memo

Project Name |	Weather Station Monitoring Program	**Date** |	12/27/2017
To / Contact info |	BCWD Board of Managers		
Cc / Contact info |	Karen Kill, District Administrator		
From / Contact info |	Mike Majeski		
Regarding |	2017 Weather Station 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 on a 15 minute interval and is operated from spring through fall of each season. This information is being collected to support a variety of District projects and programs including hydrologic and hydraulic model upgrades and calibration, thermal modeling efforts, and the Brown's Creek riparian shading study. The weather station data is routinely shared with the Washington Conservation District and University of Minnesota (Bill Herb). During the course of the 2017 monitoring season, the weather station data was evaluated for quality assurance purposes by comparing data on a monthly basis to a local weather station. This memorandum summarizes the results of this quality assurance/quality control (QA/QC) process.

QA/QC Summary

The Brown's Creek weather station was installed at the Stillwater Public Works Facility (latitude: 45°03'49.86", longitude: 92°51'21.05") on March 29, 2017 and was removed on November 6, 2017. For quality assurance and quality control of the dataset, 9 individual time periods were analyzed by comparing the data to the nearest weather station reporting similar data parameters. A review of weather station locations provided by WeatherUnderground.com indicated a personal weather station (KMNSTILL8) located 0.37 miles southeast of the Brown's Creek weather station. This weather station was chosen for comparison because it was the nearest weather station reporting hourly temperature, relative humidity, solar radiation, precipitation, and wind speed data. It was decided the Lake Elmo weather station used in previous QA/QC memos should no longer be used to compare data due to distance from the Brown's Creek weather station (4.6 miles south) and lack of solar radiation data.

Beginning in April, individual time periods in each month were compared to the KMNSTILL8 station for the same time period. For example, the time period selected in April was April 1 at 6:30 for the Brown's Creek station and April 1 at 6:28 for the KMNSTILL8 station. In addition, time periods were selected at different times of the day (early morning, late morning, early afternoon, evening, and night) to compare the data against temperature, relative humidity, and solar radiation extremes. Nine time periods were analyzed from April-November (Table 1).

Table 1. Comparison of Weather Station Data for the 2017 Monitoring Season

Weather Station	Date/ Time	Temp (°F)	RH (%)	Solar Radiation (w/m2)	Wind Speed (mph)	Gust Speed (mph)	24 hr Precip (in)
Brown's Creek	4/1/2017 6:30	25.5	92.9	0.6	0.0	0.0	0.00
KMNSTILL8	4/1/2017 6:28	29.9	84.0	0.0	0.0	0.0	0.00
Brown's Creek	5/4/2017 14:00	66.5	38.2	856.9	6.8	14.6	0.00
KMNSTILL8	5/4/2017 13:59	67.8	41.0	916.0	5.0	15.0	0.02
Brown's Creek	6/10/2017 17:00	92.6	48.4	529.4	3.4	18.0	0.00
KMNSTILL8	6/10/2017 16:59	92.1	53.0	508.0	2.0	3.0	0.00
Brown's Creek	6/22/2017 8:45	69.3	92.5	214.4	0.0	4.5	0.50
KMNSTILL8	6/22/2017 8:44	69.0	52.0	214.0	0.0	1.0	0.45
Brown's Creek	7/22/2017 13:45	75.2	63.8	1244.4	1.1	5.6	0.00
KMNSTILL8	7/22/2017 13:44	72.2	70.0	1071.0	0.0	5.0	0.00
Brown's Creek	8/3/2017 2:30	62.5	72.7	0.6	0.0	5.6	0.75
KMNSTILL8	8/3/2017 2:32	63.7	71.0	0.0	0.0	3.0	0.71
Brown's Creek	9/12/2015 11:00	80.9	64.6	530.6	0.0	4.5	0.00
KMNSTILL8	9/12/2017 11:01	77.4	65.0	550.0	0.0	1.0	0.00
Brown's Creek	10/2/2017 8:15	54.9	96.2	53.1	0.0	3.4	1.66
KMNSTILL8	10/2/2017 8:14	55.3	N/A	40.0	0.0	2.0	1.52
Brown's Creek	10/25/17 23:00	45.3	73.4	0.6	2.3	7.9	0.00
KMNSTILL8	10/25/17 23:01	45.7	70.0	0.0	0.0	3.0	0.00

The greatest deviation in values between the two weather stations occurred in wind gust speed. Differences in wind gust could be influenced by differences in measuring equipment, location and age of the anemometer, logging rate and time, and landscape obstructions such as buildings, trees, and topography. It should be noted that the Brown's Creek weather station was upgraded in the spring of 2016 with a new anemometer, wind direction sensor, and data logger. The relative humidity sensor was replaced in 2014. It is unknown what caused the significant difference in relative humidity readings on June 22, though it appears the Brown's Creek station was reading accurately based on a comparison to the Lake Elmo weather station during the same time period. The relative humidity value for the Lake Elmo station on June 22 at 8:32 a.m. was 94%, which was very close to the reported value from the Brown's Creek station. It is possible the KMNSTILL8 station experienced a faulty reading or the relative humidity sensor was obstructed during that time. All other KMNSTILL8 relative humidity readings for the remainder of the year were similar to the Brown's Creek weather station.

Conclusion

With the recent upgrades to the Brown's Creek weather station, the District can expect several years of good operating performance from the weather station. The pyranometer (solar radiation sensor) was inspected in 2017 and was determined to be in good condition based on an assessment of the filter window and color. The filter window should be white at all times; if the filter window begins to fade to a dull yellow color or darker, the sensor should be replaced.

Recommendations

In early spring of 2016, Stillwater Public Works staff cut down the box elder trees that were growing along the berm where the weather station is located. Unfortunately, sucker growth has occurred around each cut stump, and it is unlikely that any herbicide was applied to the stumps when the trees were cut. The suckers have now grown to over 7 feet in height and will need to be removed before the weather station is re-installed in March of 2018. EOR will contact Stillwater Public Works again to inquire if they can conduct the cutting and herbicide application before the weather station is re-installed. The cost to coordinate this effort easily fits within the existing 2017 Weather Station Program budget, so no action item is needed at this time. If Stillwater Public Works Staff are unable to perform this work, EOR will remove the trees and coordinate with Tara Kelly with the Washington Conservation District to apply herbicide to the cut stumps.

2018 Scope of Services

The following scope identifies the costs associated with the collection and review of weather data for the 2018 monitoring season (March to November). This scope includes the cost to prepare a memo describing the quality control used to evaluate data integrity and to forward the data to the Washington Conservation District, University of Minnesota, and other entities if requested.

Task	**Hours**	**Estimated Cost**
Equipment Prep and Installation of Weather Station	5	$575.00
Monthly Download of Data	8	$920.00
End of Season Equipment Removal	4	$460.00
Data Storage, Quality Control memo, and Distribution to the WCD	10	$1,150.00
Expenses	N/A	$120.00
TOTALS	**27**	**$3,225.00**

Action Item

1. Authorize EOR to implement the weather station monitoring program in the spring of 2018 per the costs identified in this scope. This work will be completed by December 31, 2018.