



Water Quality Monitoring for the Mancos River in Mesa Verde National Park

2014 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2017/1132



ON THE COVER
Mancos River in Mesa Verde National Park
Photography by SCPN

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Abstract

Water-related vital signs are fundamental components defining overall riparian and aquatic ecosystem integrity. The Southern Colorado Plateau Network (SCPN) has identified water quality as one of seven key vital signs used to determine the condition and long-term status of aquatic ecosystems in park streams. This report summarizes water quality core parameter data and bacteria, nutrient, major element, and trace metal data for water quality samples collected from the Mancos River in Mesa Verde National Park in 2014. In addition, it reports data on Contaminants of Emerging Concern found in water quality samples for an agreement with the U.S. EPA. The data presented in this report represent a snapshot of the water quality in this system in 2014.

1 Introduction

The National Park Service Inventory and Monitoring Program was designed to determine the current status and monitor long-term trends in the condition of park natural resources, providing park managers with a scientific foundation for making decisions and working with other agencies and the public to protect park ecosystems. Hydrologic vital signs are the fundamental components that define overall riparian and aquatic ecosystem integrity. The Southern Colorado Plateau Network (SCPN) has identified 7 vital signs pertaining to riparian and spring ecosystems: 1) aquatic macroinvertebrates, 2) stream water quality, 3) stream flow and depth to groundwater, 4) spring water quality, 5) fluvial geomorphology, 6) riparian vegetation, composition, and structure, and 7) spring ecosystems. These vital signs are closely related and are all included in the Vital Signs Monitoring Plan for the Southern Colorado Plateau Network (Thomas et al. 2006). The context and ecological significance of these vital signs are further explained in Scott et al. (2005). In this report we focus on stream water quality.

Specific objectives for monitoring stream water quality in SCPN parks are

- Determine status and trends for selected core water quality parameters (water temperature, pH, specific conductance, dissolved oxygen, turbidity and discharge) at selected sites in priority streams within SCPN parks.
- Determine status and trends of selected water quality constituents, including bacteria, nutrients, major elements, and trace metals at selected sites in priority streams within SCPN parks.
- Compare water quality data against state standards for chronic exceedances. Multiple exceedances in a year typically indicate non-compliance.

1.1 Selecting potential water quality monitoring sites

We targeted streams and springs in SCPN parks with potential for water quality monitoring by reviewing (1) water quality data inventory and analysis reports prepared by the Water Resources Division (WRD) of the National Park Service (NPS); (2) a USGS summary and review of available water quality data from streams in SCPN parks (Brown 2008); (3) data collected during a Level 1 water quality inventory of streams in SCPN parks (Macy and Monroe 2006); and (4) results of water quality monitoring planning meetings with park staff.

SCPN water bodies were selected for water quality monitoring based on the following criteria:

- 303(d) listed waters¹ — where previous sampling indicates one or more parameters regularly approach or exceed established water quality standards or recommended levels
- waters with demonstrated threat levels—where an analysis of existing data indicate that measured conditions regularly approach or exceed standards or recommended levels, but where the frequency of exceedances or the quality of the database do not support a 303(d) listing
- pristine waters—where there is no direct impact of human activities (provides baseline data)
- ecological significance—presence of unique species or species of concern
- waters of management concern—where past sampling may not indicate constituent values of concern, but where anthropogenic activities indicate that contamination is a significant threat
- historic data—waters identified as important, for which substantial historic water quality data are available
- data gaps—waters identified as important, but where little or no water quality information exists

Whenever possible, SCPN water quality monitoring sites are located where a history of water quality data collection exists, and co-located with SCPN aquatic macroinvertebrate monitoring sites.

¹ Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters— waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes (EPA 2011).

1.2 Water quality monitoring at Mesa Verde National Park

The Mancos River is a perennial stream flowing from the La Plata Mountains in southwestern Colorado to its confluence with the San Juan River in northwestern New Mexico. Approximately 6 km of the river flow along the eastern boundary of Mesa Verde National Park (MEVE). Upstream from the park, Jackson Gulch Dam and numerous diversions in the Mancos Valley reduce the amount of Mancos River flow that reaches the park (Colorado Water Trust 2011). In August of 2000, the NPS, in cooperation with the United States Geological Survey (USGS), installed a streamflow gaging station on the Mancos River within MEVE (Figure 1).

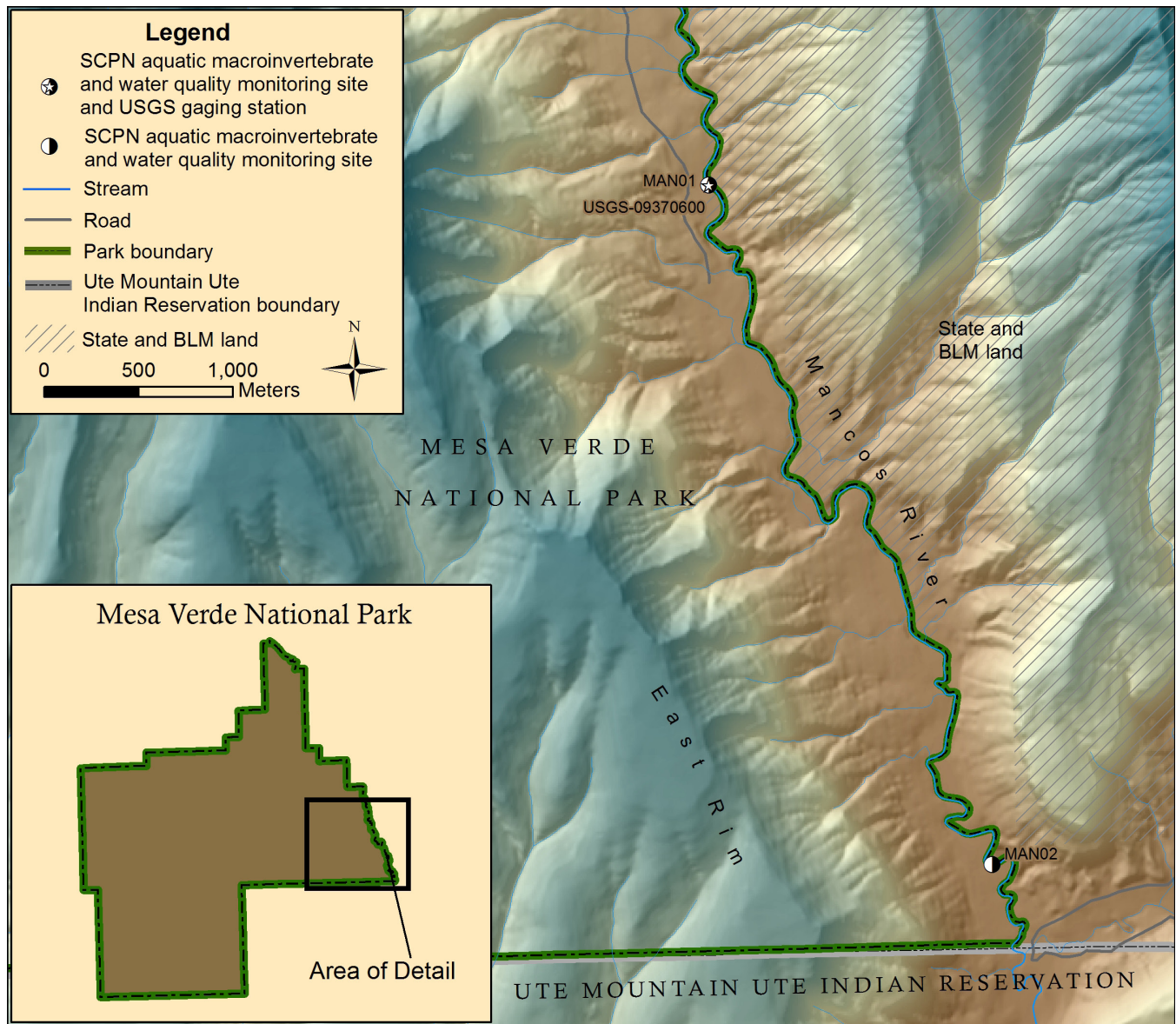


Figure 1. Map of the Mancos River, Mesa Verde NP, Colorado, with the location of Southern Colorado Plateau Network's aquatic macroinvertebrate and water quality monitoring sites MAN01 and MAN02, which were visited in 2014.

Water quality concerns within the park include insecticide, algicide, and herbicide applications (Brown 2008). Adjacent agriculture and sewage-treatment facilities have been sources of nutrient and bacterial contamination (Thomas et al. 2006). Irrigation practices along the Mancos River and its tributaries may be contributing to their elevated salinity levels (Yochum 2004). Drought and wildfire have also affected the river. In 2000, a high-

intensity fire burned portions of the watershed in MEVE; fire retardant drops during the fire resulted in fish kills in the Mancos River (San Miguel, G., Natural Resource Manager, Mesa Verde NP, personal communication, 28 July 2011). In 2012, the Weber Fire burned 10,000 acres outside nearby Mancos, CO. The Ute Mountain Ute Tribe has been restocking an average of 12,000 native fish each year to the Mancos River downstream from MEVE since 2003 (Larrick and Ashmore 2014). For more than a century mining activities in the Mancos River watershed have potentially mobilized metals and other contaminants into the river. Most recently an illegal gold processing mill near the Town of Mancos released large quantities of mercury and other contaminants into the environment close to the Mancos River (Weston Solutions, Inc. 2014).

Prior to 2010, when SCPN began water quality monitoring at the Mancos River, data documenting water quality conditions in the river were sparse. In 2006, the USGS completed a Level 1 water quality inventory of water bodies in SCPN parks that included the Mancos River in MEVE (Macy and Monroe 2006). An assessment of the functional condition of the Mancos River conducted in 2006 found high concentrations of algal blooms, a possible indicator of poor water quality (Stacey 2007), probably caused by a combination of high solar exposure and a wide shallow channel near MAN01. The Ute Mountain Ute Tribe completed a water quality assessment for nutrients, metals, *E. coli*, stream habitat, and macroinvertebrates for 2011–2012 downstream from MEVE, and also included samples of post-fire runoff. Occasional high levels of selenium, aluminum, iron, copper, and *E. coli* were found (Larrick and Ashmore 2014).

In 2010, SCPN implemented water quality monitoring at two sites on the Mancos River in MEVE:

- *Mancos River at Gage* (MEVEMAN01), identified in this report as MAN01 (Appendix A), was established in 2010 as SCPN's primary water quality monitoring site. The site is co-located with a SCPN aquatic macroinvertebrate monitoring site and the USGS streamflow gaging station Mancos River at Anitas Flat below Mancos, CO (USGS 09370600).
- *Mancos River above Downstream Boundary* (MEVEMAN02), identified in this report as MAN02, is co-located with a SCPN aquatic macroinvertebrate monitoring site. NPS core water quality parameter measurements are collected here once each year, concurrently with SCPN aquatic macroinvertebrate monitoring. The site is on a large bend in the river near the downstream park boundary.

SCPN collects core water quality data and water quality samples at regular intervals throughout the year. Water quality samples are analyzed by SCPN staff and by a qualified contract laboratory. In 2014, SCPN staff made four water quality monitoring site visits to MAN01, once every three months. Limited water quality data were also collected at MAN02 during an aquatic macroinvertebrate site visit. This report documents all SCPN water quality monitoring activities at MEVE in 2014 and summarizes the data collected.

2 Methods

A brief description of water quality data collection and procedures followed by SCPN staff at MEVE during 2014 is presented here. Detailed descriptions of these procedures are available in the Water Quality Monitoring Protocol for Streams and Springs in the Southern Colorado Plateau Network (Monroe et al. 2016; available at <https://irma.nps.gov/DataStore/Reference/Profile/2233293>).

2.1 Water quality core parameters

National Park Service core water quality parameters include water temperature, pH, specific conductance, dissolved oxygen, turbidity, and discharge. During each site visit, we noted the hydrologic conditions and collected water quality core parameter data using the following methods:

- Water and air temperatures were recorded at 15-minute intervals by HOBO Pendant Temperature/Alarm Loggers #UA-001-64 (Onset Computer Corporation) deployed at the monitoring site.
- As soon as possible after arriving at the site, SCPN water resources crew calibrated and deployed a multi-parameter sonde (Hydrolab-MS5; OTT Hydromet, Inc.) in a well-mixed part of the stream channel, logging water temperature, pH, specific conductance, and dissolved oxygen data at 5-second intervals. The sonde was left stationary in the stream for the entire site visit.
- Turbidity samples were collected and kept on ice for a maximum of 24 hours, then analyzed with a Hach 2100P Portable Turbidimeter (Hach Inc.).
- Discharge was measured using a FlowTracker Acoustic Doppler Velocimeter (SonTek Inc.).

We attempted to obtain all measurements and samples as close in time to one another as possible. Streamflow data from the USGS gaging station documented flow variation during site visits and throughout the year at 15-minute intervals.

2.2 Water quality samples

During each site visit, we collected a sample for bacterial analysis by dipping a sample bottle at the center of flow. SCPN staff analyzed the sample for total coliforms and *E. coli* using the Quanti-Tray® 2000 system (IDEXX Inc.). We collected samples to be tested for other analytes in a similar manner. Sample water was filtered and/or acid-treated (as required), kept on ice, and shipped to the contract laboratory. For 2014, SCPN contracted with the USGS National Water Quality Laboratory (NWQL) in Denver, Colorado for analysis of water samples for selected water quality constituents. These analyses fall into three categories: nutrients, major elements and trace metals (Table 1). Information documenting NWQL methods is included in SOP #8 of the SCPN water quality monitoring protocol (Monroe et al. 2016).

In 2014 SCPN continued a partnership with the US Environmental Protection Agency (EPA) to sample at MEVE, GLCA, GRCA, and BAND for a suite of contaminants of emerging concern (CEC), which include

Table 1. USGS National Water Quality Laboratory and U.S. Environmental Protection Agency Laboratory sample analytes.

Analytical group	Analytes
Nutrients	ammonia, nitrite, nitrite + nitrate, orthophosphate
Major elements	calcium, chloride, fluoride, magnesium, potassium, silica, sodium, sulfate, acid neutralizing capacity (ANC; as CaCO ₃), total dissolved solids
Trace metals	aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, uranium, vanadium, zinc
Contaminants of emerging concern	pharmaceuticals, personal care products, waste water indicators, pesticides

pharmaceuticals, personal care products, waste water indicators, and pesticides. The purpose is to develop a baseline dataset documenting the occurrence of these contaminants within SCPN parks. Samples were kept on ice and analyzed at the EPA Region 8 Laboratory in Golden, Colorado within seven days of collection, as required.

2.3 Data handling and reporting

All multiparameter sonde electronic data, discharge, and temperature logger files are stored on the SCPN server and in an in-house Access database. In this report, we only include the median values of a subset of seven consecutive multiparameter sonde measurements taken at the time of sample collection. Similarly, only the median values for each set of turbidity triplicate samples are presented. For total coliforms and *E. coli* samples, most-probable numbers (MPN/100 mL) are reported. MPN is a statistical estimate of the number of bacteria per unit volume of a sample determined by using a lookup table provided by the manufacturer of Quanti-Tray 2000, the method used by SCPN to analyze bacteria in stream samples (IDEXX Inc.). We compared our results for *E. Coli* against the criteria for Class N (not primary contact use, from Nov. 1 to April 30) and Class E (existing primary contact use, from May 1 to Oct. 31) recreation, depending upon the time of year the samples were collected. Although the Colorado criteria are expressed as colony forming units per 100 mL (cfu/100 mL) and do not assume an estimation, it is comparable to MPN as reported by SCPN.

All results from the NWQL and EPA are presented as they were reported from the lab. In cases where analytes were not detected, we present the applicable laboratory reporting level, which is the lowest concentration that can be reliably measured by a given analytical method. For the NWQL data, results which are below the laboratory reporting level but above the method detection level are flagged to indicate that the analyte was detected, but the concentration was not high enough to report.

Where applicable, we compared our results against the State of Colorado's 2016 surface water quality standards and to the standards specific to the Mancos River (Colorado Department of Public Health and Environment [CDPHE] 2016a, b). We noted any exceedences of the applicable standards.

2.4 Understanding water quality data and standards

The NPS Natural Resource Challenge (NRC) provides funding for water quality monitoring in NPS park units. This funding is intended to advance NPS's long-term goals to protect pristine water quality and improve impaired water quality in parks by supporting Clean Water Act protections and provisions for designated unimpaired and impaired waters. Preliminary analysis of data available through the water quality data synthesis (Brown 2008), a Level 1 water quality inventory (Macy and Monroe 2006), and SCPN monitoring indicate that water quality conditions at many SCPN parks exceed established USEPA, State or Tribal standards.

To meet requirements of the Federal Clean Water Act (Clean Water Act of 1972), the State of Colorado has developed statewide water quality standards and criteria for surface waters (CDPHE 2016a), as well as specific additional criteria relevant to the reach of the Mancos River within MEVE (CDPHE 2016b). This report includes all water quality standards and criteria applicable to the Mancos River. A water quality standard refers to a specific parameter and its associated beneficial-use designation, in conjunction with a criterion. A criterion is the numeric component against which a result is compared. For example, the standard for chronic selenium (parameter) for aquatic life (beneficial use designation) is 4.6 µg/L (numeric criterion). This is a criterion for dissolved samples.

All of SCPN samples are filtered through a 0.45 µm filter in order to remove the particulate component of the sample before it is shipped for analysis and analyzed for the dissolved fraction, which is the fraction most aquatic life criteria are based on. This method more accurately measures the form of metals that is most toxic to aquatic life while excluding less toxic forms. However, not all Colorado state water quality criteria are based on dissolved samples—the criteria for agriculture, domestic water supply, some metals, and others are for the total sample, which includes the portion of the analyte bound to particulates. Because our samples exclude the particulate

component, our data are not necessarily comparable to criteria based on the total sample. Because of this, only the criteria for dissolved parameters are listed in the Results section of this report. However, we note when concentrations from dissolved samples exceed the criterion for total concentration samples.

The SCPN water quality monitoring program collects samples on a quarterly basis in order to document the range of hydrologic conditions that occur in network parks. Thus, rare and short-term events are often not captured. These “grab” samples represent conditions at the point and time of sampling; they do not represent the condition of the entire water body, spatially or temporally.

For this report, results for each water quality core parameter measurement were evaluated against applicable water quality standards as defined by the State of Colorado. Colorado surface waters can have up to five beneficial use classifications. Four beneficial uses are identified for the relevant reach of the Mancos River and are discussed in this report: Class 1 warm water aquatic life, agriculture, domestic water supply, and recreation (CDPHE 2016b). Each beneficial use may have different criteria for one parameter. In this report, we present only the lowest applicable criteria.

2.4.1 Chronic and acute standards

Numeric criteria for aquatic life water quality standards address potential effects of both chronic exposure to a parameter over an extended period of time (months) and acute exposure over a short period of time (hours or days). Acute criteria are based on either a single sample or an average of samples collected during a one-day period. Criteria are much lower for chronic exposure than for acute exposure and are not necessarily comparable to the results obtained from a one-time grab sample. This is because chronic standards are based on either a single representative sample or the average of all samples collected during a thirty-day period (CDPHE 2016a); the exact number of samples is not specified. When determining whether or not a sample meets both acute and chronic standards, the representative nature of the data must be considered. From a compliance standpoint, the acute instantaneous criteria afford the only direct comparison for such data because they apply to a single sample. However, from a resource-conservation standpoint, instantaneous grab-sample data, when compared against more stringent chronic criteria, can provide evidence of a problem that may require more attention. Therefore, we have identified when results are outside the chronic criterion in the Results section of this report.

2.4.2 Regulatory authority

The National Park Service does not have regulatory authority over waters in U.S., or even the authority to make assessments for designated use. This report compares water quality data to designated use criteria without stating whether a designated use was attained. Those designations are reported by the states or tribes in their triennial 305(b) reports to Congress. However, the NPS cooperates with states and tribes in collecting data used in the protection of water bodies under state jurisdiction.

3 Results

3.1 Water quality core parameter data

Summary statistics for water quality core parameter data collected at MAN01 and MAN02 during 2014 are presented here. MAN01 was visited on 19 February, 6 May, 25 July, and 29 October. MAN02 was visited on 28 October. Data for 2013 are included for comparison, however, MAN02 was not visited in 2013. Complete results for MAN01 are presented in Appendix B. Measurements at MAN02 were collected on October 28 (Table 2) and were similar to those collected at MAN01 on October 29. At MAN01, the data exhibited considerable within-year variability for several parameters (Table 3), but there were no exceedances of Colorado state water quality criteria at MAN01 or MAN02 during our site visits (CDPHE 2016b).

Table 2. Water quality core parameter data from the site visit to MAN02 on the Mancos River in Mesa Verde NP on 28 October 2014 in conjunction with aquatic macroinvertebrate monitoring (n=1). The associated Colorado state aquatic life criteria are indicated for each parameter; “nc” indicates that no criterion has been developed for a specific parameter.

Core parameter	2014	CO aquatic life criteria
Water temperature (°C)	7.04	Warm water stream Tier 2 ^a
pH	8.5	>6.5 or <9
Specific conductance (µS/cm)	1350	nc
Dissolved oxygen (%)	101	nc
Dissolved oxygen (mg/L)	9.8	>5
Turbidity (NTU)	8.7 ^b	nc
Discharge (cfs)	8.5	nc

a See section 3.1 for an explanation of CO water temperature criteria.

b Replicate turbidity measurements were not within 10% of one another for this sample.

Table 3. Summary of water quality core parameter data from site visits to MAN01 on the Mancos River in Mesa Verde NP in 2013 (n=4) and 2014 (n=4), and associated Colorado State aquatic life criteria for each parameter; “nc” means that no criteria have been developed for a specific parameter.

Core parameter	2013		2014		CO aquatic life criteria
	Median	Range	Median	Range	
Water temperature (°C)	11.1	(-)0.3–21.8	11.6	5.8–26.4	Warm water stream Tier 2 ^a
pH	8.3	8.2–8.5	8.3	8.0–8.5	6.5–9.0
Specific conductance (µS/cm)	1840	1530–1970	1320	451–2540	nc
Dissolved oxygen (mg/L)	9.2	7.5–11.1	8.6	6.7–11.0	5
Dissolved oxygen (%)	104	95–108	104	100–108	nc
Turbidity (NTU)	9.9	3.6–170	7.3	4.8–220	nc
Discharge (cfs)	3.5	1.3–7.9	8.9	0.3–51.9	nc

^a See section 3.1 for an explanation of CO water temperature criteria.

Air and water temperature data from MAN01 for 2014 are summarized here and shown in Figure 2, data from 2013 are included for comparison. From June through September, minimum and maximum river temperature fluctuated greatly. These temperatures coincide with a period of extreme low flow for the river. The maximum water temperature for the year was 30.9°C, occurring on July 10, and the average water temperature was 10.4°C. The maximum air temperature for the year was 40.0°C, occurring on July 22, and the minimum air temperature was -21.3°C, occurring on February 5. The average air temperature was 8.8°C.

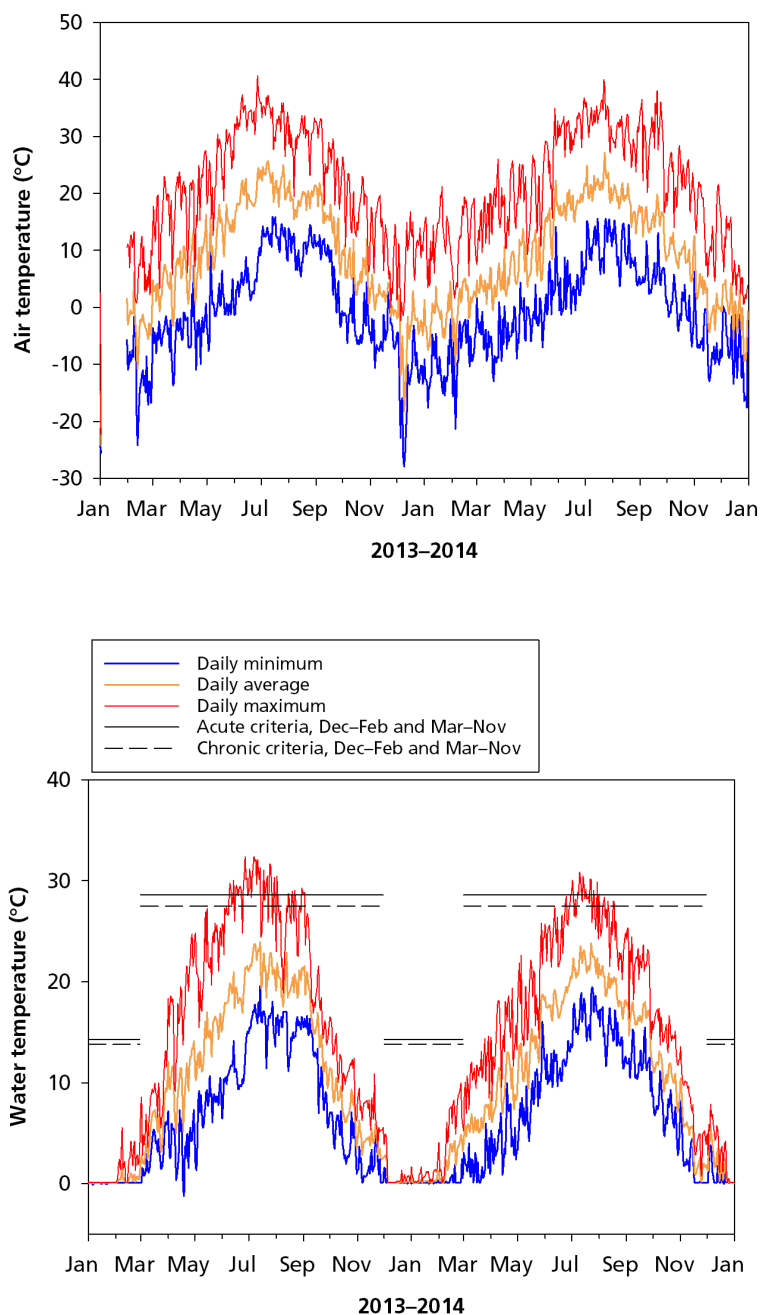


Figure 2. Daily maximum, average, and minimum air temperatures (top) and water temperatures (bottom) at MAN01 at the Mancos River in Mesa Verde NP, 2014.

This section of the Mancos River is designated by the State of Colorado as a Class 1–Warm Water Biota stream. There are three “tiers” of temperature standards, depending on the assemblage of fish species expected to occur. The Mancos River is subject to the Tier II criteria, which include both acute and chronic standards (CDPHE 2016b). The acute criteria are expressed as a daily maximum temperature, calculated as the highest two-hour average temperature during a 24-hour period. The acute criteria were 14.3°C from December through February and 28.6°C from March through November. The lower acute criterion was not exceeded, but the higher criterion was exceeded on nine days in July. The chronic criteria are expressed as a maximum weekly average temperature, a value calculated as the mean of at least three equally spaced temperatures per day over a seven-day consecutive period. The chronic criteria were 13.8°C from December through February, and 27.5°C from March through November. River temperatures did not exceed the chronic criteria in 2014.

Measured pH at MAN01 ranged from 8.0–8.5 and were within the Colorado water quality criteria of >6.5 and <9.0 (CDPHE 2016b).

Specific conductance ranged from 451 to 2540 $\mu\text{S}/\text{cm}$. The lowest measurement corresponded with a snowmelt period where stream discharge was slightly higher than normal. The highest measurement occurred in summer, when stream discharge was only 0.3 cfs.

The dissolved oxygen criterion for the Mancos River is 5 mg/L; the dissolved oxygen measurements were above this level, ranging from 6.7–11.0 mg/L. All measurements were approximately 100% saturation.

Turbidity levels ranged from 4.8–220 NTU.

The highest measurement occurred along with the highest measured discharge, while the lower measurements corresponded with lower discharge levels.

Discharge at the Mancos River was measured during each water quality sampling visit as part of an agreement with the USGS to collect and process data from the streamflow gaging station Mancos River at Anitas Flat below Mancos, CO (09370600) (USGS 2016). Measured discharges during these site visits ranged from 0.3–51.9 cfs. Figure 3 shows the 2014 stream discharge recorded for the periods that the gage was not affected by ice. Also plotted are the SCPN site visits along with discharges measured during those visits. Due to a lack of significant winter precipitation, sustained high flows from snowmelt did not occur at MAN01 in the spring of 2014. Streamflow was very low at times; discharge decreased below 10 cfs for significant periods starting in March, though not consistently. Starting in June, discharge decreased greatly and ultimately reached a low point of 0.02

cfs on July 28, according to the gage. SCPN measured discharge three days earlier, on July 25, and the flow in the river was 0.2 cfs. After this low point, discharge in the river began increasing. However, discharge was still low except immediately following precipitation events. The highest gage reading in 2014 was 474 cfs, recorded on September 28.

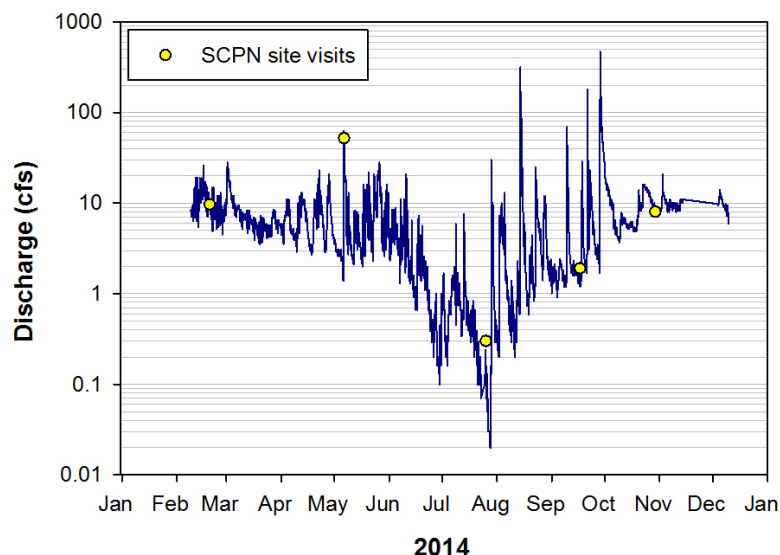


Figure 3. 15-minute discharge readings from the streamflow gaging station Mancos River at Anitas Flat below Mancos, CO (09370600) located at MAN01 on the Mancos River in Mesa Verde NP, 2014. SCPN measurements are in yellow.

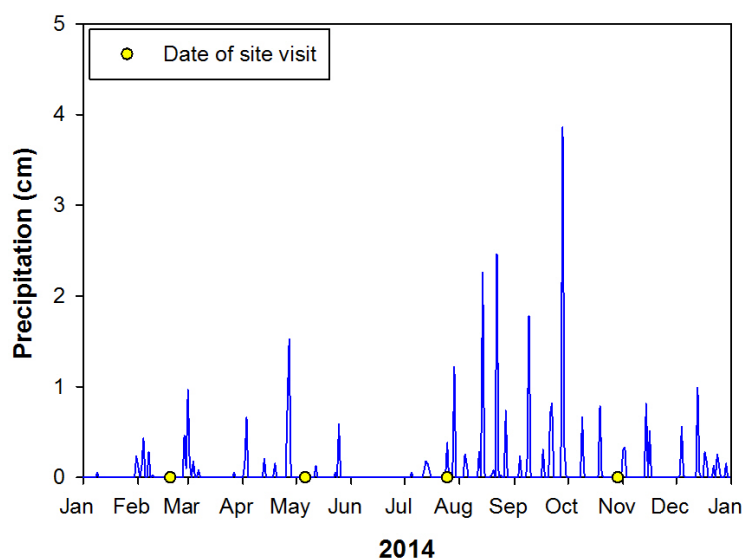


Figure 4. Daily precipitation from the CSU/USDA weather station (MNC01) at Mancos, Colorado, 2014.

3.2 Precipitation

Colorado State University and the USDA Agricultural Research Service Water Management Unit operate a weather station in the town of Mancos (MNC01) approximately 8 km from MAN01 (Colorado Agricultural Meteorological Network 2014). Daily precipitation for 2014 is plotted in Figure 4, showing that precipitation was very sparse until the monsoonal rains began in July. The summer monsoon lasted through September; over half (16.7 cm) of the year's precipitation occurred during this time. Six precipitation events greater than 1 cm were recorded, five of them occurred between July and September; one occurred in April. The total precipitation in 2014 was 30.5 cm.

3.3 Total coliforms and *E. coli*

Bacteria data collected by SCPN at MAN01 in 2013 and 2014 are presented in Figure 5 and listed in Appendix B. The Colorado criteria for *E. coli* are based on the geometric mean of at least four evenly-distributed samples collected over a 60-day period. The criteria applicable at MAN01 in 2014 were 126 cfu/100 mL from May through October and 630

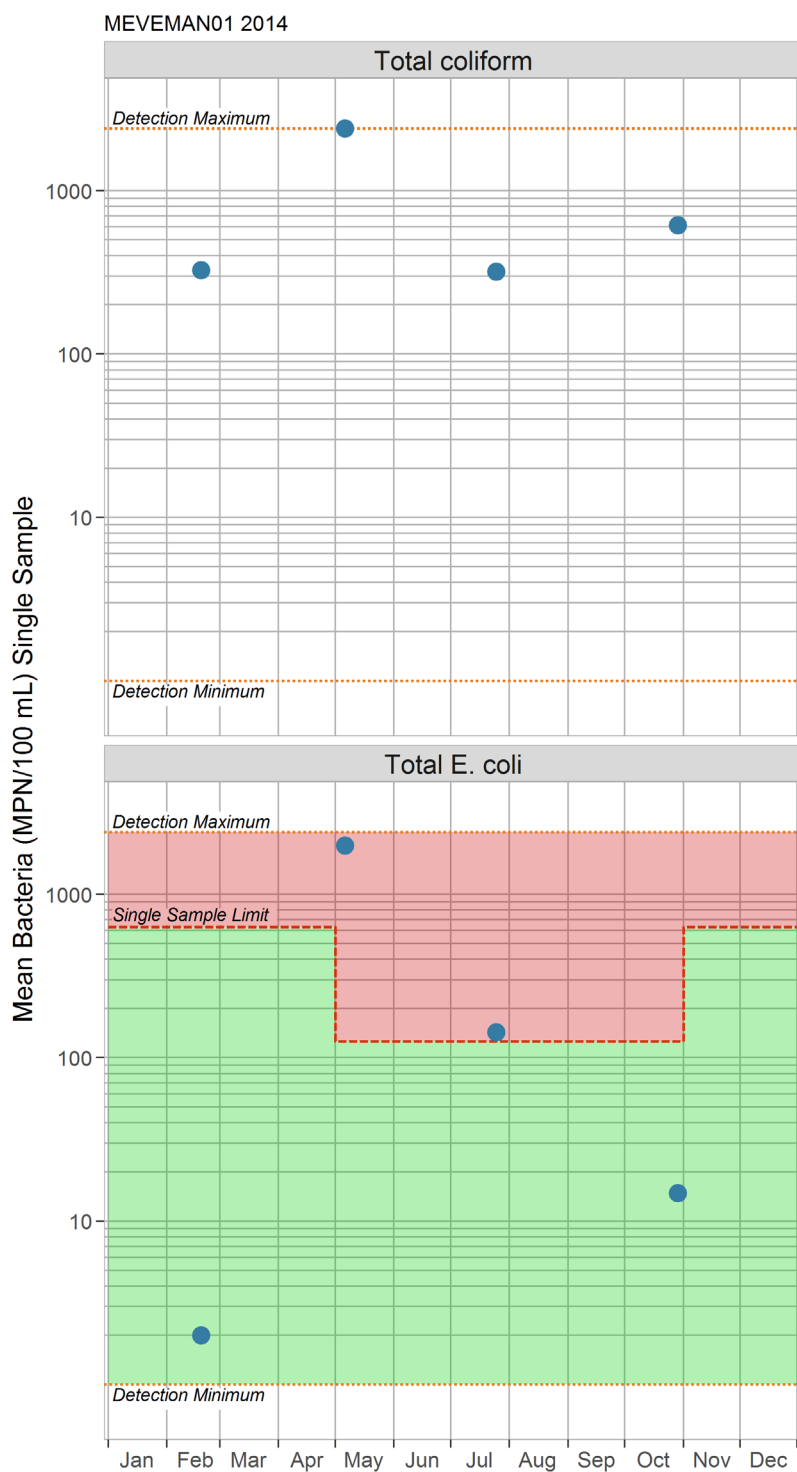


Figure 5. Total coliform (top) and *E. coli* data (bottom) in samples collected from MAN01 on the Mancos River in Mesa Verde NP, 2013–2014.

reporting levels, which were 0.0200 mg/L for ammonia, 0.080 mg/L for nitrate plus nitrite, and 0.00200 mg/L for nitrite. Water quality criteria exist for ammonia and nitrite, but the reporting levels were far below these criteria. Orthophosphate was detected in the February and May samples (0.0332 and 0.00839 mg/L), but not detected above the reporting level (0.00800 mg/L) in July and October.

cfu/100 mL from November through April (CDPHE 2016b). Total coliforms are also included in the IDEXX analyses. They are indicators of the presence of all coliform groups of bacteria, both vegetative and fecal in origin. For drinking water, total coliforms are the standard diagnostic test because their presence indicates contamination of a water supply by an outside source, though there are no water quality criteria for total coliforms. Total coliforms ranged from 320 to >2400 MPN/100 mL. The lowest result occurred in the July sample, while the highest occurred in the May sample.

E. coli levels in the four samples ranged from 2–2000 MPN/100 mL (MPN/100 mL is comparable to cfu/100 mL; see section 1.2). The highest result occurred during the May sample, when the highest discharge and the highest turbidity was also measured. The May result and the July result (140 MPN/100 mL) both exceeded the Colorado recreation criterion of 126 MPN/100 mL. However, our sampling was not frequent enough to assess compliance with the water quality standard because four samples are needed within a two month period. More summer samples would be needed to fully determine an exceedance of this standard.

3.4 Water quality laboratory data

Four water samples were collected at MEVE by SCPN during 2014 to be analyzed for nutrients, major elements, and trace metals (Table 1). Complete laboratory results for water samples are shown in Tables 4–6.

Nutrient concentrations (Table 4) were very low and the nitrogen species (ammonia, nitrite+nitrate, and nitrite) were not detected above the laboratory

Table 4. Dissolved nutrient data from MAN01 on the Mancos River in Mesa Verde NP, 2014, and applicable water quality criteria. An “nc” indicates that no criteria have been developed for a particular nutrient; “ndc” indicates that there is no criterion for dissolved analytes. Results that were lower than the National Water Quality Laboratory reporting levels are noted as “<[reporting level]”.

Nutrients (mg/L)	2/19/2014 13:54	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	Lowest criterion (mg/L)	# of exceedances	Beneficial use
Ammonia as N	<0.0200	<0.0200 ^a	<0.0200 ^a	<0.0200	ndc	ndc	ndc
Nitrite + nitrate as N	<0.080	<0.080	<0.080	<0.080	ndc	ndc	ndc
Nitrite as N	<0.00200	<0.00200 ^a	<0.00200 ^a	<0.00200	0.05	0	aquatic life
Orthophosphate as P	0.0332	0.00839	<0.00800	<0.00800	nc	nc	nc

a Result is above the Method Detection Level and below the Laboratory Reporting Level.

Table 5. Dissolved major element data from samples collected at MAN01 on the Mancos River in Mesa Verde NP, 2014. Because the Colorado state water quality criteria for these analytes are based on the total concentration, only the sulfate criterion is presented due to multiple exceedances. An “nc” indicates that no criteria have been developed for a particular analyte; “ndc” indicates that there is no criterion for dissolved analytes. DWS = domestic water supply.

Major elements (mg/L)	2/19/2014 13:54	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	Lowest criterion (mg/L)	# of exceedances	Beneficial use
Calcium	146	55.2	313	191	nc	nc	nc
Chloride	10.0	2.75	17.4	10.5	ndc	ndc	ndc
Fluoride	0.165	0.138	0.163	0.178	ndc	ndc	ndc
Magnesium	60.2	17.1	153	69.3	nc	nc	nc
Potassium	2.75	1.89	4.46	3.03	nc	nc	nc
Silica	7.30	7.49	9.73	8.57	nc	nc	nc
Sodium	56.8	15.6	121	60.1	nc	nc	nc
Sulfate	513	144	1270	594	250 (total)	3	DWS (30-day)
Acid neutralizing capacity, as CaCO ₃ (unfiltered)	194	119	165	174	nc	nc	nc
Total dissolved solids	939	306	2150	1110	nc	nc	nc

Major element data, which includes major ions, silica, acid neutralizing capacity, and total dissolved solids, are summarized in Table 5. Total dissolved solids, which mainly consist of the ions listed in Table 5 plus carbonate/bicarbonate, ranged from 306–2150 mg/L; the lowest concentration occurred during the snowmelt period in May while the highest occurred during the extremely low flow in July. In 2014, a domestic water supply (DWS) designation was added to this reach of the Mancos River, which extends from Highway 160 in Mancos to the Ute Reservation boundary. As a result of the DWS designation, the water+fish standards now apply. The DWS criteria are expressed as the total concentration, rather than the dissolved concentration that the SCPN water results represent. While our results for chloride and fluoride did not exceed the criteria, they are based on the dissolved fraction and cannot be used to evaluate compliance with the DWS standard. However, despite representing only the dissolved fraction, our sulfate results exceeded the DWS criterion of 250 mg/L in 3 out of 4 samples. Results ranged from 144–1270 mg/L.

Figure 6 depicts the major ion composition of the Mancos River, presented as the percentage of total milliequivalents per liter, for all water sampling events. In all but one sample, anions consisted mainly of sulfate

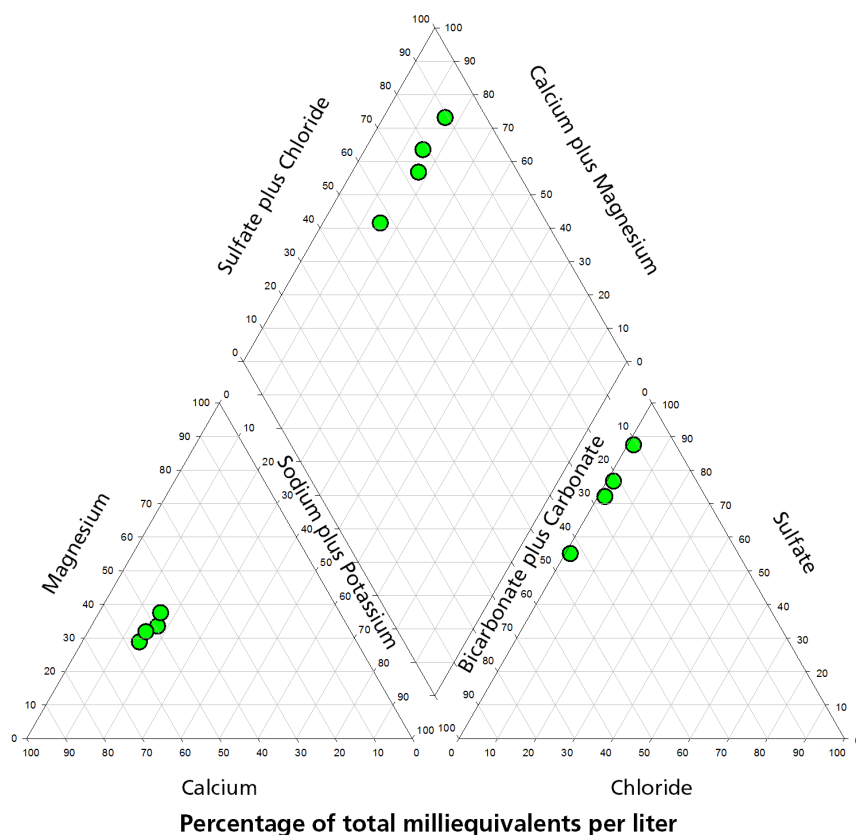


Figure 6. Major ion composition from samples collected at MAN01 on the Mancos River in Mesa Verde NP, 2014.

and, to a much lesser extent, bicarbonate. Cation composition was more evenly mixed, with calcium comprising the highest proportion, followed by magnesium, then sodium. Potassium was the least prevalent cation.

Table 6 reports the dissolved trace metals analyzed in samples from 2014. Also included are the lowest applicable water quality criteria which, depending on whether the criteria are based on hardness, may be presented as a range. Most trace metals measured below the applicable water quality criteria except for arsenic and manganese (CDPHE 2016b). In 2014, the water+fish standard was applied to the Mancos River, and the total recoverable arsenic criterion is 0.02 µg/L. The four results, which were based on dissolved arsenic concentrations, ranged from 0.353–0.530 µg/L; all in exceedance of the criterion. Also in 2014, the drinking

Table 6. Dissolved trace metal results from samples collected at MAN01 on the Mancos River in Mesa Verde NP, 2014; number of times that the samples were outside the applicable water quality criteria. A “nc” indicates no criteria have been developed for a particular trace metal, a “ndc” indicates that no dissolved criterion exists. Results that were lower than the NWQL reporting levels are noted as “<[reporting level]”.

Trace metal (µg/L)	2/19/2014 13:54	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	Lowest criterion (mg/L)	# of exceedances	Beneficial use
Aluminum	<6.00	33.1	<6.00	<6.00	ndc	ndc	ndc
Antimony	0.136	0.149	0.111	0.0779	5.6	0	water + fish
Arsenic	0.370	0.530	0.439	0.353	0.02 (total)	4	water + fish
Barium	37.5	23.2	31.2	46.4	ndc	ndc	ndc
Beryllium	<0.040	<0.040	<0.040	<0.040	ndc	ndc	ndc
Boron	42.4	21.4	154	67.0	ndc	ndc	ndc
Cadmium	<0.060	<0.060	<0.060	<0.060	0.74–3.10	0	aquatic life (chronic)
Chromium	<0.60	<0.60	<0.60	<0.60	135–648 (Cr III), 11 (Cr VI)	0	aquatic life (chronic)
Cobalt	0.849	0.825	0.523	0.574	nc	nc	nc
Copper	<1.60 ^a	2.66	<1.60	<1.60 ^a	16.8–86.0	0	aquatic life (chronic)
Iron	11.2	29.5	9.70	<8.00 ^a	300	0	DWS (30-day)

Table 6 (continued).

Trace metal (µg/L)	2/19/2014 13:54	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	Lowest criterion (mg/L)	# of exceedances	Beneficial use
Lead	<0.080 ^a	<0.080	0.125	<0.080	5.54–37.5	0	aquatic life (chronic)
Manganese	84.6	57.2	8.88	62.8	50	3	DWS (30-day)
Mercury	<0.010	<0.010	<0.010	<0.010	ndc	ndc	ndc
Molybdenum	1.89	1.17	2.69	2.16	ndc	ndc	ndc
Nickel	2.40	1.49	4.92	3.88	97–488	0	aquatic life (chronic)
Selenium	1.52	0.677	6.77	1.06	4.6	0	aquatic life (chronic)
Silver	<0.040	<0.040	<0.040	<0.040	1.13–30.4	0	aquatic life (chronic)
Uranium	4.44	1.14	10.1	4.35	3370–27,766	0	aquatic life (chronic)
Vanadium	0.206	0.399	0.463	0.260	nc	nc	nc
Zinc	<4.00	<4.00	<4.00	<4.00	236–1346	0	aquatic life (chronic)

a Result is above the Method Detection Level and below the Laboratory Reporting Level.

water supply standard was applied, and the criterion for manganese is 50 µg/L. Manganese concentrations ranged from 8.88–84.6 µg/L; three of these concentrations are above the drinking water supply criterion. Six metals—beryllium, cadmium, chromium, mercury, silver, and zinc—were not present above the laboratory reporting levels.

3.5 Contaminants of emerging concern

In 2014 four water samples were collected at MAN01 to be analyzed by the EPA Region 8 Laboratory for a suite of over 250 contaminants of emerging concern. The complete dataset is in Appendix B, the analyte list is in Appendix C, and detections for eight contaminants, in ng/L concentrations, are summarized in Table 7. Most of the contaminants detected were pharmaceuticals, likely due to the sample site being located downstream from the Town of Mancos' wastewater treatment plant.

Table 7. Summary of contaminants of emerging concern detections in samples collected at MAN01 (n=4) on the Mancos River in Mesa Verde NP, 2014.

Contaminant	Use	No. of detections
Pesticides		
2,4-D	herbicide	1
Pharmaceuticals and personal care products		
Gabapentin	anticonvulsant medication	2
Aripiprazole	antipsychotic medication	1
Dehydroaripiprazole	metabolite of aripiprazole	1
Desmethylvenlafaxine	antidepressant medication	1
Metformin	type-2 diabetes medication	1
Sulfamethoxazole	antibiotic	1
Waste indicators		
Bisphenol A	used in the production of polycarbonate plastics and epoxy resins (hard plastic bottles and metal food cans)	1

4 Quality Assurance/Quality Control

We followed the Quality Assurance/Quality Control procedures described in Monroe et al. (2016) and in National Park Service 2013. To assure accuracy of the instruments, we calibrated and performed maintenance on the multiparameter sondes in an indoor laboratory several times per year, and instruments were also calibrated in the field prior to measurements. We checked the current meters according to manufacturer recommendations to ensure that they were in working order, and calibrated the turbidimeter quarterly in the lab. The turbidimeter was also checked for drift in the field prior to each measurement. We collected five duplicate bacteria samples at several SCPN monitoring sites by filling two sample bottles in succession and comparing tray results after the incubation period. Two blank samples were processed using sterile water provided by IDEXX.

To verify the cleanliness of both the sampling equipment and the sample filtration process for nutrients, major elements, and trace metals, NWQL analyzed two sample sets of certified inorganic blank water, and results were compared to the 2014 reporting levels.

To evaluate data quality for the contaminants of emerging concern, SCPN collected two blanks at MEVE. These sample results were considered, as well as the results provided by the EPA lab for laboratory method blanks, blank spikes, matrix spikes, and other QA/QC checks in their reports to SCPN.

5 Summary

In 2010, SCPN implemented long-term water-quality monitoring at MAN01 on the Mancos River in MEVE. In 2014, four site visits were made to MAN01 on February 19, May 6, July 25, and October 29. Data from these site visits is summarized here and compared against the Colorado water quality standards applicable to this reach of the Mancos River (CDPHE 2016a, b). Core parameter data was collected at MAN02 on October 28 and did not exceed water quality standards.

We made site visits at regular intervals throughout the year, capturing a variety of different seasonal and flow conditions. Discharge at the time of sample events ranged from 0.3 to 51.9 cfs. Dissolved oxygen and pH did not exceed water quality standards. Water temperatures were logged at 15-minute intervals year-round and did not exceed the chronic water temperature criterion, but exceeded the acute criterion of 28.6°C for nine days in 2014.

E. coli ranged from 2 MPN/100 mL to 2000 MPN/100 mL. Two samples exceeded the chronic *E. coli* criterion applicable to MAN01. However, SCPN's sampling strategy is not designed to assess compliance with chronic water quality standards and additional samples would be needed to make a definite determination.

Most laboratory-measured results for nutrients and trace metals were below applicable water quality criteria. Three analytes exceeded the water quality criteria: arsenic, manganese, and sulfate. Arsenic exceeded the water+fish criterion in all four samples. Manganese exceeded the domestic water source criterion on February 19, May 6, and October 29. Sulfate exceeded the domestic water source criterion on February 19, July 25, and October 29.

Eight contaminants of emerging concern were detected in the four samples collected at MAN01; the majority of the detections were pharmaceuticals.

The data in this report should be viewed as a snapshot of water quality conditions existing at the time that the data was collected. Data and analyses in this report are provisional and are subject to change. When sufficient data are available, SCPN plans to produce an interpretive report which will include trend analysis of water quality data for the Mancos River in Mesa Verde National Park.

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Appendix A. Southern Colorado Plateau Network Water Quality Monitoring Sites at Mesa Verde National Park, 2014

Site code	Common name	Report name	Easting	Northing	Elevation (m)
MEVEMAN01	Mancos River at Gage	MAN01	734375	4126163	1933
MEVEMAN02	Mancos River above downstream boundary	MAN02	735878	4122566	1882

Note: Horizontal coordinates are reported in Universal Transverse Mercator (UTM) projection, Zone 12 North, North American Datum of 1983 (NAD 83). Vertical (elevation) coordinates are referenced to the North American Vertical Datum of 1988 (NAVD 88).

Appendix B. Water quality monitoring results for the Mancos River at Mesa Verde National Park, 2014

Table B-1. Water quality core parameter data from MAN01 on the Mancos River in Mesa Verde NP, 2014

Parameter	Unit	Sample collection date and time				Colorado aquatic life criteria
		2/19/2014 11:30	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	
Water temperature	°C	5.8	11.6	26.4	11.5	Warm water stream Tier 2
pH	none	8.5	8.3	8.0	8.4	6.5–9.0
Specific conductance	µS/cm	1190	451	2540	1450	nc
Dissolved oxygen	mg/L	11.0	8.5	6.7	8.7	5
Dissolved oxygen	%	108	99.8	107	101	nc
Turbidity	NTU	8.3	220	4.8	6.4 ^a	nc
Discharge	cfs	9.7	51.9	0.3	8.0	nc

^a Replicate turbidity measurements were not within 10% of one another for this sample

Table B-2. Total coliforms and *E. coli* in samples collected at MAN01 on the Mancos River in Mesa Verde NP, 2014

	Unit	Sample collection date and time				Colorado aquatic life criteria
		2/19/2014 11:30	5/6/2014 12:11	7/25/2014 18:45	10/29/2014 16:48	
Total coliforms	MPN/ 100 mL	330	>2400	320	610 ^a	>2400
<i>E. coli</i>	MPN/ 100 mL	2	2000	140	15 ^b	>2400

^a Exceeded the maximum detection level of the IDEXX system, which is 2400 MPN/100 mL.

^b Incubator lost power for 8 hours, incubation temperature decreased to 27.2°C during this time.

Table B-3. Contaminant of Emerging Concern detections in samples collected at MAN01 on the Mancos River in MEVE, 2014. Only the pesticide 2,4-D had a Colorado water quality criterion, and it was not exceeded.

Analyte (ng/L)	Reporting limit (ng/L)	Sample collection date and time			
		5/6/2014 12:11	7/25/2014 18:45	9/18/2014 10:00	10/29/2014 16:48
Pesticides					
2,4-D ^a	10	nondetect	nondetect	30.8 ^a	nondetect
Pharmaceuticals and personal care products					
Gabapentin	10	35.7	nondetect	nondetect	82.9 ^a
Aripiprazole	10	nondetect	nondetect	nondetect	10.3 ^a
Dehydroaripiprazole	10	nondetect	nondetect	nondetect	11.1 ^a
Desmethylvenlafaxine	10	nondetect	nondetect	nondetect	11.6 ^a
Metformin	10	nondetect	nondetect	nondetect	22.7 ^a
Sulfamethoxazole	10	nondetect	nondetect	nondetect	10.4 ^a
Waste indicators					
Bisphenol A	50	nondetect	96.0	nondetect	nondetect

^a Analyzed outside holding time, result may be biased low.

Appendix C. List of analytes and reporting limits for contaminants of emerging concern

Table C-1. Target analytes and U.S. Environmental Protection Agency reporting limits for pesticides

Analyte	Reporting limit (ng/L)	Analyte	Reporting limit (ng/L)
2,4,5-T	10.0	Ethoprop	10.0
2,4,5-TP	10.0	Fipronil	20.0
2,4-D	10.0	Fipronil sulfide	10.0
3-Hydroxycarbofuran	10.0	Fipronil sulfone	10.0
Acetochlor	20.0	Foramsulfuron	20.0
Acetochlor OA	20.0	Hexazinone	10.0
Alachlor	20.0	Imazaquin	20.0
Alachlor OA	50.0	Imazethapyr	20.0
Aldicarb	10.0	Imidacloprid	20.0
Aldicarb sulfone	20.0	Linuron	20.0
Aldicarb sulfoxide	10.0	Malathion	10.0
Atraton	10.0	MCPP	20.0
Atrazine	10.0	Metalaxyl	10.0
Atrazine de-ethyl	20.0	Methiocarb	20.0
Atrazine de-isopropyl	20.0	Methomyl	20.0
Azoxystrobin	20.0	Metolachlor	10.0
Bentazon	10.0	Metolachlor ESA	20.0
Bromacil	50.0	Metribuzin	20.0
Bromoxynil	10.0	Monuron	10.0
Butachlor ESA	10.0	Neburon	50.0
Carbaryl	10.0	Oryzalin	20.0
Carbofuran	10.0	Oxamyl	10.0
Chlorimuron ethyl	20.0	Prometon	20.0
Chlorsulfuron	20.0	Propachlor	10.0
Clothianidin	20.0	Propachlor ESA	20.0
Cyanazine	10.0	Propachlor OA	10.0
Dacthal monoacid	20.0	Propazine	20.0
Diazinon	20.0	Propiconazole	50.0
Dichloroprop	10.0	Propoxur	10.0
Dimethachlor	10.0	Simazine	20.0
Dimethenamid	10.0	Sulfometuron methyl	20.0
Dimethenamid ESA	20.0	Tebuconazole	50.0
Disulfoton sulfone	20.0	Tebuthiuron	10.0
Diuron	20.0	Terbutylazine	10.0
Diuron Metabolite	20.0	Thiamethoxam	20.0
EPTC	20.0	Triclopyr	20.0

Table C-2. Target analytes and U.S. Environmental Protection Agency reporting limits for pharmaceuticals and personal care products

Analyte	Reporting limit (ng/L)	Analyte	Reporting limit (ng/L)
(+/-)11-nor-9-carboxy-delta-THC	10.0	Duloxetine	25.0
10,11-dihydro-10-hydroxycarbamazepine	10.0	Ecgonine Methyl Ester	10.0
6-Acetylmorphine	10.0	EDDP	10.0
Acebutolol	10.0	Erythromycin	10.0
Acetaminophen	10.0	Erythromycin-anhydro	10.0
Albuterol	10.0	Escitalopram	10.0
Amitriptyline	10.0	Famotidine	10.0
Amitriptyline (+/-)-E-10-hydroxylated	10.0	Fenbufen	25.0
Amphetamine	10.0	Fentanyl	10.0
Aripiprazole	10.0	Fluoxetine	10.0
Atenolol	10.0	Fluticasone propionate	10.0
Atorvastatin	10.0	Furosemide	10.0
Atrazine	10.0	Gabapentin	10.0
Benzoylecgonine	10.0	Gemfibrozil	10.0
Bezafibrate	10.0	Glyburide	10.0
Buprenorphine	10.0	Hydrochlorothiazide	10.0
Bupropion	10.0	Hydrocodone	10.0
Caffeine	25.0	Hydromorphone	10.0
Carbamazepine	10.0	Hydroxybupropion	10.0
Carbamazepine 10,11 epoxide	10.0	Ibuprofen	25.0
Carisoprodol	10.0	Ketoprofen	10.0
Celecoxib	10.0	Lamotrigine	10.0
Chloramphenicol	10.0	Levorphanol	10.0
Chlorpheniramine	10.0	Lidocaine	10.0
Clenbuterol	10.0	Loratadine	10.0
Clopidogrel carboxylic acid	10.0	Lorazepam	25.0
Cocaethylene	10.0	MDA	10.0
Cocaine	10.0	MDEA	10.0
Codeine	10.0	MDMA	10.0
Cotinine	10.0	Mefenamic acid	10.0
DEET	10.0	Meperidine	10.0
Dehydroaripiprazole	10.0	Meprobamate	10.0
Desmethylcitalopram	10.0	Metformin	10.0
Desmethylvenlafaxine	10.0	Methadone	10.0
Dextromethorphan	10.0	Methamphetamine	10.0
Diclofenac	10.0	Methotrexate	10.0
Diclofenac 4-hydroxy	25.0	Methylparaben	25.0
Diltiazem	10.0	Methylphenidate	10.0
Diphenhydramine	10.0	Metoprolol	10.0
Disopyramide	10.0	Mevastatin	10.0
Donepezil	10.0	m-Hydroxybenzoylecgonine	10.0

Table C-2. Target analytes and U.S. Environmental Protection Agency reporting limits for pharmaceuticals and personal care products, *continued*

Analyte	Reporting limit (ng/L)	Analyte	Reporting limit (ng/L)
Modafinil	10.0	Pregabalin	10.0
Modafinil acid	25.0	Primidone	25.0
Monoethylglycinexylidide	10.0	Propranolol	10.0
Montelukast	10.0	Pseudoephedrine	10.0
Morphine	10.0	Quetiapine	10.0
Naproxen	25.0	Ritalinic acid	10.0
n-Butylparaben	25.0	Sertraline	10.0
Nifedipine	10.0	Sildenafil	10.0
Nifedipine oxidized	10.0	Simvastatin	10.0
Norfentanyl	10.0	Sotalol	10.0
Norfluoxetine	10.0	Sulfamethazine	10.0
Normeperidine	10.0	Sulfamethoxazole	10.0
Norquetiapine	10.0	Sumatriptan	10.0
Norsertaline	10.0	Tadalafil	25.0
Norverapamil	10.0	Temazepam	10.0
Omeprazole	10.0	Thiabendazole	10.0
Oxazepam	10.0	Tramadol	10.0
Oxcarbazepine	10.0	Trazodone	10.0
Oxycodone	10.0	Triamterene	10.0
Oxymorphone	10.0	Triclocarban	10.0
Oxymorphone glucuronide	10.0	Triclosan	25.0
Paroxetine	10.0	Trimethoprim	10.0
Phenmetrazine	10.0	Tylosin	25.0
Phenobarbital	25.0	Valsartan	10.0
Phentermine	25.0	Venlafaxine	10.0
Phenylpropanolamine	10.0	Verapamil	10.0
Phenytoin	10.0	Warfarin	10.0
Pioglitazone	10.0	Zolpidem	10.0
Pravastatin	25.0	Zolpidem phenyl-4-carboxylic acid	10.0

Table C-3. Target analytes and U.S. Environmental Protection Agency reporting limits for wastewater indicators

Analyte	Reporting limit (ng/L)	Analyte	Reporting limit (ng/L)
1,4-Dichlorobenzene	50.0	Galaxolide	50.0
17beta-Estradiol	100	Indole	50.0
1-Methylnaphthalene	50.0	Isoborneol	50.0
2,6-Dimethylnaphthalene	50.0	Isophorone	50.0
2-Methylnaphthalene	50.0	Isoquinoline	50.0
3-Methyl Indole	50.0	Menthol	50.0
4-Cumylphenol	50.0	Methyl Salicilate	50.0
4-n-Octylphenol	50.0	Metolachlor	50.0
4-tert-Octylphenol	50.0	Musk ketone	50.0
Acetophenone	50.0	Naphthalene	50.0
Benzophenone	50.0	Nonylphenol	50.0
Bisphenol A	50.0	p-Cresol	50.0
Bromacil	50.0	Pentachlorophenol	100
Butylated Hydroxyanisole	100	Phantolide	50.0
Caffeine	50.0	Phenanthrene	50.0
Camphor	50.0	Phenol	50.0
Carbaryl	50.0	Prometon	50.0
Carbazole	50.0	Pyrene	50.0
Celestolide	50.0	Tonalide	50.0
Chlorpyrifos	50.0	Tri(2-butoxyethyl) Phosphate	50.0
Dacthal	50.0	Tri(2-chloroethyl) Phosphate	50.0
Diazinon	50.0	Tri(dichloroisopropyl) Phosphate	50.0
Dichlorvos	50.0	Tributyl Phosphate	50.0
Equilenin	100	Triclosan	50.0
Estrone	100	Triethyl Citrate	50.0
Ethinylestradiol	100	Triphenyl phosphate	50.0
Fluoranthene	50.0		

Appendix D. Abbreviations, chemical formulas, and symbols used in this report

Term	Definition
ANC	acid neutralizing capacity of solutes plus particulates in an unfiltered water sample
CaCO ₃	chemical formula for calcium carbonate
cfs	cubic feet per second
cfu/100 ml	colony forming units, for bacteria sampling, a measure of the number of viable bacteria per 100 mL
LRL	laboratory reporting level
MDL	method detection level
µg/L	micrograms per liter
µS/cm	microsiemens per centimeter at 25°C, a measure of specific conductance
mg/L	milligrams per liter
Milliequivalents per liter	an expression of the concentration of substances that is chemically equivalent in terms atomic weight and electrical charge
MPN/100 mL	most probable number, for sampling bacteria, a statistical estimation of the number of coliform that would give the results shown by the laboratory examination
N	chemical symbol for the element nitrogen
ng/L	nanograms per liter
NTU	nephelometric turbidity unit, a measure of turbidity
P	chemical symbol for the element phosphorous

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