



## MEMORANDUM

**TO:** Kristina Handt, Administrator, City of Scandia

**FROM:** Erik Anderson, Water Resource Specialist

**DATE:** January 15, 2015

**RE:** **Zavoral Mining and Reclamation Project – Annual Surface Water Monitoring Report**

As per the contract (14-01) between the Washington Conservation District (WCD) and the City of Scandia, WCD staff performed surface water monitoring tasks pertaining to Technical Service 1 of Exhibit B. This memorandum serves as a summary of those activities.

The Washington Conservation District installed stream monitoring equipment at two locations on Zavoral Creek in 2013 and 2014, and one location on Middle Creek in 2014. Of the sites on Zavoral Creek, one is located at the monitoring point that was installed for the EIS pump test near the creek mouth (referred to simply as Zavoral Creek), the other site is located upstream of all groundwater inputs to the creek (Crystal Springs) and is dry during periods of no rain or snowmelt. This paired monitoring setup can be used to help determine sources of impacts to Zavoral Creek by potentially either eliminating or supporting the mine as a source. The Middle Creek site was added in 2014 because groundwater elevation data collected by Leggette, Brashears, and Graham, Inc. (LBG) in 2013 suggests groundwater is potentially flowing in a southeast direction towards Middle Creek. The monitoring site is located near the creek mouth. Continuous turbidity, dissolved oxygen (D.O.), temperature, specific conductivity, stage, velocity, and discharge data were collected at all three locations. Water quality samples were collected during base and storm flow at Zavoral Creek and analyzed for total & volatile suspended sediments. No samples were collected at Crystal Springs or Middle Creek. Equipment at Zavoral Creek and Crystal Springs was installed on 6/12/13 with the intention of gathering baseline data previous to the commencement of mining activities. Due to the harsh winter weather, all equipment was removed at Crystal Springs on 10/31/13 and the stage/flow recorder was removed at Zavoral Creek on 11/14/13. All equipment at Crystal Springs and Middle Creek, and the Zavoral Creek stage/flow recorder was installed on 5/6/14 and removed on 11/3/14 for the winter season. At the time of this report, all other parameters are still being recorded at Zavoral Creek. Macroinvertebrate samples were collected in June and September in 2013 and 2014 at Zavoral Creek, and results were forwarded to the Carnelian-Marine-St. Croix Watershed District.

### **Results/Conclusions/Recommendations**

Surface water data collected at Zavoral Creek, Crystal Springs, and Middle Creek from 6/12/13 – 12/31/14 were analyzed by the WCD for this summary. Groundwater data collected by LBG was compared to the surface water data to determine if a correlation exists between the two datasets. To date, data results do not indicate any impacts to the stream caused by the mining operations. Rainfall data collected from a monitoring station at Bone Lake in Scandia was used for comparison because of its close proximity to the project location. It should be noted, quick unsustained spikes in turbidity have been recorded at all monitoring locations, independent of each other, previous to or outside of any mining activities occurring, and in the absence of recorded rainfall. Possible explanations for these anomalies include logger error, sediment adhering to the sensor, animal activity in the stream, or some other natural phenomenon. These data have been included in the final dataset to show that very short fluctuations in stream turbidity have been recorded outside of mining activities. A reading of 1616 NTU (Nephelometric Turbidity Units) was recorded at Zavoral Creek on 11/17/13 at 8:00 pm (after site preparation but before any hauling activity began) and is not thought to be a result of any mining activities, mainly due to the time it occurred and the adjacent 15-minute periods recorded 0 NTU. This is an example of sediment possibly adhering to the sensor or some

other cause of a quick anomaly in the data. Tables and hydrographs showing the data collected through 12/31/14 at Zavoral Creek, Crystal Springs, and Middle Creek can be found at the end of this report.

I recommend monitoring the same locations on Zavoral Creek, Crystal Springs, and Middle Creek in 2015, following the same procedures and methods as in 2014.



	Zavoral Creek		Crystal Springs		Middle Creek
	2013	2014	2013	2014	2014
<b>Average Baseflow Discharge (cfs)</b>	0.27	0.24	No baseflow		0.14
<b>Peak Discharge (cfs)*</b>	0.69*	44.63	1.66*	13.96	1.81
<b>Average Baseflow Turbidity (NTU)**</b>	0	0.37	No baseflow		1.55
<b>Peak Turbidity (NTU)**</b>	854	2923	2268	2985	3000

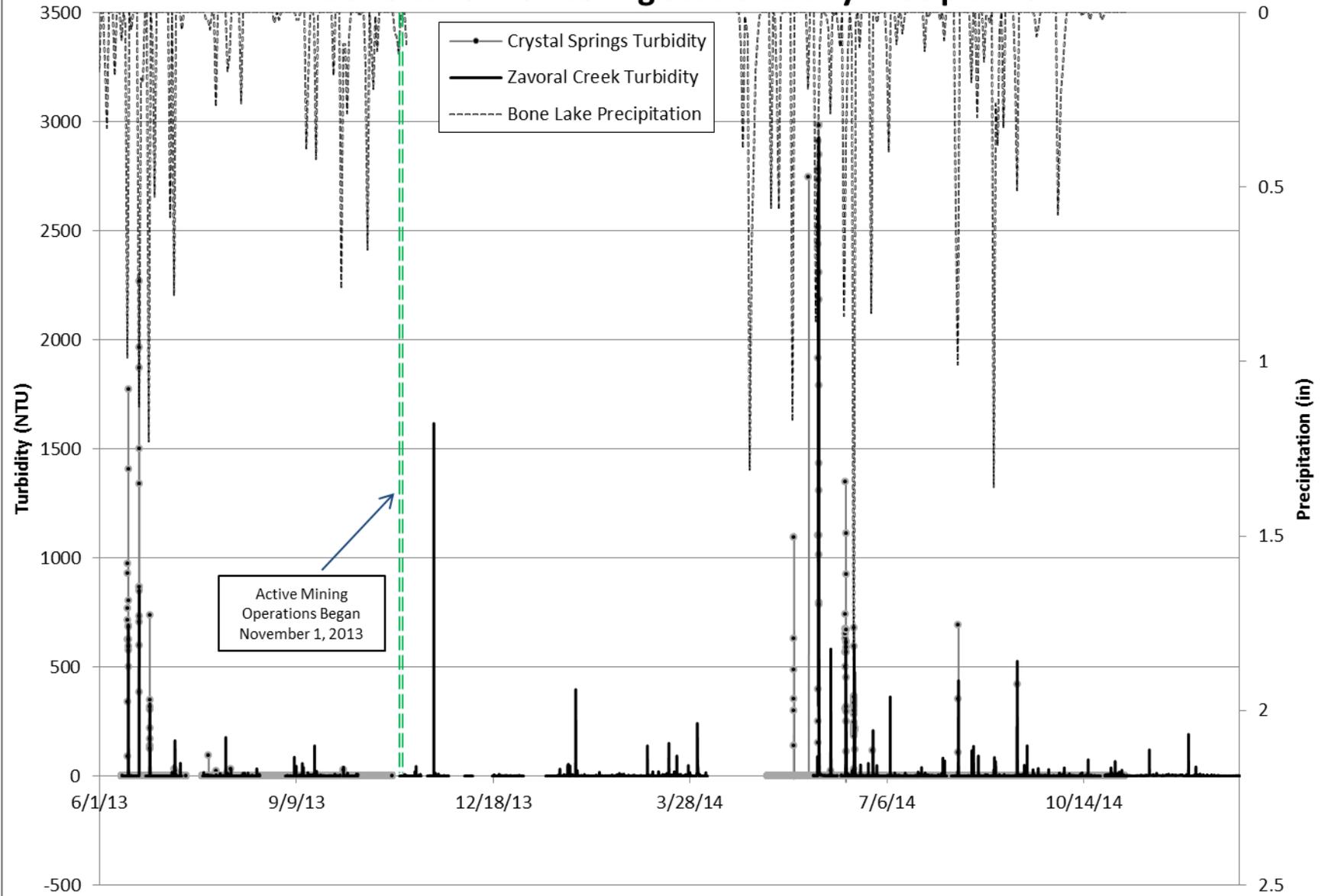
\*Discharge was not collected at Zavoral Creek during the Crystal Springs peak discharge event (2013)

\*\*Excludes anomaly data

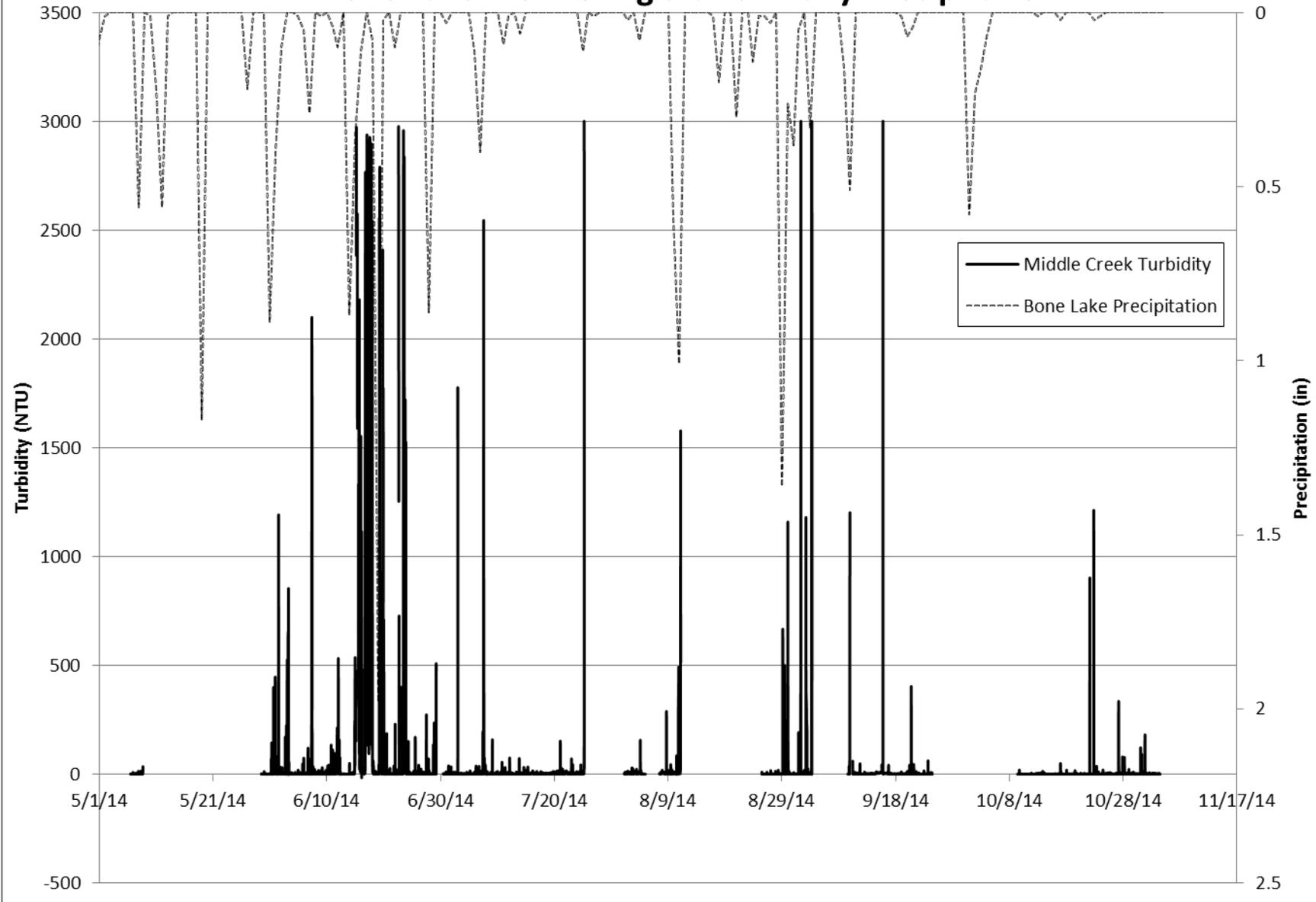
cfs: cubic feet per second

NTU: Nephelometric Turbidity Units

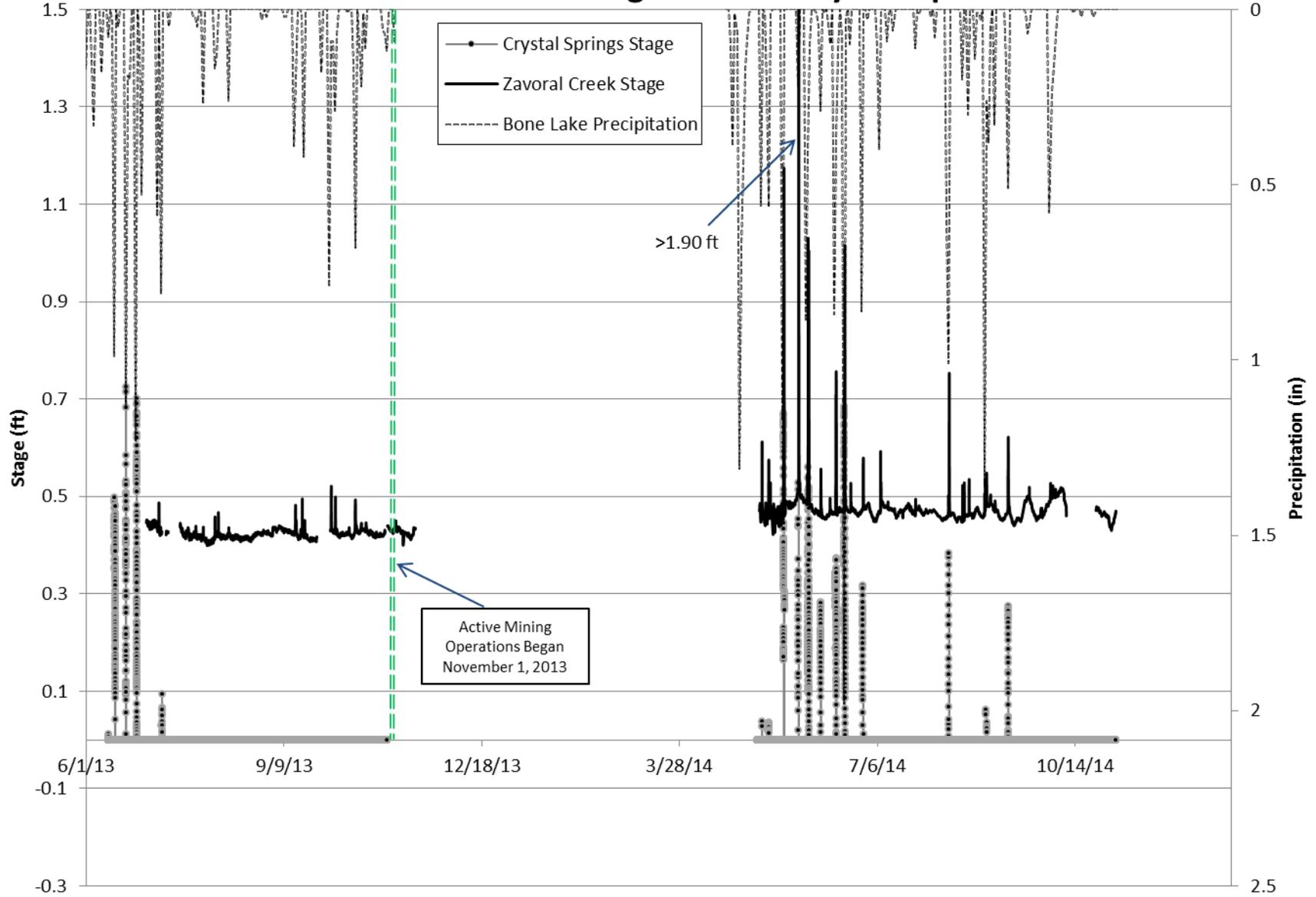
# Zavoral Creek & Crystal Springs Turbidity, Bone Lake Monitoring Station Daily Precipitation



# Middle Creek Turbidity, Bone Lake Monitoring Station Daily Precipitation

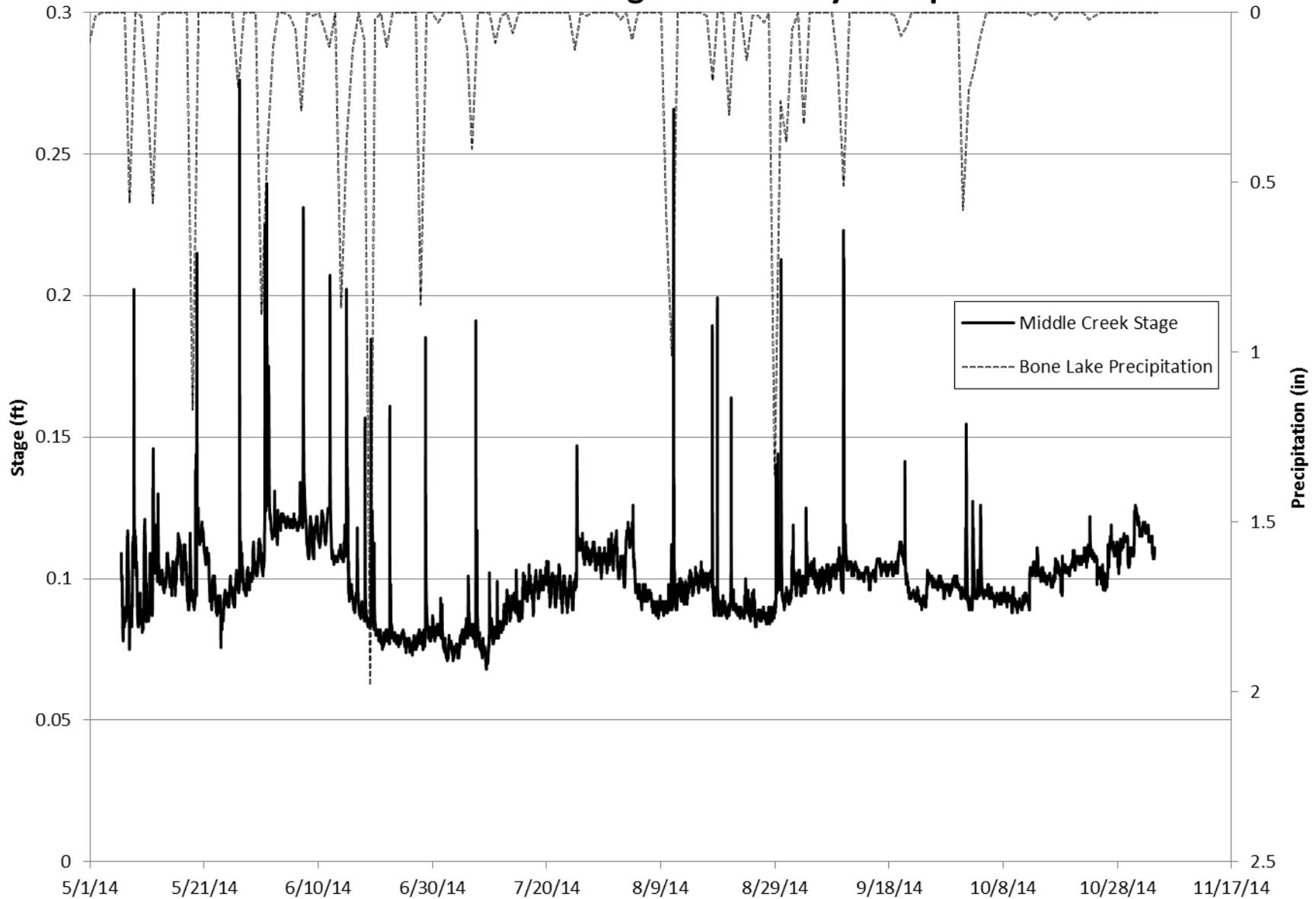


# Zavoral Creek & Crystal Springs Stage, Bone Lake Monitoring Station Daily Precipitation

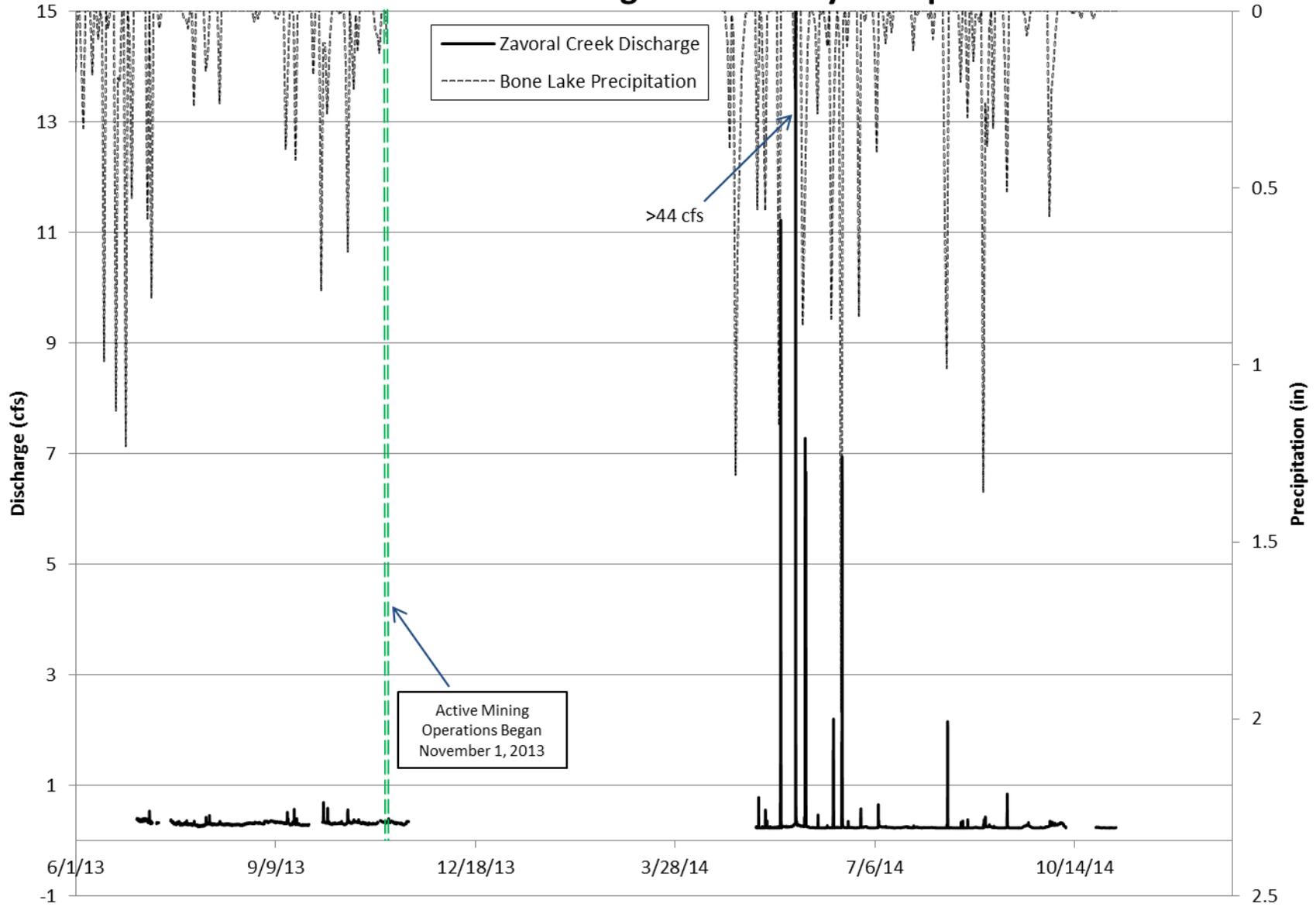


# Middle Creek Stage

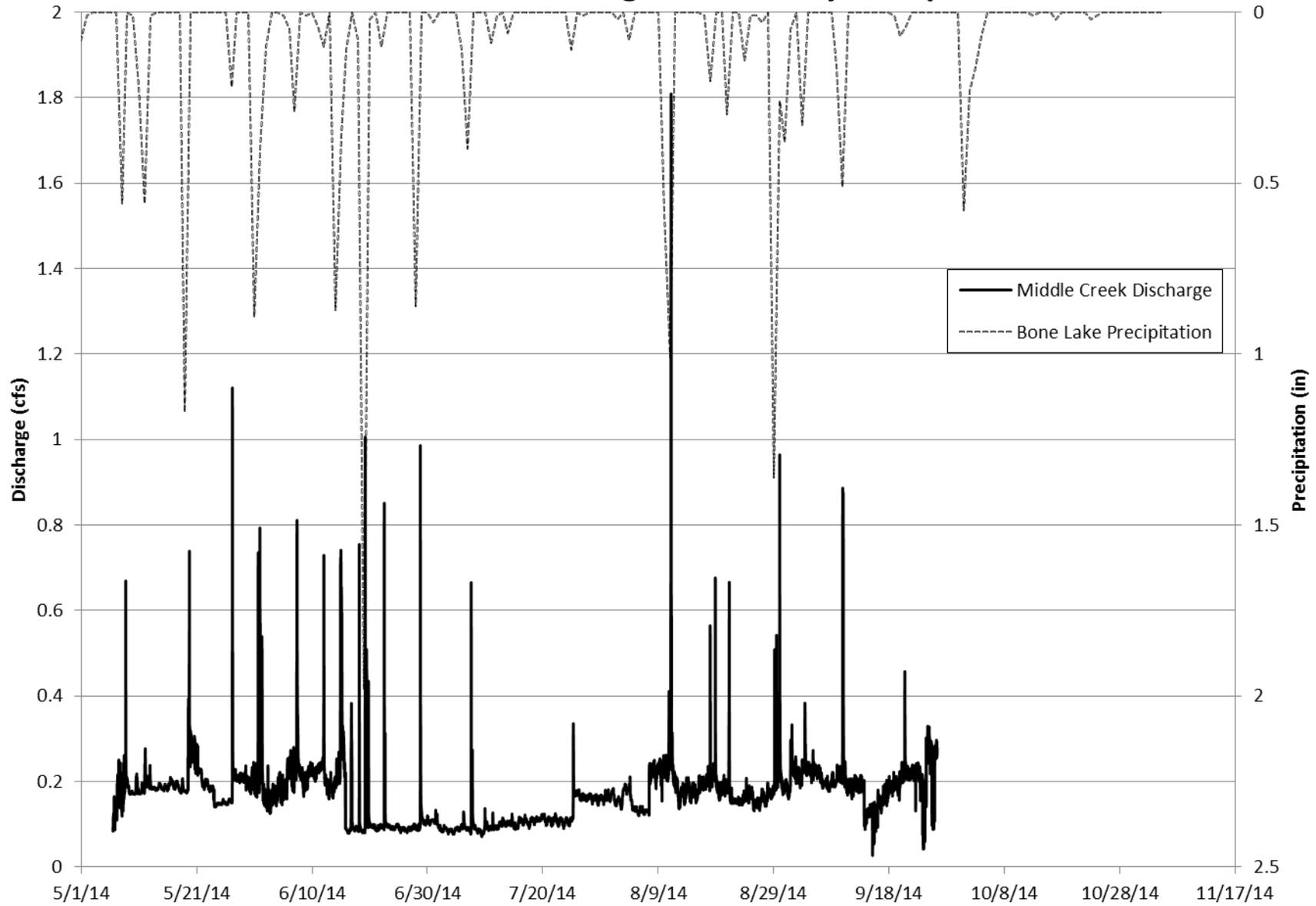
## Bone Lake Monitoring Station Daily Precipitation



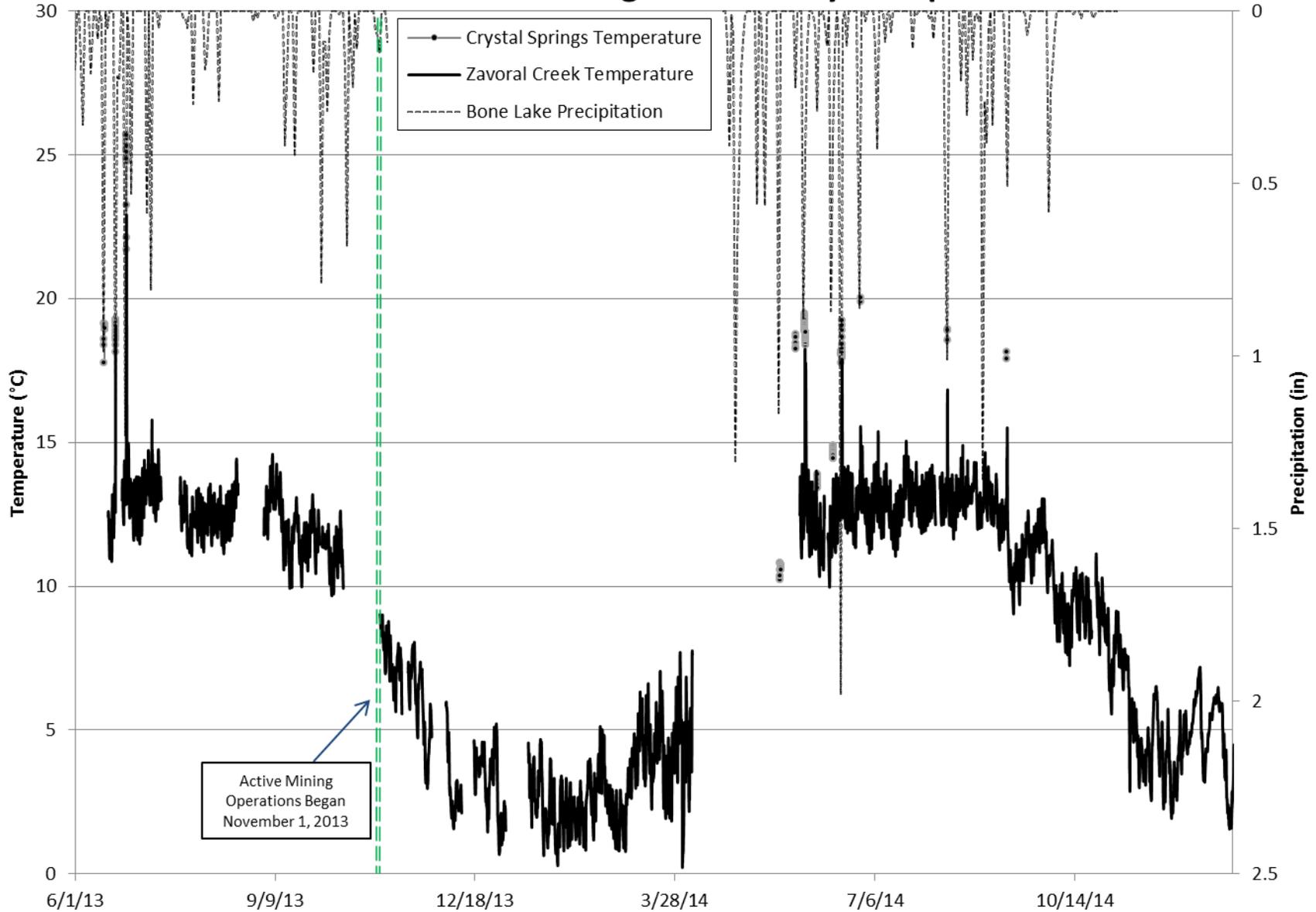
# Zavoral Creek Discharge, Bone Lake Monitoring Station Daily Precipitation



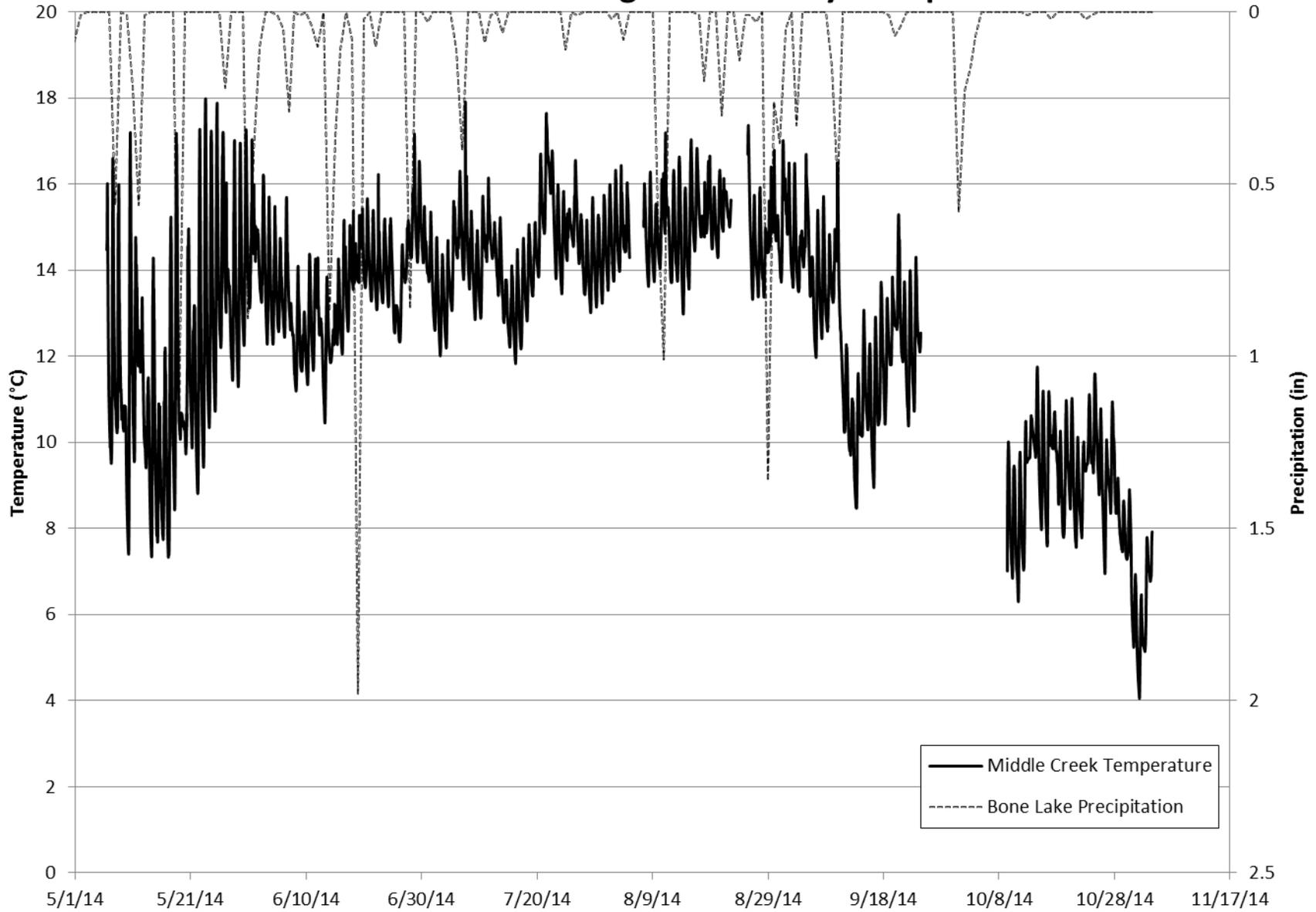
# Middle Creek Discharge, Bone Lake Monitoring Station Daily Precipitation



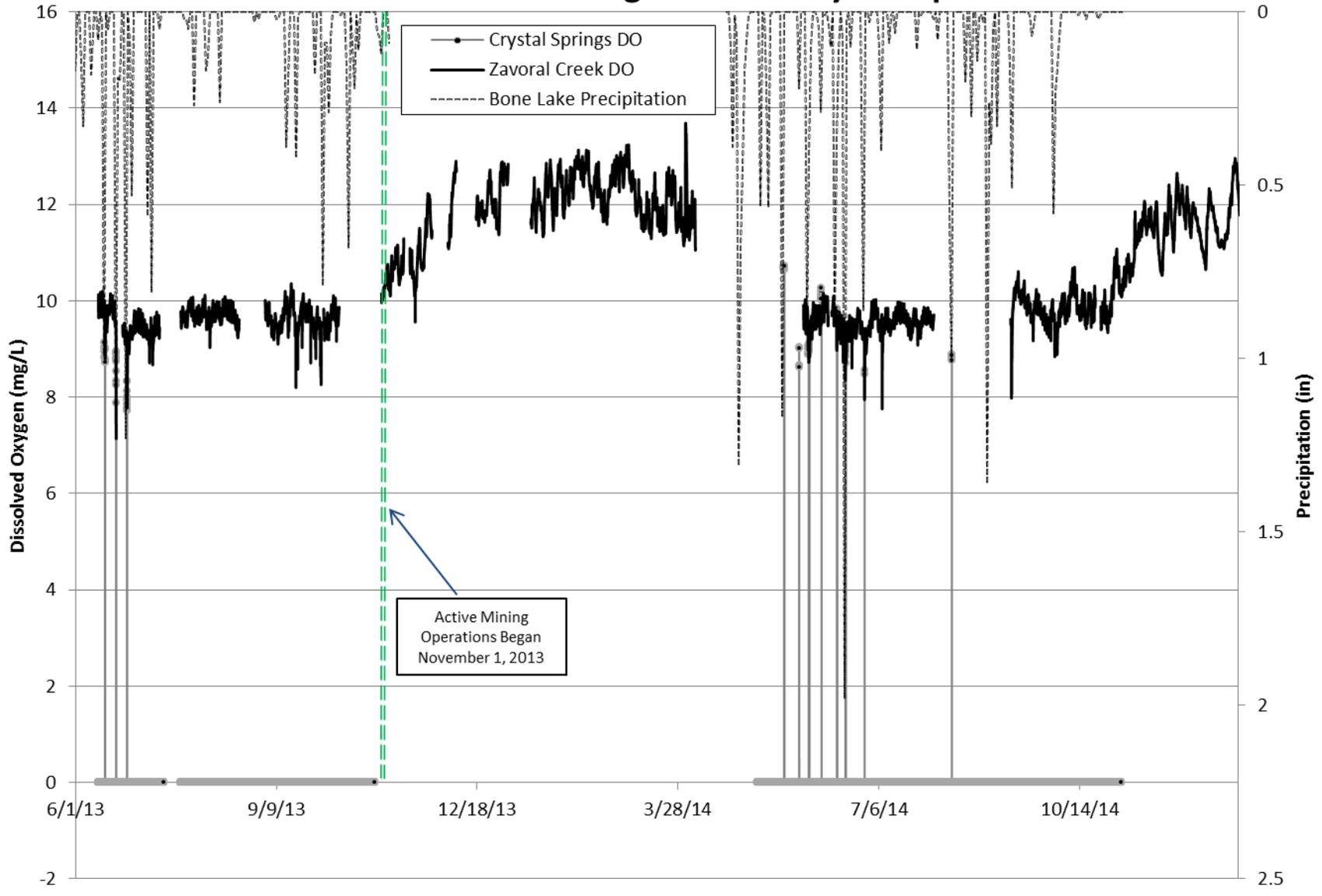
# Zavoral Creek & Crystal Springs Temperature, Bone Lake Monitoring Station Daily Precipitation



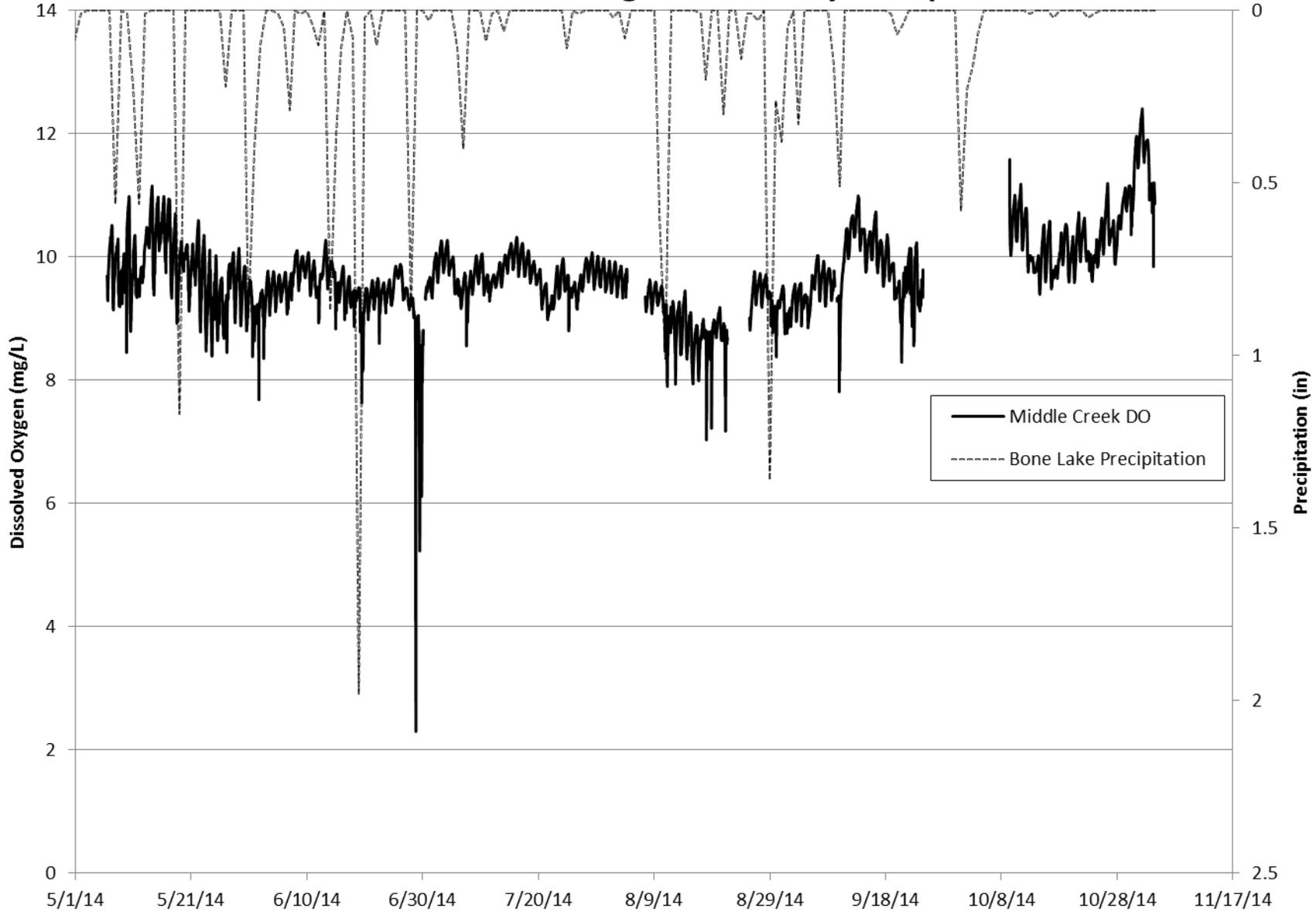
# Middle Creek Temperature, Bone Lake Monitoring Station Daily Precipitation



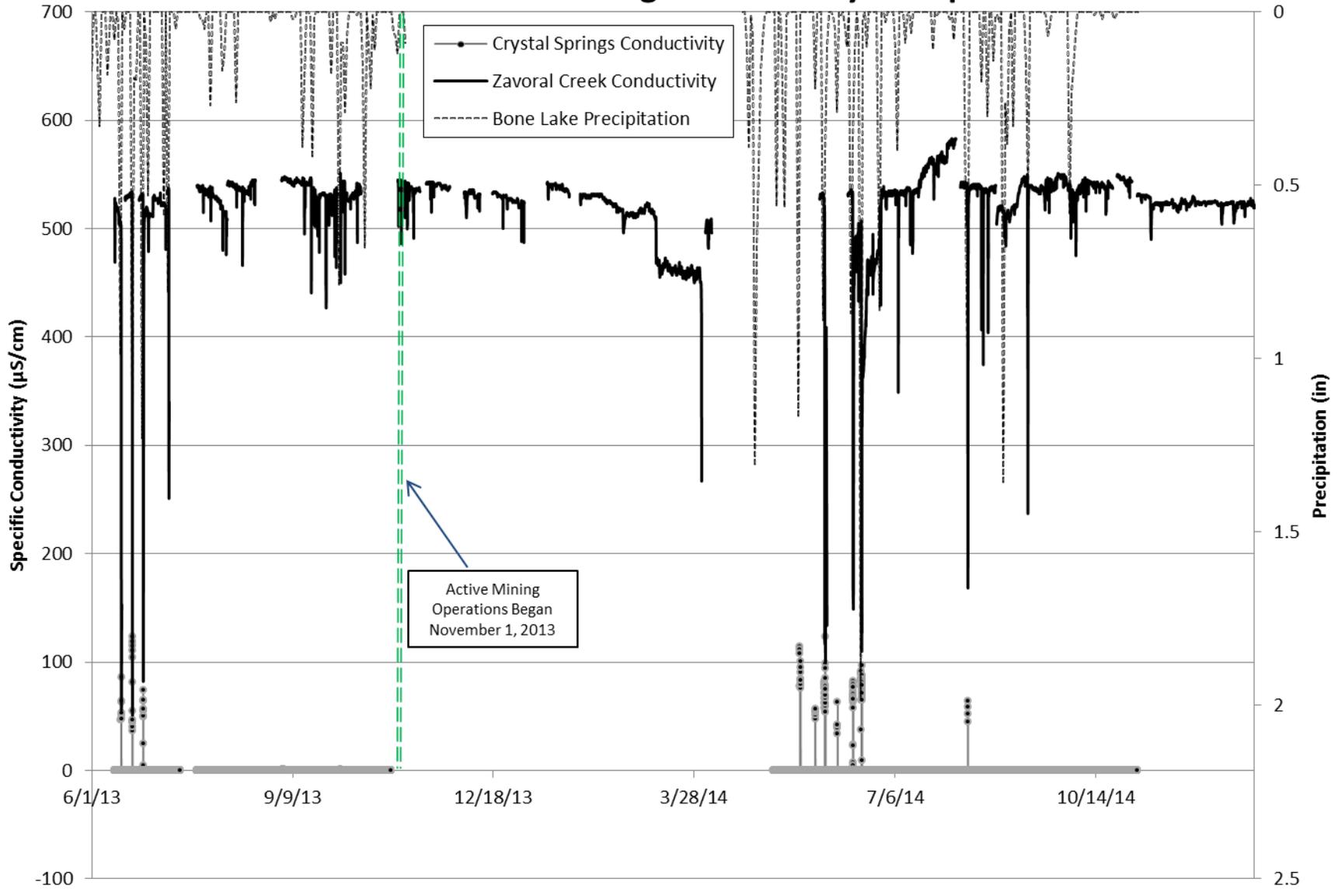
# Zavoral Creek & Crystal Springs Dissolved Oxygen, Bone Lake Monitoring Station Daily Precipitation



# Middle Creek Dissolved Oxygen, Bone Lake Monitoring Station Daily Precipitation



# Zavoral Creek & Crystal Springs Specific Conductivity, Bone Lake Monitoring Station Daily Precipitation



# Middle Creek Specific Conductivity, Bone Lake Monitoring Station Daily Precipitation

