 (0.13" in 22 days), July 29-Aug 10 (0.09" in 13 days), and Aug 15-Sept 14 (0.19" in 31 days).

Air temperatures recorded at the weather station fluctuated above and below the average high and low temperatures throughout the monitoring season, and there were 24 days when the maximum air temperature exceeded 90° F (Table 1 and Figure 2). According to the Twin Cities National Weather Service, 2023 was tied for the fourth hottest meteorological summer (June-August) on record with an average temperature of 74.8°F, which is only 0.9°F below the record set in the summer of 2021 at 75.7°F. Despite the near record heat, water temperatures recorded in Brown's Creek at the WOMP station remained relatively cool and never exceeded a maximum water temperature of 70°F at any

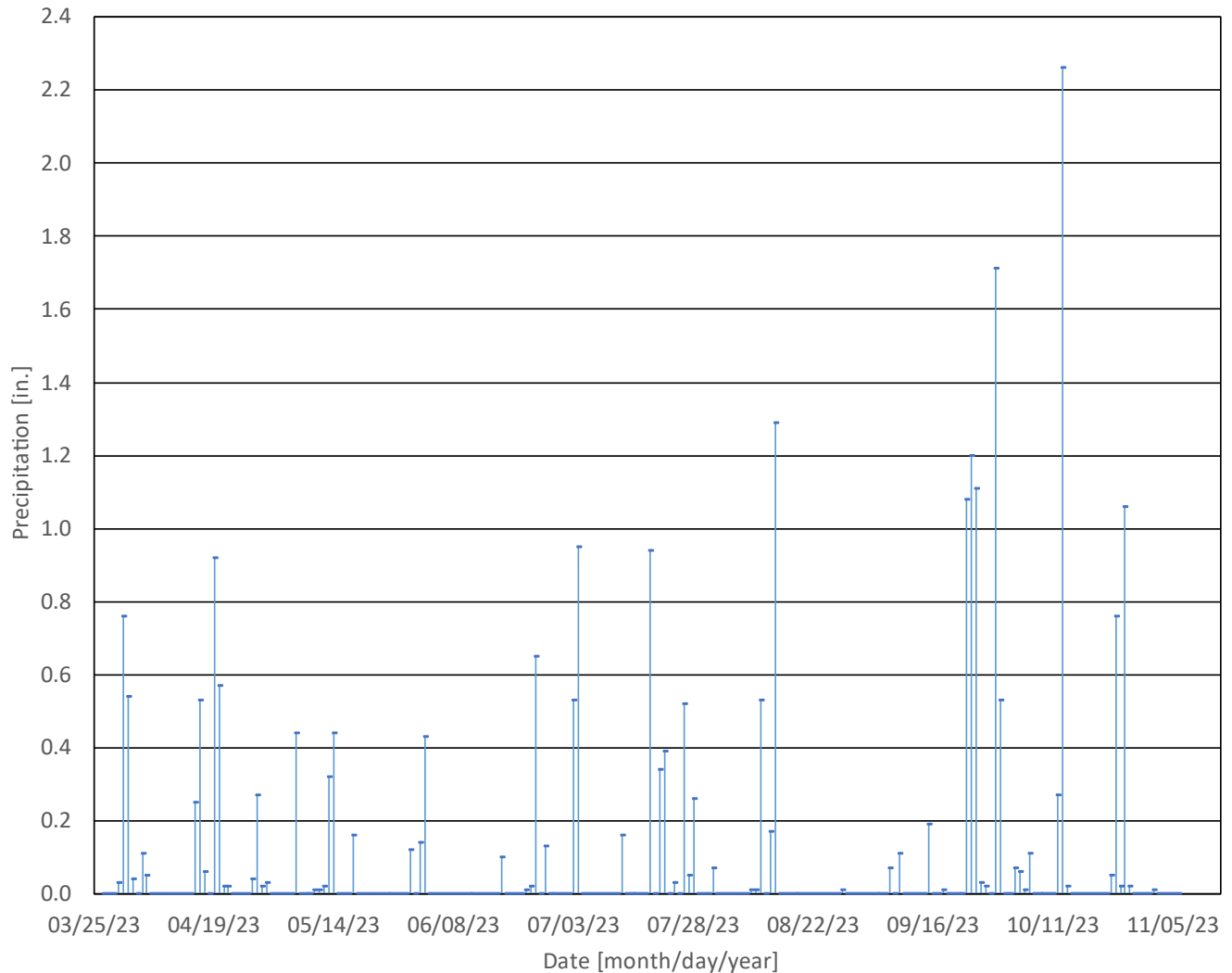


Figure 1. Daily precipitation recorded by the BCWD weather station (Mar 27-Nov 6).

point during the year. This is notable since several aquatic species in Brown’s Creek require cool water temperatures to survive. For example, brown trout can become physiologically stressed when water temperatures exceed 65°F, and young trout may stop feeding when water temperatures exceed 71°F (personal comm. MNDNR Fisheries).

Below average precipitation during the summer of 2023 likely influenced the recorded water temperatures at the WOMP station, with cool groundwater discharge supporting the majority of stream flow during the summer. There are multiple factors that influence instream temperatures that require detailed analysis beyond the scope of this project; however, the data summarized in Table 1 suggest that a combination of warm air temperatures with concurrent precipitation events appear to have a greater effect on instream temperatures than warm air temperatures alone. For example, since 2012, 2021 had the greatest number of days above 90°F and the warmest nights (nights when the low air temperature was above the average low), yet there was only one day when water temperatures exceeded 70°F at the WOMP station that year. 2021 was also the second driest

Table 1. Air and water temperature trends for Brown's Creek during warm weather months (May 1-September 1, 2012-2023)

Year	# days with max. air temp above 90° F	# nights with low air temp above average low [°F]	Average low air temp. above average low [°F]	# days when WOMP water temp. exceeded 70° F	Total precip. May 1-Sept 1 [in.]	Total precip. [in.] on days when WOMP water temp. exceeded 70° F
2012	20	43	5.10	21	17.26	5.28
2013	12	34	4.74	11	17.31	2.12
2014	0	25	4.64	7	21.28	0.10
2015	2	25	3.37	4	21.14	1.55
2016	12	38	3.79	10	20.80	4.96
2017	9	16	3.27	0	17.12	0
2018	18	45	4.58	8	15.84	3.10
2019	5	15	2.02	1	22.93	0.83
2020	15	42	4.20	8	21.68	3.14
2021	34	33	7.03	1	12.14	0
2022	16	30	4.69	1	13.30	0
2023	24	34	4.03	0	9.26	0

year (from May 1-Sept.1) since the weather station was installed in 2012. Conversely, the years that had greater amounts of precipitation during warm weather periods had the greater number of days when the WOMP water temperature exceeded 70°F. Since the weather station was installed, 2023 had the second most days above 90°F but was also the driest year (from May 1-Sept.1), and WOMP water temperatures never exceeded 70°F at any point during the monitoring season.

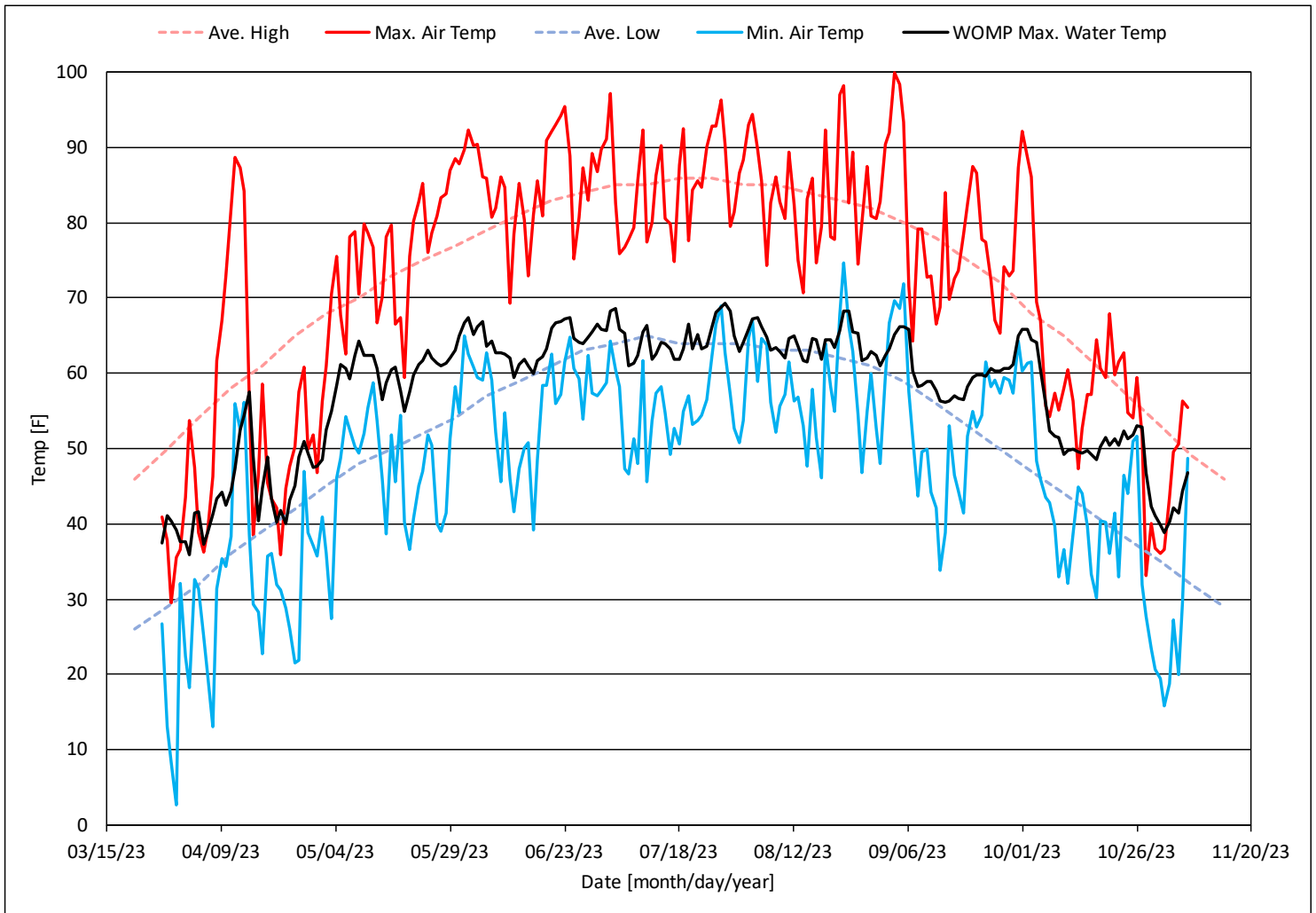


Figure 2. Daily maximum and minimum temperatures recorded by the BCWD weather station and WOMP daily maximum water temperatures recorded by the WCD/ Met Council. Average air temperature data source: <https://weather.com/weather/monthly/1/45.067273,-92.854033>

Weather Station Maintenance

Prior to equipment installation, the precipitation gauge was calibrated to a simulated one-inch rain event according to the manufacturer’s specifications. During the monitoring season, the weather station was visited periodically to download data and check for sensor fouling. All weather sensors were inspected in the fall of 2023 and no upgrades or replacements are needed at this time.

2024 Scope of Services

The following scope identifies the costs associated with equipment preparation, precipitation gauge calibration, data collection, and reporting for the 2024 monitoring season (March to November). All data collected in 2024 will be forwarded to the Washington Conservation District and other entities as requested.

Task	Hours	Estimated Cost
Precipitation Calibration & Installation of Weather Station	5	\$745
Monthly Download of Data	7	\$938
End of Season Equipment Removal	3	\$447
Data QA/QC & Report, Data Storage, & Distribution to the WCD	8	\$1,192
Expenses	N/A	\$320*
TOTALS	23	\$3,642

- * Includes the cost for sensor replacement if needed (temp/ humidity or pyranometer sensor) during the 2023 monitoring season

Requested Action

1. Approve this scope of services from account number 957-0000. All tasks including the annual report will be completed by February 28, 2025.