

Middle Colorado “Citizen Science” Water Quality Monitoring Action Plan

Middle Colorado Watershed Council

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I. Introduction

The Middle Colorado Watershed Council Citizen Science Water Quality Monitoring Action Plan is intended to guide the development and implementation of the citizen science water quality monitoring program. The Middle Colorado Watershed Council (MCWC) will use the document internally for staff and board members to understand the goals of the program and how it will operate. This document will be revisited and revised as the program is developed.

Development of a comprehensive water quality monitoring program is a priority project outlined in the Middle Colorado River Watershed Plan (2016). Within the comprehensive program, citizen science water quality monitoring is identified as a key component. The Watershed Plan outlines issues and opportunities for protecting and enhancing the health of the middle Colorado River watershed. The Citizen Science Water Quality Monitoring Program (CSWQM Program) will be an important contribution.

The MCWC would like to thank the Colorado Nonpoint Source Pollution Control Program for supporting development of the Watershed Plan and the U.S. Bureau of Reclamation Cooperative Watershed Management Program for its funding to initiate development of the CSWQM Program.

II. Background

The MCWC developed the Middle Colorado River Watershed Plan after completing a comprehensive Surface Water Quality Data Analysis (March 2015) of the middle Colorado River and its tributaries. Together, these documents outline the gaps in water quality data, and the need for consistent water quality data collection. The MCWC looks to the CSWQM Program to provide consistent data collection in areas where gaps exist and in areas that are flagged as needing consistent data collection.

Below is more information about the water quality and data gaps in the Middle Colorado River Watershed (MCRW), reinforcing the need for a water quality monitoring program.

Water Quality Analysis

Water quality data are important for understanding the dynamics that contribute to the health of a watershed. With this in mind, the MCWC conducted an analysis of publicly available water quality data for the area. The basic objectives of the study were to:

- Compile, analyze, and describe water quality conditions in the streams, lakes and rivers

in the MCRW.

- Locate areas where water quality issues may be present.
- Identify areas that could benefit from voluntary clean-up or restoration.
- Identify where additional water quality information could be useful.
- Recommend strategies to improve and guide future water quality monitoring.

This study focused on data collected from 2000 to 2013 and included over 30,000 records collected at nearly 400 locations in the MCRW.

Need for Water Quality Data

The analysis identified many data gaps and monitoring needs for the MCRW. While there are a number of historic monitoring locations, sampling has been limited in geographic distribution and temporal consistency. Therefore, the ability to identify baselines, patterns, and trends is limited.

Other specific monitoring issues that have been highlighted include:

- Lack of data for headwater tributaries.
- Lack of nutrient-related data throughout the MCRW, as nutrients have been identified as an issue of concern state-wide.
- Lack of data on the Colorado River that provides an understanding of the impact of tributary water quality on the mainstem.
- Lack of meaningful selenium data to fully characterize the extent and source of this naturally occurring metal where it has been identified as potentially problematic.
- Need for flow information in order to evaluate mass loads of pollutants.

Identified data gaps and the need for continued monitoring reinforce the importance of a CSWQM Program in the MCRW.

Please see Appendix A for excerpted information, results, and conclusions from the Surface Water Quality Data Analysis.

III. Program Goals and Objectives

Goals

The CSWQM Program is consistent with many MCWC organizational goals identified in the Watershed Plan, namely to:

- Support the long-term health of the watershed;
- Advance water quality monitoring, enhancement, and improvement;

- Increase awareness and stimulate interest in the watershed;
- Offer educational opportunities and information resources;
- Inform planning and decision-making; and
- Create partnerships and collaboration among stakeholders.

Objectives

Specific objectives of the CSWQM Program are to:

- Fill in identified gaps in water quality monitoring in the MCRW;
- Engage watershed stakeholders, including school-age children and adults in the protection and monitoring of their water;
- Keep concerned stakeholders, including land managers, county and city officials, and the public informed of water quality condition in the MCRW;
- Encourage decision-makers to utilize the data and conclusions that can be drawn from it to inform land use planning, resource utilization and management activities, and other actions that can affect water quality conditions;
- Identify areas of impairment to prioritize MCWC monitoring efforts and provide more intensive monitoring if necessary; and
- Work with partnering organizations to ensure continuity of data up and downstream of the watershed.

IV. Operational Format

Models for Success

The MCWC looks to model the citizen science program on existing, successful programs from River Watch of Colorado and the Roaring Fork Conservancy (RFC).

River Watch of Colorado

River Watch of Colorado is a well-established, volunteer-based, statewide water quality monitoring project supported by Colorado Parks and Wildlife (CPW). This program has a successful track record for creating new water stewards while also collecting useful water quality data throughout the state. The MCWC will participate in the River Watch of Colorado program to receive the following benefits:

- standardized trainings and use of established protocols to ensure accurate and consistent data collection;
- laboratory analysis of water quality samples by CPW's certified laboratory;
- third-party review of data for quality control/quality assurance; and
- use of sampling equipment and field gear.

MCWC staff participating in the program will undergo River Watch of Colorado training to establish proficiency in sampling protocols and data collection (all current staff have been trained). MCWC staff will assume responsibility for managing and training its own volunteers.

MCWC will submit all collected data to River Watch for upload to the state database, Colorado Data Sharing Network, and the national database, STORET and WQX. This data is freely available to any interested party or decision maker.

The Roaring Fork Conservancy

The Roaring Fork Conservancy (RFC), a neighboring non-profit in Basalt, Colorado, administers a comprehensive water quality monitoring program in its watershed. RFC staff manage a citizen science monitoring program, provide assistance to local schools that conduct monitoring, and conduct routine and special projects monitoring throughout the Roaring Fork basin. The MCWC will look to the RFC for input and guidance on volunteer recruitment and program management for the citizen science program.

Working Together

Water quality is best managed by approaching the river basin as a whole. With this in mind, the MCWC intends to coordinate its efforts with entities currently collecting water quality and quantity data in the region. This includes regulated entities like municipal water and wastewater treatment facilities and oil/gas operators; land management agencies; regulatory agencies; science-based governmental agencies; and neighboring local watershed organizations.

This coordination will focus on information sharing, identification of common areas/data of interest, and incorporating continuity and efficiency into data collection efforts. Much of this coordination will be accomplished through use of the MCWC Technical Advisory Committee.

Technical Advisory Committee Involvement

The Technical Advisory Committee (TAC) of the MCWC will guide the CSWQM Program. This committee is comprised of water and natural resource managers, involved stakeholders, and MCWC staff and board members. The TAC will assist with the program by:

- guiding decisions on prioritizing sampling sites based on the data gaps and areas of concern highlighted in the MCWC Water Quality Assessment and Watershed Plan;
- establishing design elements such as sampling frequency, parameters sampled, sampling and analysis methodologies (when there is a need to differ from River Watch protocols), etc.
- assisting with data interpretation and synthesis; and
- identifying potential sources for continued program funding.

The TAC will periodically revisit the sampling design and other program elements as they evolve to ensure the citizen science program effectively addresses watershed concerns while meeting program goals and objectives.

The MCWC will use the TAC's expertise and vast combined experience to establish a successful program. By facilitating communication between government agencies as well as other entities concerned with watershed health, this exchange will benefit not only the MCWC but also the TAC member agencies by keeping them informed of current watershed health and management projects.

Measurable Results

Based upon data collected through the program, annual reports will be developed to track water quality in the MCRW. Annual reports will be shared with volunteers, TAC members, and made available to the public through the MCWC website. These reports will serve as an educational tool for those engaged in the program, as motivation for continued engagement in something important and useful, and as a demonstration of what can be achieved through voluntary service. Information garnered from these reports will also provide an opportunity for reflection on how the citizen science program is progressing and if the goals and objectives are achieved.

IV. Next Steps

Volunteer Recruitment

The MCWC looks to leverage partnerships with existing programs, local non-profits, and other organizations to recruit school-age and adult volunteers. Through its various outreach efforts, the MCWC will inform stakeholders of the opportunity to be involved in monitoring their local water quality. This includes using social media platforms, local newspapers, and radio stations to talk about the opportunity and include ways to sign-up to be a part of the CSWQM Program.

The MCWC will work with River Watch of Colorado to identify schools that have participated with River Watch programs in the past, but have lapsed in their involvement. The MCWC will provide guidance and help to get the lapsed programs started again.

The MCWC will reach out to citizen groups concerned with water quality to solicit active adult volunteers in the watershed.

Action Items

Ongoing efforts will include Volunteer Recruitment through the Outreach and Education Committee, made up of MCWC staff, board members, and community members. The TAC will

also provide ongoing oversight of site selection and data monitoring, as well as revisiting this document to make changes as necessary to ensure goals and objectives are being met.

The next priorities are to:

- Identify priority sites and actively begin recruitment of volunteers;
- Train volunteers, perform site visits, and collect initial data;
- Establish sampling frequency for each site;
- Create a program manual for volunteers to use into the future.

Periodically, the MCWC with assistance from the TAC will evaluate the CSWQM Program to assess what works well and address any challenges that have been identified. The team will then establish ways to overcome those challenges to ensure successful continuation of water quality monitoring for the foreseeable future.

Appendix A – Detailed Report of the Surface Water Quality Analysis

Impaired Waterbodies

The compiled data were compared to water quality standards as established and regulated by the CDPHE. These standards are assigned to all waterbodies in the state in an effort to protect beneficial uses, such as drinking water, fisheries, recreation, and agriculture. A comparison of the data to the standards allows for a determination of whether the uses are being met; if pollutant levels exceed the standards then the waterbody is considered to be “impaired.” CDPHE has compiled and regularly updates its list of impaired waterbodies across the state. Those that have been identified in the MCRW are reported in Table 1.

Table 1. 303(d) listed segments in the Middle Colorado River Watershed (from Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation #93, Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List – effective 3/1/16).

Water Body Identification Number	Stream or Lake Segment Description	Portion	303(d) Parameter(s) of Impairment	TMDL Priority
COLCLC01	Colorado River, Roaring Fork to Rifle Creek	All	Temperature	High
COLCLC01	Colorado River, Roaring Fork to Rifle Creek	Colorado River from Roaring Fork to Paradise Creek	Arsenic	Low
COLCLC04a	Tributaries to Colorado River, Roaring Fork to Parachute Creek except for specific segments	Mamm Creek	Iron (total recoverable)	Medium
COLCLC04a	Tributaries to Colorado River, Roaring Fork to Parachute Creek except for specific segments	All	Selenium	Medium
COLCLC04a	South Canyon Creek from hot springs to Colorado River	South Canyon Creek above hot springs	Iron (total recoverable)	High
COLCLC04c	South Canyon Creek	All	Arsenic	Low
COLCLC10	East Rifle Creek, West Rifle	All	Arsenic	Low

	Creek and Rifle Creek, including tributaries from Rifle Gap to the Colorado River			
COLCLC14c	Mainstem of Roan Creek including all tributaries from Kimball Creek to the Colorado River	Dry Fork	Selenium	Low
COLCLC14c	Mainstem of Roan Creek including all tributaries from Kimball Creek to the Colorado River	Roan Creek	Iron (total recoverable)	High
COLCLC14c	Mainstem of Roan Creek including all tributaries from Kimball Creek to the Colorado River	All	Manganese	Low
COLCLC20	Rifle Gap Reservoir, Harvey Gap Reservoir, and Vega Reservoir	Rifle Gap Reservoir	Aquatic Life Use – Mercury in Fish Tissue	High

Table 2. Monitoring and Evaluation (M&E) segments in the Middle Colorado River Watershed (from Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation #93, Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List – effective 3/1/16).

Water Body Identification Number	Stream or Lake Segment Description	Portion	Monitoring & Evaluation Parameter(s)
COLCLC01	Colorado River, Roaring Fork to Rifle Creek	All	Sediment
COLCLC02a	Colorado River, Rifle Creek to Rapid Creek	All	Sediment
COLCLC04a	Tributaries to Colorado River, Roaring Fork to Parachute Creek except for specific segments	All	Temperature, Total Phosphorus, Sulfate
COLCLC04a	South Canyon Creek from hot springs to Colorado River	South Canyon Creek above hot springs	Sulfate
COLCLC04b	South Canyon Hot Springs	All	Dissolved Oxygen, Lead
COLCLC04c	South Canyon Creek	All	<i>E. coli</i> (May-October)
COLCLC04e	Dry Creek and tributaries from source to Last Chance Ditch	All	Cadmium, Iron (total recoverable), Selenium, Copper

COLCLC10	East Rifle Creek, West Rifle Creek and Rifle Creek, including tributaries from Rifle Gap to the Colorado River	West Rifle Creek	Iron (total recoverable and dissolved), Sulfate
COLCLC10	East Rifle Creek, West Rifle Creek and Rifle Creek, including tributaries from Rifle Gap to the Colorado River	All	<i>E. coli</i>
COLCLC14b	Clear Creek from Tom Creek to Roan Creek. Roan Creek, including tributaries from Clear Creek to Kimball Creek	All	<i>E. coli</i> , Iron (total recoverable)
COLCLC14c	Mainstem of Roan Creek including all tributaries from Kimball Creek to the Colorado River	All	Arsenic

The water quality parameters that are causing known or suspected impairments each have differing impacts on the uses.

Selenium is a naturally-occurring substance found in sedimentary rocks in western Colorado. Water infiltrates through those rock formations and leaches selenium which is transported to the nearest waterway. Elevated selenium concentrations are particularly detrimental to four endangered fish species found in the Colorado River: the humpback chub, Colorado pikeminnow, bonytail and razorback sucker. Agricultural, residential, and commercial irrigation, unlined ponds and canals, and other water uses can mobilize large quantities of selenium.

Metals such as iron, lead, arsenic, copper, and zinc can impair or be lethal to humans and aquatic life if concentrations exceed water quality standards. As geologic formations weather, either naturally or through human activity, metals can be released into waterways. Human activities that cause large scale ground disturbance, like mining or road construction, expose soils and rock at the surface and can accelerate the weathering process and increase erosion and mobilization of these metals. Corrosion of metal pipes that deliver potable drinking water can be another potential source of metals pollution.

Dissolved oxygen is an important indicator of the health of a waterbody and sufficient concentrations are required to support healthy aquatic life. Undesirable conditions such as eutrophication, increased plant and algal growth due to increased nutrient loading from over-fertilization, are often characterized by low dissolved oxygen concentrations. Water temperature also significantly influences dissolved oxygen concentrations because warm water

cannot hold as much dissolved oxygen as cold water.

Escherichia coli (*E. coli*) is a bacteria found in the intestines of humans and animals. Contact with *E. coli* contaminated waters can cause minor illnesses like nausea, diarrhea, and stomach cramps. Potential sources of *E. coli* include individual sewage disposal systems, runoff from areas with intense grazing or where manure or other wastes are applied, and native wildlife.

Sediment deposition on the bottom of streams in excessive quantities can significantly impact aquatic life. Impacts include the smothering of fish spawning gravels, loss of macroinvertebrate (an importance source of fish food) habitat, and loss of pool and other habitat types through changes in stream channel morphology.

Mercury is a highly toxic element that is found both naturally and as an introduced contaminant in the environment. People are exposed to forms of mercury almost entirely by eating contaminated fish and wildlife. The mercury impairment and subsequent advisories in place at Rifle Gap Reservoir are "fish tissue based" and not "water column based", meaning that potential health problems may result from eating fish caught in the reservoir. The advisories do not ban eating fish but serve as a guide to help citizens reduce risk and make informed decisions. Consumption advisories do not affect those who swim, ski or boat on the reservoir. Mercury emissions from U.S. coal burning power plants are the largest source of mercury released to the air. Airborne mercury enters waterways primarily through deposition associated with rainfall.

States are required by the Federal Clean Water Act to actively address known impairments. Impairments are typically addressed through the development of total maximum daily loads or "TMDLs" (see inset). Development of reliable TMDLs is predicated on a well-developed set of water quality data combined with flow information. Watershed groups like the MCWC can assist the state by collecting additional data to improve the analysis while determining the sources of apparent pollutants, which often are due to NPS sources.

Findings and Conclusions from the Water Quality Data Analysis

The analysis found that the vast majority of water quality data in the MCWC meets regulatory standards and supports existing water uses and overall watershed health. For locations where the data suggest otherwise, the analysis highlights and discusses why those water quality standards are not being met. It also points out where there is a lack of data. This is where the MCWC hopes to focus efforts for the CSWQM Program.

The following breaks down the findings and conclusions for specific portions of the MCRW.

East Watershed (includes Glenwood Canyon tributaries, Elk and Rifle Creek Drainages).

The vast majority of water quality data that exists for the East Watershed meets applicable standards and supports existing water uses and overall watershed health. However, overall lack of data in the East Watershed is a concern. Many of the tributaries that drain off the Flat Tops,

such as No Name, Spruce, French, Devil's Hole and Paradise creeks have not been sampled. The headwaters of Elk and Rifle creeks, situated in developed recreational areas, have also not been sampled. It will be important to determine the existing quality of those areas and continue monitoring there given increased recreational use. South Canyon Creek, Rifle Creek, and to a lesser extent Elk Creek are highlighted as priorities for additional investigation.

Water quality in South Canyon Creek appears to be impacted by the South Canyon Hot Springs, particularly for stream temperature, dissolved oxygen, and *E. coli*. Elevated selenium and iron concentrations near the mouth of South Canyon Creek may be attributed to other sources and warrants additional investigation.

The available data from Rifle Creek suggest that additional monitoring is needed to identify sources of elevated selenium, iron, and *E. coli*. Rifle Gap Reservoir shows depressed dissolved oxygen concentrations that may point to internal water quality issues. This should be studied in greater detail. The tributaries to Rifle Creek including the east, middle, and west forks of Rifle Creek and Government Creek and their effect on exceedances of water quality standards need further evaluation.

South Watershed (includes tributaries to the Colorado River generally entering from the south below Glenwood).

In the South Watershed, selenium was identified as a water quality concern and further data collection is recommended to identify potential sources in Mamm, Alkali, Dry Hollow, and Divide creeks.

Lead samples from Battlement Creek are at levels that can be detrimental to aquatic life, including fish. Additional data collection is recommended to determine whether elevated lead concentrations persist today and to identify potential sources.

West Watershed (includes Roan and Parachute Creek Drainages).

Given the history of natural gas development in the West Watershed area, volatile organic compounds associated with natural gas – benzene, toluene, ethylbenzene and xylenes (BTEX) – have been sampled. The vast majority of these samples indicated BTEX concentrations below regulatory levels.

As in the East and South Watersheds, there is a data gap with respect to selenium. Additional sampling in Parachute, Roan and the Dry Fork of Roan creeks is needed to fully evaluate this parameter.

With the intersection of unique and important native populations of Colorado cutthroat trout, extensive recreation, energy development, and agriculture in this portion of the MCRW, there is an increased need for more consistent and widespread water quality sampling and evaluation.

Main Stem of the Colorado River.

The primary concern within the Colorado River mainstem is the lack of water quality monitoring sites. Without more sampling sites, it is difficult to bracket the effect of the tributaries on water quality in the mainstem of the river. Currently, the Colorado River lacks an active water quality monitoring site west of Rifle, resulting in a large data gap.

Specific parameters that are recommended for further evaluation include nutrient data, sediment, *E. coli*, selenium and BTEX.