Colorado Basin Implementation Plan Update

Volume 2

January 2022

SGM

COLORADO BASIN ROUNDTABLE

Table of Contents

Tables

Figures

ACKNOWLEDGEMENTS

Special thanks to the BIP Update Team including:

- Brown and Caldwell General Contractor Team
- Colorado Basin Roundtable
- Colorado Water Conservation Board Staff and Board
- Regional Leads
- Other Basin Local Experts

EXECUTIVE SUMMARY

Introduction

Colorado is facing significant water supply challenges to meet future demands. These challenges are driven by a growing population, variable hydrology, agricultural needs, protecting and restoring river health, and an expanding recreation economy. In response, Governor Hickenlooper issued an Executive Order (EO) in 2013 calling for the Colorado Water Conservation Board (CWCB) to work with the nine Basin Roundtables, the Interbasin Compact Committee (IBCC), and other stakeholders to develop Colorado's first Water Plan. The Governor's EO required that the Colorado Water Plan (CWP) incorporate the following fundamental water values:

- A productive economy that supports vibrant and sustainable cities, viable and productive agriculture, and a robust skiing, recreation, and tourism industry
- Efficient and effective water infrastructure promoting smart land use
- A strong environment that includes healthy watersheds, rivers and streams, and wildlife

Each of the nine Basin Roundtables (**Figure 1**) developed a Basin Implementation Plan (BIP) that identified existing or new projects, policies, and processes (IPP) to meet water needs to 2050 and beyond. They were compiled by municipal, industrial, agricultural, recreational, and environmental stakeholders. Each roundtable delivered its BIP to the CWCB in April 2015.

The basin roundtables played a critical role in the development of the CWP. Each BIP framed regional values and offered strategies for how each basin's future water needs will be addressed at the local level. As a result, much of the CWP's success has been basin-specific – where local governments, water utilities, elected officials, community organizations, and citizens are involved on the ground with locally-tailored efforts.

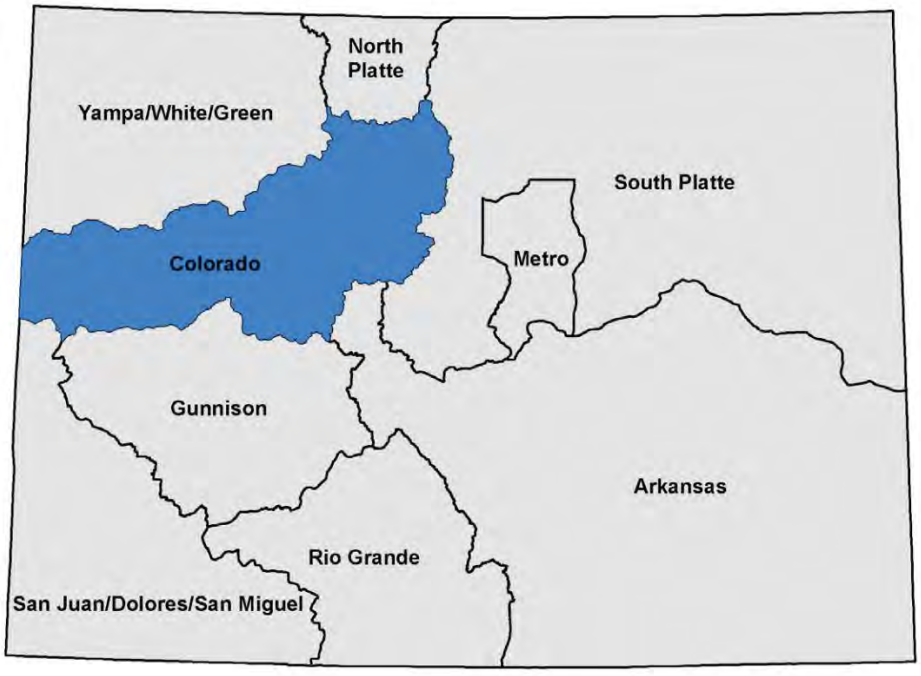


Figure 1: Nine Basin Roundtables

What is Basin Implementation Planning?

The Basin Implementation Plan (BIP), developed in a collaborative process by basin stakeholders, focuses on the current and future water needs in the Colorado Basin, the vision for how individuals and organizations can meet future needs, and the goals and projects that provide a pathway to success. The initial Colorado BIP was completed in 2015, and this is the first update of that plan.

The Colorado Basin Implementation Plan consists of two volumes:

VOLUME 1:	VOLUME 2:
A summary of the Colorado Basin's current and future water resources, focusing on goals, projects, and a strategic vision to meet future water needs.	A more comprehensive description of Colorado Basin achievements, challenges, goals, and strategic vision for meeting future water needs as well as detailed regional supplies and demands. Note that Volume 2 is organized in a slightly different order than Volume 1.

This document is Volume 2 of the Colorado BIP Update.

Colorado Basin Vision

The Colorado Basin Roundtable (CBRT) "envisions a Colorado River basin that is home to thriving communities benefiting from vibrant, healthy rivers and outstanding water quality that provides for all of the Colorado Basin's needs. We acknowledge the interdependence of the varied Basin water users. Protecting the water and river flows that will ensure the future for all of us is a high priority. We also recognize that the influence of historic drought patterns, the uncertainty of climate change, population growth, energy development and Compact compliance are interwoven within this vision. We are prepared to work together to solve the basin's challenges (CBRT, 2021)."

The Vision and the Western Slope Principles (NWCCOG, 2014a) were incorporated into the Colorado River Basin's White Paper (CBRT, 2014); a document developed and adopted by the CBRT members to articulate how to approach the statewide water planning process. These documents (located in **Exhibit A**) served as the foundation for the 2015 BIP, representing the collective values of the Basin's citizens and stakeholders, their stories and how they are standing their ground, negotiating their positions, and educating their constituents, including their children and grandchildren (CBRT, 2015).

Progress Since 2015 Basin Implementation Plan

The CBRT continued meeting every month since the 2015 BIP was completed with the larger stakeholder groups meeting every other month and the smaller focused CBRT members (Next Steps Committee) meeting on the alternating month.

Progress on Top Basinwide Projects

Significant progress was made with the completion of 70 projects included in the 2015 BIP.

The 2015 BIP highlighted five "top basinwide projects." Progress on these top basinwide projects is described below:

- Grand Valley Roller Dam Rehabilitation

  - Significant progress on this project has been made since 2015, including completion of the Grand Valley Roller Dam & Canyon Master Plan Phase 1 and Phase 2, as well as the Upper Canyon Improvement Project and portions of the Electrical Upgrades Project. See **Exhibit D** for a complete list of the projects and their status as of the date of this report.
- Colorado Basin Stream Management Plan
  - While the Roundtable has decided not to pursue a single basinwide stream management plan, significant progress has been made on developing individual stream management plans and integrated water management plans throughout the Basin, as described in other sections. The Basin is shifting focus to characterizing streams and watersheds throughout the Basin and prioritizing streams and watersheds for development of integrated water management plans, which would be driven by local watershed groups and other partners.
- Colorado River Cooperative Agreement
  - Actions initiated by the Colorado River Corporative Agreement (CRCA) continue to progress, including the Learning by Doing (LBD) program and multiple rehabilitation projects on the Fraser River. Several projects identified in this agreement are completed or underway. See **Exhibit D** for a complete list of the projects and their status as of the date of this report.
- Protection of the Shoshone Hydroelectric Plant Call
  - Protection of the Shoshone Hydroelectric Plant call remains a top priority of the Colorado BRT, these efforts are ongoing and continue to be the focus of significant conversation.
- Protect existing and future west slope uses
  - The Roundtable now considers this to be a policy statement rather than a project that can be tracked. This continues to be a priority for the Colorado Basin, and a central tenet of this 2022 BIP Update.

Grant Funds Provided by the Roundtable

The CBRT has provided $3.7 million in grant funding to further the projects identified in the 2015 BIP. These Roundtable funds assisted in leveraging $6.5 million in State funding.

Following are maps showing the locations of funded projects. A full list of funded projects and supporting information is included in **Exhibit F**.

- **Figure 2** is a map of projects funded by Colorado Water Plan (CWP) grants. Locations are labeled by the ID assigned to the project, from which the reader can look up more information in **Exhibit F**.
- **Figure 3** is a map of projects funded by Construction Fund grants. Locations are labeled by Contract Number, from which the reader can look up more information in **Exhibit F**.
- **Figure 4** is a map of projects funded by Water Supply Reserve Fund (WSRF) grants. Locations are labeled by the ID assigned to the project, from which the reader can look up more information in **Exhibit F**.

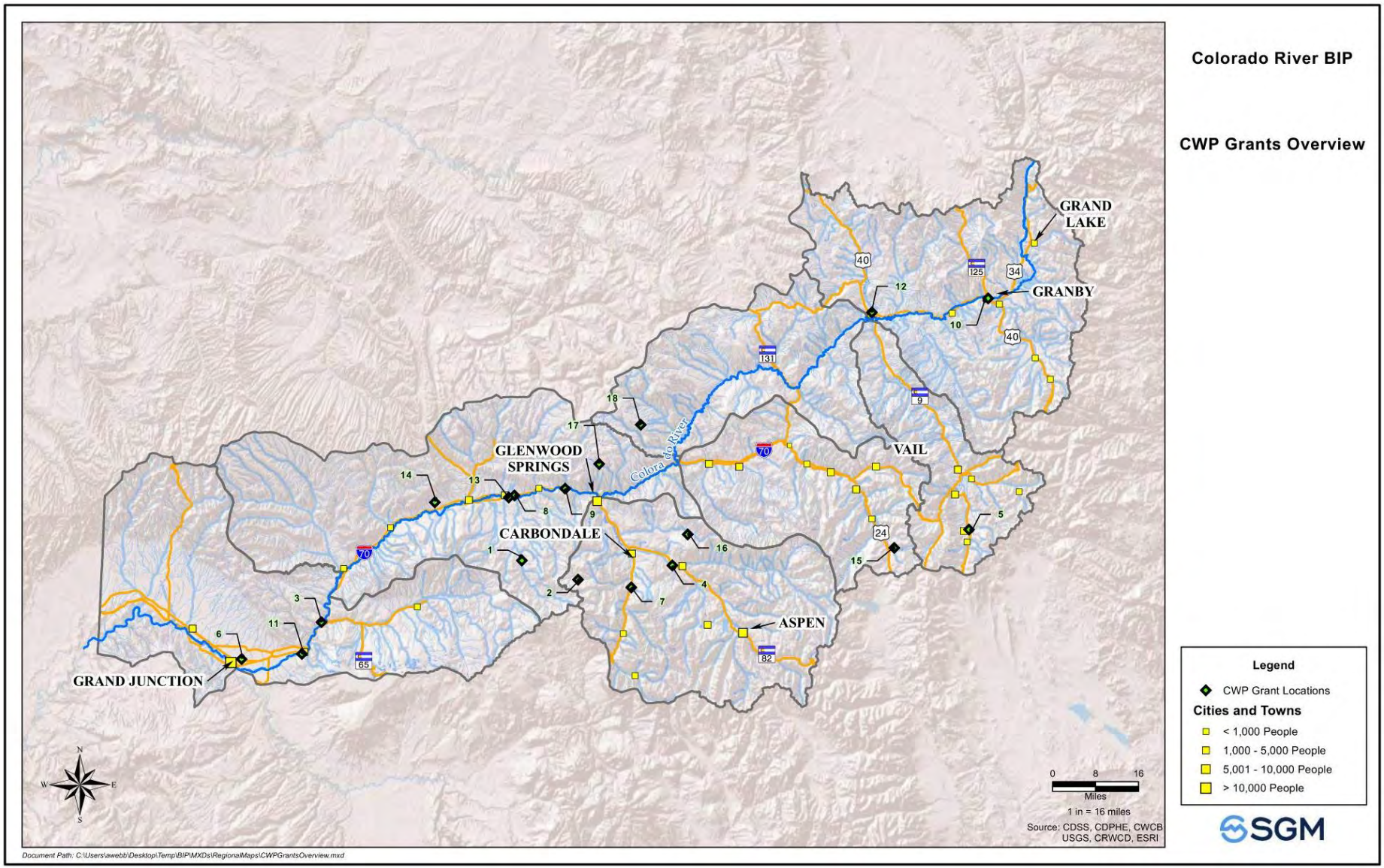


Figure 2: Map of Projects Funded by Colorado Water Plan (CWP) Grants

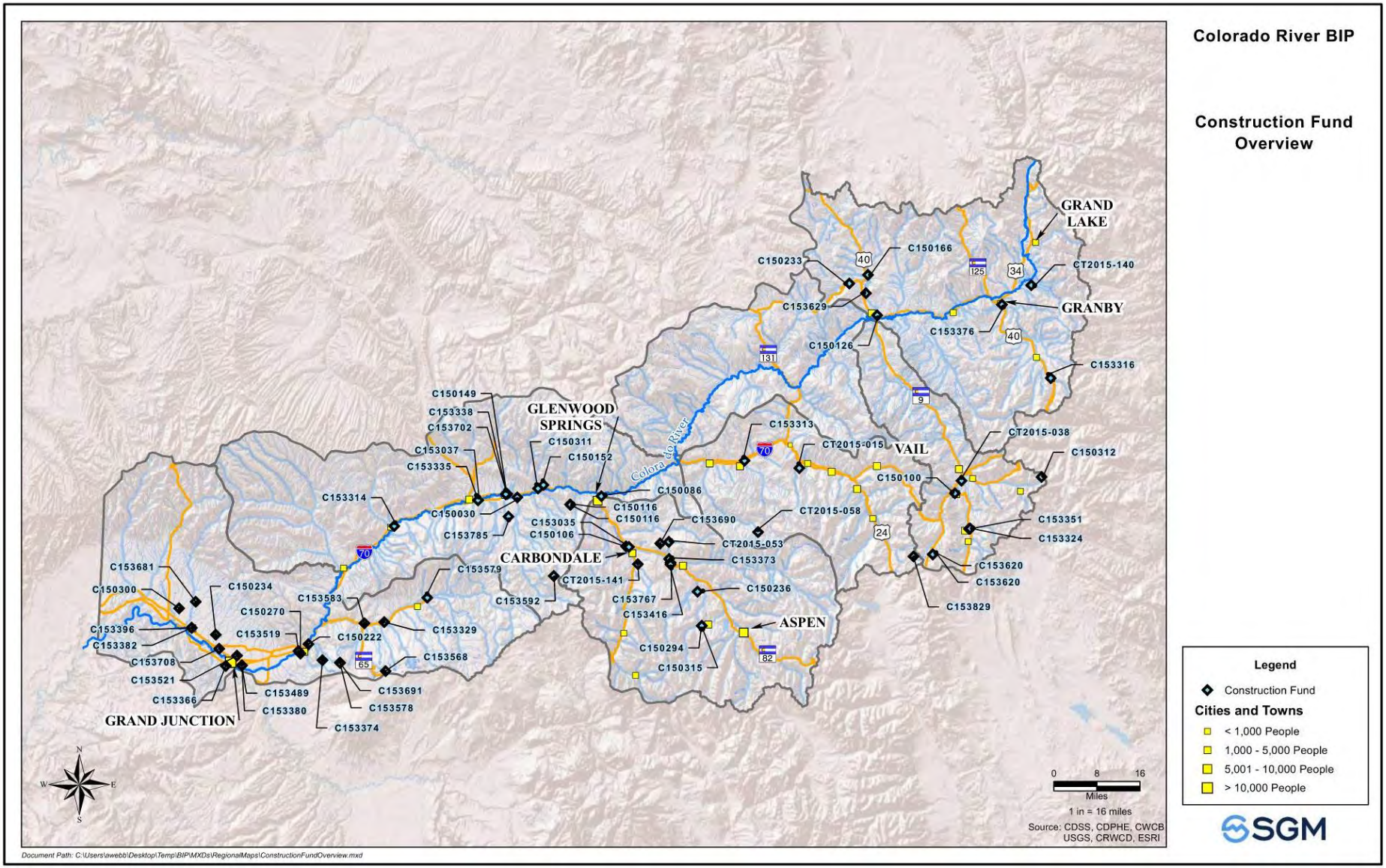


Figure 3: Map of Projects Funded by the Construction Fund Grants

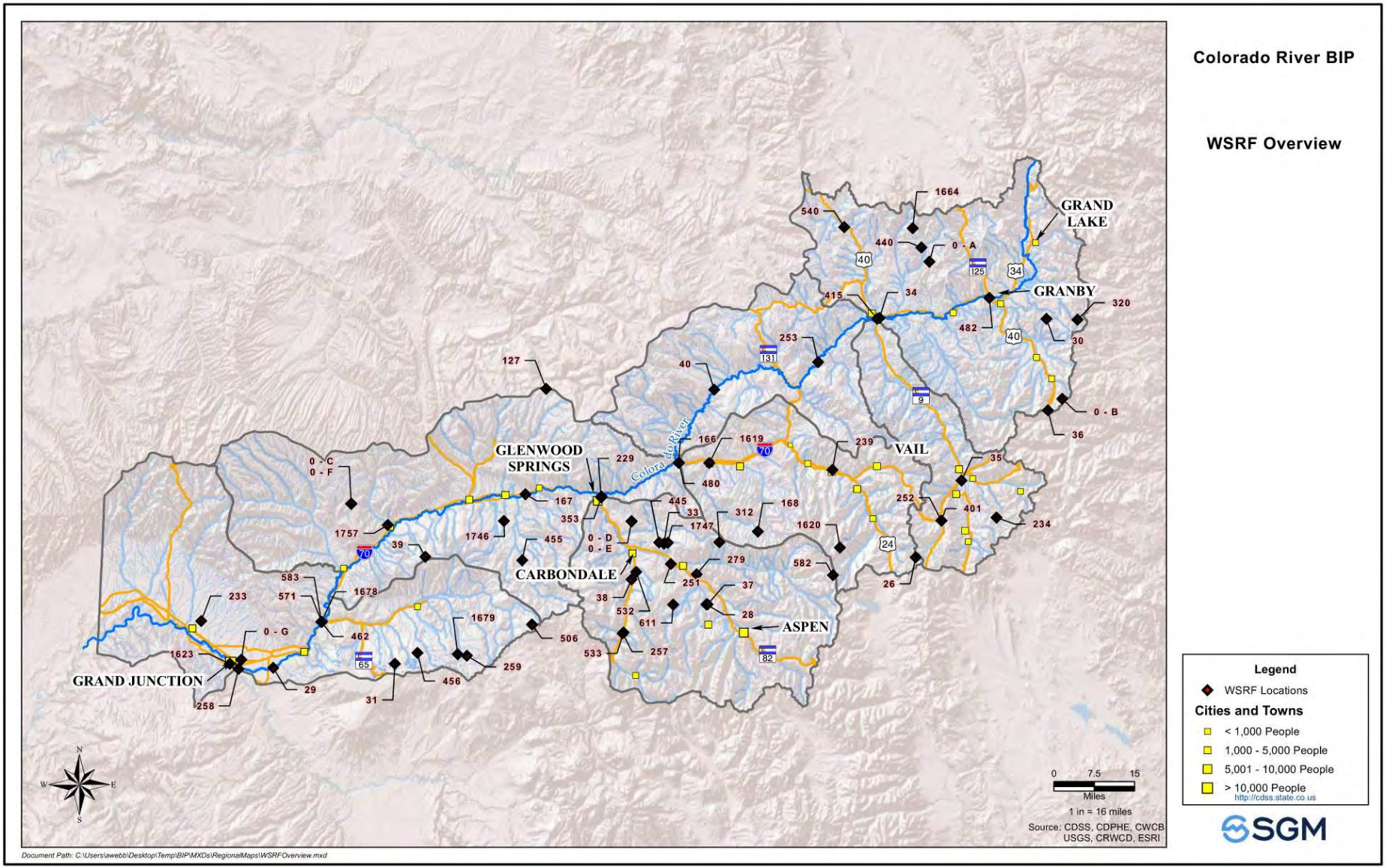


Figure 4: Map of Projects Funded by the Water Supply Reserve Fund (WSRF)

Stream Management Plans and Integrated Water Management Plans

The 2015 Colorado Water Plan set a measurable objective to cover 80 percent of the locally prioritized lists of rivers with stream management plans, and 80 percent of critical watersheds with watershed protection plans, all by 2030. The Roundtable believes that one of the Basin's top successes since the 2015 is the progress made on the development of stream management plans and integrated water management plans (IWMPs) throughout the Basin. Below is a list of stream management plans, IWMPs, and other similar efforts that have been completed or initiated since the 2015 BIP.

- Crystal River Management Plan – 2016
- Upper Roaring Fork River Management Plan - 2017
- Roaring Fork River Watershed Plan – 2019 Update
- Middle Colorado IWMP – 2021
- Blue River IWMP – Phase 1 complete, Phase 2 in progress
- Eagle River Community Water Plan – In progress
- Grand Valley Watershed Plan – Update in progress

Integrated Water Management Plan (IWMP) Framework

To facilitate IWMPs across the Colorado Basin, the CBRT commissioned a project to assemble tools, frameworks and datasets designed to 1) promote understanding of local needs or opportunities for integrated water management planning; 2) help structure planning efforts to ensure that environmental and recreational needs are evaluated along with agricultural, municipal, industrial, and residential needs; and 3) facilitate reporting of locally generated planning outcomes in a form that enables straightforward synthesis and comparison of results between watersheds. The resulting project deliverables seek to build a foundation for conducting stakeholder-driven IWMPs in the mainstem Colorado River Basin in Colorado. In addition to guidance for implementing stepwise IWMP planning processes, the project developed the following tools:

- A set of data dashboards that enables users to explore existing and natural flows, water use and shortages, the degree of hydrologic alteration, water quality and water quality compliance issues across the basin.
- A library compiling past studies in the basin relevant to integrated water management planning.
- A set of interactive maps compiling data layers from numerous sources, including the Colorado Basin Implementation Plan, that show the locations of major water infrastructure and water quality issues.
- A scoring matrix for assessing the ecological integrity of streams and the degree to which they are successfully meeting the needs and desires of communities, including providing water for irrigation and domestic use.
- A spatial mapping layer that delineates all major streams in the basin into stream mile units.

The 2018 update to the IWMP Planning Framework can be found at:

- https://www.coloradomesa.edu/water-center/colorado-basin-roundtable-integrated-water-management-planning-framework-project.html

The website that houses these on-line tools can be found at:

- http://uppercoloradoriver.org/co-river-headwaters/

Critical Studies and Projects

Risk Studies

The Risk Study effort began from joint West Slope basin roundtable discussions and reflections on the Drought Contingency Planning (DCP) process. The studies were completed in three phases by Colorado River District and the Southwestern Water Conservation District. The objectives explored by the Risk Studies are to avoid a compact deficit which might lead to curtailment under the 1922 Colorado River Compact, and to protect the water level elevation in Lake Powell. The Risk Studies explores drivers of risk including hydrology, consumptive use, and low reservoir storage conditions.

Phases I and II evaluated system-wide risks in the Colorado Basin, and developed a new approach to modeling both in-state (Colorado) impacts of potential involuntary curtailment, and/or the development of a demand management program. Phase III builds on Phases I and II by continuing to use these tools to revisit current and future risks and explore some potential approaches to involuntary curtailment. Phase III was completed and published in November 2019. (Risk Study Phase III, 2019)

Colorado River Cooperative Agreement (CRCA)

The Colorado River Cooperative Agreement (CRCA) began a long-term partnership between Denver Water and the West Slope. The agreement is a framework for numerous actions by the parties to benefit water supply, water quality, recreation, and the environment on both sides of the Continental Divide While the CRCA was completed in September 2013 (before the 2015 BIP), it continues to be an important agreement and driver in the Colorado Basin.

Eagle River Memorandum of Understanding (ERMOU)

The ERMOU Joint Use Water Project (ERMOU Project) derives from the 1998 Eagle River MOU among East and West Slope water users for development of a joint use water project in the Eagle River basin that minimizes environmental impact, is cost effective, technically feasible, can be permitted by local, state and federal authorities, and provides 20,000 acre feet per year (AFY) average annual yield for East Slope use, 10,000 AFY firm dry year yield for West Slope use, and 3,000 AF of reservoir capacity for Climax Molybdenum Co. The ERMOU Project is proposed as a cooperative alternative to construction of the Homestake II Project in the Holy Cross Wilderness. The ERMOU Project will utilize conditional water rights held by the ERMOU Parties and a yet-to-be determined combination of gravity diversion, storage, pumping, and/or groundwater infrastructure to develop the contemplated project yield.

The total yield of 30,000 AF/year (plus 3,000 AF storage) has the following breakdown: 10,000 AF average annual yield over a 25-year period for City of Aurora; 10,000 AF average annual yield over a 25-year period for City of Colorado Springs; 10,000 AF firm dry-year yield for Eagle Park Reservoir Company (which includes Eagle River Water and Sanitation District, Upper Eagle River Water Authority, Colorado River Water Conservation District, and the Vail Associates); and 3,000 AF of storage space for existing absolute water rights for Climax Molybdenum Co. The cost is estimated at $20,000-$30,000 per AF.

The ERMOU Partners include: Cities of Aurora and Colorado Springs; Eagle Park Reservoir Company (consisting of the Colorado River Water Conservation District, Eagle River Water & Sanitation District, Upper Eagle Regional Water Authority and Vail Associates, Inc.); and Climax Molybdenum Company.

Eagle County, El Paso County, Adams County, Arapahoe County and Douglas County are all counties that will be served by or benefit from the ERMOU Project.

Shoshone Hydropower Plant

The Shoshone hydropower plant in Glenwood Canyon helps power the City of Glenwood Springs. The Shoshone water right is one of the oldest in this stretch of river, so its water cannot be diverted by upstream users. Once diverted, water used for hydropower is not consumed. After spinning the turbines, it flows back to the river where flows support environmental and recreational resources. Whenever the Shoshone Power Plant is subject to a shutdown for repair, maintenance, or other reasons, the Shoshone Call cannot be exercised, and river flows may drop.

Shoshone Hydropower Plant circa 1935
Photo: Library of Congress / Historic American Buildings

Xcel Energy owns the 16-Megawatt hydropower plant and this incredibly important water right. In 2007, Denver Water negotiated a 25-year agreement with Xcel Energy to reduce the Shoshone Call to a one-turbine call (704 cfs) during certain drought conditions. Unfortunately, when the Front Range is experiencing low water conditions, the West slope is usually suffering the same low-flow conditions. The Colorado Basin Roundtable desires to keep the flow regime of the Colorado River as it has been historically influenced by the Shoshone Call. Ideally this "permanency" would be accomplished by West Slope acquisition of the water right. Another way in which the Shoshone flow regime is maintained is through the Shoshone Outage Protocol (ShOP) whereby upstream reservoir operators — when the Shoshone Powerplant is shut down (such as during the Grizzly Creek Fire in 2020) — operate their reservoirs as if the call were in place and forego storage. These reservoir operators include both West Slope and East Slope entities as well as the federal government.

15-Mile Reach

The 15-Mile Reach refers to 15 miles of the Colorado River upstream of its confluence with the Gunnison River in Grand Junction in the Grand Valley region. The 15-Mile Reach is home to four endangered species of fish.

The 15-Mile Reach Programmatic Biological Opinion addressed flow recommendations as well as other recovery efforts in the 15-Mile Reach to address scenarios when diversions reduce river flows, impacting the endangered fish. The Programmatic Biological Opinion requires 10,825 acre-feet of water per year to be supplied by water users. This commitment to provide 10,825 acre-feet of water per year is divided equally between East and West Slope water users. The 10,825 water is released, half each from Granby and Ruedi Reservoirs. The 10,825 acre-feet of reservoir water, in addition to other pools of water managed by the Upper Colorado River Endangered Fish Recovery Program, are intended to enhance flows and habitat to recover the species. The successful implementation of the Programmatic Biological Opinion permits water projects to go forward in the Colorado River Basin without individual Section 7 consultations under the Endangered Species Act.

Overview of 2022 Basin Implementation Plan Update

In May of 2013, Colorado Governor John W. Hickenlooper directed the Colorado Water Conservation Board (CWCB) to commence work on Colorado's first Water Plan.

In 2015, as part of a statewide initiative to develop the first Colorado Water Plan (CWP), the Colorado Basin Roundtable completed its own Basin Implementation Plan (BIP) to address water needs within the main-stem Colorado River basin in Colorado. The 2015 BIP contains sections to address the needs of each of the basin's subregions, from Grand County to the Grand Valley.

The first Colorado Water Plan was completed in 2016. The technical basis for the first BIPs and CWP was the 2010 Statewide Water Supply Initiative (SWSI).

BIP Update Process

The CWP and BIPs are periodically updated through a cyclical statewide planning process.

In 2016, following the release of the CWP and BIPs, the CWCB initiated the next phase of updating the technical basis for water supply and demand analyses that was originally described in the 2010 Statewide Water Supply Initiative (SWSI). This effort culminated in the 2019 Analysis & Technical Update to the CWP (2019 Tech Update). The 2019 Tech Update served as the basis for each roundtable's BIP Update which will then inform the next CWP Update (**Figure 5**).

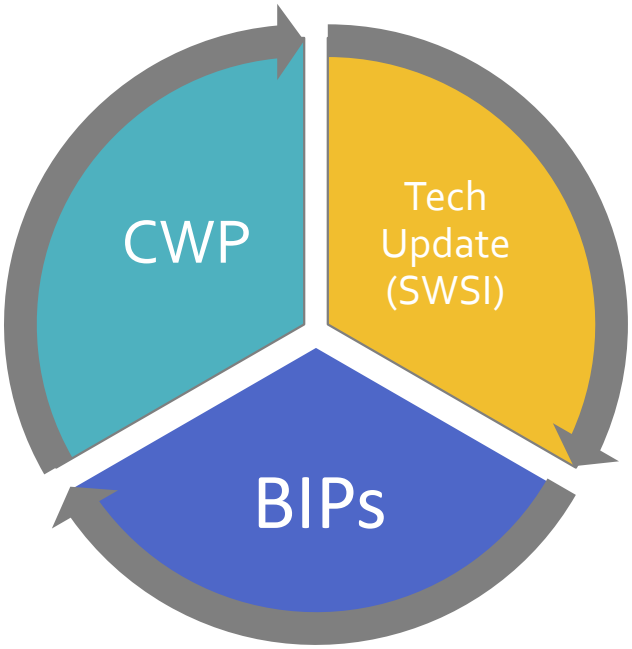


Figure 5: BIP Update Process

2022 BIP Update

The 2015 BIP served as the framework for the 2022 BIP Update. Updates were made to accomplish the following key tasks:

- Revisit the Basin's Themes and Goals to ensure they are still relevant and adequate, and revise as necessary
- Review the Basin's revised water supply and demand gaps and risks based on the results of the 2019 Tech Update and the associated Planning Scenarios
- Update the 2015 list of identified projects and processes (IPPs), which is now referred to as the Projects Database

Each of these main drivers behind the 2022 BIP Update are briefly introduced below. In addition to these three main drivers behind the update, the 2022 BIP Update seeks to accomplish the following:

- Improve upon the format of the 2015 BIP to make the document more useful and user-friendly
- Work more collaboratively with other basins during the BIP Update process

Basinwide Themes, Undercurrents, Goals, and Strategies

The six Themes that were developed in the 2015 BIP have not been changed as a part of this update, as the BIP Update Team received unanimous feedback that they were still applicable and adequate. However, the term "Undercurrents" was added in 2021 to incorporate feedback that is applicable across all Themes.

The six Themes and four Undercurrents are depicted in **Figure 6** as a wheel connected by arrows to show that all six Themes are connected and interrelated, and that the Undercurrents run through all six Themes.

Each of the six Themes are supported by Goals (or in other words, the Goals are organized by Theme), as illustrated in **Figure 7.** The 2015 Goals were reviewed and found to be still relevant. Some of the Goals were tweaked and some Goals were added to address emerging issues, such as forest health and wildfire impacts.

The term "Strategies" was coined during the 2022 BIP Update to condense and consolidate the "Measurable Outcomes" and "Projects and Methods" from the 2015 BIP.

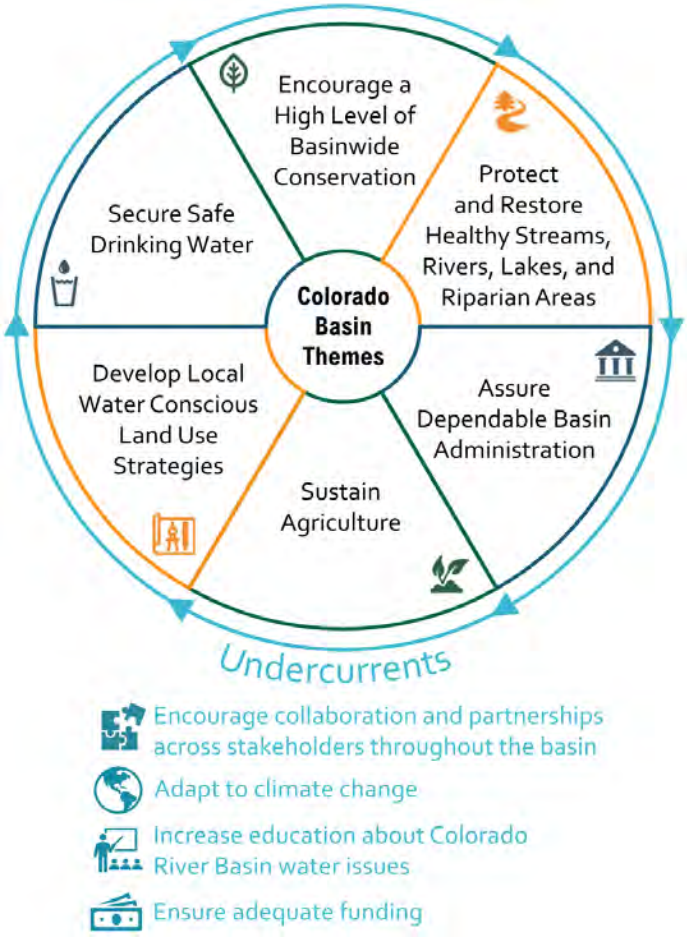


Figure 6: Colorado Basin Themes and Undercurrents

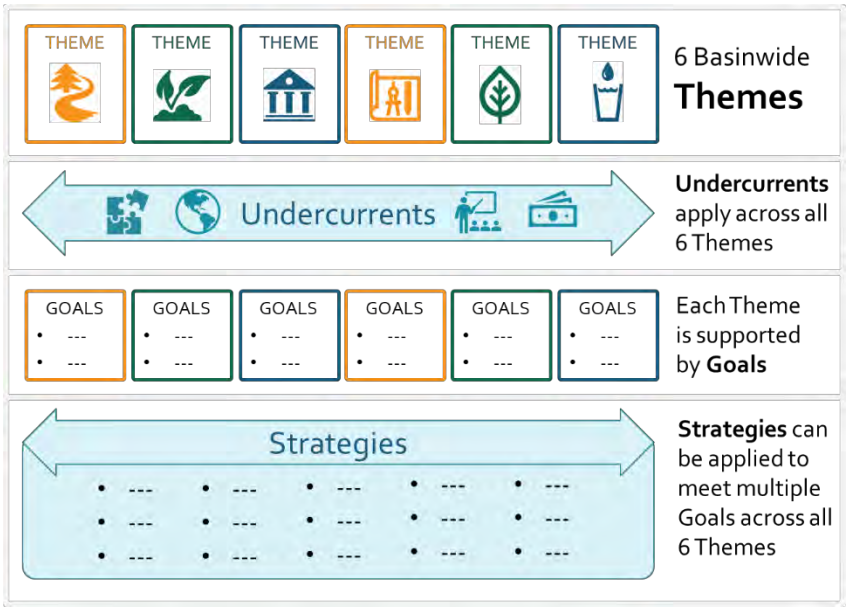


Figure 7: How Themes, Undercurrents, Goals, and Strategies Relate

Strategies are general actions and pathways identified to meet and support the Colorado Basin's Goals. They include and transcend the Projects Database. Strategies are intended to answer the question of "How can the Basin make progress toward its Goals and achieve the Basin's vision?" As illustrated **Figure 7.** Strategies can be applied to meet multiple Goals across the Six Themes and are therefore not categorized by Theme.

2019 Tech Update and Planning Scenarios

As part of the 2019 Tech Update, five planning scenarios were developed to compare against the baseline or current water situation. The five planning scenarios are: Business as Usual, Weak Economy, Cooperative Growth, Adaptive Innovation, and Hot Growth. The planning scenarios are a new way of modeling a range of future gaps based on water supply and demand drivers associated with the potential effects of climate change, population growth, and other factors. They present a range of plausible "stories" about our water future based on different kinds of uncertainties (water supply, climate status, social values, agricultural needs, and municipal and industrial (M&I) needs), as summarized below in **Figure 8.** (2019 Tech Update).

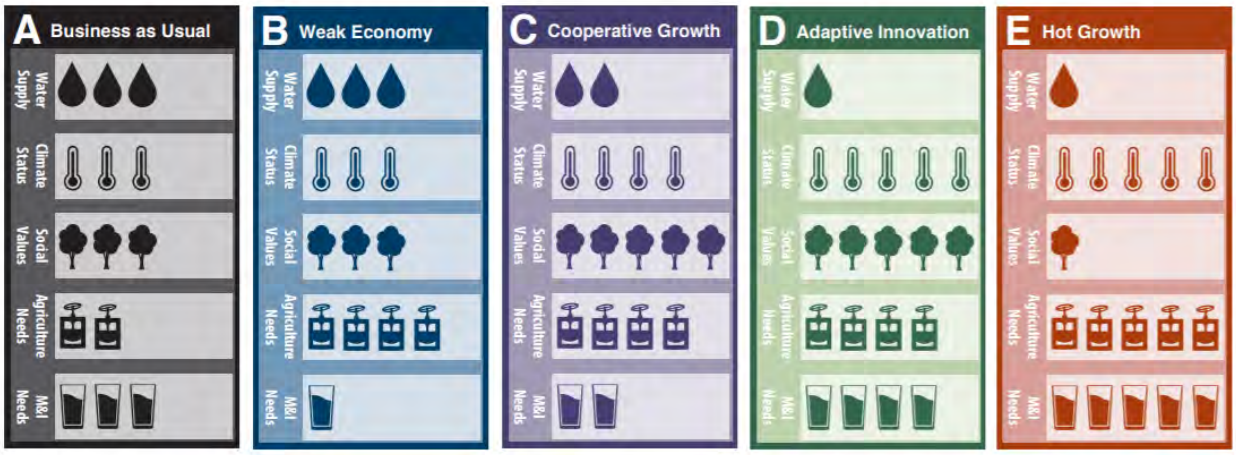


Figure 8: 2019 Tech Update Five Planning Scenarios

The 2022 BIP Update considers and reviews the gaps for the Basin under each of these scenarios, which were modeled as part of the 2019 Tech Update.

In addition to reviewing basinwide gaps, the 2022 BIP Update accomplished a more detailed break-down of the modeling results on a regional level. The purpose of the regional breakdown is to allow insight into the unique water supply and demand challenges of the Basin's unique and varied regions (Grand Valley, Middle Colorado, Roaring Fork, Eagle, State Bridge, Summit, and Grand County).

Projects Database Update

A primary objective of the CBRT's BIP Update was to revise the 2015 BIP IPP information, now referred to as the Projects Database. This effort resulted in more details such as project implementation status, location, sponsor contact information, volume and/or flow values, and costs across the unique seven sub-basins.

The Projects Database seeks to document and track many and varied ideas, projects, conditional water rights and environmental concerns, processes, and agreements that exist across the Basin and which support the Basin's Goals. It does not favor one project over another but focuses on consumptive and non-consumptive uses within the Basin. While concentrating on intrabasin needs by necessity, it also addresses other basins looking to the Colorado River system to help solve their water supply gaps by moving Western Colorado water across the Continental Divide to the Front Range. Current and future proposed projects by out of basin users are referred to as Transmountain Diversions, or TMDs within this BIP. See **Section 3** for additional details regarding the Projects Database. The Projects Database can be viewed in **Exhibit D.**

SECTION 1 – ABOUT THE COLORADO RIVER BASIN

The Colorado River Basin (Basin) encompasses approximately 9,830 square miles. It is among the largest watersheds in the state (**Figure 9**). The six counties within the Basin (Grand, Summit, Routt, Gunnison, Eagle, Pitkin, Garfield, and Mesa) have vastly different topography, climate conditions, land use characteristics, population growth, economic base, and geology. All these factors impact our water needs and the amount of water available in our streams, rivers, lakes, and groundwater.

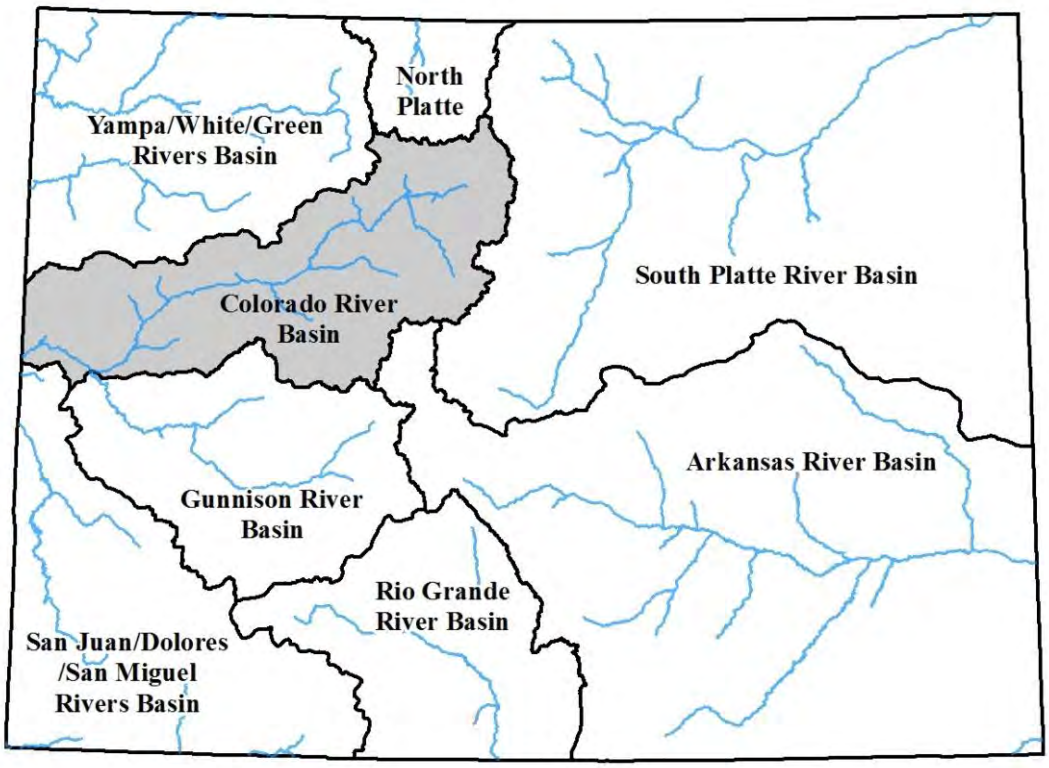


Figure 9. Colorado Basins

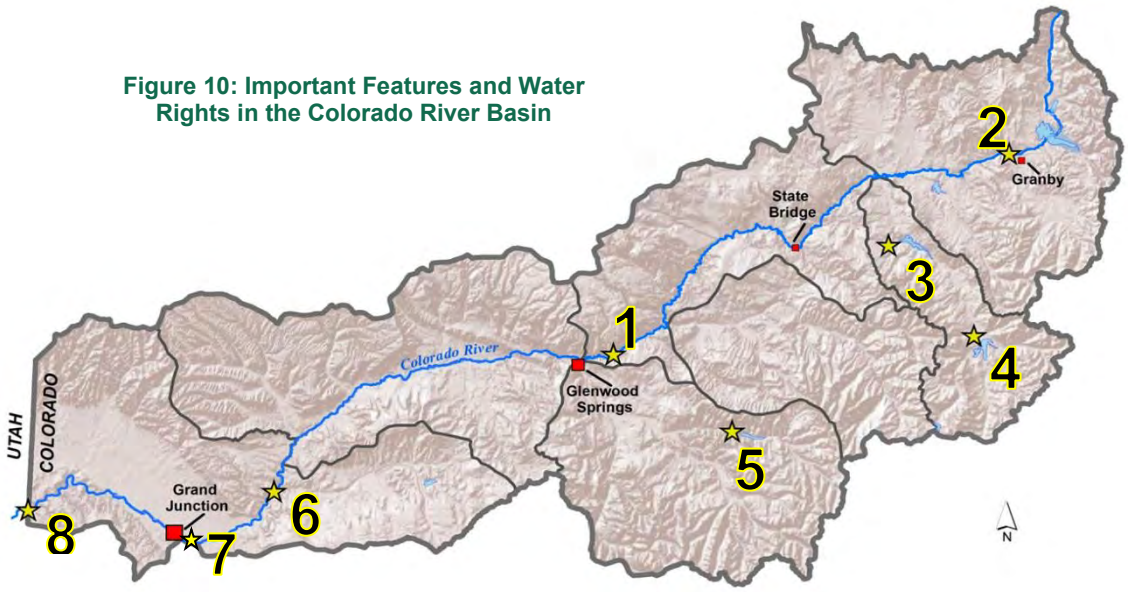
There is no certainty regarding the future climate of the Basin, except that normal climate variability, changes in average winter and summer temperatures, and increasing extremes due to climate change will continue to challenge the state in the 21st century. Due to the lack of certainty regarding future water availability it is difficult to plan for future growth and current needs based on hypothetically available water left to be developed within the Basin. As such the CBRT believes that reliance on a future TMD to meet the needs of other basins is not sound and that any future TMD must – at a minimum – be consistent with the Conceptual Framework developed by the IBCC and adopted by the CWCB for inclusion in the Colorado Water Plan (CWP, 2015; see page 8-13, Section 8, for Colorado's Conceptual Framework).

Background

Basin Water Administration and Development

A snapshot of some of the important water rights features and water rights within the Basin are depicted in **Figure 10** on the following page.

Figure 10: Important Features and Water Rights in the Colorado River Basin



1. Shoshone Hydroelectric Plant

Located in Glenwood Canyon along the Colorado River the Shoshone Hydroelectric Plant is an essential water right for the Colorado River Basin. The plant holds very senior water rights and could call for water year-round whenever the Colorado River is flowing below 1,250 cfs (1,408 cfs including the junior water right). Placing a call requires the cessation of all junior diversions above the Shoshone Plant. These operations maintain important stream flows for a wide range of users. Xcel Energy owns the 16-Megawatt hydropower plant.

2. Windy Gap Project

Windy Gap is an example of one of the complicated water projects in the Upper Colorado River Basin where Front Range interests and Colorado River Basin interests meet head on. The Windy Gap Project consists of a diversion dam on the Colorado River, a 445-acre-foot reservoir, a pumping plant, and a six-mile pipeline to Lake Granby. Windy Gap water is pumped and stored in Lake Granby before it is delivered to water users on the East Slope via the Colorado-Big Thompson Project's distribution system.

3. Green Mountain Reservoir

Green Mountain Reservoir (GMR) represents a great compromise that made the Colorado-Big Thompson Project (C-BT) possible: it compensates (augments) the Colorado River Basin for water diverted to farmers and municipalities in Northeastern Colorado from Granby Reservoir, further upstream on the Colorado River. GMR was constructed in 1943 and was the first facility to be constructed as part of the C-BT. GMR also serves as an important augmentation source for Colorado River Basin Water users.

4. Dillon Reservoir

Dillon Reservoir resides in the middle of Summit County along the Blue River and was built by Denver Water as a water source for their growing population. The Reservoir can store 254,036 acre-feet of water which can be transferred to Denver via the Harold D. Roberts Tunnel.

5. Ruedi Reservoir

Ruedi Reservoir is located near Basalt, CO on the Fryingpan River. This Bureau of Reclamation project, part of the Fryingpan Arkansas Project, was built to augment east-slope diversions higher up on the Fryingpan River. Ruedi Reservoir also serves as a major augmentation water supply for Colorado River Basin water users.

6. Grand Valley Irrigation Ditches

The Roller Dam on the Colorado River is the diversion point for several large irrigation ditches. The water rights associated with these ditches are very senior on the Colorado River and generally are the primary calling rights during the irrigation season. While these water rights can divert most of the Colorado River flow, they also ensure water is flowing down river from the Upper Colorado River Basin protecting stream flows through a majority of the Colorado River within Colorado.

7. 15-Mile Reach

The 15-Mile Reach, which starts east of Grand Junction and stretches to the confluence with the Gunnison River just west of town, is home to four federally endangered fish species that Colorado is working to recover. The 15-Mile Reach Project restores flows and improves habitat for these endangered fish.

8. Colorado River Compact

In 1922, the seven basin states entered into the Colorado River Compact. This Compact allocated the consumptive use of the River between the Upper Basin and Lower Basin. Colorado has not been restricted in its water use by the Compact; however, as the annual average yield of the Colorado River decreases and water demand from the 7 states increases, chances of Colorado being affected by a Compact call increase.

In Colorado, the complexity of water law reflects the scarcity of the resource. Due to our semi-arid environment, managing water has become essential to water supply development both within the state and across the entire seven states region. Colorado employs a system of water administration known as the Doctrine of Prior Appropriation. Under this doctrine, the first user to put the water to beneficial use without waste has a senior right to that water and that right must be satisfied before any rights junior to that can receive water.

The Colorado River is considered over-appropriated, meaning that there are more decreed water rights claims on the system than can generally be satisfied by the physical supply of water available. During above-average years and during peak runoff periods, there can be available "free river" water (un-appropriated water that may be diverted without a water right). There are many junior conditional water rights in the Colorado River Basin. To make a conditional water right absolute, a water rights holder must put that water, in priority, to beneficial use. If climate change results in earlier runoff and less streamflow available, this will make it increasingly difficult for junior water rights to be fulfilled. Additional diversions or consumption, including transmountain diversions (which are fully consumptive to the basin of origin) would also increase the problem of over-appropriation faced by the Colorado Basin.

Water development in the Basin first started for mining followed by agriculture. The most senior major agricultural water right in the Basin is the Grand Valley Canal which was first established in 1882 with an original water right for 520.81 cfs. The Shoshone Hydroelectric Plant located in Glenwood Canyon started operation in 1909 with a water right for 1,250 cfs.

In 1922, the seven basin states entered into the Colorado River Compact allocating the waters of the Colorado River System among the Upper Basin and Lower Basin. The Compact and the body of federal and state laws that govern the allocation of water on the Colorado River system have impacts on future development. The years that followed the Compact revealed that the river flow measurements on which the allocations under the 1922 Colorado River Compact may have been based on a period of above average hydrology, and that on average there was not as much water available in the system as previously thought:

- Hydrologic predictions were based on an inadequate hydrologic record and over-predicted availability
- Climate change was unknown in 1922

In 1937 the Colorado River Water Conservation District (River District) was formed by the Colorado General Assembly (the Colorado legislature) to advocate for and develop water resources for the benefit of western Colorado and to safeguard Colorado's entitlement under the 1922 Compact. The advent of the River District was a direct result of the difficult negotiations in the early 1930s over the Colorado-Big Thompson (C-BT) Project, the State's largest transmountain diversion (TMD). One result of that negotiation was the construction of Green Mountain Reservoir, a project to compensate West Slope water users and provide for future West Slope growth.

The 1937 Water Conservancy District Act, the Act under which the Northern Colorado Water Conservancy District was formed, requires basin of origin mitigation for TMD projects such as the C-BT. Basin of origin mitigation resulted in the construction of Green Mountain Reservoir (to mitigate the impacts of the C-BT) and Ruedi Reservoir (to mitigate impacts of the Fryingpan-Arkansas Project, which benefits Southeastern Colorado). Other significant TMDs in the Basin include Denver Water's Moffat Tunnel Collection System and Blue River Collection System (Dillon Reservoir and Roberts Tunnel), Homestake Reservoir for Aurora and Colorado Springs and the Windy Gap Project for Northern Colorado

entities. Other reservoirs include Wolford Mountain Reservoir operated by the Colorado River District, which provides for West Slope water use and replaces out of priority diversions associated with some TMDs, Denver Water's Williams Fork Reservoir, which replaces Denver Water's out of priority diversions, and Eagle Park Reservoir operated by the Eagle Park Reservoir Company.

The 15-Mile Reach Programmatic Biological Opinion for four species of Endangered fish in the Grand Valley area addressed flow recommendations and other recovery efforts to address scenarios when diversions reduce river flows, impacting the endangered fish. Water users, both West Slope and East Slope, provide 10,825 acre-feet of water, in addition to pools of water managed by the recovery program, to enhance habitat flows in the 15-Mile Reach while cooperating on other measures with federal entities to enhance flows, propagate the species and create fish passages at dams.

Current Transmountain Diversions

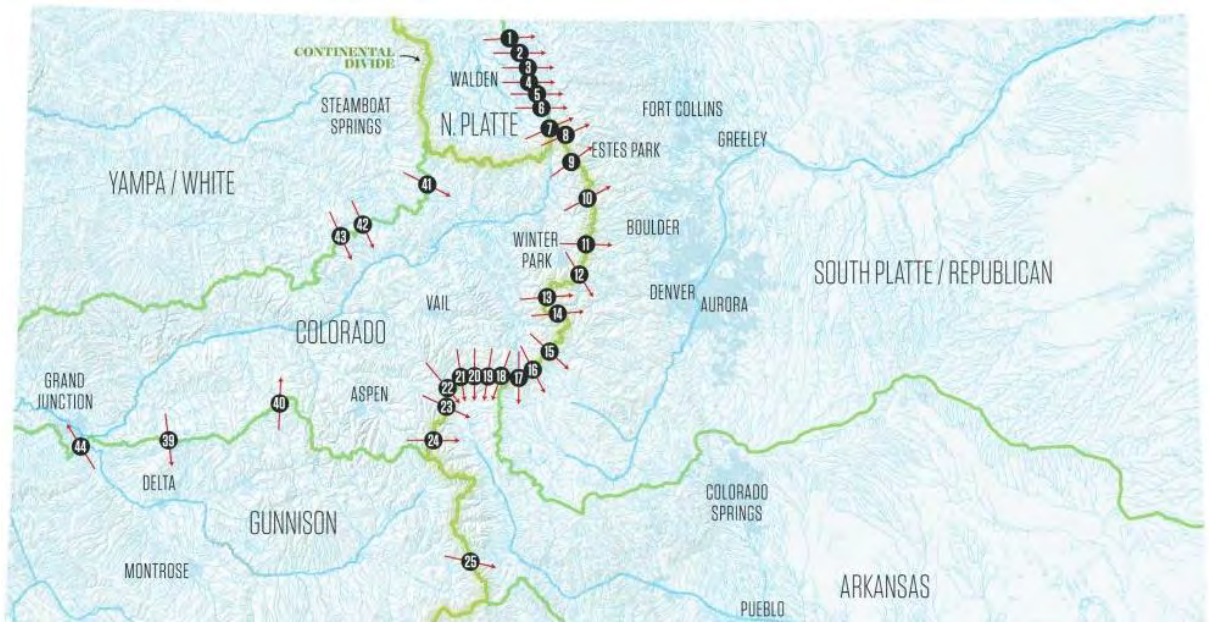
The Colorado River Basin currently has over 17 major TMD's bringing supplies out of the Basin – primarily to the South Platte River and Arkansas River Basins. **Table 1** shows a list of existing transmountain diversion projects leaving the Colorado River Basin, as well as the average annual amount of diversions. This table has been adapted from Water Education Colorado's Citizen's Guide to Colorado's Transbasin Diversions, which is an excellent resource for anyone looking to learn more about the history and present situation of transmountain diversions. (WECO, 2014)

In an average year, 38% of the Roaring Fork headwaters above Aspen are diverted and 41% of the Fryingpan headwaters above Meredith are diverted (RFC, 2021). On average, 60% of the water in Grand County is diverted from the basin (Grand County, 2021). On average, 21% of the Blue River flows are diverted; this could increase to 35% based on existing decrees (Bailey, 2021). The average annual diversions leaving the Colorado Basin amount to over 483,000 acre-feet, a volume of water equivalent to filling Green Mountain Reservoir 3.1 times, or filling Ruedi Reservoir 4.7 times. (WECO, 2014)

A view inside the Twin Lakes Diversion Tunnel from one of the annual Twin Lakes Diversion System Tours. Every summer, Roaring Fork Conservancy and Twin Lakes Reservoir and Canal Company offer a tour of the Twin Lakes Diversion System. (Photo credit: Bailey Leppek)

The Independence Pass Transmountain Diversion System (Twin Lakes) collects water from a 45 square mile area of the Upper Roaring Fork River subbasin. The Twin Lakes Diversion moves water from the Roaring Fork River, Lost Man Creek, Lincoln Creek, Brooklyn Creek, Tabor Creek, New York Creek and Grizzly Creek through the Twin Lakes Tunnel to Twin Lakes Reservoir, in the Arkansas River watershed. The project currently diverts 38,000 acre feet of water but has water rights to divert as much as 46,000 acre feet, annually. (RFC, 2021)

Table 1: Existing Transmountain Diversions Leaving the Colorado River Basin (WECO, 2014)



Existing Transmountain Diversions leaving the Colorado River Basin Source: Water Education Colorado Citizen's Guide to Colorado's Transbasin Diversions				
Receiving Basin	**Map #**	**Diversion**	**Source Stream(s)**	**Mean AF/Year**
South Platte River Basin	9	Grand River Ditch	North Fork Colorado River	17,462
	10	Adams Tunnel	North Fork Colorado River	216,570
	11	Moffat Tunnel (includes A.P. Gumlick Tunnel)	Fraser River tributaries, Williams Fork River	52,390
	12	Berthoud Pass Ditch	Fraser River	664
	13	Straight Creek Tunnel	Straight Creek	311
	14	Vidler Tunnel	Peru Creek	518
	15	Harold D. Roberts Tunnel	Blue River	58,426
	16	Boreas Pass Ditch	Indiana Creek	117
	17	Hoosier Pass Tunnel	Blue River tributaries	8,375
Arkansas River Basin	18	Columbine Ditch	East Fork Eagle River	1,431
	19	Ewing Ditch	Piney Creek	1,027
	20	Wurtz Ditch	Eagle River tributaries	2,508
	21	Homestake Tunnel	Homestake Creek and tributaries	25,286
	22	Charles H. Boustead Tunnel	Frying Pan River and tributaries, Roaring Fork River tributaries	52,013
	23	Busk-Ivanhoe Tunnel	Frying Pan River	5,108
	24	Twin Lakes Tunnel	Roaring Fork River and tributaries, Frying Pan River tributaries	40,005
Gunnison River Basin	39	Leon Tunnel	Middle Fork Leon Creek	1,373
Total Diversions Leaving Colorado Basin (Mean AF/year)				**483,584**

Pending Likely Transmountain Diversions

Four future transmountain diversion (TMD) projects are in the planning process to divert additional water from the West Slope and deliver it to the East Slope to serve growing demands. The projects are listed and described in **Table 2** and are shown on **Figure 11**. The projects may potentially affect unappropriated water supplies and streamflows in parts of the Colorado River Basin.

Table 2: Planned Future Transmountain Diversions in the Colorado River Basin

	PROPONENT	COMPLETION	DESCRIPTION AND STATUS
Gross Reservoir Expansion	Denver Water	2027	Existing collection system will divert additional supplies to enlarged Gross Reservoir on the East Slope. Water quality and environmental enhancements are captured in the Colorado River Cooperative Agreement (CRCA).
Windy Gap Firming & Chimney Hollow Reservoir Project	Northern Colorado Water Conservancy District	2025	Existing collection system will divert additional supplies to new Chimney Hollow Reservoir on the East Slope. Actions will be implemented to enhance aquatic habitat on West Slope.
Continental-Hoosier System Project	Colorado Springs Utilities	2030	Optimize existing collection system by enlarging Montgomery Reservoir located in the South Platte Basin.
Eagle River Joint Use Project	Colorado Springs Utilities, Aurora Water, and West Slope entities	2040	Existing water rights and new/existing infrastructure will provide supplies to users on the East Slope (20,000 AF/yr avg yield) and West Slope (10,000 AF/yr firm yield).

In general, no future water supply projects, including future TMDs, were modeled in the Technical Update, reserving consideration of these future projects for the BIP update process.

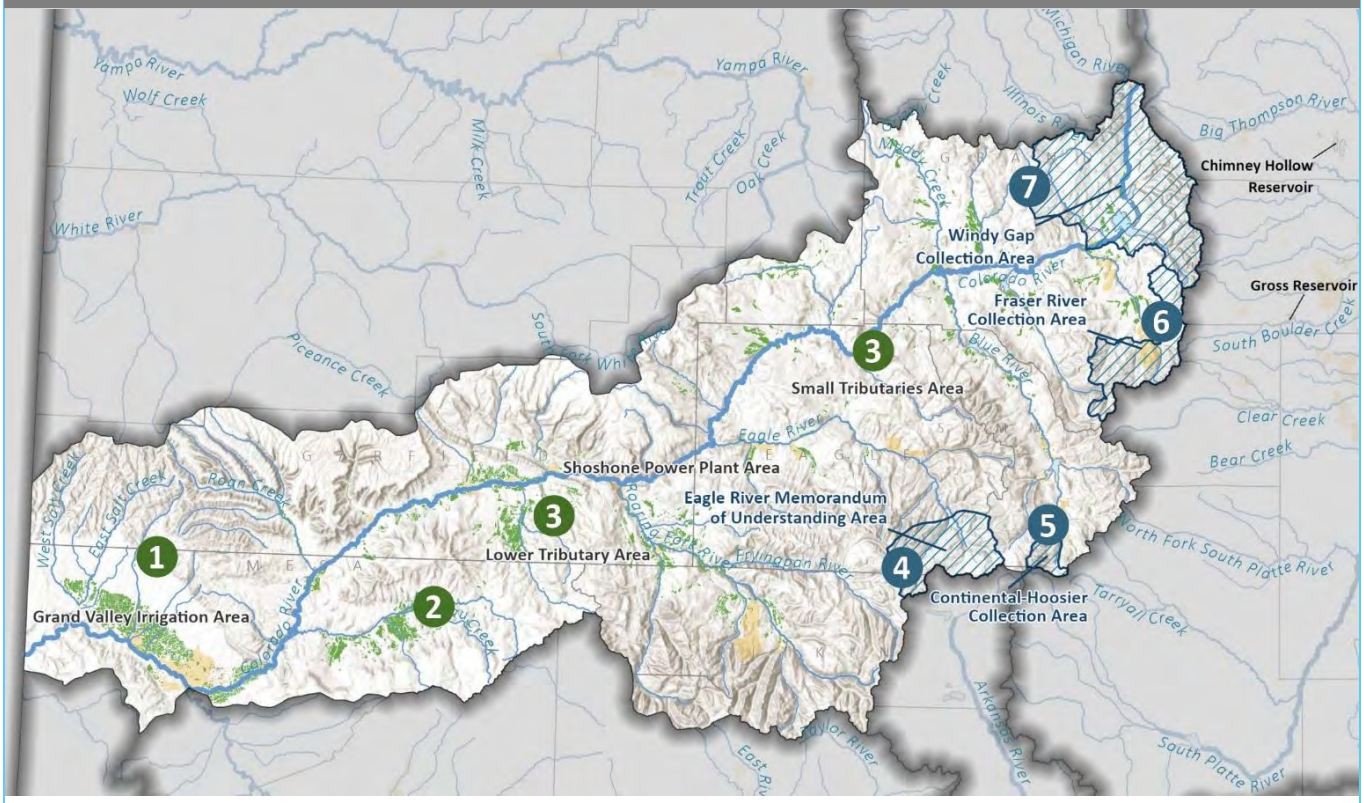
The potential effects of future TMD projects on available water supplies and streamflows are important for the Colorado BRT to understand and have been incorporated into basinwide strategies for meeting future water needs. A qualitative description of the potential effects of the future TMD projects is provided on the next page. The description was derived from various public documents including Environmental Impact Statements.

Future TMDs cannot be modeled at this time for the following reasons:

- Several of the TMD projects are either undergoing permitting or in litigation.
- The CWCB did not include modeling specific to TMDs. The CWCB understands the importance of this modeling for both West and East Slope stakeholders and intends to engage those stakeholders in identifying an appropriate approach for future updates to the Colorado Water Plan.

The map in **Figure 11** shows the general locations of the four future transmountain diversion projects and the approximate areas where the effects of stream flow depletions from TMDs may or may not be realized. The observations below the map are intended to provide a high-level understanding of potential TMD effects for CBRT planning purposes. Refer to public and permitting documents for more specifics on the development of the projects.

All future diversions, absent augmentation, will cause additional depletions to the Colorado River system.



Potentially Unaffected Areas:

1. Water rights senior to TMDs should not be affected (example: Shoshone Hydroelectric Plant and Grand Valley agricultural water rights).

2. Some tributaries of the Colorado River, such as the Roaring Fork or Divide Creek, should not be affected by the TMDs.

3. Diversion to TMDs will typically occur when streamflow conditions are high and would not impact gaps on smaller tributaries that experience physical shortages.

Potentially Affected Areas:

4. The Eagle River Joint Use Project will deliver 20,000 AF/yr on average for East Slope water users from the upper Eagle River Basin with diversions occurring during average and wet years. The project will provide 10,000 AF/yr of firm yield from the upper Eagle River Basin for West Slope water users in the Eagle River Basin.

5. The Continental-Hoosier System Project will divert, on average, 4,000 AF in average and wet years during spring runoff from the headwaters of the Blue River.

6. The Gross Reservoir Expansion will divert 10,300 AF and 11,800 AF in average and wet years (respectively) during spring runoff from several tributaries to the Fraser River.

7. Adams Tunnel deliveries would increase about 19,100 AF with the Windy Gap Firming Project compared to an increase of about 10,700 AF under the No Action Alternative.

Figure 11: Planned Future Transmountain Diversions in the Colorado River Basin

Additional resources related to planned future transmountain diversions:

- Eagle River Memorandum of Understanding, 1998
- Denver Water Gross Reservoir Expansion Project Updates (https://www.denverwater.org/project-updates/gross-reservoir-expansion-project)
- Denver Water Gross Reservoir Expansion Project (https://grossreservoir.org/)
- Moffat Collection System Project FEIS and ROD (https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Mofat/)
- Chimney Hollow Reservoir Project Site (https://www.northernwater.org/chrp)
- Colorado River Connectivity Channel (CRCC) Project Site (https://www.northernwater.org/what-we-do/protect-the-environment/river-health-and-restoration/connectivity-channel)
- Reclamation Windy Gap Permitting Documents (https://www.usbr.gov/gp/ecao/nepa/windy_gap.html)
- US Army Corps of Engineers Windy Gap Permitting Documents (https://www.nwo.usace.army.mil/Missions/Regulatory-Program/Colorado/EIS-Windy-Gap-Firming/)

Pending Likely TMDs and Colorado River Basin Demands and Gaps

The Colorado Basin Roundtable agreed that as part of the 2022 BIP Update process, it wanted to model the impacts to the Basin from development of these pending transmountain diversions. Following many discussions, the Colorado Basin Roundtable was told that future transmountain diversions could not be modeled as a part of the 2019 Tech Update for the following reasons discussed in the previous section.

As existing and pending transmountain diversions were not modeled as a part of this BIP Update, and the demands and gaps presented in this report do not include the demand and gaps that will be caused by diversions under these projects. However, the Roundtable maintains modeling of transmountain diversions as a Strategy, which is discussed in **Section 2.**

General Water Situation and Challenges

Hydrology

As a semi-arid state that straddles the Continental Divide, meeting demand with water supply has always been a challenge in Colorado. Of all the renewable water generated within Colorado's high country, approximately 80 percent is on the West Slope while the remaining 20 percent is on the East Slope (WECO, 2014). The challenge of managing this valuable resource is that 88 percent of our state's population and a majority of the irrigated agricultural lands are located on the East Slope (2019 Tech Update). This challenge forms the basis for the state's reliance on transmountain diversions (TMDs). The Reservoirs and TMDs discussed in **Table 1** provide the operational backbone to move the water from the West Slope to the East Slope.

Drought and Climate Change

Colorado has always been vulnerable to extreme weather and climate events as was evidenced in the droughts of the 1930s, 1954, 1977, 2002, 2012, 2013, 2018, 2020, and 2021. Many Colorado River Basin water providers and irrigators depended upon surface supply intakes that were unable to divert due to low flows during the droughts of 1977, 2002 and 2012. This inability to capture low flows resulted in lost production for irrigators. Many Colorado River Basin utilities were forced to impose water restrictions.

The most serious anticipated impacts of climate change include shifts in timing and intensity of precipitation, streamflows, reductions in late-summer flows, decreases in runoff, increases in drought, and modest declines for Colorado's high-elevation snowpack (Avery, et.al., 2011). These effects will ripple into water supply reliability, impacting municipalities, wildlife, ecosystems, forests, recreation, industries including power generation, snowmaking, energy extraction/ production, and agriculture.

Since 2000, the Colorado River Basin has been experiencing a historic extended drought, showing the lowest 16-year period of inflows to Lake Powell since its construction (DOI, 2021). In 2020 (for the first time since 2013), the entire state of Colorado was experiencing some level of drought. During 2021, the conditions on the Front Range improved, and much of the Front Range was removed from the U.S. Drought Monitor's map of drought conditions. However, as of September 2021, the entire Western Slope remains in some level of drought, which significant portions of the Colorado Basin in extreme drought.

Hot Drought

The recent drought has been characterized not by reduced precipitation, but by increased temperatures. Increased temperatures affect the hydrologic cycle in many ways, including earlier runoff, higher sublimation of snow, higher evaporation, higher rates of water use by plants (evapotranspiration), decreased soil moisture, declining runoff efficiency. (CRRG, 2018).

Based on a review of multiple studies, it is estimated that for every 1-degree Fahrenheit rise in temperature, streamflow is reduced between 3% to 5.2% (River District, 2020).

Aridification

Drought refers to a temporary lack of water supply, often exacerbated by water use management practices, and implies an eventual return to normal conditions. Aridity refers to permanent dryness. Aridification describes a transition to an increasingly water scarce environment (CRRG, 2018).

Because the recent drought is driven primarily by increased temperatures and climate change, rather than a temporary lack of precipitation, some argue that the Basin's water supply risks should be characterized as aridification.

Dry Soil Moisture Conditions

Exceptionally dry conditions contribute to dry soil moisture conditions, which has a lasting impact on streamflow. The soil moisture deficit means that much more of rain or snowmelt soaks into the soil and less reaches the stream. Recent studies have shown that the same amount of snowpack results in less runoff now than it did in the past century. This is referred to as declining runoff efficiency (CRRG, 2018).

Impacts to Streamflow and Water Supplies

Projected future temperature impacts will tend to reduce streamflows, due to increased sublimation of snowpack; increased evaporation from lakes, reservoirs, streams, irrigation ditches, and soils; and increased evapotranspiration from crops, landscapes, and native plants. "To overcome these effects, large increases in precipitation amounts would be required. However, most climate-change-based projections suggest that large precipitation increases will not occur … and that streamflows will decrease across all or nearly all of the state's water basins." (RMCO, 2018)

Impacts to Snowpack

The increasing temperatures associated with climate change also have consequences for the Colorado Basin's largest water storage reservoir – it's snowpack. "Across the West, less winter precipitation is falling as snow and more as rain, snowpacks are declining, and snowmelt is occurring earlier. The flows of the Colorado River, fed mostly by mountain snow, have recently been the lowest in the past century—driven in large part by the evaporative effects of higher temperatures. Projections are that these changes will become more pronounced, with mountain snowfall being reduced to less than half of the precipitation in winter, snowpacks being cut by about one quarter, and river flows being reduced more than anywhere else in the West." (RMCO, 2018) "For Colorado, the average projections (of multiple models) are that spring snowpacks will be 13 percent smaller in 2041–2070 and 26 percent smaller in 2070–2099, compared to late in the 20th century" (RMCO, 2018).

The greatest impacts of the shift between snow and rain are being seen at lower elevation areas, where a few decrees can make the difference between snow and rain or freezing and melting. One study of changes from snowfall to rainfall shows that if heat-trapping emissions continue increasing at a high rate, the share of winter precipitation in the Colorado River Basin falling entirely as snow is projected to decrease sharply from 73% (average from 1979 to 2012) to 43% (average from 2035 to 2065). (RMCO, 2018)

Another challenge associated with higher temperatures is that snowpack can be lost to sublimation - where snow and ice are released straight into the atmosphere without first melting into a liquid state. (RMCO, 2018)

Earlier Runoff

In the Colorado River Basin, snowpack is our largest reservoir. Climate monitoring has shown trends toward earlier snowmelt, which causes challenges in water supply planning (Musselman, 2021). The snowmelt season is starting on average three weeks earlier than in the previous century. This trend is impacted by rising temperatures and other factors such as earlier rain on snow events and dust on snow. "Dust on snow" is where fine layers of dust are deposited on snow, increasing sunlight absorption and accelerating snowmelt. Recently the Rocky Mountains have seen five to seven times as much dust

on snow as in the 19th century, trends which are due in part to soil disturbances from land use practices such as grazing and unpaved roads throughout the Colorado Plateau and Great Basin (CRRG, 2018). "One study suggests that increased deposition of dust on snow could double the shift of snowmelt timing, to a total of as much as six weeks earlier than historically" (RMCO, 2018).

Earlier runoff will seriously impact irrigated agriculture in Colorado because more water is available earlier when producers don't have a need for the water, and less water is available in mid- to late-summer when temperatures are hotter and producers have a greater need for the water.

Extreme Storms

"Across most of the nation and the world, the frequency of extreme storms has increased and is projected to increase further as the climate continues changing. This is expected under the basic laws of physics, as warmer air can hold more moisture. However, across the southwestern six states, including Colorado, there has been less of a trend of an increase in extreme storms, and there is greater uncertainty than elsewhere in the nation about the extent to which extreme storms will become more frequent." (RMCO, 2018). While the individual projections of precipitation patterns and frequency of severe storms vary widely, and is less well understood in the Colorado headwaters, a recent study in Boulder, Colorado projected that "the frequency of heavy storms (those with a half an inch or more of liquid precipitation in a day, whether as rainfall or snowfall) could increase" while "the frequency of everyday storms, with less than a quarter-inch of precipitation in a day, would be essentially unchanged" (RMCO, 2018).

Watershed Function and Forest Health

Role of Forests in Watershed Health

Healthy forests play an important role in our ability to deal with climate change by storing atmospheric carbon. But healthy forests also play a critical role in watershed health.

> *More than 24.4 million acres of Colorado forestland impact Colorado's water supply, according to the Colorado State Forest Service. According to the U.S. Forest Service, which manages more than 14.5 million acres of national forest lands in Colorado, 90 percent of those lands are located in watersheds that contribute to public water supplies. About 80 percent of the state's population relies on those forested watersheds for municipal water supplies.*
>
> *As snowpack melts, streams drain runoff toward rivers, creating watersheds and river basins. As water flows down mountain slopes, forests stabilize soil and prevent erosion, filter contaminants, enhance soil moisture storage and groundwater recharge, and reduce the likelihood of flooding. Due to these ecosystem services, water running off undisturbed forests typically has lower nutrient and sediment concentrations compared to flows from urban or agricultural watersheds.*
>
> *But Colorado's forested source watersheds are susceptible to damage and contamination that lead to water impairments. Risks include severe wildfire, insect infestation, and long-term drought. Colorado has seen a growing number of large, high-severity wildfires and never-before-seen levels of tree mortality caused by bark beetle outbreaks over the past two decades. Those natural risks will likely be amplified in the future as a result of climate change. In addition, human-induced factors such as disturbance, roads and pollution also impact forest health and water quality (WECO, 2020).*

With the loss of forests come risks to infrastructure, including, but not limited to water supply reservoirs, pipelines, and pumping stations. Watersheds critical to supplying water to our communities

should have a plan that provides specific actions needed to protect reservoirs, intakes, water transportation and distribution structures and other facilities from high-severity wildfires and other impacts that can influence our water quality. The CBRT recognizes the importance of protecting and maintaining healthy watersheds and forests and restoring ones that have been compromised by wildfires. The CBRT promotes planning and actions that will support sustainable ecosystems and protect critical water supplies, with good water quality and adequate water quantity during critical times of the year. Due to the breadth of the Basin, planning will necessarily occur at the local level as a Basinwide Plan is geographically infeasible.

Forest Health Challenges

The Basin faces many challenges related to forest health. Key challenges are discussed here.

Insect Infestations

Since the mid-1990s, mountain pine beetle has affected roughly 80%, or about 3.4 million acres, of ponderosa-lodgepole pine in the state, while the spruce beetle has caused tree mortality in approximately 40% of Colorado's high-elevation Engelmann spruce forests. In addition to the stark visual impact of dead and dying forests, this has an impact on wildfires. When wildfires burn in forests dense with beetle-killed trees, the resulting fuel arrangement often significantly affects a fire's behavior, its ecological effects and options available for fire managers. (CSFS, 2020).

The 2020 East Troublesome Fire is an example of how beetle kill can impact wildfire behavior. It became one of the quickest moving fires on record in Colorado as it engulfed stands of dead lodgepole pines at the epicenter of the state's mountain pine beetle outbreak in the mid-1990s. (CSFS, 2020).

Wildfires

Fires are becoming more and more destructive with drier climate conditions. All of the 20 largest wildfires in Colorado history have occurred since 2000, and the top three wildfires all occurred during the 2020 fire season. Until 2020, the largest fire in Colorado history was the 2002 Hayman fire (137,760 acres). As of spring 2021, the top three largest wildfires all occurred during the 2020 wildfire season: Cameron Peak fire (208,663 acres), East Troublesome fire (193,812 acres), and the Pine Gulch fire (139,007 acres). In total, more than 650,000 acres were burned in the 2020 wildfire season. (Stein, 2020).

Wildfire risk is heightened by higher temperatures and drought. Climate science has shown a strong link between climate change and the increased frequency and severity of the wildfire season. The wildfire season is starting earlier and lasting longer (Stein, 2020).

In the Colorado Basin, increased development at the wildland-urban interface has created increased risk of property damage from wildfires. Debris flow from fire-impacted landscapes can also create damage to property and water infrastructure. Other lasting impacts from wildfires include water quality impacts to streams in burned watersheds, especially increased sediment and turbidity.

Debris Flows

Debris flows caused by storm events on burned areas are another major challenge associated wildfires. In burned areas, especially those that experienced high fire intensity, root systems and groundcover are no longer effective at holding soils in place. Furthermore, soils in severely burned areas are covered in ash and can become hydrophobic, reducing the amount of moisture that can

infiltrate into the soils and increasing runoff. With less to hold the soil in place and more water running over the ground surface, heavy precipitation events can trigger large and hazardous debris flows. For example, a rain event on July 29, 2021 caused large debris flows in the Grizzly Creek Fire burn area; the debris flows closed I-70 for weeks and left lasting damage to the highway.

In addition to causing damage to infrastructure, these post-fire debris flows can have major water quality impacts to receiving streams. The debris flows that closed I-70 were so large that they altered the channel of the Colorado River and dramatically increased the loads of sediment and organic material coming down the river for months after the rain event. Sediment-laden water can damage the pumps at drinking water intakes and cause water treatment processes to run less efficiently. In addition, these debris flows have a negative impact on aquatic habitat and fish populations, and in some cases cause fish die-off events. Even when acute effects are less severe, fine sediments accumulating in the riverbed can have long-term impacts to food sources and spawning habitat for the fish.

Colorado Department of Transportation crews clear debris and assess damage near Mile Marker 123.5 along Interstate 70 in Glenwood Canyon. Eastbound lanes in the section were destroyed by July 29 mudslides. Photo Credit: Pam Boyd and Post Independent (Boyd, 2021).

Avalanches

While snowpack is essential to the Basin's water supply, the snowpack can create avalanches that have the potential to damage water supply infrastructure. The spring of 2019 saw one of the largest and most destructive avalanche cycles witnessed in Colorado. Colorado Avalanche Information Center (CAIC) reported 855 artificially triggered avalanches (380 of which impacted a highway) and 108 naturally triggered avalanches which impacted highways. Of the record number of avalanches, 47 were classified as large or very large. Avalanches ran on slide paths which had not run in over 60 years, such as the avalanche on the Disney slide path near Berthoud Pass which last ran in 1957 and the avalanche on Peak 1 near Frisco that last ran in 1898 (Mauer, 2019).

Some of these unprecedentedly large avalanches impacted water supply infrastructure. Avalanches near Grizzly Reservoir and Lincoln Creek Road impacted infrastructure for the Twin Lakes Tunnel transmountain diversion. Avalanches in the East Snowmass Creek drainage ran dangerously close to Snowmass Water and Sanitation District's potable water intake just

downstream of the slide path, causing concerns about water quality impacts. The dead and downed timber from large avalanches also contributes to increased fire hazards.

Riparian Health

An important aspect of the watershed health that is most often neglected is the riparian areas and floodplains the forest and the overall Basin. In some areas, county and municipal building codes allow homeowners and businesses to develop up to a rivers' bank. The loss of a natural buffer to human activity degrades water quality. Stream and river diversions to fill reservoirs have meant a loss of peak spring flows resulting in decreased overbank flooding which is necessary to sustain riparian vegetation. Infringement on the riparian corridor and a loss of flows for riparian health has added additional stress to overall river health.

Grazing practices can also impact riparian health by contributing to loss of riparian plants in incising of natural stream channels.

Half of the nutrients found in rivers come from riparian areas. In order to protect watershed health, we must embark on additional assessments to quantitatively identify flow needs to sustain riparian health, and thus help provide clean water and suitable habitat and nutrients for aquatic life.

Inter-Agency Coordination

Planning for forest health and watershed health protection requires participation from many entities, local, state, and federal. There is a need for more active and continuous conversations among the many stakeholders. Further inter-agency coordination and collaboration needs to be an important part of the overall solution.

Watershed and Forest Health Protection Efforts

Watershed Organizations

There are many watershed groups in the Basin assessing impaired water bodies and lands. Certain watershed groups within each Region are described in **Section 4.** These organizations promote the health and conservation of their watersheds through research, education, and project identification and implementation. In many cases these groups have been key operators in the development of watershed plans outlining specific needs, vulnerabilities and projects. These groups are critical to the successful protection of Basin watersheds and forests as they are leading the efforts in protection, reclaiming, and maintaining this vibrant and living resource.

2020 Colorado Forest Action Plan

The Colorado State Forest Service (CSFS) recently unveiled the 2020 Colorado Forest Action Plan — a road map that guides forest management for the next decade.

Rooted in science and driven by collaboration, this 85-page report built by the CSFS, federal, state and community partners provides an in-depth analysis and solutions to improve the health of Colorado's forests and ensure they persevere. (CSFS, 2020).

The Forest Action Plan is organized around six themes, shown in **Figure 12.** For each of these themes, the Action Plan offers conditions and trends, challenges and threats, goals, strategies, and approaches.

Figure 12: Themes of the 2020 Forest Action Plan
Colorado State Forest Service

Colorado Community Wildfire Protection Plans

Additional plans that evaluate and protect our forests include the Colorado Community Wildfire Protection Plans (CWPPs). Community Wildfire Protection Plans are authorized and defined in Title I of the Healthy Forests Restoration Act, which was passed by Congress in November 2003. Colorado Community Wildfire Protection Plans brings together diverse local interests to discuss their mutual concerns for public safety, community sustainability and natural resources. They offer a positive, solution-oriented environment in which to address challenges such as: wildland-urban interfaces; local firefighting capability; the need for defensible space around homes and subdivisions; and where and how to prioritize land management on both federal and non-federal land. (CSFS, 2021)

Colorado Forest Atlas

The Colorado Forest Atlas is a website that serves as a one-stop shop for the Colorado State Forest Service, the public, and partners to access statewide geospatial data and information related to forestry and natural resources. Applications in the Colorado Forest Atlas can be used as decision support tools for developing new projects, writing forestry plans, assessing wildfire risk to communities, evaluating forest conditions, and more. These applications will be updated on a regular basis using the best available science and data. (CSFS, 2021)

The Colorado Forest Atlas has several public applications available on its Colorado Forest Atlas Information Portal.

- The Forest Action Plan 2020 can be used to view and print maps from the 2020 Colorado Forest Action Plan.
- The Risk Reduction Planner is to support community wildfire protection planning efforts. It allows a user to define a project area, generate a detailed risk summary report, and export wildfire risk GIS data.
- The Wildfire Risk Viewer is a web-mapping application that allows users to identify specific wildfire risk levels within a 1/2-mile radius of a home, or other point of interest.

Water Quality

Colorado River Salinity Control Program

The Governor of Colorado appoints representatives to the Colorado River Basin Salinity Control Program (CRBSCP). The CRBSCP is a cooperative effort of the seven Colorado River Basin states, the federal government and Basin water users to limit river salinity. Irrigation improvements and vegetation management are employed to reduce deep percolation and the transport of salts. Point sources, such as saline springs like Glenwood Hot Springs are also controlled. The program, a long-term interstate and interagency public/private partnership effort, is carried out to reduce the amount of salts in the river and its associated impacts in the Basin. Salinity control measures, installed with USDA assistance, control over 450,000 tons of salt annually. Measures installed with Bureau of Reclamation assistance control about 600,000 tons of salt each year. (NRCS, 2021)

Salinity Control Projects in the Colorado Basin include:

- Grand Valley Unit: Canal lining, piped laterals and on-farm irrigation improvements in the Grand Junction area, funded by U.S. Bureau of Reclamation (BOR) and Natural Resources Conservation Service (NRCS)
- Additional NRCS study areas: Silt, Whitewater and De Beque

In conjunction with the removal of salts from the Colorado River basin, selenium is also removed. Reductions in selenium concentrations in the lower Colorado River have resulted in attainment of the chronic and acute selenium standards on the lower Colorado River from the Gunnison River to the Colorado-Utah state line. This portion of the river was first identified on the state's 303(d) List as impaired for selenium in 2004 and remains critical habitat for the endangered species, the Colorado pikeminnow and razorback sucker.

Multiple projects in the Projects Database address salinity issues, including the following projects:

- Project ID CO-2015-0019 – (Basinwide project to support continued implementation of Colorado River basin salinity control program improvements)
- Project ID CO-2020-0028 (Middle Colorado region project to implement a water quality monitoring strategy)
- Project ID CO-2020-0035 (Middle Colorado region project for targeted outreach for salinity control)

The full Projects Database including more information about these projects can be found in **Exhibit D.**

Water Quality Regulations

Two federal laws, the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA), were established to ensure the quality of surface waters and drinking supplies. Under the SDWA, EPA sets standards for drinking water quality and oversees the states, localities, and water suppliers who need to comply with those standards (EPA, 2014). Under the CWA, the statute employs a variety of regulatory and non-regulatory tools to reduce direct pollutant discharges into waterways, finance municipal wastewater treatment facilities, and manage polluted runoff.

The Colorado Department of Public Health and Environment (CDPHE) – Water Quality Control Commission (WQCC) and Water Quality Control Division (WQCD) are responsible for implementation of the CWA and SDWA in Colorado and in developing specific state water quality policies in a manner that implements the broader policies set forth by the Legislature in the Colorado Water Quality Control Act. The WQCC adopts water quality classifications and standards for surface and groundwaters of the state,

as well as various regulations aimed at achieving compliance with those classifications and standards and the WQCD protects and restores water quality for public health and environment through the development and enforcement of permits.

Several regulations have been established to protect the beneficial uses (public water supplies, domestic, agricultural, industrial and recreational uses, and the protection and propagation of terrestrial and aquatic life), of Colorado's water bodies. Two specific surface water regulations identify narrative and numeric limits for waters within the Colorado Basin, Regulation No. 33, covering the Upper Colorado River Basin and North Platte River Basins, and Regulation No. 37, covering the Lower Colorado River Basin. These regulations are revisited on a triennial basis by the WQCC to ensure site-specific standards protect identified uses.

Another regulation, Regulation No. 93, establishes Colorado's List of Water-Quality-Limited Segments Requiring Total Maximum Daily Loads ("TMDLs") and Colorado's Monitoring and Evaluation List (M&E List). The list of Water-Quality-Limited Segments Requiring TMDLs fulfills requirements of section 303(d) of the CWA which requires that states submit to the EPA a list of those waters for which technology-based effluent limitations and other required controls are not stringent enough to achieve water quality standards. The M&E List includes a list of those water bodies where there is reason to suspect water quality problems, but there is also uncertainty regarding one or more factors, such as the representative nature of the data. Water bodies that are impaired, but it is unclear whether the cause of impairment is attributable to pollutants as opposed to pollution, are also placed on the M&E List. This M&E List is a state-only document that is not subject to EPA oversite. Both lists have been compiled and considered as part of the non-consumptive needs evaluation as part of this BIP and depicted on the figures within the Regional Breakdown section. Note these lists are updated periodically and subject to change. (Reg 93, 2020)

Water Quantity and Water Quality Nexus

The amount of flow in a stream affects the water quality of the stream. Without a sufficient volume of water for dilution, pollutants concentrations can increase. Flushing flows can also be critical to moving fine sediment within the riverine system, supporting and maintaining a healthy aquatic habitat environment.

Low flows, especially in the late summer, increase the water temperature which presents a problem for cold water fish. As cooler water holds more dissolved gasses, lower flows with warmer water also hold less dissolved oxygen. Lower streamflows also have less aeration and oxygenation than fast moving "white water." As a result of these two factors, low stream flows can result in critically low dissolved oxygen.

Flow reductions related to drought, climate change, and increasing diversions from TMDs and other users can also impact water quality. For example, on June 15, 2021 the flow at the Colorado River at K Barger Ditch near Kremmling (Gage ID COLKBDCO) dropped below 150 cubic feet per second (cfs). On that day, the flow recorded several miles downstream at the Colorado River Near Kremmling, CO (USGS Gage ID 09058000), below the confluence of Troublesome Creek, Barger Gulch, Muddy Creek, the Blue River, and Sheep Creek was 375 cfs and the maximum recorded temperature hit 74.8 degrees Fahrenheit – a temperature which can be dangerous for cold water fish such as trout.

Colorado Basin's Economy & Relationship to Water

Tourism, agriculture, and energy are all critical and integral components of the Basin's Economy. Tourism is the predominant basic-sector industry in the headwaters counties (Grand, Eagle, Summit, and Pitkin) with world-class visitor attractions, including ski resorts, Gold Medal fishing, a National Park, and Wild and Scenic eligible rivers. Each County ranks tourism as a top economic development strategy. Tourism comprises 48% of all jobs in the Colorado Basin, compared with 8% statewide. Therefore, any impacts to recreation from declining river flows will have a disproportionately large impact on jobs in the Colorado Basin. In 2010, 60% of all overnight skier visitors came from out-of-state. Most major ski resorts are in the six headwaters counties (including Gunnison and Routt counties). **Figure 13** shows economic contributions of water-related outdoor recreation in the Colorado River Basin. This economy also benefits the Front Range counties, where travel and equipment expenditures comprise an important component.

Headwaters counties are highly dependent on and vulnerable to changes in environmental conditions that impact tourism (NWCCOG, 2012). Risks to environmental and recreational uses already exist. For example, the ecosystems of many headwater streams have been significantly altered from depletions by transmountain diversions and local water uses. Further development of transmountain diversions, including the pending projects identified in **Figure 11** , may further impact the available recreational and environmental flows which in turn may impact recreationally related industries in the Basin. Recreation, the economic mainstay for many counties in the Basin, requires virtually no consumptive use of water (NWCCOG, 2012).

The value of agriculture to the Basin is often understated. Agriculture is part of the historical culture; it is complementary to tourism and a vital source of return flows that sustain late season streamflows for fisheries. It produces cattle that support east slope feedlots (NWCCOG, 2012) and summer produce that fills our grocery stores. A large percentage, of the beef raised within our Basin is exported outside of the state and to other countries. Colorado's agricultural and food industries support about four percent of Colorado's jobs and many of Colorado's counties are "ag dependent" (CDM, 2011b).

Energy also represents an important though varied segment of the economy. Water needs of the energy industry are similarly varied and added in more detail in **Section 1**.

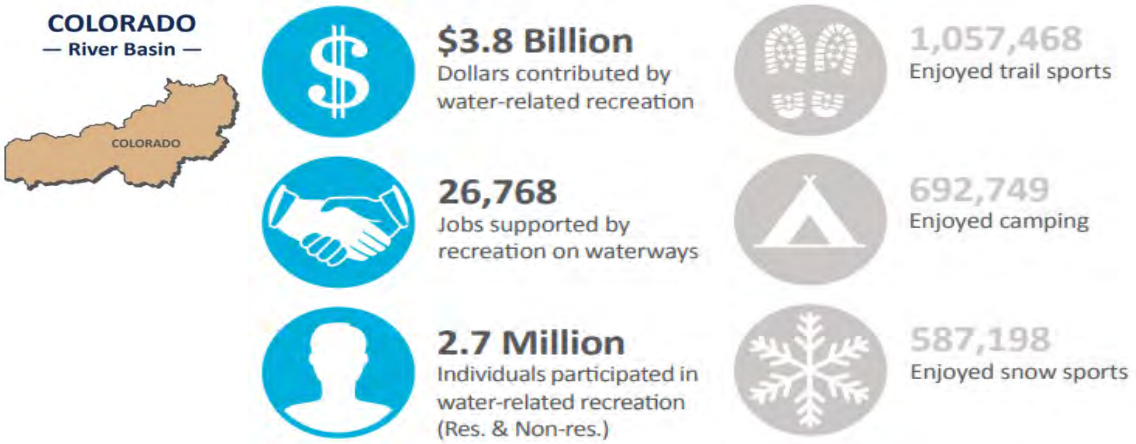


Figure 13: Economic Contributions of Water-related Outdoor Recreation in Colorado – Colorado River Basin (Business for Water Stewardship, 2020)

Integrated Water Management Planning & Stream Management Planning

The 2022 BIP Update focuses heavily on integrated water management planning as a tool for managing water as a resource for multiple uses: in rivers as an environmental and recreational amenity; in our municipalities as drinking water, wastewater, and stormwater; and as a source for life-sustaining agriculture. The term Stream Management Plan has also been used to describe these multi-faceted planning efforts (River Network, 2021). Other terms for these planning efforts include Community Water Plan and Watershed Management Plan. This report uses the term Integrated Water Management Plan (IWMP) to describe these planning efforts.

IWMPs are typically created over dozens of meetings that span years, and involve many stakeholders including municipal water providers, transmountain diverters, farmers and ranchers, irrigation districts, soil and water conservation districts, watershed organizations, commercial fishing and rafting companies, and other parties that depend on rivers. These plans are developed for specific river segments or watersheds and describe current uses and trends that could be affected by future shortages. IWMPs review uses, demands, and gaps on a much more detailed and local level than is currently possible for the Colorado Water Plan Technical Updates. IWMPs identify projects and methods to address current or future gaps as well as address the environmental and recreational risks and needs of the reach. The plans are increasingly used to "adaptively manage" rivers, which refers to changing the amount and timing of river diversions based on real-time river conditions.

Since the 2015 BIP, the Colorado Basin has made significant progress on developing IWMPs throughout the Basin. The following is a list of IWMPs and other similar efforts that have been completed or initiated since the 2015 BIP:

Plans Completed Since 2015 BIP:

- Crystal River Management Plan – 2016
- Upper Roaring Fork River Management Plan – 2017
- Roaring Fork River Watershed Plan – 2019 Update
- Middle Colorado IWMP – 2021

Plans Currently In-progress:

- Blue River IWMP
- Eagle River Community Water Plan
- Grand Valley Watershed Plan

The Colorado Basin Roundtable recommends permanently funding these plans and identifying who is responsible for keeping them up-to-date as conditions change. This BIP recognizes several Strategies related to using the IWMP mechanism to reduce risks and enhance benefits across all sectors, which are discussed in the Strategies section of **Section 3.**

Crystal River near Carbondale at Thomas Road Bridge (Photo credit: Ken Neubecker)

One of the Colorado River Basin Roundtable's six Themes is to protect and restore healthy streams, rivers, lakes, and riparian areas. This photograph of the Crystal River near Carbondale, one of the largest rivers on the West slope, was taken September 12, 2012. The CWCB holds one of Colorado's oldest and largest in-stream flow rights on the Crystal River, but it is so junior that it is ineffective in low-water years like 2012.

The Roundtable supports the development of Integrated Water Management Plans to address environmental and recreational priorities while managing agricultural, municipal, and industrial needs.

The Technical Update & Planning Scenarios

The Colorado Water Plan set an adaptive management framework for future water planning activities and described five planning scenarios under which demands, supplies, and gaps were to be estimated. The scenarios included new considerations, such as climate change, that were not a part of prior SWSIs. In addition, the CWCB has continued to work with the Division of Water Resources to develop and refine consumptive use and surface water allocation models that were not ready for use in earlier analyses. As a result of these factors, the 2019 Tech Update took a different and more robust approach to estimating future gaps. (2019 Tech Update).

Colorado Water Plan Technical Update Volume I and Volume II

Planning Scenarios

As part of the 2019 Tech Update, five planning scenarios were developed to compare against the baseline or current water situation. The five scenarios present a range of plausible "stories" about our water future based on different kinds of uncertainties. The planning scenarios are a new way of modeling a range of future gaps based on water supply and demand drivers associated with the potential effects of climate change, population growth, and other factors. The five scenarios present a range of plausible "stories" about our water future based on different kinds of uncertainties (water supply, climate status, social values, agricultural needs, and municipal and industrial (M&I) needs), as summarized below in **Figure 14**.

The planning scenarios are described in more detail in the 2019 Tech Update, but the graphical summary from the 2019 Tech Update is presented in **Figure 14** as a refresher. (2019 Tech Update).

A. Business as Usual

Recent trends continue into the future. Few unanticipated events occur. The economy goes through regular economic cycles but grows over time. By 2050, Colorado's population is expected to be close to 9 million. Single-family homes dominate, but there is a slow increase of denser developments in large urban areas. Social values and regulations remain the same, but streamflows and water supplies show increased stress. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation of new water development slowly increases. Municipal water conservation efforts slowly increase. Oil-shale development continues to be researched as an option. Large portions of agricultural land around cities are developed by 2050. Transfer of water from agriculture to urban uses continues. Efforts to mitigate the effects of the transfers slowly increase. Agricultural economics continue to be viable, but agricultural water use continues to decline. The climate is similar to the observed conditions of the 20th century.

B. Weak Economy

The world's economy struggles, and the state's economy is slow to improve. Population growth is lower than currently projected, which is slowing the conversion of agricultural land to housing. The maintenance of infrastructure, including water facilities, becomes difficult to fund. Many sectors of the state's economy, including most water users and water-dependent businesses, begin to struggle financially. There is little change in social values, levels of water conservation, urban land use patterns, and environmental regulations. Regulations are not well coordinated and create increasing uncertainty for local planners and water managers. Willingness to pay for social and environmental mitigation decreases due to economic concerns. Greenhouse gas emissions do not grow as much as currently projected, and the climate is similar to the 20th century observed conditions.

C. Cooperative Growth

Environmental stewardship becomes the norm. Broad alliances form to provide for more integrated and efficient planning and development. Population growth is consistent with current forecasts. Mass transportation planning concentrates more development in urban centers and in mountain resort communities, thereby slowing the loss of agricultural land and reducing the strain on natural resources compared to traditional development. Coloradans embrace water and energy conservation. New water-saving technologies emerge. Eco-tourism thrives. Water development controls are more restrictive and require both high water-use efficiency and environmental and recreational benefits. Environmental regulations are more protective, and include efforts to re-operate water supply projects to reduce effects. Demand for more water-efficient foods reduces water use. There is a moderate warming of the climate, which results in increased water use in all sectors, in turn affecting streamflows and supplies. This dynamic reinforces the social value of widespread water efficiency and increased environmental protection.

D. Adaptive Innovation

A much warmer climate causes major environmental problems globally and locally. Social attitudes shift to a shared responsibility to address problems. Technological innovation becomes the dominant solution. Strong investments in research lead to breakthrough efficiencies in the use of natural resources, including water. Renewable and clean energy become dominant. Colorado is a research hub and has a strong economy. The relatively cooler weather in Colorado (due to its higher elevation) and the high-tech job market cause population to grow faster than currently projected. The warmer climate increases demand for irrigation water in agriculture and municipal uses, but innovative technology mitigates the increased demand. The warmer climate reduces global food production, which increases the market for local agriculture and food imports to Colorado. More food is bought locally, which increases local food prices and reduces the loss of agricultural land to urban development. Higher water efficiency helps maintain streamflows, even as water supplies decline. Regulations are well defined, and permitting outcomes are predictable and expedited. The environment declines and shifts to becoming habitat for warmer-weather species. Droughts and floods become more extreme. More compact urban development occurs through innovations in mass transit.

E. Hot Growth

A vibrant economy fuels population growth and development throughout the state. Regulations are relaxed in favor of flexibility to promote and pursue business development. A much warmer global climate brings more people to Colorado with its relatively cooler climate. Families prefer low-density housing, and many seek rural properties, ranchettes, and mountain living. Agricultural and other open lands are rapidly developed. A hotter climate decreases global food production. Worldwide demand for agricultural products rises, which greatly increases food prices. Hot and dry conditions lead to a decline in streamflows and water supplies. The environment degrades and shifts to becoming habitat for species adapted to warmer waters and climate. Droughts and floods become more extreme. Communities struggle unilaterally to provide services needed to accommodate rapid business and population growth. Fossil fuel is the dominant energy source, and there is large production of oil shale, coal, natural gas, and oil in the state.

Figure 14: Graphical Summary of Planning Scenarios and Key Drivers from 2019 Tech Update

The Gaps

Key challenges for the Colorado River Basin found in the 2019 Tech Update are summarized in **Figure 15.** Key results in the Colorado River Basin found in the 2019 Tech Update are summarized in **Figure 16.** Both figures are excerpts from the 2019 Tech Update Report. Findings of basinwide gaps and risks for agricultural, municipal, and industrial, and environmental and recreational needs are also briefly summarized in this section.

Agriculture	Environment and Recreation	Municipal and Industrial	Compacts and Administration
• Despite the importance of agriculture, continued urbanization of agricultural lands could reduce irrigated acres in the basin.	• Success of the Upper Colorado River Endangered Fish Recovery Program is vital to the river's future. The program is designed to address the needs of endangered fish while protecting existing and future use of Colorado River water. • Recreational use and environmental conservation are major drivers in the basin and are important for economic health and quality of life.	• Development of conditional transbasin water rights is a concern, and Colorado must consider the effect on in-basin supplies.	• There is concern over a potential compact shortage during severe and sustained drought and the potential effects to in-basin supplies. Demand management to conserve water per the recently signed Drought Contingency Plan is a pressing issue.
• Selenium and salinity are of concern in parts of the basin.			

Figure 15: Key Future Water Management Issues in the Colorado Basin from 2019 Tech Update

Agriculture	Environment and Recreation	Municipal and Industrial
• Although irrigated area is estimated to decrease by 13,600 acres as cities expand onto irrigated land, IWR may increase in a warmer future climate. • Emerging technology, including adoption of higher system efficiencies, may mitigate climate impacts and reduce demand below baseline. • The future incremental gap ranges from 0 to 4 percent of baseline demand • Scenarios that assume current climate conditions (Business as Usual and Weak Economy) have agricultural gaps around 3 percent of demand. Gaps (as a percentage of demand) increase in scenarios that assume a warmer and drier future climate.	• In climate-impacted scenarios, peak flow generally moves earlier in the year. • Aquatic and riparian attributes may be affected differently based on location and potential changes in stream flow magnitude and timing.	• Per capita municipal usage is projected to decrease in the future. • Municipal demand is projected to increase for all scenarios due to increased population; however, except for Hot Growth, the systemwide demand projections for all future scenarios are similar, showing that pairing of drivers and population can offset each other and even out the results. • Increases in SSI demands in Business as Usual and Hot Growth represent anticipated energy development.

Figure 16: Summary of Key Results from the 2019 Tech Update in the Colorado Basin

Municipal and Industrial Gap

Municipal and Industrial Demands

The municipal baseline and projected diversion demands in **Figure 17** show the combined effect of population and per capita demands.

Figure 17 shows baseline and projected diversion demand by scenario, as well as population for each scenario. All projection scenarios result in an increase relative to the baseline. Note that in increase in population does not always yield an increase in demand; this demonstrates how the pairing of drivers (such as efficiency and housing density) and population can offset each other and even out the results.

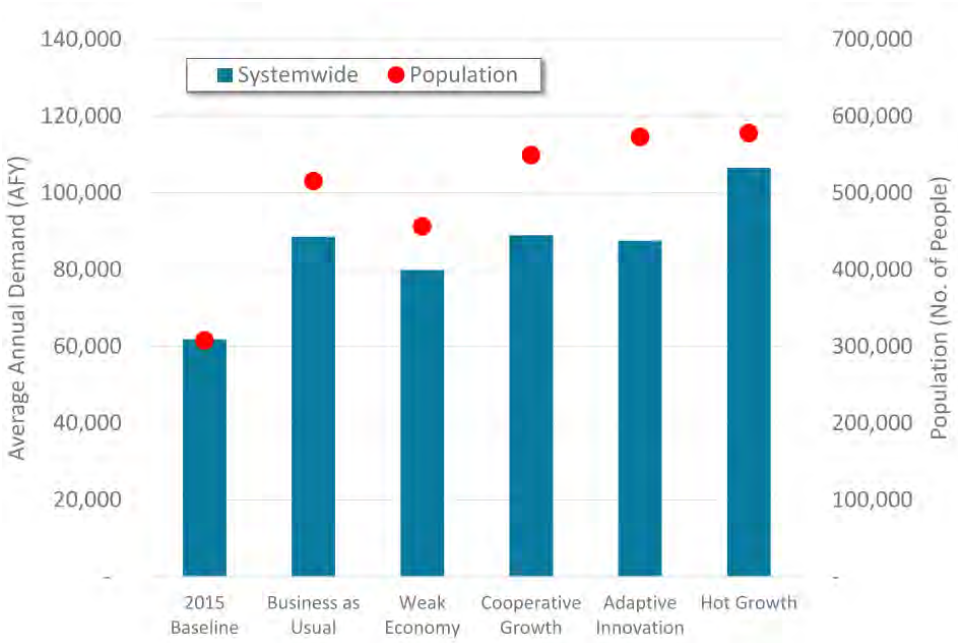


Figure 17: Colorado Basin Baseline and Projected Population and Municipal Demands (2019 Technical Update)

SWSI 2010 defined self-supplied industrial demands as large industrial water users that have their own water supplies or lease raw water from others. Self-supplied industrial demands in this basin are associated with the large industry, snowmaking, and energy development sub-sectors.

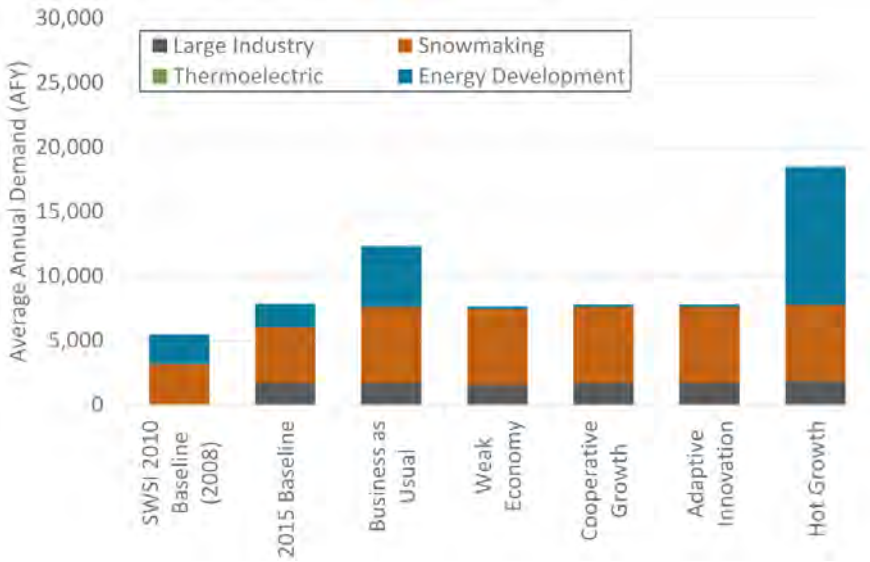


Figure 18: Colorado Basin Self-Supplied Industrial Demands (2019 Technical Update)

Large-industry demands are related to a mining facility in Grand County, which was not modeled in SWSI 2010 but was added as it is a significant use. Energy development demands are related to large-scale production of oil shale, coal, natural gas, and oil in Garfield and Mesa counties. The baseline snowmaking demand is 4,340 AFY as compared to 3,180 AFY in SWSI 2010. Projected demands increase to 5,890 AFY under all scenarios.

Municipal and Industrial Gap

The 2019 Tech Update presented the following summary of observations on M&I diversion demands and gaps:

- Average annual M&I gap in the Colorado Basin is far less than the agricultural gap, ranging from 500 AF to more than 4,700 AF.
- The maximum M&I gap for the five planning scenarios ranges from 2,300 AF to nearly 16,000 AF.
- Per capita municipal usage is projected to decrease, from 179 gallons per capita per day (gpcd) under the Baseline condition to 136 gpcd under Adaptive Innovation and 165 gpcd under Hot Growth. The Baseline demand of 179 gpcd is already a reduction from the 182 gpcd demands used for the SWSI 2010 Baseline.
- Overall municipal demand is projected to increase for all scenarios due to increased population; however, except for Hot Growth, the systemwide demand projections for all future scenarios are similar.
- Increase in self-supplied industrial demand in Business as Usual and Hot Growth represent anticipated energy development.

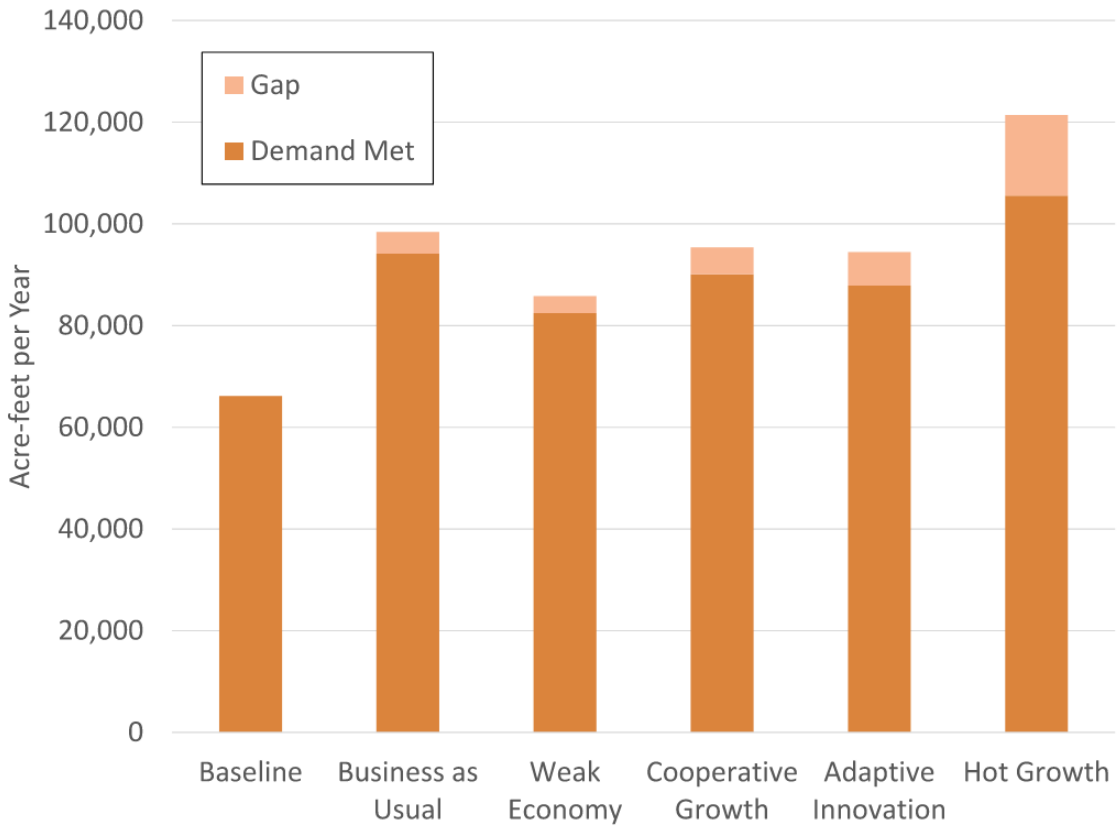


Figure 19: Projected Maximum Annual M&I Demand Met and Gaps in the Colorado Basin (2019 Tech Update)

Agricultural

Agricultural Demands

Demand is lower than current conditions in Business as Usual and Weak Economy because irrigated acreage is projected to be urbanized. Although Cooperative Growth and Hot Growth feature the same reduction in irrigated acres, higher IWR could drive demand above current levels. In Adaptive Innovation, the reduction in IWR, increase in system efficiency, and reduction in acreage results in the lowest demand among all scenarios even with the potential effects of a hotter and drier climate.

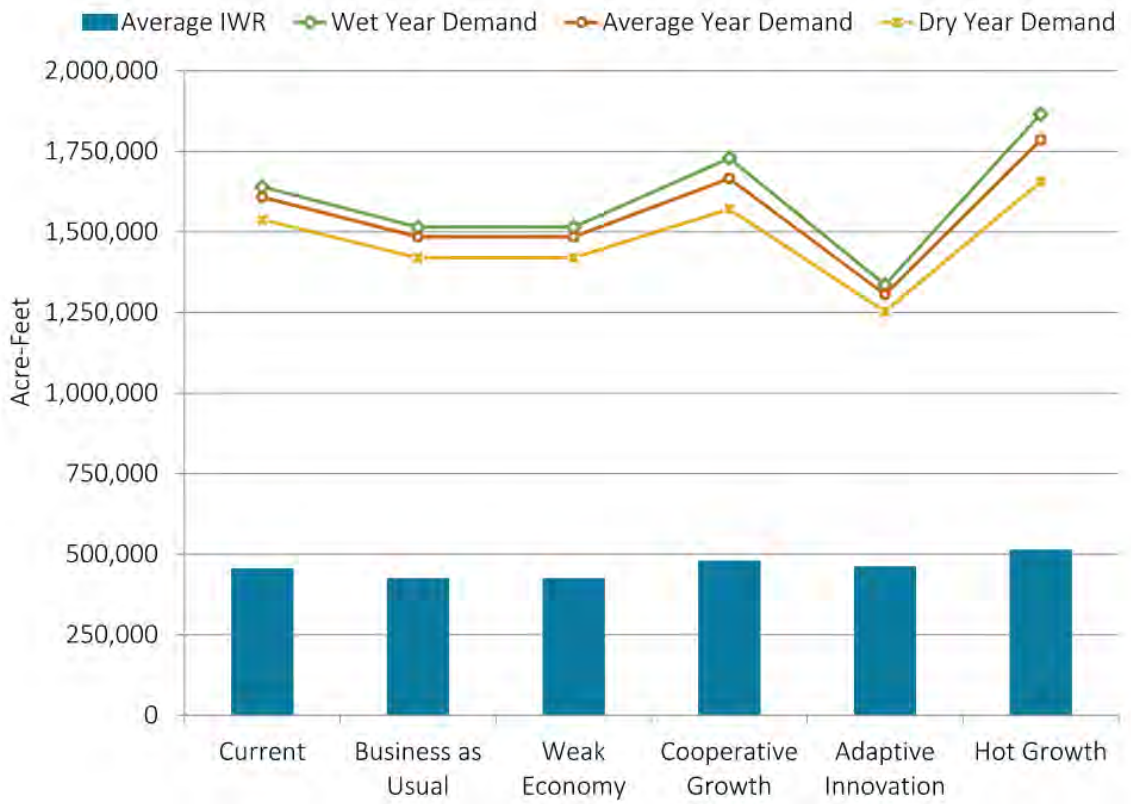


Figure 20: Agricultural Diversion Demands and IWR Results in the Colorado Basin (2019 Tech Update)

Agricultural Gap

The 2019 Tech Update presented the following summary of observations on agricultural diversion demands and gaps:

- Although irrigated area is estimated to decrease by 13,600 acres as cities expand onto irrigated land, basinwide IWR and diversion demand may increase in a warmer future climate.
- Emerging technologies, including the adoption of more efficient irrigation practices, modernizing irrigation infrastructure (e.g., automation) and crops with lower irrigation requirements, may mitigate climate impacts and reduce demand below baseline.
- The future incremental gap ranges from 0 to 4 percent of baseline demand.
- Scenarios that assume current climate conditions (Business as Usual and Weak Economy) have agricultural gaps around 3 percent of demand. Gaps (as a percentage of demand) increase in scenarios that assume a warmer and drier future climate.

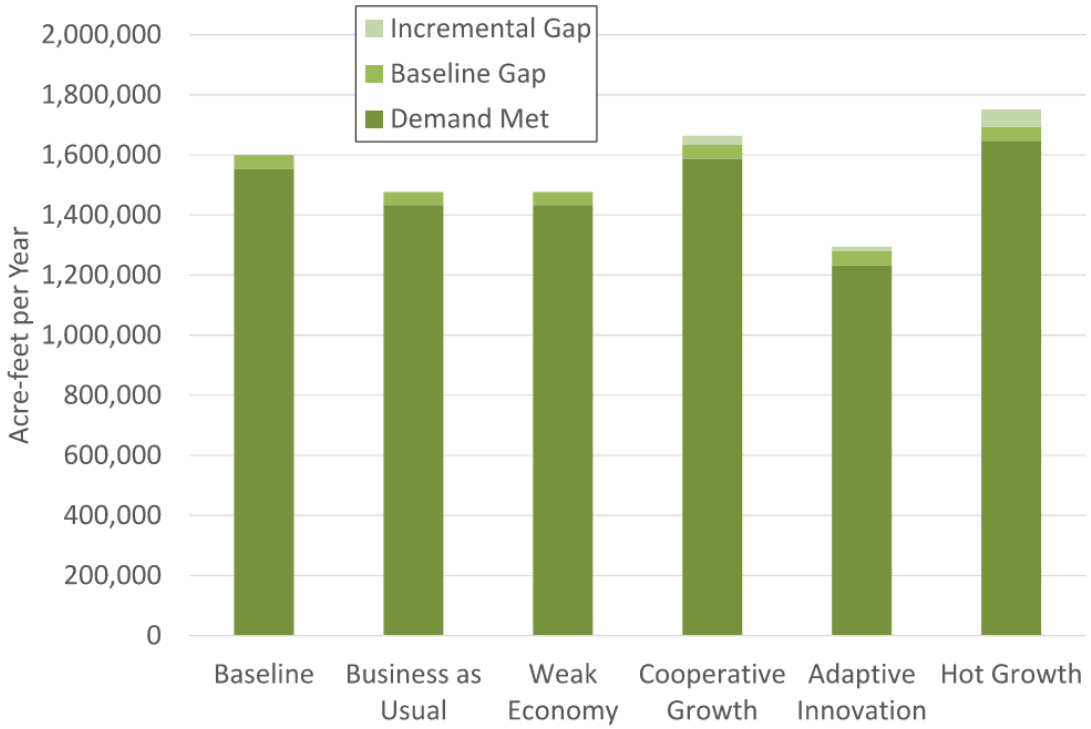


Figure 21: Projected Average Annual Agricultural Diversion Demand, Demand Met, and Gaps in the Colorado Basin (2019 Tech Update)

Environmental and Recreation

The 2019 Tech Update presented the following summary of environmental and recreational findings for the Colorado River Basin:

- In climate-impacted scenarios, peak flow is projected to move earlier in the year, with March, April and May flows increasing substantially and June flows decreasing; possible mismatches between peak flow timing and species' needs may occur. Flow magnitude could decrease some, but peak-flow risk for plants and fish is projected to remain moderate.
- In some areas (e.g., Crystal River above Avalanche Creek near Redstone), peak flow magnitude is projected to increase substantially, potentially over-widening the creek channel and causing habitat issues during low-flow periods.
- Under Cooperative Growth, Adaptive Innovation, and Hot Growth, mid- and late-summer flows may be reduced by 60 to 70 percent and create high risk for fish from loss of habitat and, in trout regions, high water temperatures.
- Downstream from major reservoirs (e.g., Ruedi, Green Mountain), diminished peak flows could create high to very high risk for riparian/wetland vegetation and fish habitat if sediment is not flushed, while consistent mid- and late-summer flows could keep risk to fish low to moderate.
- Several recreational in-channel diversions (RICDs) and Instream Flow water rights may be unmet more often with diminished June to August flows.
- In critical habitat for endangered species, highly reduced flows in mid- and late summer will make it more difficult to meet flow recommendations.

Watershed Flow Evaluation Tool (WFET)

The Colorado Environmental Flow Tool (Flow Tool) was designed to serve as a resource to help Basin Roundtables (BRTs) refine, categorize, and prioritize their portfolio of environmental and recreational (E&R) projects and methods through an improved understanding of flow needs and potential flow impairments, both existing and projected. The Flow Tool uses hydrologic data from Colorado's Decision Support System (CDSS), additional modeled hydrologic data for various planning scenarios, and stablished flow-ecology relationships to assess risks to flows and E&R attribute categories at pre-selected gages across the state. The Flow Tool is a high-level tool that is intended to provide guidance during Stream Management Plan development and Basin Implementation Plan (BIP) development. Note that in the past, the term "non-consumptive" has also been used in the place of "E&R". In the 2019 Tech Update, these two terms are viewed as interchangeable. (2019 Tech Update)

The Flow Tool, as developed for this Technical Update, can be used to assess the risk that stream-based ecological resources may change as a result of climate change, human uses, and/or the diversion of water. The Flow Tool is intended to be a high-level planning tool that (2019 Tech Update):

- Uses the foundations of the HSAT and WFET to scale to a statewide platform;
- Post-processes CDSS projections to provide summaries of changes in monthly flow regime at pre-selected locations under different planning horizons;
- Identifies potential risks to E&R attribute categories through flow-ecology calculation projections;
- Serves as a complementary tool to the CDSS to refine, categorize, and prioritize projects; and
- Provides guidance during Stream Management Plan development and BIP development.

Supply, Demand, and Gap Modeling – 2021 Updates

Water supply and gap results were developed initially in September 2019 and the approach and results were documented in the Current and 2050 Planning Scenario Water Supply and Gap Results documentation. The approach and results for the Colorado Basin were presented to the Roundtable and other stakeholders, and feedback was obtained regarding areas where the approaches to developing the agricultural, municipal, and industrial demands or the modeling could be improved or refined. Wilson Water Group worked to incorporate that feedback into a revised modeling effort. The update process and resulting impact to the overall water supply and gap in each basin are documented in a February 22, 2021 technical memo from Wilson Water Group (WWG, 2021). The changes and results for the Basin are summarized here.

Summary of Modeling Revisions

Several revisions were implemented in the Colorado River Basin, including revisions to agricultural demands, industrial demands, and model operations. A portion of these revisions were identified by stakeholders in the basin after review of the approach and initial results. Other revisions, however, were identified through on-going modeling efforts that also rely on the Colorado water allocation models. These identified revisions were implemented in at the same time as the stakeholder-driven revisions to improve the representation of the modeled demands and operations.

The following summarizes major revisions to the model implemented based on stakeholder comments:

- Snowmaking demands increase of 90 AF/year for Powderhorn Mountain Resort
- Red Top Valley Ditch changes to reflect Northern Water's storage of their purchased ditch shares in Lake Granby

- Redlands Canal (Gunnison Basin) diversion updates, with returns impacting the Colorado River Basin
- Green Mountain Reservoir operation revisions
- Grand Valley area acreage reduction from 68,900 acres to 54,000 acres
- Instream flow water rights modeling corrections for 13 instream flow water rights in the basin
- Eagle River transbasin diversion capacity and water rights modeling revisions (revised representation of the Columbine Ditch water rights and Wurtz Ditch capacity)

Several minor revisions to the Colorado water allocation model were also made, primarily to correct model input file formatting, which have little impact to the overall results. Collectively, the revisions had a limited impact to the overall water supply and gap results in the basin, however it is important that the representation of the model has been improved through the process of these revisions.

Impacts of Modeling Revisions

Overall, the revisions had less than a one percent impact on the average agricultural water supply and gap results for the basin. The maximum agricultural demand also remained very similar to previous results, however the maximum agricultural gap slightly increased in all scenarios.

There was a general reduction in the M&I demand and gap in the basin that can be partially attributable to the change in the snowmaking demands in Mesa County. The reduction is also attributable to the revised Routt County industrial demand, as discussed in the Yampa River basin results. A portion of Routt County is located in the Colorado River basin, therefore the reduction in the county-wide demand led to a reduction in the demand in the Colorado River basin as well. The reduction in demand and changes to water availability as a result of the model revisions led to approximately 100 to 5,000 acre-feet reduction in the maximum M&I gap during critically dry years across the Planning Scenarios.

As discussed in the 2019 Tech Update, the Colorado River Basin benefits from the delivery of a small amount of imported transbasin supplies from the Gunnison River basin for M&I purposes in and around the Grand Junction area. Revisions to the Gunnison River basin did not impact the transbasin import supply gap associated with these deliveries; the information presented in the 2019 Tech Update for this gap remains unchanged.

Future Modeling Revisions Recommended

The municipal gap for the Middle Colorado region is solely from the City of Rifle and is entirely in error. This error was identified as part of the detailed modeling that was done for the Middle Colorado IWMP and is discussed in more detail in that report (see section 2.6.8 of the IWMP report). As this error was identified after the modeling revisions for the 2019 Tech Update were complete, results in this report show this error. The modeling shows that the City of Rifle experiences water shortages even in the Baseline scenario, which shows a disconnect between the City's water planning and the Technical Update modeling. This disconnect is understood to be because the model erroneously did not correctly include certain supplies (Green Mountain Historic Users Pool (HUP) water, Ruedi contract water, the augmentation plan in Case No. 83CW110, and raw irrigation supplies from Rifle Creek utilized for watering parks). These issues should be resolved in the next Technical Update to the Water Plan. (MCRIWMP, 2021)

More broadly, the Roundtable recommends updating the modeling to improve accuracy at the regional level and incorporate more detailed modeling done by others (for example from stream management plans) to better understand the gaps. This is included as one of the Basin's Strategies.

SECTION 2 – BIP UPDATE

Technical Update Regional Analyses and Modeling

Regional Results

The Basin decided that it wanted further modeling to understand the results on a finer level to understand regional insights. This section presents a regional breakdown of the Colorado Basin modeling results from the 2019 Tech Update.

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions could not be modeled as a part of the 2019 Tech Update.

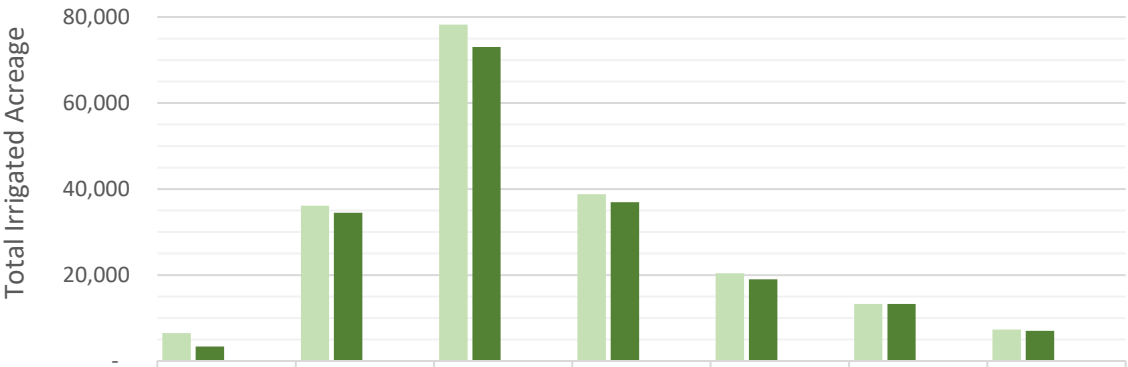
Agricultural

Agricultural demand and gaps are characterized in terms of averages. Living with shortages is way of life for Colorado agricultural producers, who mainly rely on tributary supplies which have senior water rights and reduced physical availability leading to curtailment in most years.

Irrigated Acres

For the Colorado Basin, all five planning scenarios predict a 13,600-acre reduction in irrigated land due to urbanization. The most pronounced change in terms of total acreage is predicted in the Grand Valley region where the baseline scenario has the highest amount of irrigated lands and high anticipated municipal growth is projected. The most pronounced change in terms of percentage is predicted in the Eagle region, where high population growth is projected.

The risks of this projected loss in irrigated acreage were considered in refining the Basin's Goals related to the Theme of Sustain Agriculture, and to specific project included in the Projects Database.



	Eagle	Grand County	Grand Valley	Middle Colorado	Roaring Fork	State Bridge	Summit
Baseline Scenario	6,489	36,134	78,223	38,830	20,425	13,287	7,302
Scenarios A-E	3,338	34,447	73,062	36,965	18,971	13,287	7,030
Change	(3,151)	(1,687)	(5,161)	(1,865)	(1,455)	-	(272)
Percent Change	49%	5%	7%	5%	7%	0%	4%

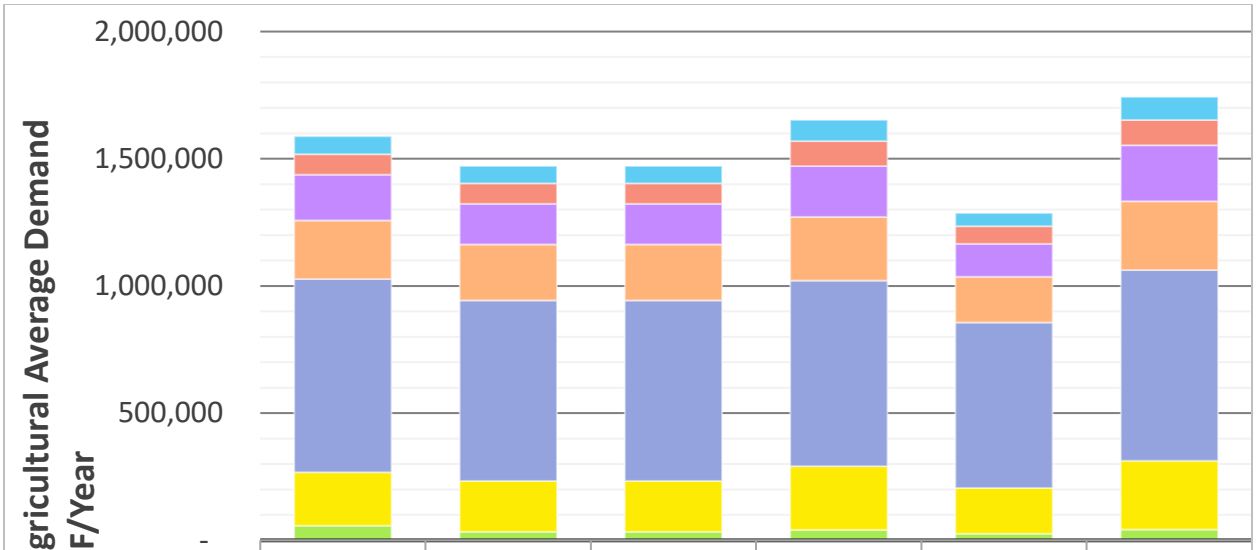
Figure 22: Regional Results for Irrigated Acreage

Agricultural Demand

Agricultural demands across regions and planning scenarios are shown in **Figure 23**. The baseline gap refers to the demand shortages currently experienced throughout the Basin. Cooperative Growth scenario assumes moderate climate change: 3.8 °F temperature increase and 5% increase in precipitation. Both Adaptive Innovation and Hot Growth scenarios assume significant climate change: 4.2 °F temperature increase and 1% decrease in precipitation.

As all regions experience reductions in irrigated acreage, both the Business as Usual and Weak Economy scenarios show a decrease in demands. Demand increases under Cooperative Growth are related to increasing crop irrigation water requirements under a warming climate. Further demand reductions under Adaptive Innovation are related to adaptive practices (increase in agricultural efficiency and conversion to lower water-use crops, which are not included in Cooperative Growth), which partially compensate for the warming climate. Increase in demand under Hot Growth is associated with increasing crop irrigation water requirements under a warming climate with no adaptive practices.

In discussions during Roundtable meetings, SGM heard feedback that the Adaptive Innovation scenario assumptions for crop type switching may not be regionally appropriate for regions such as Grand County and the Roaring Fork region where climate does not lend itself to crops besides alfalfa and pasture grass. However, others felt that the shift in crop focus was reasonable, and reflects trends already seen such as increased greenhouse agriculture and hemp farming.



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	70,000	67,000	67,000	83,000	51,000	90,000
State Bridge	81,000	81,000	81,000	99,000	69,000	100,000
Roaring Fork	180,000	160,000	160,000	200,000	130,000	220,000
Middle Colorado	230,000	220,000	220,000	250,000	180,000	270,000
Grand Valley	760,000	710,000	710,000	730,000	650,000	750,000
Grand County	210,000	200,000	200,000	250,000	180,000	270,000
Eagle	57,000	33,000	33,000	41,000	26,000	43,000

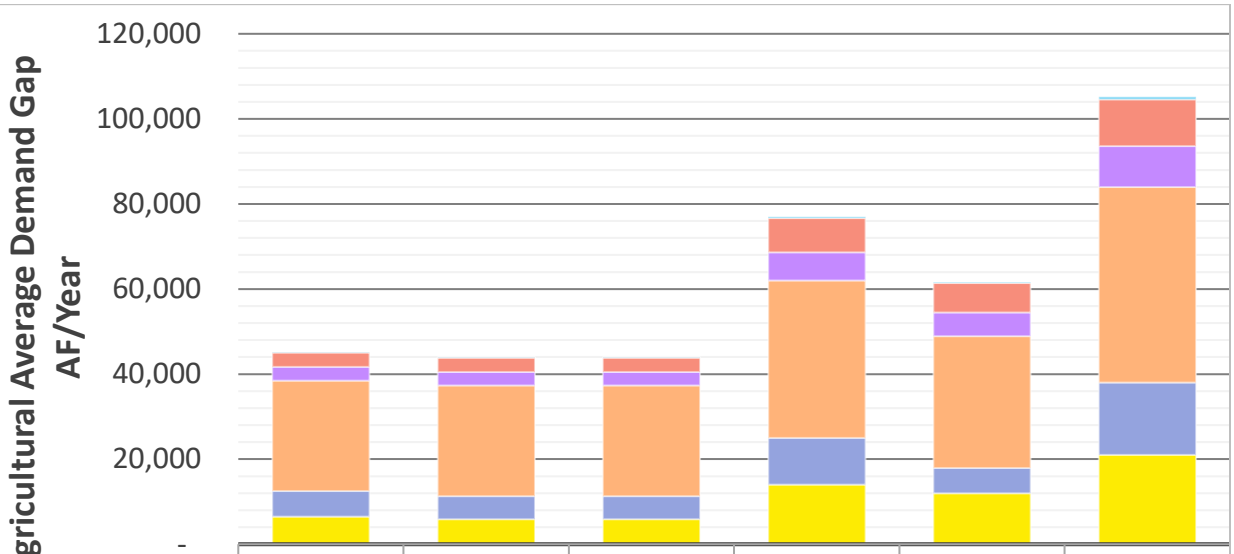
Figure 23: Regional Breakdown of Agricultural Demand

Agricultural Gap

Agricultural gaps across regions and planning scenarios are shown in **Figure 24.** Across all scenarios, the Middle Colorado region has the highest agricultural demand gap. As discussed in detail in the Middle Colorado IWMP, this gap is primarily within District 45, in the Garfield Creek, Cache Creek, Divide Creek, Baldy Creek, and Mamm Creek drainages. This is discussed in more detail in the Middle Colorado Region Demand, Gap, and Supply Projects Discussion in **Section 4**.

Grand County also experiences a high agricultural shortage, related to its location in the headwaters with little access to upstream storage. While Grand County's gap is similar to that for Grand Valley, recall from **Figure 22** that Grand Valley has over twice the acreage of the Grand County region. Considering the high acreage in Grand Valley, the region's gaps are not as drastic as other regions; due in part to the seniority of the regions agricultural water rights (i.e. the Cameo Call).

In discussions during Roundtable meetings, SGM heard feedback that the low agricultural gap for the Eagle region across scenarios seemed unrealistic. Brown and Caldwell and Wilson Water Group have explained that this is likely related to the way that the modeling attributes demands on smaller tributaries (i.e. not on the mainstem of the Colorado River). The main takeaway from this discussion was that the Basin would benefit from improved modeling accuracy on a regional level; this is seen surfacing in the Basin's Strategies.



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	57	37	37	280	190	550
State Bridge	3,400	3,400	3,400	8,100	6,900	11,000
Roaring Fork	3,200	3,200	3,200	6,600	5,600	9,600
Middle Colorado	26,000	26,000	26,000	37,000	31,000	46,000
Grand Valley	6,000	5,400	5,400	11,000	5,900	17,000
Grand County	6,500	5,900	5,900	14,000	12,000	21,000
Eagle	1	0	0	5	3	12

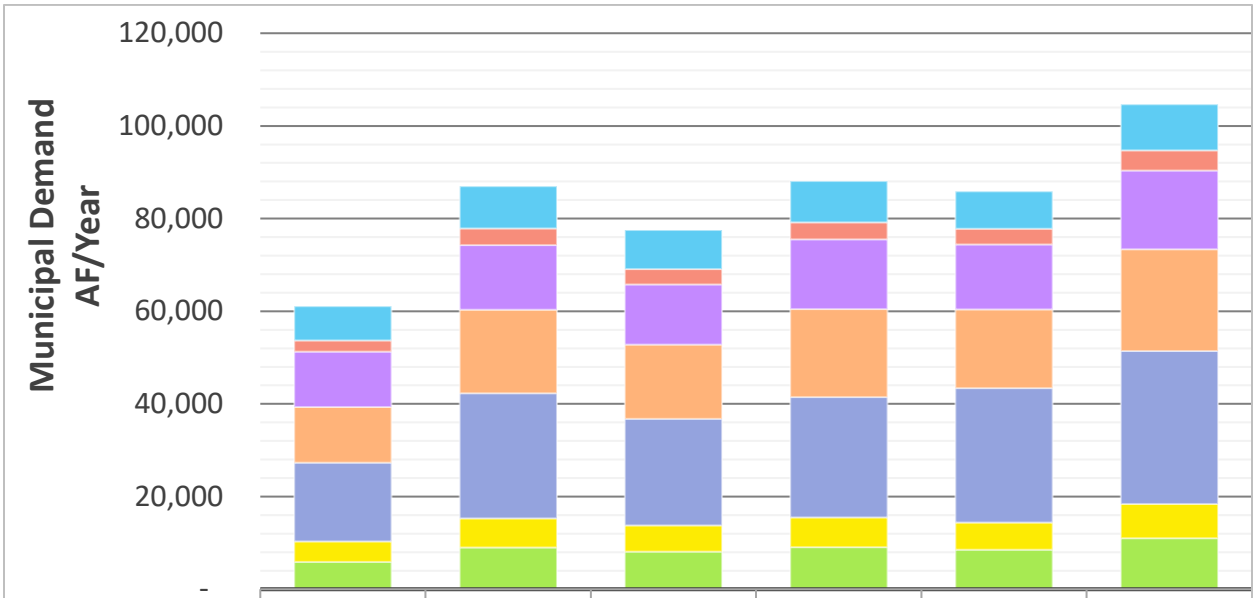
Figure 24: Regional Breakdown of Agricultural Demand Gap

Municipal and Industrial

Whereas agricultural demands and gaps are characterized in terms of averages, municipal demands and gaps are characterized in terms of maximums. The reason for this is that water providers must plan for the maximum demand to meet service standards.

Municipal Demand

Municipal demands across regions and planning scenarios are shown in **Figure 25.**



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	7,400	9,100	8,400	8,900	8,100	10,000
State Bridge	2,400	3,600	3,300	3,700	3,400	4,300
Roaring Fork	12,000	14,000	13,000	15,000	14,000	17,000
Middle Colorado	12,000	18,000	16,000	19,000	17,000	22,000
Grand Valley	17,000	27,000	23,000	26,000	29,000	33,000
Grand County	4,400	6,300	5,700	6,400	5,900	7,400
Eagle	5,900	9,000	8,100	9,100	8,500	11,000

Figure 25: Regional Breakdown of Municipal Demand

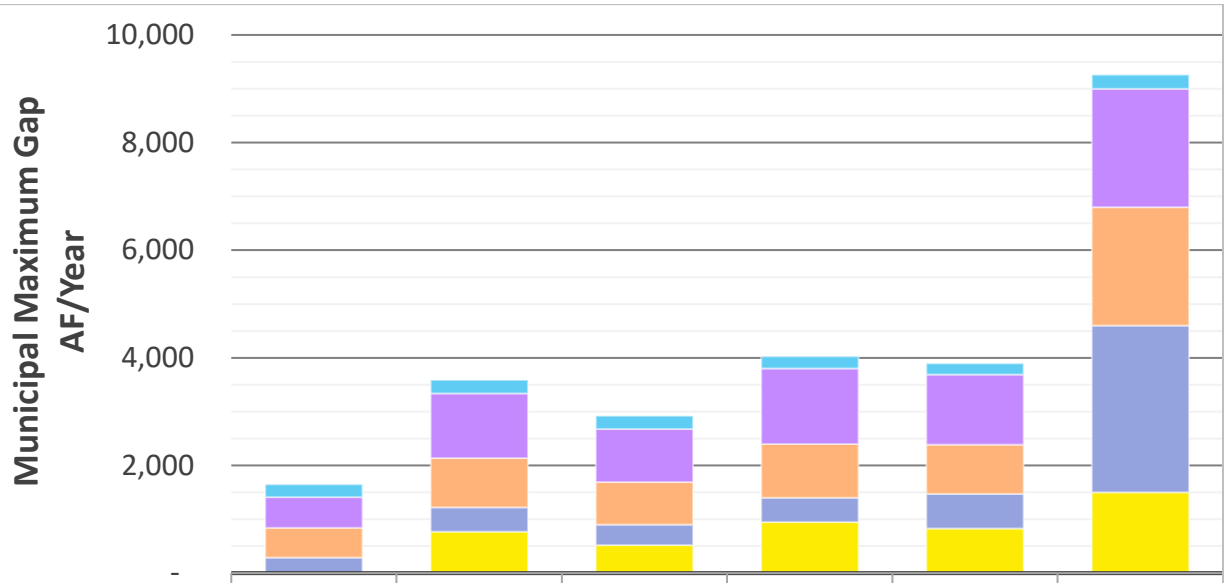
Municipal Gap

Municipal gaps across regions and planning scenarios are shown in **Figure 26.** The Roaring Fork region has the highest maximum municipal gap across all planning scenarios except for Hot Growth. The Roaring Fork region is experiencing rapid urbanization and municipal growth.

However, in the Hot Growth scenario, maximum municipal gap for the Grand Valley region eclipses the Roaring Fork region. As described in the 2019 Tech Update, the Hot Growth scenario assumes higher per-capita outdoor municipal use and more urban sprawl (in contrast to the shifting values toward more compact urban development in the Cooperative Growth and Adaptive Innovation Scenarios. Coupled with higher temperatures, this exacerbates the municipal gap for the Grand Valley regions in the Hot Growth scenario.

The municipal gap for the Middle Colorado region is solely from the City of Rifle and is entirely in error. This error was identified as part of the detailed modeling that was done for the Middle Colorado IWMP and is discussed in more detail in that report (see section 2.6.8 of the IWMP report). The modeling shows that the City of Rifle experiences water shortages even in the Baseline scenario, which shows a disconnect between the City's water planning and the Technical Update modeling. This disconnect is understood to be because the model erroneously did not correctly include certain supplies (contract water, augmentation supplies, and raw irrigation supplies). These issues should be resolved in the next Technical Update to the Water Plan. (MCRIWMP, 2021)

The lack of a municipal gap in the State Bridge region makes sense; the region also has the smallest M&I demands and very few population centers. However, in discussions during Roundtable meetings, SGM heard feedback that the low municipal gap for the Eagle region across scenarios seemed unrealistic. The Eagle region contains several major municipalities including Eagle, Gypsum, Vail, Edwards, and Avon. This may be related to the way the model allocates demands for smaller tributaries; the model was designed to report on demands at a basinwide level, with later modifications done to report demands and gaps at a regional level. The main takeaway from this discussion was that the Basin would benefit from improved modeling accuracy on a regional level and to incorporate more detailed modeling done by others. This is seen surfacing in the Basin's Strategies.



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	240	250	240	230	210	260
State Bridge	-	-	-	-	-	-
Roaring Fork	570	1,200	990	1,400	1,300	2,200
Middle Colorado	550	920	790	1,000	920	2,200
Grand Valley	290	450	380	450	640	3,100
Grand County	-	770	520	950	830	1,500
Eagle	-	-	-	-	-	-

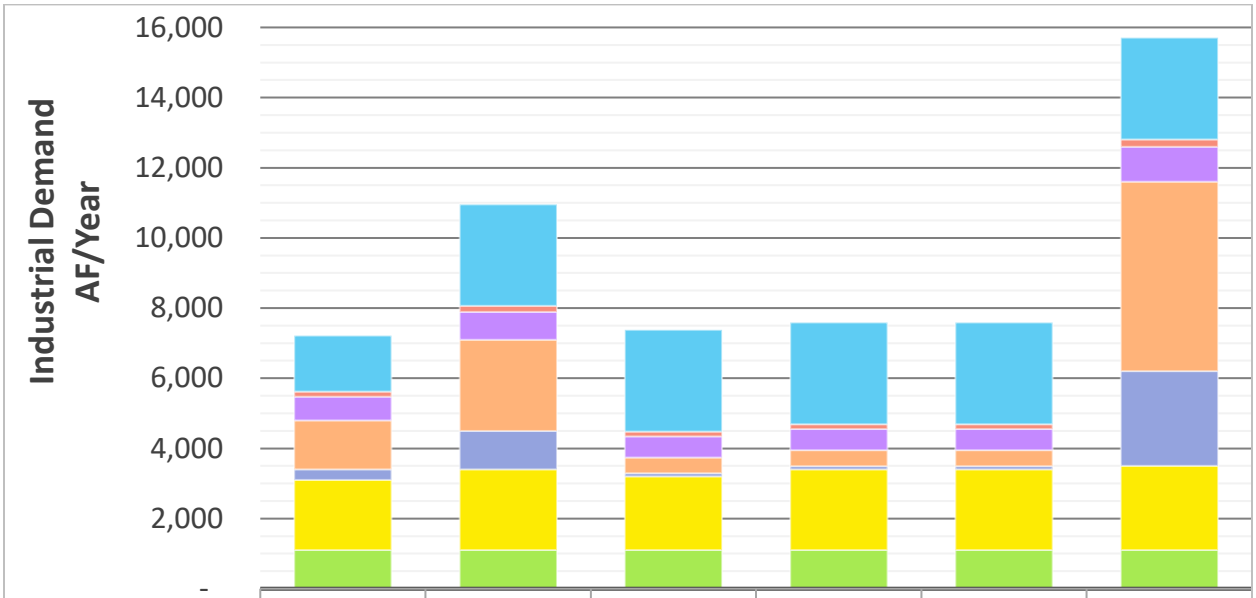
Figure 26: Regional Breakdown of Municipal Gap

Industrial Demand

Industrial demands across regions and planning scenarios are shown in **Figure 27**. Large industrial demands in Grand County are primarily related to a mining facility. This facility was not represented in SWSI 2010 but was added in the 2019 Tech Update because it is a significant use. The mining industrial demands decrease slightly from Baseline to Weak Economy and increased slightly to Hot Growth, related to the scenario's trends of relaxed regulations and increased development (2019 Tech Update). Of the Grand County industrial demand, 630 AF is attributed to snowmaking across all future planning scenarios, a consistent increase from the 360 AF Baseline snowmaking demand.

Industrial demands in the Middle Colorado and Grand Valley region are related to energy development demands in Garfield and Mesa Counties. The significant increase in industrial demands for Grand Valley and Middle Colorado region in the Hot Growth scenario are a result of the Hot Growth scenario assumptions that fossil fuel is the dominant energy source and that there is large-scale production of oil shale, coal, natural gas, and oil.

Snowmaking occurs in the following counties: Eagle, Garfield, Grand, Mesa, Pitkin, and Summit. The industrial demands in the Roaring Fork and Summit regions are primarily snowmaking.



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	1,600	2,900	2,900	2,900	2,900	2,900
State Bridge	150	170	140	140	140	210
Roaring Fork	670	790	600	600	600	1,000
Middle Colorado	1,400	2,600	450	460	460	5,400
Grand Valley	300	1,100	92	92	92	2,700
Grand County	2,000	2,300	2,100	2,300	2,300	2,400
Eagle	1,100	1,100	1,100	1,100	1,100	1,100

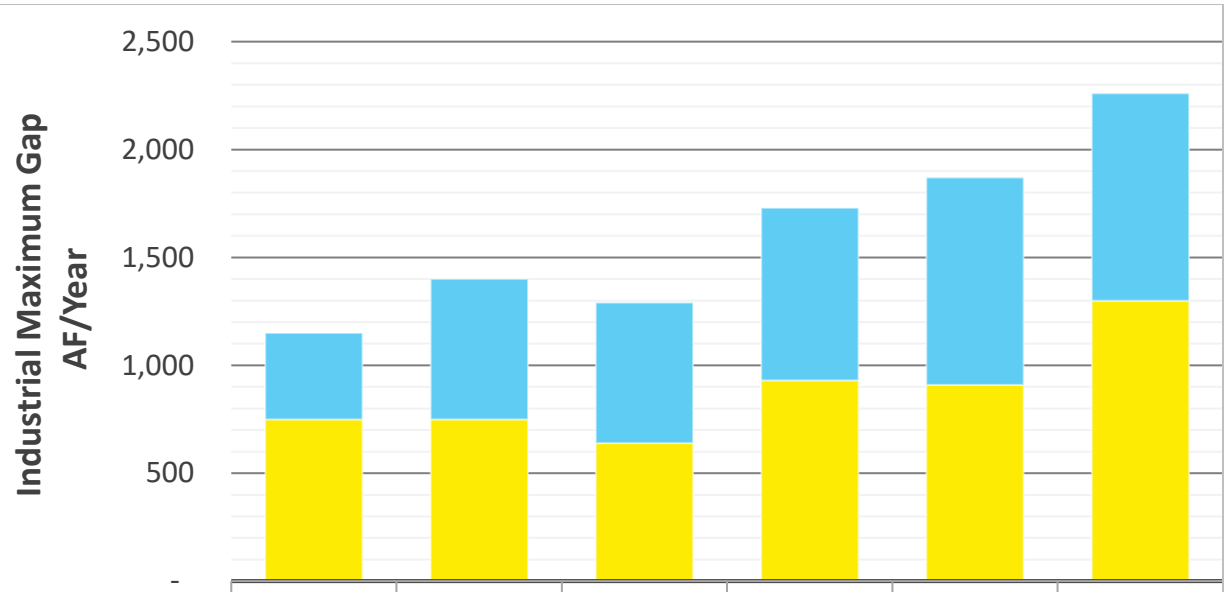
Figure 27: Regional Breakdown of Industrial Demand

Industrial Gap

Industrial gaps across regions and planning scenarios are shown in **Figure 28.** While the Hot Growth scenario shows an increase in industrial demands for energy production in the Middle Colorado and Grand Valley regions, these demands are met across the planning scenarios and so no gap is projected.

The industrial gap projected in the Summit region is entirely attributed to snowmaking demands. While Summit region's demands are constant across the five planning scenarios, the regions' gaps increase for the scenarios with hotter climate projections due to supply reductions. Snowmaking demands in other regions are met across planning scenarios.

The industrial gap projected in the Grand County region are related to the mining facility demands, and the trends in this region's gap track with the changes in demand across scenarios.



	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Summit	400	650	650	800	960	960
State Bridge	-	-	-	-	-	-
Roaring Fork	-	-	-	-	-	-
Middle Colorado	-	-	-	-	-	-
Grand Valley	-	-	-	-	-	-
Grand County	750	750	640	930	910	1,300
Eagle	-	-	-	-	-	-

Figure 28: Regional Breakdown of Industrial Gap

Basinwide Themes, Undercurrents, Goals, and Strategies

The intentions of the Roundtable for the Colorado BIP update are organized by Themes, Undercurrents, Goals, and Strategies. **Figure 29** illustrates how the Themes, Undercurrents, Goals, and Strategies fit together. Each of these terms is defined and explained in this section.

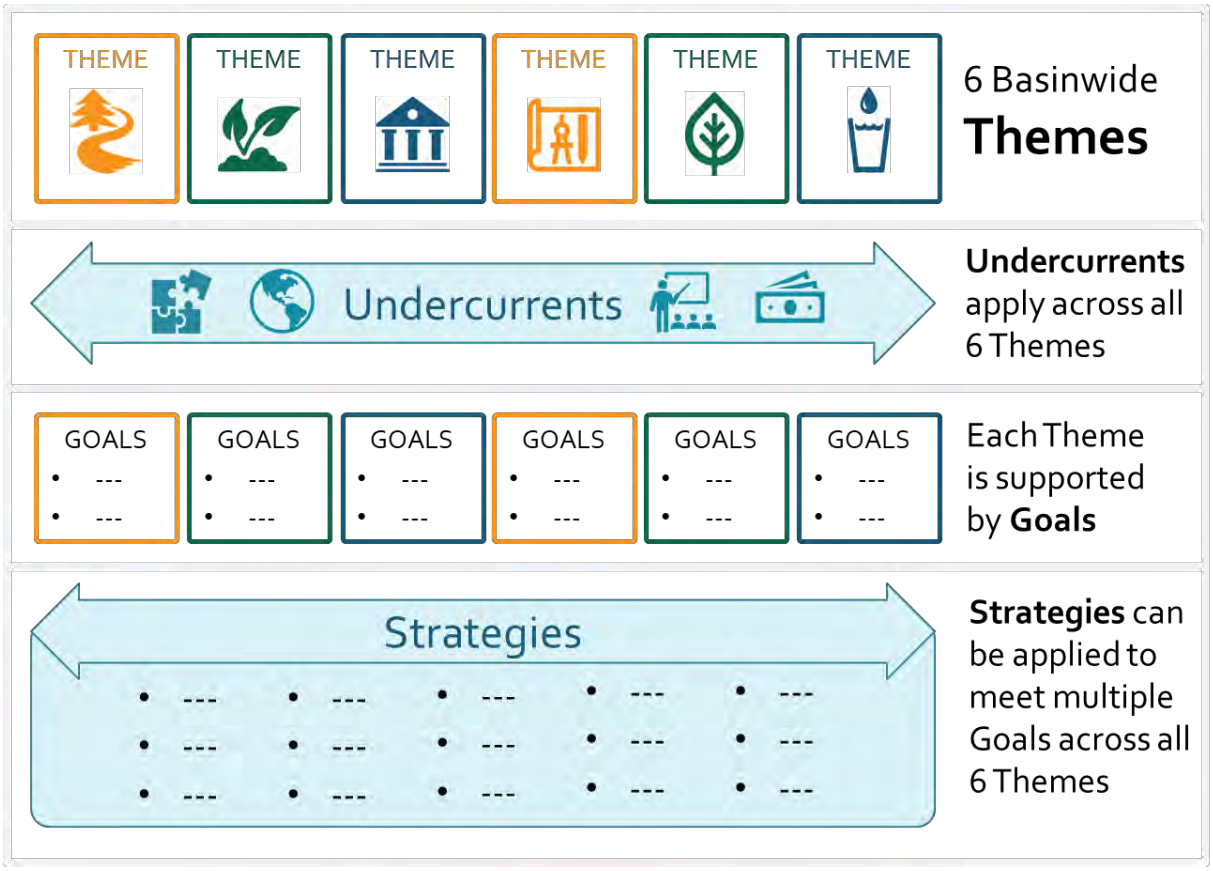


Figure 29: How the Basin's Themes, Undercurrents, Goals, and Strategies Fit Together

Input Process

As with everything else during the Covid-19 pandemic, the public input process for updating the Basin's Themes, Goals, and Strategies looked very different for the 2022 BIP Update than it did for the 2015 BIP. All meetings were held over conference call or a virtual meeting platform. Roundtable and Next Steps Committee Meetings were hosted over Zoom and comments were received through discussion and through the meeting's chat. Due to the limitations of virtual meetings, SGM facilitated additional meetings to solicit feedback and facilitate one-on-one discussions.

The BIP Update Team sought input from the Roundtable and other stakeholders on the Themes and Goals through multiple avenues, including:

- **November 23, 2020, Roundtable Meeting:** SGM presented the 2015 Themes and Goals.
- **Regional meetings:** SGM coordinated with the regional leads to set up meetings with representatives from individual regions to review and discuss Themes and Goals.
- **Survey responses:** SGM developed a survey (Google forms) requesting feedback on the Themes and Goals. The survey was emailed to the entire Roundtable email distribution list on January 19,

2021 in preparation for the January 25, 2021 Roundtable Meeting. The survey and a summary of input received is included as **Exhibit B**. The survey presented the 2015 Themes, as well as the Goals, Measurable Objectives, and Projects and Methods within each Theme, requesting comments or suggested revisions to each. Feedback on the Goals was used to develop 2021 Goals. Feedback on Measurable Objectives, and Projects and Methods was used to help develop 2021 Strategies.

- **January 25, 2021 Roundtable Meeting:** SGM presented feedback received from the survey and the Roundtable workshopped the draft Goals and draft Strategies.
- **Individual stakeholder discussions:** SGM held discussions with stakeholders who expressed interest in providing additional feedback, including (but not limited to): Roundtable Members, the River District, Trout Unlimited, agricultural representatives, representatives of local watershed groups throughout the Basin, and representatives of water providers throughout the Basin.
- **February 23, 2021 Roundtable Next Steps Committee Meeting:** SGM presented the draft final Themes, Undercurrents, and Goals/ The Next Steps Committee agreed on minor revisions and then recommended the draft final for approval at the March Roundtable Meeting.
- **March 29, 2021 Roundtable Meeting:** SGM presented the draft final Themes, Undercurrents, and Goals recommended by the Next Steps Committee and the Roundtable voted to approve them. SGM also presented draft Strategies and received input. Prior to the meeting, the Roundtable distribution list was provided with drafts of the Themes, Undercurrents, Goals, and Strategies to review prior to the meeting.
- **April 26, 2021 Roundtable Next Steps Committee Meeting:** SGM presented the draft Strategies to the Next Steps Committee. Next Steps Committee provided input and recommended approval for the Roundtable's consideration during the May 24, 2021 meeting.
- **May 24, 2021 Roundtable Meeting:** SGM presented the final draft Strategies to Roundtable at the May 24, 2021 meeting, and the Roundtable voted to approve and finalize the Strategies as they appear in this report.

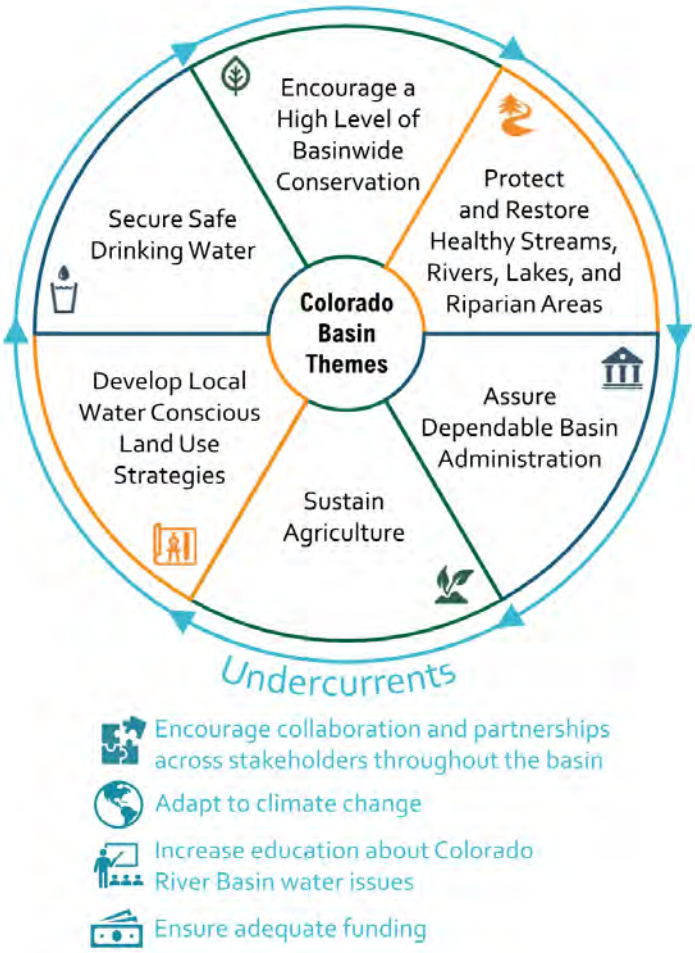


Figure 30: Colorado Basin Themes and Undercurrents

Six Themes

The BIP Update Team received unanimous feedback from the Roundtable and other stakeholders that the six Themes identified in the 2015 BIP are still applicable and adequate. The Roundtable voted to keep the same six Themes identified in 2015. Each Theme is discussed in more detail in the following sections.

Undercurrents

The term "Undercurrents" was added in 2021 to incorporate feedback that is applicable across all Themes. In the process of reviewing the Themes, stakeholders wanted to recognize the importance of funding, education, climate change, and basinwide collaboration and partnership on a level with Themes, in a way that recognized that they are woven throughout all of the six Themes. Hence the concept of Undercurrents was created.

The six Themes are depicted in **Figure 30** as a wheel connected by arrows to show that all six Themes are connected and interrelated, and that the Undercurrents are applicable across all six Themes.

Goals

Each of the six Themes are supported by Goals (or in other words, the Goals are organized by Theme), as presented in **Figure 31.**

Through the stakeholder engagement process, SGM received and consolidated feedback on the 2015 Goals. The consensus was that the Goals were generally applicable but needed some additions, minor revisions, and wordsmithing. New Goals that were added since 2015 include a Goal to address forest health and wildfire impacts, and a Goal to protect and preserve agricultural lands.

The intent of the Goals and Themes is to represent the Roundtable's support of these actions or activities and/or support for a desired outcome or vision. The Roundtable recognizes that its role in making progress toward many of these goals is to support, promote, educate about, and fund efforts of other entities throughout the Basin toward these desired outcomes.

Figure 31: Each of the Six Basinwide Themes is Supported by Goals

Strategies

The term "Strategies" was coined during the 2022 BIP Update. Strategies are general actions and pathways identified to meet and support the Colorado Basin's Goals. They include and transcend the Projects Database. Strategies are intended to answer the question of "How can the Basin make progress toward its Goals and achieve the Basin's vision?"

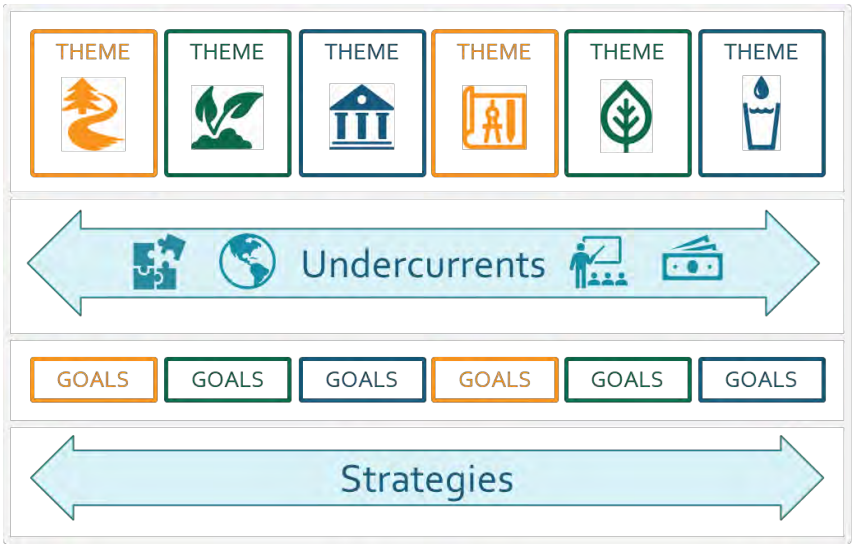


Figure 32: Strategies

The Strategies include a set of suggested actions for any and all interested parties in the Colorado Basin to consider; the Roundtable's role is to support, promote, and fund these Strategies.

As illustrated in **Figure 32,** Strategies can be applied to meet multiple Goals across the Six Themes and are therefore not categorized by Theme or associated with a particular Goal. Undercurrents can be seen surfacing throughout the Strategies.

Strategies consider, condense, and consolidate the "Measurable Outcomes" and "Projects and Methods" from the 2015 BIP. Both Measurable Outcomes and Projects and Methods in the 2015 BIP were much more specific, but Strategies are intended to be general, rather than specific action items or metrics. Strategies are intended to be broad but concise, rather than an exhaustive list.

Below are the Basin's Strategies, organized into eight categories.

Fund the Basin Implementation Plan

- Inventory existing funding mechanisms, including federal
- Develop new and/or use existing toolkits and informational resources to help project proponents find funding opportunities
- Connect with potential project partners early in project development and find matching funding sources
- Develop creative new funding solutions
- Coordinate funding efforts among multiple entities, convene recurring funding workshops with representatives from multiple funding agencies
- Fund Integrated Water Management Plans (IWMPs) and projects and actions identified by IWMPs

Support and promote legislation, policies, and agreements that align with the Goals

- Support existing critical Colorado River agreements and pursue future agreements through a lens of collaboration and partnerships among stakeholders
- Increase public outreach, education, and participation regarding policies and legislation that align with the Goals
- Investigate and support improvements to Colorado water law that encourage alternative transfer methods (ATMs), agricultural water efficiency practices, and other creative solutions while protecting the value of the water rights for the water rights owners

Use the IWMP mechanism to reduce risks and enhance benefits across all sectors

- Map key data and information across planning scenarios
  [data and information such as: diversions, water quality impairments, burn areas, insect infestations, non-consumptive needs assessment (NCNA) at-risk waterbodies, recreational attributes and considerations, etc.]
- Use the maps to characterize reaches and sub-basins
- Develop IWMPs that outline the approach, processes, monitoring programs, and projects that will align with the Basin's Goals
- Implement projects identified by IWMPs
- Revise the CBRT IWMP Framework Project information and website to include recent data, reports, and information and lessons learned from recent IWMPs
- Revise the IWMP Planning Framework to facilitate regular updates of existing IWMPs
- Use the existing IWMP framework and local partnerships to coordinate and promote local actions and projects that were identified by IWMPs or are a continuation of local work relevant to the IWMP

Implement projects that support the Goals

- Implement projects on the Project Database
- Identify and support additional projects beyond the Project Database (especially multi-use and collaborative projects), that address water shortages, infrastructure needs, and E&R needs
- Form partnerships to support multi-use reservoir projects
- Promote pilot projects that look for creative solutions and new technologies
- Address aging infrastructure needs for municipal and agricultural water users
- Use CBRT funds strategically to prioritize projects that support the Basin's Goals
- Track project data for projects funded by the Roundtable to inform modeling

Plan for uncertainty in water supply

- Develop drought plans, source water protection plans, water efficiency plans, land use plans, and other planning efforts that address water security
- Encourage entities to incorporate climate change impacts and planning scenarios from the Colorado Water Plan Technical Update into water supply planning efforts
- Reduce vulnerability of water systems to natural disasters and climate change by increasing redundancy (for example, through intakes on multiple water supply sources or permanent interconnects)
- Promote coordinated water supply planning efforts across sectors (agricultural, municipal, E&R, etc.)
- Establish regional water provider and ditch company cooperatives focused on improved regional relationships, water supply redundancy and operational flexibility, water quality mitigation, coordinated efforts for multi-beneficial projects and addressing environmental and recreational needs

Address the Gap

- Update the modeling in the Colorado Water Plan (CWP) Technical Update to improve accuracy at the regional level and incorporate more detailed modeling done by others (for example from stream management plans) to better understand the gaps
- Capitalize on science and data to understand gaps and risks and to inform the Basin's priorities and decision making
- Model impacts from planned future transmountain diversions
- Protect key West Slope water rights and resources
- Protect irrigation water rights
- Promote conservation easements to preserve agricultural land and water rights
- Encourage and pursue alternative transfer methods (ATMs) as an alternative to permanent buy-and-dry to meet growing municipal demands, while protecting agricultural water rights

Integrate the Public Education, Participation & Outreach (PEPO) Plan with the BIP Update

- Promote participation in CBRT meetings from all sectors (agricultural, municipal, E&R, etc.)
- Increase education among the general population about Colorado River Basin water issues and efforts

Use the CBRT Next Steps committee to support, foster, and implement these Strategies

- Dedicate set time at Roundtable meetings to check in on progress toward the Basin's Goals
- Dedicate set time at Roundtable meetings to check in on State and Federal issues and the Basin's water supply situation

Discussion of the Six Themes

Protect and Restore Healthy Streams, Rivers, Lakes and Riparian Areas

Rivers are the lifeblood of all basins, and the Colorado Basin in particular. Tourism, recreation, and agriculture are economic drivers, and biologically healthy rivers are foundational for these industries to thrive. Colorado's outdoor recreation economy generates $37 billion in consumer spending annually, contributes 511,000 direct jobs, and represents 10% of the states' gross domestic product. Those who work in the industry have collectively earned over $21 billion in wages and salaries, while those who support it have generated $9 billion in state and local tax revenue (COEDIT, 2021).

The core water values of vibrant and sustainable cities, productive agriculture, safe drinking water, wildlife and habitat, and robust recreation and tourism industries, depend on a strong environment that includes healthy watersheds, streams, rivers, lakes, and riparian areas.

The environmental and recreational sectors – often collectively referred to as environmental and recreational (E&R) – do not consume or use water as part of their existence, they simply thrive from the presence of water. This type of water use is referred to as non-consumptive use.

The Colorado Basin Roundtable also recognizes that watershed health is a function of the condition of the forests and impact the quality of streams, rivers, lakes, and riparian areas. The Colorado Basin faces many forest and watershed health challenges, such as wildfire and debris flows (discussed in detail earlier in the General Water Situation and Challenges Section, subsection on Watershed Function and Forest Health). As such, enhancing climate resiliency of watersheds is a critical part of protecting and restoring healthy streams, rivers, lakes, and riparian areas. One of the Goals of this Theme is to protect and maintain healthy forests, mitigate wildfire impacts, and rehabilitate damaged forests.

Assure Dependable Basin Administration

Colorado's water law and the administration of those laws form the foundation of our ability to provide reliability and flexibility in the development and protection of water resources. Protecting the Shoshone Hydroelectric Plant, Grand Valley irrigators' water rights (Cameo Call), and the 15-Mile Reach are vital to both consumptive and non-consumptive needs. It is imperative that Basin and West Slope entities work together to ensure the Shoshone Hydroelectric Plant water rights are maintained in perpetuity to ensure downstream water deliveries are made.

Other challenges in assuring dependable basin administration are related to the 1922 Colorado River Compact. One challenge is avoiding a compact deficit which might lead to administration or curtailment. This is related to maintaining Lake Powell elevations above the minimum power pool elevation to continue power production at Lake Powell. The Risk Study effort completed by the Colorado River District and the Southwestern Water Conservation District explored drivers of risk including hydrology, consumptive use, and low reservoir storage conditions. Phase III of the Risk Study also explored some potential approaches to involuntary curtailment. (Risk Study Phase III, 2019)

Sustain Agriculture

Agriculture is extremely important to the Colorado Basin and is important its local economies. Agriculture supports our open space, provides wildlife habitat, contributes to late season flows in our rivers and streams, maintains groundwater levels, produces food and fiber we all rely upon in our daily lives, and is part of our culture and heritage. The younger generations overwhelmingly say that local food sources are key to a sustainable future. Farmers are often called stewards of the land, because of the connection between land and water resources and sustainable production.

Colorado production agriculture (all farming and ranching) generated total economic contribution of about $14 billion in 2019 and supported nearly 86,000 jobs, equating to 2.2% of all jobs in Colorado. Of Colorado's production agriculture industries, the cattle ranching and farming industry is the most productive, accounting for a total economic output of over $3.5 billion and employing over 18,800 people in 2019 (Lipetzky, 2020).

Agritourism is a growing segment of the headwaters counties economies as ranchers and farmers look for additional ways to support their business activity. The Colorado Department of Agriculture defines agritourism as activities, events, and services related to agriculture that connect consumers with the heritage, natural resource, or culinary experience they value.

With the many challenges facing the Colorado Basin, the agricultural community will continue to be a leader in our Basin's efforts toward building water, climate, and economic resilience. Agricultural producers have always been resilient in adapting to reduced water supplies and challenging market forces.

Sustaining agriculture protects our working landscapes that benefit us all. The Colorado Basin Roundtable supports protecting and preserving agricultural lands, water rights, and the ability of producers to maintain profitable and productive operations. Infrastructure repairs and upgrades can help keep agricultural lands in operation and can aid producers in more efficiently diverting water for beneficial uses. Many producers rely on tributary supplies which have senior water rights, but reduced supply often leads to curtailment. Storage in tributaries can help reduce these water supply gaps.

Throughout the State, loss of agricultural land is a risk. As development increases, there has been significant pressure to convert agricultural land to other land uses. Agriculture uses the largest amount of water in the Basin and generally holds the most senior water rights. These senior agricultural water rights are a potentially attractive water supply for municipalities and industrial water users. The transfer of agricultural water rights to other uses and the resulting permanent loss of irrigated lands is referred to as "buy and dry." Buy and dry of irrigated lands has lasting impacts on the rural economies supported by agriculture, as well as on the landscape and environment.

Hay meadow dried for one year.
(Photo credit: Paul Bruchez)

Alternatives to buy and dry, referred to as alternative transfer methods (ATMs), aim to provide a temporary water supply to municipal or industrial users while preventing the permanent loss of irrigated lands. Examples of agricultural water supply methods for ATMs include temporary fallowing, deficit irrigation, and switching to lower water use crops. Water transfer methods include water banking, interruptible water supply agreements, and purchase and lease-back (in which a municipality purchases water rights and leases them back to farmers). Since 2015, the CWCB has funded many ATM studies through the CWCB Alternative Agricultural Water Transfer (ATM) Methods Grant Program, including multiple studies in the Grand Valley region.

The agricultural community in the Basin has concerns with alternatives to buy and dry that should be addressed in any ATM program:

- Producers do not want to lose their water rights or have the value of their water rights reduced.
- Landowners should be provided with help to address issues such as lost income, lost market share.
- Payments must adequately cover all of the producers' expenses.
- The land might not tolerate short term fallowing (grapes, orchards, and forages for example).
- ATM practices such as fallowing may have longer term impacts on the productivity of the land even after fallowing ceases, which would have to be included in the compensation agreement or farmers would lose income.
- Producers may not have the equipment or experience to produce new types of crops.

Reducing the buy and dry trend would require that producers be given help to transition to different practices and be protected from financial losses, and that the support be provided long term.

The problems with alternatives to buy and dry are not just limited to the Colorado Basin – the issues are the same for the producers statewide. If the alternatives to buy and dry are addressed on a broad scale, it may be possible to continue profitable agricultural production with less water use and address future water demands without building new diversion projects from the Colorado Basin.

The difficulties associated with successfully implementing alternatives to permanently taking agricultural lands out of production reflect the overall trend in Colorado's agricultural sector. The fact is that the number of agricultural producers statewide continues to decline, which leads to a sell off of land and water previously used to grow food. The primary reason that land and water are being taken out of production and sold for other uses is the fact that producers are leaving the industry. Because farm economics cannot compete with the prices offered by buyers for the land and water, incoming generations of producers elect to leave the industry. If this trend is to be reversed, the root causes of the decline in the number of producers needs to be thoroughly examined. Farm economics, limited options for young producers, centralized markets, transportation costs, access to consumers, and consumer willingness to pay are factors that have impacted the agricultural sector.

Secure Safe Drinking Water

Clean safe drinking water is essential. The public has taken safe drinking water for granted because of the excellent uninterrupted service provided by water utilities.

The Colorado Basin includes about 6 percent of the statewide population. Between the years 2015 and 2050, the 2019 Tech Update projected the Basin's population to grow from approximately 310,000 to between 460,000 and 580,000 people in the low and high growth projections, respectively. This is an increase in population of 48 percent to 88 percent. M&I water usage is also expected to nearly double, even with savings from passive conservation.

Across all planning scenarios in the 2019 Tech Update, the per capita demands are projected to decrease, but all planning scenarios project an increase in municipal demands relative to the baseline. Municipal demands are projected to grow from approximately 62,000 AFY in 2015 to between 80,000 and 107,000 AFY in 2050. Mesa County accounts for about 28 percent of the baseline demand, followed by Garfield County at about 23 percent of the basin demand. Colorado Basin combined M&I diversion demand projections for 2050 range from approximately 88,000 AFY in Weak Economy to 125,000 AFY in Hot Growth (2019 Tech Update).

The Colorado Basin has approximately 66 water providers in the basin (including municipalities, special water districts, and conservation or conservancy districts). Most of these water providers are small (< 5,000 taps). For many residents in rural areas, drinking water is supplied from private wells. The two largest water providers in the basin include the Ute Water Conservancy District in the Grand Valley region and the Eagle River Water and Sanitation District in the Eagle River region. Many water providers in the resort headwater communities face the unique challenge of highly variable demands; during peak seasons city populations can swell to over 600% of the permanent population.

Most water providers throughout the Basin have surface water intakes and/or wells as their primary source of supply and very few rely upon physical water from larger upstream reservoirs. The majority of water providers rely upon augmentation from Green Mountain Reservoir, Wolford Mountain Reservoir, or Ruedi Reservoir to meet mainstem senior calls.

Water providers in the Basin are vulnerable to extended droughts, potential Compact administration, future forest fires, uncertainties of climate change, water supply development by others, and unpredictable future land use. Several water providers (especially higher up in the headwaters) are seeking upstream reservoirs as an additional source of physical and legal water supply despite the challenges associated with the cost, complexity and timeframe associated with the permitting and regulatory climate. The development of additional water supplies may create adverse environmental, recreational, and economic impacts to the Colorado Basin that should be identified during permitting and approval processes with required mitigation. Water quality may be negatively impacted as diversion increase or diminish high quality dilution flows.

Another growing concern, not unique to the Colorado Basin, is the aging infrastructure requiring costly and timely replacement.

Water treatment plants do not remove all contaminants. Emerging contaminants are chemicals that are detected at trace levels in drinking water supplies, such as pharmaceuticals, personal care products, antibiotics, pesticides, herbicides, and endocrine disrupting compounds. Many of these emerging contaminants are difficult to remove in the treatment process, and the impacts of these compounds are still not fully understood. Emerging contaminants are a growing concern, especially for water providers that use the Colorado River as the primary source of supply.

Develop Local Water Conscious Land Use Strategies

We cannot solve Colorado water issues without addressing the fundamental link between water and land use. Basin residents recognize that the limited water supply in Colorado and the ever-increasing water demands both in the Basin and throughout the state require the development of new policies linking land use and water.

An increased emphasis is being placed on the importance of integrating land use and water use planning in Colorado and the Western United States. The 2015 Colorado Water Plan identified a Goal of integrating land use and water planning (Chapter 6.3). Colorado Senate Bill SB15-008, introduced in 2015, directed the CWCB, with assistance from Department of Local Affairs (DOLA), to incorporate land use planning into water efficiency planning. The bill directed CWCB and DOLA to implement training to support integration of these concepts and make recommendations regarding management practices that a municipality could include in its water efficiency plan that can be implemented through land use planning efforts.

The Colorado Basin from the headwaters to the Stateline is very diverse. Land use policies, water conservation practices, and local economies are all very different and are best managed by local authorities who represent and understand the local needs and are directly accountable to the local population. Implementation of these policies will likely vary based on geographic region within the Basin. Local governments have the authority and tools to ensure that new growth and development do not out strip water supply.

In general, these policies should ultimately:

- Build a culture of water conservation within the development community
- Encourage local authorities to implement conservation and growth strategies that protect and preserve efficient water resources not only for meeting consumptive needs but to address non-consumptive needs as well
- Promote regional cooperation for water resource use within the Basin
- Plan for water demands that will continue to grow beyond the current 2060 planning horizon
- Achieve balanced economies which protect and encourage agriculture
- Adopt local and regional comprehensive plans which respect and recognize locally available limited water supplies
- Direct denser growth within urban growth boundaries where water supply infrastructure and plans are in place
- Recognize the shortage and limits of water supply and establish achievable and meaningful water conservation goals
- Recognize and articulate preserving water for streams and rivers and maintaining agriculture as a trade-off for efficient outdoor landscapes and indoor use

The CBRT recommends that these policies be supported in Colorado's Water Plan, recognizing that current and future land use practices will have a significant impact on water use statewide.

Encourage a High Level of Basinwide Conservation

The CBRT supports adoption of significant water conservation and efficiency measures for all water users, including water providers, agriculture, and industry. Conservation and efficiency measures vary significantly throughout the Basin, which is expected based upon the unique geographic, cultural, economic, and climatic setting of each region. In general, there is a broad recognition that water is a finite resource.

The former "Soil" Conservation Districts, established by state law in the 1950s, now called the Conservation Districts, encouraged landowners to install soil and water conservation practices. The Colorado River Main Stem Drainage area has 7 Conservation Districts promoting conservation work with the private landowners. This work is generally not public information; however, it is estimated that these landowners have spent over $100 million of private dollars to install conservation practices over the last 60 years within the Colorado Basin. In some instances, these improvements had a 50% match with federal and or state programs, such as Environmental Quality Incentive Program (EQIP) and the many other matching dollars programs. These practices include, but are not limited to, pipelines, water control structures, gated pipes and sprinklers systems.

Currently most water providers in the Basin have conservation programs. Typical efficiency and conservation measures include:

- Education and outreach
- Voluntary and or mandatory outdoor watering restrictions (often with increasing restrictions triggered by drought or water supply conditions)
- Leak detection and correction programs
- Water loss tracking
- Integration of conservation into land use planning and regulations
- Increasing block rate structures (tiered rates) which encourage conservation
- Radio read meters which can detect leakage or red flag water usage
- Limitations on use of potable water for outside irrigation
- Adoption of Best Management Land Use Practices (BMP's) for outside irrigation
- Adoption of plans that require more xeriscaping, using plants that don't require irrigation, and reducing irrigation of remaining turf
- Codes or ordinances requiring low-flow appliances

The basin has been making continual progress toward this goal. The Colorado Basin average baseline per capita systemwide demand has decreased slightly from 182 gpcd in SWSI 2010 to approximately 179 gpcd in 2019 (2019 Tech Update). Some water providers have even seen a decrease in overall demand despite population growth. Despite this progress, there is still work to be done.

Other examples of more cutting-edge conservation practices within the Basin include:

- Some providers have offered incentives for xeriscaping.
- Several headwater water providers do not allow any outdoor irrigation for new development.
- Several communities have adopted land use comprehensive plans that have a maximum allowable population growth or number of taps limited by finite water supplies and/or based upon leaving adequate water in receiving streams for instream flows.
- Some providers require new developments to incorporate raw water irrigation, or offer incentives for raw water irrigation.
- Some water providers and agricultural users coordinate conservation goals and stream management plans or IWMPs. For example, the Brush Creek Management Plan includes agreed-upon diversion reductions triggered by low flows.

SECTION 3 – PROJECTS DATABASE

As described previously, one of the Basin's Strategies is to implement projects that support the Basin's Goals. The Projects Database seeks to document and track these varied ideas, projects, conditional water rights and environmental concerns, processes, and agreements.

The Projects Database is by no means a complete list of all plans and works in progress within the Basin. The Projects Database rather helps the Basin track progress, illuminates potential next steps to make progress toward the Goals, helps the Basin strategically allocate funding for projects that support the Goals, and helps the CWCB understand the need for funding.

The 2015 BIP introduced the concept of the Projects Database (at the time also referred to as the Identified Projects and Processes, or IPP List). A major effort of the 2022 BIP Update was to create a standard framework for gathering project data for a dynamic project database. Types of project data gathered as part of this effort include:

- Project name and description
- Project implementation status (concept, planned, implementing, completed, or not pursuing)
- Keywords (based on the measurable objectives from Chapter 10.2 of the CWP)
- Project location (county, water district, and coordinates)
- Lead proponent and contact information for the proponent
- Percent of project need, emphasis, or focus dedicated to each of four categories (municipal & industrial, agricultural, environmental and recreational, administration)
- Estimated yield and capacity of the project
- Estimated cost of the project
- Funding amount and source already secured for the project
- Project tier in five categories (described in the following section)

A static version of the Projects Database (at the time of writing this report) is in **Exhibit D**. A dynamic version of the Projects Database which may be updated as needed is in **Exhibit E.**

Input Process

SGM solicited input far and wide for the 2021 update of the Projects Database. SGM developed a form template for adding new projects or updating projects from 2015. This form template is included as **Exhibit C**.

The input process consisted of two main tasks: updating the 2015 Projects Database and soliciting new projects that should be added to the list in 2021.

To update projects in 2015, SGM relied upon the expertise of the Regional Leads and reached out to project proponents as necessary to gather additional details about the project. SGM also relied upon the expertise of the River District in updating Basinwide projects. SGM also solicited for new projects during Roundtable and Next Steps meetings and during the November 9, 2020, Webinar. During each of these meetings, SGM provided an explanation on the Projects Database and its relevance to the BIP Update and Colorado's water planning process and provided guidance on how to update and add projects.

Revisions and additions to the Projects Database were solicited during the following meetings:

- May 18, 2020 Roundtable Meeting
- May 29, 2020 Regional Leads Meeting (with meeting focus of updating the Projects Database)
- July 10, 2020 Regional Leads Meeting (with meeting focus of updating the Projects Database)
- July 13, 2021 Roundtable Next Steps Committee Meeting
- July 27, 2020 Roundtable Meeting
- September 28, 2020
- October 19, 2020 Regional Leads Meeting
- November 9, 2020 Webinar
- November 23, 2020 Roundtable Meeting
- January 25, 2021 Roundtable Meeting
- Special meetings with Regional Leads and representatives from each region

SGM also distributed the Projects Database form template (**Exhibit C**) and draft Projects Database list to solicit input. SGM send these materials and solicited input to many groups, including:

- Cities, towns, special districts, and other water providers throughout the Basin
- Counties throughout the Basin
- Local watershed groups throughout the Basin
- Regional Leads (who then distributed the form to interesting parties within their regions)
- The Colorado Basin Roundtable and Next Steps Committee email distribution lists

SGM also hosted special meetings, calls, and email consultations to discuss IPP List additions and updates with the representatives from the following entities who expressed interest participating in the Projects Database:

- Garfield County
- Grand County
- Summit County
- Pitkin County
- City of Glenwood Springs
- City of Aspen
- Town of Vail
- Town of Granby
- Homestake Partners
- Grand County Water & Sanitation District
- Eagle River Water and Sanitation District
- Upper Eagle Regional Water Authority
- Middle Park Water Conservancy District
- Colorado River District
- Middle Colorado Watershed Council
- Eagle River Watershed Council
- Roaring Fork Conservancy
- Upper Colorado River Watershed Group
- Blue River Watershed Group
- Trout Unlimited
- Colorado Parks and Wildlife
- CBRT Environmental Representative
- CBRT Agriculture At-Large Member
- Grand Valley Drainage District
- Grand Valley Water Users Association
- Holy Cross Cattleman's Association
- Ruedi Water and Power Authority
- Orchard Mesa Irrigation District
- Ute Water Conservancy District

Costs

For many projects with a status of implementing or which are planned for the near future, the project proponent has detailed and accurate cost estimates. For projects where costs have not already been estimated, SGM relied upon the Costing Tool which was developed by the CWCB as part of the 2019 Tech Update. The assumptions made in the Costing Tool are documented in the 2019 Tech Update Volume 2 Section 5. Specific assumptions made in developing costs for individual projects in the Projects Database are documented in the descriptions for each project in **Exhibit D**.

Tiering

The 2022 BIP Update introduced the concept of assigning "tiers" to projects on the list. The project tiering is a preliminary characterization of the project's alignment with the Goals and readiness to begin. Project tiering was a team effort accomplished with help from the CBRT, Regional Leads, project proponents, and BIP Update Team.

Projects are assigned tiers in five categories, as described in **Figure 33**. A formula in the Projects Database spreadsheet then calculates an overall tier for the project based on the project status, the five categories of tiering, and the completeness of other core data needs (such as yield, capacity, and cost). **Figure 34** describes the meaning of the overall project tier. The Projects Database is dynamic and as such, projects may move through tiers over time.

Category	Tier 1	Tier 2	Tier 3	Tier 4
Timeline	Read to launch < 1 year	Could launch in < 2 years	Could launch in 3 – 5 years	Unclear or >5 years
Basin Plan Alignment	Meets 3+ Themes of CO BIP	Meets 2 Themes of CO BIP	Meets 1 Theme of CO BIP	Unclear or none
Local Plan Alignment	Extensive local planning & support	Some local planning & support	Not clearly identified in local efforts	Unclear or none
Colorado Water Plan Alignment	Benefits multiple (3+) sectors in the Water Plan (Ag, Env & Rec, M&I)	Benefits multiple (2+) sectors in the Water Plan	Benefits at least 1 sector in the Water Plan	Unclear or none
Criticality	Critical (severe impact to Basin if not pursued)	Significant Basin effort (would advance Goals)	Could be of Basin interest, not as clear	Unclear or none

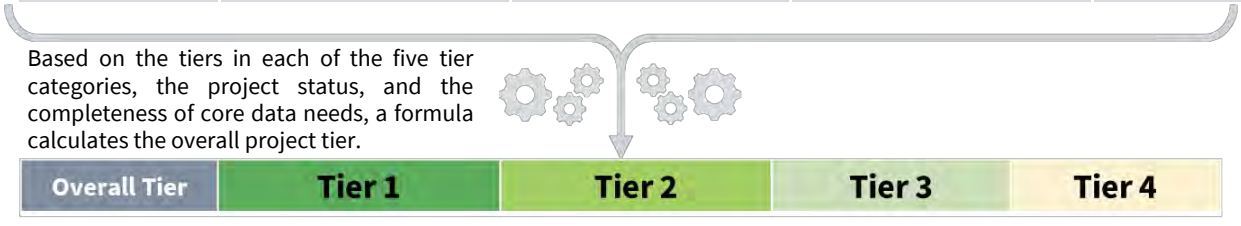


Figure 33: Explanation of Criteria for Five Categories of Project Tiering and Overall Project Tier

The meaning of the overall project tier is described in **Figure 34**. The purpose of the project tiering is *not* to rank or pit one project against another. The tiering is intended to be a tool for the Roundtable to track projects, identify projects for funding, and consider all projects (E&R, Ag, and M&I) on equal footing. Project tiers will be useful for basin-level WSRF grant approval discussions where the data fields describing alignment with BIPs, local planning, and criticality are likely to be considered. It is also a tool for CWCB to assess overall costs and funding needs on different timescales from immediate to long-term, and to understand each basin's priorities.

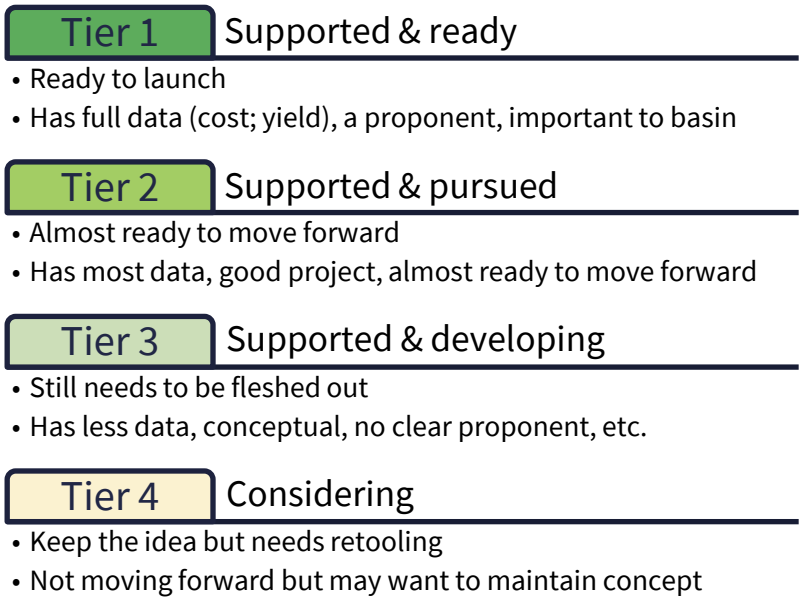


Figure 34: Meaning of the Overall Project Tier

Projects Discussion

This section presents and discusses findings about the projects in the Projects Database as of May 1, 2021. The projects database is an evolving list, and as such the graphs and statistics in this section are a snapshot in time. The Projects Database can be viewed in **Exhibit D**.

Of the 407 projects from the 2015 list, 174 projects remain on the list as implementing, planned, or concept. 152 projects were added in 2020, of which 5 had already been completed and 147 are implementing, planned, or concept. A total of 321 active projects remain on the list.

Projects by Status

All the projects from 2015 were assigned a status during the 2022 BIP Update effort, and status was assigned for all new projects added as a part of this effort. Finished projects were marked as "completed" and then were not assigned tiers. Some projects were marked as "not pursuing" because have been determined as not feasible, are not relevant on the list, are no longer supported, are too vague for tracking, or if insufficient information was available from the 2015 list. These were marked as "not pursuing" and not deleted to keep a record of the Basin's efforts. **Figure 35** shows the status of all 2015 and new projects, including those marked completed or "not pursuing."

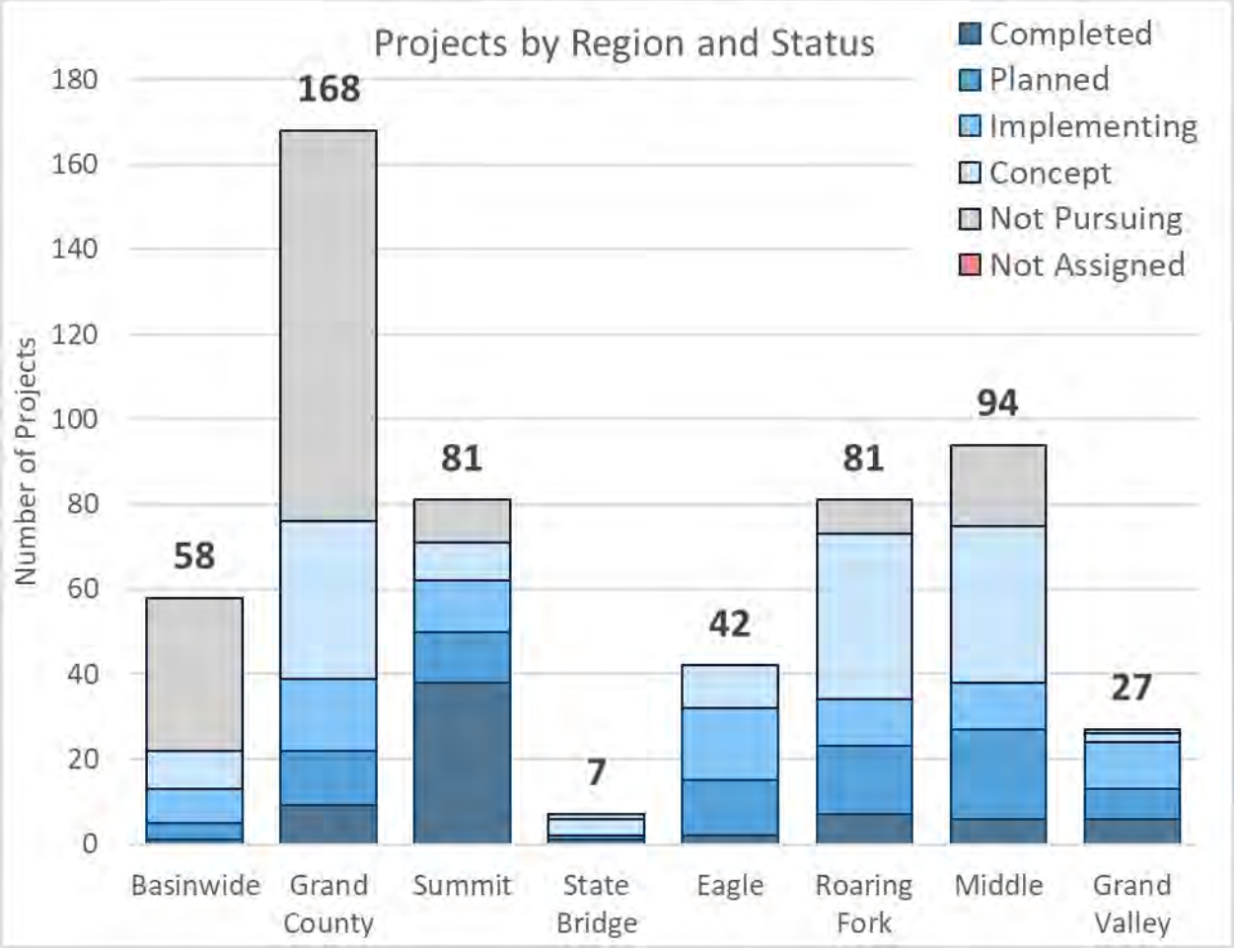


Figure 35: Projects by Region and Status

Consolidating the Projects Database

The BIP Update Team heard feedback from stakeholders that the Projects Database felt cumbersome because of its size. With over 400 projects from 2015 alone, there was concern that after adding new projects in 2020 the list would become unwieldy. A primary goal of this 2022 BIP Update was to make the BIP more usable. Hearing this feedback, the team put substantial effort into condensing and consolidating the list. The team used the status of "not pursuing" to pare down the list.

Many of the projects from 2015 that were marked as "not pursuing" (over 80 projects) were individual provisions from the Colorado River Cooperative Agreement (CRCA), the Windy Gap Firming Project Intergovernmental Agreement, and other relevant agreements. Most of these agreement provisions were located in the Grand County region, which is why that region shows so many projects in the "not pursuing" category. To make the Projects database more manageable and more usable, the Grand County region opted to consolidate these many agreement-related projects from 2015 into a few new projects with a 2020 date. The Summit Regional Leads and stakeholders were able to approach the many CRCA provision related projects in the region in a different manner; they marked fourteen of these projects as "completed" based on the status of the provision. This is a significant factor in why more projects have been marked completed in the Summit region.

Many of the projects from 2015 that were marked as "not pursuing" were Basinwide projects. These include duplicate projects (such as multiple entries regarding Shoshone); projects that the BIP Update Team and CBRT considered to be more of position statements than projects (such as "Reuse to extinction on all existing transbasin diversions prior to any additional transbasin projects"); projects that were too vague or broad to track (such as a project titled "Education and Outreach, Conservation and Stewardship"); projects that are currently being pursued and funded federally and do not require support or funding from the CBRT (such as certain NRCS programs); and projects that were determined to be infeasible (such as pursuing imported water from other states).

Projects by Tier

All projects with a status of implementing, planned, and concept were assigned tiers and an overall project tier was calculated. **Figure 36** is a summary of project tiering. **Figure 37** shows the number of projects in each region by tier.

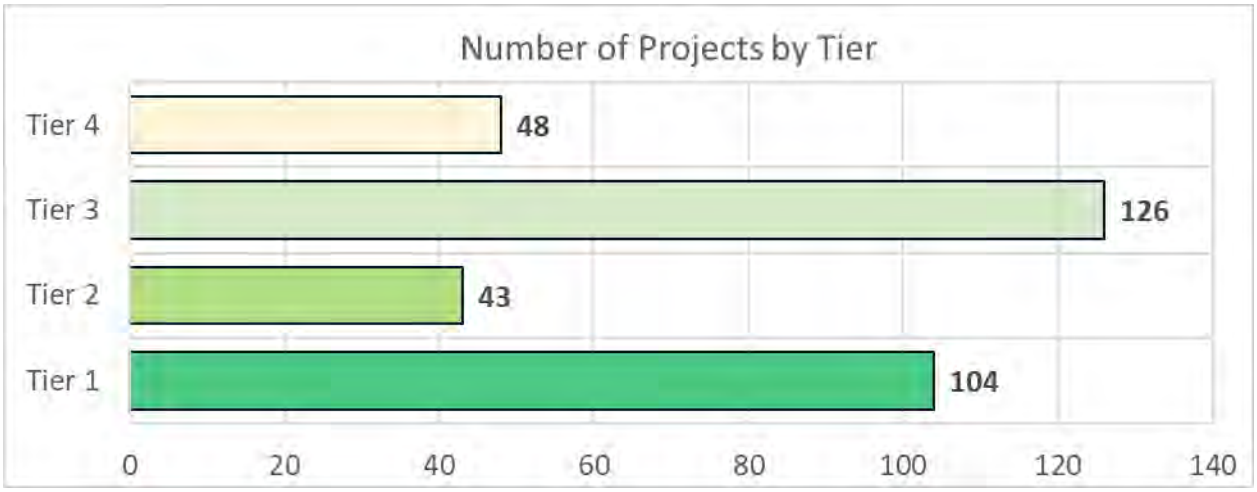


Figure 36: Number of Projects by Tier

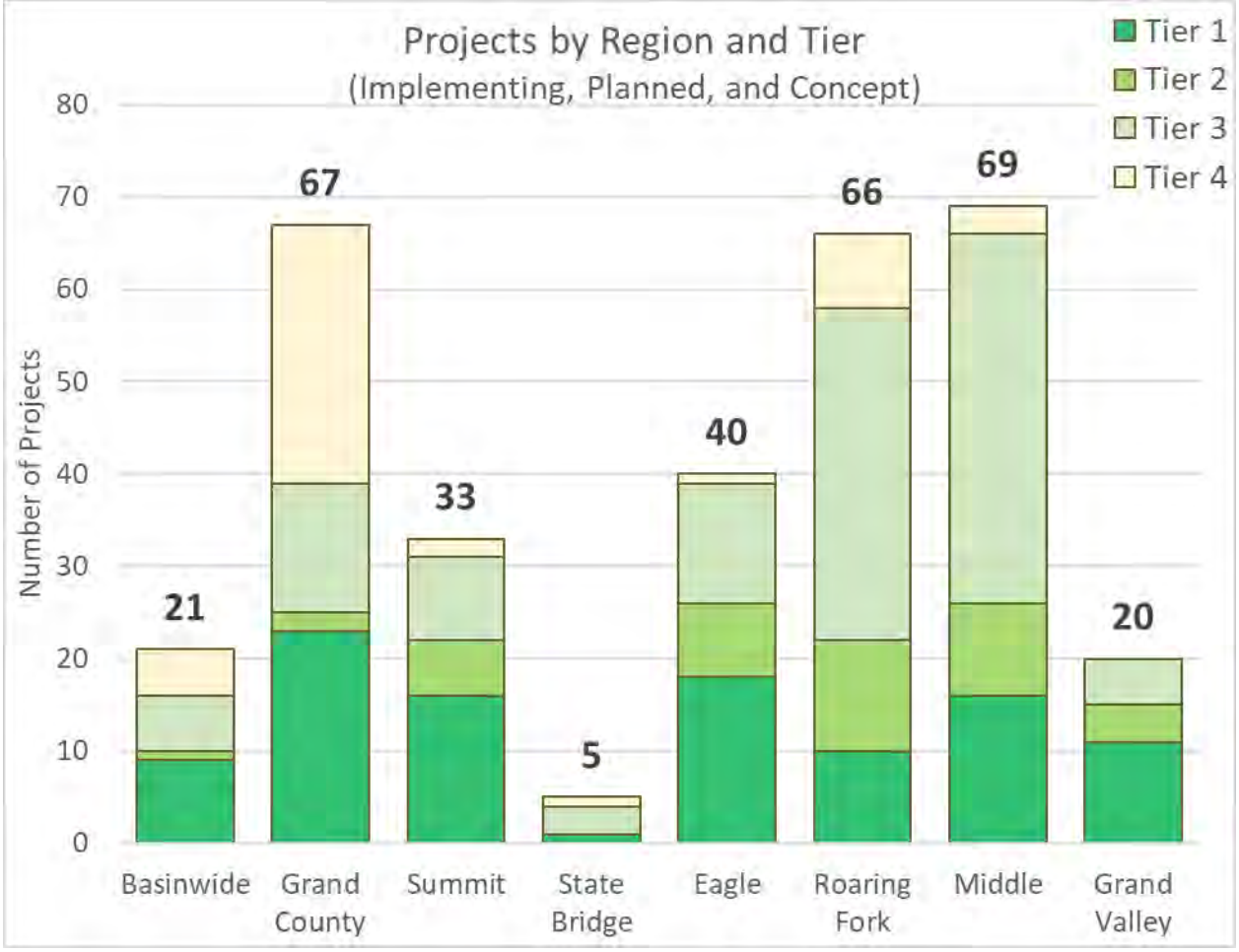


Figure 37: Projects by Region and Tier

Project Costs

The comparison shown in **Figure 38** between total estimated project cost and funding secured shows that the Basin is facing a massive funding gap in the short and long-term. Understandably, more project funding is secured for the Tier 1 (supported and ready) projects. The total cost of all Tier 1 projects in the Basin is an estimated $484 Million, with only $ 4.87 Million in funding secured. This comparison shows that significant funding efforts will be needed to make progress on the Basin's identified projects.

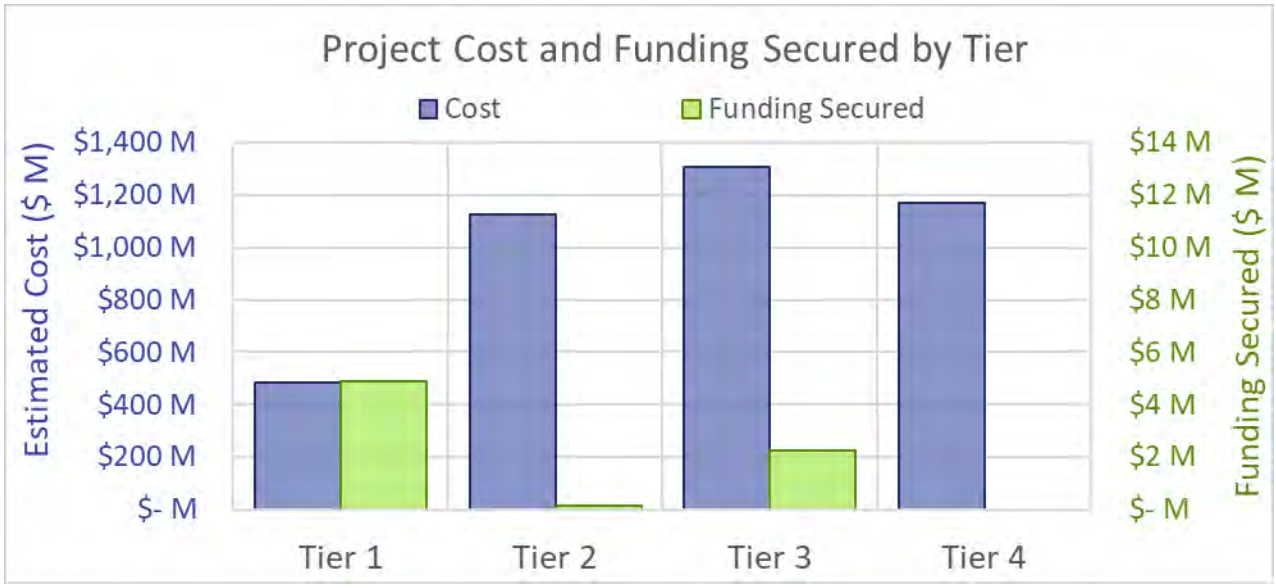


Figure 38: Project Cost and Funding Secured by Tier

Note that the axis values for cost in **Figure 38** are 100-times the axes values for funding secured (in order to show both figures on the same figure).

Volunteers plant native vegetation along Rifle Creek as part of a riparian restoration project with Colorado Natural Heritage Program and Middle Colorado Watershed Council. Photo by Lisa Tasker.

Project Categorization

Each project was categorized into one of five categories: environment and recreation (E&R), storage, municipal and industrial (M&I), agriculture (Ag), and compact and inter-basin issues. These categories are based on keyword 4 in the Projects database. SGM assigned these categories based on input from project proponents, the project description, and percentage of project need dedicated to M&I, E&R, Ag, and administration. These figures show projects with a status of implementing, planned, and concept (does not include projects with a status of completed or not pursuing). **Figure 39** shows categorization of all projects in the Projects Database.

The large percent of projects in the environment and recreation category shows that this is a major focus for the Basin.

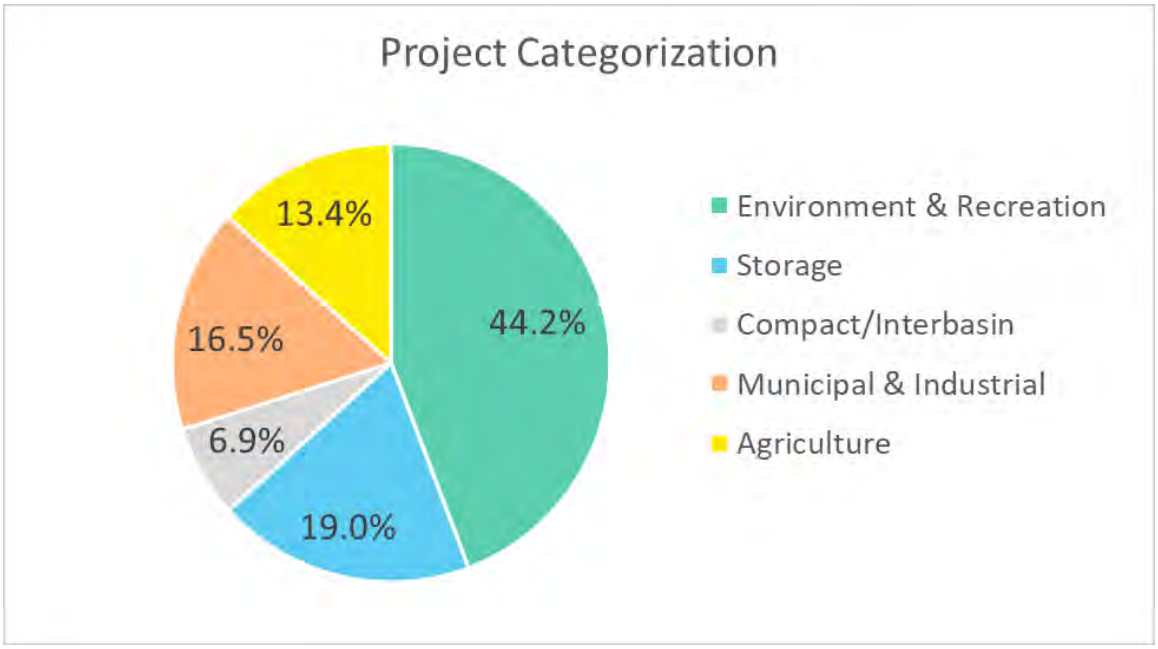


Figure 39: Project Categorization

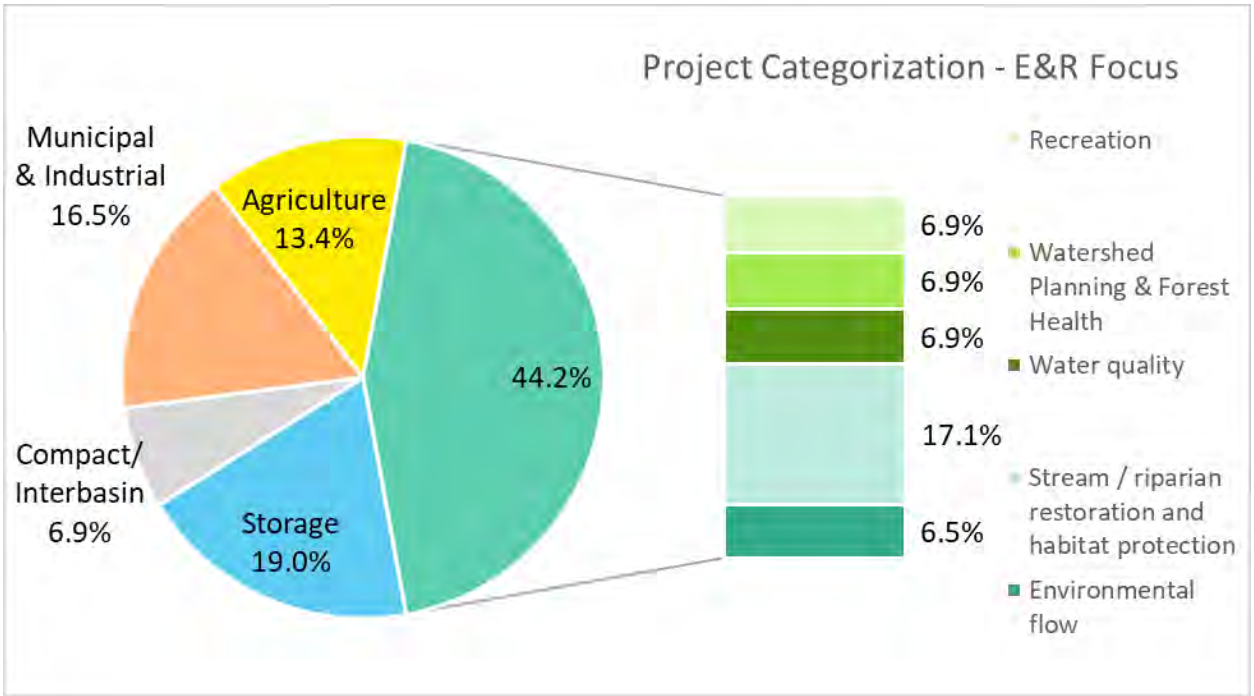


Figure 40: Project Categorization – Environment and Recreation (E&R) Focus

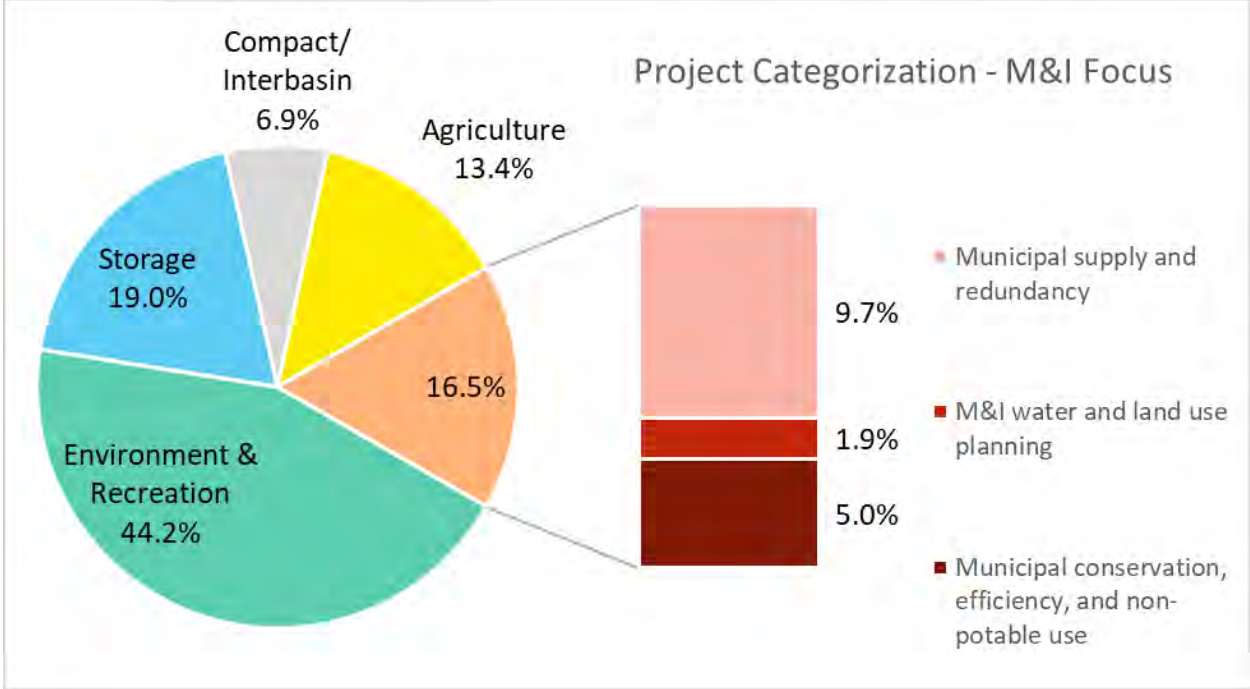


Figure 41: Project Categorization – Municipal & Industrial (M&I) Focus

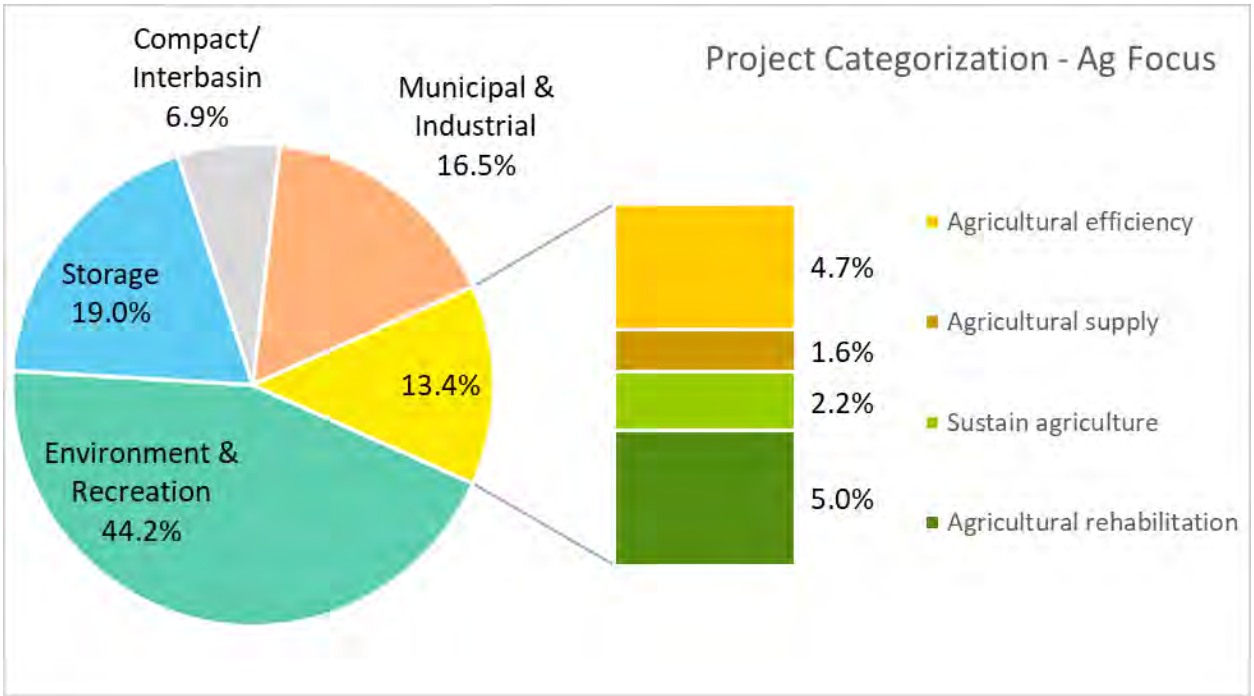


Figure 42: Project Categorization – Agriculture (Ag) Focus

Note that the reservoir projects may have a component of agriculture, municipal, and environment and recreation.

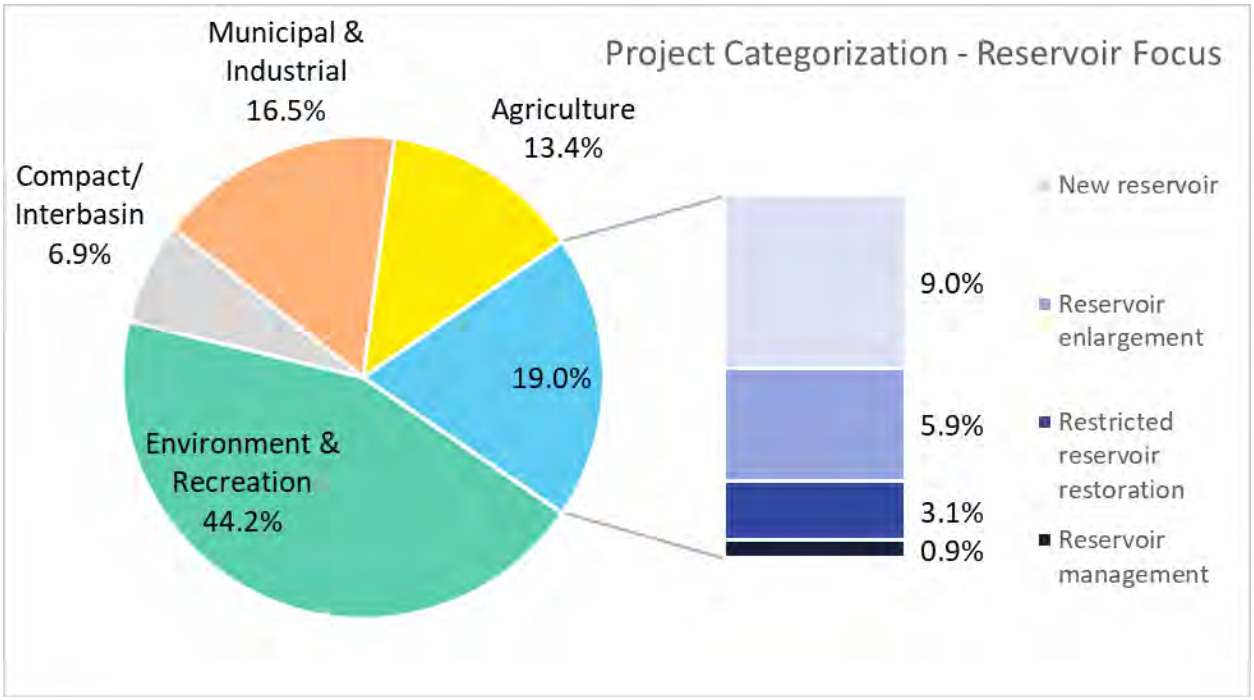


Figure 43: Project Categorization – Reservoir Focus

Water Supply Projects

Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

Project Yields

During the Projects Database effort, not enough information was collected about projects to be able to accurately compare the yield of projects to the basin's water supply gaps. For many projects, not enough was known to estimate a yield. For most projects where yield was provided, the yield was a very high-level estimate. Not enough information was available about large projects to do further modeling with any certainty to estimate anticipated yield from completion of the project. The BIP Update Team felt that the limited yield data that was collected was not reliable enough to report on total possible yield from projects for the basin or for individual regions.

Number of Water Supply Projects

As the yield data was not sufficient to provide a summary of yield from the Projects Database, this report presents a summary of the total number of projects that are considered water supply projects. Wilson Water Group reviewed information about each project in the projects database to categorize each as either a water supply project or a non-supply project (which would not have a yield).

Figure 44 shows the number and type of water supply projects by region.

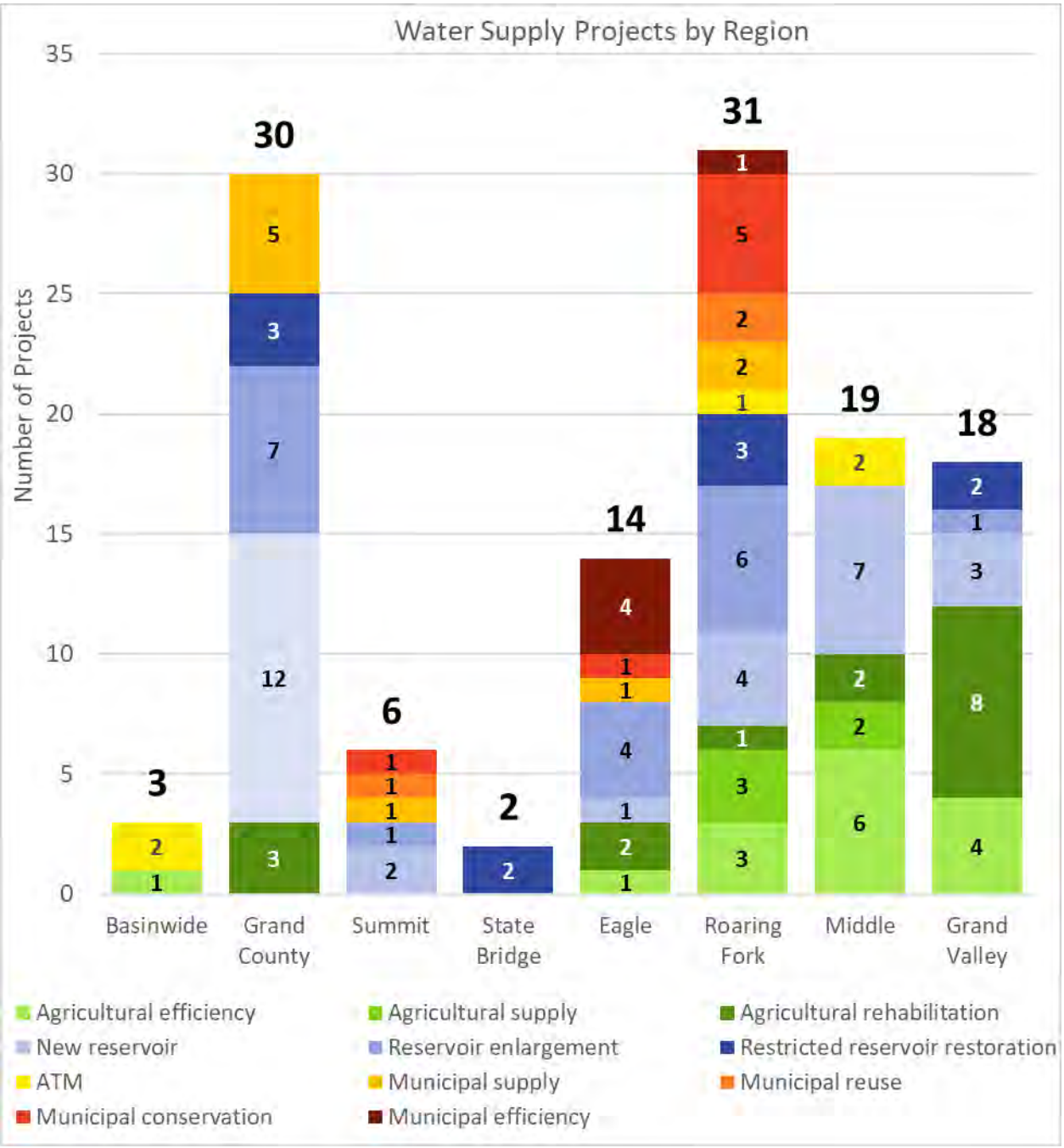


Figure 44: Water Supply Projects by Region

Basinwide Projects

All Basinwide projects that are active (status of implementing, planned, or concept) are listed **Table 3.** More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.** Similar tables listing regional projects are included in Section 4 – Regional Perspectives.

Table 3: Basinwide Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Keyword 4
CO-2015-0001	Support Ongoing Water Bank Work Group Efforts	Tier 1	3,400 AF	$ 1,375,000	ATM
CO-2015-0006	Permanency of Shoshone Call Flows	Tier 1	NA		Protect key West Slope water rights
CO-2015-0007	Shoshone Outage Protocol (ShOP)	Tier 1	NA		Protect key West Slope water rights
CO-2015-0015	Map of places where reservoir releases could help maintain minimum instream flows	Tier 4	NA		Reservoir release timing
CO-2015-0016	Develop a shepherding program for local and regional conservation efforts	Tier 4	NA		Instream flow
CO-2015-0018	Support Continued Implementation of Upper Colorado River Endangered Fish Recovery Program	Tier 1	NA	$ 8,070,000	Endangered fish recovery
CO-2015-0019	Support Continued Implementation of Colorado River Basin Salinity Control Program Improvements	Tier 1	NA	$ 3,400,000	Water quality
CO-2015-0020	Support Continued Implementation of NRCS on-farm and off-farm programs	Tier 1	NA	$ -	Agricultural efficiency
CO-2015-0031	Basinwide Environmental Projects Funding Mechanism Study	Tier 3	NA	$ 100,000	E&R funding mechanism
CO-2015-0033	Develop Basinwide Stream Management Plan	Tier 4	NA		IWMP
CO-2015-0034	Support development of statewide regulations to address responsible (water wise) growth planning	Tier 3	NA	$ -	Growth planning
CO-2015-0037	Ag Incentives Study (existing and new)	Tier 4	NA		Sustain agriculture
CO-2015-0042	Support Green Mountain Reservoir Administrative Protocol	Tier 1	NA		Protect key West Slope water rights
CO-2015-0043	Green Mountain Slot Group Inclusion for Historic Users Pool Protection	Tier 2	NA		Protect key West Slope water rights
CO-2015-0046	Pharmaceutical take-back program	Tier 4	NA		Water quality
CO-2015-0262	Relaxation of Shoshone Call Agreement Renewal	Tier 3	45,000 AF	$ 77,807,000	Protect key West Slope water rights

CO-2015-0340	Upper Colorado Wild & Scenic Alternative Management Plan implementation	Tier 1	NA	$ 170,000	Wild & Scenic Rivers Act
CO-2020-0106	Develop a regional market for water leasing between water users.	Tier 3		$ 100,000	ATM
CO-2020-0107	Promote Integrated Water Management Plans for 2021 Identified Priority Streams	Tier 1	-	$ -	IWMP
CO-2020-0108	Update Framework for Integrated Water Management Plans	Tier 3	-	$ 10,000	IWMP
CO-2020-0109	Update Basin Hydrology Data Dashboard Annually	Tier 1	-	$ 10,000	Modeling

SECTION 4 – REGIONAL PERSPECTIVES

Although united by the six Themes, the priorities and challenges from the headwater counties of Grand, Eagle, Summit and Pitkin, to the Colorado-Utah State line, are diverse. The water demands to support tourism, recreation, municipal, industrial and agricultural demands carry a different emphasis in each of these areas. The Basin was divided into seven regions to allow more focus on regional needs, vulnerabilities, methods and projects.

Each of the following regional sections begins with a brief description of the region followed by a series of three maps that depict the existing consumptive uses, environmental and recreational conditions, and key identified projects. For each map of key identified projects, projects are labeled by the project ID number to allow readers to look up projects from the map in the Projects Database (**Exhibit D**).

Focusing on specific goals, vulnerabilities, needs and top projects within each region is not intended to split the Basin but instead draw it together through better understanding of how the Basinwide Themes are prioritized.

The regional boundaries were delineated based on the State Engineer Office's (SEO) water district boundaries. Several regions mimic the exact SEO district boundaries while some were a combination of several districts and in one instance; the Middle Colorado region, was enlarged to include the Shoshone Hydroelectric Plant.

The seven regions are depicted in **Figure 45**.

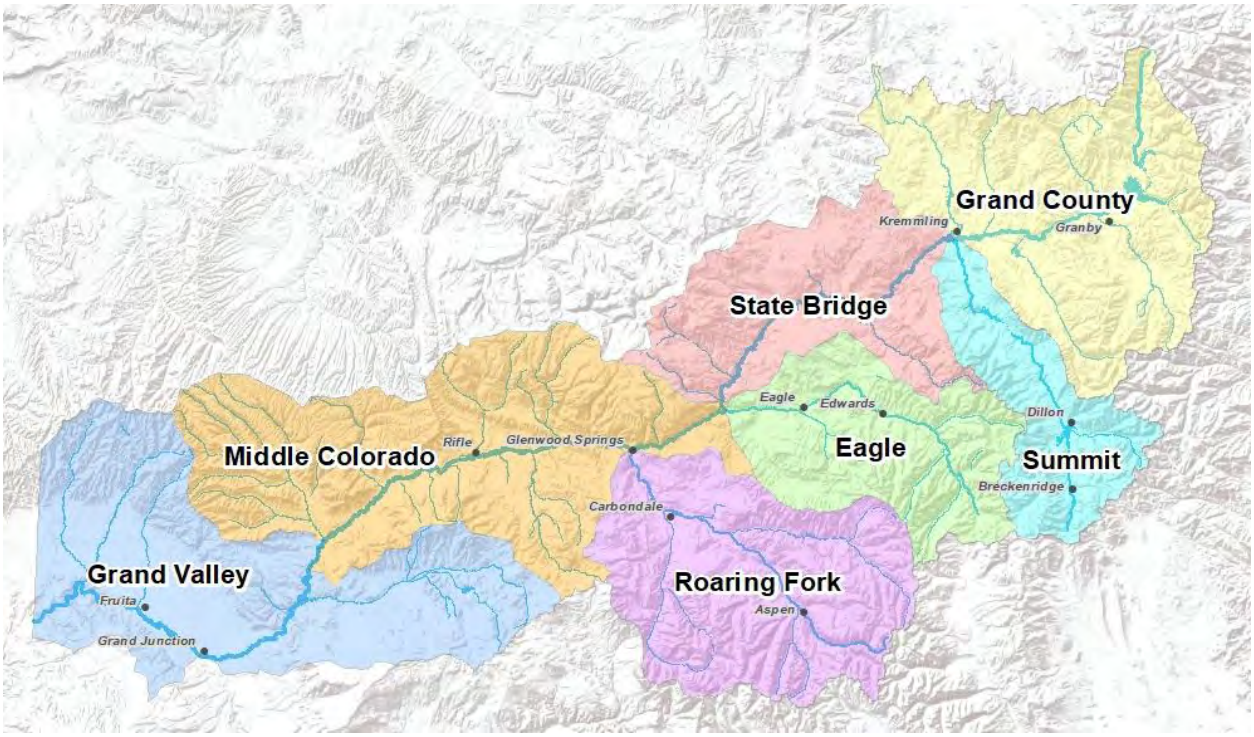


Figure 45: Colorado BIP Update Regions

Grand County Region

The Grand County region consists of the Fraser and the upper Colorado River watersheds and follows the boundary of Grand County.

This region is the most impacted region in the Colorado basin from TMDs. The diversions out of Grand County amount to more than 300,000 AFY, more than any other region in the Colorado Basin. On average, more than 60% of the Fraser River is diverted out of the Basin above Tabernash (Ranch Creek Confluence).

Colorado River near Grand Lake (Photo credit: Anita Winter)

The major TMDs include:

- Northern Water Conservancy Districts Colorado Big Thompson Project (C-BT) which diverts water through the Alva B. Adams Tunnel at Grand Lake (BOR, 2014)
- Windy Gap Project (Northern Water, 2014) sponsored by Northern Water, diverts water through a pump back system to Lake Granby and is delivered to water users via the C-BT project
- Moffat Collection System which diverts water above Winter Park through the Moffat Tunnel (Denver Water, 2014) and the Williams Fork Basin sponsored by Denver Water
- Grand Ditch, a diversion project in the Never Summer Mountains, delivers water to the Cache La Poudre River via a 14.3-mile-long ditch

Water providers in the upper Fraser River Valley are vulnerable to extended droughts, lack of redundancy, regulatory changes from Groundwater Under the Direct Influence (GWUDI) classifications, further firming from Denver's Moffat Collection Project and lack of upstream reservoir storage. Further, Grand County water providers experience large fluctuations in demand due to the tourist/recreational seasonal economy.

The protection and restoration of the Fraser and upper Colorado Rivers are critical needs for Grand County. Recent studies and reports including the Upper Colorado River Basin Study (UPCO) (Hydrosphere Resource Consultants, 2003) investigated water quantity and quality issues in Grand and Summit Counties. The Grand County Stream Management Plan (Tetra Tech, et. al., 2010) developed a framework for maintaining a healthy stream system in Grand County and was used extensively to assist Grand County in the negotiations for the Colorado River Cooperative Agreement (CRCA) and the Windy Gap Firming Projects.

Water providers in the upper Fraser Valley could consider interconnected water systems which would have multiple benefits to all users. The Grand Valley Water Council and the Eagle River Water and Sanitation District (ERWSD) are good examples that could be followed to guide these interconnections. The cooperation and interconnections would result in multiple supplies and redundancy that could protect water users from extended droughts, impacts from climate change and upstream spills in the Fraser River.

The Fraser Valley will continue to see significant growth. Existing water providers and municipalities have land use planning and water master planning in place. If land use and growth occur outside of these planned areas where plans do not exist, the development of physical and legal water supplies will be challenging and will further stress specific reaches of the Fraser River. A land use/water supply study should be undertaken to develop plans in the Fraser River that would result in better collaboration on reservoir planning and municipal water distribution system interconnections in the upper Fraser River. The lower Fraser River water providers should continue to work toward consolidation and interconnecting water systems.

Hay fields at Reeder Creek Ranch.
(Photo credit: Paul Bruchez)

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the Grand County region include:

- Grand County Water Information Network

  The organization's mission is "to coordinate, manage and consolidate the comprehensive water quality monitoring, information and educational programs in Grand County, Colorado." (GCWIN, 2021)

- Upper Colorado River Watershed Group

  Established in 2016, the Upper Colorado River Watershed Group (UCRWG) promotes awareness, conservation and appreciation of the lands and streams that compose the headwaters of the Colorado River through science, education, and outreach. The group's programs include stream corridor and forest health restoration projects, guided educational hikes and citizen science initiatives, aerial monitoring of conditions through drone photography, and community outreach and education. (UCRWG, 2021)

- Learning By Doing

  The Grand County Learning By Doing Cooperative Effort (LBD) is a unique partnership of East and West Slope water stakeholders in Colorado. LBD emerged from Inter-Governmental Agreements (IGAs) resulting from two water diversion projects, both impacting rivers in Grand County: Denver Water's Moffat Project and the Northern Water Subdistrict's Windy Gap Firming Project. Both IGAs establish a long-term partnership of cooperation, not conflict, among the groups. With a shared vision of river health, LBD cooperatively responds to setbacks in Grand County's aquatic environment. While already underway, LBD will become fully implemented—with added resources of funding, enhancement water and operational flexibility—following construction of the Moffat Collection System Project and Windy Gap Firming Project. (LBD, 2021)

- Friends of the Fraser

  The Friends of the Fraser River works to restore in-stream flows, where a minimum of 65% of the water is diverted for storage and use by Front Range cities. In the near future, the group will be focusing on public education and outreach concerning the Moffat firming project and the Windy Gap firming project. (CWA, 2021)

- Three Lakes Watershed Association

  Landowners surrounding Grand Lake, Lake Granby, and Shadow Mountain Reservoir established the Three Lakes Watershed Association to monitor water quality in the lakes affected by the Colorado-Big Thompson Project. The Association works in conjunction with public and private stakeholders to monitor lake health, including algae and plant growth, turbidity, and dissolved oxygen content. (CWA, 2021)

- Blue River Watershed Group

  While this group's focus area is primarily within the Summit Region, there is overlap with the Grand County Region. The group's mission is "to promote, protect and restore a healthy Blue River watershed through cooperative community education, stewardship, and resource management." (BRWG, 2021)

- Friends of the Lower Blue River

  While this group's focus area is primarily within the Summit Region, there is overlap with the Grand County Region. The group's mission is "to sustain and protect the traditional agricultural character, promote the safety of the residents, livestock and wildlife, and maintain the environmental integrity of the Lower Blue River Valley through education, collaboration and community involvement." (FOLBR, 2021)

The Grand County region includes the following water conservancy districts:

- Middle Park Water Conservancy District

The Grand County region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- Middle Park Conservation District

Regional Topics

East Troublesome Fire 2020

The East Troublesome fire burned a total of 193,812 acres from October 14, 2020, when the fire was first reported, to November 30, 2020, when full containment was achieved.

Rapid spread of the fire was fueled by wide-spread drought, high temperatures, low humidity, high winds, and high concentrations of dead and downed beetle-killed trees (an estimated 60-80% of the trees in the burned areas were affected by beetle kill).

East Troublesome fire impacts near Sun Valley (Photo: Merrit Linke)

The fire started in the Arapaho National Forest northeast of Kremmling. Public lands impacted include areas of Arapaho & Roosevelt National Forests, Medicine Bow-Routt National Forests, Rocky Mountain National Park, and Bureau of Land Management (BLM) lands. Private lands were also impacted. Over 35,000 people were placed under mandatory evacuation, over 7,000 structures were threatened, and

an estimated 366 residences and 214 outbuildings and commercial structures were destroyed or damaged.

> *"The fire was fueled by wide-spread drought, numerous dead and down beetle-killed trees, red flag weather conditions created by high winds and dry conditions, and poor humidity recovery overnight. The combination of these factors led to unprecedented, wind-driven, active fire behavior with rapid spread during the overnight hours. During this period the area north of US Highway 40 from near Granby and extending eastward to Grand Lake and Estes Park had over 7,000 structures threatened, and a population of over 35,000 placed under a mandatory evacuation.*
>
> *Land managers have turned their attention to post wildfire emergency response and recovery efforts. Impacted areas included the Arapaho & Roosevelt National Forests, Medicine Bow-Routt National Forests, Bureau of Land Management, Rocky Mountain National Park, and private lands. A preliminary estimate of 366 residences and 214 outbuildings and commercial structures were destroyed or damaged. Portions of these areas remain closed for public safety due to snag trees and other hazards." (InciWeb 7242)*

Williams Fork Fire 2020

The Williams Fork fire burned a total of 14,833 acres from August 14, 2020, when the fire was first reported, to Nov. 30, 2020, when the fire was reported controlled.

The fire started approximately 15 miles southwest of Fraser and threatened the communities of Fraser and Winter Park. Spread of the fire was compounded by drought, high temperatures, low humidity, and high concentrations of dead and downed beetle-killed trees.

> *"The fuels consisted of heavy dead and down beetle killed lodgepole pine and during the first week low relativity humidity of around 10 to 30 percent contributed to fire growth and behavior." (InciWeb 6971)*

Grand County Stream Management Plan 2010

The Grand County Stream Management Plan completed by Tetra Tech, et. al. in 2010. This Stream Management Plan covered 80 miles of river in the Upper Colorado River basin, spanning the length of Grand County from Winter Park to the Grand-Eagle County Line. The Plan focused on the Colorado and Fraser Rivers, and ten tributaries: Williams Fork, Blue River, Muddy Creek, Reeder Creek, Troublesome Creek and Willow Creek along the Colorado River and Jim Creek, Vasquez, Saint Louis and Ranch Creeks along the Fraser River.

The purpose of the 2010 Stream Management Plan was to provide the framework for maintaining a healthy stream system in Grand County, Colorado through the protection and enhancement of aquatic habitat while at the same time protecting local water uses, and retaining flexibility for future water operations. The report proposed to measure success based on the presence of a self-sustaining aquatic ecosystem and fishery resource while meeting water user's needs. The 2010 Plan provided recommendations of target flows, restoration opportunities, and monitoring recommendations. The report used a ranking system to help prioritize restoration and implementation efforts by reach (Tetra Tech et. al., 2010).

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 46** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 47** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 48** – depicts the location of projects from the Projects Database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up information about each project. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known. The following projects are not shown on the map because they were not assigned a project location:

- CO-2015-0167
- CO-2015-0169
- CO-2015-0180
- CO-2015-0221
- CO-2020-0114
- CO-2020-0122

IWMP Focus Areas

Stakeholders have expressed that the priorities for IWMP development in this region should be watersheds impacted by the East Troublesome and Williams Fork fires.

As discussed previously, the 2010 Grand County Stream Management Plan primarily focused on the Colorado and Fraser Rivers. Grand County identified updating the Stream Management Plan as a future project (documented in the Projects Database for the 2015 BIP and 2022 BIP Update). The Fraser River was identified as a continuing priority for the region due to the high concentration of local and transmountain diversions, as shown in **Figure 46**.

The following streams/watersheds have been identified as focus areas for development of an IWMP:

- Areas impacted by the East Troublesome Fire: East Troublesome Creek, Troublesome Creek, Willow Creek, etc.
- Areas impacted by Williams Fork Fire: Williams Fork River
- Fraser River and mainstem of the Colorado (either as an update to the 2010 Grand County Stream Management Plan or renamed as an IWMP)

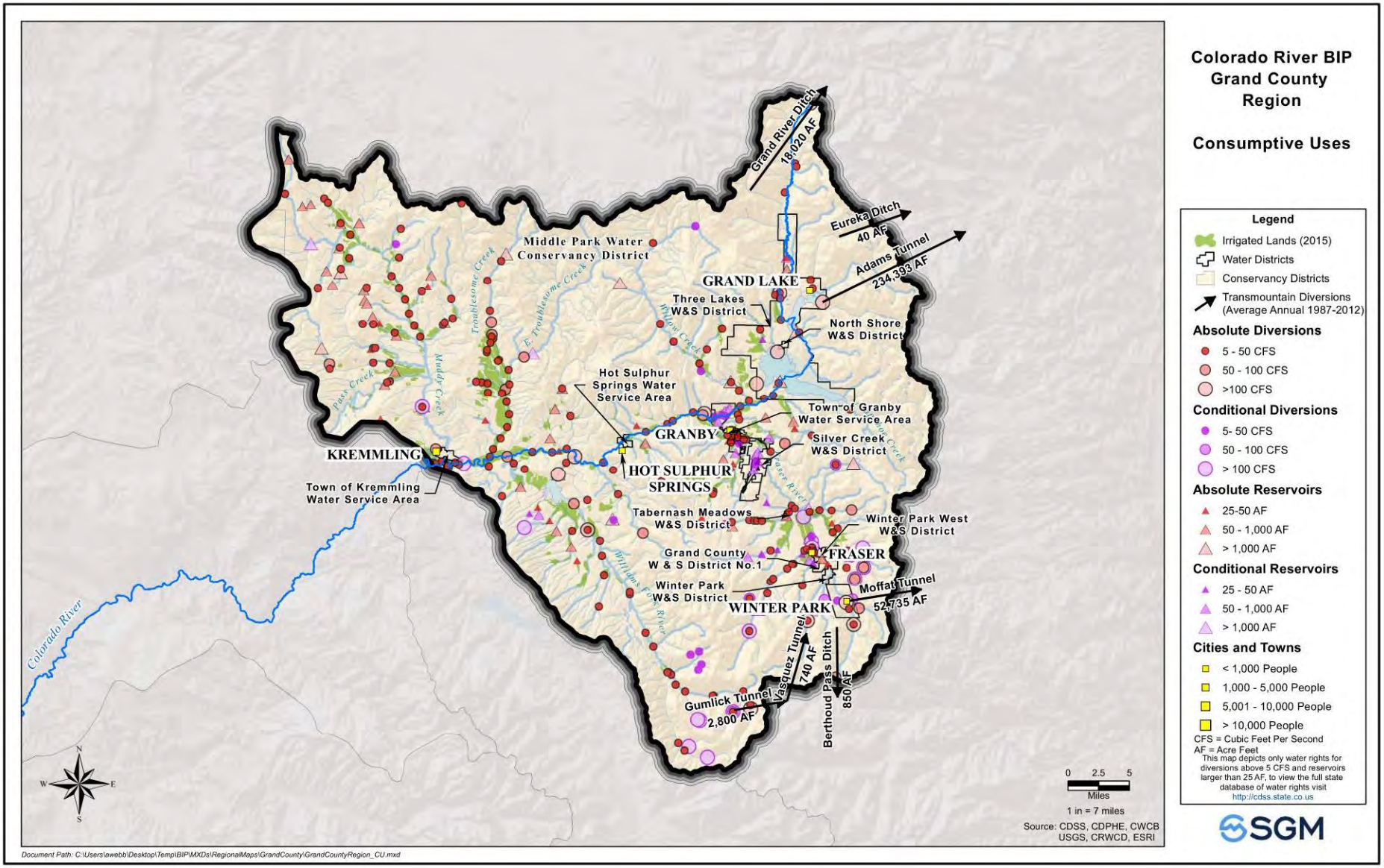


Figure 46: Map of Consumptive Uses – Grand County Region

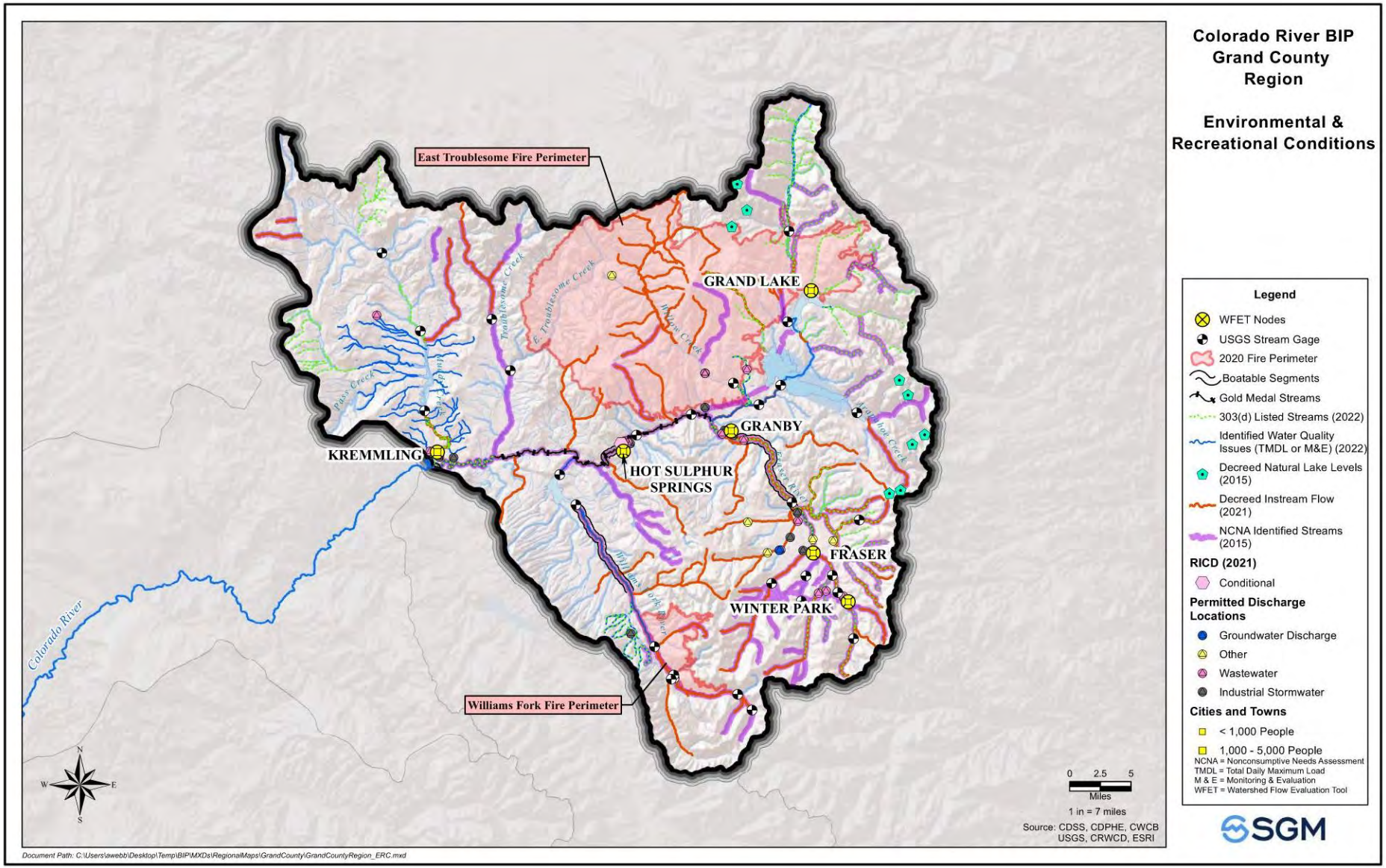


Figure 47: Map of Environmental & Recreational Conditions – Grand County Region

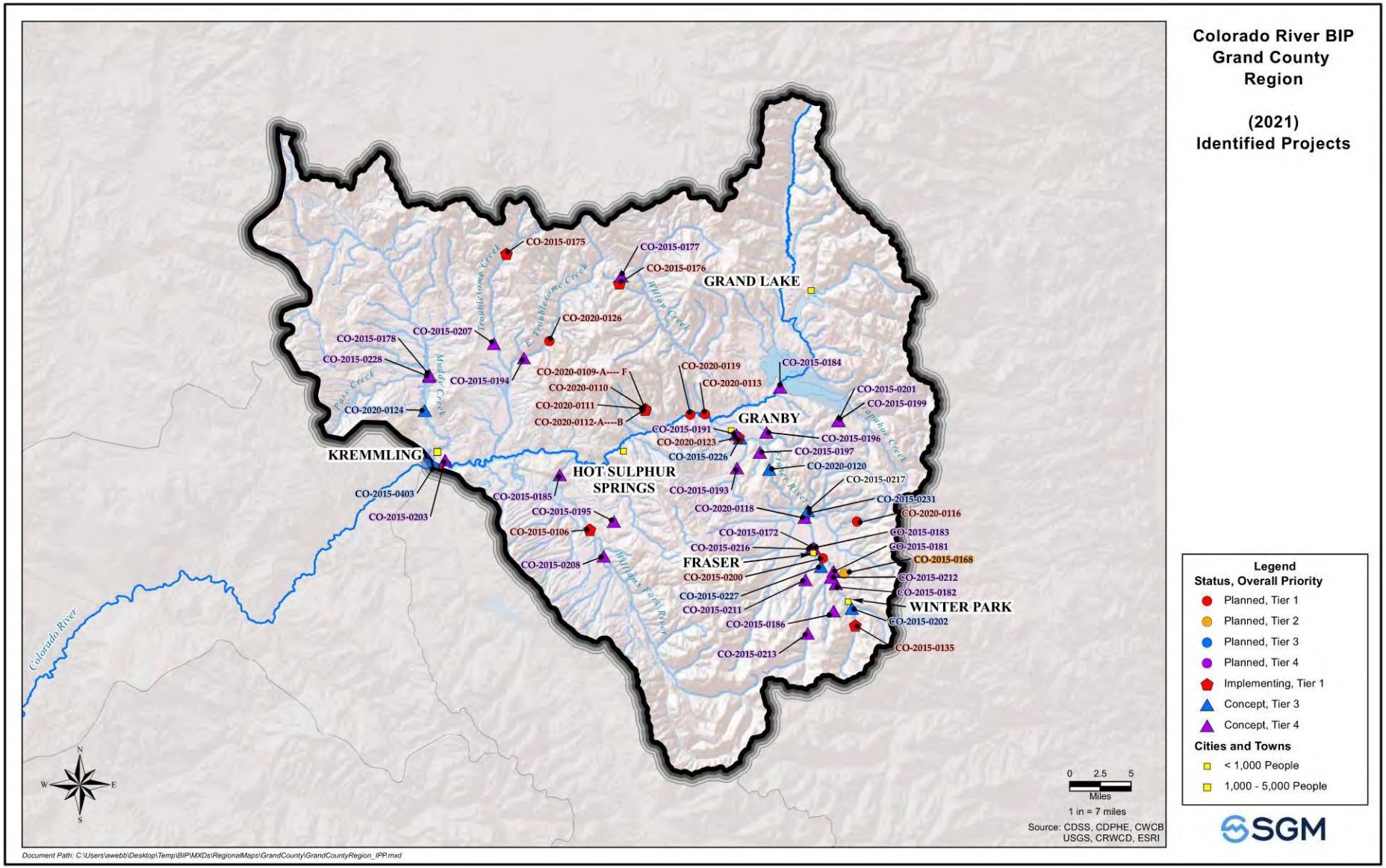


Figure 48: Map of Identified Projects from Projects Database – Grand County Region

Grand County Region Projects

All projects in the Grand County region that are active (status of implementing, planned, or concept) are listed in **Table 4**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 4: Grand County Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0106	Big Lake Ditch Study Implementation	Tier 1			Agricultural rehabilitation
CO-2015-0135	Fraser River Sediment Project – Annual Sediment Removal	Tier 1	-	$ 351,900	Water quality
CO-2015-0167	Grand Lake Clarity Agreement - Extend in Jan 2022	Tier 3			Water quality
CO-2015-0168	Winter Park Reservoir No. 2 Enlargement (GCSW&S #1)	Tier 2	15 AF	$ 25,000,000	Reservoir enlargement
CO-2015-0169	Winter Park Water and Sanitation Pump back to protect instream flows	Tier 4			Pumpback
CO-2015-0172	Remove 303d listing from Hammond Ditch, Ranch Creek, St. Louis Creek, Fraser River	Tier 4	-		Water quality
CO-2015-0175	Matheson Reservoir Restoration	Tier 1	1,074 AF	$ 100,000	Restricted reservoir restoration
CO-2015-0176	Little King Ranch Reservoir restoration	Tier 1	900 AF	$ 100,000	Restricted reservoir restoration
CO-2015-0177	Milk Creek Reservoir restoration	Tier 4	32 AF	$ 100,200	Restricted reservoir restoration
CO-2015-0178	Wolford Mountain Reservoir hydro-power and enlargement	Tier 4	6,500 AF	$ 10,108,000	Reservoir management
CO-2015-0180	Construct additional in-basin reservoir(s) in Fraser River above Fraser, in in conjunction with pumpback	Tier 4			Municipal supply
CO-2015-0181	Reduce CWCB instream flow in Fraser River below Vasquez Creek	Tier 4			Municipal supply
CO-2015-0182	Dry-year water supply, such as non-tributary groundwater, to maintain higher flows in the Fraser River.	Tier 4			Municipal redundancy
CO-2015-0183	Wastewater treatment consolidation with pumpback (Fraser River below Fraser)	Tier 4			Municipal supply
CO-2015-0184	Supplement fall and winter flow below Lake Granby through reservoir releases that could be recovered at Windy Gap	Tier 4			Reservoir release timing
CO-2015-0185	Use William Fork Reservoir for replacement releases during low flow periods instead of Green Mountain and/or Wolford Reservoirs	Tier 4			Instream flow
CO-2015-0186	Winter Park land use policy review	Tier 4			Land use policy
CO-2015-0187	Reservoir releases for endangered fishes below Kremmling	Tier 4			Reservoir release timing
CO-2015-0188	Upper Colorado Wild & Scenic Alternative Management Plan Stakeholder Group – Partnership developing management alternative to wild and scenic designation	Tier 2	-	$ 1,500,000	Wild & Scenic Rivers Act

Continued on next page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
Continued from previous page					
CO-2015-0191	GCILC – Vail Ditch	Tier 4	61.5 cfs		Agricultural rehabilitation
CO-2015-0193	Ten Mile Creek Reservoir	Tier 4			New reservoir
CO-2015-0194	Haypark Conduit and Reservoir	Tier 4	28,000 AF	$ 78,344,000	New reservoir
CO-2015-0195	Sylvan Reservoir enlargement	Tier 4	349 AF	$ 2,582,000	Reservoir enlargement
CO-2015-0196	Strawberry Ranch Reservoir	Tier 4			New reservoir
CO-2015-0197	DeBerard Reservoir (Silver Creek)	Tier 4	7.8 AF	$ 1,213,000	New reservoir
CO-2015-0199	Elk Creek Reservoir	Tier 3	7,000 AF	$ 49,758,000	New reservoir
CO-2015-0200	Grand County W&S Reservoirs Nos. 1 & 2	Tier 1	74 AF	$ 4,000,000	Reservoir enlargement
CO-2015-0201	Weloiman Creek Reservoir	Tier 4			New reservoir
CO-2015-0202	Jim Creek Reservoir	Tier 3	25 AF	$ 2,758,000	New reservoir
CO-2015-0203	Meadow Pumpers Water Rights Tabulation	Tier 4			Sustain agriculture
CO-2015-0204	ILVK Upper Colorado River Irrigation and Restoration Project (Phase 1)	Tier 1	14 stream miles		Habitat protection
CO-2015-0205	ILVK Upper Colorado River Irrigation and Restoration Project (Phase 2)	Tier 3	14 stream miles		Habitat protection
CO-2015-0207	Kirtz Ditch	Tier 4			Agricultural rehabilitation
CO-2015-0208	Lost Creek Reservoir	Tier 4	1,900 AF	$ 38,641,000	Reservoir enlargement
CO-2015-0211	Welk Creek Reservoir	Tier 4			New reservoir
CO-2015-0212	Lower Vasquez Reservoir (Fraser River Diversion Project)	Tier 4	6,616 AF	$ 56,137,000	New reservoir
CO-2015-0213	Upper Vasquez Reservoir (Fraser River Diversion Project)	Tier 4	6,616 AF	$ 56,137,000	New reservoir
CO-2015-0216	St. Louis Reservoir (Fraser River Diversion Project)	Tier 4	1,500 AF	$ 42,466,000	New reservoir
CO-2015-0217	Ranch Creek Reservoir (Fraser Valley Project)	Tier 3	20,000 AF	$ 89,607,000	New reservoir
CO-2015-0221	Stream Management Plan Update	Tier 1	NA	$ 250,000	IWMP
CO-2015-0223	Jones 1 Reservoir (Sheep Creek)	Tier 3	311 AF	$ 780,000	Reservoir enlargement
CO-2015-0224	Jones 2 Reservoir 2nd refill	Tier 3	311 AF	$ 10,000	Reservoir enlargement
CO-2015-0226	Granby North Service Area / South Service Area – drinking water system permanent interconnect	Tier 3			Municipal redundancy
CO-2015-0227	Fraser / Winter Park drinking water system interconnect	Tier 3			Municipal redundancy
CO-2015-0228	Town of Kremmling Wolford Mountain Contracts	Tier 4			Municipal supply
CO-2015-0231	Sunset Ridge Pond	Tier 4			Reservoir enlargement
CO-2015-0403	Proposed Wetland Bank	Tier 3	TBD	TBD	Stream / riparian restoration
CO-2020-0109-A	Colorado River Cooperative Agreement Implementation	Tier 1	NA		Colorado River Cooperative Agreement
CO-2020-0109-B	CRCA West Slope Water Supply Enhancement	Tier 1	NA		Colorado River Cooperative Agreement
Continued on next page					
Continued from previous page					

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2020-0109-C	CRCA Water Quality Improvement Projects	Tier 1	NA		Water quality
CO-2020-0109-D	CRCA Water Supply Infrastructure Projects	Tier 1	NA		Municipal supply
CO-2020-0109-E	CRCA Habitat Improvement Projects	Tier 1	NA		Habitat protection
CO-2020-0109-F	CRCA Public Access	Tier 1	NA		Recreation access
CO-2020-0110	Grand County Mitigation and Enhancement Coordination Plan (MECP)	Tier 1	NA		Protect key West Slope water rights
CO-2020-0111	Moffat Mitigation Requirements	Tier 1	NA		Habitat protection
CO-2020-0112-A	Windy Gap Firming Project 1041 & IGA	Tier 1	NA		Transmountain diversion
CO-2020-0112-B	Windy Gap Firming Project IGA Key Provisions	Tier 1	NA		Transmountain diversion
CO-2020-0113	Colorado River Connectivity Channel	Tier 1	-	$ 23,000,000	Stream / riparian restoration
CO-2020-0114	Learning by Doing (LBD) program	Tier 1	NA		Habitat protection
CO-2020-0116	Cabin Creek Fish Passage Project	Tier 1	-	$ 200,000	Fish passage
CO-2020-0118	Fraser Flats Project II	Tier 3	-	$ 359,000	Stream / riparian restoration
CO-2020-0119	Colorado River (Kemp-Breeze) Habitat Improvement Project	Tier 1	-	$ 1,200,000	Stream / riparian restoration
CO-2020-0120	Granby Ranch Stream Improvement	Tier 3	-	$ 300,000	Stream / riparian restoration
CO-2020-0122	Colorado River Fish Passage Improvement Project	Tier 3	-	$ 1,100,000	Fish passage
CO-2020-0123	Kaibab Park Stream Improvement Project	Tier 1	-	$ 100,000	Stream / riparian restoration
CO-2020-0124	Muddy Creek diversion structure and channel improvements	Tier 3	-	$ 400,000	Stream / riparian restoration
CO-2020-0126	East Troublesome Fire Restoration and Watershed Protection Projects	Tier 1	-	$ 5,300,000	Forest health

Projects Discussion

The Grand County region is represented by a wide variety of projects in the Projects Database. **Table 5** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 5: All Active Projects (Implementing, Planned, Concept) by Category – Grand County Region

Project Category		Number of Projects Grand County	
E&R Projects	Recreation	1	25
	Watershed Planning & Forest Health	2	
	Water quality	4	
	Stream / riparian restoration and habitat protection	14	
	Environmental flow	4	
Reservoir Projects	New reservoir	12	23
	Reservoir enlargement	7	
	Restricted reservoir restoration	3	
	Reservoir management	1	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	5	5
M&I Projects	Municipal supply and redundancy	9	10
	M&I water and land use planning	1	
	Municipal conservation, efficiency, and non-potable use	-	
Ag Projects	Agricultural efficiency	-	4
	Agricultural supply	-	
	Sustain agriculture	1	
	Agricultural rehabilitation	3	
Total		**67**	

The Grand County region has a large focus on environmental and recreational projects. **Table 6** provides statistics about the capacity of these projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity, especially those which are still conceptual.

Table 6: Statistics for Environment and Recreation Projects – Grand County Region

	Grand County
Project Category	**Project Capacity**
Fish passage	4 stream miles
Habitat protection	14 stream miles
Stream / riparian restoration	12 stream miles
Wild & Scenic Rivers Act	54 stream miles
Forest Health	192,000 burned acres

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize the yield of projects from the Projects Database. Instead, a discussion of the region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 7**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 49**. Note that reservoir projects may have an agricultural component, a municipal component, or both. As such, some reservoir projects are shown both as a municipal and industrial supply project and an agricultural supply project, and some are shown only in one category.

Table 7: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Grand County Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	210,000	200,000	200,000	250,000	180,000	270,000
Agricultural Average Demand Gap (AF/year)	6,500	5,900	5,900	14,000	12,000	21,000
Municipal & Industrial Max Demand (AF/year)	6,400	8,600	7,800	8,700	8,200	9,800
Municipal & Industrial Maximum Gap (AF/year)	750	1,500	1,200	1,900	1,700	2,800

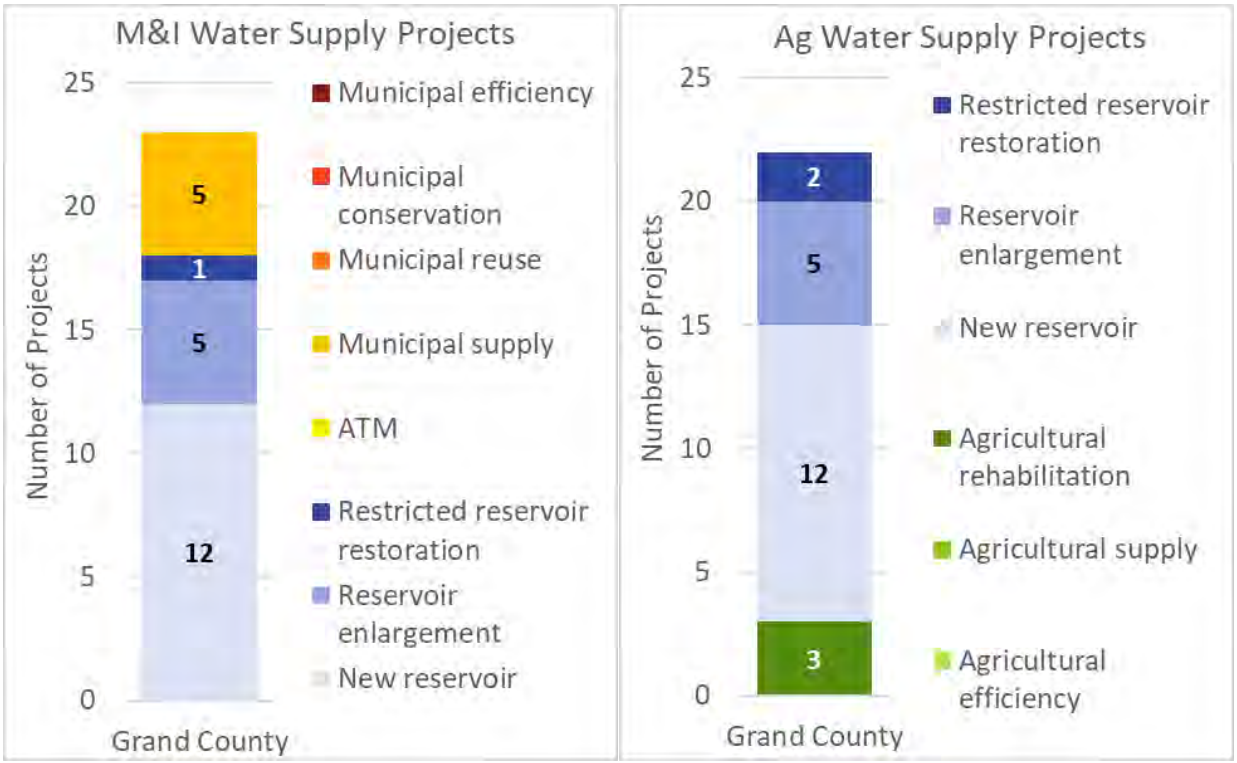


Figure 49: Water Supply Projects – Grand County Region

Water supply challenges in the region are driven by the headwaters nature of the region, where supplies for agricultural, municipal, and industrial uses are sourced from small high altitude tributaries. The region's supply is also heavily impacted by the large volume of transmountain diversions supplied from this headwaters region, with more than three times the amount diverted from any other region.

Many of the supply projects in this region are small high-altitude storage, including small new reservoirs located above the physical diversion locations. Regulatory restrictions, high costs, and variable geologic conditions have prevented proceeding with these conditional storage rights. Collaboration among the water users in the Fraser Valley, Grand County, Middle Park Water Conservancy District, Denver Water, Winter Park Recreation Association, CWCB (minimum instream flow program) and others should occur in order to permit and build these small reservoirs to provide redundant water supplies. This relates strongly to the Basin's Strategy to "form partnerships to support multi-use reservoir projects."

The Grand County region has significant agricultural demand gaps under all scenarios. Recall from **Figure 24** in **Section 2** that the Grand County region has the second highest agricultural gap of any region under most of the planning scenarios. To address this gap with projects, the region is primarily focused on multi-use storage project with an agricultural component. The other agricultural projects are all focused on agricultural rehabilitation, such as the Big Lake Ditch Study Implementation (CO-2015-0106) which focuses on maintaining agricultural uses of the Big Lake Ditch will require improvements to the ditch and/or diversion structure.

Recall from **Section 2** that the Grand County region has the second lowest municipal demand of the regions (**Figure 25** in **Section 2**) but the third highest municipal gap (**Figure 26** in **Section 2**). This is also related to the challenges of sourcing supply from small headwaters streams impacted by transmountain diversions. The region also has the largest industrial gap (**Figure 28** in **Section 2**), which is related to the mining facility demands.

Small high-altitude storage projects are critical to supporting the region's municipal and industrial needs. In addition to municipal and industrial storage in multi-use reservoir projects, many of the municipal supply projects in this region focus on pumpback options on the Fraser River. The goal of pumpback options is to continue supporting environmental and recreational instream flow needs through specific reaches while still capturing that supply for municipal and industrial needs. Pumpback projects are typically paired with storage. The CRCA also includes multiple provisions aimed at improving water supply infrastructure in Grand County, which are captured in project number CO-2020-0109-D.

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

State Bridge Region

State Bridge River access near Wolcott (Photo credit: CBRT)

The State Bridge region consists of the Colorado River from below Kremmling at the top of Gore Canyon to Dotsero at the confluence with the Eagle River and includes Rock Creek, Piney River and Deep Creek. The Colorado River throughout this region has significant whitewater recreational amenities including Gore Canyon. This region is defined by the lack of significant municipal or industrial water uses. Water use in this region is mainly limited to ranching and irrigation along the tributaries and mainstem of the Colorado River. Included in the region is the largest average annual TMD imported to the Colorado River Basin for irrigation use into Rock Creek drainage called the Stillwater Ditch which conveys approximately 1,700 AFY.

Because of the large open spaces and low population present in the State Bridge region, there are numerous areas being studied for identification as holding Outstandingly Remarkable Values (ORV) as part of the BLM and White River National Forest (WRNF) Wild & Scenic suitability assessment. The upper Colorado River and Deep Creek areas within this region are currently being studied for consideration for inclusion into the Wild and Scenic Rivers Act. Eligibility and suitability studies are currently finished. Deep Creek segments have been recommended as 'Suitable' as of February 2014 and are currently in public comment/objector phase prior to final Record of Decision (ROD) by WRNF and BLM. Colorado River segments were found Suitable, but an official Suitability recommendation will be delayed pending acceptance of the Wild & Scenic Stakeholder Group's Alternative Management Plan as the Preferred Alternative for the BLM's 2014 updated Resource Management Plan. The Alternative Management Plan seeks to protect ORVs but defers an official Suitability recommendation which might restrict the flexibility of water management options by upstream and downstream stakeholders.

The largest identified threats to this region are the ongoing TMDs and associated reservoir operation schedules upstream in Summit and Grand Counties. The TMDs reduce needed flushing flows along the mainstem of the Colorado and dilution flows throughout the year which help keep the water temperature low to maintain existing ecosystems. For example, on June 15, 2021 the flow at the Colorado River at K Barger Ditch near Kremmling (Gage ID COLKBDCO) dropped below 150 cubic feet per second (cfs). On that day, the flow recorded several miles downstream at the Colorado River Near Kremmling, CO (USGS Gage ID 09058000), below the confluence of Troublesome Creek, Barger Gulch, Muddy Creek, the Blue River, and Sheep Creek was 375 cfs and the maximum recorded temperature hit 74.8 degrees Fahrenheit – a temperature which can be dangerous for cold water fish such as trout.

The Colorado River Restoration & Conservation Project (CRRCP) is focused on identifying and implementing restoration and conservation projects on the Upper Colorado River reach in Eagle County. As part of the effort, the Eagle River Watershed Council (ERWC) has embarked on a "Colorado River Inventory and Assessment" (CRIA) to close the gap on the lack of research for this reach. The CRIA, completed in 2014, provides important information on the primary natural and human drivers of the river ecosystem's current state, and its potential future direction. The CRIA includes baseline information on aquatic and terrestrial communities in the mainstem Colorado River and select perennial tributaries, as well as reviewing threats and opportunities arising from river management

upstream and downstream of the State Bridge region. Sections of the report with special relevance to the Colorado BIP include preliminary quantification of non-consumptive needs for habitat maintenance in the State Bridge region via hydrologic alteration and flushing flows analyses.

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the State Bridge region include:

- Eagle River Watershed Council

  Mission statement: "Eagle River Watershed Council advocates for the health of the Upper Colorado and Eagle River watersheds through research, education and projects. The Watershed Council strives to protect and enhance the high-quality natural, scenic and economic values that our rivers and tributaries provide to the citizens, visitors and wildlife of the Eagle River and Colorado River watersheds located in Eagle County." (ERWC, 2021)

  The Eagle River Watershed Council's covers a portion of the State Bridge region which is located in Eagle County, in addition to the Eagle River watershed.

- The Upper Colorado River Wild and Scenic Stakeholder Group

  The Upper Colorado River Wild and Scenic Stakeholder Group (UPCO Stakeholder Group) was formed as an independent, collaborative group in 2007. The UPCO Stakeholder Group is comprised of over 100 individuals representing various state agencies, local governments, environmental and recreational interests, landowners, anglers, and water providers. They have formed an independent, collaborative partnership to develop and implement a local management alternative to Wild & Scenic designation on the Upper Colorado River. (UPCO Wild & Scenic, 2021)

The State Bridge region includes the following water conservancy districts:

- Middle Park Water Conservancy District
- Upper Yampa Water Conservancy District

The State Bridge region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- Middle Park Conservation District
- Eagle County Conservation District
- Routt County Conservation District

Colorado River near Horse Creek River access in fall
(Photo credit: Eagle County Open Space)

Colorado River near Horse Creek River access
(Photo credit: Eagle County Open Space)

Regional Topics

Upper Colorado River Wild and Scenic Alternative Management Plan

The UPCO Stakeholder Group developed an Upper Colorado Stakeholder Group Management Plan (SG Plan) to serve as an alternative to a Wild and Scenic determination by the Bureau of Land Management (BLM). The UPCO Stakeholder Group's intention for this collaborative plan is to balance permanent protection of the ORVs, certainty for the stakeholders, water project yield, and flexibility for water users (SG Plan, 2020).

It is intended to serve as a Wild and Scenic Rivers management alternative for the resource management plan revision process. A significant benefit of the SG Plan is that through the cooperative and voluntary efforts of interested water users, local governments, and other entities, the ORVs can be protected (and perhaps enhanced) in ways that coordinate with federal agency management. Stakeholders have participated in the development of the SG Plan based on the premise that Cooperative Measures under the SG Plan are voluntary and cooperative (SG Plan, 2020).

The SG Plan was first adopted in 2012, starting a provisional period. The SG Plan was made effective as of June 15, 2015 when it was approved by BLM and USFS as a Wild and Scenic Rivers management alternative under the agencies' respective resource management plans. The SG Plan was amended and restated in June 2020.

Deep Creek Wild and Scenic Designation


Deep Creek Canyon (Photo credit: CBRT)

The National Wild and Scenic River System (NWSRS) was established in 1968. This Act looks to preserve free flowing rivers with outstanding values (such as natural, cultural, and recreational). The Act safeguards the special character of these rivers while also recognizing the potential for their appropriate use and development. To be included in the NWSRS, a river must be evaluated for eligibility. The evaluation considers the area within one-quarter mile of the high-water marks on both sides of a river. This area can be expanded to include other areas and features outside of the quarter-mile corridor if their inclusion is essential for the protection of the river's outstandingly remarkable values. To be eligible for inclusion in the nation system, a river must be free-flowing and have at least one outstandingly remarkable value. Once eligible, rivers can also be considered for suitability. This evaluation considers possible congressional inclusion of the river in the NWSRS in terms of social and economic values, effects on other resources, and effects on private lands and other uses of the area. (WRNF, 2015; Hartman, 2021)

The USFS and BLM found Deep Creek to be eligible for a wild and scenic designation in 1995 and made a wild and scenic suitability decision in 2015 for a total of almost 15 stream miles. A Wild and Scenic designation for Deep Creek would protect and enhance the three identified outstandingly remarkable values (ORVs) (ecologic, geologic and scenic), which include rare combinations of riparian plant species, expansive cave & karst systems, and habitat for many riparian-dependent species. If designated, a water right would be appropriated to maintain the current streamflow necessary to ensure the on-going protection of the ORVs. Instead of the traditional federal reserve water right to protect the ORVs of Deep Creek, there is a separate, but parallel effort to pursue an instream flow water right through the CWCB. (Coleman, 2018; Hartman, 2021)

If this designation is made, it will be Colorado's second wild and scenic river (after the Cache La Poudre).

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 50** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 51** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft). Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 52** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up information about each project. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known. The following projects are not shown on the map because they were not assigned a project location:

- CO-2015-0342
- CO-2015-0345

IWMP Focus Areas

While the Upper Colorado Wild & Scenic Alternative Management Plan extends beyond the State Bridge region (hence why the project, ID CO-2015-0340, is categorized as a Basinwide project in the Projects Database), the segments from Kremmling to Dotsero cover the entire stretch of the Colorado River through the State Bridge region. This effort is serving in a similar capacity to an IWMP process. The monitoring process is tracking key data such as streamflow, boating opportunities, recreational use patterns, macro invertebrate and fish populations, stream temperature, other water quality parameters. The data collection will be used to inform potential cooperative measures to protect the outstanding remarkable values in the reach. This is like the IWMP process of studying the region to identify vulnerabilities and recommend projects to protect values and reduce risks.

The Roundtable and other stakeholders considered the possibility of building upon the Wild & Scenic Alternative Management Plan efforts to create an IWMP for the mainstem of the Colorado River through the State Bridge region. Stakeholders have also expressed interest in developing an IWMP for the many tributaries and perennial streams originating from the Flat Tops, with a focus on the Red Dirt watershed.

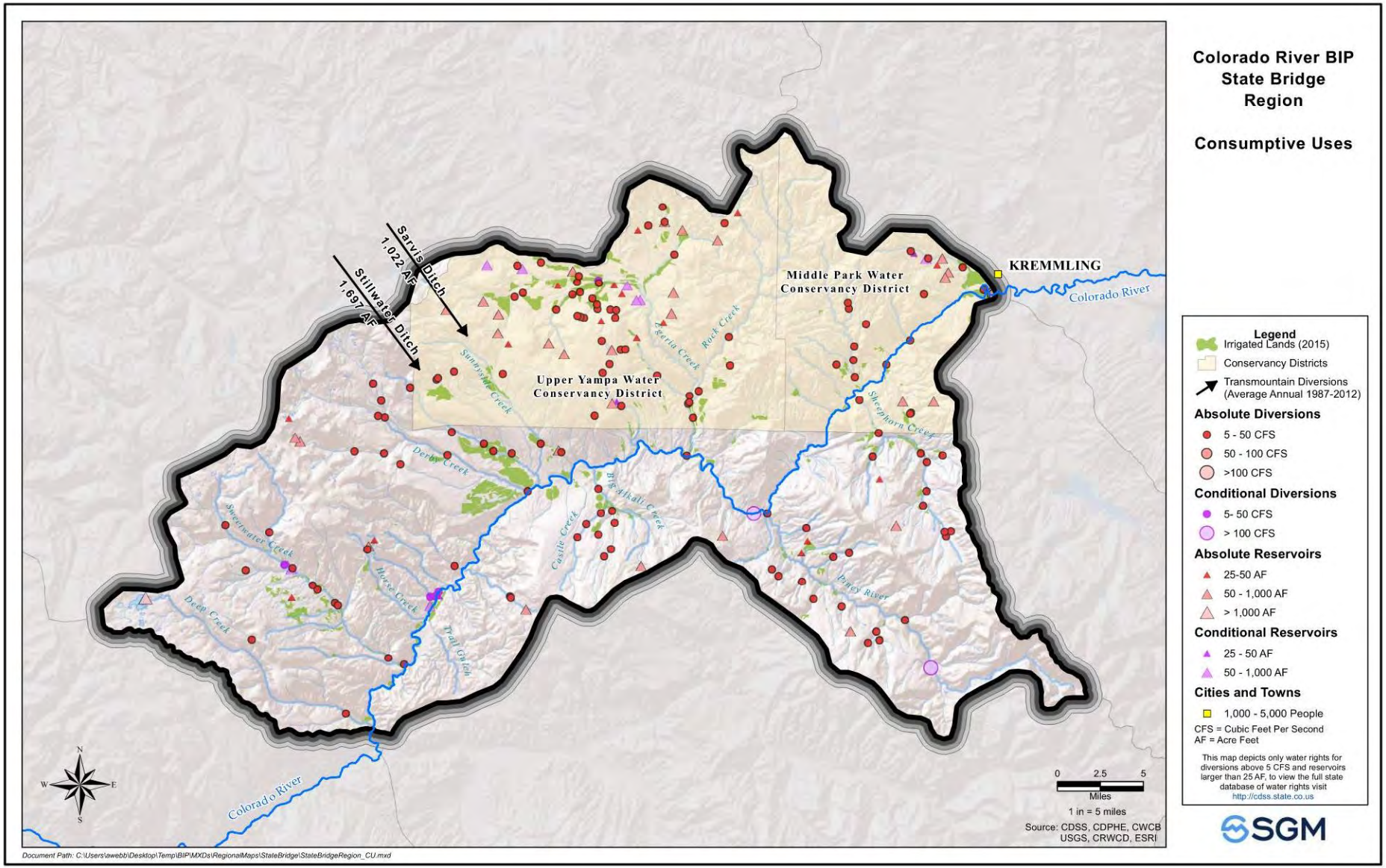


Figure 50: Map of Consumptive Uses – State Bridge Region

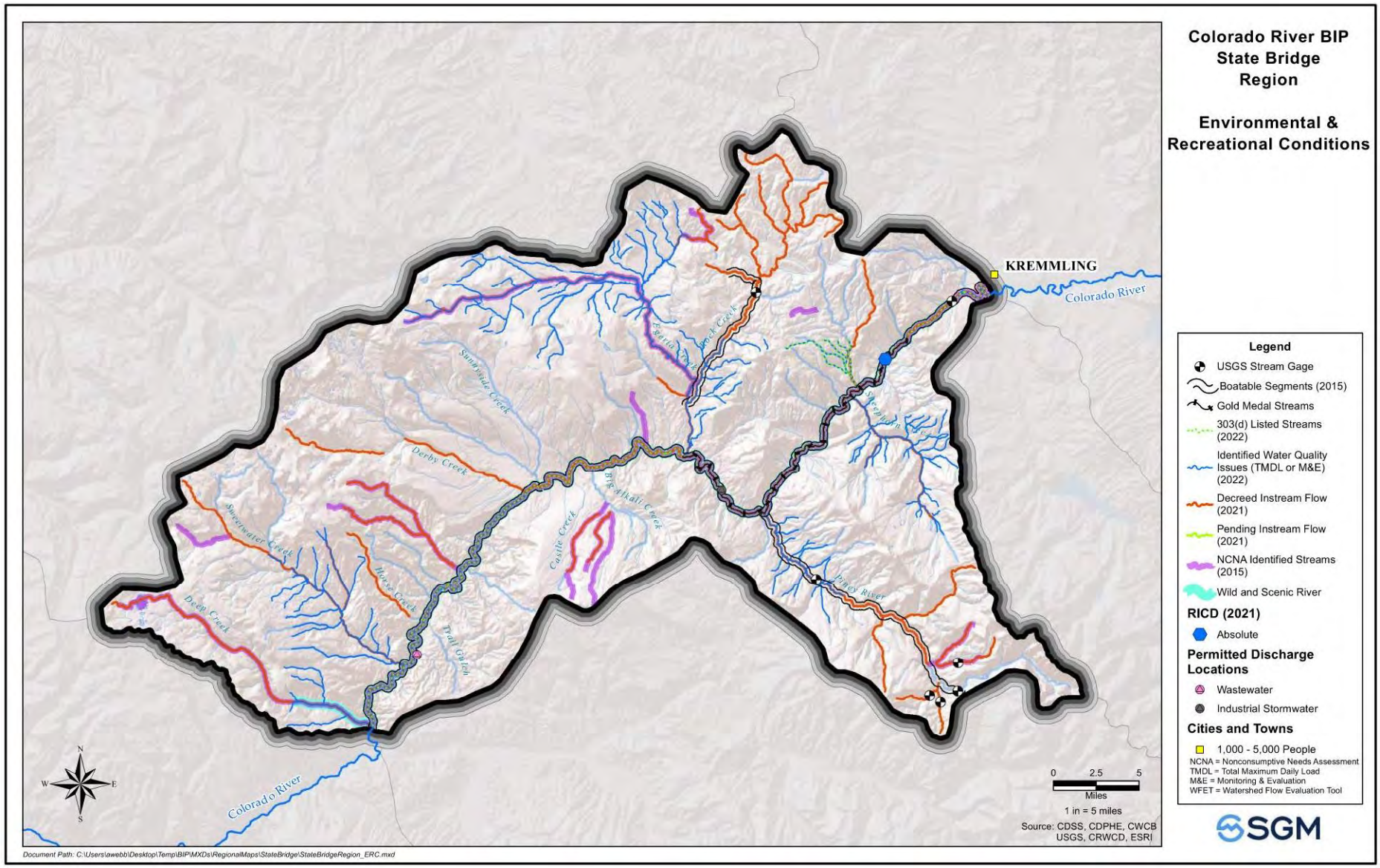


Figure 51: Map of Environmental & Recreational Conditions – State Bridge Region

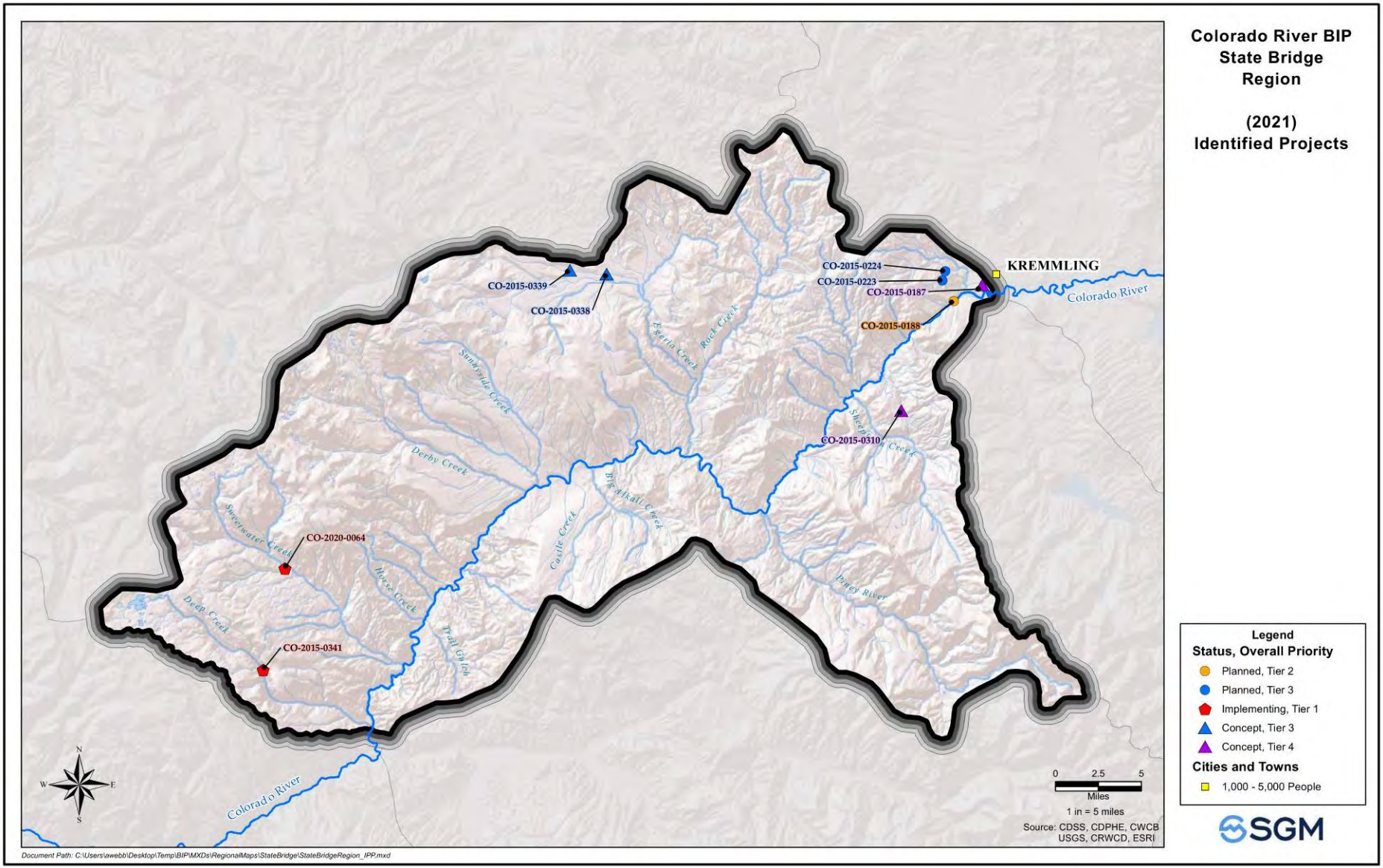


Figure 52: Map of Identified Projects from Projects Database – State Bridge Region

State Bridge Region Projects

All projects in the State Bridge region that are active (status of implementing, planned, or concept) are listed in **Table 8**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 8: State Bridge Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0338	Holden Reservoir Restoration	Tier 3	25 AF	$ 44,000	
CO-2015-0339	Kelly Reservoir Restoration	Tier 3	29 AF	$ 53,000	
CO-2015-0341	Wild and Scenic Designation – Deep Creek	Tier 1	NA	$ 20,000	Wild & Scenic Rivers Act
CO-2015-0342	Coordinated flushing flows releases from upstream reservoirs	Tier 3	NA		
CO-2015-0345	State Bridge Region Tributary Fishery Restoration	Tier 4	-		

Projects Discussion

Projects in the State Bridge region focus on environment and recreation and storage. **Table 9** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 9: All Active Projects (Implementing, Planned, Concept) by Category – State Bridge Region

Project Category		Number of Projects State Bridge	
E&R Projects	Recreation	-	3
	Watershed Planning & Forest Health	-	
	Water quality	-	
	Stream / riparian restoration and habitat protection	1	
	Environmental flow	2	
Reservoir Projects	New reservoir	-	2
	Reservoir enlargement	-	
	Restricted reservoir restoration	2	
	Reservoir management	-	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	-	-
M&I Projects	Municipal supply and redundancy	-	-
	M&I water and land use planning	-	
	Municipal conservation, efficiency, and non-potable use	-	
Ag Projects	Agricultural efficiency	-	-
	Agricultural supply	-	
	Sustain agriculture	-	
	Agricultural rehabilitation	-	
Total		**5**	

The State Bridge region has a large focus on environmental and recreational projects. **Table 10** provides statistics about the capacity of these projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity. For example, State Bridge Region Tributary Fishery Restoration (Project ID CO-2015-0345) is still a "concept" status and so the number of stream miles to be restored is not yet known, though perennial tributaries targeted by this project include the Piney River, Deep Creek, and Red Dirt Creek.

Table 10: Statistics for Environment and Recreation Projects – State Bridge Region

	State Bridge
Project Category	**Project Capacity**
Wild & Scenic Rivers Act	15 stream miles

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 11**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 53.** Both reservoir projects shown have an agricultural component and a municipal component.

Table 11: Summary of Agricultural and Municipal & Industrial Demands and Gaps – State Bridge Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	81,000	81,000	81,000	99,000	69,000	100,000
Agricultural Average Demand Gap (AF/year)	3,400	3,400	3,400	8,100	6,900	11,000
Municipal & Industrial Max Demand (AF/year)	2,500	3,800	3,400	3,800	3,500	4,500
Municipal & Industrial Maximum Gap (AF/year)	-	-	-	-	-	-

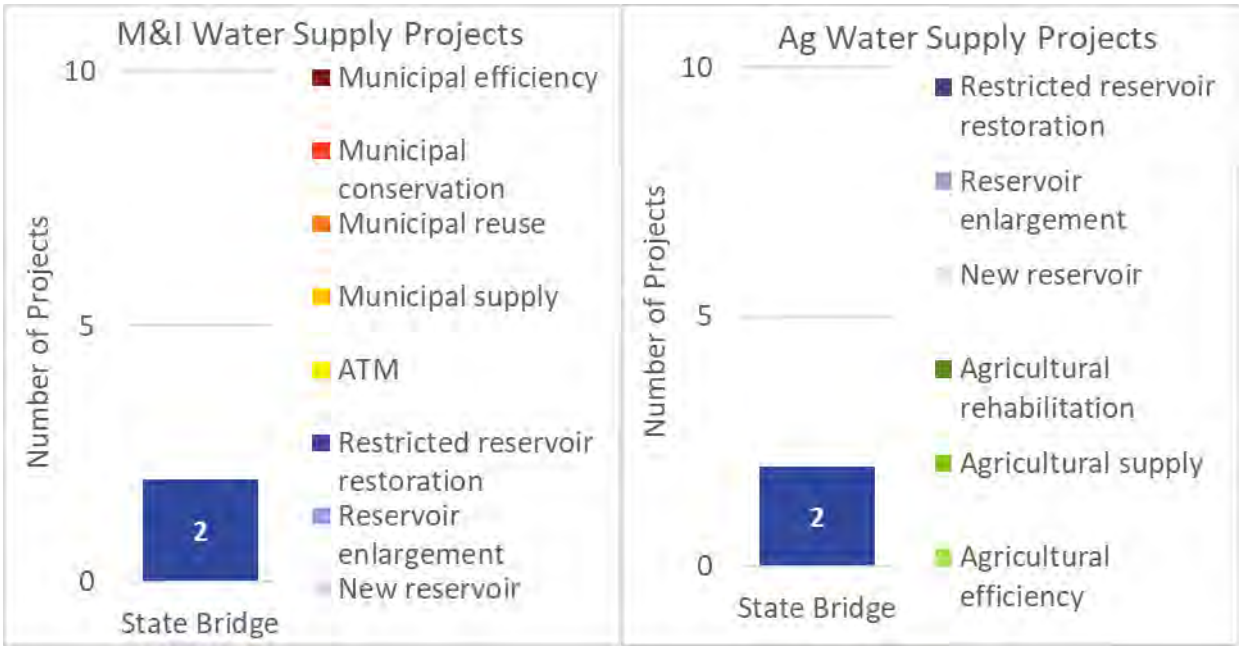


Figure 53: Water Supply Projects – State Bridge Region

The State Bridge is dominated by State and Federal land, with few local governments or municipalities compared to the other regions. As shown in **Table 11** the region also does not have a projected gap for municipal and industrial demands under any scenario. This aligns with the lack of projects specific to municipal supply.

The two water supply projects in this region are restricted reservoir restoration projects, for Holden Reservoir and Kelly Reservoir, both of which are multi-use projects with irrigation included in the decreed uses. Restricted reservoirs are constructed reservoirs which have been placed under storage restrictions because of the need for infrastructure repairs. The advantage to restoring restricted reservoirs (over constructing new reservoirs) is the relative simplicity of having the water right and permitting already acquired.

Other than the agricultural component of the two reservoir projects, the State Bridge region has no projects focused on agricultural supply. Recall from **Figure 22** in **Section 2** that the amount of irrigated acreage in the State Bridge region is not projected to change, which is a stark contrast to all the other regions which show a projected decrease in irrigated acreage under all planning scenarios. With the dominance of public lands and relative lack of large cities, it makes sense that this region does not see the same drivers for loss of irrigation lands due to municipal development.

The summary in **Table 11** shows that the region already has a baseline agricultural demand gap, which is not projected to worsen under the Business as Usual or Weak Economy scenarios. However, that gap is projected to double under the Cooperative Growth, Adaptive Innovation, and Hot Growth scenarios. Under some scenarios, additional projects could benefit the region's ability to avoid an incremental gap.

While there are no agricultural projects in the Projects Database for this region, the database is by no means a complete list of all projects in the Basin. There could be conceptual or planned projects that have a clear proponent but are missing from the list. This region should prioritize additional outreach to agricultural representatives in the State Bridge region during the next BIP Update. Many of the irrigated lands within the region fall under the domain of one of the conservation districts in the region (Middle Park, Eagle County, and Routt County); these conservation districts would be a useful starting place for such outreach. This also relates to the Basin's Strategy to "Promote participation in CBRT meetings from all sectors (agricultural, municipal, E&R, etc.)"

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

Summit Region

The Summit region aligns with the Summit County boundaries and includes the Blue River, Tenmile Creek, Snake River, Straight Creek and Swan River, to name a few of the main tributaries. The region is home to some of the largest and most visited ski resorts in Colorado including Keystone, Breckenridge, Copper Mountain, and Arapahoe Basin ski resorts. These resort communities are not only known for their winter activities but sport great boating and fishing opportunities in their rivers, streams and lakes during other times of the year. Summit County is also home to many productive ranches.

The Summit region is a major donor basin, providing approximately 68,000 AFY through the Roberts Tunnel, Straight Creek Tunnel, Vidler Tunnel and the Continental Hoosier Tunnel (WECO, 2014). Dillon Reservoir, owned by Denver Water, has a capacity of 254,000 AF, diverting the largest amount of water from the Blue River through the Roberts Tunnel to the South Platte River Basin. The Blue River between Dillon and Green Mountain is significantly impacted by TMDs and Dillon Reservoir.

Blue River between Silverthorne and Kremmling
(Photo credit: Anita Winter)

Tenmile Range
(Photo credit: Bailey Leppek)

The Colorado Springs Utilities' Hoosier Pass Collection System and the City of Golden's Vidler Tunnel impact flows in the Blue River and Snake River. Streamflows in the Blue River below Dillon Reservoir under additional anticipated diversions through the Roberts Tunnel would be at or just above the decreed minimum stream flows of 50 cfs as identified by the CWCB instream flow program, and well below flows needed for recreation purposes during normal water years. In very dry years, flows below Dillon Reservoir have fallen below 50 cfs and may continue to decrease below the ISF target if inflows to Dillon Reservoir are less than 50 cfs and Denver Water reduces outflows in accordance with the 1966 right-of-way from the Department of Interior (subject to conditions of the CRCA).

Portions of the region, including the upper Blue River watershed, have been impacted by historical mining practices which resulted in significant water quality challenges. The Snake River Task Force, Blue River Watershed Group, and other watershed organizations described in the following section have been actively identifying and implementing projects to remediate these issues.

Summit County government is proactive in water issues including assisting water providers, ski areas, and smaller water users in unincorporated areas of the County. The County offers water allotment contracts for legal water supplies and augmentation plans with water from Dillon Reservoir, Old Dillon Reservoir, Clinton Reservoir and Green Mountain Reservoir. Ruedi Reservoir serves as a source of replacement water for Green Mountain Reservoir, when needed. The County is actively pursuing plans that will stress comprehensive land use and development codes, promoting smart land use, water efficiency and conservation, density, open space, and Best Management Practices.

While Summit County has taken a lead in countywide legal augmentation water, there are still significant infrastructure needs to support drinking water treatment, conveyance, and storage of this water. The Town of Breckenridge is an example of proactive long-range planning to provide potable water from current Town boundaries to Dillon Reservoir. During the stakeholder engagement process for the 2015 BIP, many stakeholders in the headwaters regions (including the Summit Region) identified a need to develop high-elevation storage above water users' points-of-use to provide water security against drought, climate change and uncertainty in the future. Further regional collaboration of all water users in the County and including Denver and Colorado Springs could result in additional storage projects and better instream flow management.

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the Summit region include:

- Blue River Watershed Group

  The group's mission is "to promote, protect and restore a healthy Blue River watershed through cooperative community education, stewardship, and resource management." (BRWG, 2021)

- Friends of the Lower Blue River

  The group's mission is "to sustain and protect the traditional agricultural character, promote the safety of the residents, livestock and wildlife, and maintain the environmental integrity of the Lower Blue River Valley through education, collaboration and community involvement." (FOLBR, 2021)

- Snake River Task Force

  The group's mission is "to improve water quality in the Snake River watershed, the Task Force focuses on identifying, evaluating, and implementing opportunities to reduce heavy metal concentrations of concern." (SRTF, 2021)

- Summit County Abandoned Mine Dialogue Group

  This group is comprised of the Blue River Watershed Group; Breckenridge Heritage Alliance; Colorado Division of Reclamation, Mining, and Safety; Summit County Open Space; Town of Breckenridge Open Space; Trout Unlimited; U.S. Environmental Protection Agency; U.S. Forest Service; and the U.S. Geological Survey. It is convened by Keystone Policy Center. The purpose of the dialogue is to bring together mine reclamation partners to assess the scope of abandoned mines cleanup activities and opportunities in Summit County. The group reviews the status of completed or ongoing work, existing inventories, and prioritization efforts, and discusses potential future partnership opportunities in Summit County. (Fuller, 2021)

The Summit region includes the following water conservancy districts:

- Middle Park Water Conservancy District

The Summit region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- Middle Park Conservation District

Regional Topics

Wildfires

The Buffalo Mountain Fire burned 91 acres in June 2018 near the town of Silverthorne, threatening up to 1,500 structures and causing the evacuation of more than 1,600 people. The region has also been impacted by the Peak Two Fire and the Tenderfoot Fire in 2017.

Blue River Integrated Water Management Plan (BRIWMP)

The Blue River Watershed Group (BRWG) and Trout Unlimited began work on the Blue River Integrated Water Management Plan (BRIWMP) in 2019, and the plan is still currently in progress. The scope of the BRIWMP covers 65 river miles and encompasses the watershed that makes up the entire Summit region.

The Blue River Basin currently supplies consumptive uses, enables recreation and sustains a high mountain riverine environment. To maintain this balance, consumptive and non-consumptive water users must now join forces and collaboratively plan for the Blue River Basin's future.

The Blue River Trout Fishery is in decline. That decline resulted in the recent removal of "Gold Medal Fishery" status by Colorado Parks and Wildlife. A group of stakeholders, the Blue River Enhancement Workgroup (BREW), formed to assess the decline and is currently working with the BRWG in Phase Two of the BRIWMP to assess causes of the declining fishery and possible remedies.

In addition, the BRIWMP aims to enable consumptive and non-consumptive water users to understand and quantify current and future use and integrate those uses for the maximum benefit of all users while protecting the existing water resource (BRIWMP Summary, 2019).

The BRIWMP has identified the following goals for Phase One of the IWMP:

- To better understand the potential causes of the declining fishery and determine whether and how the fishery can be improved
- To engage a diverse range of stakeholders through a community-driven process
- To compile and analyze existing data, research and studies
- To formulate goals and objectives, identify "real time" projects and innovative water management techniques that will form the foundation for Phase Two, which ultimately is intended to guide future water management decisions

Initial results from this Phase One effort pointed to the need for additional data in several areas to pinpoint effective strategies to address the declining fishery between Dillon and Green Mountain Reservoirs. The following tasks are proposed for Phase Two of the BRIWMP, currently underway:

- Task 1: Develop scientifically valid restoration strategies through evaluation of existing stream flows, both temporally and quantitatively, in relationship to the geomorphology of the stream (Reaches 1 and 2).
- Task 2: Sample macroinvertebrates and compare to 2020 sampling.

- Task 3: Sample periphyton (coincident with macroinvertebrate sampling sites) and compare to 2020 sampling.
- Task 4: Continue continuous temperature monitoring in Reach 2 and add monitoring sites on one or two tributaries.
- Task 5: Continue to work closely with stakeholders including the Advisory Committee and BREW; work with agricultural community to improve delivery and application efficiencies.
- Task 6: Integrate the findings of Tasks 1 through 5 of Phase Two into an updated BRIWMP.

Reach-specific recommendations are included in the body of the BRIWMP Phase One Report, most of which can be categorized into one of the above tasks, although some of the reach-specific recommendations will align better with future phases of the BRIWMP such as physical restoration, monitoring programs, and support of other agencies and local municipalities for existing and ongoing efforts. (BRIWMP, 2021 and Bailey, 2021)

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 54** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 55** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 56** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up projects in the Projects Database. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known.

The following projects are not shown on the map because they were not assigned a project location:

- CO-2015-0368
- CO-2015-0371
- CO-2015-0404

IWMP Focus Areas

The Blue River IWMP already covers the entire Summit region. It is anticipated that future efforts will be a continuation of this IMWP, driven by current and future stakeholders in the IWMP process (including Blue River Watershed Group and Trout Unlimited).

Future efforts under the umbrella of the Blue River IWMP include:

- Implementing projects identified by the IWMP (some of which are also in the Projects Database)
- Periodically updating the Blue River IWMP
- Identifying and implementing additional projects

As the entire region's watershed is already covered by an IWMP, no new reaches or watersheds were identified as priorities for IWMP development.

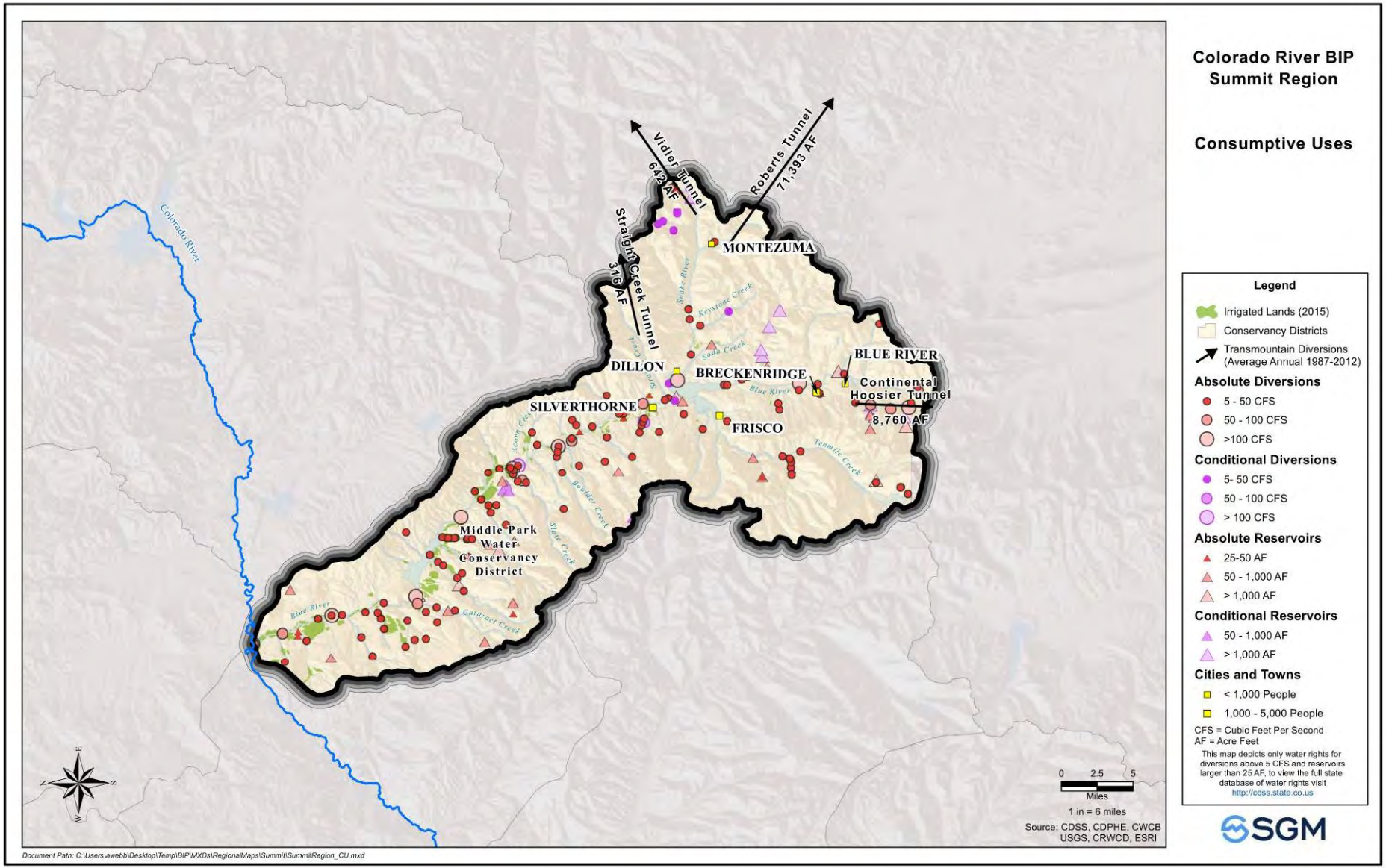


Figure 54: Map of Consumptive Uses – Summit Region

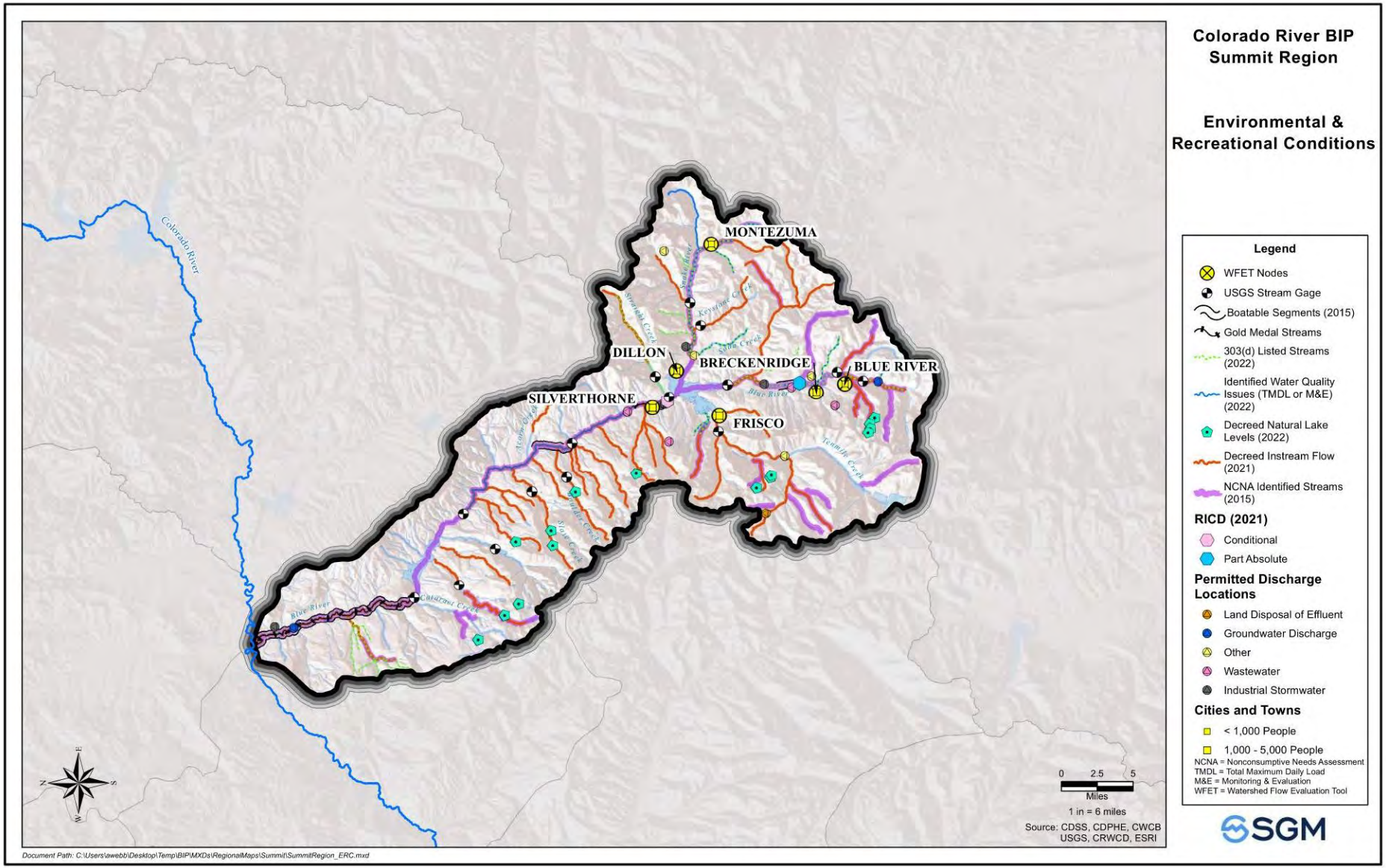


Figure 55: Map of Environmental & Recreational Conditions – Summit Region

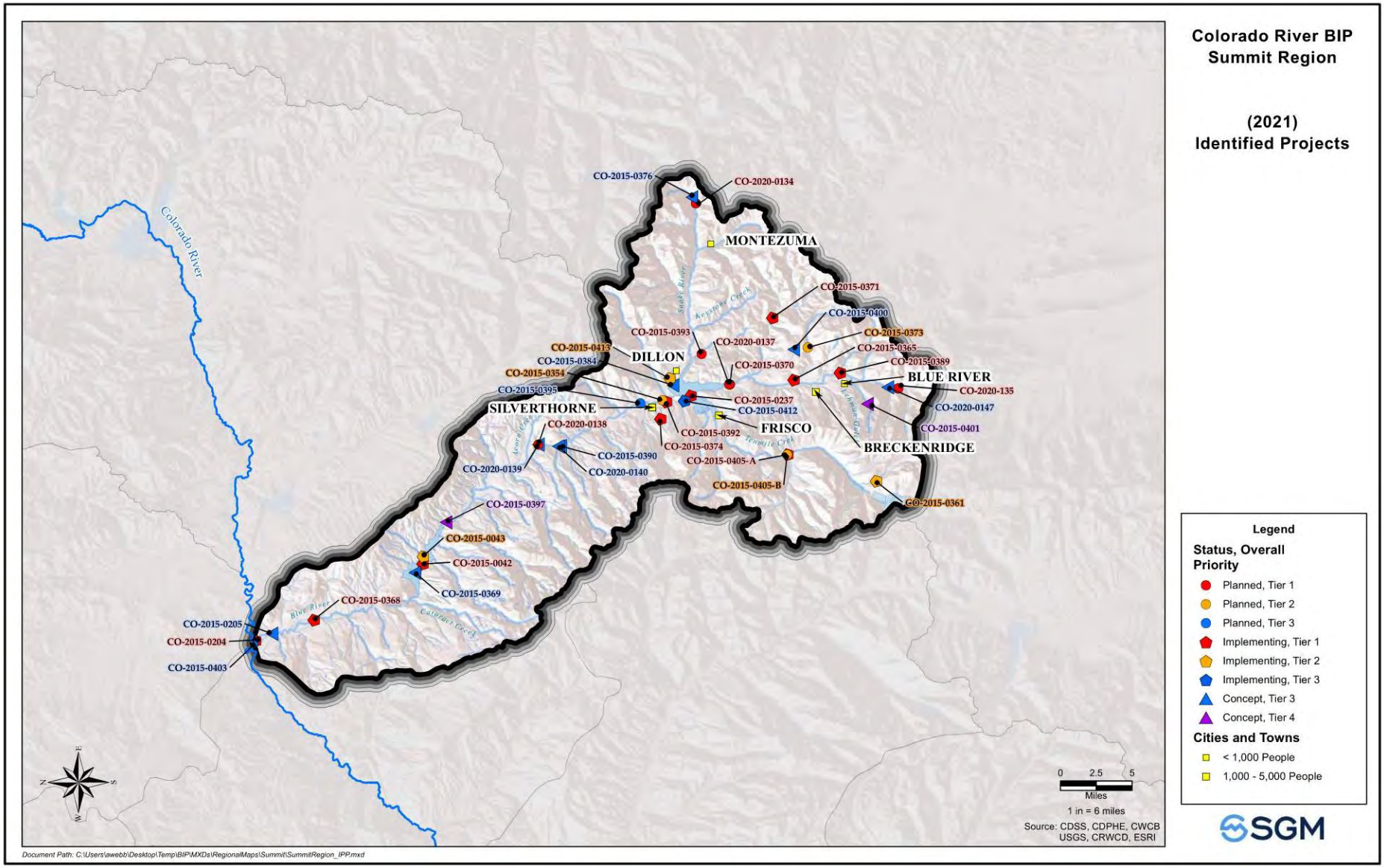


Figure 56: Map of Identified Projects from Projects Database – Summit Region

Summit Region Projects

All projects in the Summit region that are active (status of implementing, planned, or concept) are listed in **Table 12**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 12: Summit County Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0237	East Slope Storage of Blue River Water	Tier 1			Transmountain diversion
CO-2015-0242	Continental-Hoosier System Project	Tier 1	4,000 AF	$ 140,000,000	Transmountain diversion
CO-2015-0354	Silverthorne Kayak Park	Tier 2	-	$ 1,000,000	RICD
CO-2015-0361	Clinton Reservoir 1st Enlargement and Refill (06CW252)	Tier 2	500 AF	$ 790,000	Reservoir enlargement
CO-2015-0365	Town of Breckenridge irrigation minimization plan (well mitigation)	Tier 1		$ -	Municipal conservation
CO-2015-0368	Blue Valley Ranch fishery restoration efforts on the lower Blue River (a private proponent for the Blue River)	Tier 1	-	$ 2,457,000	Stream / riparian restoration
CO-2015-0369	Green Mountain Reservoir controlled flow fluctuations	Tier 3	-		Reservoir release timing
CO-2015-0370	Aquatic habitat study and future restoration project(s) on Blue River above Dillon	Tier 1	-	$ 16,000,000	Habitat protection
CO-2015-0371	Swan River Restoration	Tier 1	-	$ 10,000,000	Stream / riparian restoration
CO-2015-0373	Cleanup measures in French Gulch mine drainage	Tier 2	-	unknown	Water quality
CO-2015-0374	Non-potable water reuse on Summit County golf courses	Tier 1			Municipal reuse
CO-2015-0376	Construction of reservoir in Peru Creek drainage	Tier 3	2,050 AF	$ 28,200,000	New reservoir
CO-2015-0384	Multiple Level Staged Dillon Reservoir release structure	Tier 3	NA	$ 32,000,000	Reservoir release timing
CO-2015-0389	Goose Pasture Tarn/Blue River watershed protection	Tier 1		$ 40,000	Forest health
CO-2015-0390	Lower Blue River habitat improvements/wetlands mitigation (Summit Co.)	Tier 3	NA	$ 36,000,000	Habitat protection
CO-2015-0392	Drilling deeper wells (Buffalo Mountain Metropolitan District)	Tier 1	20 AF	$ 350,000	Municipal supply
CO-2015-0393	Direct intake from Dillon Reservoir (East Dillon Water District)	Tier 1			Municipal redundancy
CO-2015-0395	Connect Hamilton Creek Sys to Silverthorne Sys via Angler Mtn Ranch (Hamilton)	Tier 3			Municipal redundancy
CO-2015-0397	Develop boat ramps on the Blue River	Tier 4			Recreation access
CO-2015-0400	Swan Reservoirs (Town of Breckenridge)	Tier 3	15,000 AF		Stream / riparian restoration
CO-2015-0401	Spruce Creek Reservoir (Summit County)	Tier 4			New reservoir
CO-2015-0404	Upper Basin Forest Health/Watershed Improvements	Tier 2	NA		Forest health
CO-2015-0405-A	Blue River Integrated Water Management Plan Phase One	Tier 1	NA	$ 253,639	IWMP
CO-2015-0405-B	Blue River Integrated Water Management Plan Phase Two	Tier 2	NA	TBD	IWMP

Continued on next page
Continued from previous page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0412	Town of Dillon Salt Lick Gulch Pipeline/Siphon	Tier 3	303 AF	$ 750,000	Municipal redundancy
CO-2015-0413	Dillon Marina Shoreline Stabilization and Wharf Structure Improvements	Tier 2	-	$ 4,000,000	Recreation Access
CO-2020-0134	Abandoned mine mitigation above Dillon Reservoir	Tier 1	-	$ 31,000,000	Water quality
CO-2020-0135	Assess impacts of additional TBD in Blue River Reach 1 (above Dillon Reservoir)	Tier 1	-	$ 300,000	Stream / riparian restoration
CO-2020-0136	Assess general fishery health in Blue River above Dillon Reservoir	Tier 1	-	$ 300,000	Water quality
CO-2020-0137	Assess impacts of low flow diversions on Blue River above Dillon Reservoir	Tier 1	NA	$ 300,000	Instream flow
CO-2020-0138	Assess environmental conditions associated with declining fishery between Dillon and GM Reservoirs	Tier 1	NA	$ 200,000	Habitat protection
CO-2020-0139	Blue River nutrient injection project	Tier 3	NA	$ 150,000	Water quality
CO-2020-0140	Sustaining AG and Pre-compact water rights	Tier 3		$ 4,200,000	Sustain agriculture

Projects Discussion

Projects in the Summit region focus on environment and recreation, with water supply projects focused on municipal and industrial demands. **Table 15** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 13: All Active Projects (Implementing, Planned, Concept) by Category – Summit Region

Project Category		Number of Projects Summit	
E&R Projects	Recreation	3	21
	Watershed Planning & Forest Health	4	
	Water quality	4	
	Stream / riparian restoration and habitat protection	7	
	Environmental flow	3	
Reservoir Projects	New reservoir	2	3
	Reservoir enlargement	1	
	Restricted reservoir restoration	-	
	Reservoir management	-	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	2	2
M&I Projects	Municipal supply and redundancy	4	6
	M&I water and land use planning	-	
	Municipal conservation, efficiency, and non-potable use	2	
Ag Projects	Agricultural efficiency	-	1
	Agricultural supply	-	
	Sustain agriculture	1	
	Agricultural rehabilitation	-	
Total		**33**	

Table 14 provides statistics about the capacity of the environmental and recreational projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity, especially those which are still conceptual.

Table 14: Statistics for Environment and Recreation Projects – Summit Region

	Summit
Project Category	**Project Capacity**
Habitat protection	20 stream miles
Reservoir release timing	20 stream miles
Stream / riparian restoration	22 stream miles

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 15**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 57**. Note that reservoir projects may have an agricultural component, a municipal component, or both. In this case, the reservoirs shown in **Figure 57** were only assigned a municipal needs component in the Projects Database, and so are not shown under the agricultural water supply projects.

Table 15: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Summit Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	70,000	67,000	67,000	83,000	51,000	90,000
Agricultural Average Demand Gap (AF/year)	57	37	37	280	190	550
Municipal & Industrial Max Demand (AF/year)	9,000	12,000	11,000	12,000	11,000	13,000
Municipal & Industrial Maximum Gap (AF/year)	640	900	890	1,000	1,200	1,200

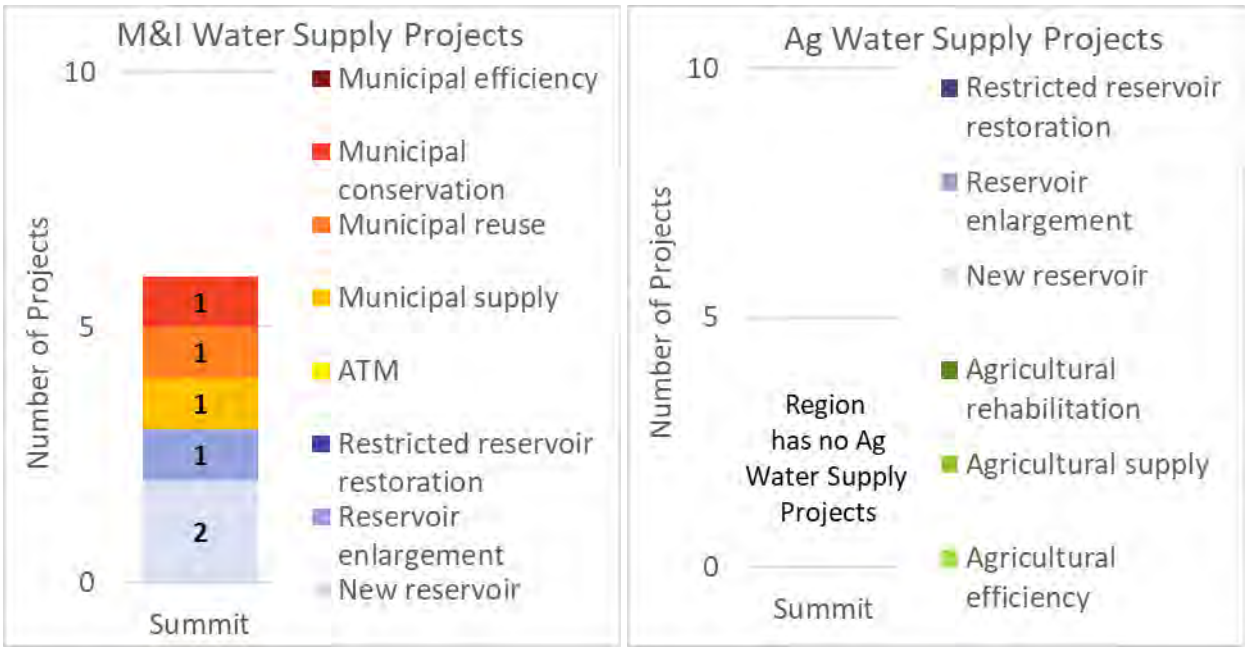


Figure 57: Water Supply Projects – Summit Region

The most prominent takeaway from **Figure 57** is that three of the six M&I supply projects are related to the expansion and construction new reservoirs which will serve to increase transmountain diversions. Secondly there are no agricultural water supply projects currently in the projects database for Summit

region. This however will be addressed in Phase Two of the BRIWMP with additional outreach to the agricultural community, with emphasis on improvements to delivery and application efficiencies.

The one agriculture-focused project in the region shown in **Table 13** for Summit region is under the Sustain Agriculture category and not considered a supply project; it is called Sustaining AG and Pre-compact water rights (Project ID CO-2020-0140). This project was identified as part of the Blue River IWMP, with a goal of sustaining agriculture and improving the environment while working with irrigators to understand water use and return flows, upgrade existing infrastructure, and support changes to delivery and application methods. It is still conceptual and has a large and broad scope with up to 20 smaller individual projects.

While the region's projected municipal gap is larger than its agricultural gap (in magnitude and percentage of demand as shown in **Table 15**), the municipal gap is still relatively small compared to other regions. Recall from in **Figure 26** in in **Section 2** that of the regions that show a projected municipal gap, Summit region's is the smallest. Municipal projects in the region focus less on municipal supply and more on municipal redundancy and regional collaboration (project types which are not considered supply projects).

The lack of agricultural supply project aligns with the region's relatively low gaps for agricultural demands. **Table 15** shows that the projected agricultural gap is relatively small – less than a percent of projected demand even under the hot growth scenario. Recall also from **Figure 24** in **Section 2** that the Summit region has the second lowest agricultural demand gap (after Eagle region).

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

Eagle River Region


Eagle River above Gypsum (Photo credit: CBRT)

The Eagle River region, located in Eagle County, encompasses the Eagle River watershed which includes the Eagle River, Gore Creek, Homestake Creek, Brush Creek and Gypsum Creek, (to name a few of the main tributaries). Like many headwater regions, residents and communities in this region place a high priority on the economic, recreational, and natural values associated with its streams and rivers. Healthy, functioning streams best support these common values. Continuing the work to support and promote the environmental and recreational needs will best maintain healthy, functioning streams (ERWC, 2014). The economy of this region is very much dependent upon tourism and recreation industries. Eagle County is home to the Vail, Beaver Creek and Arrowhead Ski Areas. Healthy environments within the watershed are vital for maintaining this recreation-based economy. Development focus has shifted from the upper valley resorts to lower valley towns. Eight hundred homes in the proposed Haymeadow area of Eagle, 700,000 square feet of retail and 550 homes in the proposed Eagle River Station, and almost 600 new residential units at Village of Wolcott offer challenges for water providers in managing water resources and providing for healthy stream communities (ERWC, 2014).

The Columbine, Ewing & Wurtz Ditches and the Homestake Tunnel divert water out of the Eagle River watershed to the Arkansas River Basin. The Colorado River Water Conservation District (River District), Climax Molybdenum Company, Eagle River Water and Sanitation District (ERWSD), Upper Eagle Regional Water Authority (UERWA), and Vail Associates have and continue to collaborate with water providers on the Front Range as participants in the Eagle River Memorandum of Understanding (ERMOU). The objective of the ERMOU is to develop a joint use water project that meets the water requirements of the participants, minimizes the environmental impact, is technically feasible, and cost effective. The ERMOU was first established in 1998 to develop 30,000 AF of yield in the upper Eagle River that would be jointly developed; 20,000 AF of average annual yield over a 25-year period for Colorado Springs and Aurora, 10,000 AF of firm dry-year yield for the Eagle Park Reservoir Company (which includes ERWSD, UERWA, River District, and the Vail Associates), plus 3,000 AF of storage space for existing absolute water rights for Climax Molybdenum Co.

ERWSD is the second largest water provider in the Colorado Basin and in Western Colorado. The ERWSD operates the Upper Eagle Regional Water Authority through contract and has since the Authority was created in 1984. The service area extends from east Vail to Wolcott and includes Vail, Minturn, Eagle-Vail, Avon, Arrowhead, Beaver Creek, Edwards, Cordillera, and many other outlying developed areas. The ERWSD and UERWA serve approximately 60,000 people during the peak season and have the most complex water system in Colorado consisting of: 3 water plants, 17 wells, 73 pressure zones, and 270 miles of water mains with over 3,000 feet of elevation change. The ERWSD uses the Eagle River, Gore Creek, and their aquifers as direct supplies supported by minimal storage in Black Lakes, Eagle Park Reservoir and Homestake Reservoir. The ERWSD is a good example of the positive benefits of

consolidation of multiple water systems into one regional system. The consolidated management of the ERWSD has allowed for cooperation and strong coalitions with municipalities and the ski industry through Vail Resorts and Eagle County. This cooperation has resulted in a well-managed efficient umbrella agency that could serve as a model for many other competing water systems throughout the Colorado Basin that not only supplies drinking water but provides environmental flows.

Several municipal governments including the Town of Vail, Town of Avon, and Town of Eagle continue to initiate proactive programs to address the existing water quality impairment issues, allocating significant financial resources and personnel time on research, stormwater improvements, land planning, and community outreach. Eagle County government supports progressive land use codes and continues to invest heavily in recreational access and stream-related amenities that support the recreation-based economy. In Gypsum's planning documents, the Town's goals include continuously providing adequate high-quality water for service to its citizens for potable and business needs. Other Town goals include ensuring that minimum instream flows are met, and local river habitat is protected and improved. As part of all development approvals, the Town requires new developments to dedicate water to the Town to cover new uses (Kropf, 2014). The Town of Eagle's water planning efforts are an excellent example of collaboration and long-range planning. With the construction of the Lower Basin Water Treatment Plant, the Town of Eagle will have redundant supply and treatment from three different sources, Upper Brush Creek, Lower Brush Creek and the Eagle River. The Town of Eagle has strategically planned water management in Brush Creek by cooperating with new developments and agricultural communities.

Examples of other efforts to support the environmental and recreational needs within this region include the Gore Creek Water Quality Improvement Plan, the Camp Hale-Eagle River Headwaters Collaborative Restoration Implementation Plan, the NWCCOG 208 WQ Management Plans, and the Brush Creek Watershed Management Plan.

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the Eagle region include:

- Eagle River Watershed Council

  Mission statement: "Eagle River Watershed Council advocates for the health of the Upper Colorado and Eagle River watersheds through research, education and projects. The Watershed Council strives to protect and enhance the high-quality natural, scenic and economic values that our rivers and tributaries provide to the citizens, visitors and wildlife of the Eagle River and Colorado River watersheds located in Eagle County." (ERWC, 2021)

  The Eagle River Watershed Council's area also covers a portion of the State Bridge region.

The Eagle region does not include the service area boundaries of any water conservancy districts. The region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- Eagle County Conservation District

Regional Topics

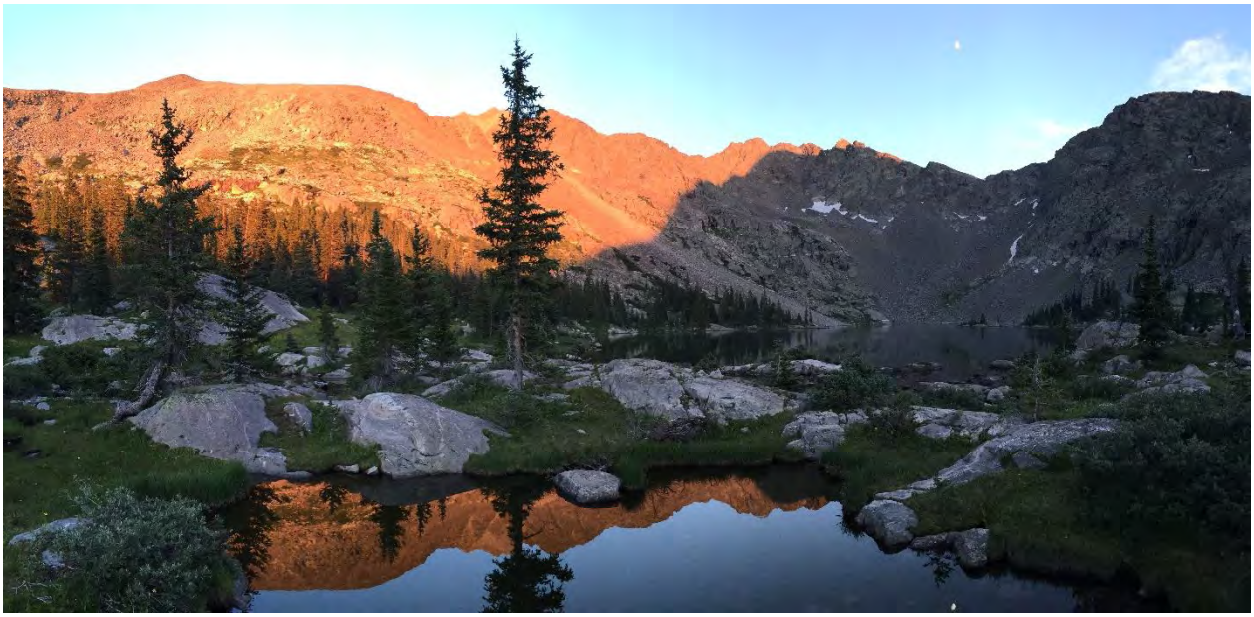
Eagle River Community Water Plan

The Eagle River Community Water Plan effort is being led by the Eager River Watershed Council and is currently in progress. The Plan will cover 970 square miles, essentially covering the entire Eagle BIP region.

The Eagle River Watershed Council initiated the Eagle River Community Water Plan to develop proactive water management recommendations that anticipate changes to local hydrology and water demand. Some of the planning aspects in the Eagle River watershed include:

- Population growth and increasing municipal demand for water in Eagle County
- Climate change
- Eagle River Joint Use Water Project phases related to the Eagle River MOU, an intergovernmental agreement for developing municipal water supplies in the upper Eagle River watershed.

The scope of work for the Community Water Plan is to assess conditions and identify risks, and then to work with stakeholders to prioritize river reaches, set management objectives, and identify potential alternative management scenarios to achieve local goals (Eagle CWP Summary, 2019).



Sunset on alpine lakes in the headwaters of East Brush Creek.
(Photo credit: Doug Winter)

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 58** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 59** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 60** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up projects in the Projects Database. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known.

The following projects are not shown on the map because they were not assigned a project location:

- CO-2020-0055

IWMP Focus Areas

The Eagle River Community Water Plan already covers the entire Eagle region. As discussed previously, the Community Water Plan serves the same function as an IWMP, just under a different name. It is anticipated that future efforts will be a continuation of this Community Water Plan, driven by current and future stakeholders in the planning process (including Eager River Watershed Council).

Future efforts under the umbrella of the Eagle River Community Water Plan include:

- Implementing projects identified by the Community Water Plan (some of which are also captured in the Projects Database)
- Periodically updating the Community Water Plan
- Identifying and implementing additional projects

As the entire region's watershed is already covered by the Community Water Plan, no new reaches or watersheds were identified as priorities for IWMP development.

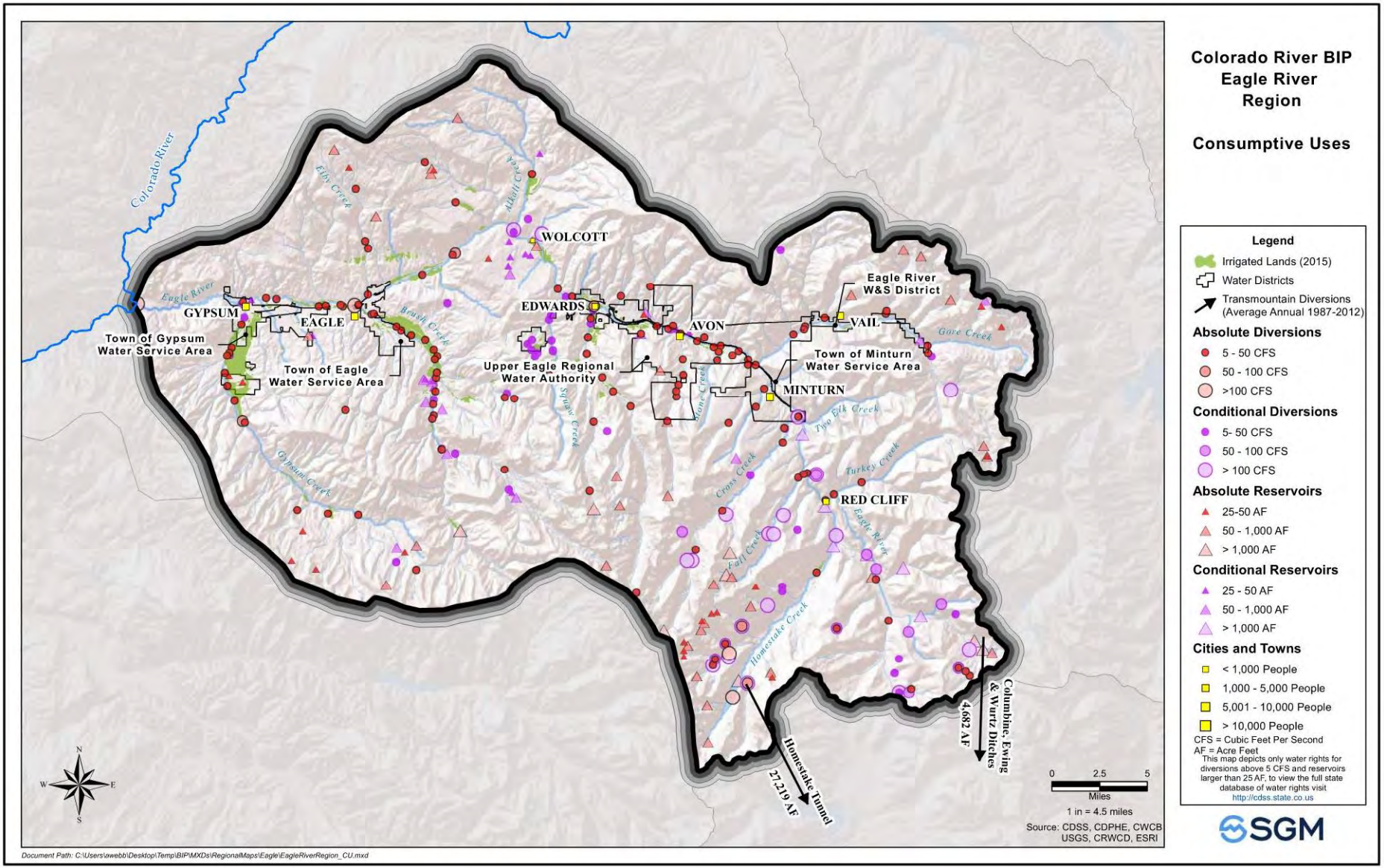


Figure 58: Map of Consumptive Uses – Eagle Region

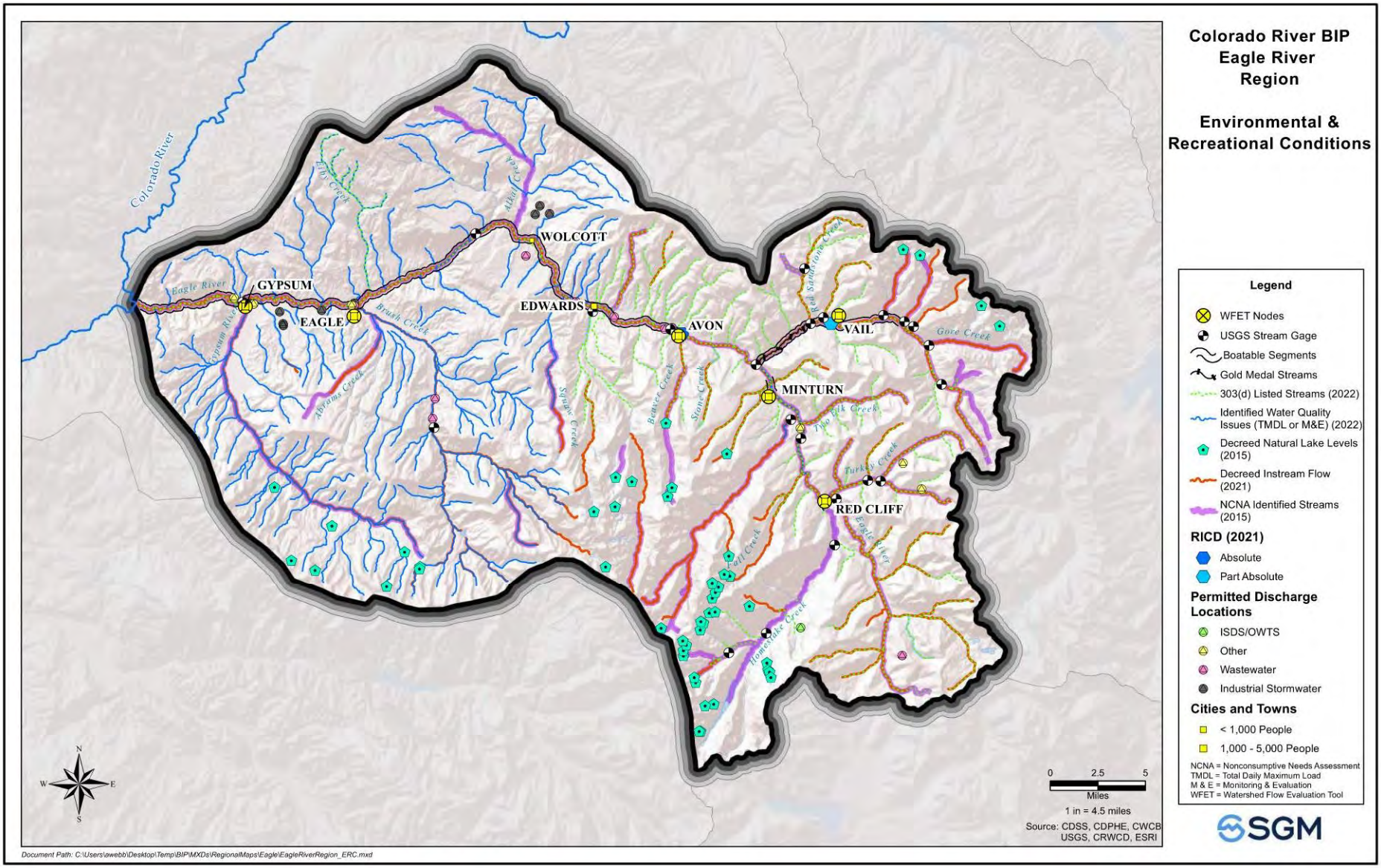


Figure 59: Map of Environmental & Recreational Conditions – Eagle Region

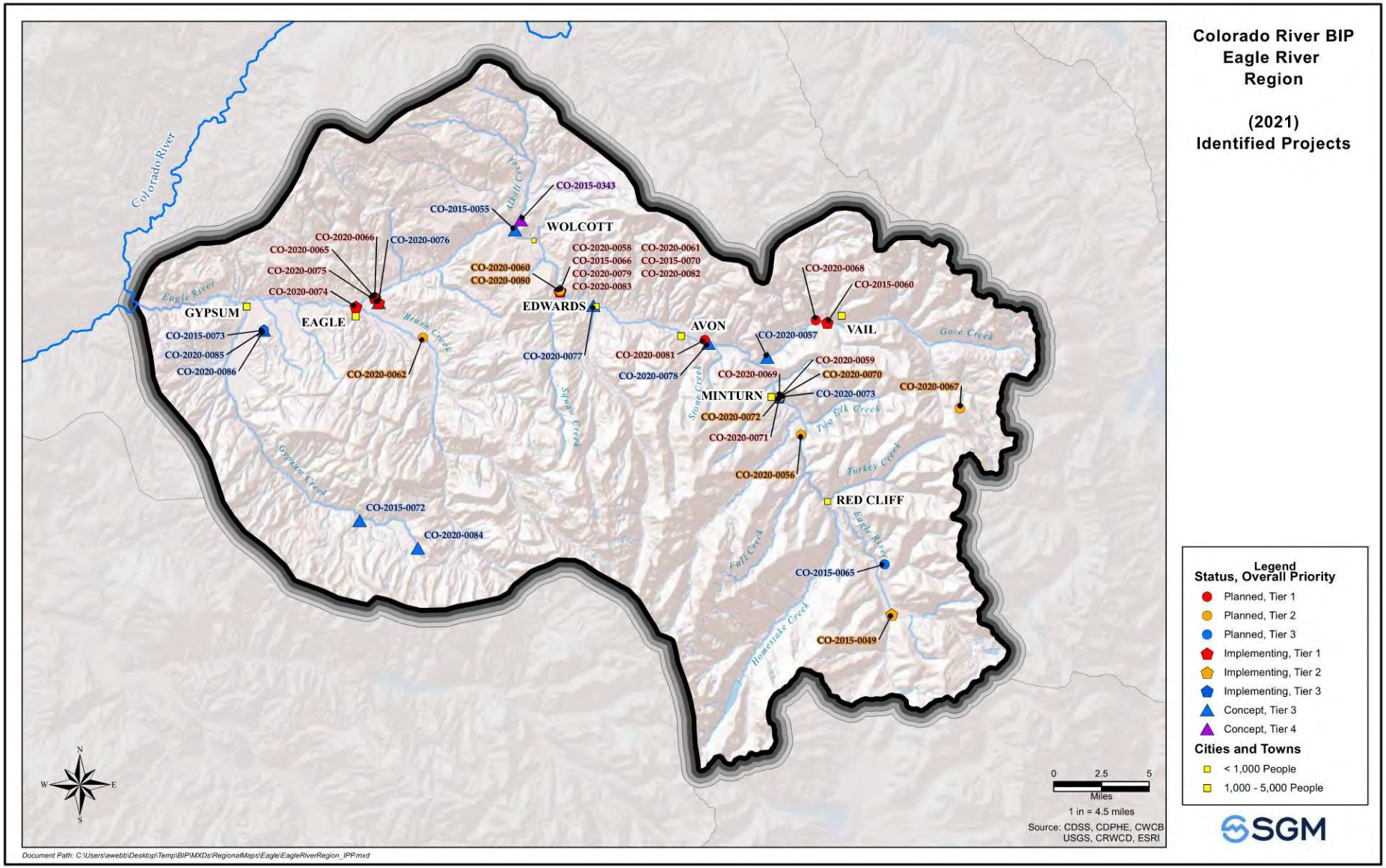


Figure 60: Map of Identified Projects from Projects Database – Eagle Region

Eagle Region Projects

All projects in the Eagle region that are active (status of implementing, planned, or concept) are listed in **Table 16**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 16: Eagle Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0049	Eagle River Memorandum of Understanding Joint Use Water Project (ERMOU Project)	Tier 2	10,000 AF (West Slope portion)	$ 300,000,000 (West Slope portion)	Transmountain diversion
CO-2015-0055	Wolcott Reservoir	Tier 3	63,006 AF	$ 178,291,000	New reservoir
CO-2015-0060	Gore Creek Strategic Action Plan implementation	Tier 1	NA	$ 8,500,000	Water quality
CO-2015-0065	Camp Hale Restoration	Tier 3	-	$ 20,000,000	Stream / riparian restoration
CO-2015-0066	Water Quality Action Planning	Tier 1	NA	$ 100,000	Water quality
CO-2015-0070	Eagle River Community Water Plan completion/implementation	Tier 1	NA	$ 453,000	IWMP
CO-2015-0072	Storage expansion: Eye Lake Reservoir	Tier 3	1,200 AF	$ 6,000,000	Reservoir enlargement
CO-2015-0073	Storage Expansion: Upstream Off-channel Eagle River	Tier 3	2,969 AF	$ 15,000,000	Reservoir enlargement
CO-2015-0343	Denver Water Eagle-Colorado Reservoir at Wolcott	Tier 4	350,000 AF	$ 883,569,000	Transmountain diversion
CO-2020-0055	Develop Eagle River Fund	Tier 3	NA		E&R funding mechanism
CO-2020-0056	Bolts Lake Reservoir Redevelopment	Tier 2	1,210 AF	$ 40,000,000	Reservoir enlargement
CO-2020-0057	Intermountain Sewer Pipe removal	Tier 3	-	$ 2,000,000	Recreation Access
CO-2020-0058	Weed Warriors program	Tier 1	NA	$ 10,000	Invasive species removal
CO-2020-0059	Hwy 24/Minturn stormwater mitigation	Tier 1	NA	$ 12,000	Stormwater
CO-2020-0060	Conduct Eagle & Colorado River Asset Inventory Phase II	Tier 2	-	$ 75,000	Agricultural rehabilitation
CO-2020-0061	Implement Projects Identified in Eagle & Colorado River Asset Inventory Phase I	Tier 1	Unknown	Unknown	Agricultural rehabilitation
CO-2020-0062	Brush Creek stream/riparian restoration needs assessment	Tier 2	-	$ 200,000	Stream / riparian restoration
CO-2020-0064	Sweetwater Lake conservation	Tier 1	-	$ 9,500,000	Stream / riparian restoration
CO-2020-0065	Town of Eagle Water Efficiency Plan implementation	Tier 1	NA	$ 125,000	Municipal efficiency
CO-2020-0066	Town of Eagle Source Water Protection Plan identified BMP implementation	Tier 1	NA	$ 10,000,000	Source water protection plan
CO-2020-0067	Vail Pass Auxiliary Lane project	Tier 2	-	$ 700,000,000	Stormwater

Continued on next page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
Continued from previous page					
CO-2020-0068	ERWSD/UERWA Service Area Source Water Protection Plan	Tier 1	NA	$ 23,750	Source water protection plan
CO-2020-0069	Minturn Tank construction	Tier 1	-	$ 1,670,000	Municipal redundancy
CO-2020-0070	Maloit Park Tank construction	Tier 2	-	$ 900,000	Municipal redundancy
CO-2020-0071	Leak detection system installation	Tier 1	3 AF	$ 50,000	Municipal efficiency
CO-2020-0072	Water Meter Replacement Program	Tier 2	-	$ 250,000	Municipal efficiency
CO-2020-0073	New well field & pipeline	Tier 3		$ 5,220,000	Municipal supply
CO-2020-0074	Lower Basin Water Treatment Plant	Tier 1	-	$ 14,400,000	Municipal redundancy
CO-2020-0075	Cemetery Water Tank replacement/expansion	Tier 1	2.15 AF	$ 2,400,000	Municipal redundancy
CO-2020-0076	Town of Eagle metering upgrades to AMI	Tier 3	-	$ 258,000	Municipal efficiency
CO-2020-0077	Edwards riparian restoration and community outreach	Tier 3	-	$ 25,000	Stream / riparian restoration
CO-2020-0078	McGrady Acres restoration and access project	Tier 3	-	$ 15,000	Recreation Access
CO-2020-0079	Eagle River Water Festival	Tier 1	-	$ 20,000	Community engagement
CO-2020-0080	Water Policy program	Tier 2	-	$ 10,000	Policy
CO-2020-0081	Piping of Nottingham-Pouder ditch	Tier 1	4 cfs	$ 600,000	Agricultural efficiency
CO-2020-0082	Qualified Water Efficiency Landscaper (QWEL) Certification	Tier 1	NA	$ 30,000	Municipal conservation
CO-2020-0083	ERWC community outreach programs	Tier 1	NA	$ 20,000	Community engagement
CO-2020-0084	L.E.D.E. Reservoir expansion II	Tier 3	2,074 AF	$ 2,000,000	Reservoir enlargement
CO-2020-0085	Wastewater Treatment Plant Upgrade and Expansion	Tier 3	-	$ 30,000,000	Municipal redundancy
CO-2020-0086	Eagle River Pump and Pipeline	Tier 3	600 AF	$ 1,000,000	Municipal redundancy

Projects Discussion

Projects in the Eagle region is represented by a wide variety of projects in the Projects Database, with a focus on environment and recreation and on municipal and industrial needs. **Table 17** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 17: All Active Projects (Implementing, Planned, Concept) by Category – Eagle Region

Project Category		Number of Projects Eagle	
E&R Projects	Recreation	2	15
	Watershed Planning & Forest Health	4	
	Water quality	4	
	Stream / riparian restoration and habitat protection	5	
	Environmental flow	-	
Reservoir Projects	New reservoir	1	5
	Reservoir enlargement	4	
	Restricted reservoir restoration	-	
	Reservoir management	-	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	3	3
M&I Projects	Municipal supply and redundancy	7	14
	M&I water and land use planning	2	
	Municipal conservation, efficiency, and non-potable use	5	
Ag Projects	Agricultural efficiency	1	3
	Agricultural supply	-	
	Sustain agriculture	-	
	Agricultural rehabilitation	2	
Total		**40**	

Eagle region has a large focus on environmental and recreational projects. **Table 18** provides statistics about the capacity of these projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity, especially those which are still conceptual.

Table 18: Statistics for Environment and Recreation Projects – Eagle Region

	Eagle
Project Category	**Project Capacity**
Stormwater	10 stream miles
Stream / riparian restoration	3 stream miles 524 wetland acres

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 19**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 61**. Note that reservoir projects may have an agricultural component, a municipal component, or both. As such, some reservoir projects are shown both as a municipal and industrial supply project and an agricultural supply project, and some are shown only in one category.

Table 19: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Eagle Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	57,000	33,000	33,000	41,000	26,000	43,000
Agricultural Average Demand Gap (AF/year)	1	0	0	5	3	12
Municipal & Industrial Max Demand (AF/year)	7,000	10,000	9,200	10,000	9,600	12,000
Municipal & Industrial Maximum Gap (AF/year)	-	-	-	-	-	-

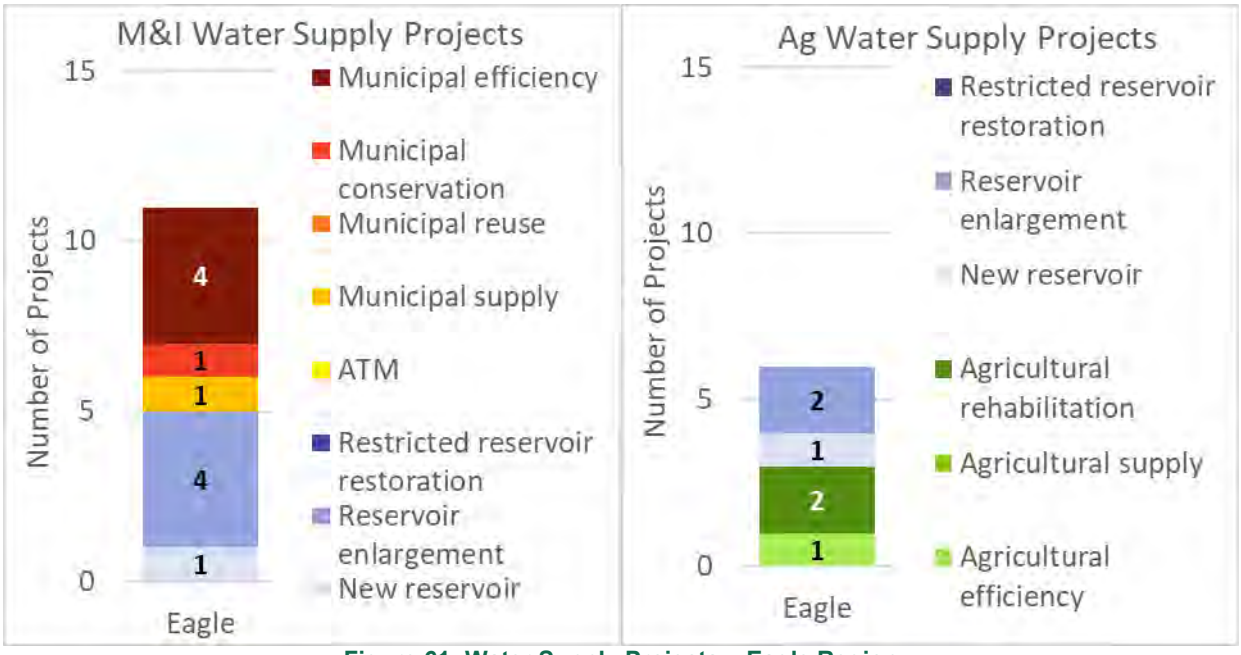


Figure 61: Water Supply Projects – Eagle Region

In discussing the Eagle region's projected demands, gaps, and projects at Roundtable and Next Steps committee meetings, stakeholders noted that the lack of projected municipal gap for the Eagle region across scenarios (shown in **Table 19**) seemed unrealistic. Recall from **Figure 26** in **Section 2** that Eagle was the only region besides State Bridge that showed no projected municipal gap. Whereas the State Bridge region is notable for its low population density, Eagle region contains several major municipalities including Eagle, Gypsum, Vail, Edwards, and Avon. Furthermore, stakeholders have noted that the Eagle region's focus on municipal and industrial supply projects tells a different story; water providers in the region have their own planning projections and are planning for a gap. This observation gave rise to the Basin's Strategy to "update the modeling in the Colorado Water Plan (CWP) Technical Update to improve accuracy at the regional level and incorporate more detailed modeling done by others (for example from stream management plans) to better understand the gaps."

The Eagle region has a notable focus on storage. Reservoir enlargement projects include the enlargement and redevelopment of Bolts Lake Reservoir, enlargement of Eye Lake Reservoir, and the enlargement of L.E.D.E. Reservoir. New reservoir projects include Wolcott Reservoir (Project ID CO-2015-0055 and CO-2015-0073) and Denver Water Eagle-Colorado Reservoir at Wolcott (Project ID CO-2015-0343). These two projects are separate, but easily confused. Another major storage project is the Eagle River Memorandum of Understanding Joint Use Water Project (ERMOU Project, Project ID CO-2015-0049).

Wolcott Reservoir is water right for 65,975 AF, of which 2,969 AF has been conveyed to Town of Gypsum (reflected in Project ID CO-2015-0073) and 63,006 AF is owned by the River District (reflected in Project ID CO-2015-0055).

Denver Water's Eagle-Colorado Reservoir at Wolcott has a conditional water right for 350,000 AF, which is owned by Denver Water but currently contemplated as a joint-use project. The reservoir would be used for on-site recreation, direct beneficial use within the Colorado River basin, indirect beneficial uses by Denver by replacement, substitution or exchange by West Slope and East Slope water users, and environmental flow purposes. Denver Water's Eagle-Colorado Reservoir at Wolcott could allow existing TMDs to increase diversions out of Grand and Summit Counties by providing augmentation releases to satisfy the Shoshone and Cameo calls. Eagle River Water and Sanitation District (ERWSD) and Upper Eagle River Water Authority (UERWA) are in favor of the project.

The Eagle River MOU Project derives from the 1998 Eagle River MOU among East and West Slope water users for development of a joint use water project in the Eagle River basin that minimizes environmental impact, is cost effective, technically feasible, can be permitted by local, state, and federal authorities, and provides 20,000 AFY average annual yield for East Slope use, 10,000 AFY firm dry year yield for West Slope use, and 3,000 AF of reservoir capacity for Climax Molybdenum Co. The ERMOU Project is proposed as a cooperative alternative to construction of the Homestake II Project in the Holy Cross Wilderness. The ERMOU Project will utilize conditional water rights held by the ERMOU Parties and a yet-to-be determined combination of gravity diversion, storage, pumping, and/or groundwater infrastructure to develop the contemplated project yield.

The Eagle region is also projected to have a very low agricultural demand gap compared with its demands, as shown in **Table 19**. Recall also from **Figure 24** in **Section 2** that Eagle has the lowest agricultural gap of any region. The region correspondingly shows a relatively low emphasis on agricultural supply projects. Agricultural projects in the Eagle region focus on rehabilitation and efficiency. Two of these projects relate to the Eagle & Colorado River Asset Inventory effort led by Eagle

County Conservation District: Implementation of projects identified in phase I of the inventory (Project ID CO-2020-0061) and conducting Phase II of the inventory (Project ID CO-2020-0060).

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

Roaring Fork Region


The Maroon Bells (Photo credit: CBRT)

The Roaring Fork region, a main headwaters region, consists of the Roaring Fork River and many sizable tributaries including: Maroon Creek, Castle Creek, Hunter Creek, Woody Creek, Fryingpan River, Crystal River, Cattle Creek and Fourmile Creek. The Roaring Fork region consists of nine major water providers, three Water Conservancy Districts and four counties. Additionally, the region is characterized by strong watershed organizations including the Roaring Fork Conservancy and Pitkin County Healthy Rivers and Streams Board. The Ruedi Water and Power Authority is a quasi-governmental agency made up of representatives from the five municipalities in the watershed, plus representatives from Pitkin and Eagle Counties.


Fly Fishing on the Lower Roaring Fork
(Photo credit: Bailey Leppek)

The region is very dependent upon tourism and recreation economies with a vibrant winter and summer recreation industry. There are five ski resorts contributing to the strong winter tourism in the region including Aspen, Highlands, Buttermilk, Snowmass and Sunlight Ski Resorts. These resort communities attract summer visitors as well through local Gold Medal fisheries, whitewater rafting, mountain biking, hiking, cultural attractions and overall scenic mountain settings.

Water is currently diverted out of the Basin to Front Range communities including Colorado Springs, Aurora and Pueblo through the Fryingpan-Arkansas Project and Twin Lakes Projects, amounting to an average annual yield of approximately 100,000 AFY. In an average year, 38% of the Roaring Fork headwaters above Aspen are diverted (40,000 AFY) and 41% of the Fryingpan headwaters above Meredith (57,000 AFY) are diverted (RFC, 2021). These are the 5th and 3rd largest transmountain diversions, respectively, in the state. These diversions can severely limit flows in the Roaring Fork River through Aspen, which can drop to less than 30 cfs in low-flow periods.

Water providers in the upper reaches of the Basin are dependent upon direct flow stream intakes and are susceptible to extended drought periods. Because the watersheds above these intakes are primarily located on U.S. Forest Service (USFS) lands, the process for permitting a new reservoir will be rigorous. Due diligence to thoroughly investigate every option along with a detailed environmental mitigation plan, will be a necessary part of any permitting process. These water providers should also seek redundancy through other means including: enlargement of existing reservoirs, interconnects between regional water providers, development of well supplies and reliance upon multiple stream water supplies.

A recent issue in the Roaring Fork region that may impact water development in the future is the complete allocation of Ruedi Reservoir augmentation water. Ruedi has been the source of

augmentation and physical water for not only the Roaring Fork region but the entire Colorado Basin. Ruedi Reservoir became 100% allocated in 2013 when the Bureau of Reclamation contracted for the remaining unallocated volume in the reservoir. Several entities including the Basalt Water Conservancy District, the Colorado River Water Conservation District, Ute Water Conservancy District, and Garfield County have large water holdings in Ruedi that can continue to provide augmentation water for future growth in the Roaring Fork region. Further study is needed to determine if the water under contract with these entities is sufficient for future needs in the region to the year 2050 or beyond. Many Roaring Fork water providers have relatively junior water rights that are augmented by Ruedi Reservoir. Roaring Fork water providers that have post Compact water rights (junior to 1922) should aggressively convert agricultural rights senior to 1922 to points of potable water supply diversions. These pre-1922 water rights will provide protection against a future Compact call. This will require change cases in water court.

The primary need of the Roaring Fork region is to protect, maintain and restore healthy rivers and streams. Almost 140 of 185 miles of streams surveyed in the Roaring Fork region have moderately modified to severely degraded riparian habitat. There are three critical reaches of mainstreams that have been targeted for restoration 1) the Roaring Fork River below the Salvation Ditch through the City of Aspen; 2) the Roaring Fork River upstream from the confluence of the Fryingpan River; and 3) the Crystal River upstream from Carbondale. These three main reaches do not include all the smaller tributaries in the upper Fryingpan and the upper Roaring Fork that have been altered due to TMDs. Active efforts are underway to restore these reaches with innovative methods including, but not limited to, coordinated efforts among irrigators to maintain stream flows, improvements to irrigation ditch infrastructure efficiency and legislation similar to Senate Bill 14-023 (not enacted) promoting voluntary transfer of water efficiency savings to instream flows.

Some of the top priority projects in the region are conservation focused. A Regional Water Conservation Plan for the Roaring Fork watershed is currently underway and is exploring water conservation measures on a regional basis. The Roaring Fork Watershed Plan (RFC, 2012) has outlined additional actions and projects to protect and restore the watershed and riparian habitats. Additionally, consideration is being given to studying the viability of small reservoirs located along some of the small tributaries such as Fourmile Creek and Cattle Creek which have been subject of diminished late season flows from irrigation diversions, and out of basin diversions. These reservoirs could provide multiple benefits including instream environmental flows during times when the tributaries dry up. Finally, the region should collaborate more with unified constituencies in a cooperative effort to develop multipurpose projects. Regional efforts among water providers, irrigators, conservation organizations and recreational enthusiast are pivotal to the implementation of any future project.

Watershed Groups and Conservation Districts

Active watershed organizations in the Roaring Fork region include:

- Roaring Fork Conservancy

  Mission: "Since 1996, Roaring Fork Conservancy has inspired people to explore, value, and protect the Roaring Fork Watershed. We bring people together to protect our rivers and work to keep water in our rivers, monitor water quality, and preserve riparian habitat. As one of the largest watershed organizations in Colorado, Roaring Fork Conservancy serves residents and visitors throughout the Roaring Fork Valley through school and community-based Watershed Education programs and Watershed Science and Policy projects including regional watershed planning, water resource policy initiatives, stream management and restoration." (RFC, 2021)

The Roaring Fork region includes the following conservancy and/or conservation districts:

- Basalt Water Conservancy District
- West Divide Water Conservancy District
- Mount Sopris Conservation District

Regional Topics

Lake Christine Fire 2018

The Lake Christine Fire burned a total of 12,588 acres of public and private land near Basalt, El Jebel, Carbondale, and the Fryingpan Valley. The fire started on July 3, 2018, originating from the Basalt Shooting Range, and was downgraded to a Burned Area Response on September 4, 2018.

Crystal River – Ella Ditch Call 2018

The senior Ella Ditch placed a call on the Crystal River for the first time in August 2018, causing the City of Carbondale to seek an emergency substitute water supply plan for domestic water supply to about 40 homes on the Nettle Creek pipeline. This unprecedented call highlighted vulnerabilities in water supplies in the Crystal River Basin which do not currently have augmentation supplies to protect against a senior Crystal River call (Sackett, 2019).

Crystal River Management Plan (2016)

The Crystal River Management Plan used a "science-based and stakeholder-centered approach to consider complex interactions between the physical components driving watershed structure; the biological components of riverine ecosystems; the social context of competing perspectives, needs, and values; and the existing legal and administrative frameworks governing water use in an effort to identify and evaluate management and structural alternatives that honor local agricultural heritage, preserve existing water uses, and enhance the ecological integrity of the river." The Planning process was driven by Roaring Fork Conservancy, Public Counsel of the Rockies, and Lotic Hydrological. The team engaged many stakeholders throughout the process, including water rights holders, agricultural producers, water users, Town of Carbondale, state agencies, federal agencies, and environmental groups. (CRMP, 2016)

Upper Roaring Fork River Management Plan (2017)

The Upper Roaring Fork River Management Plan (URFRMP) effort was motivated by several studies completed in the early 2000s, each showing varying degrees of ecological degradation in the stretch of the Roaring Fork that flows through Aspen. In response to those findings and in an effort to develop goals and strategies for managing land and water more effectively in the upper Roaring Fork watershed, in 2016 the City of Aspen and Pitkin County worked with a team of consultants and local stakeholders to understand and synthesize these ecological considerations. For elements of river health considered degraded, specific stressors were identified, with a special focus on degradation caused by modified patterns of streamflow. The assessment area included the Roaring Fork mainstem and major tributaries between Lost Man Creek on Independence Pass and the Brush Creek confluence near Woody Creek. (URFRMP, 2017)

Stream reaches covered in the project area include:

- Roaring Fork, Lost Man to Difficult Creek

- Lincoln Creek, Grizzly Reservoir to Roaring Fork
- Roaring Fork, Difficult Creek to Salvation Ditch
- Roaring Fork, Salvation Ditch to Castle Creek
- Hunter Creek, Fry-Ark Diversions to Roaring Fork,
- Roaring Fork, Castle Creek to Brush Creek
- Castle Creek, Conundrum Creek to Roaring Fork
- Maroon Creek, West Maroon to Roaring Fork

A major takeaway from this effort was a process for future project evaluation. The plan describes lessons learned:

> *Lessons learned from the planning process should inform future water management decision-making in the upper watershed. In addition to elucidating community values and preferences for water use, stakeholders weighed the potential ecological benefits of several water management opportunities against the financial, legal, administrative, and political constraints (and other tradeoffs) each posed. Final planning outcomes and deliverables provide the City and County with valuable insight into community perspectives on river health (URFRMP, 2017).*

Snowpack in the headwaters of the upper Roaring Fork region provides recreational opportunities as well as water supply. (Photo credit: Bailey Leppek)

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 62** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 63** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 64** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up projects in the Projects Database. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known.

The following projects are not shown on the map because they were not assigned a project location:

- CO-2015-0315
- CO-2015-0316
- CO-2015-0326
- CO-2015-0335
- CO-2020-0150
- CO-2020-0153
- CO-2020-0154
- CO-2020-0155
- CO-2020-0156
- CO-2020-0157
- CO-2020-0158
- CO-2020-0161
- CO-2020-0162
- CO-2020-0163
- CO-2020-0164

IWMP Focus Areas

Significant portions of the Roaring Fork region are already covered by management plans: The Crystal River (by the 2016 Crystal River Management Plan) and the upper Roaring Fork River and tributaries above the confluence with Brush Creek (by the 2017 Upper Roaring Fork River Management Plan).

Stakeholders have noted that other major tributaries to the Roaring Fork that are not covered by existing management plans include the Frying Pan River and Sopris Creek.

The following streams/watersheds have been identified as focus areas for development an IWMP:

- Frying Pan River (possibly focused on the upper Frying Pan River above Ruedi Reservoir)
- Sopris Creek

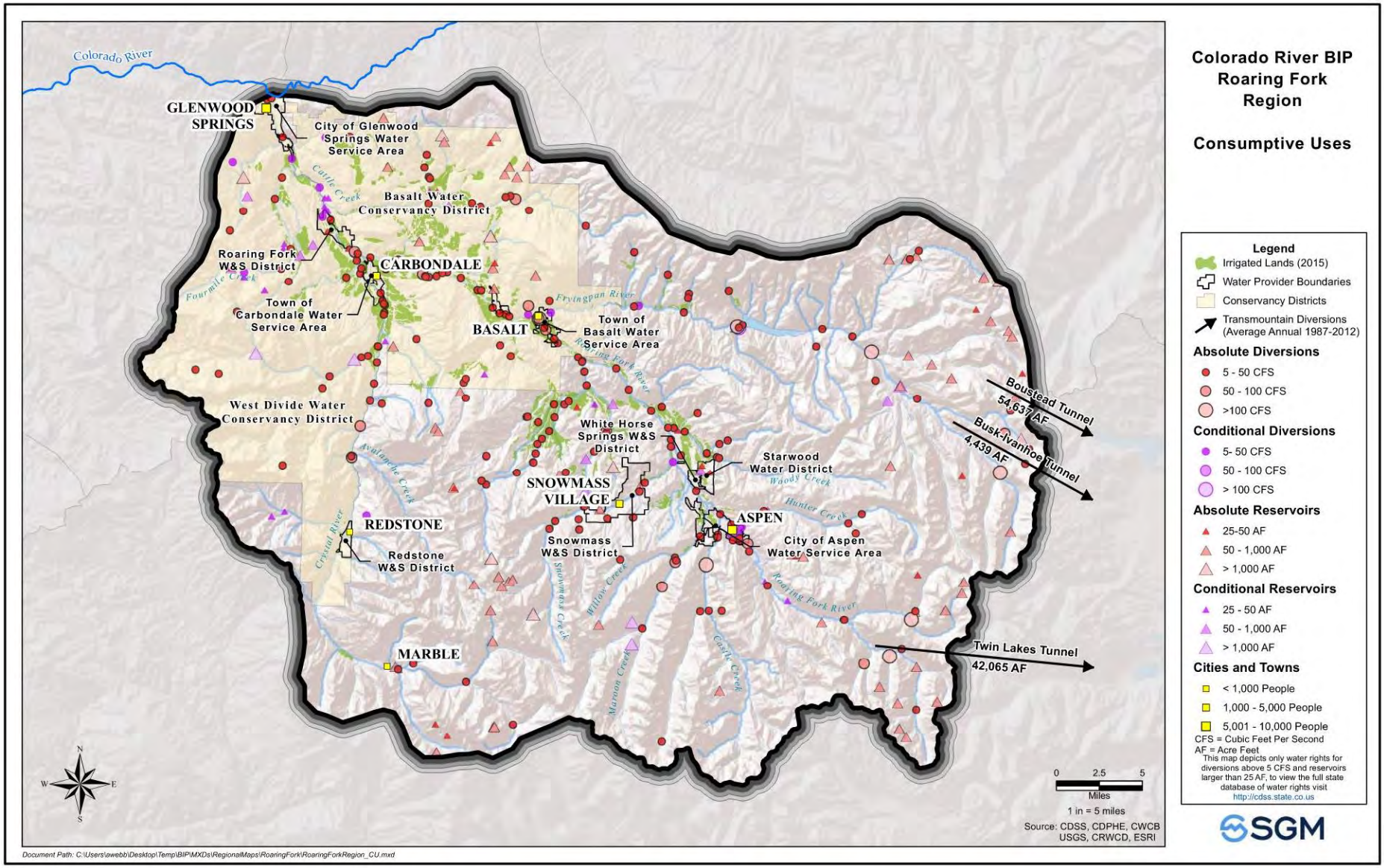


Figure 62: Map of Consumptive Uses – Roaring Fork Region

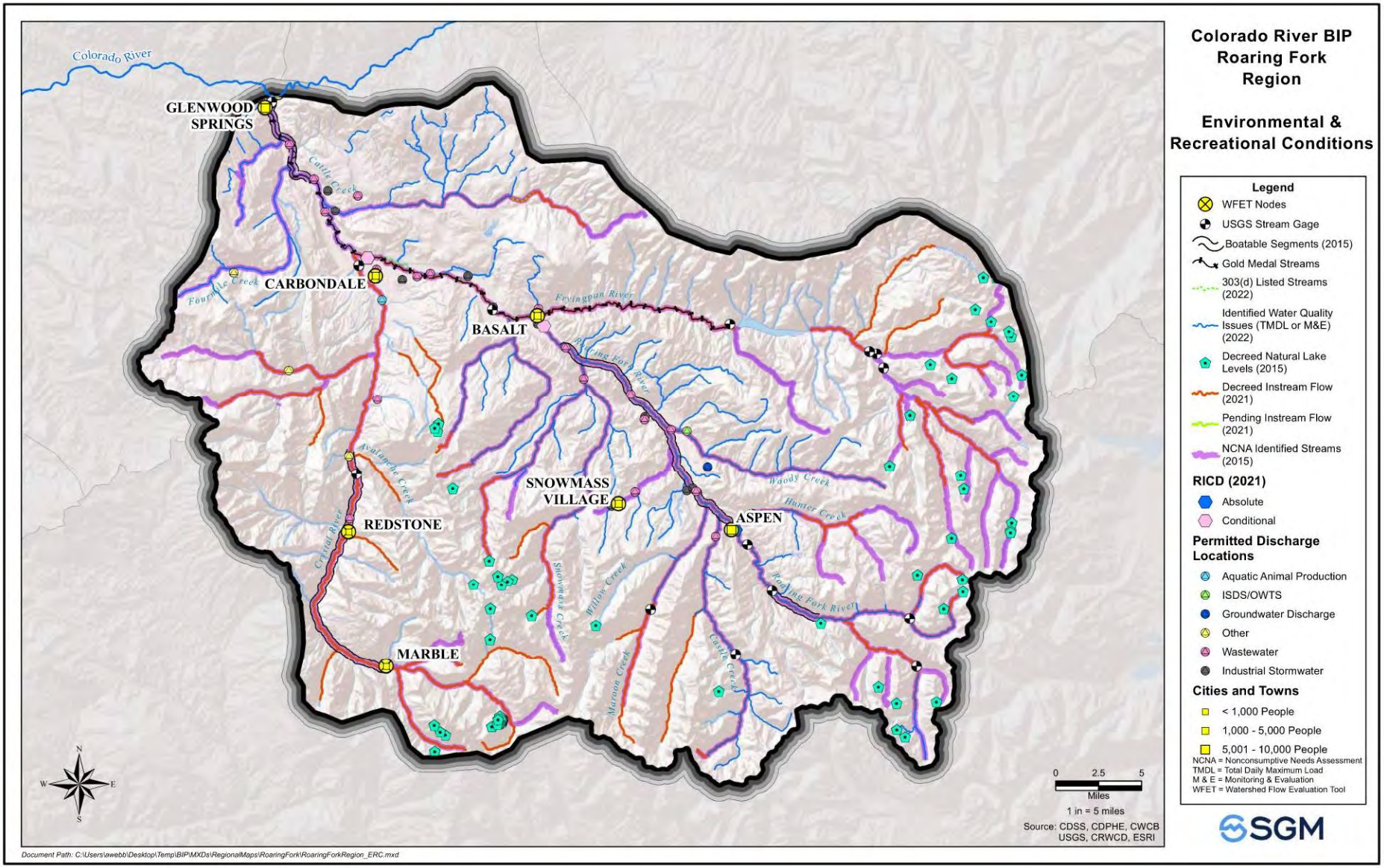


Figure 63: Map of Environmental & Recreational Conditions – Roaring Fork Region

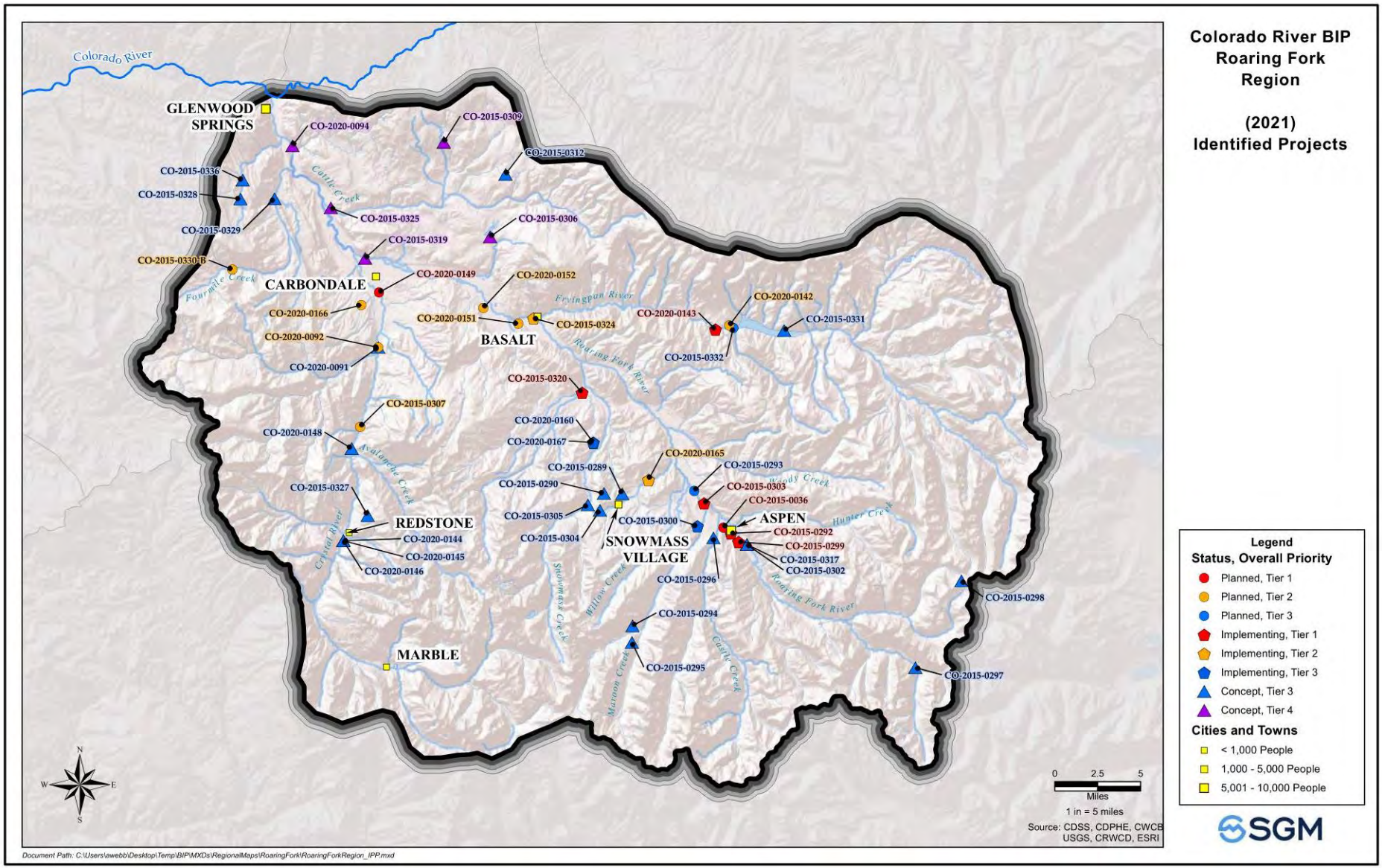


Figure 64: Map of Identified Projects from Projects Database – Roaring Fork Region

Roaring Fork Region Projects

All projects in the Roaring Fork region that are active (status of implementing, planned, or concept) are listed in **Table 20**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 20: Roaring Fork Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0036	Aspen Alternative Transfer Method (ATM) Program	Tier 1		$ 250,000	ATM
CO-2015-0289	Snowmass W&SD Roaring Fork Valley Pumpback	Tier 3	500 AF	Unknown	Pumpback
CO-2015-0290	Snowmass W&SD Conservation of an additional 7-8%	Tier 3	140 AF		Municipal conservation
CO-2015-0292	Aspen Municipal Conservation Projects and Programs	Tier 1	30 AF	$ 200,000	Municipal conservation
CO-2015-0293	Aspen Reclaimed Water Project	Tier 3			Municipal reuse
CO-2015-0294	Maroon Creek Reservoir	Tier 3	10,000 AF	$ 51,014,000	New reservoir
CO-2015-0295	Castle Creek Reservoir	Tier 3	9,000 AF	$ 60,849,000	New reservoir
CO-2015-0296	Leonard Thomas Reservoir Enlargement	Tier 3	24 AF	$ 10,000,000	Reservoir enlargement
CO-2015-0297	Grizzly Reservoir Enlargement	Tier 3	4,030 AF	$ 46,000,000	Reservoir enlargement
CO-2015-0298	Lost Man Reservoir Enlargement	Tier 3	42.5 AF	$ 130,000	Reservoir enlargement
CO-2015-0299	Wheeler Ditch Non-Diversion Agreement	Tier 1	-		Stream / riparian restoration
CO-2015-0300	City of Aspen Roaring Fork Ditches Improvements	Tier 3	-		Municipal raw water irrigation
CO-2015-0302	Roaring Fork River Pumpback	Tier 3	25 cfs	$ 1,000,000	Pumpback
CO-2015-0303	Pitkin County Instream Flow	Tier 1	3 cfs	$ 10,000	Instream flow
CO-2015-0304	Zeigler Reservoir Enlargement	Tier 3	105 AF	$ 332,000	Reservoir enlargement
CO-2015-0305	Sam's Knob Reservoir	Tier 3	565 AF	$ 25,890,000	New reservoir
CO-2015-0306	Spring Park Reservoir Enlargement	Tier 4			Reservoir enlargement
CO-2015-0307	Crystal River Irrigators Coordinated effort to maintain instream flows	Tier 2	-	$ 45,000	Instream flow
CO-2015-0309	Ralston No. 1 Reservoir restoration	Tier 4	59 AF	$ 93,000	Restricted reservoir restoration
CO-2015-0310	Christenson Reservoir restoration	Tier 4	11 AF	$ 17,000	Restricted reservoir restoration
CO-2015-0312	Polaris Reservoir restoration	Tier 3	774 AF	$ 1,220,000	Restricted reservoir restoration
CO-2015-0315	Create legal authority to use agricultural efficiencies for non-consumptive uses	Tier 3	NA		Instream flow
CO-2015-0316	Stream flow analysis to identify reaches in need of instream flow	Tier 4	NA		Instream flow
CO-2015-0317	Salvation Ditch Agricultural Efficiencies	Tier 3	1,517 AF	$ 600,000	Agricultural efficiency

Continued on next page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
Continued from previous page					
CO-2015-0319	Roaring Fork River Recreational In Channel Diversion (RICD) near Carbondale	Tier 4	-		RICD
CO-2015-0320	Capitol Creek flow efficiency improvement project	Tier 1	5 cfs		Instream flow
CO-2015-0321	Cancel Conditional Transbasin Diversions in Upper Roaring Fork River and Fryingpan River	Tier 1	500 cfs	$ 1,000	Protect key West Slope water rights
CO-2015-0324	Basalt Riparian and Floodplain Restoration	Tier 2	-	$ 2,100,000	Stream / riparian restoration
CO-2015-0325	Restoration at Cattle Creek	Tier 4	-		Stream / riparian restoration
CO-2015-0326	Wild and Scenic Designation – Crystal River	Tier 2	-		Wild & Scenic Rivers Act
CO-2015-0327	Avalanche Canal and Siphon	Tier 3	29 cfs	$ 100,000	Agricultural supply
CO-2015-0328	Fourmile Canal & Siphon (from Three Mile Creek Diversion)	Tier 3	50 cfs	$ 100,000	Agricultural supply
CO-2015-0329	Fourmile Canal & Siphon (from Four Mile Creek Diversion)	Tier 3	50 cfs	$ 100,000	Agricultural supply
CO-2015-0330-B	Martin Reservoir (Fourmile Creek): Martin Reservoir Alt 4 and/or Alt 3 expansion study	Tier 2	227.24 AF	$ 692,000	New reservoir
CO-2015-0331	Improved Management of Ruedi Reservoir	Tier 3	-		Reservoir management
CO-2015-0332	Ruedi Reservoir Hydropower Plant Outflow Improvement	Tier 3	-		Reservoir management
CO-2015-0335	Pitkin County Land Use Policy Review	Tier 3	-		Land use policy
CO-2015-0336	Hughes Reservoir Enlargement	Tier 3	1,415 AF	$ 2,200,000	Reservoir enlargement
CO-2020-0091	Crystal River Augmentation Plan Feasibility Study	Tier 2	NA	$ 100,000	Municipal supply
CO-2020-0092	Crystal River Augmentation Plan Implementation/Construction	Tier 3	100 AF	TBD	Municipal supply
CO-2020-0142	Ruedi Reservoir Release Management Options	Tier 2	-		Reservoir release timing
CO-2020-0143	Fryingpan Environmental Flow Management	Tier 1	-		Instream flow
CO-2020-0144	Phillips Project Aspen, CO	Tier 3			Habitat protection
CO-2020-0145	Redstone Braids	Tier 3		$ 600,000	Stream / riparian restoration
CO-2020-0146	Slaughterhouse Falls Aspen, CO	Tier 3			Stream / riparian restoration
CO-2020-0147	Crystal River Instream and Riparian Restoration Projects	Tier 3			Stream / riparian restoration
CO-2020-0148	Crystal River Riparian Habitat Enhancements on Pitkin County Open Space	Tier 3	-	$ 200,000	Stream / riparian restoration
CO-2020-0149	Crystal River- Riverfront Park Restoration	Tier 1	-	$ 1,055,000	Stream / riparian restoration
CO-2020-0150	Roaring Fork Watershed Demand Management Exploration	Tier 3			Compact compliance
CO-2020-0151	Irrigation Improvements – Pitkin County Open Space Ditches	Tier 2	-	$ 100,000	Agricultural efficiency
CO-2020-0152	Irrigation Improvements – Glassier Open Space	Tier 2	TBD	$ 300,000	Agricultural efficiency
CO-2020-0153	Environmental Benefits of Conservation and Efficient Water Use	Tier 3	75 AF/yr	$ 75,000	Municipal efficiency
CO-2020-0154	Identify Streams Needing Stream Management Plans	Tier 3	-		IWMP
CO-2020-0155	Municipal Water Loss Audits	Tier 3	600 AF/yr	$ 40,000	Municipal conservation
CO-2020-0156	Regional Agricultural Infrastructure Assessment	Tier 3	-	$ 200,000	Agricultural rehabilitation
Continued on next page					

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
Continued from previous page					
CO-2020-0157	Regional Irrigation Audit and Landscape Certification Program	Tier 3	200 AF/yr	$ 100,000	Municipal conservation
CO-2020-0158	Regional Water Conservation Campaign	Tier 1	120 AF/yr	$ 40,000	Municipal conservation
CO-2020-0159	Roaring Fork River Riparian Restoration and Enhancements	Tier 3	-	$ 200,000	Stream / riparian restoration
CO-2020-0160	Roaring Fork Watershed Plan Implementation	Tier 2	-		IWMP
CO-2020-0161	Soil Moisture Data Collection Stations	Tier 2	-		Monitoring
CO-2020-0162	Update State of Watershed Reports	Tier 4	-		Watershed planning
CO-2020-0163	Water Reuse Opportunities in the Roaring Fork	Tier 4	-		Municipal reuse
CO-2020-0164	Economic Impacts of River Recreation in the Roaring Fork	Tier 1	-	$ 100,000	Recreation
CO-2020-0165	Brush Creek Riparian Restoration & Enhancement	Tier 2	-	$ 200,000	Stream / riparian restoration
CO-2020-0166	Penny Hot Springs Bank Restoration / Stabilization	Tier 2	-	$ 300,000	Stream / riparian restoration
CO-2020-0167	Roaring Fork Observation Network (iRON)	Tier 3	NA	$ 80,678	Monitoring

Projects Discussion

The Roaring Fork region is represented by a wide variety of projects in the Projects Database. **Table 21** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 21: All Active Projects (Implementing, Planned, Concept) by Category – Roaring Fork Region

Project Category		Number of Projects Roaring Fork	
E&R Projects	Recreation	2	27
	Watershed Planning & Forest Health	3	
	Water quality	2	
	Stream / riparian restoration and habitat protection	12	
	Environmental flow	8	
Reservoir Projects	New reservoir	4	15
	Reservoir enlargement	6	
	Restricted reservoir restoration	3	
	Reservoir management	2	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	2	2
M&I Projects	Municipal supply and redundancy	5	15
	M&I water and land use planning	1	
	Municipal conservation, efficiency, and non-potable use	9	
Ag Projects	Agricultural efficiency	3	7
	Agricultural supply	3	
	Sustain agriculture	-	
	Agricultural rehabilitation	1	
Total		**66**	

The Roaring Fork region has a large focus on environmental and recreational projects. **Table 22** provides statistics about the capacity of these projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity, especially those which are still conceptual.

Table 22: Statistics for Environment and Recreation Projects – Roaring Fork Region

	Roaring Fork
Project Category	**Project Capacity**
Stream / riparian restoration	8 stream miles
Habitat protection	0.5 stream miles
Wild & Scenic Rivers Act	39 stream miles

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 23**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 65**. Note that reservoir projects may have an agricultural component, a municipal component, or both. As such, some reservoir projects are shown both as a municipal and industrial supply project and an agricultural supply project, and some are shown only in one category.

Table 23: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Roaring Fork Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	180,000	160,000	160,000	200,000	130,000	220,000
Agricultural Average Demand Gap (AF/year)	3,200	3,200	3,200	6,600	5,600	9,600
Municipal & Industrial Max Demand (AF/year)	13,000	15,000	14,000	16,000	15,000	18,000
Municipal & Industrial Maximum Gap (AF/year)	570	1,200	990	1,400	1,300	2,200

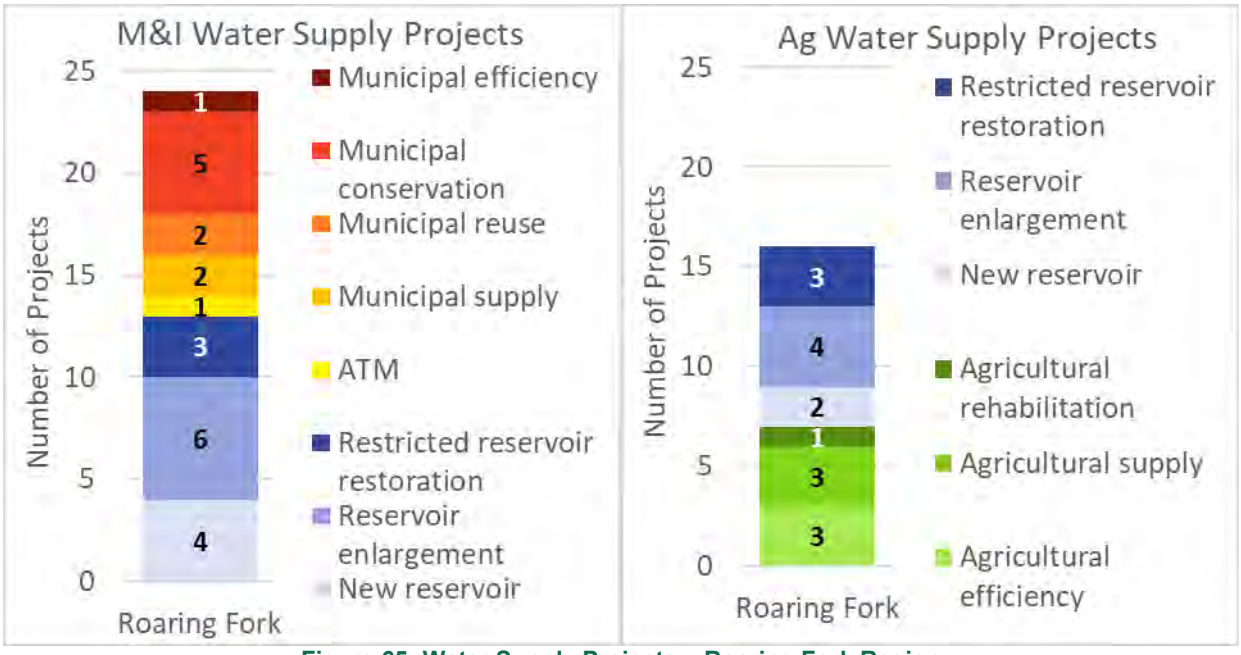


Figure 65: Water Supply Projects – Roaring Fork Region

The Roaring Fork region is experiencing rapid urbanization and municipal growth. Recall from **Figure 26** in **Section 2** that the Roaring Fork region has the highest maximum municipal gap of any region across all planning scenarios (except for Hot Growth). This gap is driven by increasing demands and limited supply. Water providers in the upper reaches of the Basin are dependent upon direct flow stream intakes and are at risk from low streamflows during extended drought, which is compounded by the prevalence of transmountain diversions.

These are reminiscent of the supply challenges seen in the Grand County region, another headwaters region heavily impacted by transmountain diversions. Like the Grand County region, the Roaring Fork region also has a focus on many small high-altitude storage projects, including small new reservoirs located above the physical diversion locations. Most of these proposed reservoir projects are multi-use, but some are predominantly focused on meeting municipal demand (such as Maroon Creek and Castle Creek Reservoirs). These small high-altitude reservoirs present significant challenges, including permitting, construction, high costs, and public opposition. As such, most of these reservoirs in the Projects Database are tiered at a Tier 3 or lower primarily due to timeline constraints.

While Ruedi Reservoir is an important resource in the region for augmentation against the downstream Cameo Call near Grand Junction, many water providers require local augmentation on supply-limited tributaries. One example of a municipal supply project planned for the region is the Crystal River augmentation plan feasibility study (Project ID CO-2020-0091) which aims to address the supply vulnerabilities raised by the first ever call placed on the Crystal River in 2018 by the Ella Ditch.

A concern for stakeholders in this region is the loss of irrigated lands associated with development to provide much needed municipal supply. As does the rest of the Basin, the Roaring Fork region's priorities align with the Basinwide Theme of sustaining agriculture and Goal of preserving agricultural lands. The municipal supply projects shown in **Figure 65** reflect active efforts in the region to meet growing demand with means other than buy-and-dry or agricultural lands. Other municipal projects in the region focus on municipal conservation, efficiency, reuse, and alternative transfer methods (ATMs).

The Roaring Fork region also has a significant agricultural gap. Agricultural supply challenges in this region are similar to the municipal supply challenges, reflecting a headwaters basin with insufficient upstream storage where low flows during dry years can cause serious supply issues. **Figure 65** shows an approach to address this challenge that combines agricultural storage in multi-use reservoir projects, supply projects, efficiency projects, and a rehabilitation project. Examples of agricultural efficiency projects include irrigation improvement efforts lead by Pitkin County Open Space and Trails (Project IDs CO-2020-0151 and CO-2020-0152).

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

Middle Colorado Region

The Middle Colorado region includes the mainstem Colorado River from the Eagle/Garfield County line at the head of Glenwood Canyon to the confluence of Roan Creek at the Town of De Beque. Some of the smaller tributaries include No Name, Grizzly Creek, Canyon Creek, Divide Creek, Rifle Creek, Garfield Creek, Mamm Creek, Parachute Creek, and Roan Creek. Several communities are located along the Colorado River and include Glenwood Springs, New Castle, Silt, Rifle, Parachute, Battlement Mesa, and De Beque.

The Middle Colorado region emerged as an identifiable reach of the Colorado River through the efforts of the Middle Colorado Watershed Council (MCWC), which was formed in 2012 (MCWC, 2021). MCWC lead the efforts on the Middle Colorado IWMP and is currently leading fire restoration and recovery efforts.

Rafting in Glenwood Canyon. Photo: Bailey Leppek

The Middle Colorado region contains the Shoshone Hydropower Plant in Glenwood Canyon. The Shoshone Plant's hydropower right is arguably one of the most powerful water rights in the Basin, with a 1902 priority for 1,250 cubic feet per second (and a second 1940 priority for 158 cfs). "During low flows (less than 1,408 cfs), as the most senior water right on the River, Shoshone Hydro may divert the entire flow out of the river into its turbines, leaving several miles of the Colorado River in Glenwood Canyon dry for up to 12 weeks a year. However, its effect on downstream flows is actually beneficial. Shoshone Hydro's use of the water is non-consumptive, meaning almost 100 percent of the water it diverts returns to the River downstream (Sloan, 2004)." That unconsumed water flows out of Shoshone Hydro's turbines and into the Colorado River, where it can be enjoyed by recreators, fish, and diverters alike.

Of the seven regions within the Colorado Basin, the Middle Colorado supports the second highest number of irrigated acres (after the Grand Valley), at approximately 52,000 acres, according to the USDA 2017 Census of Agriculture. A significant portion of this acreage is irrigated with water from the smaller tributaries. This region is supported by the Silt Water Conservancy District, Bluestone Water Conservancy District and the West Divide Water Conservancy District. This area is also served by the Bureau of Reclamation Silt Project (BOR, 2014) which is located near the towns of Rifle and Silt.

The Middle Colorado region is also characterized by the ongoing natural gas drilling and potentially marketable oil shale formations. It contains more natural gas wells than any region in the state outside of Weld County. In the past, this region was also subject to significant conditional water rights filed by energy entities for a future oil shale industry. One of the largest oil shale reserves in the world is located within the Middle Colorado region. For many years, oil companies have tried to extract the oil from this hard rock but have yet to find a cost-effective method. Several research and development operations are ongoing in the region and surrounding areas to find the key to unlocking this valuable resource. If development of oil shale becomes a viable industry, water use will increase.

The Colorado River through this reach is a direct source of drinking water for the Town of Silt, City of Rifle, Parachute, Battlement Mesa and De Beque. It also provides a backup supply for the Town of New Castle (providing redundancy for the Town's primary supply from East Elk Creek). This reach is impacted by all Colorado Basin headwater transmountain diversions which take high quality clean water, leaving less water and lower flows to help dilute the poorer quality water downstream. Concentrations of salinity, selenium, hardness, total dissolved solids, iron and manganese are examples of potential water quality concerns through this reach. Additional concerns include emerging contaminants and endocrine disruptors; however, limited water quality data has been collected to understand the trends. The City of Rifle was experiencing significant impacts of water quality concerns, and in 2017 they completed a new surface water drinking water plant using Colorado River water. The expense of this new plant has significantly increased water rates for the citizens of the City of Rifle.

The Endangered Species Act designation of critical habitat for three of the T&E listed fish species extends upstream on the Colorado River mainstem from the 15-Mile Reach in Mesa County to the main Rifle I-70 Bridge. This designation has resulted in more stringent discharge permit standards for wastewater treatment discharges. For example, the City of Rifle's copper limits have become more stringent to meet the water quality standard protective of the aquatic fish within this stream segment. This same reach of river is also home to three native fish species of concern: the roundtail chub, bluehead sucker, and flannelmouth sucker. Management actions are needed to ensure that populations of these species do not decline to the point requiring a T&E listing.

One of the region's most important needs is to protect water quality and riparian habitat along the Colorado River. Plans matching future land use with restoration needs for the numerous abandoned and existing gravel pits should be developed to provide comprehensive standards focusing on restoration of riparian habitat; this is an element that will be addressed through watershed planning efforts. Finally, this region may experience uncertainty with regards to water supply because of the potential oil shale industry development and the significant amount of conditional water rights which, if developed, may impact the priority of other water rights in the Colorado Basin.

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the Middle Colorado region include:

- Middle Colorado Watershed Council

  The group's mission is "to evaluate, protect and enhance the health of the middle Colorado River watershed through the cooperative effort of watershed stakeholders." (MCWC, 2021)

- Glenwood Canyon Restoration Alliance

  Glenwood Canyon Restoration Alliance is a collaboration of local government, non-profit, and business partners created in response to the August, 2020 Grizzly Creek Fire. Members include Middle Colorado Watershed Council, Roaring Fork Outdoor Volunteers, Roaring Fork Conservancy, Eagle River Watershed Council, Wilderness Workshop, Aspen Center for Environmental Studies, Garfield County Libraries, and City of Glenwood Springs. Together, these organizations are working on a multi-year effort to restore Glenwood Canyon and its surrounding landscape. (GCRA, 2021)

The Middle Colorado region includes the following water conservancy districts:

- West Divide Water Conservancy District
- Battlement Mesa Water Conservancy District

- Bluestone Water Conservancy District
- Silt Water Conservancy District

The Middle Colorado region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- Bookcliff Conservation District
- Mount Sopris Conservation District
- Southside Conservation District
- DeBeque – Plateau Valley Conservation District

Regional Topics

Grizzly Creek Fire

The Grizzly Creek Fire burned a total of 32,631 acres from its August 10, 2020 start date through October 23, 2020 when 91% containment was reported. Though the fire did not grow further after October 23, the fire was not reported fully contained until December 18, 2020 when the uncontained areas received significant snowfall (InciWeb 6942).

The Grizzly Creek Fire closed I-70 to traffic for two weeks (from August 10, 2020 through August 24, 2020), significantly impacting not only local economy but also the entire country. The fire also closed the popular Hanging Lake trail. "While Hanging Lake itself was not burned in the Grizzly Creek Fire, the fire burned much of the area above the lake and trail. Some areas of the trail were also burned, as was a large portion of glenwood Canyon."- White River National Forest Service (Glenwood Springs, 2020).

Grizzly Creek, post fire
(Photo credit: April Long)

The burn area included portions of No Name Creek and Grizzly Creek, both of which are important watersheds to the City of Glenwood Springs' drinking water.

> *Eric Petterson of SGM engineering in Glenwood said that about 2.9% of the Grizzly Creek watershed above the diversion over to No Name was in the burn area, and that was mostly low to moderate intensity — not the type usually associated with debris flows.*
>
> *There was little burn above the Grizzly Creek pipeline, so there is little concern of damage there.*
>
> *The fire burned much more intensely below the diversion, and while that is not a concern for the water supply, there is potential for big debris flows there, Petterson said.*
>
> *No Name was a little worse off, with 9.2% of its watershed in the burn area. It was also mostly low-to-moderate-intensity burn, but there was some high-intensity burn on the ridge between the two drainages.*
>
> *Petterson said there is a moderate to high risk of ash and mud flows in No Name and low to moderate risk of a major debris flow in either drainage. (Wertheim, 2020)*

Pine Gulch Fire 2020

The Pine Gulch fire burned a total of 139,007 acres from its July 31, 2020 start date through September 15, 2020 when 100% containment was achieved. Of the total acreage, 91,939 acres lie in the Middle Colorado region. The portion of the Pine Gulch Fire burn area that is within the Middle Colorado region is located at the very west of the region, west of Roan Creek and north of the Town of De Beque.

The fire started from a lightning strike approximately 18 miles north of Grand Junction. The burn area includes portions of Garfield and Mesa County and is predominantly (74%) located on BLM land.

> *The combination of drought-stressed vegetation, unseasonably hot weather and steep terrain led to weeks of active burning. Smoke columns were often visible from Grand Junction and the surrounding area as the wildfire exhibited extreme fire behavior. During the night of August 18, the fire grew quickly due to thunderstorm winds up to 40 mph for a three to four-hour period. As a result, the fire increased by more than 30,000 acres that night.*
>
> *Land Ownership Breakdown: BLM 101,714 / Private: Garfield County 35,791 / Private: Mesa County 1,502. (InciWeb 6906)*

Middle Colorado River IWMP (2021)

The Middle Colorado River IWMP covers 75 river miles and 20,000 square miles. It encompasses the entire Middle Colorado region. The Middle Colorado IWMP effort was led by the Middle Colorado Watershed Council (MCWC) and Mount Sopris, Bookcliff and South Side Conservation Districts (Conservation Districts), though many stakeholders participated in the development of the plan. (MCRIWMP, 2021).

The Middle Colorado IWMP mission statement is:

> *To improve security for all water uses in the Middle Colorado River by understanding and protecting existing uses, meeting shortages, and promoting healthy riverine ecosystems and agriculture in the face of increased future demand and climate uncertainty. (MCRIWMP, 2021).*

Some of the challenges addressed include (MCRIWMP Summary, 2021):

- Population growth: Garfield County is expected to increase by 40% by 2040, increasing demands for municipal water and recreation flows.
- Aridification: temperature-induced runoff is expected to decline by 35% or more by the end of the century.
- Agricultural water shortages and aging infrastructure: Tributary users face chronic shortages in available water to irrigate crops and raise livestock.
- Impaired waterways: declining fish populations (including endangered and threatened species), encroachment of invasive species, and water quality issues are all observed.
- Impaired watersheds: several stressors, including forest fires, pine beetle, and surface disturbances such as access roads on public and private lands are impacting the quality of the watershed.
- Energy development: increased demands from potential energy development, including oil shale and natural gas extraction.

Middle Colorado IWMP Action Plan

As part of the IWMP, an action plan was developed and used by watershed stakeholders as a quick reference guide for carrying out planned activities that further the mission of and goals associated with the Middle Colorado River Integrated Water Management Plan (IWMP). It contains written descriptions for each of the Projects, Initiatives, and Studies identified through the planning process (MCRIWMP, 2021). Many of these projects were added to the BIP Projects Database in 2020 and 2021.

Glenwood Springs from Storm King Mountain
(Photo credit: Doug Winter)

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 66** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 67** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 68** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up projects in the Projects Database. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**. Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. Some projects were not assigned a location because the project is not associated with a physical location or because the location is not known.

The following projects are not shown on the map because they were not assigned a project location:

- CO-2015-0255
- CO-2015-0256
- CO-2020-0093

IWMP Focus Areas

The Middle Colorado IWMP already covers the entire Middle Colorado region. It is anticipated that future efforts will be a continuation of this IMWP, driven by current and future stakeholders in the IWMP process (including Middle Colorado Watershed Council).

Future efforts under the umbrella of the Middle Colorado IWMP include:

- Implementing projects identified by the IWMP (some of which are also captured in the Projects Database)
- Periodically updating the Middle Colorado IWMP
- Identifying and implementing additional projects

As the entire region's watershed is already covered by an IWMP, no new reaches or watersheds were identified as priorities for development of a new IWMP. In the near future, much of the continued work under the umbrella of the Middle Colorado IWMP will focus on impacts from the Grizzly Creek and Pine Gulch fires. These next steps are being led by the Middle Colorado Watershed Council. An example of planned work is the installation of rain gages in Glenwood Canyon to enhance the weather communication network to protect people and infrastructure in the vicinity of the burn scar from flash flooding and debris flows.

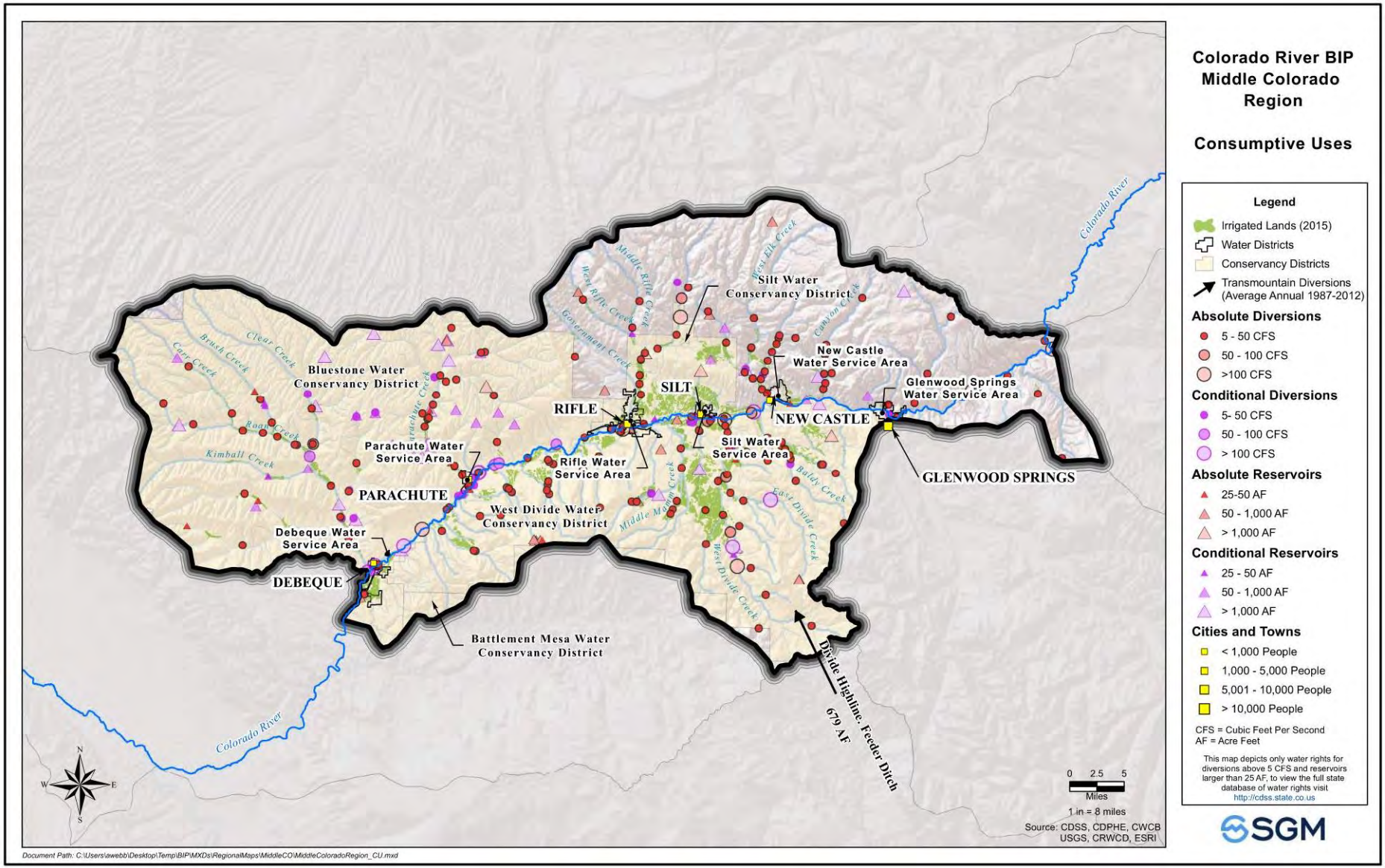


Figure 66: Map of Consumptive Uses – Middle Colorado Region

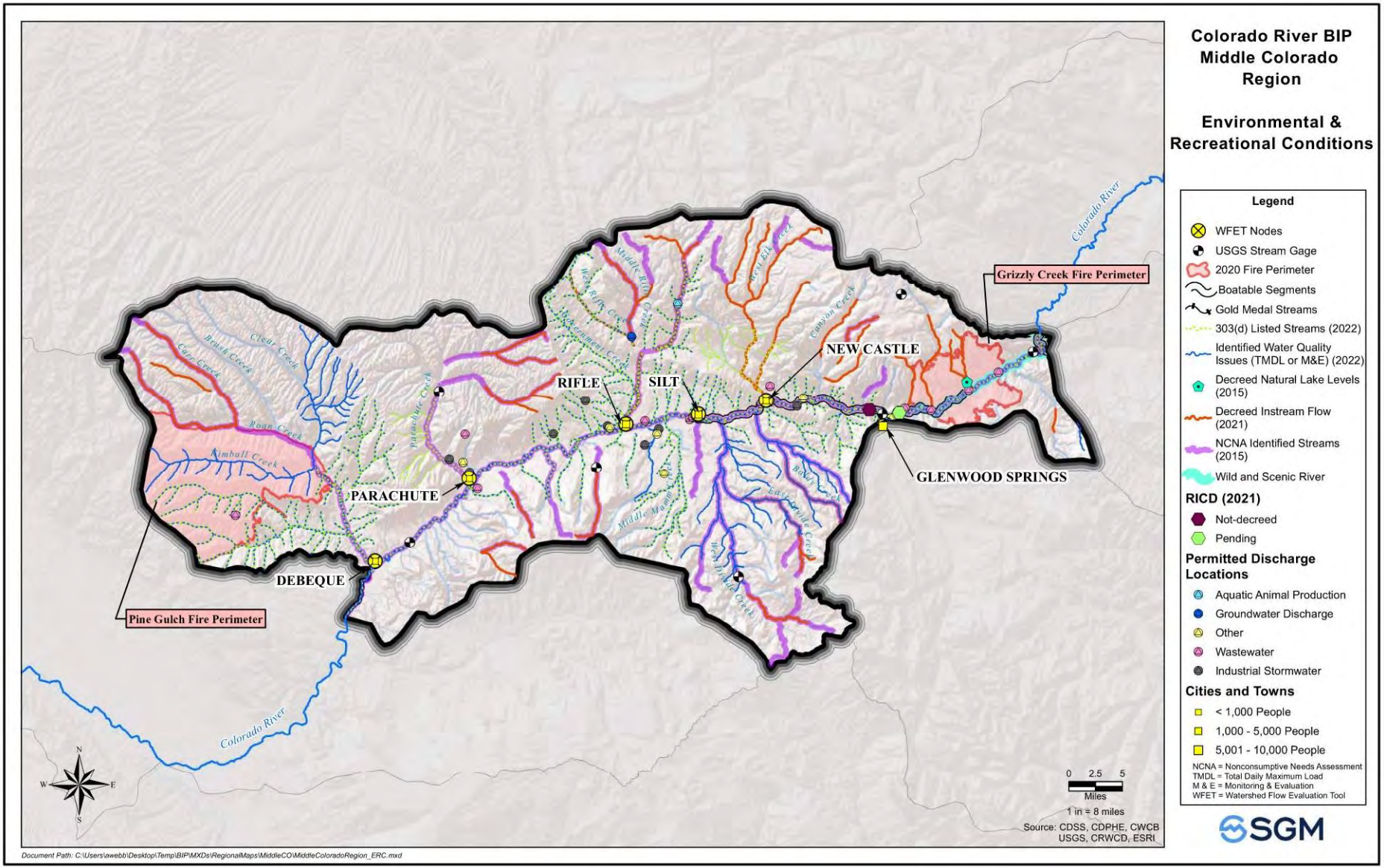


Figure 67: Map of Environmental & Recreational Conditions – Middle Colorado Region

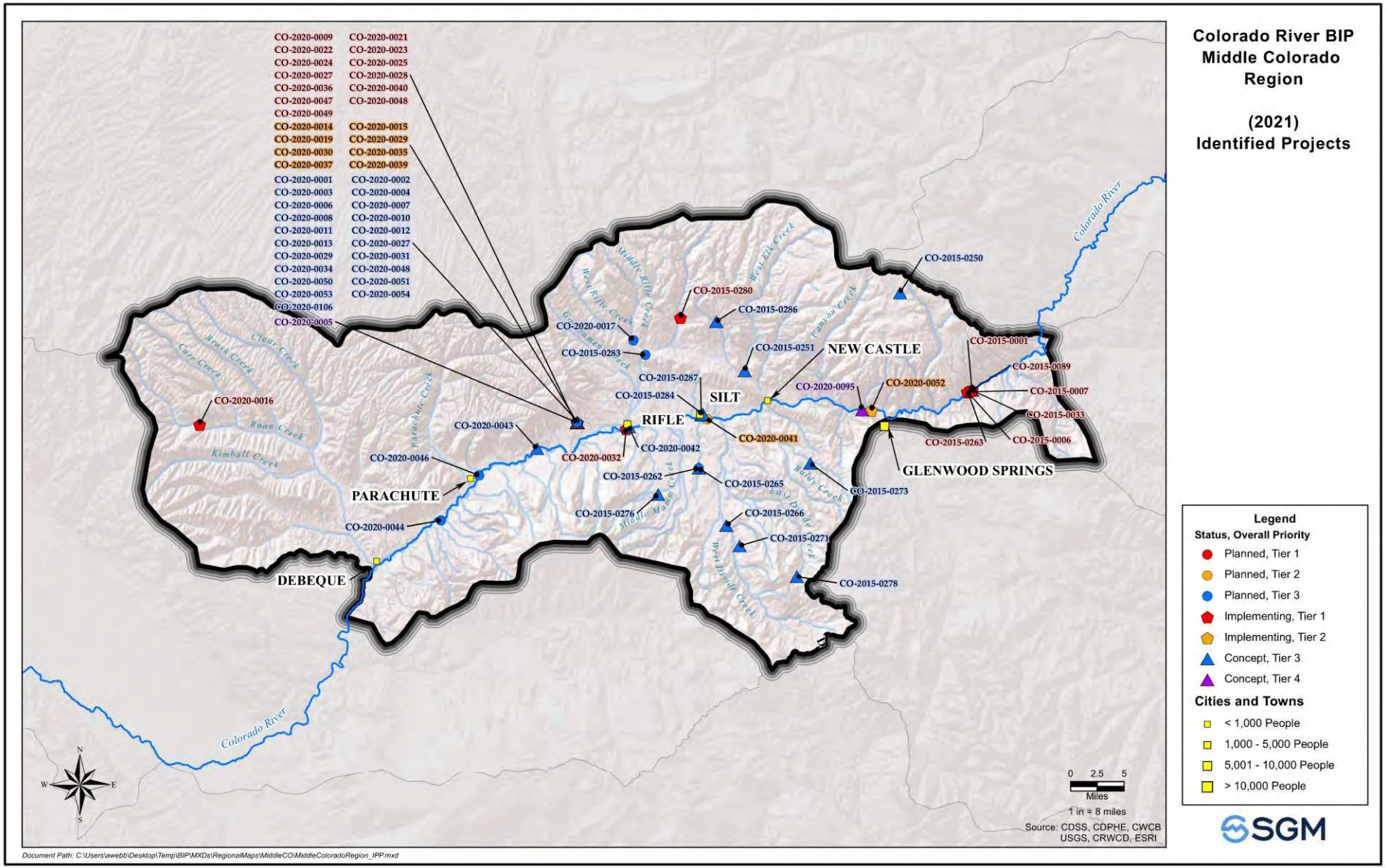


Figure 68: Map of Identified Projects from Projects Database – Middle Colorado Region

Middle Colorado Region Projects

All projects in the Middle Colorado region that are active (status of implementing, planned, or concept) are listed in **Table 24**. Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 24: Middle Colorado Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0250	Grizzly Creek Reservoir Construction	Tier 3	3,879.8 AF		New reservoir
CO-2015-0251	Main Elk Reservoir	Tier 3	34,922 AF		New reservoir
CO-2015-0255	On-Farm Treatment for Conservation Practices Study	Tier 2	NA		Agricultural efficiency
CO-2015-0256	Enhance conservation easement incentives to prevent agricultural water from being sold for diversion or other uses.	Tier 1	NA		Sustain agriculture
CO-2015-0263	Shoshone Operations – Sediment Flushing Protocols	Tier 1	NA	$ -	Water quality
CO-2015-0265	Dry Hollow Reservoir and Feeder Canal	Tier 3	45,000 AF	$ 77,807,000	New reservoir
CO-2015-0266	Horsethief Canal Construction	Tier 3	550 cfs	$ 24,000,000	Agricultural supply
CO-2015-0271	Kendig Reservoir and First Enlargement Construction	Tier 3	18,060 AF	$ 101,000,000	New reservoir
CO-2015-0273	West Divide Canal Construction	Tier 3	300 cfs	$ 10,778,000	Agricultural supply
CO-2015-0276	West Mamm Creek Reservoir	Tier 3	6,500 AF	$ 48,669,000	New reservoir
CO-2015-0278	Baldy Reservoir (East Divide Creek)	Tier 3	46 AF	$ 102,000	New reservoir
CO-2015-0280	Grass Valley Canal Improvements & Siphon Replacement	Tier 1	1,000 AF	$ 5,495,900	Agricultural rehabilitation
CO-2015-0283	Davie Ditch Pipe Installation	Tier 3			Agricultural efficiency
CO-2015-0284	Silt Pump Canal Pipe Installation	Tier 3			Agricultural efficiency
CO-2015-0286	Dry Elk Valley Lateral Lining	Tier 3			Agricultural efficiency
CO-2015-0287	East and West Laterals' Seepage Reduction	Tier 3			Agricultural efficiency
CO-2020-0001	Coordinate agricultural infrastructure upgrade designs to benefit aquatic habitat and fish passage.	Tier 3	NA	$ 7,500,000	Agricultural rehabilitation
CO-2020-0002	Increased Streamflow Monitoring	Tier 3	NA	$ 110,000	Monitoring
CO-2020-0003	Support for Colorado River Water Conservation District	Tier 3	NA	$ 20,000	Protect key West Slope water rights
CO-2020-0004	Develop a local market for water leasing between water users.	Tier 3	NA	$ 100,000	ATM
CO-2020-0005	Pilot a local market for locally produced agricultural products	Tier 4	NA	$ 10,000	Sustain agriculture

Continued on next page

Continued from previous page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2020-0006	Limit export of Trans-basin Diversion	Tier 3	NA	$ 50,000	Protect key West Slope water rights
CO-2020-0007	Bi-Annual Event to provide producers with available funding mechanisms available.	Tier 3	NA	$ 10,000	Sustain agriculture
CO-2020-0008	Educational opportunities for water right owners on Alternative Transfer Mechanisms.	Tier 3	NA	$ 50,000	ATM
CO-2020-0009	Collaborative post-fire watershed management	Tier 1	NA	$ 10,480,000	Forest health
CO-2020-0010	Encourage Water Right Owners to Keep Water Rights Tied to Land	Tier 3	NA	$ 150,000	Sustain agriculture
CO-2020-0011	Support Multi-Benefit storage projects	Tier 3	NA	$ 100,000	New reservoir
CO-2020-0012	Demand Management Investigations	Tier 3	NA	$ 100,000	Compact compliance
CO-2020-0013	Study irrigation scheduling effectiveness	Tier 3	NA	$ 100,000	Agricultural efficiency
CO-2020-0014	Reconfigure barriers for fish passive on tributaries	Tier 2	NA	$ 2,925,000	Fish passage
CO-2020-0015	Install fish screens to minimize entrainment	Tier 2	NA	$ 1,040,000	Fish passage
CO-2020-0016	Roan Creek Barrier	Tier 1	NA	$ 200,000	Fish passage
CO-2020-0017	Process Based Restoration in Rifle Creek Basin	Tier 3	NA	$ 202,500	Process based restoration
CO-2020-0019	Educational Signage About Nonnative Transport	Tier 2	NA	$ 31,250	Invasive species removal
CO-2020-0021	Participation in flow management forums	Tier 1	NA	$ 15,000	Reservoir release timing
CO-2020-0022	Support renewal of upper Colorado river endangered fish recovery program	Tier 1	NA	$ 3,000	Endangered fish recovery
CO-2020-0023	Best practices for gravel pit reclamation	Tier 1	NA	$ 25,000	Habitat protection
CO-2020-0024	Landowner outreach for fishery management best practices	Tier 1	NA	$ 30,000	Habitat protection
CO-2020-0025	Citizen science program to track invasive species	Tier 1	NA	$ 17,000	Invasive species removal
CO-2020-0026	Evaluate fish movement above Cameo diversion	Tier 3	NA	$ 100,000	Fish passage
CO-2020-0027	Monitor fish entrainment in mainstem diversion structures	Tier 3	NA	$ 100,000	Fish passage
CO-2020-0028	Implement water quality monitoring strategy	Tier 1	NA	$ 470,000	Water quality
CO-2020-0029	Develop site-specific temperature standards	Tier 3	NA	$ 75,000	Water quality
CO-2020-0030	Riparian restoration and invasive species control	Tier 2	NA	$ 500,000	Stream / riparian restoration
CO-2020-0031	Pilot gravel operation reclamation project	Tier 3	NA	$ 365,000	Invasive species removal
CO-2020-0032	Interpretive education at river stop	Tier 1	NA	$ 100,000	Community engagement
CO-2020-0034	Contract water for environmental support	Tier 3	-	$ 500,000	Habitat protection
CO-2020-0035	Targeted outreach for salinity control	Tier 2	NA	$ 5,000	Water quality
CO-2020-0036	Best management practices for floodplain uses	Tier 1	NA	$ 40,000	Floodplain development
CO-2020-0037	Develop and Administer Incentive Programs for River Habitat Protection	Tier 2	NA	$ 62,500	Habitat protection
CO-2020-0039	Educational programming to protect local water resources	Tier 2	NA	$ 50,000	Community engagement
CO-2020-0040	Develop and distribute recreational river guide	Tier 1	NA	$ 24,000	Recreation Access
CO-2020-0041	Improvements at Silt boat ramp at Island Park	Tier 2	-	$ 275,000	Recreation Access

Continued on next page
Continued from previous page

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2020-0042	Rifle whitewater park and RICD	Tier 3	-	$ 3,150,000	RICD
CO-2020-0043	Construct new boat ramp at Rulison	Tier 3	-	$ 800,000	Recreation Access
CO-2020-0044	Una bridge boat ramp improvements	Tier 3	-	$ 310,000	Recreation Access
CO-2020-0045	Construct new boat ramp in De Beque canyon	Tier 3	-	$ 550,000	Recreation Access
CO-2020-0046	Riverside camping in Town of Parachute	Tier 3	-	$ 237,500	Recreation Access
CO-2020-0047	River access facilities improvements	Tier 1	-	$ 165,000	Recreation Access
CO-2020-0048	Property ownership river signage	Tier 3	-	$ 55,000	Recreation Access
CO-2020-0049	Increase river camping opportunities	Tier 1	NA	$ 5,000	Recreation Access
CO-2020-0050	Land acquisition for river access	Tier 3	-	$ 50,000	Recreation Access
CO-2020-0051	River trail planning	Tier 3	-	$ 17,125,000	Recreation Access
CO-2020-0052	Glenwood recreational in-channel diversion (RICD) structure	Tier 2	-	$ 1,000,000	RICD
CO-2020-0053	Flow preference survey	Tier 3	-	$ 10,000	Recreation
CO-2020-0054	Track river use, needs, contributions	Tier 3	-	$ 85,000	IWMP
CO-2020-0093	Regional Stormwater Master Planning and Water Quality Regionalization	Tier 3	NA	$ 150,000	Stormwater
CO-2020-0094	Glenwood raw water intake improvements	Tier 4	-		Municipal redundancy
CO-2020-0095	Conduct a feasibility assessment for a new water treatment plant on the north side of Colorado River, downstream of the wastewater treatment effluent.	Tier 4	NA		Municipal redundancy

Projects Discussion

Projects in the Middle Colorado region focus heavily on environment and recreation, with water supply projects focused on agricultural demands and new multi-use reservoirs. **Table 25** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 25: All Active Projects (Implementing, Planned, Concept) by Category – Middle Colorado Region

Project Category		Number of Projects Middle Colorado	
E&R Projects	Recreation	14	40
	Watershed Planning & Forest Health	4	
	Water quality	6	
	Stream / riparian restoration and habitat protection	15	
	Environmental flow	1	
Reservoir Projects	New reservoir	7	7
	Reservoir enlargement	-	
	Restricted reservoir restoration	-	
	Reservoir management	-	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	3	3
M&I Projects	Municipal supply and redundancy	4	5
	M&I water and land use planning	1	
	Municipal conservation, efficiency, and non-potable use	-	
Ag Projects	Agricultural efficiency	6	14
	Agricultural supply	2	
	Sustain agriculture	4	
	Agricultural rehabilitation	2	
Total		**69**	

Note that one project as outlined in the Projects Database may encompass multiple individual projects. For example, Project ID CO-2020-0001 includes habitat restoration and fish passage projects for 25 different structures.

Middle Colorado region has a large focus on environmental projects and a notably larger focus on recreational projects than any other region. **Table 26** provides statistics about the capacity of these projects reported in the Projects Database (such as number of stream miles to be restored by the project). Note that not all environmental and recreational projects were assigned a capacity, especially those which are still conceptual. Quantifying these metrics was not a focus of the IWMP Action Plan.

Table 26: Statistics for Environment and Recreation Projects – Middle Colorado Region

	Middle Colorado
Project Category	**Project Capacity**
Process based restoration	3 stream miles
Stream / riparian restoration	5 stream miles
Forest Health	124,570 burned acres

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 27**, and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 69**. Note that reservoir projects may have an agricultural component, a municipal component, or both. As such, some reservoir projects are shown both as a municipal and industrial supply project and an agricultural supply project, and some are shown only in one category.

Table 27: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Middle Colorado Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	230,000	220,000	220,000	250,000	180,000	270,000
Agricultural Average Demand Gap (AF/year)	26,000	26,000	26,000	37,000	31,000	46,000
Municipal & Industrial Max Demand (AF/year)	13,000	21,000	16,000	19,000	17,000	27,000
Municipal & Industrial Maximum Gap (AF/year)	550	920	790	1,000	920	2,200

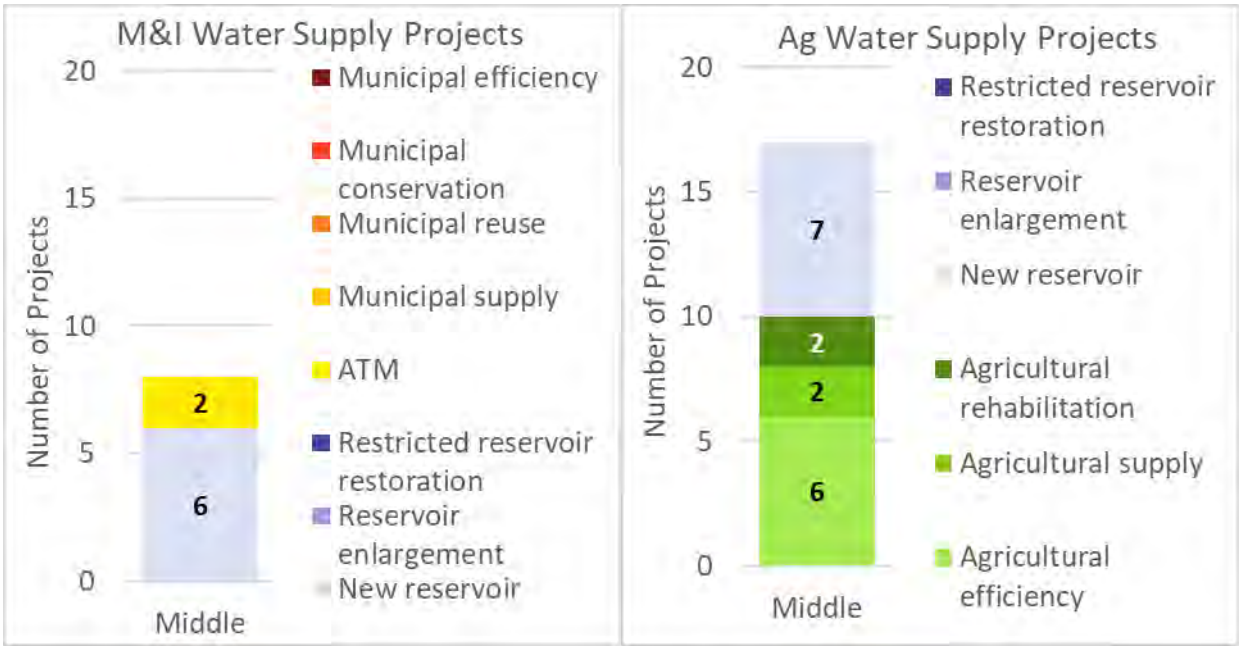


Figure 69: Water Supply Projects – Middle Colorado Region

The Middle Colorado region is notable for its agricultural gaps. As shown in **Table 27**, the Middle Colorado region has large agricultural gaps. Recall from **Figure 22** in **Section 2** that the Middle Colorado region's projected agricultural gap is the largest of any region across all planning scenarios, two to four times greater than the gaps for the next highest region, Grand County.

Detailed modeling done as part of the Middle Colorado IWMP showed that most of the agricultural shortages occur in the tributaries on the south side of the Colorado River, including Cache Creek, Garfield Creek, Divide Creek, Baldy Creek, and Mamm Creek. These shortages are shown for the Baseline scenario in **Figure 70** (which is an excerpt from the IWMP report). Shortages increase for other planning scenarios. "These shortages are the result of the less dependable water supply south of the Colorado River. These basins do not have very high elevations which can provide a more dependable winter snowpack" (MCRIWMP, 2021). Climate change impacts water supply in low elevation basins especially because as temperatures warm more of the water supply is delivered as rain than as snow, resulting in less storage in snowpack.

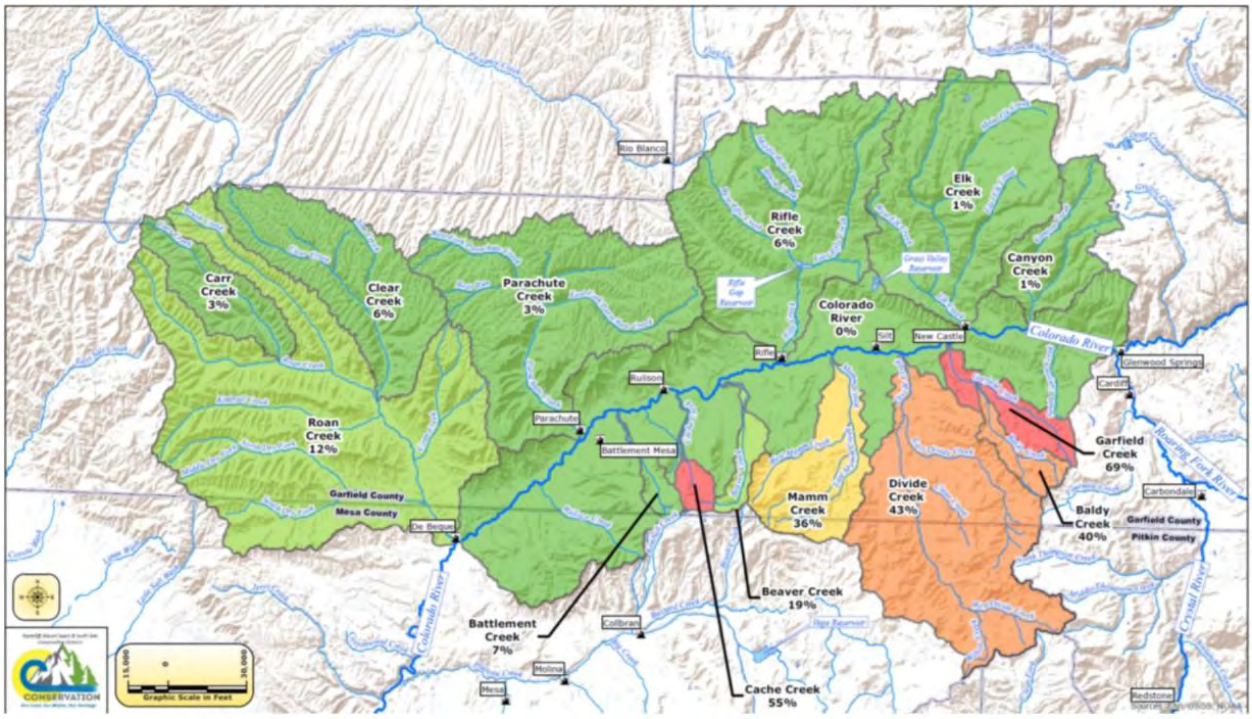


Figure 70: Magnitude of shortages experienced in each tributary basin under Baseline conditions from Middle Colorado River IWMP (MCRIWMP, 2021)

Many of the region's planned projects to address this agricultural shortage are related to the West Divide Project, which is sponsored by the West Divide Water Conservancy District. One specific component of the West Divide Project is construction of Kendig Reservoir (Project ID CO-2015-0271). The Middle Colorado IWMP included modeling of the potential for Kendig Reservoir to address these agricultural shortages. **Figure 69** shows that the region also has many other planned multi-use new small-scale reservoir construction projects to address these gaps. Dam rehabilitation and enlargement have also been identified as a critical part of the overall solution in this region.

These lessons learned from the detailed modeling done in the Middle Colorado IWMP highlight the importance of the Basin's Strategy to "update the modeling in the Colorado Water Plan (CWP) Technical

Update to improve accuracy at the regional level and incorporate more detailed modeling done by others (for example from stream management plans) to better understand the gaps."

The Middle Colorado region also has significant municipal and industrial demands. Recall from **Figure 27** from **Section 2** that the region's industrial demand increases almost four-fold from Baseline under the Hot Growth scenario which projects large-scale production of oil shale, coal, natural gas, and oil. However, the region does not have a projected gap for industrial demands under any scenario (**Figure 28** from **Section 2**).

The municipal and industrial gaps shown in **Table 27** are all erroneous municipal gaps related to modeling errors for City of Rifle. This error was identified as part of the detailed modeling that was done for the Middle Colorado IWMP and is discussed in more detail in that report (see section 2.6.8 of the IWMP report). The modeling shows that the City of Rifle experiences water shortages even in the Baseline scenario, which shows a disconnect between the City's water planning and the Technical Update modeling. This disconnect is understood to be because the model erroneously did not correctly include certain supplies (Green Mountain HUP water, Ruedi contract water, the augmentation plan in Case No. 83CW110, and raw irrigation supplies from Rifle Creek utilized for watering parks). These issues should be resolved in the next Technical Update to the Water Plan. (MCRIWMP, 2021)

Other than the municipal component of multi-use storage, municipal supply projects in this region include two alternative transfer method (ATM) projects. Glenwood Springs also has two projects focused on municipal redundancy (related to Grizzly Creek fire impacts) which are not considered supply projects.

The municipal gaps in the Middle Colorado region are especially pronounced under the Hot Growth scenario, compared with other regions (as shown in **Figure 26** in **Section 2**). The Hot Growth scenario assumes higher per-capita outdoor municipal use and more urban sprawl (in contrast to the shifting values toward more compact urban development in the Cooperative Growth and Adaptive Innovation Scenarios. Coupled with higher temperatures (higher demand for the increased lawn areas), this exacerbates the municipal gap for the Middle Colorado region in the Hot Growth scenario. This suggests that to preemptively avoid such gaps in a Hot Growth scenario, the region would benefit from additional projects focused on municipal efficiency and land use planning.

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

Grand Valley Region


Agriculture in the Grand Valley (Photo credit: CBRT)

The Grand Valley region follows the mainstem of the Colorado River stretching from De Beque Canyon to the Colorado-Utah state line. The two main tributaries are the Gunnison River (in the Gunnison Basin) and Plateau Creek.

Due to the favorable growing conditions and the supply of the Colorado River (previously the Grand River) the valley was one of the first areas in the Basin to develop and consequently, it has some of the most senior water rights. These senior water rights historically place a call on the river requiring water to be delivered to the region; this call is often referred to as the "Cameo Call". Maintaining this call and requiring delivery of the large flow of water to the lower Basin is a top priority. The irrigation entities that comprise the Cameo Call are the Grand Valley Irrigation Company, Palisade Irrigation District, Orchard Mesa Irrigation District (OMID), Mesa County Irrigation District and Grand Valley Water Users Association. "Like the Shoshone Call, the Cameo Call effectively keeps water instream until it reaches the Grand Junction area. This means that upstream diversions, including Front Range reservoirs and direct diversions, must shut down to satisfy senior agricultural needs at Cameo, and upstream reservoirs may need to release additional water into the River to meet the Call." (Sloan, 2004).

Grand Valley domestic water providers have made strong efforts to coordinate their services by establishing over 16 interconnects among, at least, four separate systems. This regional cooperation has even expanded to include the local irrigation entities to better coordinate water needs and manage the water resources in the Valley. This type of regional cooperation should be a model for not only the Basin but the entire state.

Ute Water Conservancy District (Ute Water) is the largest domestic water provider in the Colorado Basin with approximately 80,000 customers (Ute Water, 2020). Despite strong conservation gains lowering the average indoor water use to less than 75 gallons per person per day, Ute Water anticipates a water Gap of approximately 4,500 AFY by the year 2045. To meet this Gap, Ute Water is currently a pursuing permit to enlarge Monument Reservoirs No. 1, located in the Plateau Creek watershed along the north side of the Grand Mesa. After 15+ years and more than $2.1 million dollars spent by Ute Water the permit application continues to be under review by the U.S. Environmental Protection Agency and U.S. Forest Service. (Kurath, 2021).

Grand Valley region is known throughout the state for its robust agriculture production that produces vegetables, fruits and grains on over 70,000 acres (Spahr, et. al., 2000). The most famous products from the Grand Valley are the prized Palisade peaches and numerous vineyards and associated wineries. The region is home to the City of Grand Junction and the surrounding communities which combined make it the largest population center in Colorado's West Slope. Although the region is located in the lowest elevations of the Basin it is still home to the Powderhorn Ski Resort located on the north side of the Grand Mesa.

The most significant needs heard from the Grand Valley can be summarized by the need to protect, maintain and, if possible, increase flows in the Colorado River, not only to benefit the streams but to assure Colorado River Compact compliance and power production at Lake Powell. The Grand Valley desires to make best use of the Shoshone and Cameo calls, improve water quality in the streams and particularly in the mainstem of the Colorado River, and improves the permitting process to allow for more efficient approval of water storage projects.

A further concern for the Grand Valley is the continuation and success of the recovery of the endangered fish in the lower Colorado River. Water quality improvements are also a need due to high salinity and selenium concentrations which result from applying water to Grand Valley soils. Substantial investments have been made to line ditches and improve irrigation practices to reduce salt and selenium loading in the river. High salt levels cause problems for downstream agriculture, while high selenium levels negatively impact waterfowl and endangered fish.

Watershed Groups, Conservancy Districts, and Conservation Districts

Active watershed organizations in the Grand Valley region include:

- Grand Valley Stakeholder Group and Grand Valley Selenium Task Force

  The Grand Valley Stakeholder Group and the Grand Valley Selenium Task Force were both formed as a part of the Selenium Watershed Management Plan. Both the Task Force and the Stakeholder Group have been involved in the process of developing total maximum daily loads (TMDLs) for the Grand Valley for stream segments recently placed on the State of Colorado's 303(d) list as impaired for dissolved selenium, total recoverable iron, and E. coli. Both groups are involved in the Grand Valley Watershed Plan (current update to the Selenium Watershed Management Plan).

The Grand Valley region includes the following water conservancy districts:

- Battlement Mesa Water Conservancy District
- Bluestone Water Conservancy District
- Collbran Water Conservancy District
- Ute Water Conservancy District

The Grand Valley region includes the following resource conservation districts (also sometimes known as soil and water conservation districts):

- DeBeque – Plateau Valley Conservation District
- Mesa Conservation District

Regional Topics

Pine Gulch Fire

The Pine Gulch fire burned a total of 139,007 acres from its July 31, 2020 start date through September 15, 2020 when 100% containment was achieved. Of the total acreage, 47,067 acres lie in the Grand Valley region. The portion of the Pine Gulch Fire burn area that is within the Grand County region is north of Fruita and Grand Junction, in areas tributary to East Salt Creek, Big Salt Wash, and Adobe Creek.

The fire started from a lightning strike approximately 18 miles north of Grand Junction. The burn area includes portions of Garfield and Mesa Counties and is predominantly (74%) located on BLM land.

> *The combination of drought-stressed vegetation, unseasonably hot weather and steep terrain led to weeks of active burning. Smoke columns were often visible from Grand Junction and the surrounding area as the wildfire exhibited extreme fire behavior. During the night of August 18, the fire grew quickly due to thunderstorm winds up to 40 mph for a three to four-hour period. As a result, the fire increased by more than 30,000 acres that night.*
>
> *Land Ownership Breakdown: BLM 101,714 / Private: Garfield County 35,791 / Private: Mesa County 1,502. (InciWeb 6906)*

TMDL Development

Tributaries to the Colorado River in the Grand Valley (segment COLCLC13b) are on the State of Colorado's 303(d) list as impaired for dissolved selenium, total recoverable iron, and E. coli. Their placement on the 303(d) list sets in motion the requirement for the Water Quality Control Commission (WQCC) to develop a TMDL for these parameters on these tributaries.

The Water Quality Control Division (WQCD) has been working to develop new TMDLs for the segments that appeared on the 303(d) list in the 2018 listing cycle. To prioritize TMDL development, WQCD uses EPA's Recovery Potential Screening Tool, and screens out listings with uncertainties about data or standards as low priorities. Through this prioritization process, WQCD has selected metals, selenium, and E. coli impairments as higher priorities for TMDL development.

Grand Valley Watershed Management Plan

Members of the Gunnison Basin and Grand Valley Selenium Task Force (STF) developed the Selenium Watershed Management Plan (SeWMP) which was published in December 2012, as an update to the previous Selenium Watershed Restoration Action Plan. An update to the SeWMP is currently in progress, with anticipated completion in 2022. As the current update addresses additional water quality parameters beyond just selenium (total recoverable iron and E. coli) which were placed on the 303(d) list, this effort has been renamed as the Grand Valley Watershed Management Plan Update.

This watershed planning effort also includes areas of the Gunnison Basin, but watershed planning boundary for the Grand Valley portion includes the Colorado River mainstem and tributaries from the confluence with Plateau Creek to the State line (does not include the Plateau Creek watershed).

The purpose of the SeWMP and subsequent Watershed Plan is to have a cooperative, stakeholder driven program and process for reducing concentrations of water quality parameters of concern in the lower Uncompahgre, lower Gunnison, and Colorado (below Grand Junction) Rivers. Successful implementation of the Grand Valley Watershed Plan should result in the reduction and maintenance of selenium concentrations below the 4.6 ppb chronic water-quality standard for aquatic life by addressing existing sources of loading and preventing and minimizing new loading sources.

This Watershed Plan is part of an adaptive management program that will be revisited on a periodic basis, as needed, to respond to uncertainties, new knowledge (e.g., climate change effects, new monitoring data and/or changes in selenium mobilization and loading), the ability to meet in stream standards, and future funding levels for selenium reduction activities. (SeWMP, 2012)

Focus Area Maps and Initial Stream Characterization

To characterize the varied uses, conditions, and projects throughout the region, three maps were prepared. The consumptive use maps and environmental and recreational conditions map were first developed for the 2015 BIP but have been updated with new information for this report. The identified projects location map is new for the 2022 BIP Update; the additional information collected as a part of this effort allows projects to be mapped by their location and identified by project status and overall project tier.

The first map – **Figure 71** – depicts attributes related to consumptive uses, including: absolute and conditional direct diversion rights; absolute and conditional reservoir storage rights; irrigated lands; cities and towns; boundaries of water districts; and boundaries of water conservancy districts.

The second map – **Figure 72** – depicts attributes related to environmental and recreational conditions. Attributes are noted in the legend with the year the data was last updated (attributes with a 2022 date indicates the data is currently published as draft).

Note that some features may overlap, for example, the Watershed Flow Evaluation Tool (WFET) nodes are frequently located near towns, so icons for towns are often placed over the WFET node icons.

The third map – **Figure 73** – depicts the location of projects from the projects database that are active (status of implementing, planned, or concept), categorized by status and overall priority. Each project is labeled with the project ID number to allow readers to look up projects in the Projects Database. Following this map is a table, which lists projects in the region by project ID and gives project name and certain key information for each project. More information can be found in **Exhibits E and F**.

Note that some project locations overlap, especially projects that were assigned a location of the centroid of the region. All projects in the Grand Valley region were assigned a location, so there are no active projects which are not pictured.

IWMP Focus Areas

The Grand Valley Watershed Plan (currently in progress) covers the Colorado River mainstem and tributaries from the confluence with Plateau Creek to the State line but does not include Plateau Creek. As shown in **Figure 72**, the Plateau Creek watershed has a high concentration of tributaries highlighted by the non-consumptive needs assessment (NCNA), streams on the 303(d) list, and other identified water quality issues. Stakeholders have expressed that the Plateau Creek watershed is a priority for development of an IWMP.

Another priority for the region based on stakeholder input is areas affected by the Pine Gulch wildfire. These areas are north of Fruita and Grand Junction, in areas tributary to East Salt Creek, Big Salt Wash, and Adobe Creek. This area of post-fire concern overlaps with the tributaries on the 303(d) list that are currently areas of focus for the TMDL development (tributaries on the north side of the Colorado River from Lewis Wash to Salt Creek). An IWMP developed for this region would be able to build on the work done as part of the Grand Valley Watershed Plan to address water quality concerns and expand to address concerns related to the Pine Gulch fire impacts.

The following streams/watersheds have been identified as focus areas for development an IWMP:

- Plateau Creek watershed
- Tributaries on the north side of the Colorado River from Lewis Wash to Salt Creek

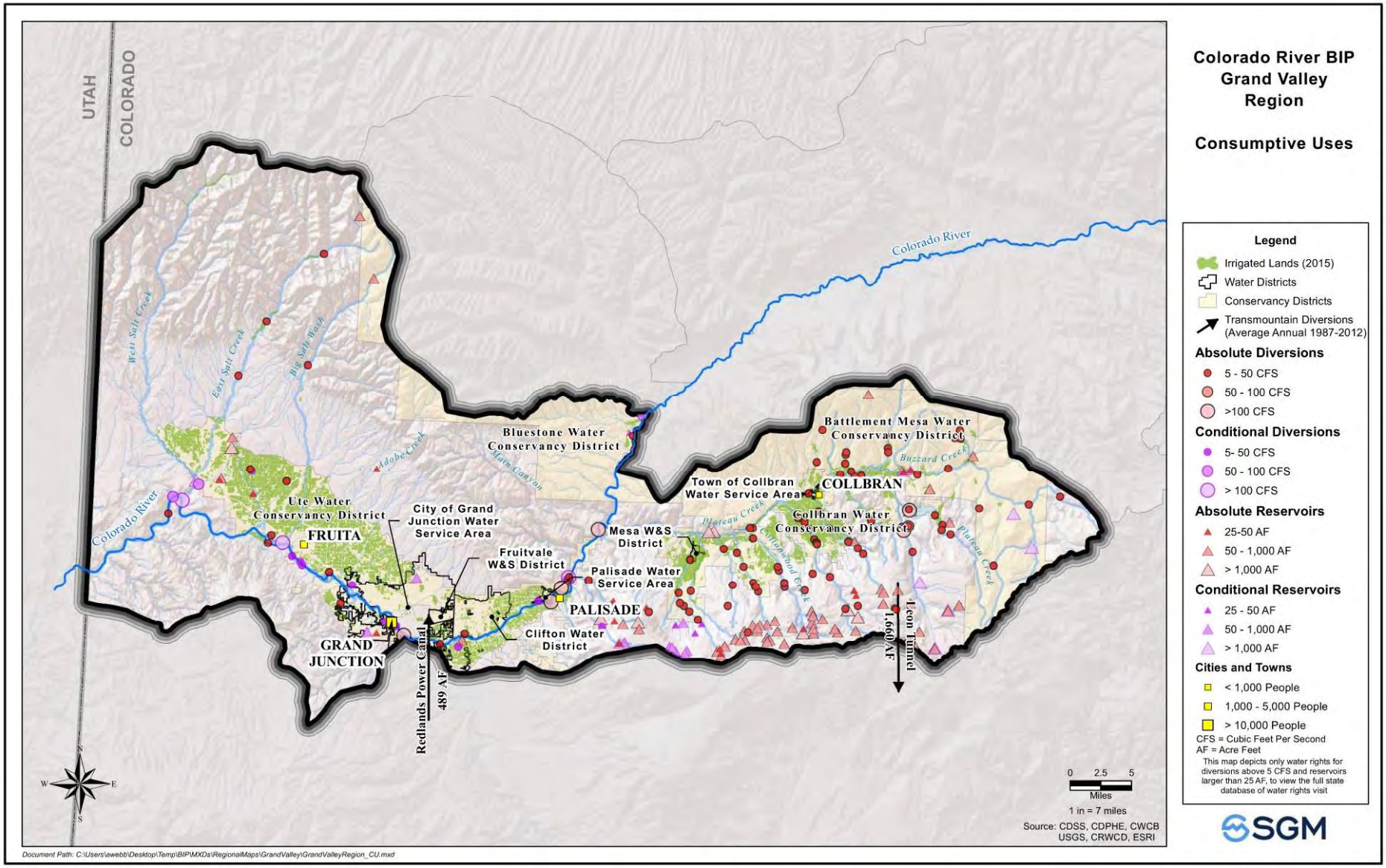


Figure 71: Map of Consumptive Uses – Grand Valley Region

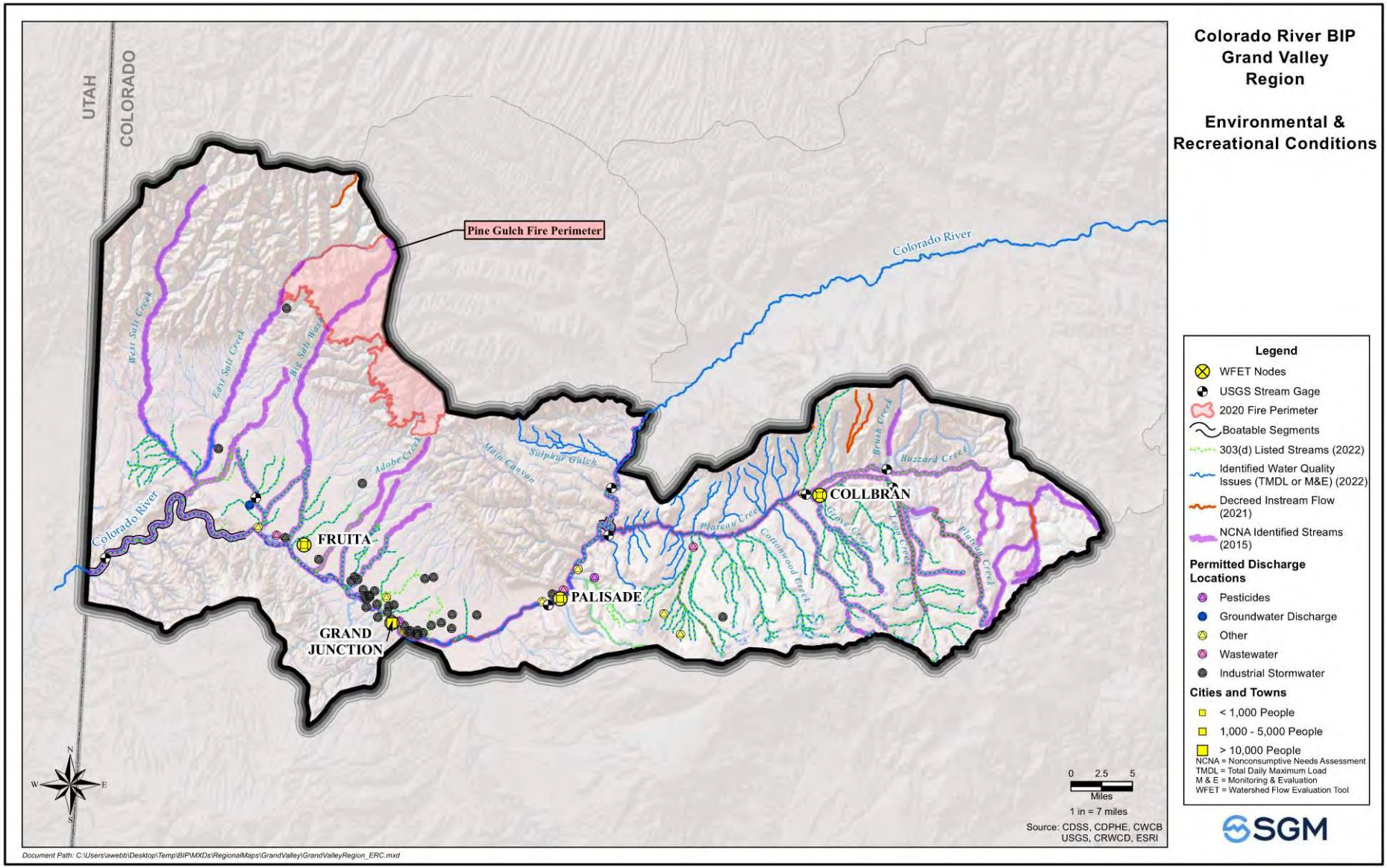


Figure 72: Map of Environmental & Recreational Conditions – Grand Valley Region

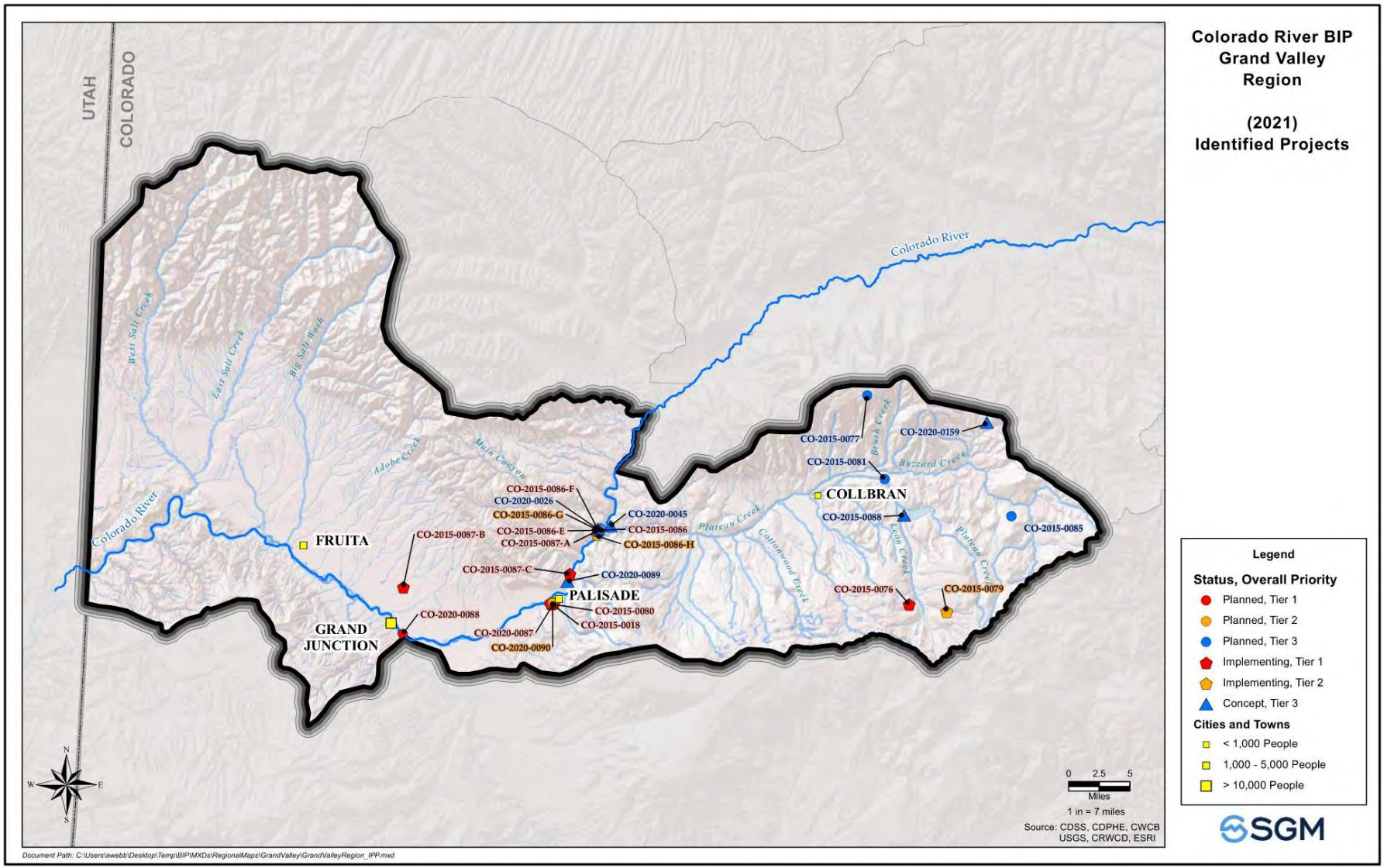


Figure 73: Map of Identified Projects from Projects Database – Grand Valley Region

Grand Valley Region Projects

All projects in the Grand Valley region that are active (status of implementing, planned, or concept) are listed in **Table 28.** Projects are listed in order of Project ID to allow the reader to look up a project name and key information based on the locations labeled by Project ID on the map on the previous page. More information about each project – including those marked completed or not pursuing – is included in the Projects Database. Specific assumptions made in developing costs for individual projects are documented in the descriptions for each project in the Projects Database. A static version of the Projects Database (at the time of writing this report) is included as **Exhibit D**. A dynamic version of the Projects Database (which may be updated as needed) is included as **Exhibit E.**

Table 28: Grand Valley Region Projects

Project ID	Project Name	Overall Tier	Estimated Yield	Estimated Cost	Project Category (Keyword 4)
CO-2015-0076	Kendall Reservoir Restoration Project	Tier 1	87 AF	$ 150,000	Restricted reservoir restoration
CO-2015-0077	Hawxhurst Reservoir Restoration	Tier 3	283 AF	$ 946,487	Restricted reservoir restoration
CO-2015-0079	Monument Reservoir No. 1 Enlargement	Tier 2	5,284 AF	$ 37,000,000	Reservoir enlargement
CO-2015-0080	Efficiency Improvements to Orchard Mesa Irrigation District (OMID) System	Tier 1	17,000 AF	$ 71,000,000	Agricultural efficiency
CO-2015-0081	Buzzard Creek Reservoir Construction	Tier 3	4,500 AF	$ 36,844,000	New reservoir
CO-2015-0085	Owens Creek Reservoir Construction	Tier 3	7,151.9 AF	$ 41,650,000	New reservoir
CO-2015-0086	Grand Valley Diversion Dam (Roller Dam) Improvements. Yield and capacity reported for umbrella project (CO-2015-0086). Costs and funding reported for each phase (A-H).	Tier 1	4,000 AF	See A-H	Agricultural rehabilitation
CO-2015-0086-E	Grand Valley Roller Dam & Canyon Electric Upgrades (Part 2)	Tier 1	-	$ 448,080	Agricultural rehabilitation
CO-2015-0086-F	Grand Valley Roller Dam & Canyon Headworks Inc. Transition	Tier 1	-	$ 4,500,000	Agricultural rehabilitation
CO-2015-0086-G	Grand Valley Roller Dam & Canyon Roller Tracks Concrete Rehabilitation	Tier 2	-	$ 1,500,000	Agricultural rehabilitation
CO-2015-0086-H	Grand Valley Roller Dam & Canyon Station 22 Emergency Spillway	Tier 2	-	$ 1,000,000	Agricultural rehabilitation
CO-2015-0087-A	Comprehensive Grand Valley canal lining: Government Highline Canal	Tier 1	12,853 AF	$ 25,000,000	Agricultural efficiency
CO-2015-0087-B	Comprehensive Grand Valley canal lining: Grand Valley Canal	Tier 1	9,283 AF	$ 13,377,000	Agricultural efficiency
CO-2015-0087-C	Comprehensive Grand Valley canal lining: Orchard Mesa Canal	Tier 1	8,033 AF	$ 45,000,000	Agricultural efficiency
CO-2015-0088	Collbran Conservation District Main Canal Improvements and Siphon Replacement	Tier 3	Unknown	$ 140,000,000	Agricultural rehabilitation
CO-2015-0089	Decision Support System for Upper Colorado River Basins	Tier 1	NA		Water management
CO-2020-0087	Grand Valley Power Plant Replacement	Tier 1	10,000 AF	$ 9,258,000	Agricultural rehabilitation
CO-2020-0088	Colorado River Corridor Plan, Grand Valley	Tier 1	NA	$ 115,000	River corridor plan
CO-2020-0089	Retrofit of Grand Valley Gravel Pit(s) for Water Storage	Tier 3	500 AF	$ 6,000,000	New reservoir
CO-2020-0090	Orchard Mesa Check Improvements	Tier 2	2,678 AF	$ 1,500,000	Agricultural rehabilitation

Projects Discussion

Projects in the Grand Valley region focus heavily on agricultural supply (with a primary focus on agricultural rehabilitation and efficiency) and reservoir projects. **Table 29** shows a breakdown by project category for all active projects in the region. This table includes only projects with a status of implementing, planned, and concept; projects with a status of completed or not pursuing (for which keywords were not assigned) are not included.

Table 29: All Active Projects (Implementing, Planned, Concept) by Category – Grand Valley Region

Project Category		Number of Projects Grand Valley	
E&R Projects	Recreation	-	1
	Watershed Planning & Forest Health	1	
	Water quality	-	
	Stream / riparian restoration and habitat protection	-	
	Environmental flow	-	
Reservoir Projects	New reservoir	3	6
	Reservoir enlargement	1	
	Restricted reservoir restoration	2	
	Reservoir management	-	
Compact/ Inter-basin Projects	Compact compliance, TMDs, Policy, Protect key West Slope water rights, Water management, Modeling	1	1
M&I Projects	Municipal supply and redundancy	-	-
	M&I water and land use planning	-	
	Municipal conservation, efficiency, and non-potable use	-	
Ag Projects	Agricultural efficiency	4	12
	Agricultural supply	-	
	Sustain agriculture	-	
	Agricultural rehabilitation	8	
Total		**20**	

The Grand Valley region has notably fewer environment and recreation projects than other regions. Other than the environment and recreation component of multi-use reservoir projects, the region has one E&R project, the Colorado River Corridor Plan, Grand Valley (Project ID CO-2020-0088). This project's capacity is shown in **Table 30**.

Table 30: Statistics for Environment and Recreation Projects – Grand Valley Region

	Grand Valley
Project Category	**Project Capacity**
River corridor plan	76 stream miles

Demand, Gap, and Supply Projects Discussion

As discussed previously, insufficient data was collected to summarize yield of projects from the Projects Database. Instead, this section discusses region's demands and gaps compared to the number of water supply projects by type. Water supply projects are considered any project that would have a yield that would help the Basin meet its gap.

The region's demands and gaps are summarized in **Table 31,** and are discussed in more detail in **Section 2** under the Technical Update Regional Results. The region's water supply projects are summarized in **Figure 74**. Note that reservoir projects may have an agricultural component, a municipal component, or both. As such, some reservoir projects are shown both as a municipal and industrial supply project and an agricultural supply project, and some are shown only in one category.

Table 31: Summary of Agricultural and Municipal & Industrial Demands and Gaps – Grand Valley Region

Scenario	Baseline	Business as Usual	Weak Economy	Cooperative Growth	Adaptive Innovation	Hot Growth
Agricultural Average Demand (AF/year)	760,000	710,000	710,000	730,000	650,000	750,000
Agricultural Average Demand Gap (AF/year)	6,000	5,400	5,400	11,000	5,900	17,000
Municipal & Industrial Max Demand (AF/year)	17,000	28,000	23,000	26,000	29,000	36,000
Municipal & Industrial Maximum Gap (AF/year)	290	450	380	450	640	3,100

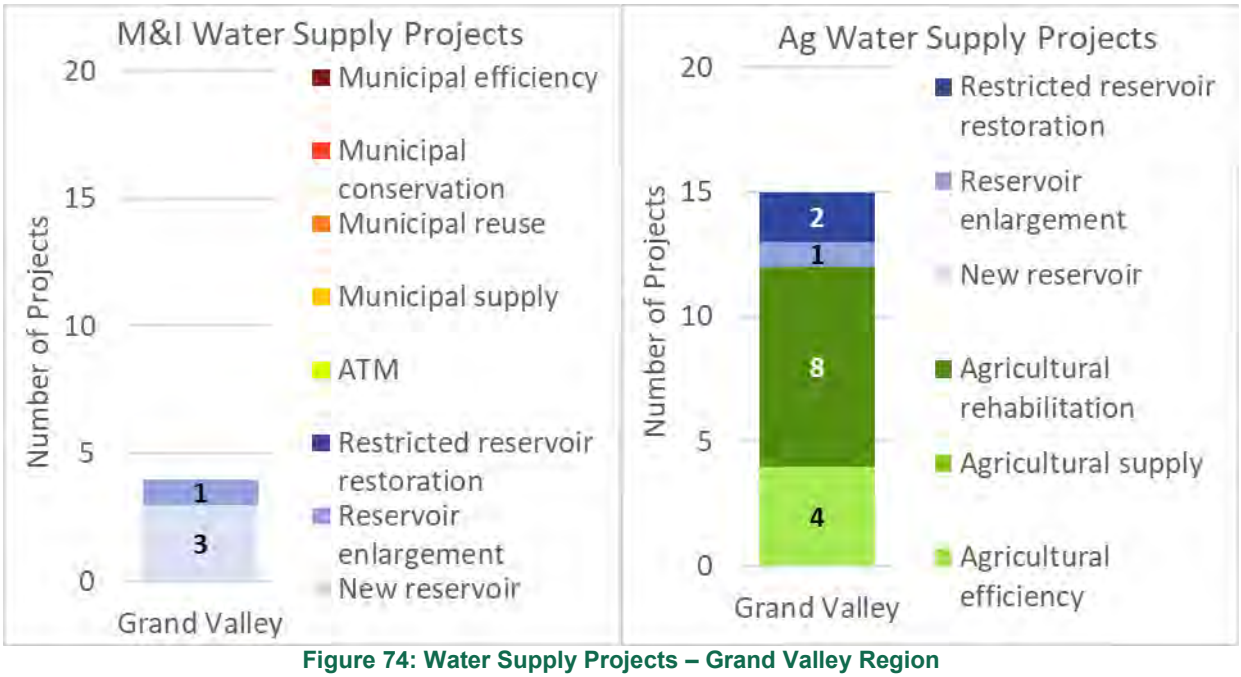


Figure 74: Water Supply Projects – Grand Valley Region

The Grand Valley does not see the same limitations on supply as do other regions. The Grand Valley is the lowest region in the Basin and therefore not as limited by physical supply as are the headwaters

region. Furthermore, the Grand Valley's senior Cameo Call water rights are critical to ensuring legal supply for the region. Due to the region's relatively stable water supply, the focus for agriculture in this region is therefore not on supply but rather on rehabilitation of aging infrastructure and on efficiency, as shown in **Figure 74**.

One notable agricultural rehabilitation effort in the region is the Grand Valley Diversion Dam (Roller Dam) Improvements (Project IDs CO-2015-0086 A through H). This project addresses rehabilitation needs for the diversion structure, dam, and the portion of the Government Highline Canal immediately below the Roller Dam. Portions of this project have been completed, including the Grand Valley Roller Dam & Canyon Master Plan Phase 1 and 2 (CO-2015-0086-A-B), the Upper Canyon Improvement Project (CO-2015-0086-C) and the Electrical and Control Systems Upgrades Project Part 1 (CO-2015-0086-D). Much work remains to be done on this project. This project is categorized as a Grand Valley project due to its location, but because of the important role the Cameo Call places in Basinwide administration, this project is also considered a Basinwide priority.

Another rehabilitation project is the Grand Valley Power Plant Replacement (CO-2020-0087); this power plant was built in 1934. In addition to the impact to the power plant, this project provides a mechanism by which water can be delivered to the 15 Mile Reach and beyond.

Yet another rehabilitation project is the Orchard Mesa Check Improvements (CO-2020-0090), a critical component of the Orchard Mesa Check Exchange. The Check Exchange benefits irrigators but is also critical in supplying water from various sources to the 15 Mile Reach. The proposed improvements would provide for greater efficiencies and responsiveness in operations of the Check structure. The operation of the Check is likely to become more important as the Colorado River faces aridification, allowing the 15 Mile Reach to remain viable for the endangered fish.

The region also has a focus on ditch lining and piping which reduce transit losses and help with water quality issues associated with salt and selenium loading. One such project is the Comprehensive Grand Valley canal lining, which includes lining projects on the Government Highline Canal (CO-2015-0087-A), Grand Valley Canal (CO-2015-0087-B), and Orchard Mesa Canal (CO-2015-0087-C).

Reservoirs are also a focus in the region. Municipal projects in the region are all storage projects, including some municipal-focused reservoirs and some multi-use reservoirs.

The municipal gaps in the Grand Valley region are especially pronounced under the Hot Growth scenario, compared with other regions (as shown in **Figure 26** in **Section 2**). The Hot Growth scenario assumes higher per-capita outdoor municipal use and more urban sprawl (in contrast to the shifting values toward more compact urban development in the Cooperative Growth and Adaptive Innovation Scenarios. Coupled with higher temperatures (higher demand for the increased lawn areas), this exacerbates the municipal gap for the Grand Valley region in the Hot Growth scenario. This suggests that to preemptively avoid such gaps in a Hot Growth scenario, the region would benefit from additional projects focused on municipal efficiency and land use planning.

The reader should keep in mind that all demand and gap results included in this report do not reflect the impacts of pending future transmountain diversions. For reasons described in **Section 1** under Pending Transmountain Diversions, the Colorado Basin Roundtable was told that future transmountain diversions cannot be modeled at this time, though the Roundtable maintains modeling of future transmountain diversions as a Strategy.

SECTION 5 – NEXT STEPS AND STRATEGIES

Colorado Basin Roundtable Meetings

The Colorado Basin Roundtable recognizes that it plays a critical role for making progress toward the Basin's Goals. In addition to continuing its meetings and role in funding projects, the Roundtable has approved Strategies to:

- Dedicate set time at Roundtable meetings to check in on progress toward the Basin's Goals
- Dedicate set time at Roundtable meetings to check in on State and Federal issues and the Basin's water supply situation

Another strategy that the Roundtable has approved is to "Use CBRT funds strategically to prioritize projects that support the Basin's Goals." The Roundtable has already begun making progress toward this goal, as it is currently working to revise its grant review schedule to allow for review of multiple projects at a time.

Public Education, Participation, and Outreach (PEPO) Education Action Plan

About the Public Education, Participation, and Outreach (PEPO) Workgroup

The Public Education, Participation, and Outreach (PEPO) Workgroup is a legislatively created committee of the Interbasin Compact Committee (IBCC). It is the only workgroup written into the legislation (C.R.S. 37-75-106).

The PEPO group is charged with:

- creating a process to inform, engage, and educate the public on the IBCC's and Roundtables activities and the progress of the interbasin compact negotiations;
- creating a mechanism by which public input and feedback can be relayed to the IBCC and compact negotiators; and
- educating IBCC and roundtable members on water issues.

The PEPO Workgroup's membership consists of the Education Liaisons, a volunteer liaison position on each basin roundtable, members of the IBCC, statewide water education experts, other volunteers from the Roundtables and staff of the Water Supply Planning section of the Colorado Water Conservation Board (CWCB). The members of this sub-committee work to identify the best approaches for education and outreach at the statewide and basin-specific levels. The PEPO Workgroup and roundtable members are collectively defining inclusive, forward looking, and meaningful ways in which the public can participate in the work of their basin roundtable.

In 2021 through 2022, the PEPO Workgroup will assist the basin roundtables in strengthening their education and outreach activities. The Colorado Basin Roundtable will bolster its Education & Outreach efforts through the creation of their Education Action Plan (EAP). The EAP will detail the educational and public engagement goals most effective for the basin roundtable.

To assist the basin roundtables in implementing their completed EAPs, the Colorado Water Conservation Board (CWCB) has created an education fund. All basin roundtables with a completed EAP will have the opportunity to receive up to $6,500/year in state funds for EAP implementation activities.

PEPO goals of the CBRT are to promote a well-informed and high-functioning basin roundtable and to support water awareness and broad scale participation of diverse water-dependent communities.

CBRT & PEPO Vision

The joint vision of the CBRT and PEPO is to:

- Develop and implement an EAP that facilitates awareness, educational and diverse public engagement opportunities about Colorado and Colorado Basin water subjects.
- Encourage awareness and development of holistic locally driven collaborative solutions supported by best available hydrologic and watershed data.
- Increase collaborations and partnerships with other Colorado basin organizations that wish to promote water awareness, education and engagement.
- Encourage CBRT members to actively participate with the PEPO sub-committee and recruit new participants.

CBRT & PEPO Goals

The goals of the CBRT and PEPO are:

- Raise public awareness of CBRT activities:
  - Work with regional news outlets on notification of CBRT meeting dates, time, location, how to participate and of CBRT vacancies.
  - Update CBRT website with current educational information for the public while serving as an effective resource for CBRT members.
  - Plan and facilitate a Colorado Basin specific short film illustrating environments and water stakeholders from headwaters to Stateline. Film to be used by CBRT, partners and for water outreach events.
  - Use social media to promote CBRT communications and education on water issues in the basin.
- Elevate awareness of the Colorado Basin Implementation Plan (CO-BIP) and Colorado's Water Plan (CWP) knowledge and engagement opportunities.
  - Engage media outlets with timely opportunities to promote public engagement on CO-BIP and CWP updates.
  - Promote CBRT membership understanding of strategies and actions contained within the updated CO-BIP.
- Align with the concrete actions identified in the Statewide Water Education Action Plan (SWEAP) including:
    - Provide trainings, leadership development, and mentorships tailored to underrepresented groups and geographies.
    - Provide equity and inclusivity training for coordinators, chairs, and appointing agencies of decision-making bodies.
    - Track metrics to ensure all demographics and geographies demonstrate progress in [educational outcomes] and identify program changes to close gaps.
  - Consider the guiding principles of the SWEAP that water education be:
    - Balanced and reflective of tradeoffs

    - Supportive of the Colorado Water Plan vision
    - Achieved with strong partnerships and collaboration
    - Objective and fact-based
    - Using a watershed approach
    - Accessible, engaging, and striving for equity
    - Implemented across Colorado
    - Adaptive and iterative in response to changing conditions
- Support CBRT watershed data/knowledge gap assessment and information gathering efforts in the basin.
    - Provide educational opportunities on river condition / freshwater assessments, Stream Management Plans/Integrated Water Management Plans.
- PEPO Sub-committee will collaborate in a timely and relevant manner to identify writers and CBRT topics to be submitted to regional / state news outlets at least two-times per year.
- Other identified water education opportunities and events as identified by CBRT members and partners.
- CBRT PEPO liaison, Abby Burk, will participate in CWCB education, and related meetings.

The goals of PEPO align with the Undercurrents, Goals, and Strategies of this BIP Update.

Development of the Basin's Education Action Plan

The PEPO sub-committee will meet quarterly to review progress on the EAP and to provide guidance and feedback on PEPO efforts at a time that is sufficient for members. Members agree to meet more if needed to complete a project. The sub-committee will make best efforts to structure its meetings to occur in the month following regularly scheduled IBCC meetings to maximize the transfer of information between the PEPO Workgroup and the Roundtable.

All Colorado Basin Roundtable members are encouraged to provide input and suggestions to the PEPO sub-committee. The sub-committee seeks to represent fully the hydrologic, agriculture, municipal, industrial, recreational, and environmental interests in the basin.

The CBRT EAP has identified its target audience as both water stakeholders and the general public. This includes Colorado Basin stakeholders interested in State and other funding and grant opportunities.

The PEPO subcommittee has identified the following critical issues in the Basin that need to be addressed over the EAP planning period:

- Colorado River Basin Issues
    - Hydrology – local, state and Big River
      Compact compliance / 2007 Interim Guidelines renegotiation
    - Colorado River Drought Contingency Plan processes – e.g. Demand Management
    - Transmountain diversions
    - Agricultural issues
    - Recreational Issues
    - Environmental Issues
    - Water Conservation
- BIP update

- CWP update

Existing partners of the EAP include:

- Colorado River Water Conservation District
- Colorado Mesa University Ruth Powell Hutchins Water Center
- Colorado State University Extension
- Colorado Parks and Wildlife
- Colorado Ag Water Alliance
- Colorado Cattlemen's Association
- Grand Valley Water Users Association
- American Rivers
- Audubon Rockies
- Colorado Trout Unlimited
- National Trout Unlimited
- Blue River Watershed Group
- Eagle River Watershed Council
- Middle Colorado Watershed Council
- Roaring Fork Conservancy
- Grand County Water Info Network
- Ute Water Conservancy District
- Eagle River Water & Sanitation District

Potential partners of the EAP include:

- All organizations, business and agencies represented on the CBRT
- Regional media contacts are established with:
  - Aspen Journalism
  - Aspen Times
  - Grand Junction Sentinel
  - Post Independent
- Colorado Public Radio:
  - Vail, Aspen, Glenwood, Grand Junction.
- KUNC Public Radio (Minturn, Steamboat Springs, Greeley)
- KDNK Public Radio (Carbondale and RF Valley)
- KAJX (Aspen and RF Valley)

Integrated Water Management Plans (IWMPs) for Priority Streams

The CWP includes a goal to have stream management plans for 80% of the prioritized streams by 2030. The focus area maps served as the basis for each region to consider future IWMPs.

Focus Area Maps and Initial Stream Characterization

The concept of focus area maps was initiated as part of the 2010 Statewide Water Supply Initiative and reviewed and update by the Colorado Basin developed for the 2015 BIP. The purpose of the focus area maps was originally to identify where environmental and recreational attributes are located throughout each basin.

The Colorado Basin expanded beyond the environmental and recreational focus this during the 2015 BIP by also creating focus area maps that show consumptive uses. Two maps were developed for the 2015 BIP for each region, one depicting environmental and recreational conditions, and one depicting consumptive uses.

For the 2022 BIP Update, the two existing focus area maps were updated with new information. A third map was also added for each section to show locations of active projects in the Projects Database.

Section 4 included the three focus area maps for each region, depicting the existing consumptive uses, environmental and recreational conditions, and key identified projects.

These maps provide a visual representation for the stakeholders to understand some of these key datasets and consider how they would like to move forward with IWMPs.

Prioritizing Streams for Future IWMPs

The BIP Update Team, Roundtable members, and other stakeholders reviewed the three focus area maps developed for each region during the April 26, 2021 Next Steps Committee Meeting. The meeting participants received a link to this information as homework prior to the meeting and provided input regarding priority areas for further studies. **Section 3** describes the determination of priority streams identified for each region. **Table 32** summarizes the existing IWMPs (and similar planning efforts) and the priority streams or watersheds identified as priorities for future IWMPs.

Table 32: Existing IWMPs and Priority Streams for Future IWMPs

Region	Existing IWMPs / Planning Efforts	Priority Streams for Future IWMPs
Grand County Region	Grand County Stream Management Plan (2010): Focus on Fraser River and Colorado River mainstem	• Areas impacted by the East Troublesome Fire: East Troublesome Creek, Troublesome Creek, Willow Creek, etc. • Areas impacted by Williams Fork Fire: Williams Fork River watershed • Fraser River and mainstem of the Colorado (either as an update to the 2010 Grand County Stream Management Plan or renamed as an IWMP)
State Bridge Region	The Upper Colorado Wild & Scenic Alternative Management Plan (in progress) is serving in a similar capacity to an IWMP	• Tributaries and originating from the Flat Tops, namely the Red Dirt watershed • IWMP for the Colorado River mainstem developed from the Wild & Scenic Alternative Management Plan process
Summit Region	Blue River IWMP (in progress): entire Blue River watershed / entire Summit region	The Blue River IWMP already covers the entire Summit region. Future efforts will be a continuation of this IMWP: implementing projects identified by the IWMP, updating the IWMP, and identifying additional projects.
Eagle Region	• Eagle River Community Water Plan (in progress): Eagle River / entire Eagle region • Brush Creek Watershed Management Plan (2011)	The Eagle River Community Water Plan already covers the entire Eagle region. Future efforts will be a continuation of this Plan: implementing projects identified by the Plan, updating the Plan, and identifying additional projects.
Roaring Fork Region	• Roaring Fork River Watershed Plan (2019 Update) • Upper Roaring Fork River Management Plan (2017): Roaring Fork mainstem, major tributaries between Lost Man Creek and Brush Creek confluence near Woody Creek • Crystal River Management Plan (2016)	• Frying Pan River • Sopris Creek
Middle Colorado Region	Middle Colorado IWMP (2021): Colorado River and tributaries / entire Middle Colorado region	The Middle Colorado IWMP already covers the entire Middle Colorado region. Future efforts will be a continuation of this IMWP: implementing projects identified by the IWMP, updating the IWMP, and identifying additional projects.
Grand Valley Region	Grand Valley Watershed Plan (in progress): Colorado River mainstem and tributaries from the confluence with Plateau Creek to the State line (does not include Plateau Creek)	• Plateau Creek watershed • Tributaries on the north side of the Colorado River from Lewis Wash to Salt Creek. These tributaries have water quality impairments and this area also includes the portions of the region impacted by the Pine Gulch fire. This IWMP effort could build upon the Grand Valley Watershed Plan efforts.

ACRONYMS

AF	Acre-Feet
AFY	Acre-Feet/Year
Ag	Agriculture
ATM	Alternative Transfer Methods
Basin	Colorado River Basin in Colorado
BEAR	Burned Area Emergency Response
BIP	Colorado Basin Implementation Plan
BLM	Bureau of Land Management
BMP	Best Management Practice
BOR	U.S. Bureau of Reclamation
BREW	Blue River Enhancement Workgroup
BRIWMP	Blue River Integrated Water Management Plan
BRWG	Blue River Watershed Group
C-BT	Colorado Big Thompson Project
CBRT	Colorado Basin Roundtable
CRWCD	Colorado River Water Conservation District
CDM	CDM Smith
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFS	Cubic Feet per Second
CO-BIP	Colorado Basin Implementation Plan
COGA	Colorado Oil and Gas Association
CPW	Colorado Division of Parks and Wildlife
CRCA	Colorado River Cooperative Agreement
CRIA	Colorado River Inventory and Assessment
CRRCP	Colorado River Restoration & Conservation Project
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWP	Colorado Water Plan
DARCA	Ditch and Reservoir Company Alliance
DNR	Department of Natural Resources

DOLA	Department of Local Affairs
DWR	Division of Water Resources
EAP	Education Action Plan
EO	Executive Order
E&R	Environment and Recreation
ERMOU	Eagle River Memorandum of Understanding
ERWC	Eagle River Watershed Council
ERWSD	Eagle River Water and Sanitation District
ESA	Endangered Species Act
Fry-Ark	Fryingpan-Arkansas
Gap	SWSI 2010 M&I Gap
gpcd	Gallons per Capita per Day
GWUDI	Groundwater Under the Direct Influence
GVIC	Grand Valley Irrigation Company
HB	House Bill
HUP	Historic Users Pool
IBCC	Interbasin Compact Committee
IGA	Intergovernmental Agreement
ILVK	Irrigators of Lands in the Vicinity of Kremmling
IPPs	Identified Projects and Processes
ISF	Instream Flow
IWMP	Integrate Watershed Management Plan
LBD	Learning by Doing
MAF	Million Acre-Feet
MCWC	Middle Colorado Watershed Council
MCRIWMP	Middle Colorado River Integrated Water Management Plan
M&I	Municipal and Industrial
mg/L	Milligrams per Liter
MOU	Eagle River Memorandum of Understanding
NCNA	Non-consumptive Needs Assessment
NEPA	National Environmental Policy Act
Northern	Northern Colorado Water Conservancy District
NOSA	National Oil Shale Association

NRCS	Natural Resource Conservation Service
NWSRS	National Wild and Scenic Rivers System
OMID	Orchard Mesa Irrigation District
ORV	Outstanding Remarkable Values
PEPO	Public Education, Participation, and Outreach
PLT	Project Leadership Team
Project ID	Project Identification Number (for Projects Database)
RFC	Roaring Fork Conservancy
RICD	Recreational In-Channel Diversion
Roller Dam	Grand Valley Diversion Dam
RFWC	Roaring Fork Watershed Collaborative
ROD	Record of Decision
SB	Senate Bill
SCAP	Sediment Control Action Plan
SCWWW	Silver Creek Water and Wastewater Authority
SeWMP	Selenium Watershed Management Plan
SG Plan	Stakeholder Group Management Plan
SSI	Self-Supplied Industrial
SEO	State Engineer's Office
Stateline	Colorado/Utah Stateline in Mesa County
SMP	Stream Management Plan
STF	Selenium Task Force
SWEAP	Statewide Water Education Action Plan
SWSI	Statewide Water Supply Initiative
TDS	Total Dissolved Solids
T&E	Threatened and Endangered
TMD	Transmountain Diversion
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UCRWG	Upper Colorado River Watershed Group
UERWA	Upper Eagle Regional Water Authority
UPCO	Upper Colorado River Study
URFRMP	Upper Roaring Fork River Management Plan

USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
Ute Water	Ute Water Conservancy District
WECO	Water Education Colorado
WGFP	Windy Gap Firming Project
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division
WFET	Watershed Flow Evaluation Tool
WRA	Western Resource Advocates
WRNF	White River National Forest
WSR	Wild and Scenic River
WSRA	Water Supply Reserve Account
2019 Tech Update	2019 Analysis & Technical Update to the Colorado Water Plan

CITATIONS AND REFERENCES

Citations are listed in alphabetical order by the citation used in the text. Hyperlinks are provided where possible.

2019 Tech Update	2019 Analysis & Technical Update to the Colorado Water Plan https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan
American Rivers, 2021	American Rivers, What Is Integrated Water Management? Website. Accessed May 25, 2021. https://www.americanrivers.org/conservation-resources/integrated-water-management/what-is-integrated-water-management/
Avery et.al., 2011	Avery, Kristen, Kelsey Cody, Eric Gordon, Roberta Klein, Jeff Lukas, Joel Smith, William Travis, Bradley Udall, and Jason Vogel. 2011. Western Water Assessment. Colorado Climate Preparedness Project – Final Report.
Bailey, 2021	Bailey, Peggy. September 2021. Comments provided on draft BIP Report.
BRIWMP, 2021	Blue River Integrated Water Management Plan Phase I Report. August 2021. Blue River Watershed Group & Trout Unlimited https://www.blueriverwatershed.org/uploads/9/6/3/3/9633489/brimwp_phase_1_final_report_august_2021.pdf
BRIWMP Summary, 2019	River Network and CWCB, 7/12/2019. Blue River Integrated Water Management Plan – Stream Management Plan Grantee Project Summary. https://coloradosmp.org/wp-content/uploads/2019/07/Blue-River_Summary.pdf
BOR, 2014	BOR. Website accessed May 2014. Silt Project Information
BOR, 2019	US Bureau of Reclamation, November 9, 2010. Colorado River Basin Drought Contingency Plans. https://www.usbr.gov/dcp/finaldocs.html.
Boyd, 2021	Boyd, Pam. August 10, 2021. "'Days, not weeks' for continued I-70 Glenwood Canyon closure." *Post Independent.* https://www.postindependent.com/news/days-not-weeks-for-continued-i-70-glenwood-canyon-closure/
BRWG, 2021	Blue River Watershed Group, Our Mission. Website. Accessed June 1, 2021. https://www.blueriverwatershed.org/our-mission.html
Business for Water Stewardship, 2020	Business for Water Stewardship, March 9, 2020. The Economic Contributions of Water-related Outdoor Recreation in Colorado. Full report: https://businessforwater.org/wp-content/uploads/2020/06/Southwick-Technical-report-2020.pdf Colorado River Basin fact sheet: https://businessforwater.org/wp-content/uploads/2020/05/SA_BWS_FactSheet_Digital_CO_1PG.pdf
CBRT, 2014	Colorado Basin Roundtable (CBRT). 2014. White Paper (Draft4.3.2). Providing for Colorado's Statewide and West Slope Water Needs.
CBRT, 2021	Colorado Basin Roundtable Vision. https://www.coloradobasinroundtable.org/about/
CFAP, 2020	Colorado State Forest Service, 2020. Colorado Forest Action Plan. https://csfs.colostate.edu/media/sites/22/2020/10/2020-ForestActionPlan.pdf
COEDIT, 2021	Colorado Office of Economic Development & International Trade, 2021. Outdoor Recreation. Accessed April 5, 2021. https://choosecolorado.com/key-industries/outdoor-recreation/

Coleman, 2018	Caitlin Coleman, Water Education Colorado, March 21, 2018. "Will Deep Creek Soon be Colorado's Second Wild and Scenic River" https://www.watereducationcolorado.org/publications-and-radio/headwaters-magazine/will-deep-creek-soon-be-colorados-second-wild-and-scenic-river/will-deep-creek-soon-be-colorados-second-wild-and-scenic-river/
CO Open Lands, 2018	Colorado Open Lands, 2018. What We Lose When We Buy and Dry. https://coloradoopenlands.org/wp-content/uploads/2018/07/What-We-Lose-When-We-Buy-and-Dry.pdf
CRMP, 2016	Crystal River Management Plan Final Report, April 2016. Prepared by Lotic Hydrological for Roaring Fork Conservancy and Public Counsel of the Rockies. http://www.roaringfork.org/media/1352/crmp_noappendix_bleeds.pdf
CRRG, 2018	Colorado River Research Group, March 2018. When Is Drought Not A Drought? Drought, Aridification, And The "New Normal." https://www.coloradoriverresearchgroup.org/uploads/4/2/3/6/42362959/crrg_aridity_report.pdf
CSFS, 2020	Colorado State Forest Service, 2020. Report on The Health of Colorado's Forests. https://csfs.colostate.edu/media/sites/22/2021/02/CSFS_2020_Forest_Health_Report_WEB.pdf
CSFS, 2021	Colorado State Forest Service, 2021. Community Wildfire Protection Plans. Website. Accessed July 29, 2021. https://csfs.colostate.edu/wildfire-mitigation/community-wildfire-protection-plans/ Colorado Forest Atlas. Website. Accessed July 29, 2021. https://csfs.colostate.edu/wildfire-mitigation/colorado-forest-atlas/
CWA, 2021	Colorado Watershed Assembly. Watershed Group Directory: Colorado River Basin. Website. Accessed June 1, 2021. https://www.coloradowater.org/colorado-basin
CWP, 2016	Colorado's Water Plan, 2015. https://cwcb.colorado.gov/read-plan
DOI, 2021	https://www.doi.gov/water/owdi.cr.drought/en/
Eagle CWP Summary, 2019	River Network and CWCB, 1/3/2019. Eagle River Community Water Plan – Stream Management Plan Grantee Project Summary. https://coloradosmp.org/wp-content/uploads/2019/02/Eagle_Summary_web.pdf
EPA, 2014	EPA. Accessed June 26, 2014.
ERWC, 2014	Eagle River Watershed Council. June 9, 2014. Letter to SGM.
ERWC, 2021	Eagle River Watershed Council, Our Story. Website. Accessed June 1, 2021. https://erwc.org/our-story/
FOLBR, 2021	Friends of the Lower Blue River, About Us. Website. Accessed June 1, 2021. https://www.folbr.org/about
Fuller, 2021	Kendra Fuller, Blue River Watershed Group. Email dated June 16, 2021.
GCRA, 2021	Glenwood Canyon Restoration Alliance, Who Is GCRA. Website. Accessed June 26, 2021. https://www.gcrestorationalliance.org/who-is-gcra
GCWIN, 2021	Grand County Water Information Network, Mission. Website. Accessed June 1, 2021. https://www.gcwin.org/mission
Glenwood Springs, 2020	Glenwood Springs, September 25, 2020. "Grizzly Creek Fire Update." Blog post, accessed March 2021. https://visitglenwood.com/blog/2020/09/grizzly-creek-fire-update/

Grand County, 2021	Grand County, Water Access and Flow. Website. Accessed June 29, 2021. https://www.visitgrandcounty.com/explore/lakes-and-rivers/water-access/flow
Hartman, 2021	Hartman, Fay. American Rivers. September 15, 2021. Comments provided on draft BIP Report.
InciWeb 6906	InciWeb Incident Information System. Pine Gulch Fire. Accessed March 2021. https://inciweb.nwcg.gov/incident/6906/
InciWeb 6942	InciWeb Incident Information System. Grizzly Creek Fire. Accessed March 2021. https://inciweb.nwcg.gov/incident/6942/. https://inciweb.nwcg.gov/incident/article/6942/58421/
InciWeb 6971	InciWeb Incident Information System. Williams Fork Fire: https://inciweb.nwcg.gov/incident/6971/. Accessed March 2, 2021.
InciWeb 7242	InciWeb Incident Information System. East Troublesome Fire Incident Report: https://inciweb.nwcg.gov/incident/7242/. Accessed March 2, 2021.
Kropf, 2014	Ramsey Kropf. June 24, 2014. Draft memo to SGM, Town of Gypsum, Eagle River Region, Colorado Basin Roundtable & Colorado Water Plan Comments
Kurath, 2021	Kirsten Kurath. June 21, 2021. Personal communication.
LBD, 2021	Grand County Learning By Doing. Who We Are. (website). Accessed December 2, 2021. https://www.grandcountylearningbydoing.org/about.html
Lipetzky, 2020	Lipetzky, Tom, Colorado Department of Agriculture, February 14, 2020.
Mauer, 2019	Maurer, Jason 2019. Analysis of a Historic Avalanche Cycle: The Spring Of 2019. https://coloradomountainschool.com/analysis-historic-avalanche-cycle/ Accessed April 10, 2021.
MCRIWMP Summary, 2021	River Network and CWCB, 1/27/2021. Middle Colorado Integrated Water Management Plan, – Stream Management Plan Grantee Project Summary https://www.coloradosmp.org/wp-content/uploads/2021/02/MiddleColorado_Summary_updated2021.pdf
MCRIWMP, 2021	Middle Colorado River Integrated Water Management Plan, February 2021. Prepared by Middle Colorado Watershed Council and Mount Sopris, Bookcliff and South Side Conservation Districts by Colorado River Engineering and Lotic Hydrological. https://www.midcowatershed.org/iwmp
MCWC, 2021	Middle Colorado Watershed Council. Our History. (website). Accessed May 2021. https://www.midcowatershed.org/about
Musselman, 2021	Musselman, K.N., Addor, N., Vano, J.A. et al. Winter melt trends portend widespread declines in snow water resources. Nat. Clim. Chang. (2021). https://doi.org/10.1038/s41558-021-01014-9
NRCS, 2021	Natural Resources Conservation Service (NRCS), Colorado River Basin Salinity Control Program. Website. Accessed June 29, 2021. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/alphabetical/?&cid=stelprdb1044198
NWCCOG, 2014a	Northwest Colorado Council of Governments (NWCCOG) Water Quality/Quantity Committee (QQ). March 10, 2014a. West Slope Principles for the Colorado Water Plan
Reg 93, 2020	Colorado Department of Public Health and Environment. Regulation #93 Dashboard, Updated 2020. https://cdphe.colorado.gov/regulation-93-dashboard

RFC, 2012	Roaring Fork Conservancy, March 2012. Roaring Fork Watershed Plan. http://www.roaringfork.org/media/1171/20120412-roaring-fork-watershed-plan-final.pdf
RFC, 2021	Roaring Fork Conservancy, About Us. Website. Accessed June 1, 2021. http://www.roaringfork.org/about-us/about-rfc/ Transmountain Diversions. Website. Accessed June 29, 2021. http://www.roaringfork.org/your-watershed/watershed-facts/transmountain-diversions/
Risk Study Phase III, 2019	Colorado River Risk Study Phase III Final Report, November 20, 2019. Prepared for the Colorado River District and the Southwestern Water Conservation District. https://waterinfo.org/wp-content/uploads/2019/12/Phase-III-Final-Report-1.pdf
River District, 2020.	Kanzer, Dave, Colorado River District, July 2020. Water With Your Lunch: Rising temperatures and rising challenges. Presentation slides. https://www.coloradoriverdistrict.org/wp-content/uploads/2020/07/crwcd-wwyl-climate-presentations.pdf
River District, 2021	Colorado River District, Colorado River Cooperative Agreement. Website. Accessed June 29, 2021. https://www.coloradoriverdistrict.org/supply-planning/colorado-river-cooperative-agreement/
River Network, 2021	River Network, Stream Management Planning in Colorado. Website. Accessed May 25, 2021. https://www.rivernetwork.org/smp/
RMCO, 2018	Stephen Saunders & Tom Easley, The Rocky Mountain Climate Organization. 2018. Climate Change in the Headwaters Water and Snow Impacts. A report to the Northwest Colorado Council of Governments.
Sackett, 2019	Heather Sackett, Post Independent, August 11, 2019. "Climate change could threaten Carbondale water supply." https://www.postindependent.com/news/local/climate-change-could-threaten-cdale-water-supply/
SeWMP, 2012	Selenium Watershed Management Plan Update: Lower Gunnison River Basin and Grand Valley, Colorado. 2012. https://www.colorado.gov/pacific/sites/default/files/WQ_nonpoint_source-3rd-Lower-Gunnison-Selenium-Watershed-Plan-Final-2012.pdf
SG Plan, 2020	Amended & Restated Upper Colorado River Wild and Scenic Stakeholder Group Management Plan, Adopted January 2012, Amended & Restated June 2020. https://www.upcowildandscenic.com/uploads/1/2/9/6/1296822/amended_and_restated_sg_plan_clean.pdf
Sloan, 2004	Sloan, Crissy. Roaring Fork Conservancy. December 2004. The Effect of the Shoshone and Cameo Calls on the Roaring Fork Watershed. http://redstonewater.ourlocalview.com/HomeTown/StaticContentServlet?f=The%20Shoshone%20and%20Cameo%20Water%20Calls.pdf
SRTF, 2021	Snake River Task Force, Home. Website. Accessed June 1, 2021. https://snakerivertaskforce.org/
Stein, 2020	Stein, Andy, October 19, 2020. 5280 Magazine. The 10 Largest Wildfires in Colorado's History. https://www.5280.com/2020/10/the-10-largest-wildfires-in-colorados-history/
Tetra Tech, et. al., 2010	Tetra Tech, et. al. 2010. Grand County Stream Management Plan. https://www.co.grand.co.us/1389/Water-Reports

UPCO Wild and Scenic, 2021	Upper Colorado River Wild and Scenic Stakeholder Group, About Us. Website. Accessed June 1, 2021. https://www.upcowildandscenic.com/about-us.html
UCRWG, 2021	Upper Colorado River Watershed Group. Website. Accessed June 26, 2021. https://ucrwg.org/
URFRMP, 2017	Lotic Hydrologic, 2017. Upper Roaring Fork River Management Plan. https://www.coloradosmp.org/wp-content/uploads/2020/05/Upper-Roaring-Fork-River-Management-Plan.pdf
Ute Water, 2020	Ute Water Conservancy District, About Us. Website. Accessed June 26, 2021. https://www.utewater.org/whoweare
WECO, 2014	Water Education Colorado, 2014. Citizen's Guide to Transbasin Diversions. https://issuu.com/cfwe/docs/cfwe_cgtb_web
WECO, 2020	Water Education Colorado, Caitlin Coleman, Apr 30, 2020. Forested Watersheds Protect Clean Water. https://www.watereducationcolorado.org/publications-and-radio/blog/six-feet-in-solidarity-week-6-forest-and-watershed-health/
WECO, 2021	Justice Gregory J. Hobbs, Jr. Water Education Colorado, 2021. Citizen's Guide to Colorado Water Law, Fifth edition. https://issuu.com/cfwe/docs/weco_cgwlaw_5thed_final
Wertheim, 2020	Wertheim, Charlie. October 1, 2020. "Glenwood Springs water system relatively safe, but water treatment costs could reach $4M." https://www.postindependent.com/news/glenwood-springs-water-system-relatively-safe-but-fire-treatment-costs-could-reach-4m/
WRNF, 2015	White River National Forest, Wild and Scenic River Eligibility. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5286435.pdf
WWG, 2021	Wilson Water Group, February 22, 2021. Analysis for Basin Implementation Plans Technical Memorandum: Current and 2050 Planning Scenario Water Supply and Gap Revised Results.

Exhibits

Exhibit A – Vision, Principles, White Paper, 2015 BIP

Exhibit B – Survey and Responses for Feedback on Themes and Goals

Exhibit C – Projects Database Form Template for New or Updated Projects

Exhibit D – Projects Database – Static 2021

Exhibit E – Projects Database – Dynamic

Exhibit F – List of Projects Funded by CWP, WSRF, and Construction Fund