memo

Project Name |	Weather Station Monitoring Program	**Date** |	02/24/2022
To / Contact info |	BCWD Board of Managers		
Cc / Contact info |	Karen Kill, District Administrator		
From / Contact info |	Mike Majeski, Conservation Biologist		
Regarding |	2021 Weather Summary		

Background

The Weather Station Monitoring Program was initiated in the spring of 2011. 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, solar radiation, wind speed, gust speed, and wind direction. The weather station is programmed to collect data from spring through fall of each season. 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 2021 and describe any maintenance or calibrations preformed on the weather station instruments.

2021 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 12, 2021 and was removed on December 10, 2021. A programming error of the weather station resulted in no data collected between August 25 – September 23, so data was substituted from Weather Underground Station KMNSTILL8. From March 12 to December 10, a total of 22.85 inches of precipitation was recorded, including five rain events over 1" (Figure 1). Above average monthly precipitation occurred only in April (3.25") and August (6.52"). A significant drought occurred during much of the growing season, with the greatest departures from normal occurring in July (-3.40"), June (-3.16"), and September (-1.34"). Notable dry periods over the course of the monitoring season included: Apr 28-May 17 (0.01" in 20 days), May 28-June 19 (0.07" in 23 days), Aug 9-Aug 21 (0.10" in 13 days), and Sept 22-Oct 19 (0.36" in 28 days).

Air temperatures recorded at the weather station fluctuated above and below the average high and low temperatures throughout the monitoring season, with 2021 containing the most days above 90 degrees F since 2015 (Table 1 and Figure 2). Despite 16 consecutive days with daily maximum air temperatures above 85 degrees F from June 3-June 18, with 11 of those days above 90 degrees F, water temperatures recorded in Brown's Creek at the WOMP station remained relatively cool, with only one day when the maximum water temperature exceeded 70 degrees F (70.14 degrees on June 10), which is below the critical temperature for brown trout (75 degrees). The lack of precipitation during this warm spell likely influenced the recorded water temperatures, with cool groundwater discharge supporting the majority of stream flow during this timeframe. There are multiple factors that influence instream temperatures that require detailed analysis beyond the scope of this project;

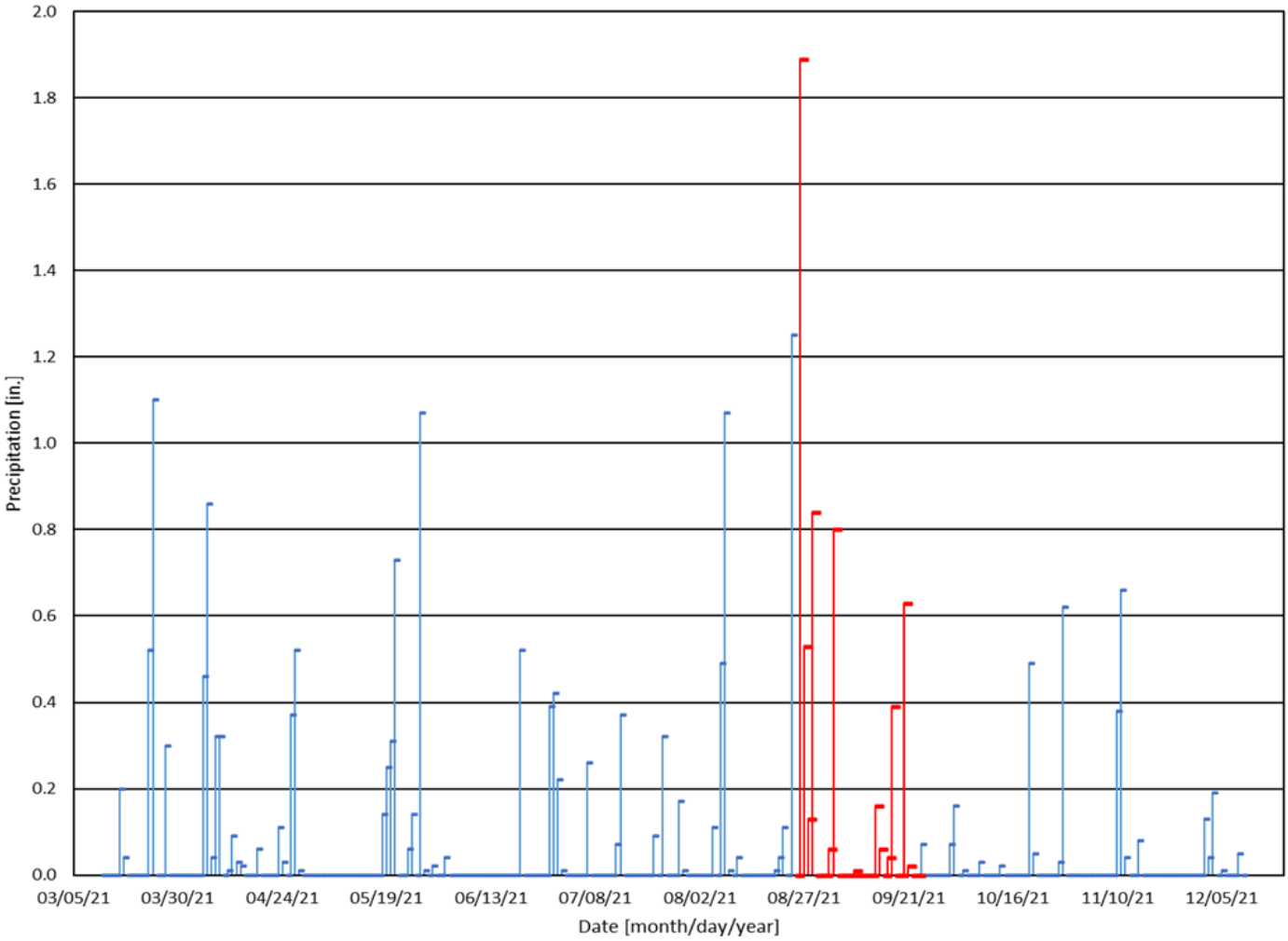

Figure 1. Daily precipitation recorded by the BCWD weather station (Mar 12-Dec 10). Data in red from Weather Underground Station KMNSTILL8

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. Since 2015, 2021 had the greatest number of days above 90 degrees F and the warmest nights (nights when the low temperature was above the average low), yet over the course of the summer there was only one day when water temperatures exceeded 70 degrees F at the WOMP station. 2021 was also significantly drier than any other year since 2015.

Table 1. Air and Water Temperature Trends at Brown's Creek during warm weather months (May 1-September 1, 2015-2021)

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 WOMP max. water temp. exceeded 70 F	Total Precip. May 1-Sept 1 [in.]	Total precip. on days when WOMP water temp. exceeded 70 F
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	0.00
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	0.00

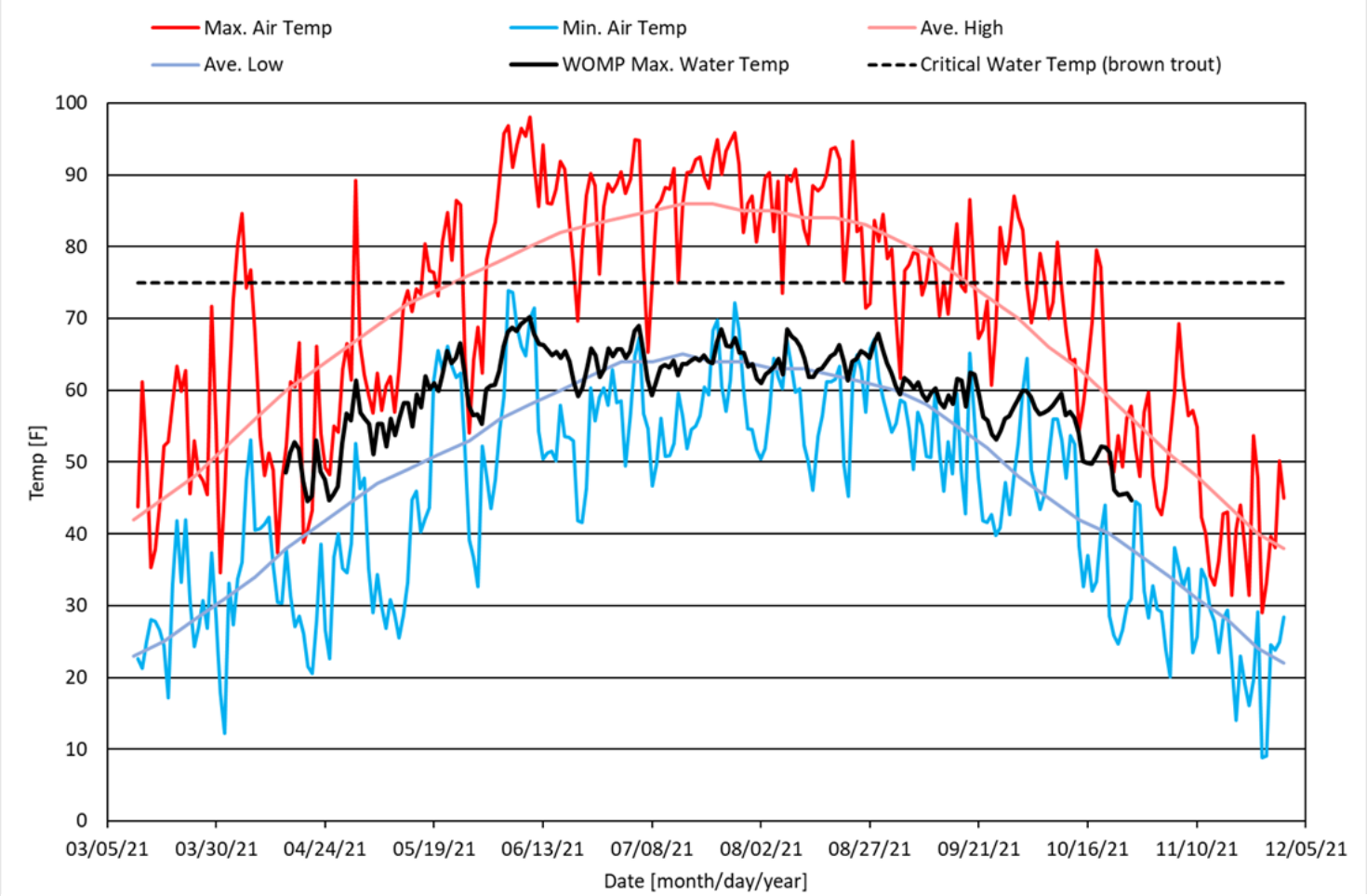

Figure 2. Daily maximum and minimum temperatures recorded by the BCWD weather station and WOMP daily maximum water temperatures recorded by the WCD. Average air temperature data source: https://weather.com/weather/monthly/l/45.067273,-92.854033

Weather Station Maintenance

Prior to equipment installation, the precipitation gauge was calibrated to a simulated one-inch rain event per the manufacturer's specifications. During the monitoring season, the weather station was visited monthly to download data and check for sensor fouling. All weather sensors were inspected in the fall of 2021 and no upgrades or replacements are needed at this time.

2022 Scope of Services

The following scope identifies the costs associated with equipment preparation, precipitation gauge calibration, data collection, and reporting for the 2022 monitoring season (March to November). All data collected in 2022 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	$300*
TOTALS	**23**	**$3,622**

* Includes the cost for sensor replacement (temp/ humidity, or pyranometer sensor, if needed during the 2022 monitoring season)

Requested Action

1. Approve this scope of services from account number 957-0000. This work will be completed by December 31, 2022.