Final

SAN JUAN RIVER BASIN RECOVERY IMPLEMENTATION PROGRAM
WATER TEMPERATURE MONITORING

2012 ANNUAL REPORT

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Ecosystems Research Inc
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and
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Submitted By:
William J. Miller and
Kristin M. Swaim
Miller Ecological Consultants, Inc
Fort Collins, Colorado

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ECOLOGICAL
CONSULTANTS, INC.
www.millereco.com

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INTRODUCTION

As part of the San Juan River Basin Recovery Implementation Program (SJRIP), water temperature and hydrology studies have been undertaken since 1992. This report summarizes the water temperature data collected from October 2011 to October 2012 as part of the long-term monitoring program.

Objectives

1. ***Monitor water temperature at seven existing locations plus two new locations in the San Juan River, NM and UT (*Figure 1*).***

Logger locations were modified beginning in October 2011. These modifications better meet the objective in the Long Range Plan to monitor water temperature changes as a result of management actions. The locations for Montezuma Creek and the Mancos River do not have continuous flow and as such, those two locations were removed. One logger was added in the San Juan River upstream of the Animas River confluence near County Road 5500 (near the Lee Acres RV Park) in April 2012. This location provides data for the San Juan River upstream of the Animas River in the reach being used to release razorback sucker. A second logger was added in McElmo Creek approximately 0.2 miles upstream of its confluence with the San Juan in October 2011.

It was also proposed that monitoring of the San Juan River at Navajo Dam be discontinued. While water temperature was collected at this site in 2012, our data were questionable due to fluctuating water levels and dam release locations and give further evidence as to why this site should be removed from future monitoring. While there is some difference in water temperature between the dam and Archuleta, that section of river is managed for trout due to the cold water release. Thermal gain between Archuleta and the Animas River was tracked with the new logger installed at County Road 5500.

2. ***Create a database of water temperatures that can be posted and accessed at the SJRIP website.***

The data base for water temperatures was created for FY2012 data. These data are in the same format as the database for previous years.

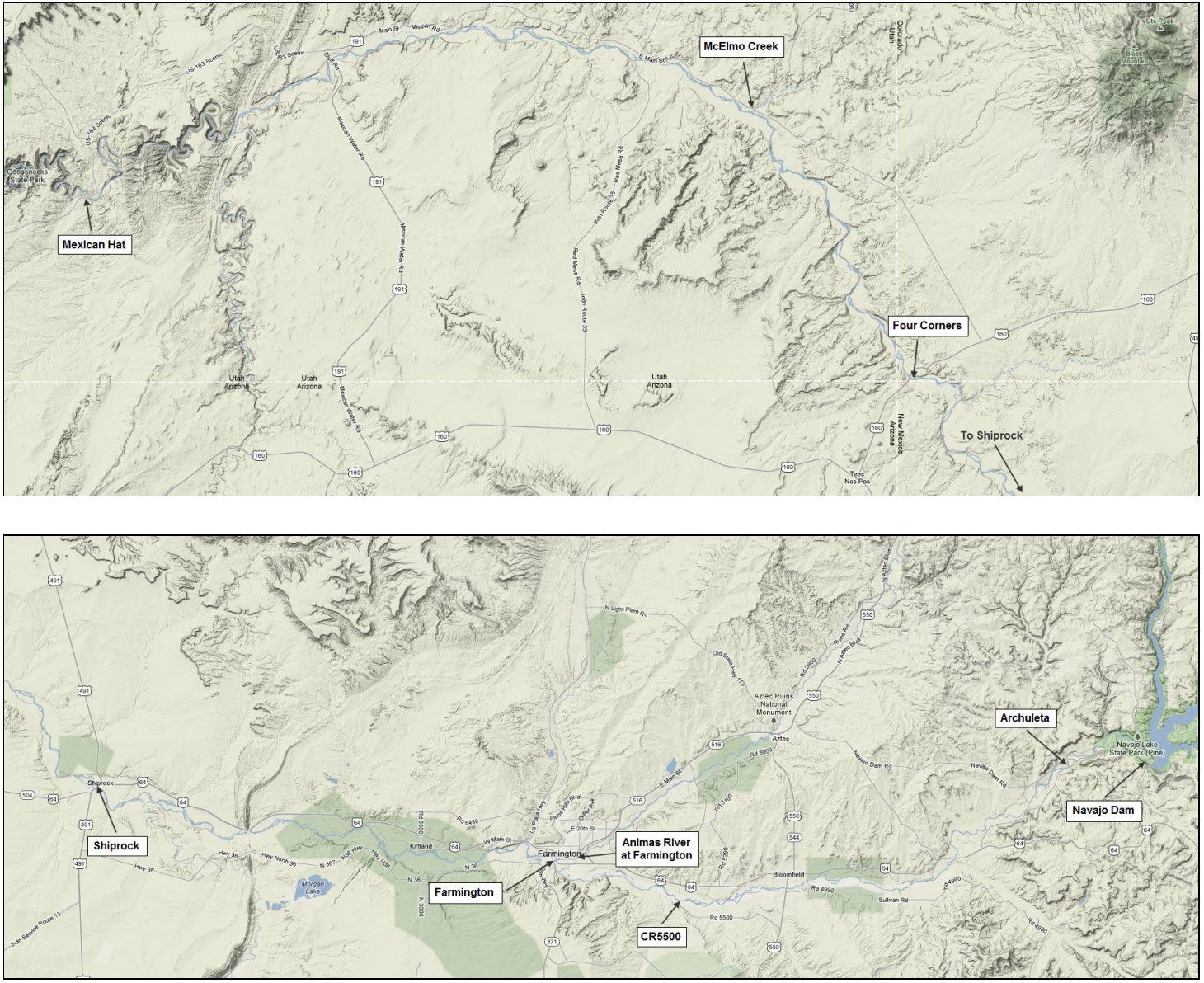

Figure 1. Water temperature monitoring locations. Map courtesy of Google maps.

METHODS

Water temperature has been recorded since the summer of 1992 at the locations shown in Table 1 (not including the two new locations). Those data are found in reports posted to the San Juan River Recovery Implementation website. At the request of the Bureau of Reclamation and the San Juan River Recovery Implementation Program, we installed Onset Corporation HOBO Water Temp TidbiT v2 loggers with built-in thermocouple temperature sensors in October 2011 in the locations described in Table 1. These loggers are accurate to ±0.2°C. Water temperature was recorded every 15 minutes. Each logger was placed in a small enclosure that is secure and hard to detect by individuals without knowledge of the deployment location. This system has been used in locations with high public use without loss of the logger or enclosure. The enclosures consisted of a steel post driven flush with the stream bed and a PVC protective housing for the logger attached to the post by steel cable (Figure 2). These housings can withstand streambed movement and protect the logger from stream debris. Two loggers (labeled primary and secondary) were installed at each location as insurance against malfunction, vandalism, and/or data loss.

HOBOware Pro software was used to deploy and download data from the loggers. This software has built-in capability to summarize data into daily values from the individual 15-minute measurements. Data were downloaded four times on a three-month time interval (winter, spring (prior to runoff), summer (after runoff), and fall). After each field visit, data were transferred to MEC's office where data were checked for quality and any erroneous or suspected incorrect data removed. A Microsoft Access database was then created to contain all 15-minute data from each site. The database also contains tables that summarize daily maximum, minimum and mean temperature for each site. Daily average water temperatures at each site were then plotted along with the daily hydrograph of the San Juan River.

Table 1. Water temperature monitoring locations.

Location	River Mile	UTM Zone	UTM Northing (m)	UTM Easting (m)
Near Navajo Dam	225.0	13S	4076511	266784
Archuleta – San Juan at USGS gage location	218.6	13S	4076301	259235
CR5500 – San Juan at CR5500 bridge near Lee Acres RV Park*	188.9	12S	4064363	759478
Farmington – San Juan at USGS gage location	180.1	12S	4067579	747929
Shiprock – San Juan at USGS gage location	148.0	12S	4073096	706294
Four Corners – San Juan at USGS gage location	119.4	12S	4096658	675400
Mexican Hat – San Juan near Bluff gage location	52.1	12S	4112151	600678
Animas at Farmington – Animas River at USGS gage location	n/a	12S	4067756	749902
McElmo Creek at confluence with San Juan*	n/a	12S	4120599	660513

*New location

Figure 2. Example data logger housing, closed and ready for deployment.

RESULTS & DISCUSSION

For some of the loggers, data from the primary logger were suspect for several dates, so we used data from the secondary loggers as needed. There were several instances where a logger was found buried in the streambed or was out of the water. The primary logger at Four Corners had to be repositioned after it was found buried during the field visit in January 2012. During the July 2012 field visit, the secondary logger at the Farmington location and the secondary logger at the Animas River location were out of the water. The primary logger at Mexican Hat was found on the bank during this visit as well, and data from the secondary logger were used. During the September field visit, the primary logger on the Animas River was found buried in the streambed. Also during this visit the secondary logger at Four Corners could not be found and was presumed lost. There were also several instances where, based on the large fluctuation in temperature on a daily basis, we suspected that a primary logger was out of the water and then resubmerged. During these times, we compared the primary logger data to the secondary logger data and used the secondary data where appropriate. Use of both primary and secondary loggers allowed for nearly continuous temperature records from October 2011 to October 2012, with a couple of exceptions. The first exception is that there are no data for the Mexican Hat site from August 27 to August 30, 2012. The second exception involves the Navajo Dam location. Data from both loggers were suspect from October 2011 to January 2012.

The Navajo Dam release started on May 21, 2012 and ended on June 1, 2012. Average daily flow at the Archuleta gage peaked at 5170 cubic feet per second (cfs) during the release. Water temperature decreased almost immediately: on May 22, 2012, average daily temperature at Navajo Dam had decreased by two degrees from the previous day (Figure 3). The minimum average daily temperature during the release was 5.2°C and the average daily temperature during the release was 5.6°C, approximately 2.5 degrees colder than the average daily temperatures of the previous week. A similar effect was seen at the Archuleta location (Figure 4). The Archuleta minimum average daily temperature during the release was 6.0°C and the average daily temperature during the release was 6.5°C, approximately 2.5 degrees colder than the average daily temperatures of the previous week. At CR5500, the minimum average daily temperature during the release was 8.1°C and the average daily temperature during the release was 8.9°C, approximately 6.5 degrees colder than the average daily temperatures of the previous week (Figure 5). As can be seen in Figure 6, the San Juan River warmed considerably between Archuleta and CR5500 prior to the release period; therefore, the cold water release had a much larger effect on temperature at CR5500 than at Archuleta.

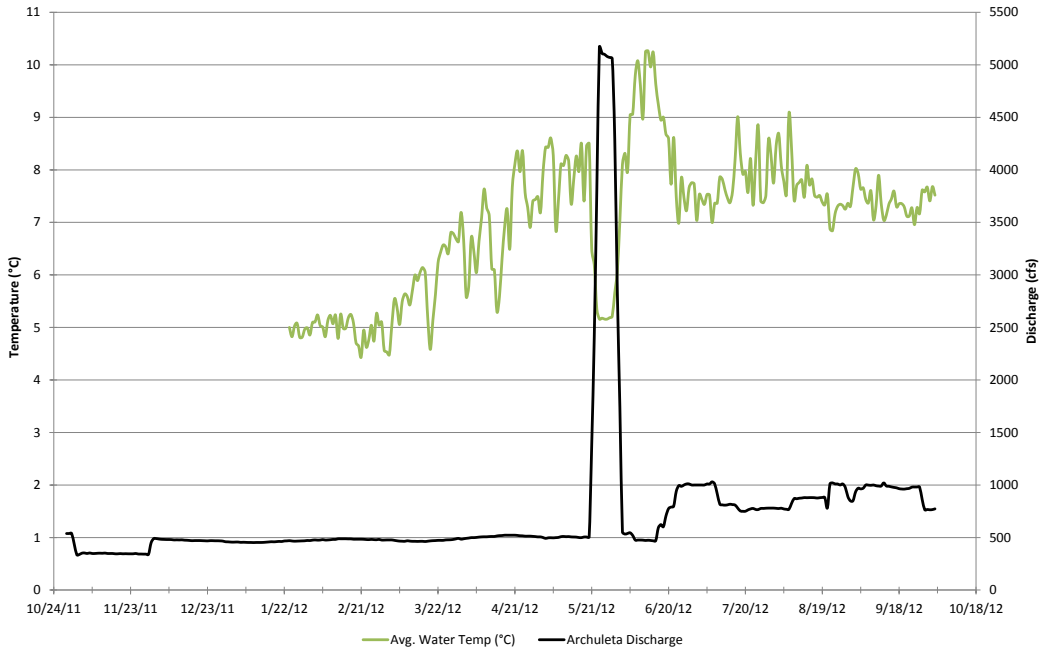

Figure 3. Average daily water temperature at Navajo Dam compared to discharge at Archuleta.

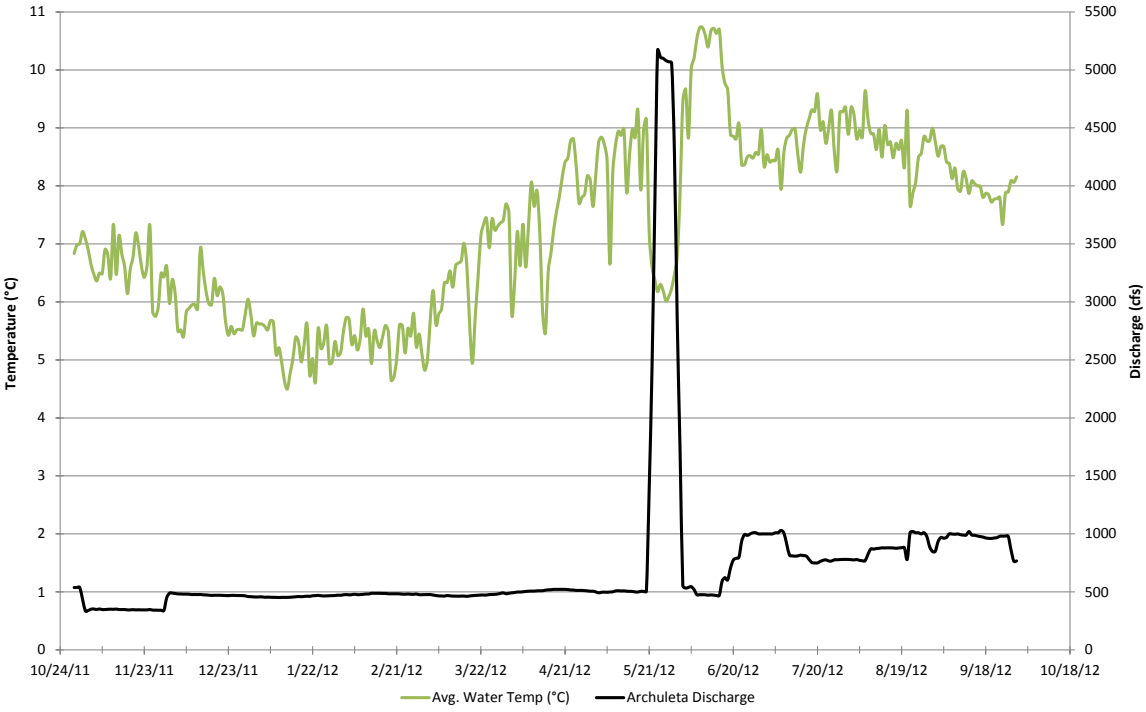

Figure 4. Average daily water temperature at Archuleta compared to discharge at Archuleta.

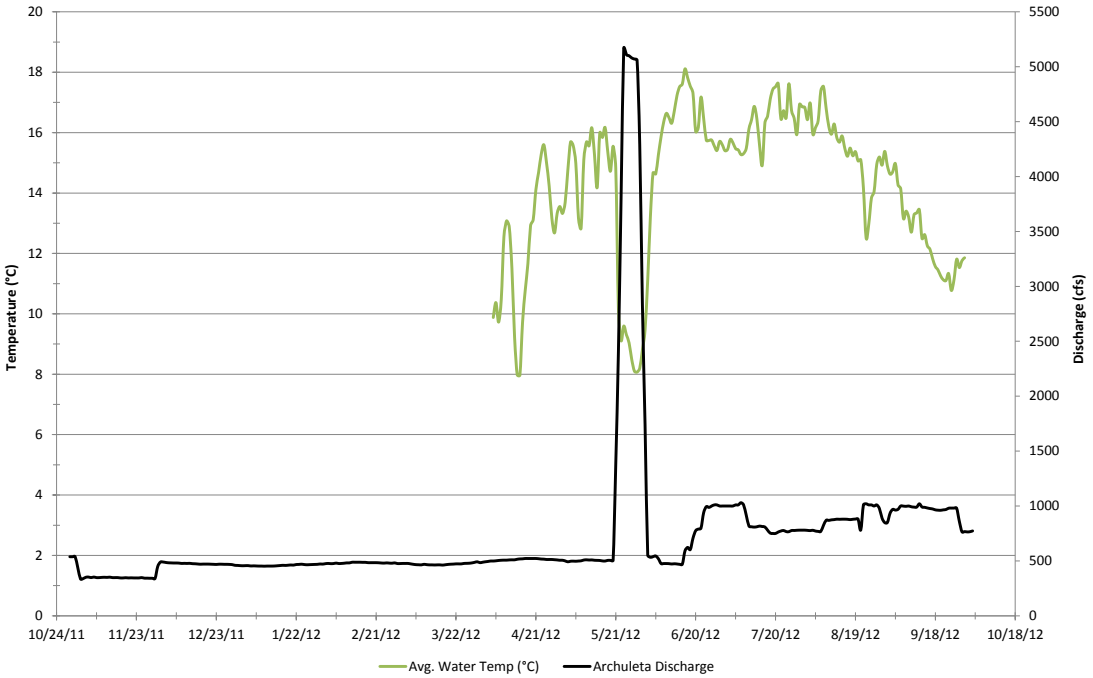

Figure 5. Average daily water temperature at CR5500 compared to discharge at Archuleta.

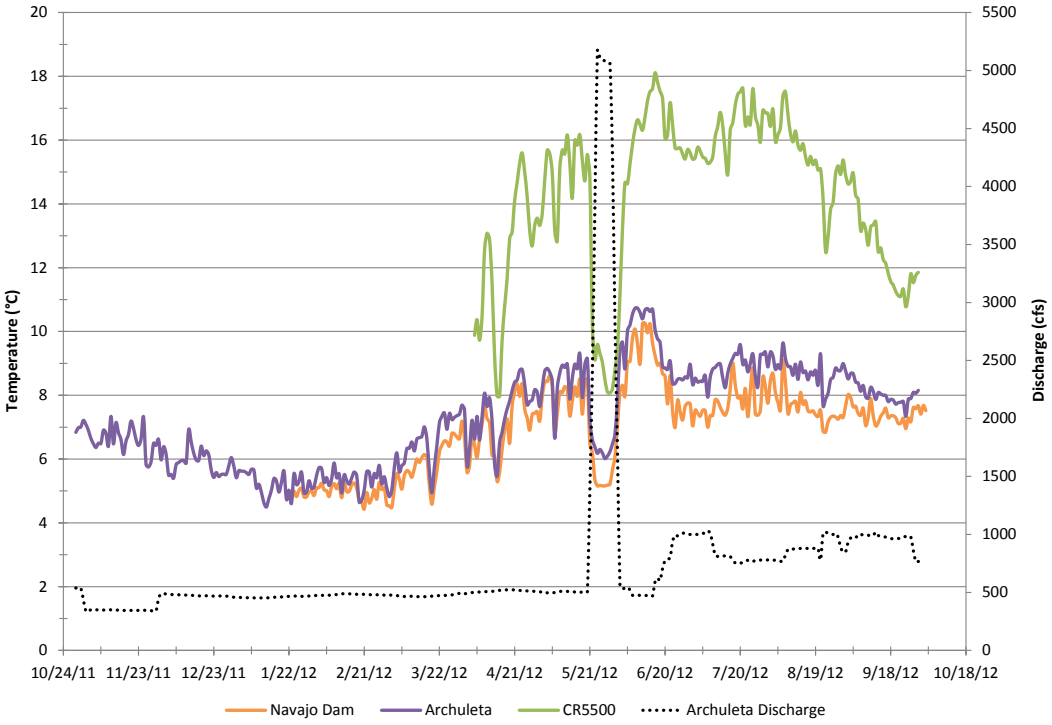

Figure 6. Average daily water temperature at Navajo Dam, Archuleta, and CR5500 compared to discharge at Archuleta.

Flows in the Animas River began to increase in March with several large flow events occurring through May (Figure 7). Water temperature correspondingly fluctuated with flow during this period. Once flows subsided in June, temperature rose steadily throughout the month, and then fluctuated a bit in July and August. The maximum average daily temperature was 25.3°C and occurred on July 30, 2012.

The temperature fluctuations in the Animas River from March through May did not appear to greatly affect temperature in the San Juan River at Farmington (Figure 8). Flows from the Animas River into the San Juan moderated the effect of the cold water release. The average daily temperature in the San Juan River at Farmington during the release was approximately 3.5 degrees colder than the average daily temperatures of the previous week (compare to CR5500, where the temperature change was 6.5 degrees). In the summer months, the warmer water of the Animas River contributed to an increase in temperature in the San Juan River.

At Shiprock, the minimum average daily temperature during the cold water release was 10.3°C and the average daily temperature during the release was 11.9°C, approximately 5 degrees colder than the average daily temperatures of the previous week (Figure 9). At Four Corners, the minimum average daily temperature during the release was 11.7°C and the average daily temperature during the release was 13.9°C, approximately 4 degrees colder than the average daily temperatures of the previous week (Figure 10).

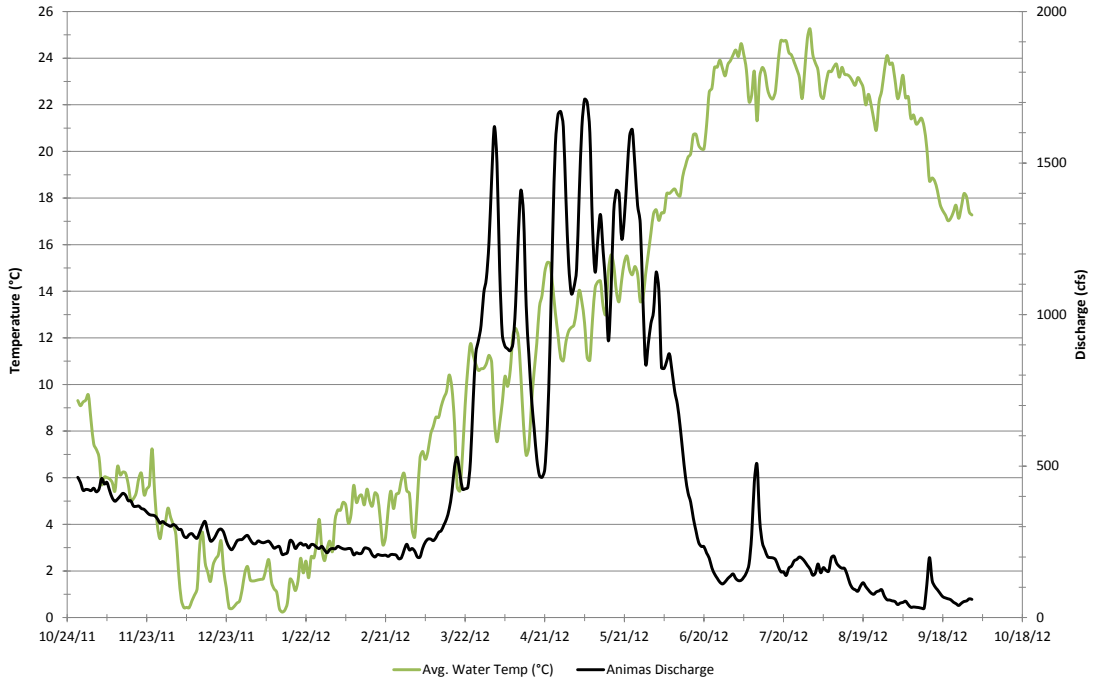

Figure 7. Average daily water temperature on the Animas River near Farmington compared to discharge on the Animas River.

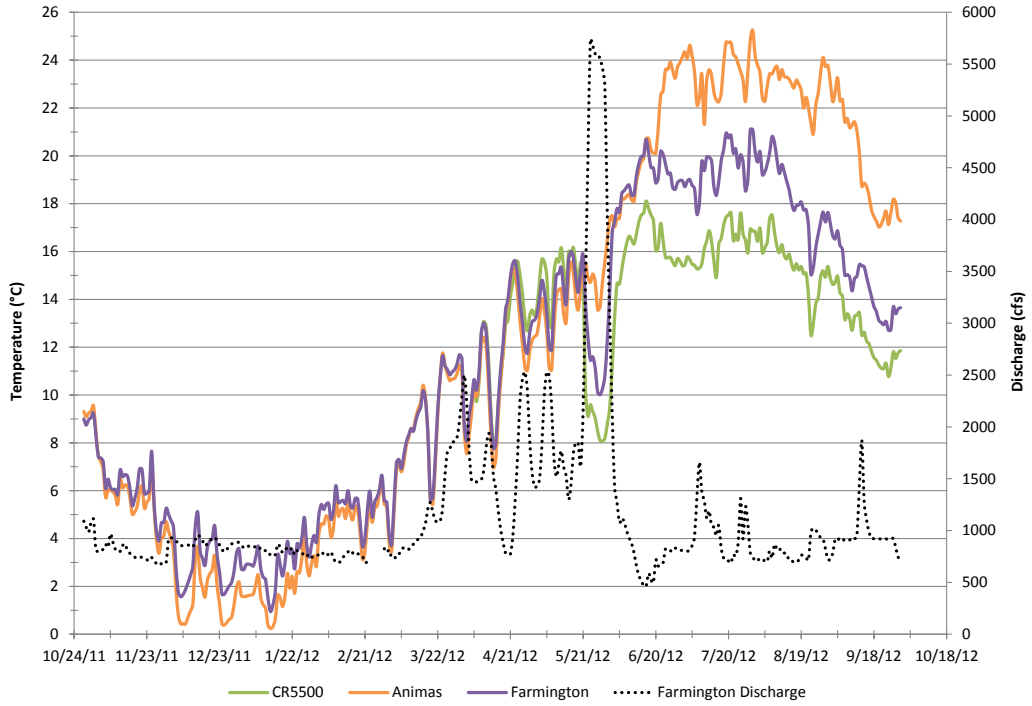

Figure 8. Average daily water temperature at CR5500, Animas River, and Farmington compared to discharge at Farmington.

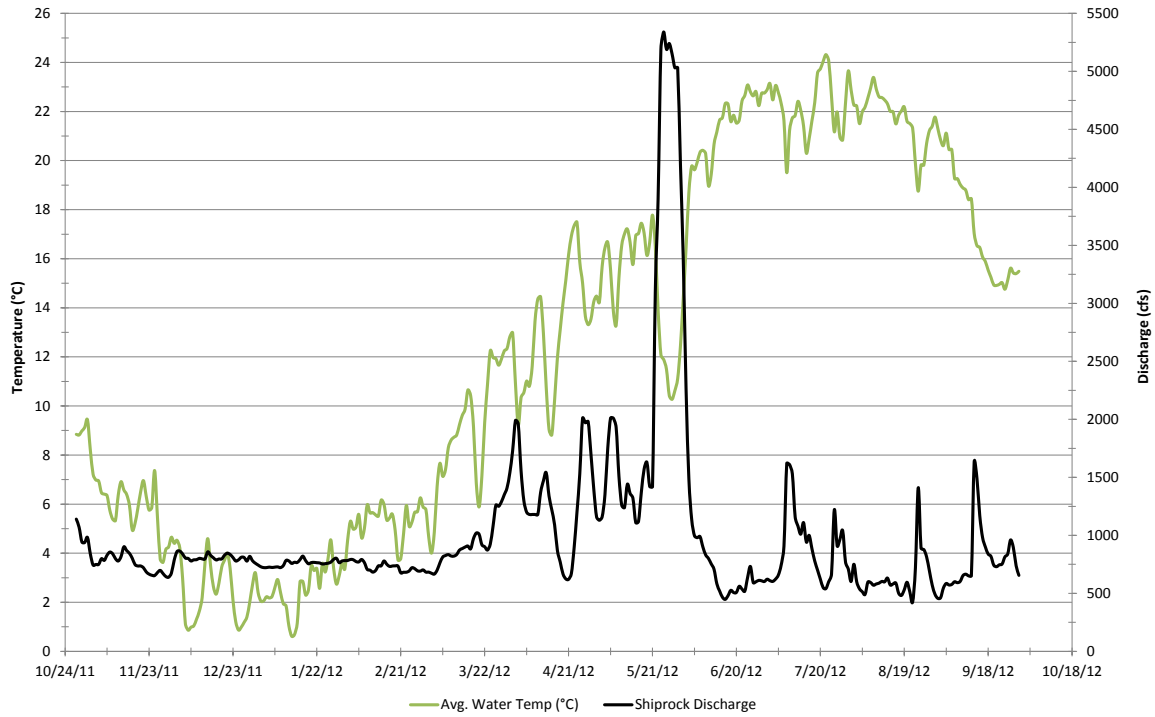

Figure 9. Average daily water temperature at Shiprock compared to discharge at Shiprock.

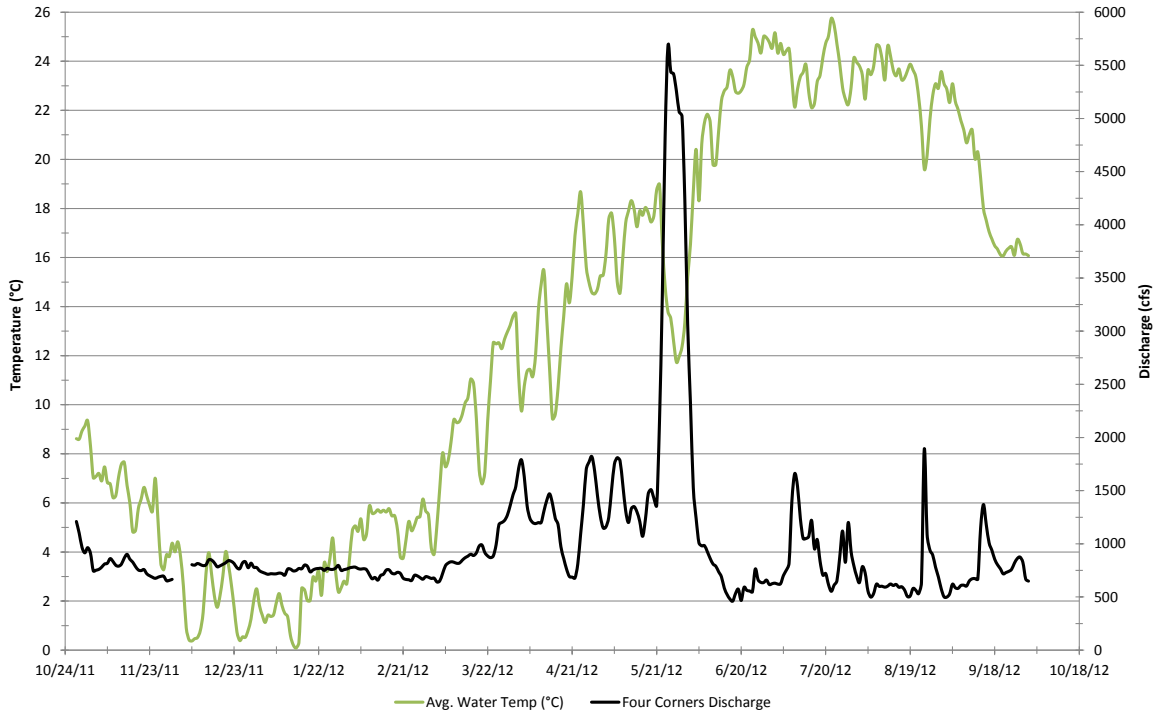

Figure 10. Average daily water temperature at Four Corners compared to discharge at Four Corners.

At McElmo Creek, water temperature fluctuated the most from March through May (Figure 11). No flow data were available for McElmo Creek so it is not possible to know if temperature fluctuations were tied to large flow events, but this seems likely. The temperature logger is close enough to the mouth of McElmo Creek that high flows in the San Juan may be backing up in McElmo Creek and influencing water temperature. Average daily temperature peaked at 25.8°C on June 24, 2012.

At Mexican Hat, the minimum average daily temperature during the cold water release was 14.3°C and the average daily temperature during the release was 16.2°C, approximately 3 degrees colder than the average daily temperatures of the previous week (Figure 12).

In summary, the cold water release at Navajo Dam resulted in a decrease in water temperature that was observed as far downstream as Mexican Hat, a distance of 173 river miles. The greatest change in temperature occurred at CR5500. At this site, the largest one-day decrease in water temperature was observed: on May 21, 2012, the average daily temperature was 14.8°C. The following day the average daily temperature had decreased to 10.2°C.

The water temperature monitoring in FY2012 shows that cold water releases from Navajo Dam can affect water temperatures as far downstream as Mexican Hat, Utah. The most pronounced change in water temperature is in the river from Navajo Dam downstream to the Animas River. The impact of the

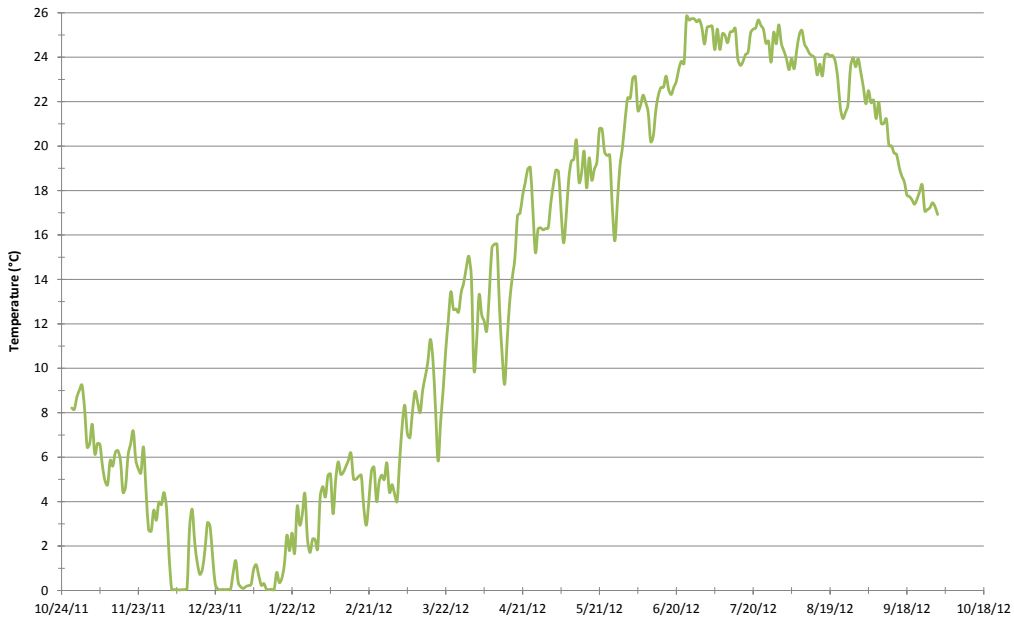

Figure 11. Average daily water temperature on McElmo Creek.

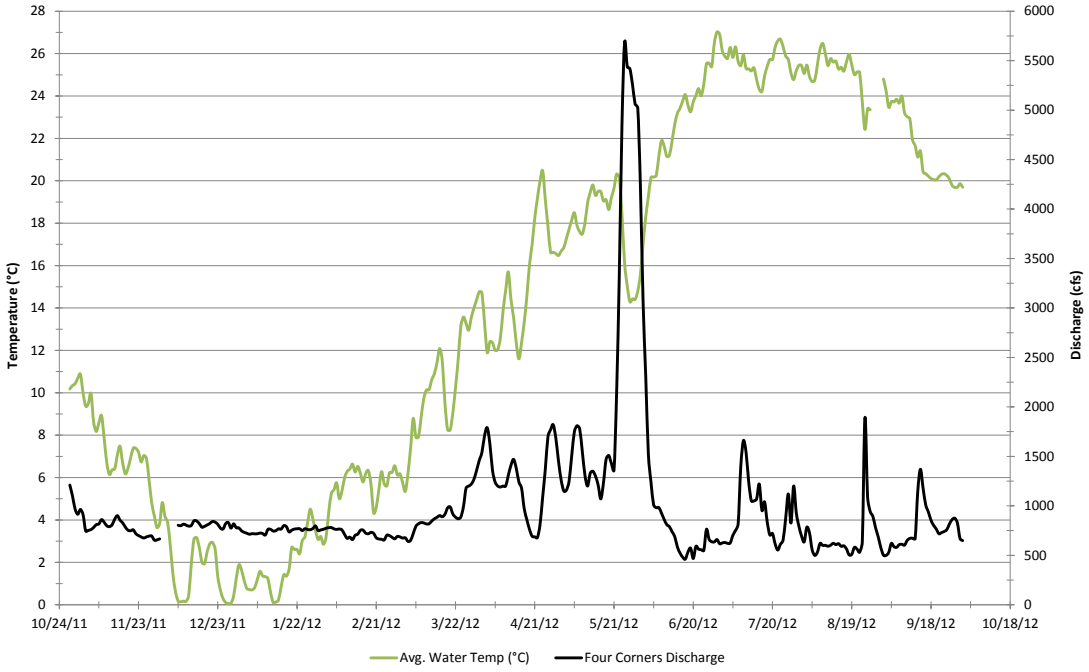

Figure 12. Average daily water temperature at Mexican Hat compared to discharge at Four Corners.

sudden change in water temperature on the San Juan River fish community is undetermined, however, it occurs at a time when the native fish would be spawning or preparing to spawn. It is possible that the sudden change in water temperature may disrupt razorback sucker and other native suckers spawning when water temperatures are decreased to less than 16° C. Further, hatching success and larval survival may be reduced by the sudden reduction in water temperature due to slower growth rates at lower water temperatures.

Water temperature and hydrology data for the San Juan River at Mexican Hat, Utah (USGS gage 09379500 San Juan River at Bluff) show the change in water temperature with high release from Navajo Dam compared with pre-dam data. An example for pre-dam data for 1945 shows elevated flow of nearly 9000 cfs for the months of May and June (Figure 13), however, the water temperature continue to warm during this period to over 25° C (Figure 14). In contrast, discharge in 2008 was elevated to 9,000 cfs in June (Figure 15) and the water temperatures were depressed for the days the release from Navajo Dam continued (Figure 16).

Recommendations

The water temperature monitoring provides documentation of annual thermal regimes in the San Juan River. The water temperature monitoring is one component of the habitat monitoring program specified in the San Juan River Recovery Implementation Program Long Range Plan. These monitoring data could be used for investigation of impacts of water temperatures on the San Juan River fish community. Further, the collection of water temperature data may be more useful as real-time information in addition to the annual summary. We make the following recommendations for the FY2014 water temperature monitoring.

1) Integration of the water temperature database, San Juan River and Animas River hydrology, and larval fish monitoring data should occur to determine if there are trends in the number and size of larvae associated with water temperature and discharge.

2) The water temperature monitoring program should be converted to real-time data collection conducted by USGS at the following gages: San Juan River at Archuleta (USGS 09355500), Animas River at Farmington (USGS 09364500), San Juan River at Farmington (USGS 09365000), San Juan River at Shiprock (USGS 09368000), San Juan River at Four Corners (USGS 09371010). These gages in addition to the current gage at Bluff, Utah would provide a more reliable water temperature database that could be accessed in real-time. The other water temperature monitoring locations should be discontinued. The conversion to USGS data collection would also remove the need to assemble and house an annual database. The data archive functions would be part of the USGS function.

3) An annual data summary should still be provided for the Program as part of the habitat monitoring program.

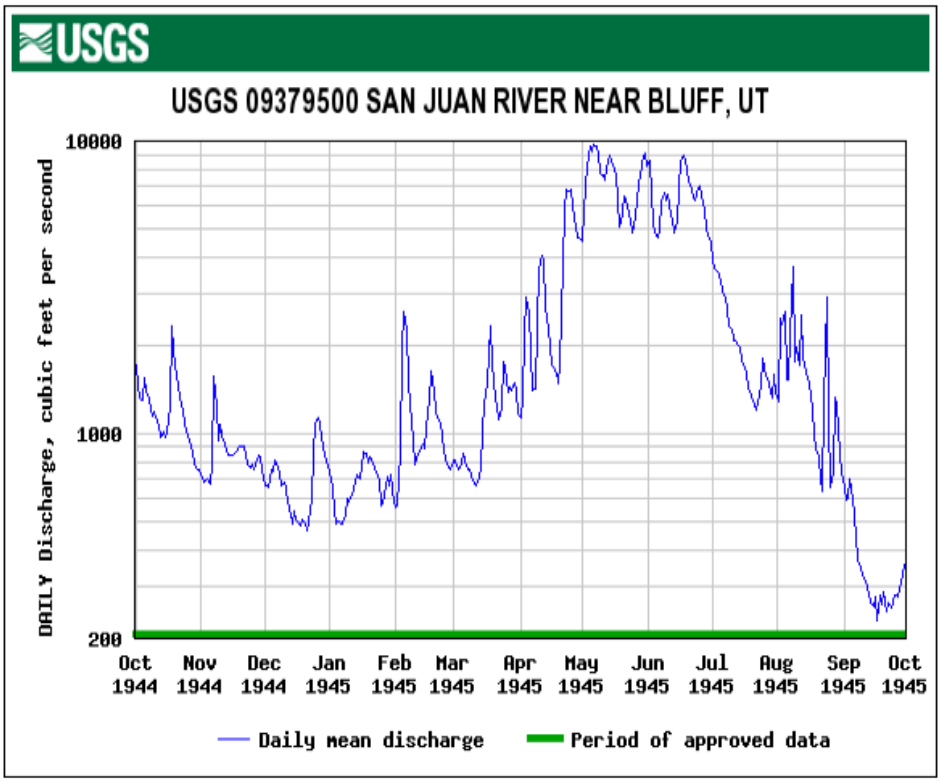

Figure 13. Daily discharge for the San Juan River at Mexican Hat, Utah, for water year 1945.

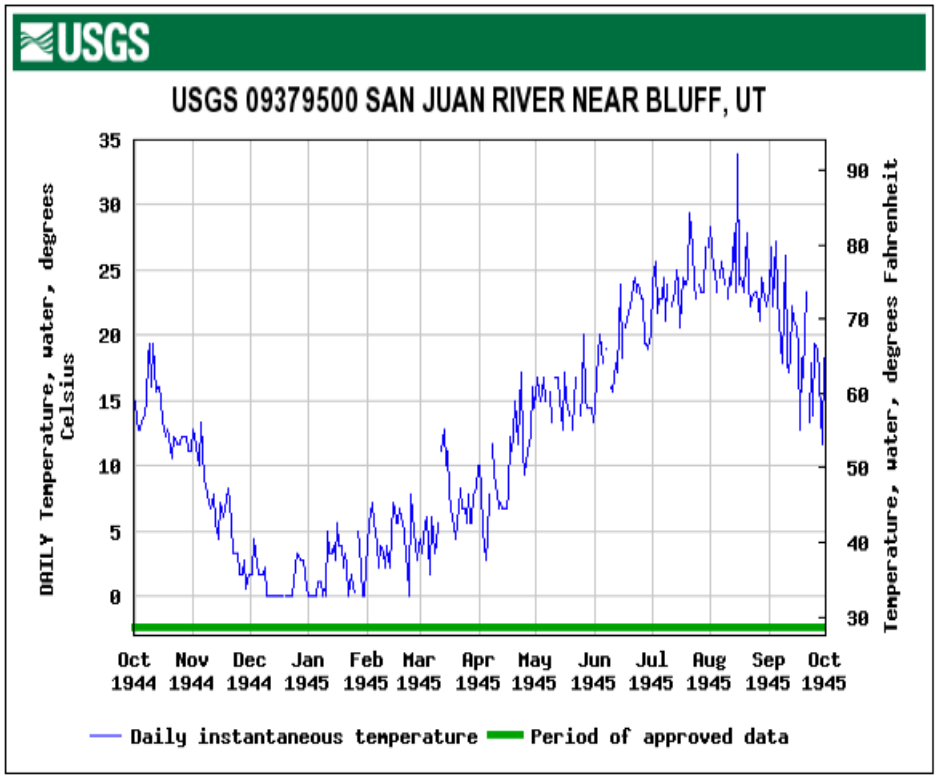

Figure 14. Daily temperature for the San Juan River at Mexican Hat, Utah, for water year 1945.

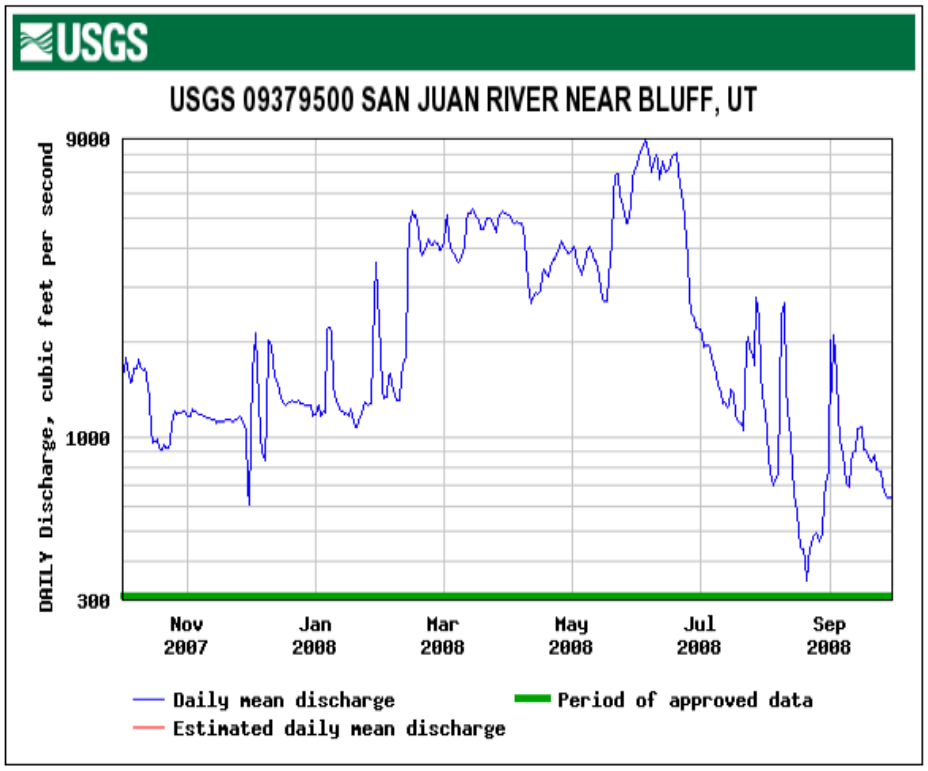

Figure 15. Daily discharge for the San Juan River at Mexican Hat, Utah, for water year 2008.

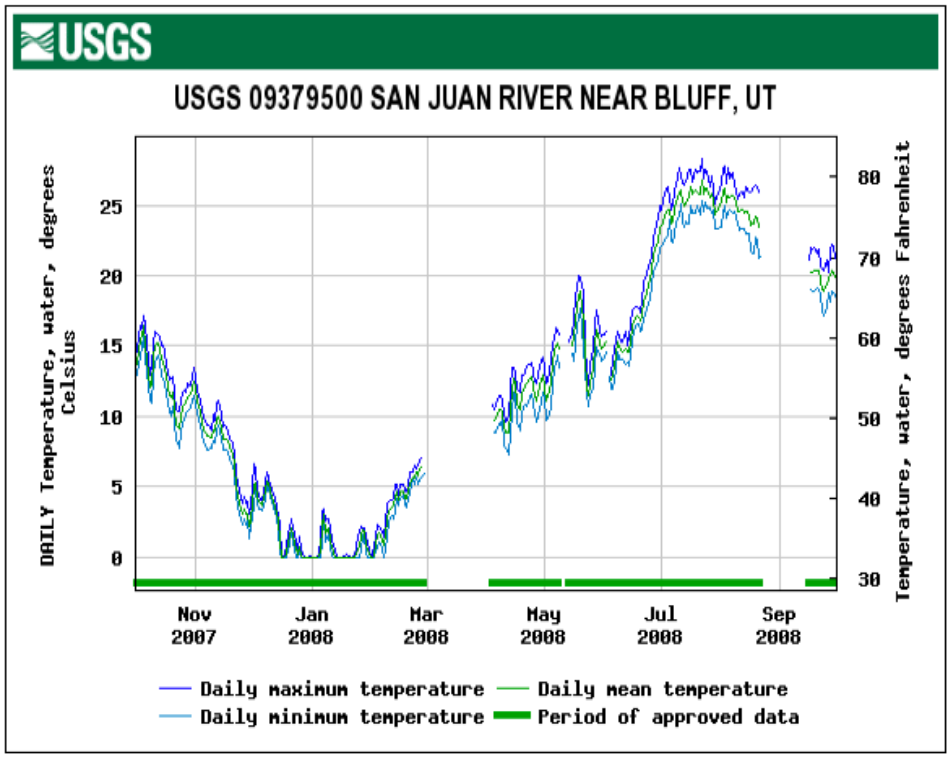

Figure 16. Daily temperature for the San Juan River at Mexican Hat, Utah, for water year 2008.

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Miller Ecological Consultants, Inc.
2111 S. College Avenue, Unit D
Fort Collins, Colorado 80525
970-224-4505