COLORADO WATER PLAN

COLORADO

Colorado Water Conservation Board

Department of Natural Resources

2023

CONTENTS

ACRONYMS

A.C.T.	Action Areas, Colorado Vision, Tools for Action
AFY	acre-feet per year
ARPA	American Rescue Plan Act
ASO	Airborne Snow Observatory
ASR	aquifer storage and recovery
ATM	Alternative Transfer Methods
BIL	Bipartisan Infrastructure Law
BIP	Basin Implementation Plan
BLM	U.S. Bureau of Land Management
BOR	Bureau of Reclamation
BRAT	Beaver Restoration Assessment Tool
CASM	Colorado Airborne Snow Measurement
CBT	Colorado-Big Thompson
CDA	Colorado Department of Agriculture
CDPHE	Colorado Department of Public Health and Environment
CDSS	Colorado's Decision Support Systems
cfs	cubic feet per second
CGWS	Colorado Growing Water Smart
CoRHAF	Colorado River Health Assessment Framework
COSWAP	Colorado Strategic Wildlife Action Program
CPW	Colorado Parks and Wildlife
CREP	Conservation Reserve Enhancement Program
CRO	Colorado Resiliency Office
CROS	Coordinated Reservoir Operations
CRSPA	Colorado River Storage Project Act
CSFS	Colorado State Forest Service
CSU	Colorado State University
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWLI	Colorado Water Loss Initiative
CWRPDA	Colorado Water Resources and Power Development Authority
CWSA	collaborative water sharing agreements
DCP	Drought Contingency Plan
DFPC	Division of Fire Prevention and Control
DHSEM	Division of Homeland Security & Emergency Management
DI	disproportionately impacted
DM	Demand Management
DNR	Department of Natural Resources
DOLA	Department of Local Affairs
DPR	direct potable reuse
DRCOG	Denver Regional Council of Governments
DROA	Drought Response Operations Agreement
DWR	Division of Water Resources
EDI	equity, diversity, and inclusion
EJ	environmental justice
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
FACE	Future Avoided Cost Explorer
FERC	Federal Energy Regulatory Commission
FHZ	Fluvial Hazard Zone
GIS	geographic information systems
GOCO	Great Outdoors Colorado
gpcd	gallons per capita per day
HB	House Bill
HUC	Hydraulic Unit Code
IBCC	Interbasin Compact Committee
IIJA	Infrastructure Investment and Jobs Act
IPR	indirect potable reuse
ISF	Instream Flow
IWMP	integrated water management plan
LiDAR	light detection and ranging
N/A	not applicable
NEPA	National Environmental Policy Act
NGO	nongovernmental organization
NLL	natural lake level
NPS	National Park Service
NRCS	Natural Resources Conservation Service
OEDIT	Colorado Office of Economic Development and International Trade
OREC	Colorado Outdoor Recreation Industry Office
OWL	One Water Leaders
PEPO	Public Education Participation and Outreach
PRRIP	Platte River Recovery Implementation Program
RGDSS	Rio Grande Decision Support System
RICD	recreational in-channel diversion water right
SB	Senate Bill

SDO	State Demography Office
SJRIP	San Juan River Basin Recovery Implementation Program
SMP	stream management plan
SNOTEL	Snow Telemetry
STEM	science, technology, engineering, and mathematics
SUIT	Southern Ute Indian Tribe
SWE	snow water equivalent
SWSI	Statewide Water Supply Initiative
TAG	Technical Advisory Groups
TMD	transmountain diversion
TMDL	total maximum daily load

UCEFRP	Upper Colorado River Endangered Fish Recovery Program
UMUT	Ute Mountain Ute Tribe
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WQCC	Water Quality Control Commission
WQCD	Water Quality Control Division
WSRF	Water Supply Reserve Fund
YWG	Yampa-White-Green Basin

COVER IMAGES AND STOCK PHOTO CREDITS

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CWCB BOARD LETTER

Fellow Coloradan,

Thank you for opening the Colorado Water Plan. With this document, the Board and Staff of the Colorado Water Conservation Board (CWCB) seek to respond to this historic moment in time with a plan for thoughtful and bold initiative.

Much has changed since 2015, when the first Colorado Water Plan was finalized. The impacts of widespread drought, coupled with a global pandemic, challenged our communities with far-reaching uncertainties that shaped new water management realities. The pandemic pushed our stakeholders to begin meeting virtually, bringing a new way for people to connect, learn, and get involved with the work of planning for water. These experiences also highlighted the ways in which Colorado is connected by water.

Towns and farms on the Front Range are tied to high mountain streams on the West Slope through the complicated plumbing that brings water through the Continental Divide. Beyond these physical connections, there is a shared understanding that water supports Colorado's culture, communities, recreation, forests, and foods. The fresh produce, meat, and beer enjoyed in restaurants and kitchens around our state are supplied by farming and ranching families with diverse backgrounds and often multi-generational and historical ties to the land they steward. Coloradans value healthy rivers that drive robust recreation economies and provide important corridors for fish and wildlife, quality drinking water for cities and towns, and spaces for people to connect with nature. Colorado is the state we know and love because of its lakes, rivers, streams, wetlands, and aquifers. Because water inextricably links people across Colorado, our water management challenges must be faced together.

GET INVOLVED—NOW IS THE TIME FOR ACTION

The West is experiencing growth in population and demand for water while our hydrology is becoming less predictable. Our temperatures have warmed, and the timing and amount of precipitation has changed, causing shifts in runoff and streamflows. It is clear this is not a temporary phenomenon, but rather a permanent trend toward aridification of the West. These changes, on top of existing concerns, present increased water quantity and water quality challenges especially as the rate and magnitude of ecosystem changes in Colorado have increased. These collective impacts have changed the way we think about water planning and shifted our collective approach to swift action.

The Colorado Water Plan was informed by robust stakeholder input and complex modeling that provides a data-driven understanding of our current water supply and potential future scenarios. The plan also highlights Colorado's values and follows four fundamental themes of Thriving Watersheds, Resilient Planning, Vibrant Communities, and Robust Agriculture through discussions of each of our major river basins. Most importantly, the plan sets forth ambitious yet attainable actions that will help Coloradans do more with less water, increase resiliency in the face of a changing climate, and ensure broad and diverse voices are included in future water management conversations.

The CWCB cannot do this important work alone, which is why the partner actions take into account close working relationships with sister agencies and the critical efforts of partner organizations, water users, and water managers across the state. This will require thoughtful and strategic partnerships across state agencies, Tribal Nations, local governments, water providers, and stakeholders. Colorado needs collaborative and creative solutions for balancing competing water demands for a finite resource. Whether by personal action or developing a Water Plan grant project proposal, you have a role to play.

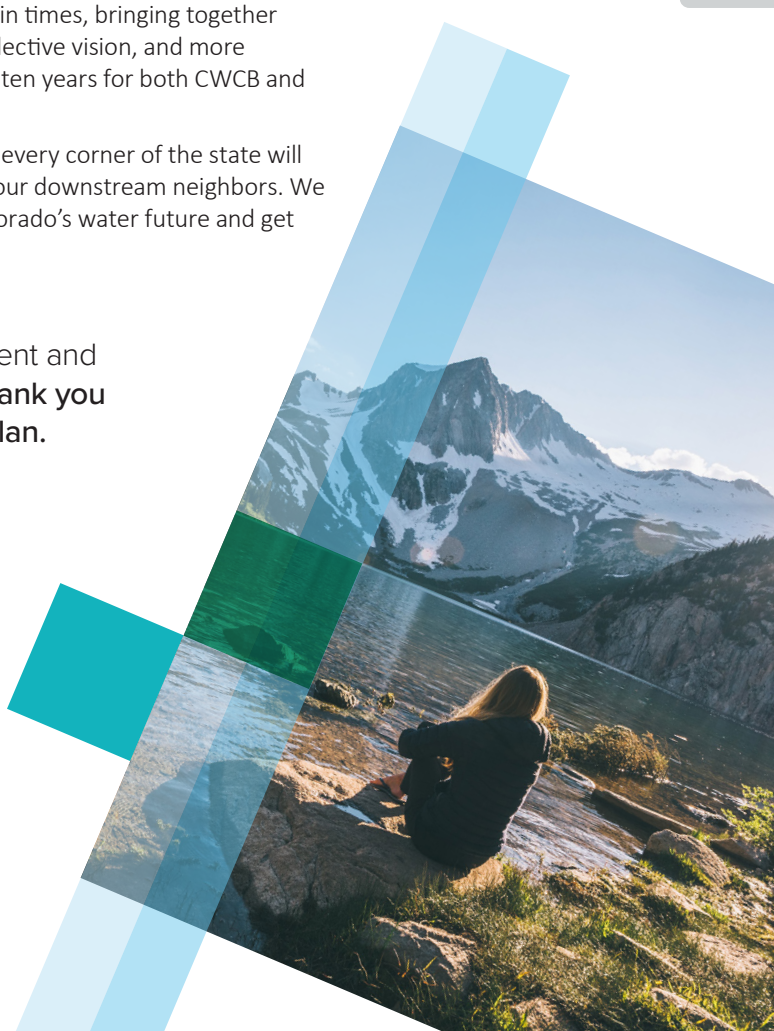
The CWCB will also continue to lead through funding, collaboration, and the agency actions it will take. Importantly, the plan outlines a 10-year schedule for future Water Plan updates and includes the addition of an annual operations plan, which will allow the CWCB Board to consider yearly priorities and respond to shifting conditions and needs. Addressing Colorado's water challenges through partnerships and collective action ensures that competing demands for water resources decisions are balanced and maximize the benefits to current and future generations.

Colorado has always been a place where the adversity of the landscape has been tempered by its ability to inspire. While our challenges are great, our natural and human resources are too. We have a long and celebrated history of innovation in water management, and we are confident the people of Colorado will continue to rise to the occasion and take on the critical work of protecting our water supply future. The Colorado Water Plan offers a light through dark and uncertain times, bringing together wide-ranging interests and voices into a collective vision, and more importantly, a plan for action over the next ten years for both CWCB and local communities across the state.

The collective actions we take today across every corner of the state will increase water resilience for Colorado and our downstream neighbors. We hope you will consider your own role in Colorado's water future and get involved—now is the time for action.

On behalf of the staff and the current and past board members of CWCB, **thank you for reading the Colorado Water Plan.**

—The Colorado Water Conservation Board



ACKNOWLEDGMENTS

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Where agency directors are included in the list of CWCB Board members they are not included in their respective agencies below.

CWCB Board members (listed left to right): Robert Sakata, Paul Bruchez, Steve Anderson, Greg Felt, Dan Gibbs, Heather Dutton, Kevin Rein, Jackie Brown, Rebecca Mitchell, and Jessica Brody (not pictured: Heather Disney Dugan, Kate Greenberg, Celene Hawkins, Curran Trick, and Phil Weiser). Photo Credit: Russ Sands

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Many thanks to all other CWCB staff who helped support meetings, contracts, invoicing, outreach, and all the other work that supports the Water Plan. Special thanks to Viola Bralish, Vivian Pinellli, and Anna Porter for all event organizing and logistics support.

OTHER STATE AGENCIES

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OTHER STATE ENTITIES, GROUPS, ORGANIZATIONS, AND TASK FORCES WHO PROVIDED WATER PLAN INPUT:

Colorado Agricultural Commission, Colorado Commission of Indian Affairs, Colorado Oil and Gas Commission Colorado State Forest Service, Colorado State Land Board, Colorado Water Resources and Power Authority, Environmental Justice Action Task Force, Great Outdoors Colorado, Interbasin Compact Committee, The Basin Roundtables, The Water Equity Task Force, and the Water Quality Control Commission.

COLORADO'S FEDERALLY RECOGNIZED TRIBES

Southern Ute Indian Tribe, Ute Mountain Ute Indian Tribe

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- **Community Language Cooperative**
- **Affinity Translation**

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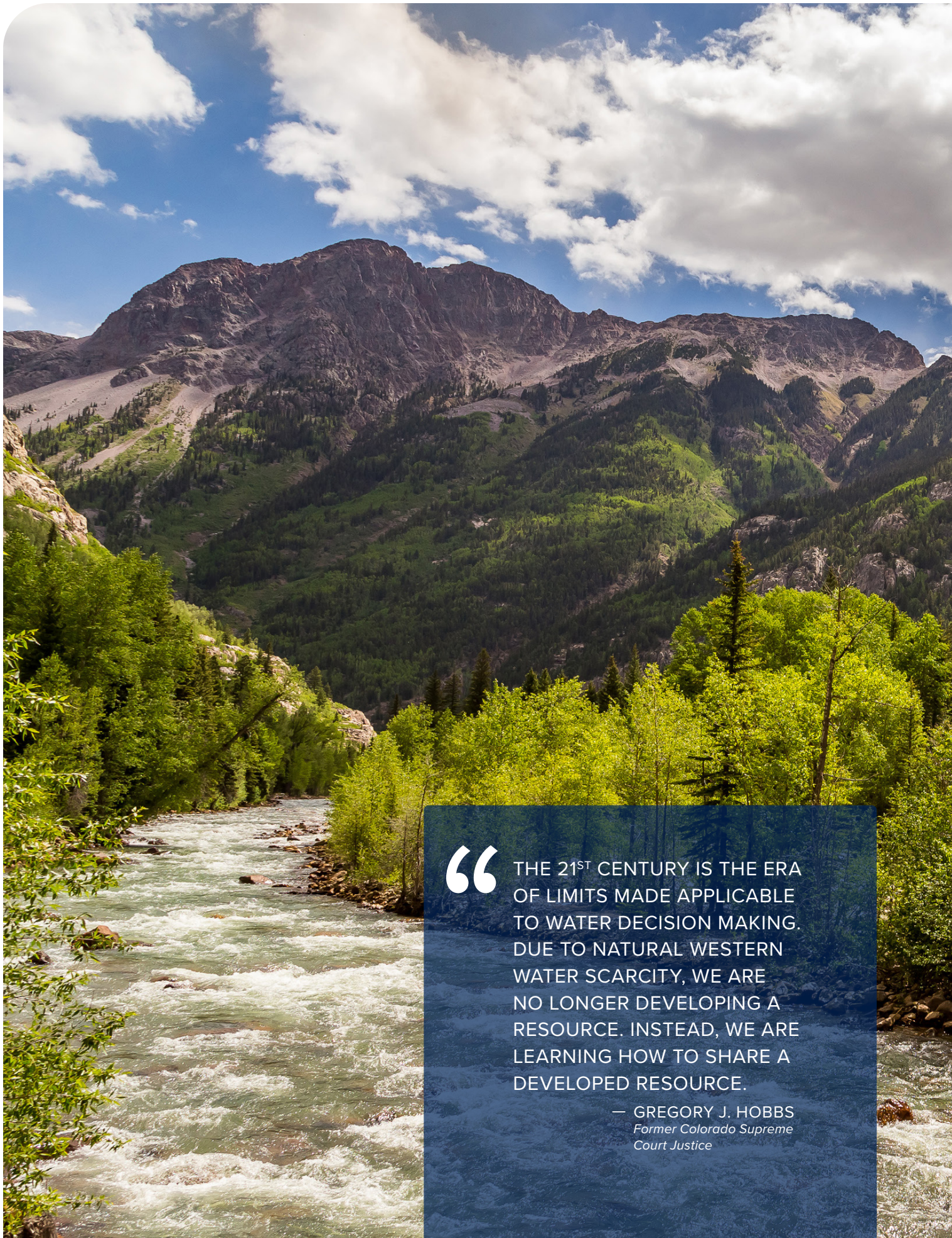
Also, CWCB would like to express appreciation to those who provided input during outreach events, listening sessions, CWCB board meetings, and public comment on the Water Plan.

**Director participation noted through their role on the CWCB Board (See list above).*

CHAPTER 1

OVERVIEW



> “THE 21ST CENTURY IS THE ERA OF LIMITS MADE APPLICABLE TO WATER DECISION MAKING. DUE TO NATURAL WESTERN WATER SCARCITY, WE ARE NO LONGER DEVELOPING A RESOURCE. INSTEAD, WE ARE LEARNING HOW TO SHARE A DEVELOPED RESOURCE.
>
> — GREGORY J. HOBBS
> *Former Colorado Supreme Court Justice*

Colorado's water touches every aspect of our daily lives. Those that depend on the water face unprecedented challenges that require all Coloradans to embrace a new water ethic. We must come together to protect this critical resource in increasingly innovative ways. The time for action is now.

As a headwaters state, water flows from Colorado's snow-capped peaks, through forests and streams, to cities and farms, and then returns to streams. Along the way, water supports habitat, wildlife, recreation, local food production, energy, industry, drinking water supplies, and more. Water connects us all. The importance of water in Colorado has long been recognized by the ancestral and Indigenous peoples of Colorado – the 48 Tribes that historically were the original stewards of this land include Colorado's two federally-recognized Tribes, the Southern Ute Indian Tribe (SUIT) and the Ute Mountain Ute Indian Tribe (UMUT). As noted by the Tribes, "Water is life."

Nearly 6 million Coloradans depend on the water from our major river basins as do 19 other states and Mexico, but that water supply is at risk. Population growth, long-term warming trends, major wildfires, aridification, and multi-year droughts are straining the system like never before.

We must understand these challenges, their associated risks, and the tools we can use to drive change. Tools that shape actions and policy to mitigate our risks can reshape the future. We must also be collaborative and understand the perspectives of water users from across the state. Basin Implementation Plans, developed by Colorado's nine basin roundtables, provide summaries of regional challenges, strategies to overcome them, and valuable data to inform the state's Water Plan. **The Colorado Water Plan sets the stage for a shared understanding of our risks and describes actions that collectively contribute to a stronger, more water-resilient Colorado.**

While Colorado faces enormous water challenges, its opportunities are tremendous. A secure water future will depend on our working together to uplift every area of the Water Plan. In reading this plan, it is important to know that the opportunity to take action is driven by you. Whatever your background, whatever your job, all Coloradans are a part of the solution. **Collaborative action needs to occur at every level, and the need for action has never been more urgent than now.**

BUILDING ON PAST SUCCESS

The devastation of the 2002 drought and Hayman Fire launched a new era of resiliency planning and collaboration in Colorado that led to the creation of many of the state's grassroots water stakeholder groups, the Colorado Water Plan (Water Plan), and a continued investment in water. These efforts have made real progress since the 2015 Water Plan to better manage and fund Colorado's water, as noted below:

- Water conservation measures have **decreased statewide per capita water use by 5%.**
- Colorado Water Plan grants were established and funded **almost $55 million in projects covering every corner of the state.**
- Annual municipal leasing of **25,000 acre-feet** of agricultural water has helped cities and farms coexist.[1]
- **More than 25 new** stream management plans have been developed.
- **400,000 acre-feet** of storage has either been constructed or will soon be completed.[2]
- Water outreach, education, and messaging is estimated to have **reached up to 2.7 million people.**
- Legislation was **passed to integrate land use and water planning** in comprehensive plans.
- Reclaimed water regulations have been updated with **18 additional uses** to allow water reclamation in residential and commercial crop irrigation, among others. See Chapter 5 for more information on reclaimed water regulations.
- **62% of Coloradans** now live in communities whose leaders have been trained by the Growing Water Smart program to integrate water and land use planning.
- Multi-purpose, multi-benefit projects continue to receive grant funding and **more than $420 million in loans.**
- Watershed health received millions of dollars in support as statewide **watershed groups exceed 150.**
- Colorado voters **passed Proposition DD**[3] to dedicate funding for the Colorado Water Plan Grant Program.

These successes should be celebrated because they show significant progress, firm resolve, and a blueprint for collaborative action. Yet, the need for progress is now more urgent than ever. In the last two decades Colorado's population has increased by more than a million people. Several major wildfires have ignited our forests and grasslands, and drought, along with a larger trend in long-term warming and drying, known as aridification, continues to challenge water resources. Significant swaths of agricultural lands have been lost to buy and dry practices, water supply reductions, and urbanization; forests face continued risk from fire; and streams face new challenges for habitat protection.

In the face of this adversity, there has been a groundswell of collaborative action leading to real progress through holistic and multi-benefit projects. **It is increasingly important to make sure every water project or strategy uses water as wisely as possible, making it stretch as far as it can to realize its maximum value for cities, farms, streams, and people.** Doing so will require shared stewardship—a commitment to partnership in which the state government and every Coloradan must work together toward greater action.

Colorado's nine basin roundtables have been instrumental in fostering our past successes and forming the future vision described in the Water Plan. Chapter 4 describes local challenges, recent achievements, and strategies to meet future needs that each basin roundtable provided in their Basin Implementation Plans - all of which inform the Water Plan.

[1] Generalized findings from **Alternative Transfer Methods in Colorado, Status Update, Framework for Continued Support, and Recommendations for CWCB Action**

[2] Includes Chimney Hollow Reservoir (90,000 acre-feet), Glade Reservoir (170,000 acre-feet), Galeton Reservoir (45,600 acre-feet), Gross Reservoir Expansion (77,000 acre-feet), and Chatfield Reallocation (20,600 acre-feet)

[3] Proposition DD is a legislatively referred state statute on the November 2019 ballot that was ultimately codified in HB19-137 and provided funds from sports betting to be used, among other things, to fund the Water Plan through the creation of a Water Plan Implementation Cash Fund that is used to support CWCB's Colorado Water Plan Grant Program.

EMPOWERING STAKEHOLDERS

As the stewards of the Water Plan and the agency charged to conserve, develop, protect, and manage Colorado's water for present and future generations, CWCB works with partners to foster action by funding local water projects through grants and loans. The CWCB also works on multiple programmatic efforts related to interstate compacts, flood mitigation, species protection, water project financing, agricultural support, and climate adaptation, all of which advance the goals of the Water Plan.

The CWCB does not build projects. It advances projects, often focusing on proven methods, by supporting project proponents with funding, analysis tools, technical assistance, programs, and policies that can help advance toward a future envisioned by the values and ideas in this Water Plan. The real power of the Water Plan is often driven by local and regional innovation, action, and project development that advance when stakeholders take action. This is readily apparent in the work that the state's nine legislatively-created basin roundtables completed to identify more than 1,800 local projects and plans in the lead-up to the Water Plan update (See Chapter 4).

Meeting the moment extends well beyond what one agency or the entirety of the state government can do. The power of nearly 6 million Coloradans rallying to embrace a new water ethic in Colorado is what we need to be successful. The Water Plan is a call to action backed by governmental support that can catalyze local planning and projects.

The Water Plan was informed by and built through stakeholder input. Basin-specific technical analyses, local stakeholder input, and statewide outreach informed the Water Plan by explaining local conditions, offering examples of successful projects, and gathering information about future projects needed for increased water resilience. The process involved ongoing work with basin roundtables and the Interbasin Compact Committee (IBCC), engagement with more than 1,200 stakeholders providing feedback during Water Plan scoping, multiple partners (agencies, Tribes, nongovernmental organizations [NGO], and members of the public) as well as a governor-created Water Equity Task Force. Stakeholders were also engaged during public review of the draft Water Plan through outreach events in all 64 Colorado counties, more than 2,000 submitted public observations on the draft plan, and more than 500 pages of public comment letters. Approximately 130 public comments were submitted in Spanish. This spirit of collaboration and the focus on Colorado water resilience is at the heart of the Water Plan, and implementing the Water Plan is critical to Colorado's future.

PUBLIC ENGAGEMENT AND WATER EQUITY TASK FORCE

Building on years of ongoing grassroots input, CWCB included a scoping phase early in the Water Plan update process to evaluate the critical issues on stakeholders' minds and provide a platform to discuss CWCB's proposed direction for the Water Plan. As part of that effort, CWCB partnered with 20 agencies and NGOs to hold more than a dozen sector-specific workshops that engaged more than 1,200 stakeholders. Targeted interviews, online surveys, and an online stakeholder engagement platform supplemented the scoping outreach. This work gathered extensive input on stakeholder issues related to agricultural, municipal, watershed, and forest health needs. Themes that sparked a wide range of interest for incorporation in this Water Plan included addressing climate change and drought as well as the need to better recognize equity, diversity, and inclusion (EDI) in water issues.

Realizing that more time was needed to discuss EDI concerns and to bring in multiple perspectives, CWCB worked with the Department of Natural Resources (DNR) and the Governor's Office to create a year-long Water Equity Task Force that focused on developing a set of principles to help inform the update to the Water Plan. The 21-member task force included nine basin roundtable members (one from each roundtable), nine community members (one from each of the eight major river basins and the Denver metropolitan area), two members from each of Colorado's federally recognized Tribes, and one member from the Acequia community.

The Water Equity Task Force's guiding principles include a need to:

1. **Promote diversity** in career pathways in water-related fields through education and engagement.
2. **Promote collaboration**, new voices, and greater community engagement in water discussions.
3. **Recognize and address elements of the rural-urban divide** but focus on creating the rural-urban opportunity.
4. **Expand grant opportunities** to new audiences.
5. Support basin roundtables facilitating broad **community engagement and collaborative solutions.**

In addition to directly informing the Water Plan's development, CWCB uses these guiding principles to inform programming, policies, and engagement for the benefit of all Coloradans.

USING THE PLAN

The Water Plan can be used in three primary ways:

Use the plan to **become more informed about water and the future vision.**

The State of Colorado encourages its residents to be informed about water issues, but a 2021 Statewide Water Awareness Survey indicated that only 35% of Coloradans are confident they have the knowledge necessary to take action to manage our water use. Becoming more informed about water and the future vision is a critical first step. It creates ripple effects in what we value, how we invest, and how we conserve. It is also foundational to collaborative and inclusive water planning. For many, understanding the complex water challenges Colorado faces, the tools that can be used to find solutions, and Colorado's shared vision will be an important commitment.

Opportunities to participate at this level include:

- Support local water initiatives and projects
- Conserve water indoors and outdoors
- Practice wise stewardship of our rivers, lands, and natural resources
- Purchase water-saving products and locally grown food products
- Help promote water conservation and water outreach efforts
- Support local utility/city/county water conservation, local food, and resilience

Use the plan as a platform to **become more engaged and take action to advance the vision.**

The Water Plan is a starting point, and it provides a larger framework for next-level action. If you can do more, whether because you are a water rights holder, a county commissioner, a water utility worker, a city planner, a business owner, a local leader, or a concerned resident looking to become more engaged, this is your time. The Water Plan provides your roadmap to identify and collaborate in implementing solutions to Colorado's water resources challenges.

Opportunities to participate at this level include:

- Attend a local water meeting (e.g., **basin roundtable**)
- Join a water-focused stakeholder group (e.g., NGO or basin roundtable)
- Start a local food or watershed group
- Apply for a grant to take action on the Water Plan
- Invest in water-efficient equipment in your home, business, or farm
- Work with your local community leaders to advance water projects

Use the plan to **understand and leverage agency actions that advance the vision.**

For the State, the Water Plan serves as a call to action, shared leadership, and partnership. Elected officials throughout the state use the Water Plan to understand policy priorities. The executive, judicial, and legislative branches all have important roles in water discussions. Yet not one of these branches of government, nor the 180 or more state agencies, can create the necessary solutions alone. The State's role in the Water Plan is to use its collective resources to set a vision that is backed by funding and support tools to advance solutions.

Opportunities to participate at this level include:

- Attend a state water meeting (e.g., CWCB board meeting, basin roundtable meeting, legislative hearing, or committee meeting)
- Apply to join a water-focused board or commission
- Learn about and use State tools that have been developed to support action
- Engage with the State to create new supporting tools and processes
- Implement a local project that aligns with the Water Plan and, if possible, use state and federal resources to help fund the project
- Coordinate with local leaders to advance water policy

PLAN ORGANIZATION

The Water Plan is structured to create a line of sight from Colorado's water values to the specific actions that address challenges. The four values in the Water Plan are based on extensive work with stakeholders and include:

- A productive economy that supports vibrant, sustainable cities, agriculture, recreation, and tourism
- An efficient and effective water infrastructure system
- A strong environment with healthy watersheds, rivers, streams, and wildlife
- An informed public with creative, forward-thinking solutions that are sustainable and resilient to changing conditions and result in strong, equitable communities that can adapt and thrive in the face of adversity

Most simply, these values represent the Colorado way of life—they are the things that make Colorado great. They are also the values that help inform the Water Plan organization and drive us to act. Taken as an acronym, our values drive us to A.C.T. through **A**ction Areas, **C**olorado Vision, and **T**ools for Action.

Action Areas

The Water Plan is organized around four overarching action areas that loosely translate to cities, farms, streams, and people. The action areas are interrelated in that issues related to steams, river recreation, commerce, agriculture, diversity, and climate challenges often are interwoven and connected. The action areas are presented separately for organizational purposes, but the Water Plan also describes how they integrate. The action areas include:

VIBRANT COMMUNITIES: counties, municipalities, utilities, cities, towns, businesses, large industries, large and small urban and rural communities, etc.

ROBUST AGRICULTURE: established crops and farms, local food, orchards, ranching, ditch companies, acequias, urban agriculture, livestock, dairy, etc.

THRIVING WATERSHEDS: environment and recreation, river health, watershed health, forest health, wildfire mitigation, wildlife and aquatic species protection, etc.

RESILIENT PLANNING: climate adaptation, planning for climate extremes, embracing EDI (equity, diversity, inclusivity), education, outreach and engagement, supportive government, etc.

Sunset over Yampa River, Photo credit: Kent Vertrees, Friends of the Yampa

Colorado Vision

The Colorado Vision, outlined in Chapter 6, describes how Colorado can achieve greater resilience across and within the four action areas as we look to the planning horizon of 2050. The vision for each action area first describes our desired future and then provides examples of the kinds of local actions stakeholders and partners can take to help realize the vision. Example actions are grouped into categories, including thoughtful storage, meeting future water needs, wise water use, healthy lands, and engaged partners. In addition, each action area vision describes ways in which it intersects and integrates with other action areas to demonstrate how the areas are intertwined and relate. The overarching vision for each action area is described below.

VIBRANT COMMUNITIES

Holistic water management is essential for creating vibrant communities that balance water supply and demand needs to create a sustainable urban landscape. Colorado communities need resilient water supplies, water-conscious and attractive urban landscapes, planning that integrates land use and water solutions, and residents who understand the importance of water to their lives and economy. An integrated One Water ethic is necessary to create the transformative change needed to meet the moment and the future.[4]

ROBUST AGRICULTURE

Agriculture not only provides food and fiber, but it is also important to Colorado's culture, heritage, and economy, and it faces unprecedented challenges. Innovations are needed to sustain irrigated agriculture, including strategies to stretch available water supplies, increase resiliency, enhance food production, and maintain profitability. Water supplies for Colorado's urban growth should not come at the expense of our rural communities through indiscriminate buy and dry methods. Collaborative partnerships among agriculture, environmental groups, and municipal water providers should be used to create multi-purpose projects that help keep irrigated lands in production and maintain ecosystem services.

THRIVING WATERSHEDS

Colorado's watersheds hold the future of our water supply security. Comprehensive water resources planning should incorporate conditions of forests, streams, wetlands, and wildlife habitat. As our state's water source, the health of watersheds affects agriculture, downstream communities, recreation, tourism, and ecosystem function. Colorado will continue to follow a shared stewardship ethic to plan and implement multi-benefit projects to enhance the health of our watersheds.

RESILIENT PLANNING

Water security is critical to the quality of life, environment, and economy of Colorado. The future is uncertain, and Colorado needs to be adaptive and resilient to face the challenges ahead. Water security roadmaps, inclusively developed at a local level and informed by strong state leadership, can identify acute and chronic risks to water supply, integrate local planning strategies, prioritize collaborative solutions, and build adaptive capacity and resilience.

[4] "One Water" means matching the right water to the right use. See glossary and Chapter 6 for details and graphic.

Tools for Action

Tools for action are the means through which partners and agencies can address water issues and meet water needs. They include:

- Public outreach and education
- Funding
- Policy and regulatory changes
- Collaboration groups
- Watershed planning
- Climate adaptation
- Innovation
- Equity
- Endangered and threatened species recovery programs
- Natural hazard planning
- Land use and water planning integration
- Data collection and sharing
- Water storage
- Conveyance infrastructure
- Water efficiency and conservation programs
- Water reuse
- Collaborative water sharing agreements
- Stream/watershed restoration and enhancement
- Flow enhancement and maintenance

Actions include:

50 PARTNER ACTIONS

While the list of partner actions is limitless, the Water Plan describes approximately 50 ideas for potential actions that could be supported by Water Plan grants.

THESE INCLUDE ACTIONS AROUND

- Increased personal conservation
- Starting a new water initiative/project
- Developing collaborative solutions

50 AGENCY ACTIONS

The Water Plan includes 50 actions CWCB and supporting agencies will take to help advance local initiatives that support the wise development and conservation of water resources.

THESE INCLUDE ACTIONS AROUND

- Developing frameworks and convening groups
- Advancing research and science
- Creating support tools

Tracking Progress

This Water Plan replaces the previous plan with transparent and trackable actions. Partner actions will be tracked through CWCB's increasingly modernized process for tracking of grants and loans as well as projects through the Project Database. As CWCB tracks the completion of the agency actions it leads, CWCB will also document major legislative and basin advancements that occur—especially where the State has played a role.

Specific actions that inform the CWCB Board's annual operating plans and processes like the next Technical Update offer opportunities to identify trends, analyze progress, and explore new data and information that will help CWCB stay nimble and responsive to shifting conditions. Implementing the plan embraces the spirit of resilience—being adaptive to both acute and chronic challenges. The Water Plan is meant to be broad and flexible enough to do all of this, but it needs you to help carry out the larger vision for water management in Colorado that uplifts all areas and people in the state.

The Path Forward

The Water Plan is a call to action. Answering the call is a commitment to long-term water collaboration, resolve in the face of adversity, and developing creative solutions that allow Colorado to advance within the bounds of our legal framework. Coloradans must come together across diverse groups and geographies to envision and implement actions that will move us closer to a resilient water future. This is how we keep Colorado strong.

We are all interconnected from our headwaters to our homes by water and have a shared responsibility to it. However you interact with water—through your drinking water tap, buying food at your farmers market, enjoying the first snowfall, or recreating in one of Colorado's watersheds—you are a steward of the Water Plan. Embrace it.

Water Plan Layout

Following this introduction, the Water Plan describes the critical elements of Colorado's history, geography, legal setting, and water-planning efforts. The background and context provide key pieces of information that guide the direction of the Water Plan.

- Water Plan methods for analyzing future water conditions (Chapter 2)
- Geography, variability, and use of water in our state and legal underpinnings for managing it (Chapter 3)
- Basin context and summary information, including potential costs of projects to meet future water needs (Chapter 4)
- Tools that can be used to take action (Chapter 5)
- Statewide vision for a more water-resilient Colorado, along with partner and agency actions (Chapter 6)
- Process for tracking and updating the Water Plan (Chapter 7)

Accessing the Plan

The Water Plan allows the reader to engage at the levels that work best for them.

1. **Executive Summary** - High-level description and highlights of the Water Plan.
2. **Water Plan** (full document) - Foundational background information, future vision, and actions.
3. **CWCB Website** - Current CWCB efforts and background materials (cwcb.colorado.gov)

You can also find additional links and interactive resources at cwcb.colorado.gov

This updated Water Plan replaces the original Water Plan developed in 2015.

Potato Harvest
Photo credit: Sinjin Eberle

CHAPTER 2

TECHNICAL ANALYSIS, SCENARIOS, and DRIVERS

TECHNICAL ANALYSIS OVERVIEW

Following the launch of the Water Plan and the Basin Implementation Plans (BIP) in 2015, CWCB initiated the process of updating the underlying water supply and demand analyses, which culminated in the Analysis and Technical Update to the Colorado Water Plan (Technical Update), completed in 2019. The work began with the input of Technical Advisory Groups (TAG) that included representatives from across the state who provided expertise and advice on assumptions and methods for the Technical Update analyses. The resulting Technical Update (formerly known as the Statewide Water Supply Initiative or SWSI) established a new approach to statewide water analysis and data sharing.

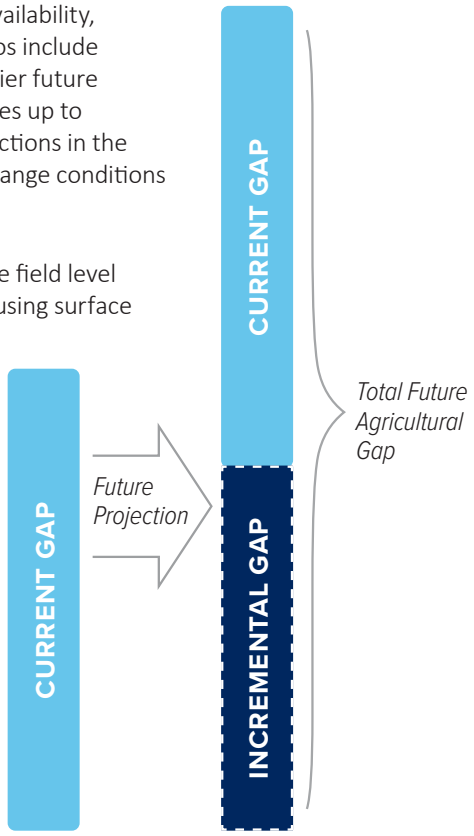
The Technical Update leverages a significant investment of over three decades in statewide water modeling efforts, which began in 1992. To that end, the Technical Update provides a significant improvement in the scope, science, and approach to water supply planning. The approach positions Colorado for a streamlined and robust evaluation of its future water needs.

The 2015 Water Plan set an adaptive management framework for future water planning activities and described five plausible futures (or planning scenarios) under which demands, supplies, and gaps (difference between demand and supply) were to be estimated. The scenarios included new considerations, such as climate change, that were not a part of analyses prior to the 2019 Technical Update. In addition, CWCB has continued to work with the Division of Water Resources (DWR) to develop and refine consumptive use and surface water allocation models that were not ready for use in earlier analyses. The Technical Update data sets were developed to be readily updatable, and during the recent BIP update process some data sets were further refined with basin roundtable input. As a result of these factors, the Technical Update took a leap forward with a different and more robust approach to estimating future gaps.

Click this link for more information on the Analysis and Technical Update to the Water Plan:
Analysis and Technical Update

Section 2 of the Technical Update (Volume 1) summarizes the methodologies used to estimate current and future municipal/industrial and agricultural demands, water supplies and potential gaps, and tools for evaluating environment and recreation needs. Volume 2 of the Technical Update includes technical memoranda with detailed descriptions of methodologies and analysis results. The methodologies used for the Technical Update build on previous datasets as well as new and improved data sources. To the extent possible, the Technical Update leveraged Colorado's investment in models and datasets developed through Colorado's Decision Support System (CDSS). Highlights of the new methodologies are described below.

- **Incorporation of scenario planning:** The 2015 Water Plan introduced scenario planning and included five scenarios that describe Colorado's potential water situation in the year 2050. The Technical Update conducted analyses of future demands, supplies, and additional water needs in the context of the potential future scenarios.
- **Municipal water use efficiency reporting data:** New data describing recent municipal water usage was employed to estimate municipal water demands. The data are collected and reported by water providers pursuant to House Bill (HB) 10-1051 (1051 data). The 1051 data were not available in prior SWSI efforts.
- **CDSS tools:** The Technical Update made extensive use of modeling tools available through CDSS. CDSS is a water resources data and modeling toolbox developed by CWCB and DWR for each of Colorado's major river basins for regional planning purposes. Tools in CDSS include HydroBase (a vast database of statewide water-related data), geographic information systems (GIS) data, surface water allocation models, and models that quantify consumptive use from crops and other vegetation. CDSS tools are available in most basins in the state. In basins where particular CDSS tools are not available, alternative methodologies were used to estimate demands and potential future gaps. The level of detail on hydrology, operations, and demands is appropriate for regional planning but does not capture daily changes in streamflow, routing of reservoir releases, or non-typical operations. As a result, the effect of local water uses on streamflows may not always be fully captured by the regional models.
- **Consideration of climate change:** The effects of climate change significantly influence hydrology, water demand and availability, and estimated gaps. Three of the five planning scenarios include assumptions and projections related to a hotter and drier future climate.[1] The analyses considered temperature increases up to 4.2 degrees Fahrenheit and were consistent with projections in the Colorado Climate Plan. Projections of future climate change conditions were not a part of past SWSI analyses.
- **Quantification of an agricultural gap:** Water demands and shortages for irrigated crops at the field level were estimated in SWSI 2010 but were not quantified using surface water modeling. Using the full suite of modeling tools available from CDSS made it possible to estimate agricultural gaps in the Technical Update under current and planning scenario conditions. Agricultural gaps are described in two ways:
  1. **Total Gap:** The overall shortage of water supplies (current plus potential incremental increases) to meet agricultural diversion demands required to provide full crop consumptive uses.
  2. **Incremental Gap:** The degree to which the gap could increase beyond what agriculture currently experiences under water shortage conditions.



Click this link for more information on Colorado's Decision Support Systems: **Colorado's Decision Support Systems**

[1] The planning scenarios developed for the Colorado Water Plan and the Technical Update were built on the foundational work of the multi-phase Colorado River Water Availability Study, Phase II (CRWAS-II). Detailed methodology and analysis results can be found in CRWAS-II Task 7: Climate Change Approach and Results.

- **Improved environment and recreation tools:** The Technical Update improved the data associated with environment and recreation attributes statewide. In addition, the Colorado Environmental Flow Tool (Flow Tool) was developed by CWCB to help assess potential flow conditions and associated ecological health in river segments in each basin. The Flow Tool was built on the framework of the Watershed Flow Evaluation Tool, a Colorado-specific application of a framework for assessing environmental flow needs at a regional scale. The tool uses flow data from the surface water allocation modeling developed for the Technical Update.

Link for the **Colorado Environmental Flow Tool**

Risk of Future Water Shortages

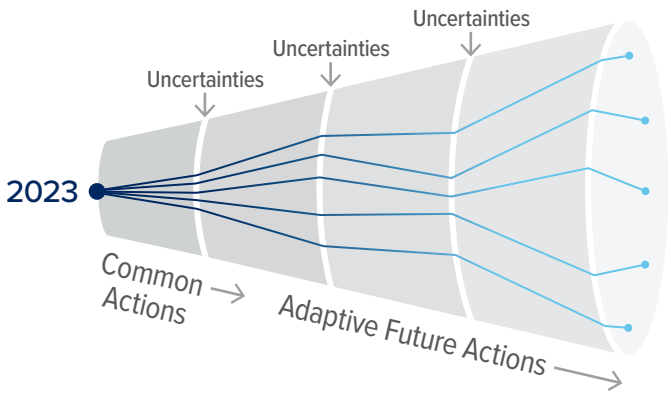
In the Technical Update, the calculated difference between water supplies and water demands for current and future conditions in the municipal and industrial and agriculture sectors was labeled the "gap." Gaps were presented for each of the five planning scenarios to reflect future uncertainty. Because gaps are estimated for future scenarios, they represent a future risk that water supplies will not be adequate to fully meet municipal, industrial, and agricultural demands. The bigger the gap, the higher the risk that Colorado will not be able to meet its future water needs. In a similar vein, potential future risks for environmental and recreational attributes based on projected future flow conditions were evaluated in the Technical Update using the Flow Tool.

Identifying potential future risks to all sectors of water use was a key objective of the Technical Update. Risk identification is a starting point and is foundational for discussions about projects and strategies that will help lessen future risk. Chapter 3 of the Water Plan summarizes the results of analyses conducted during the Technical Update and enhanced during the BIP update process.

The Water Plan uses scenario planning to identify and assess several potential water futures that together capture the most relevant uncertainties and driving forces

SCENARIO PLANNING APPROACH

The scenario planning process acknowledges that uncertainties exist in the future environmental state and social values of Colorado. As the time horizon increases, the uncertainty of these conditions increases as well. Particular scenarios can be based on assumptions about the states of future conditions. The scenario planning method is more sophisticated than a simplistic application of high-, medium-, and low-stress conditions (as were used in SWSI 2010).



Plausible range of water futures in 2050

The Water Plan uses scenario planning to consider a wide range of possible futures according to the best available science and stakeholder input. The approach considers uncertainties in future climate conditions, social conditions (such as values and economics), and supply-demand conditions (e.g., energy, agricultural, and municipal needs).

The scenario planning method included the six general steps described below and is intended to be cyclical and adaptive.

1. Evaluate drivers that impact future water conditions
2. Identify the most uncertain and impactful drivers
3. Develop future scenarios that consider variations in the drivers
4. Quantify future supply and demand conditions for each scenario
5. Calculate potential future risks of water shortages
6. Develop projects or strategies to mitigate future risks

IDENTIFICATION OF HIGH-IMPACT DRIVERS THAT INFLUENCE COLORADO'S WATER FUTURE

Before developing the 2015 Water Plan, CWCB initiated a multi-year stakeholder dialogue in conjunction with the nine basin roundtables and the IBCC to develop a methodology for projecting future water needs. The IBCC then developed a list of the following nine high-impact drivers that could greatly influence the direction of Colorado's water future. Several of these drivers are interrelated and can have integrated effects. The identification and monitoring of these nine drivers are important to understanding the direction of future water supply and demand.

1. SOCIAL / ENVIRONMENTAL VALUES

DRIVER DESCRIPTION

Social/environmental values reflect the public's perception of water use, support of water and energy conservation, and allocation of water supply toward environmental uses. Social values influence drivers such as regulations and adoption of water efficiency technologies, but they also affect the types of solutions that Coloradans pursue to meet future water needs or respond to climate change. For example, social values can impact the degree to which residents voluntarily adopt water-efficient technologies that may cost them money. They can also influence the demand for local agricultural products and the desire to maintain open space. Personal experiences, education, and outreach impact the degree of public awareness of water issues, which in turn can affect the public's perception of the water supply solutions as well as recreation and environmental protections that are pursued.

IMPACT ON WATER RESOURCES

If values trend toward greater water and energy conservation, new technologies may emerge that help conserve water. Also, development of new supplies may occur in ways that meet municipal and agricultural needs while preserving or enhancing the environment and providing recreational benefits.

2. POPULATION / ECONOMIC GROWTH

DRIVER DESCRIPTION

Population growth is driven by both state and national economic trends and land use planning and development statewide (see Driver #3). Colorado's moderate climate and quality of life draw both permanent residents and tourists. Population and economic growth/decline is forecasted by the State Demography Office (SDO) using census data and understanding of economic drivers.

IMPACT ON WATER RESOURCES

Population growth is a primary driver for municipal water demand and urbanization. Population change directly influences water use, while economic growth influences the types of water use (municipal, industrial, recreation, etc.). While Colorado's recent efforts to save water though efficiency and conservation have kept water demands steady in spite of growth, water demands are nevertheless projected to increase.

3. URBAN LAND USE / URBAN GROWTH PATTERNS

DRIVER DESCRIPTION

Urban land use and growth considers both density of development, as well as urbanization of undeveloped and agricultural lands. Zoning and other decisions affecting population density in cities and towns impacts how water is used inside and outside of single- and multi-family housing. It also impacts the degree to which urban sprawl may occur in the future.

IMPACT ON WATER RESOURCES

Population growth patterns can impact availability of water resources and how local governments use water (in-house use versus watering of green spaces). As urban areas grow into undeveloped areas of the watershed, both runoff into streams and water quality are affected. Finally, the urbanization of agricultural lands results in a shift of water use from the agricultural sector to the municipal sector, which can impact timing of use and return flows, wildlife habitat, and overall watershed health.

4. AVAILABILITY OF WATER EFFICIENCY TECHNOLOGIES

DRIVER DESCRIPTION

Availability and adoption of water efficiency technology drives water demands from municipal, industrial, and agricultural perspectives. Increased efficiency can be implemented in all sectors (municipal, industrial, energy, agricultural) and can offset growth through decreased demand by individual users.

IMPACT ON WATER RESOURCES

Indoor municipal demands can be reduced by installing low-flow fixtures, and outdoor demands are influenced by types of landscaping and efficiency of irrigation systems. On the agricultural side, irrigation efficiency technologies can reduce water losses on-farm and in ditches that deliver water from rivers and streams to farms. In addition, crop hybrids that are drought tolerant and crops that require less water can reduce irrigation demand.

5. CLIMATE CHANGE / WATER SUPPLY AVAILABILITY

DRIVER DESCRIPTION

Climate change is the long-term shift in temperature and regional weather patterns that results in a range of projected future conditions that include a warmer and potentially drier future for Colorado.

IMPACT ON WATER RESOURCES

Climate conditions impact both water supplies and water demands. Climate change may decrease streamflows and/or shift yearly streamflow patterns, which would impact agricultural, municipal, and industrial water supplies and create or increase risks for environment and recreation attributes. Higher temperatures associated with climate change will increase irrigation water demands for agricultural crops and outdoor urban landscapes and result in reduced return flows to streams.

6. LEVEL OF REGULATORY OVERSIGHT / CONSTRAINT

DRIVER DESCRIPTION

Regulatory oversight includes the legal framework in Colorado and nationwide through which water is administered, developed, and managed. This includes oversight from DWR, Colorado Department of Public Health & Environment (CDPHE), U.S. Environmental Protection Agency (EPA), and others.

IMPACT ON WATER RESOURCES

Regulatory constraints are influenced by social values, and they may drive changes in demands. For example, industrial water needs for energy extraction or thermoelectric energy production may be higher or lower in the future depending on state and local regulations and policies. Regulation can also drive the types of water supply solutions that stakeholders pursue. For example, the efficiency of permitting for certain types of water projects and the associated environmental mitigation requirements could influence their feasibility and cost.

7. AGRICULTURAL ECONOMICS / WATER DEMAND

DRIVER DESCRIPTION

Agricultural conditions, such as the amount of irrigated land in production, crops grown, and climate influence irrigation water demands. Urbanization, municipal transfers of agricultural water supply, and availability of surface and groundwater supplies all influence the amount of agricultural land that will be in production in the future. In addition, demands and prices for local agricultural products affect the economic sustainability of continued agriculture and resulting demands for water.

IMPACT ON WATER RESOURCES

Changes in the economics of the agricultural sector may impact the amount and types of crops grown, as well as the amount of land under irrigation. These changes will impact water demands for agricultural purposes.

8. ENERGY ECONOMICS / WATER DEMAND

DRIVER DESCRIPTION

The energy sector uses water in a variety of ways, including direct use for hydropower, or indirect uses such as steam generation or cooling. Water needs for energy expand relative to population growth and current regulations, policies, and planning for the energy industry. These needs are also affected by the type of energy production that is used in the future and can be influenced by state and national energy policies.

IMPACT ON WATER RESOURCES

As the sources of energy shift from non-renewable (coal and gas) to renewable (water, wind, and solar), the demand for water will shift as well. It is anticipated that renewable sources of energy will be less water consumptive.

9. MUNICIPAL AND INDUSTRIAL WATER DEMANDS

DRIVER DESCRIPTION

The municipal and industrial sector serves the residents and businesses of Colorado with water. Municipal water demands are influenced by changes in other drivers such as population, urban land use, adoption of conservation measures, and climate.

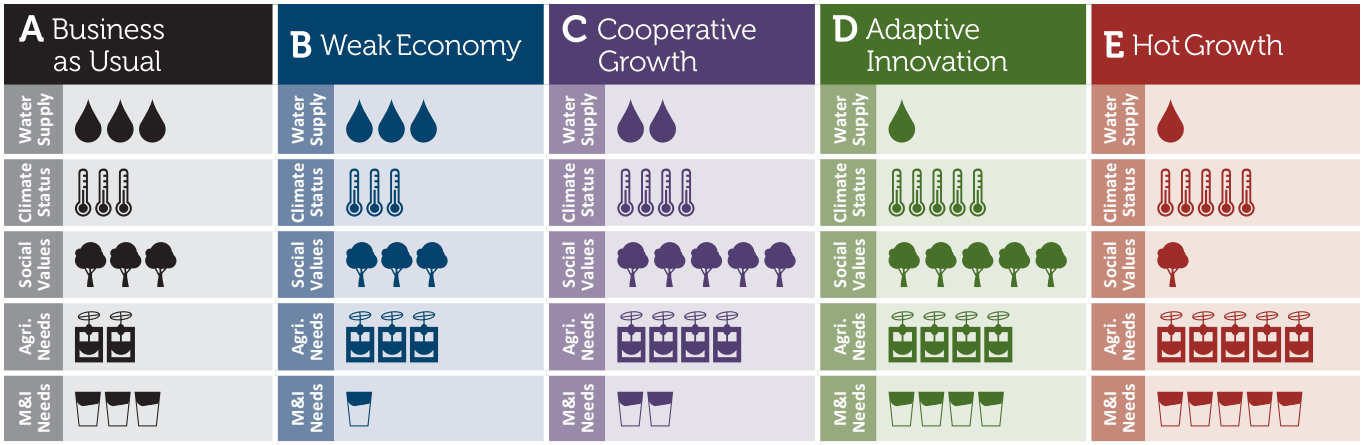
IMPACT ON WATER RESOURCES

Water in Colorado is scarce, and as the population grows, increased municipal and industrial demand for water is met through development of new supplies (if available), at the expense of water from a different sector, or through water conservation.

Using these drivers, the IBCC developed five scenarios that represent how Colorado's water future might look in 2050, knowing that the future is unpredictable and will contain a mix of multiple scenarios. A simplified graphic and descriptions of the five scenarios are shown below. The icons for each scenario illustrate the increase and decrease in levels for the generalized drivers compared to current levels (the five icons represent the combined effects of the nine drivers). The scenario names portray the overall story that each scenario tells in its respective views of the future.

Click this link for more information on the scenarios (including full text descriptions of each scenario). Refer to the Technical Update to the Water Plan, Sections 2.1.3 and 2.1.4: **Analysis and Technical Update**

SIMPLIFIED DESCRIPTION OF PLANNING SCENARIOS



A Business as Usual	B Weak Economy	C Cooperative Growth	D Adaptive Innovation	E Hot Growth
• Population growth increases at trends predicted by the SDO. • Future hydrology, per capita water demands, and adoption of conservation measures are similar to what's recently occurred.	• The world's economy slows, and the state's population growth is less than predicted. • Hydrology is similar to recent patterns. • This scenario puts the least amount of stress on future water supplies and is a bookend for scenarios.	• Climate is moderately warmer, and irrigation demands increase. • Statewide population is similar to predictions by SDO, but it is distributed differently across the state. • People seek to offset increased demands by more aggressively adopting water conservation.	• Both scenarios assume that the climate is much warmer and drier and that population growth is higher than projected. • The scenarios' primary differences revolve around conservation. In the Adaptive Innovation scenario, the state aggressively adopts conservation measures in both municipal and agricultural sectors. In the Hot Growth scenario, conservation is not a focus.	

Monitoring the Drivers

The Water Plan will be updated periodically as part of a robust planning cycle to evaluate the state's changing water conditions. Part of the periodic update process will include monitoring the status of water resources drivers and adjusting the planning scenarios based on observed trends. Some of the drivers (e.g., population, per capita municipal and industrial water demands) can be monitored with readily available data being collected by state and local entities. Other drivers (e.g., regulatory constraints and social/environmental values) may require specific data gathering, such as surveys or collaboration with other entities who collect these types of information.

The interactions of drivers and their impact on risk is complex, which underscores the need for consistent monitoring of the drivers during Water Plan implementation. If certain drivers increase future demand (e.g., urban or energy sector growth) or decrease water supply (e.g., drier climate, increased regulation), then the risk of a future water shortage may increase; however, the risk may not increase if new water-efficient technologies emerge.

Monitoring and Uncertainty

Our future is uncertain, which is why monitoring is critical for identifying trends and adaptively planning for the future. For example, using SDO population projections developed in 2017 as a foundation, the Technical Update estimated a 2050 statewide population range of 7.7 million to 9.3 million. The SDO estimate, prepared in October 2022, projects a 2050 population of 7.5 million, which corresponds closely to the projection in the Weak Economy scenario. Trends in population and other water supply and demand drivers need to be monitored so that the Water Plan can adapt to uncertain and changing future conditions. The CWCB monitors drivers, identifies changes in drivers during Technical Updates, evaluates whether recent changes signal long-term trends, and assesses how trends may affect the future.

Actions can be taken that are useful in any future scenario

Near-term strategies and actions can be taken that provide benefits regardless of how the future unfolds (also known as "low regret strategies"). As future Technical Updates are conducted and the Water Plan is updated, new near-term strategies will be developed to adapt to conditions and lower our water-related risks.

Indicators of Future Conditions

The adaptive management framework recognizes that the future hinges on how much the water resources drivers change over time. Major changes in the drivers could tilt toward one scenario or another. Monitoring results provide indicators that suggest a certain set of future scenario conditions is unfolding and help identify the types or scale of alternatives that are needed to meet the water supply challenges that are projected to emerge. In future Water Plan updates, monitoring results will be evaluated cyclically during the technical analysis phase as the State evaluates and reviews changes in the drivers.

When CWCB begins the next technical analysis phase of the Water Plan (see Chapter 7), the first step will be to evaluate trends in the drivers and whether the trends indicate a certain future scenario or set of scenario characteristics is becoming more likely. Based on this analysis, CWCB will consider changes to the planning scenario assumptions and possibly develop new planning scenarios for the technical analysis based on the observed trends.

As trends in drivers indicate a certain future or set of futures is likely, the Water Plan's vision and actions will be updated to address future risk and meet the needs of future conditions. While it is recognized that conditions can swing from one extreme to the next and there is uncertainty in planning for any of the plausible futures, Colorado is sure to face continued pressure to meet all water needs. The CWCB has recognized that there are planning steps that can be taken to mitigate risk no matter how the future unfolds.

Framework for Adaptive Planning

This statewide Water Plan requires a continuous planning process in which we assess our trends and progress and adjust to new realities. In this way, Colorado can make sure that strategies and actions are undertaken to mitigate future risks.

Engagement of stakeholders and water resources experts will inform the update of planning scenarios, assumptions, and technical analyses. Using a common and accepted framework to update and perform future technical analyses allows the CWCB to organize and evaluate a wide range of information and alternative water management strategies on a regional scale. New and more robust analysis tools and processes used in the Technical Update helped reduce uncertainty in current supply and demand assessments and captured a range of projected risks to future water supply. The CWCB anticipates that the sophistication and detail of analysis will increase with each future Technical Update and provide further clarity of future water needs. Additional discussion of the update process is included in Chapter 7.

> "WE'RE TRYING TO PACE THE RIGHT FUTURE GOALS. DROUGHT, CLIMATE CHANGE…IT WOKE US UP. MOTHER NATURE CHANGED HER PROCESSES. THE VISION OF THIS ORGANIZATION OVER THE LAST TWO DECADES OR MORE IS THE ONLY WAY WE'RE GOING TO PROTECT OURSELVES IN THE NEAR FUTURE.
>
> — RUSS GEORGE, *Former CWCB Board and IBCC Director*

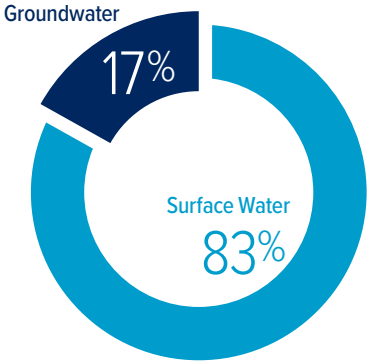
CHAPTER 3

STATE CONTEXT

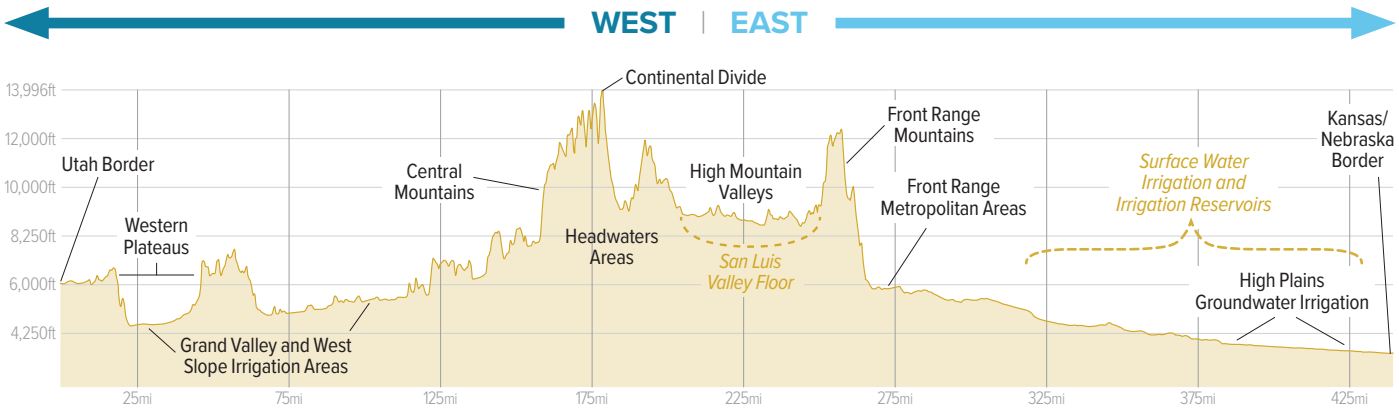
COLORADO WATER RESOURCES

Colorado's geography is diverse with terrain that ranges from low-lying plains to the second highest peak in the lower 48 states, Mt. Elbert. The varying terrain influences precipitation amounts and patterns across the state. Many major rivers originate in the high Rocky Mountains, including the four major river systems of the Arkansas, the Colorado, the Platte, and the Rio Grande. These rivers flow east, west, north, and south from Colorado's mountains and plains out of the state, through 19 downstream states and Mexico, and into the Gulf of Mexico or the Pacific Ocean.

Our state's water supply consists of both surface water and groundwater sources, and these supplies depend on complex interactions among geography, weather, and our legal system of allocating water for beneficial use. Colorado's rivers and streamflows are highly variable, both seasonally and annually, and provide surface water and replenish alluvial groundwater supplies. The quality of surface water and groundwater also influences the amount available for different uses. As described in this chapter, the use of groundwater and surface water is subject to different water rights and management institutions.



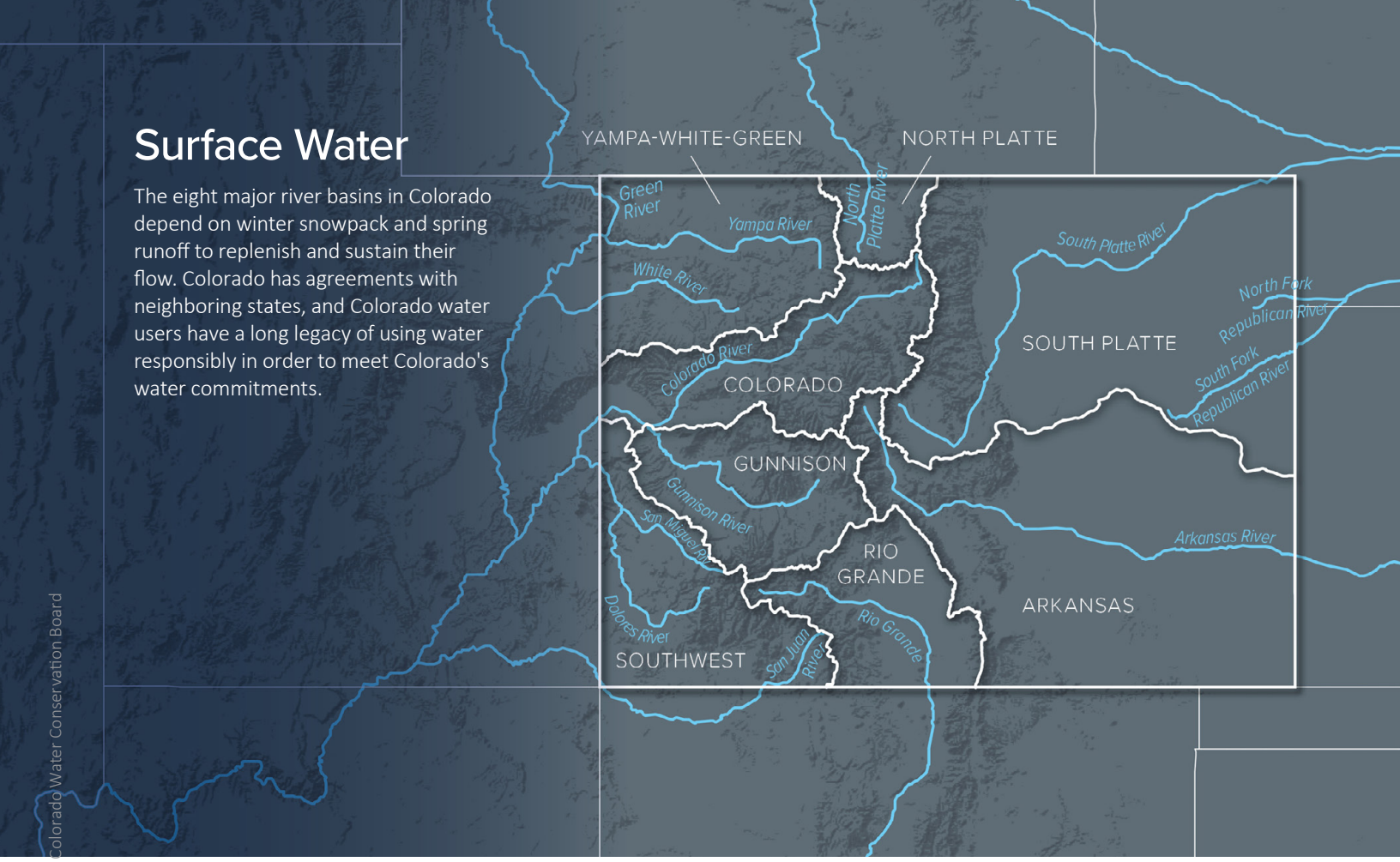
Surface water supplies the majority of water use in Colorado, but groundwater is a significant and critical resource in many regions for agriculture and municipalities



Generalized west-to-east cross section of Colorado showing varied topography and water-related features

Surface Water

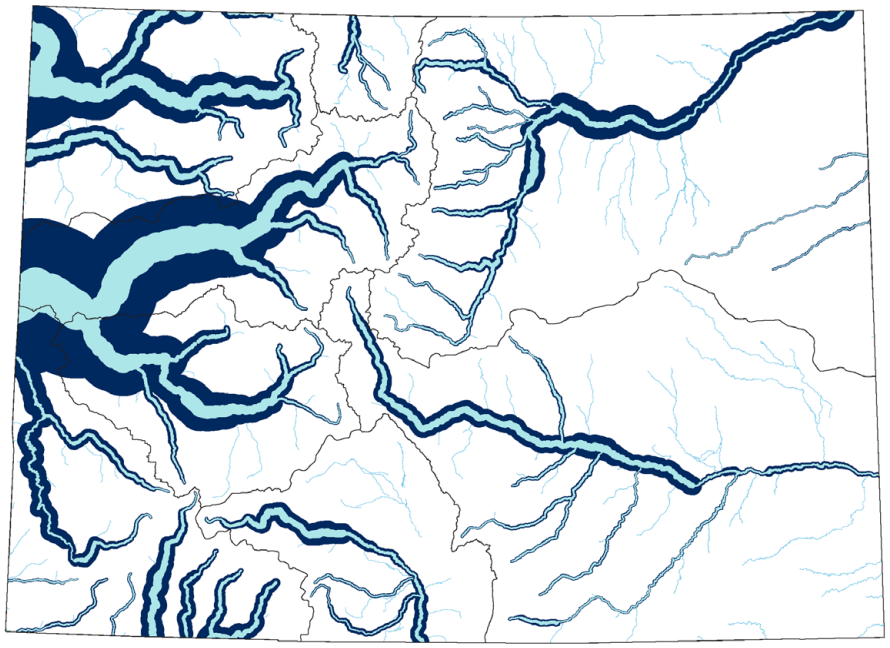
The eight major river basins in Colorado depend on winter snowpack and spring runoff to replenish and sustain their flow. Colorado has agreements with neighboring states, and Colorado water users have a long legacy of using water responsibly in order to meet Colorado's water commitments.



The western side of the Continental Divide receives most of the precipitation (80%); however, the majority of the population (nearly 90 percent) lives on the eastern side of the Continental Divide. Because streamflows are not evenly distributed across the state, water managers rely on networks of reservoirs, pumps, tunnels, and ditches to store and move water. They also must comply with relevant environmental mitigation requirements to maintain ecosystem health. Water conservation strategies can help alleviate stress on the system under both normal operating conditions and during shortages.

Annual streamflow varies significantly across Colorado's river basins

Relative Variability of Typical Wet-and-Dry Surface Water Hydrology



= Typical wet year flow volume

= Typical dry year flow volume

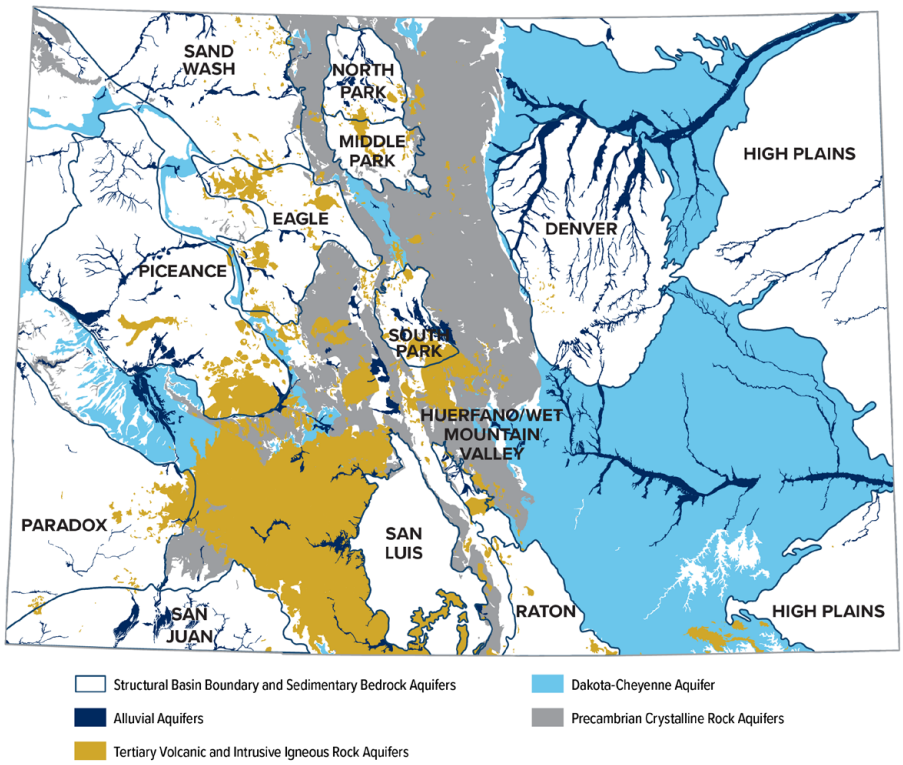
Groundwater

Groundwater plays a major role in the statewide water supply. Nineteen of Colorado's 64 counties and about 20 percent of the state's population rely heavily on groundwater.[1] Most groundwater use occurs in the eastern part of the state and in the Rio Grande Basin. The western slope, which includes the basins tributary, or connected to, the Colorado River, has not developed groundwater to the same extent due to depth of groundwater in some areas and historical abundance of Colorado River supply, though some domestic water suppliers rely on alluvial aquifers. Groundwater aquifers are naturally-formed storage and do not lose water to evaporation. Nevertheless, relying on groundwater as a primary supply may be challenging due to uncertain and varied natural recharge rates, water quality issues, constraints on operations (e.g., costs and water rights), and potential future changes to the physical characteristics of the aquifer (such as reduction in storage volume due to compaction). In some aquifers, such as those in the Denver Basin, the natural recharge rate is very low compared to extraction rates, so groundwater is considered a nonrenewable resource.

Groundwater Use in Colorado

- **85% is used for agriculture to irrigate more than 2,000,000 acres**
- **18% of Colorado's population relies on groundwater for domestic supply**
- **60% is from nonrenewable aquifers (out of approximately 2.78 million acre-feet total from all groundwater pumping)**

Colorado Aquifers



Groundwater resources exist throughout the state in alluvial and bedrock aquifers. Bedrock aquifers include sedimentary (i.e., porous) multi-aquifer systems such as the Denver Basin and Dakota-Cheyenne aquifers. Crystalline (i.e., non-porous) rock aquifers are found in most of the foothills and mountainous areas of the state and are formed as snow melts into rock fractures. Alluvial aquifers generally consist of sands and gravels, occur along many of the state's streams, and are usually tributary to the stream. Alluvial aquifers are a key component of water supply in parts of Colorado. Because of the connection between alluvial aquifers and surface water systems, alluvial water is often used conjunctively with surface water through augmentation plans.

[1] Colorado Geologic Survey, "Groundwater," 2014, Colorado Groundwater Atlas

Declining aquifer levels in several Colorado basins require proactive management of this resource. Strategies being used to keep these aquifers sustainable include monitoring and reductions of well pumping, augmentation and conjuctive use of groundwater supplies to replenish surface water systems or remedy impacts of pumping groundwater, and even retirement of irrigated parcels.

High Plains Aquifer – Arkansas Basin

Southeastern Colorado's community and irrigated farmland water sources are from aquifers, including the Southern High Plains Designated Groundwater Basin (which lies outside of the Arkansas Basin). Groundwater elevations in the area have generally been dropping, with declines between 3.5 to 21 feet from 2008 to 2018. The gradual depletion of these aquifers is a serious issue that will require further attention and planning.

High Plains Aquifer – Republican Basin

The Republican River Basin has nearly 580,000 irrigated acres, making it one of the highest producing basins of irrigated crops in the state. The basin has very limited surface water supplies. As a result, irrigators rely on groundwater supplies from the High Plains Aquifer. While all pumping in the basin is subject to the Republican River Compact, the Compact accounting recognizes that most of that pumping comes from storage in the High Plains Aquifer and not the stream system.

The current amount of irrigated land in the basin is expected to decline in the future, and irrigated lands will need to be retired to maintain compliance with the Republican River Compact. In addition, declining saturated thickness in the High Plains Aquifer will also lead to the retirement of groundwater-irrigated lands.

Denver Basin Aquifer – South Platte and Arkansas Basins

The Denver Basin Aquifer has provided a high-quality and plentiful supply to both urban and rural areas along the Front Range, with significant well development since the 1950s. During the drought of 2002, declines in the Arapahoe formation, and even drying-up of wells along the aquifer's western edge, were observed. While the Denver Basin Aquifer can be a viable water supply, it is challenged by uncertainty in statutory allocation of water and declining water levels that may limit its use to only drought resilience in some areas. Concerns about the sustainability of the Denver Basin Aquifer have driven many municipalities to pursue costly renewable surface water supplies.

San Luis Valley Aquifers – Rio Grande Basin

Groundwater development in the San Luis Valley accelerated rapidly from the late 1930s to the 1970s. Since 1977, pumping of groundwater for irrigation has resulted in an estimated reduction of water stored in the unconfined Closed Basin aquifer of approximately 1.2 million acre-feet.[2] As early as the 1970s, water users in the San Luis Valley recognized the need to monitor groundwater use and protect both surface and groundwater supplies. In 1998, the Colorado General Assembly passed HB 98-1011, which instructed the State of Colorado to conduct a study of the San Luis Valley's hydrologic resources and resulted in the Rio Grande Decision Support System (RGDSS) groundwater model. RGDSS modeling and case law show that the San Luis Valley's streams, wetlands, and aquifers are hydrologically connected, and that groundwater withdrawal results in stream depletions.

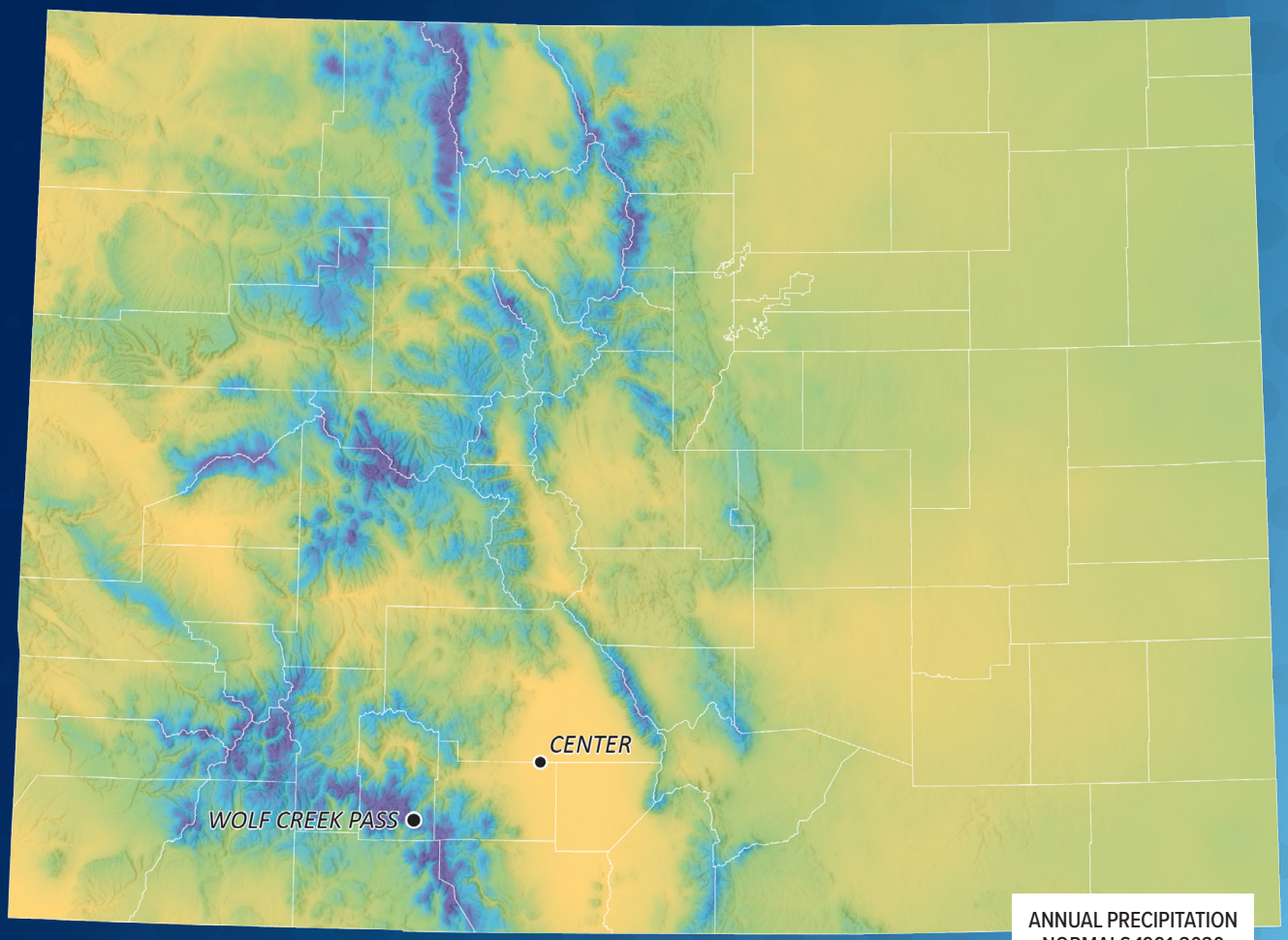
In the early 2000s, San Luis Valley water users grew increasingly concerned about groundwater use and over appropriation. In 2004, at the urging of San Luis Valley water users, the Colorado General Assembly enacted Senate Bill (SB) 04-222, which instructed the State Engineer to develop groundwater rules and regulations to prevent injury to water right holders, provide for sustainable groundwater supplies, and prevent interference with the Rio Grande Compact. SB 04-222 also enabled the formation of Groundwater Management Subdistricts (subdistricts), which are a system of self-regulation, including economic-based incentives to reduce groundwater use and collective efforts to ensure the protection of senior surface water rights.

The State Engineer submitted Well Rules and Regulations (well rules) in 2015 for existing and new uses of groundwater in Division 3. The well rules came into effect in March 2021 and require well owners to achieve sustainable aquifer levels and replace injurious stream depletions to surface water rights by either joining a subdistrict or creating or joining an augmentation plan. Water users across the San Luis Valley continue to work toward sustainable aquifer levels by utilizing conservation programs, innovative water efficiency improvements, and land fallowing programs.

[2] Change in Unconfined Aquifer Storage West Central San Luis Valley. Prepared by Davis Engineering Service, Inc. for Rio Grande Water Conservation District. May 19, 2022.

PRECIPITATION

Precipitation varies in both amount and distribution across the state, and it is influenced by both the elevation and orientation of the mountains. In general, the mountains receive more precipitation than the plains, and winters are typically wetter than summers. Despite high precipitation during the winter months, demand for water is highest during the summer growing season. Winter snowpack is a critical source of water supply to most areas of the state.



According to PRISM Climate Group 30-year normals from 1991 to 2020, Colorado receives an average of 18 inches of precipitation each year.[3] However, extreme variability exists across the state and within relatively short distances. For example, Wolf Creek Pass yields an annual average of more than 60 inches of precipitation, while Center receives just 7 inches of precipitation annually. Both sites are in the Rio Grande Basin.

[3] **PRISM Climate Group**. Northwest Alliance for Computational Science and Engineering. Oregon State University. 2021.

Variability in Water Supply

Our state's variable precipitation patterns create considerable fluctuations in hydrology. Floods and drought are possible within the same year. Three of Colorado's worst droughts have occurred in the last 20 years — 2002, 2012, and 2018 — with historic precipitation at some locations during the same 20-year period — 2003, 2011, 2013, and 2015. As depicted previously, average annual precipitation varies geographically across the state. In addition, conditions within a single year can simultaneously vary throughout the state with drought conditions in one part and relatively normal or wet conditions in another.

Drought can have substantial and lasting effects on water supplies and availability for years, while wet years offer relief and the opportunity to store excess water. Both weather extremes can have other consequences, such as increased wildfires and the flooding and debris flow that potentially follow.

Aside from the potential for wildfire, drought can also have substantial fiscal impacts. Colorado State University estimates that in 2012, lost revenues due to drought in the agricultural sector alone exceeded $409 million. Factoring in secondary economic effects to local communities, the loss increases to $726 million.[4]

Drought can also negatively influence air and water quality, water delivery infrastructure, wildlife, the environment, recreation, and tourism. Drought can last for weeks, months, or years. The longer a drought persists, the larger its effect. For instance, a municipality may be able to get through a single-year drought by using reservoir storage and drought response measures, but if stored supplies are not replenished, subsequent years become more difficult to manage. The same is true in the agricultural sector; ranchers forced to cull herds in response to drought or the loss of orchard trees may require decades to recover or may never recover at all.

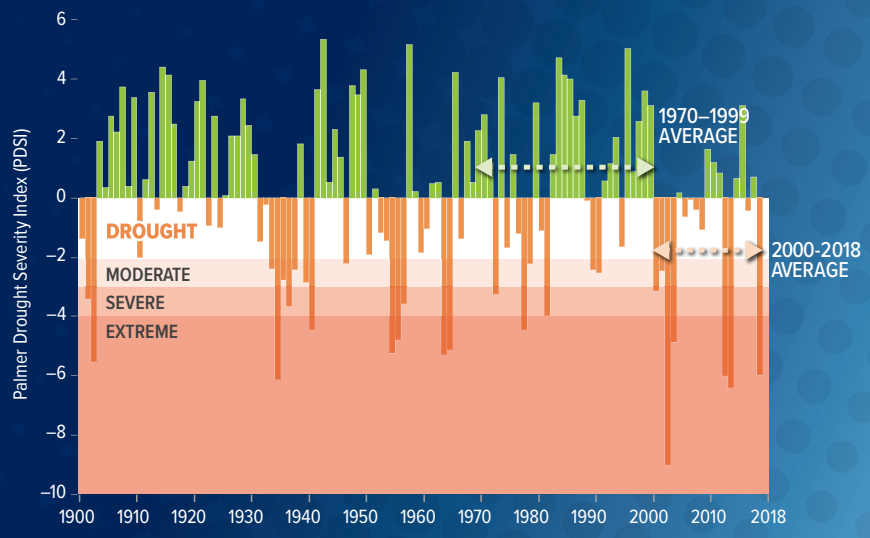
On the other end of the variability spectrum are floods—too much moisture can result in overflowing streams and reservoirs and cause extensive damage. In fall 2013, widespread flooding occurred along the northern Front Range (in the South Platte and Arkansas Basins) after 19 inches of rain fell in a few days. For these areas, the rainfall was equivalent to nearly a full year of precipitation. As many as 88 weather stations exceeded 24-hour precipitation records, and the hardest hit areas received more than 600 percent of average precipitation for the month. Water inundated entire communities.

Floods not only cause community damage, they also impact agricultural operations, drinking water supply, and water delivery systems. Flooding events can leave water supply infrastructure, such as diversions and headgates, completely disconnected from their historical source of water. These effects may take weeks, months, or years to fully repair, and some damage may be too great to ever repair economically.

The Colorado River Basin is currently experiencing its worst drought in recorded history. Since 2000, it has experienced the driest period in 1,200 years.[5]

Colorado July Palmer Drought Severity Index, 1900–2018[6]

The Palmer Drought Severity Index uses temperature and precipitation data to estimate relative dryness and quantify long-term drought. The 1970–1999 average was +0.9, or wetter than normal, while the 2000–2018 average is –1.7, or drier than normal.



Source: Adapted and updated from Lukas et al., Climate Change in Colorado, 2014; Data: NOAA NCEI; http://www.ncdc.noaa.gov/cag/

[4] Pritchett, Goemans, and Nelson, Estimating the Short and Long-term Economic & Social Impacts of the 2012 Drought in Colorado, 9-10.

[5] Williams, A.P., Cook, B.I. & Smerdon, J.E. **Rapid intensification of the emerging southwestern North American megadrought in 2020–2021**. Nat. Clim. Chang. 12, 232–234 (2022).

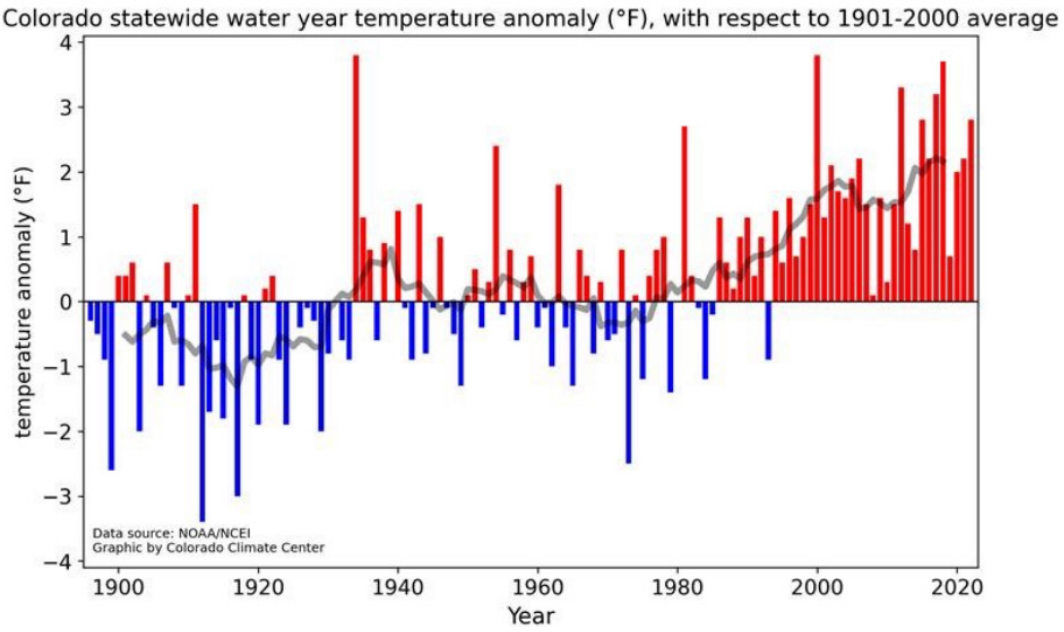
[6] Updated and adapted from Lukas et al., **Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaption**. 2014. Western Water Assessment. Data: NOAA NCEI.

Uncertainties Affecting Supply – Climate Change

Colorado's water supplies are affected by temperature and precipitation patterns, and these historical patterns have begun to change. In May 2021, NOAA updated its **30-year climate normals**, and the newest 30-year normal reflects warmer temperatures than previous iterations and also reflects changing precipitation patterns. For Colorado water supplies, this presents additional complexities and uncertainties, and points to a shift toward aridification. Some key hydrologic indicators that could be impacted by climate change are listed to the right.

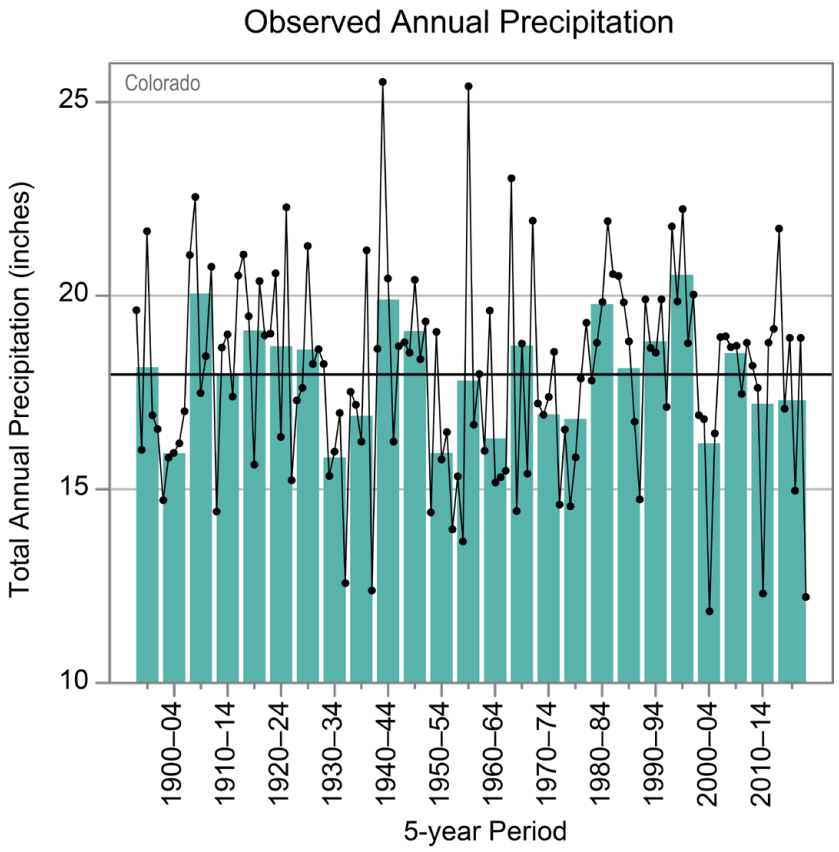
In the Upper Colorado River Basin (i.e., the states of Colorado, New Mexico, Utah, and Wyoming), recent research from the U.S. Geological Survey indicates that streamflow is decreasing by about 5 percent per degree Fahrenheit as a consequence of atmospheric warming, causing a 20 percent reduction over the past century.[7]

INDICATOR	CLIMATE CHANGE EFFECT
Annual Streamflow	*Decreases in most of the climate projections*
Peak Runoff Timing	*Earlier in all projections*
Crop Water Demand	*Increases*
Snowpack	*Decreases in most projections*
Palmer Drought Severity Index	*More drought*
Heat Waves	*More frequent*
Cold Waves	*Less frequent*

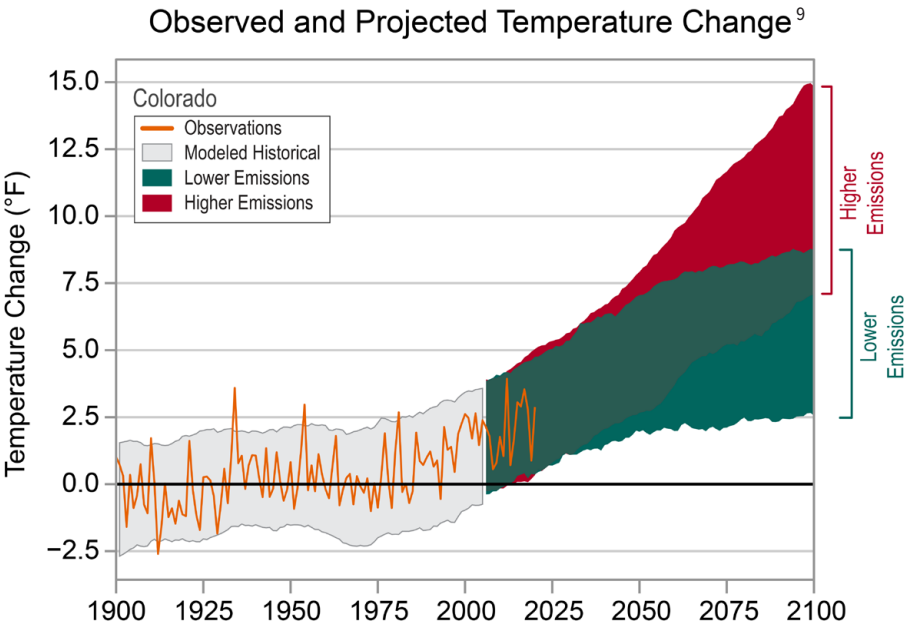


Recent statewide temperatures in Colorado have been trending up. Colorado's statewide annual temperature anomaly (deviation from the long-term average) indicates that Colorado's average yearly temperature has increased 2°F in the last 30 years.

[7] Milly PCD and KA Dunne. 2020. **Colorado River flow dwindles as warming-driven loss of reflective snow energizes evaporation**. Science. Vol 367 Issue 6483.



The graph above compares annual precipitation totals (dotted black line) to 5-year average precipitation totals (green bars) and long term average (solid black line). Average precipitation numbers can mask the high variability in precipitation seen at an annual or even 5-year average scale.[8]



Precipitation is widely variable in the state, with 5-year averages (represented by green bars) generally falling below the long-term average since 2000.

Climate models project ongoing changes in temperature trends, which will continue to impact the state's water supply. The impacts of temperature increase can influence water supplies through greater evapotranspiration, earlier snowmelt and peak runoff, increased heat waves, more intense droughts, drier soils, and more frequent and severe wildfires. These can result in a greater demand for supplemental irrigation, greater post-wildfire flooding impacts, and a decrease in annual streamflow. Model projections are less clear about whether precipitation will increase or decrease, but even moderate increases in precipitation will not be sufficient to overcome temperature-related impacts on water supply. These impacts can vary regionally, adding to the complexity. The planning scenarios account for complexities by considering both warming and precipitation.

Colorado has warmed 2°F in the last 30 years, and although models differ about the range of future conditions, it is predicted that Colorado will continue to warm by an additional 2.5°F to 5°F by mid-century.

[8] NOAA National Centers for Environmental Information. State Climate Summaries 2022 Colorado. 2022 Colorado Climate Summary

[9] Ibid.

Due to the uncertainty associated with future impacts of climate change, a hotter and drier future was included in the scenario planning process described in Chapter 2. Three scenarios have a climate different from what was observed during the 20th century, including two scenarios that experience "hot and dry" conditions, and one that features a hydrology and climate described as "between 20th-century-observed and hot and dry."

A Business as Usual	**B** Weak Economy	**C** Cooperative Growth	**D** Adaptive Innovation	**E** Hot Growth
None	**None**	**+ 3.8˚ F** **+ 5% Annual Precipitation**	**+ 4.2˚ F** **- 1% Annual Precipitation**	**+ 4.2˚ F** **- 1% Annual Precipitation**

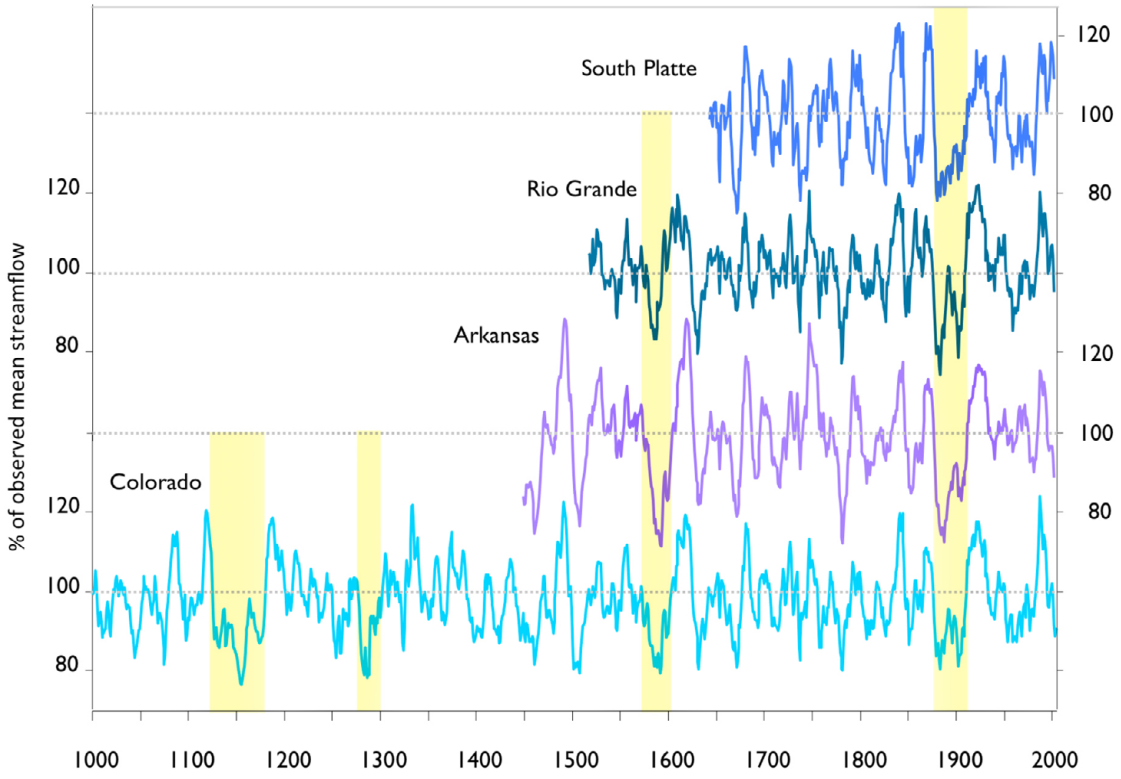
Dust on snow at the top of Red Mountain Pass
Photo credit: Steve Vandiver

Dust-On-Snow Events

"Dust-on-snow" events also introduce a level of uncertainty into managing water supplies. Dust-on-snow events occur when wind deposits dust from southwestern deserts (and other loose-soil surfaces lacking vegetation) onto mountain snowpack. This increases the effect of solar radiation, which speeds snowmelt and leads to earlier spring runoff. Studies have shown that dust events can advance snowmelt timing, enhance snowmelt runoff intensity, and decrease snowmelt yields. Dust-on-snow events can result in peak runoff three weeks earlier than normal. This shift is independent of climate change, which may also result in earlier snowmelt patterns. Since 2005, when dust tracking began, 140 dust-on-snow events have occurred. Eleven of these events were observed during the winter of 2022. The severity of future dust-on-snow events is uncertain. Nevertheless, if events continue at recently observed rates, they will affect Colorado's present and future water supply.

Historical Climate Extremes

Colorado has dealt with variability and drought over the last 150 years, but tree-ring reconstructed streamflows indicate that the state has endured longer-lasting and more severe droughts than we have seen in our relatively brief observed record. The 20th century is unique in that during that time, Colorado experienced two prolonged wet periods and no multi-decadal droughts. These wetter periods coincided with much of the water resources development occurring in the state.



Tree-ring reconstructed water-year streamflows as % of observed mean, showing the 10-year running average, for four gages representing major Colorado basins: the Colorado River at Lees Ferry, AZ (shown from 1000–2005), the South Platte River at South Platte, CO (1634–2002), the Rio Grande at Del Norte, CO (1508–2002), and the Arkansas River at Salida, CO (1440–2002). All four records show the occurrence of droughts prior to 1900 that were severe and sustained over many years. The yellow shading highlights several notable multi-decadal paleodroughts, in the mid-1100s, the late 1200s, the late 1500s, and the late 1800s.[10]

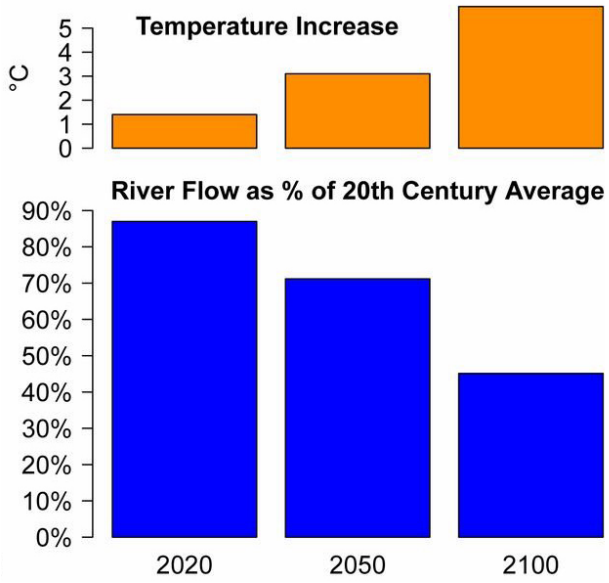
The current trend toward aridification and the knowledge that severe, long-term drought has occurred in Colorado's past underscores the need to be prepared for a warmer and drier future.

[10] TreeFlow. Streamflow reconstruction from tree rings. **Treeflow reconstructed streamflows**

Aridification is defined as the extreme dryness that leads to a more permanent dry climate. This is different than drought, which is temporary dryness. Unlike drought, which focuses on lack of precipitation, the focus of climate science has begun to include the growing role warming temperatures are playing as a potent driver of greater aridity: hotter climate extremes; drier soil conditions; more severe drought; and the impacts of hydrologic stress on rivers, forests, agriculture, and other systems. This shift in the hydrologic paradigm is most clear in the American Southwest, where declining flows have been documented in the region's two most important rivers, the Colorado and Rio Grande. However, the hydrologic shift may also impact areas east of the Rocky Mountains, based on findings of temperature-driven river flow declines in the Missouri River basin.[11]

Increasing temperature-driven aridity is more often framed in the West in terms of episodic drought. This drought framing is also common among many water and land managers as well as the public and implicitly assumes an end to arid conditions must come with the return of rain and snow. However, anthropogenic climate change calls this assumption into question because we now know with high confidence that continued emissions of greenhouse gases into the atmosphere result in warming, and that this continued warming makes more widespread, prolonged, and severe dry spells and drought almost a sure bet. This translates into an increasingly arid Southwest and West, with progressively lower river flows, drier landscapes, higher forest mortality, and more severe and widespread wildfires.[12]

Projected Relationship between Temperature and River Flow



**A 5-degree Celsius increase equals 9 degrees in Fahrenheit*

[11] J. T. Martin et al., **Increased drought severity tracks warming in the United States' largest river basin**. Proc. Natl. Acad. Sci. U.S.A. 117, 11328–11336 (2020).

[12] J. T. Overpeck and B. Udall, **Climate Change and the aridification of North America**. PNAS, Vol. 117. No. 22. 11856-11858. (2020).

What is drought resilience?

Colorado has experienced long-term warming and drying—often referred to as aridity. Despite this overall trend, droughts and wetter periods still occur. Drought periods can be relatively long (multi-year) or fairly short (occurring in a single year or part of a year). Long-term climate trends toward aridity can amplify drought conditions and cause longer and more intense droughts. Drought resilience means building strategies that reduce the impacts of drought shocks and ongoing climate stresses on communities, economies, and ecosystems, and allow them to rebound more quickly when drought occurs.

The term "drought" is often applied in a variety of ways to describe conditions of water stress. Resilience strategies need to consider the multiple ways in which drought can occur. In addition, droughts can be widespread and have state-level impacts, and they can be more local and be felt disproportionately in a region. Several ways in which "drought" describes water stress are described below:

Periods of low precipitation are described as "meteorological drought." These periods can be long term and last several years or could be short term over a season or year. High temperatures, reduced runoff, and increased evaporation typically occur in meteorological droughts.

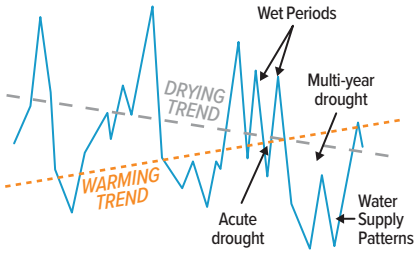
Different types of drought conditions can be caused by meteorological drought:

> **Impacts to water supply,** such as reduced streamflow, low inflows to reservoirs, and declines in groundwater aquifer levels are known as "hydrologic drought." In addition to impacting water supply, hydrologic drought can lead to the loss of wildlife habitat and impact aquatic species.

> **Impacts to agriculture**, such as poor soil moisture and reduced water supplies from surface and groundwater sources lead to "agricultural drought." Plant stress and low crop yields can result from agricultural drought.

> **Impacts to ecology** that push ecosystems toward lasting change from which recovery is difficult is known as "ecological drought." Conditions causing ecological drought can be both natural and human caused.

> **Impacts to our economy** that are driven by other types of droughts can result in shortages of goods such as fruits, vegetables, grains, and meats, or services such as rafting. Weather-related water supply deficits that cause shortages of goods or services is known as "socioeconomic drought."



Even as our hydrology trends toward aridification (extreme dryness that leads to a more permanent dry climate), wetter periods will still occur as well as acute and multi-year droughts

(Climate and hydrology models are generally consistent in projected warming trends, but there is less agreement about precipitation. Warmer air temperatures will evaporate more moisture from soils, which means more precipitation soaking into soils before it can runoff into streams, resulting in less water supply availability. These trends will also vary regionally.)

Colorado's trends

- Had three of the top five driest years on record since 2000
- Experienced a 2° F increase in average air temperature in the last 30 years
- Had generally below average precipitation since 2000
- Drought frequency has increased

Drought impact examples

- Municipal water shortages
- Warmer water temperatures, affecting aquatic life
- Agricultural surface water shortages resulting in reduced irrigation supplies
- Storage depletions
- Increased draw on groundwater aquifers
- Reduced recreation opportunities
- Increased wildfire risk, decreased forest health, and increased algal blooms
- Degradation of water quality through reduced streamflows and dilution of pollutants

Drought response

Because drought can vary in duration, severity, and geographical extent, determining the response can also vary. Local, acute drought may be mitigated with targeted solutions (e.g., reservoir releases or collaborative water sharing agreements), while long-term drought will need drought planning and response measures to mitigate impacts across all sectors.

The CWCB has long supported drought planning through multiple efforts, including grant funding, drought planning support, and the management of various drought planning groups, including the Water Availability Task Force—a group that meets monthly to monitor current conditions. The Water Plan also serves as an educational tool to highlight the importance of drought resilience and the possible solutions that will need to be explored and implemented. Some examples include:

- **Municipal Water Conservation** – outdoor watering restrictions, water use codes and ordinances, strategic pricing, conservation-based water rate structures, turf replacement, and leak detection and repair.
- **Water Reuse** – treating municipal wastewater for reuse, including both non-potable uses, such as irrigation and aquifer recharge, and potable uses allowed by CDPHE's Water Reuse Regulation 11.
- **Public Education and Outreach** – encouraging water conservation through education campaigns to all age groups.
- **Collaborative Water Sharing Agreements** – allowing water to be leased between partners during times of drought while avoiding permanent transfers.
- **Agricultural Water Conservation** – irrigation and delivery system improvements, improved soil health, soil moisture monitoring, drought-resistant crop selection.
- **Multi-Purpose Storage Projects** – maximizing the multi-purpose benefits of new and existing storage projects.
- **Collaboration** – developing trust and partnerships that create agreements and flexibility and timing of operations that can support increased flexibility in water use within the Prior Appropriation System.
- **Land Use Planning** – practices from forest management to embracing One Water planning (see Chapter 6 - Vibrant Communities), land use code changes, and green infrastructure.
- **Strategic Funding** – targeted investments that build drought resilience in cities (municipal drought funding reserves, low-water landscapes), watersheds (forest treatments, stream improvements), and on farms (greenhouses, rotational fallowing, reduced overgrazing).

A few examples are listed above, with more discussion of solutions in Chapter 5. Because drought is complex and reaches across multiple sectors, the implementation of strategies should be done in a multi-pronged and integrated approach to optimize resilience. Coloradans will need to work across each of the four action areas of the Water Plan to identify collaborative drought resilience strategies for cities, farms, streams, and people. The Water Plan describes several new actions in Chapter 6 for supporting drought preparedness and response that encompass education, collaboration, and tool development to support drought planning efforts.

Building resilience means addressing drought at every level and understanding where there are opportunities to collaborate on solutions that can create better outcomes for Colorado – especially where human induced impacts can be lessened. This includes not just surface water issues but also issues related to drought and groundwater (what the United States Geological Survey (USGS) has called a "groundwater drought").

The combined risks of drought length and frequency is expected to increase due to climate change. While the impacts of drought can be reduced when followed by a wet period, projected increases in the frequency and duration of drought will require planning and innovation to mitigate the risk to our water supplies.

COLORADO WATER USE

To plan for the road ahead, it is essential to understand the many ways in which Coloradans use water throughout the state and how these uses are connected. As Colorado grows, associated municipal and industrial demands will likely increase, more people will seek the outdoor opportunities Colorado offers, and Coloradans will continue to increase their consumption of a variety of locally-grown agricultural products. In addition to meeting the needs of communities and food production, water is necessary to support aquatic- and riparian-dependent species, as well as boating, fishing, skiing, and other water-dependent recreational activities.

The total amount of water that originates within Colorado averages 13.5 million acre-feet per year. More than 60 percent of this water is provided to the 19 states and Mexico that depend on Colorado's headwaters. Less than 40 percent, or 5.3 million acre-feet, is consumed on average per year in Colorado.

HOW RETURN FLOWS WORK

WATER IS DIVERTED FOR USE

Municipal Use Supports
- People and communities, large/small
- One acre-foot of water can support two households for a year

A PORTION OF WATER IS "CONSUMED"

Industrial Use Supports
- Local economies and employment

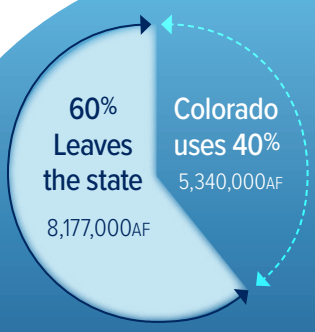
Agricultural Use Supports
- Rural economies
- Food production
- Open space and habitat

Streamflow Supports
- Our unique ecology and landscape
- Recreational activities that bring people to Colorado

UNUSED WATER RETURNS BACK TO RIVER ("RETURN FLOW")

WATER IS DIVERTED FOR ANOTHER USE

RETURN FLOW FROM UPSTREAM WILL SUPPORT DOWNSTREAM WATER USES AND HABITAT.



Reliance on Return Flows:
Colorado often uses water multiple times, and many users depend on return flows for their supply. For example, delayed return flows from irrigation recharge aquifers and increase baseflows, which benefit municipal users and may benefit aquatic habitat in some instances.

Colorado Water Consumption:
- Agricultural – 4,844,000 acre-feet (~90%)
- Municipal – 380,000 acre-feet (~7%)
- Industrial – 116,000 acre-feet (~3%)
- Streamflows support environmental and recreational uses

The Colorado way of life depends on water development and conservation.

People love Colorado for its iconic mountains, comfortable climate, and quality of life. Colorado's terrain and environment varies greatly across the state as do its water resources. Water development is needed to provide a reliable source of supply to support our people and our economy. Water conservation is needed to stretch those supplies and protect the characteristics that people love about Colorado.[13]

Water is foundational to our economy

$47 BILLION

Irrigated agriculture contributes $47 billion to Colorado's economy annually.[14]

$19 BILLION

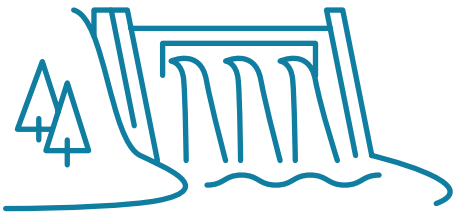
Water-related recreation contributed nearly $19 billion to Colorado's economy in 2019.[15]

$366 BILLION

Colorado's 2021 Gross Domestic Product was estimated at $366 billion.

Water development has made our way of life possible.

- **Infrastructure is complex:** Water infrastructure crisscrosses Colorado with irrigation ditches, reservoirs, pipelines, pumps, and facilities to clean our water.
- **Our infrastructure is aging:** Many agricultural water projects were built over 100 years ago, and our municipal and Tribal water infrastructure is aging as well. Improvements and upgrades are needed.
- **New projects are needed:** Colorado continues to grow, and $20 billion may be needed for municipal supply and conservation projects alone.



Water storage has been and will continue to be a critical tool for managing water supplies. Whether storing water above ground in reservoirs or below ground in aquifers, above- and below-ground storage facilities will need to meet multiple needs and be more flexible and less impactful in the future.

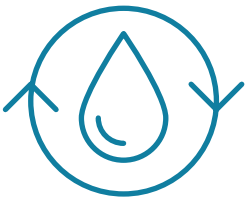
[13] SB 14-115 defines the primary purpose of a state water plan is to determine state policy regarding the optimal conservation and development of Colorado's water resources.

[14] Colorado Department of Agriculture. Colorado Agriculture.

[15] Business for Water Stewardship. The Economic Contributions of Water-related Outdoor Recreation in Colorado. 2020.

Water conservation preserves our way of life.

- **Colorado is saving water:** Colorado has invested in water conservation and efficiency, resulting in a 5% reduction in per capita municipal water use since 2008.
- **Conservation is important but complex:** Water efficiency and conservation in cities and towns saves water but can reduce revenues to water providers. Agricultural water efficiency aims to apply water according to plant demands and can lead to higher consumptive use, thereby reducing excess runoff that contributes to return flows.
- **Conservation is critical to our future:** Conservation will be critical to stretching municipal and agricultural supplies as Colorado grows. Using water wisely helps preserve water for the environment and recreation while maintaining our economy and building resilience for an uncertain future.



The Technical Update to the Colorado Water Plan estimated that water conservation and efficiency measures could reduce our potential future water needs by 300,000 acre-feet per year assuming high population growth and a future climate that is warmer and drier.

What is the right balance of water development and conservation?

It's complicated.

Colorado is a very diverse state in its geography, environment, and available water. The optimal amount of water development and conservation can be in the eye of the beholder and locally specific. In fact, the Technical Update identified that local water users across Colorado hold over 6.5 million acre-feet of conditional storage rights greater than 5,000 acre-feet. Water development and conservation solutions in one part of the state might not fit in another part. Local, collaborative solutions are needed.

Investments are needed in both.

Colorado's projected future growth in the face of an increasingly warm and dry future makes it clear that investments are needed in both water development and conservation. One Water approaches that optimize each potential source of supply will be critical to putting our developed water to its most efficient use. The potential impacts of existing and additional water development on headwater streams and communities as well as downstream water users are being scrutinized more than ever. Collaborative approaches to new water development that balance risk, emphasize conservation, and provide multiple benefits will be essential.

Investments should align with the Water Plan.

The Water Plan describes values and a vision that can guide balanced investments in both development and conservation that meet our needs while lowering water-related risks for all uses of water. The CWCB developed the Water Plan as a framework to help guide investments in development and conservation, and they can provide funding assistance, but water users, or partners, across the state are the ones who ultimately make the investments. These investments will help preserve our Colorado way of life and the economy on which Coloradans depend.

50 PARTNER ACTIONS

While the list of partner actions is limitless, the Water Plan describes approximately 50 ideas for potential actions that could be supported by Water Plan grants.

THESE INCLUDE ACTIONS AROUND

- Increased personal conservation
- Starting a new water initiative/project
- Developing collaborative solutions

50 AGENCY ACTIONS

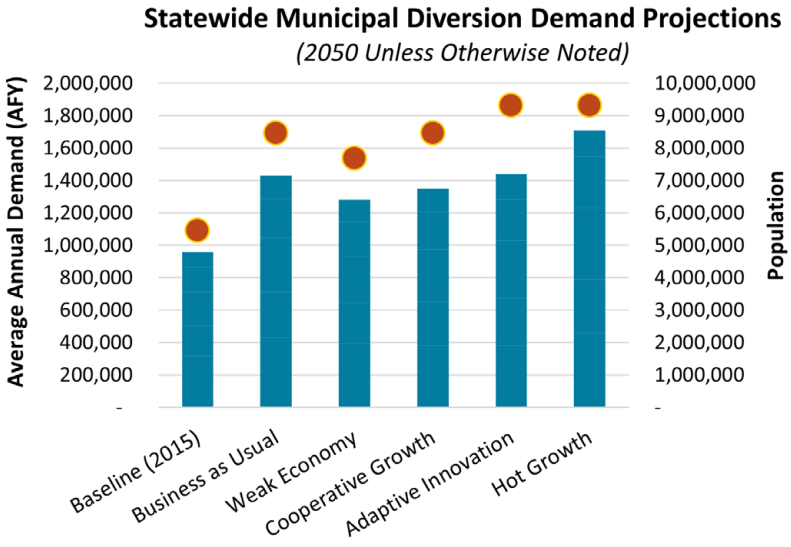
The Water Plan includes 50 actions CWCB and supporting agencies will take to help advance local initiatives that support the wise development and conservation of water resources.

THESE INCLUDE ACTIONS AROUND

- Developing frameworks and convening groups
- Advancing research and science
- Creating support tools

The State refers to water Coloradans need in their homes, yards, businesses, and small industries as "municipal water demand." Municipal water demand includes both water consumed in households and by turf, but also water that is not consumed and returns to streams, such as through wastewater treatment plants. The Technical Update calculates municipal water demand by multiplying the amount of water used per person per day (gallons per capita per day or "gpcd") by population across a range of possible future scenarios where future population and per capita water use may vary. Population estimates were based on SDO projections and adjusted upward or downward (depending on the scenario) based on historical growth statistics.

Industrial demand in Colorado is driven more by economic factors than by population, though industrial uses do tend to increase with population growth.



One acre-foot of water supports two families of four to five people for one year

= Municipal Demand

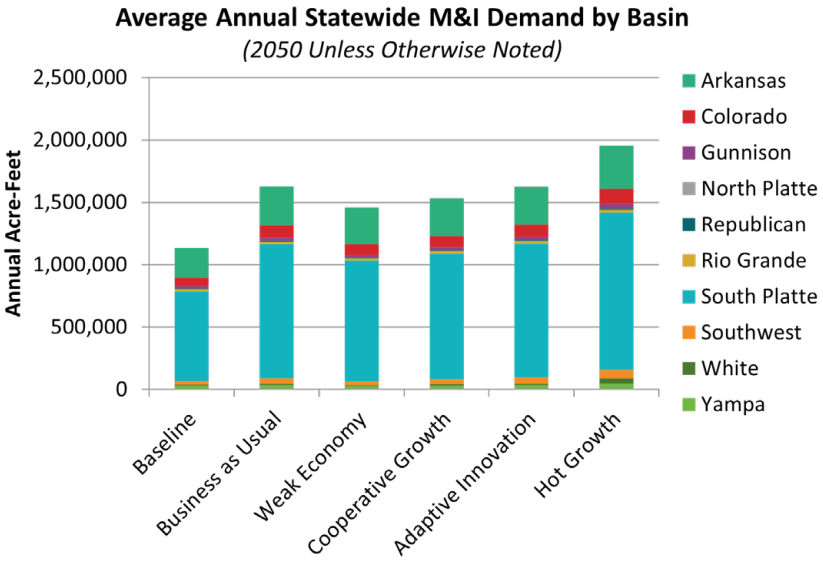
= Population

At the time of the Technical Update, the statewide population was 5.4 million and was estimated to grow to 8.5 million by the year 2050 according to prior SDO projections. To capture the range of population growth described in the planning scenarios, low and high statewide projections developed for the Technical Update range from 7.7 million to 9.3 million. After the Technical Update was completed, newer SDO projections suggest 2050 population will be 7.5 million, similar to the low end of the range in the Technical Update.

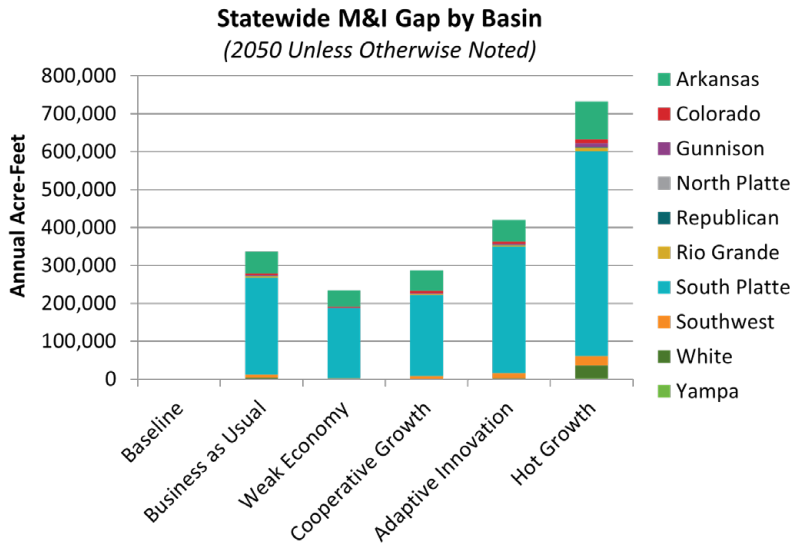
Current SDO estimates project that Colorado will grow to 7.5 million by 2050, which is 18% less than projections in the 2015 Water Plan.

Per capita baseline system demand has decreased from 172 to 164 gpcd, which is a 5% reduction in demands between 2008 and 2015.

The calculated difference between water supplies and water demands for current and future conditions in the municipal and industrial and agriculture sectors is labeled the "gap."



Municipal and industrial users do not currently experience a gap, but increasing population and potentially hotter and drier future climate conditions will increase the risk of gaps and create a need for additional supply.



- A significant source of supply on the Front Range comes from transmountain diversions (over 500,000 acre-feet annually). Reduced supplies from these sources in hotter and drier climate conditions are not reflected in the municipal and industrial gap estimates but would increase risk to those basins.
- Small communities, from headwaters to the plains, are seeing increased growth and may experience more quantity and quality impacts to water supplies due to climate change.
- Statewide municipal and industrial gaps are projected to be from 230,000 acre-feet (in Weak Economy) to 740,000 acre-feet (in Hot Growth) in dry years. These gap estimates do not account for yields from water supply projects and strategies that water providers are pursuing.
- Municipal conservation efforts significantly reduce the risk of future gaps, as demonstrated by comparing Adaptive Innovation and Hot Growth.
- Climate change could alter timing and amount of water available for transmountain diversion projects. If reductions in transmountain imports occur, projected gaps in the receiving basins could increase, potentially to a greater degree than suggested in the Technical Update, because water providers reuse the return flows from transmountain imports.

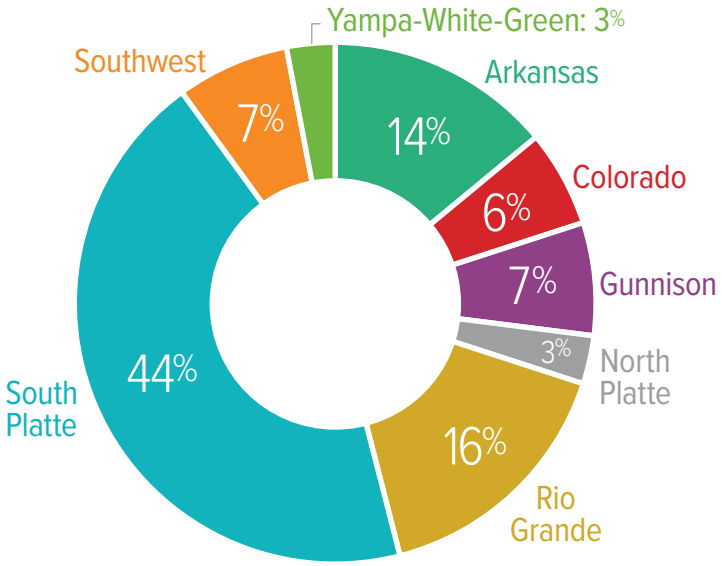
On average, industrial diversion demand is 13% of the total municipal and industrial demand. This includes snowmaking, thermoelectric generation, energy development, and large industrial users.

The Adaptive Innovation scenario assumes a water conservation ethic, which can help offset impacts of climate change and higher population growth.

Currently, 3.28 million acres of agricultural land are irrigated statewide. Irrigated agriculture supports a wide network of agribusiness in Colorado, from producers of agricultural goods to those that process and deliver those goods to consumers. Agricultural production is a large part of the state's economy, with agribusiness contributing $47 billion annually and employing nearly 195,000 people. Working agricultural operations also remain the economic backbone of many of Colorado's rural communities and provide important ecosystem services, such as open space and wildlife habitat.

Irrigated acreage drives agricultural demand. Over a quarter of the irrigated acreage in Colorado is in the South Platte Basin. The Arkansas, Rio Grande, and Republican River Basins also have significant acreage, each with approximately 15 percent of the statewide total. Grass pasture is the state's predominant crop, particularly in the western slope basins. Irrigation supports a wide range of crops grown in Colorado including alfalfa, wheat, cereals/grains, fruits, vegetables, sugar beets, hemp, other oil seed crops like sunflower, and flowers. Much of the irrigated acreage supports ranching operations, either through grass hay production for livestock or irrigated pasture grazing.

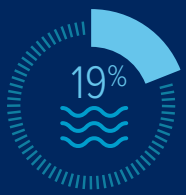
Percentage of Total Irrigated Acres by Basin in Colorado



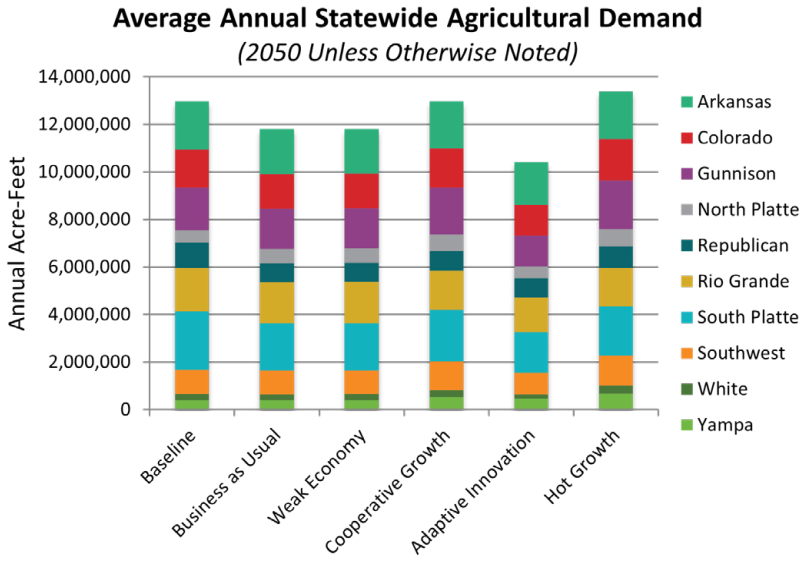
Agriculture diversion demand represents the amount of water that would need to be diverted or pumped to meet the full crop irrigation water requirement. In the Technical Update, future projected agricultural diversion demands were adjusted to reflect:

- Urbanization
- Planned Agricultural Projects
- Groundwater Acreage Sustainability
- Climate

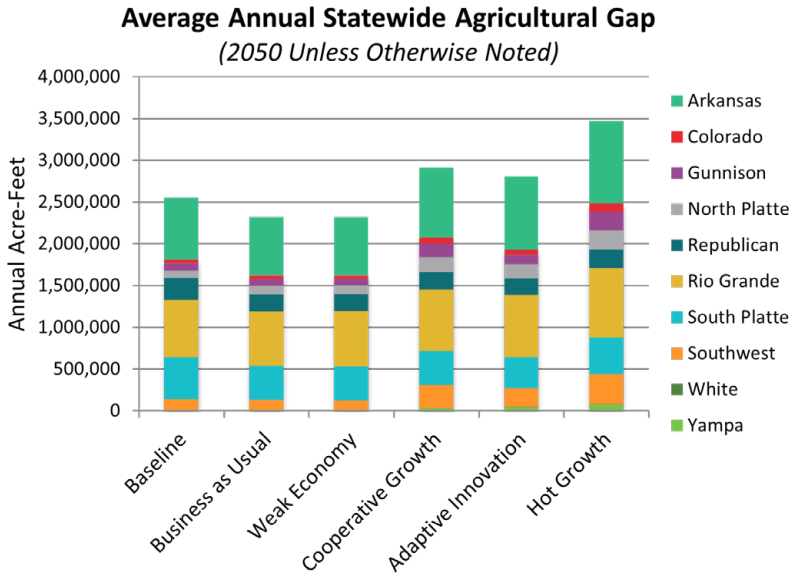
In all basins where significant agriculture is forecasted to come out of production, overall irrigation diversion demands will decline due to the decrease in irrigated acreage even as the plant demand for irrigation on the acreage that remains increases due to higher forecasted temperatures.



Groundwater supplies about 19% of overall agricultural demand and occurs primarily in the Arkansas, South Platte/Republican, and Rio Grande basins where irrigation from wells is prominent.



Future statewide agricultural diversion demand estimates range from 10 million acre-feet per year (AFY) in Adaptive Innovation to 13.5 million AFY in Hot Growth. For basins with significant irrigated acreage reductions, demands in all planning scenarios are projected to be lower than current demand. These reductions are driven by urbanization (South Platte), agricultural-to-municipal water transfers (South Platte and Arkansas), and aquifer sustainability requirements (Republican and Rio Grande).



Colorado's agricultural industry exists today with a gap between demands and the amount of water available, and it is projected to increase statewide. Increases may be substantial under scenarios that assume a hotter and drier future climate due to decreasing supply and increasing crop irrigation requirements.

- Gaps under Adaptive Innovation are significantly less than Hot Growth despite similar assumptions related to future climate conditions, which demonstrates the potential benefits of higher system efficiencies and emerging technologies that could reduce consumptive use; however, in return-flow-driven systems, conservation in one area could impact water supplies downstream, so thoughtful approaches are necessary.
- Basinwide, incremental agricultural demand gaps (or the degree to which future gaps could worsen beyond current conditions) were estimated to occur in planning scenarios that include climate change. Gaps of up to 200,000 AFY could occur in the Arkansas and Southwest basins and up to around 150,000 AFY in the Gunnison, North Platte, Rio Grande, and Yampa-White-Green basins in Hot Growth. On-farm shortages are expected to occur in scenarios with climate change conditions in all basins.

3X

Stakeholders suggest 33,000 to 76,000 irrigated acres may be lost from planned buy and dry transfers, which is three times higher than the 2015 Water Plan estimate. Substantially more could be lost in the future from transfers not yet planned.

20%
UNMET DEMAND

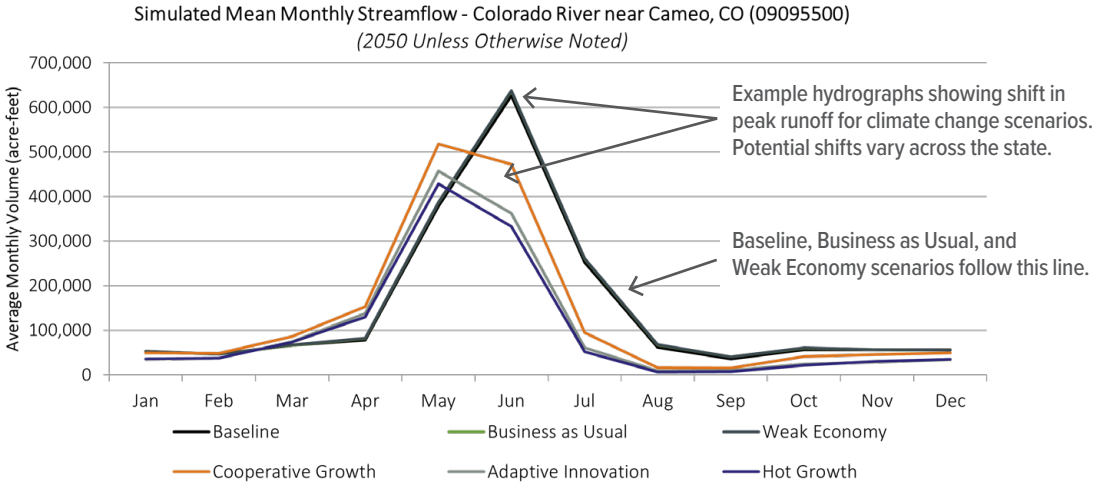
On average, approximately 80% of the overall agricultural diversion demand is currently met – and 20% is unmet – on a statewide basis, though this varies in each basin. This unmet demand contributes to a "baseline gap" for agriculture in each basin.

River flows, floodplain connectivity, aquatic and riparian habitat, ecosystem function, forest condition, water quality, bank stability, stream access, water temperature, and habitat connectivity are all critical factors to consider when determining environmental and river-based recreational needs. Therefore, river-based environmental and recreational needs are often represented by the number of stream-miles or acres of lakes/reservoirs/wetlands that have important attributes and need protection or restoration. Each of Colorado's nine basin roundtables and CWCB have worked to characterize Colorado's environmental and recreational attributes and have supported and identified projects to protect and enhance those attributes where they are at risk. A Flow Tool for evaluating current and future risk to environmental and recreational attributes (see below) was developed to foster identification of projects to lower risk (much like the identification of risks and needed projects to meet municipal and agricultural gaps).

The outdoor recreation industry provides the backbone of a sustainable economy in many communities across Colorado, especially on the West Slope. Investments in water-based recreation have provided economic diversification.

The Environmental Flow Tool

The Environmental Flow Tool was developed during the Technical Update to help assess current and future flow conditions and associated risks to ecological health at selected nodes in each basin. The tool can be used in planning frameworks that are described in the following section.



The Flow Tool compares modeling outputs from the five planning scenarios against baseline flow conditions. Key outputs include a comparison of monthly flow regimes relative to ecological-flow indicators. The Flow Tool serves as a resource to help basin roundtables and other stakeholders identify and prioritize environmental and recreational restoration and enhancement projects and to better understand risks to ecological attributes based on possible future flow conditions under each planning scenario. Modeling flows at selected nodes across the state under the five scenarios resulted in identifying several risks. For more information on the Flow Tool and its limitations, see the Technical Update.

Recreational attributes in the Focus Area Maps include attributes such as coldwater fisheries, boating, and wetlands. It also includes boating data in boating data in its analysis.

Colorado's $19 billion in outdoor recreation comes from fly fishing, rafting, paddle boarding, waterfowl hunting, wildlife watching, camping, and other activities on or near rivers, lakes, and streams.

Colorado's robust ski industry uses snowmaking to supplement snowfall. Water demands for snowmaking appear under the self-supplied industrial data in the Technical Update.

Focus Area Maps and Stream/ Watershed Planning

During the update to the BIPs, CWCB developed a web-based interactive map that included a statewide compilation of nodes from the Flow Tool, Focus Area maps, geographic information on stream management plans (SMP) and integrated water management plans (IWMP), and environmental and recreational attributes. The web-based map can be found at: **Colorado Water Plan Environment and Recreation Focus Area Maps**. The map provides a tool for roundtables and stakeholders to identify where additional planning and environmental and recreational projects are needed. General descriptions of Focus Area maps, SMPs, and IWMPs are below.

Focus Area Maps. Beginning with SWSI 2010, the effort to assess environmental and recreational needs has included extensive inventory, analysis, and synthesized mapping of each basin's environmental and recreational attributes (such as coldwater fisheries, boating, and wetlands). Through this process, each basin created Focus Area maps that identify streams or watersheds where environmental and recreational attributes are located and/or where these attributes may be at risk.

Stream Management Plans. SMPs are voluntary processes used by communities to assess and address watershed health and mitigate future risk. SMPs are data-driven assessments of river health that help communities prioritize how to protect or enhance environmental and recreational attributes in their watershed. A well-developed SMP uses biological, hydrological, geomorphological, and other data to assess the flows, water quality parameters, and other physical conditions that are needed to support environmental and/ or recreational values. SMP efforts can be combined with agricultural or other planning efforts to approach water and planning in a more integrated manner. As of 2021, 26 SMPs have been completed or are in progress in Colorado.[16]

Integrated Water Management Plans. IWMPs widened the SMP concept to include other water uses like municipal use, irrigation, and energy production. IWMPs still focus on water management practices, streamflow, and the variables affected by it but also account for a wider array of needs and a much larger group of stakeholders, including water rights owners and riparian land owners.

Watershed and Forest Health

A majority of Colorado's water supply comes from forested watersheds in the Rocky Mountains. Colorado's forests cover represents about 24 million acres, or a little over a third of the state. These forested watersheds are home to terrestrial and aquatic wildlife. Forests impact water supply by protecting soil and preventing erosion, filtering contaminants, enhancing soil moisture storage and groundwater recharge, and reducing the likelihood of flooding by protecting and maintaining plant communities.[17, 18, 19]

The CWCB assessed the "state of the science" around watershed- and forest-health-related issues that impact water quality and quantity in 2021. Ten takeaways from this assessment informed the Water Plan update.

1. Forest health is a part of watershed health
2. We need to support and learn from working groups
3. The science is evolving and points to a range of outcomes
4. Climate change is forest change… but changes are unclear
5. Planning scenario updates should include forest health
6. We need to support thoughtful decision making
7. Colorado-specific research is key
8. Wildfire, drought, and flood are costly and have lasting impacts
9. Climate change and natural hazards have rising costs
10. Need to keep supporting and funding research and planning[20]

[16] River Network and CWCB. Stream Management Plans. **Colorado Stream Management Plan Resource Library**

[17] Colorado State Forest Service. **Colorado Statewide Forest Resource Assessment: A Foundation for Strategic Discussion and Implementation of Forest Management in Colorado**. 2009. Colorado State University, Fort Collins, CO, 96 pp.

[18] Colorado State Forest Service, 2016b. **Colorado State Forest Service Five-Year Strategic Plan**: 2016-2020. Colorado State University, Fort Collins, CO 12 pp.

[19] Venable, N.B. H., Lockwood, R., DiMaria, J., Duda, J., Rhoades, C., & Mason, L. 2017. **Forest Management to Protect Colorado's Water Resources: A Synthesis to Support House Bill 16-1255**. Colorado State Forest Service, CWCB.

[20] CWCB. 2021. **Forest Health Study: 10 Takeaways to Inform the Colorado Water Plan**.

1 MONTH

Peak runoff may shift as much as one month earlier, which could lead to drier conditions in summer months and impact storage, irrigation, and streamflow.

Earlier runoff may result in mismatches between peak flow timing and aquatic species needs. Drier conditions in late summer could increase risk to fish due to higher water temperatures and impacted habitat.

Ecosystems and recreational opportunities will be more diminished in climate-impacted scenarios.

Summary of Statewide Findings

Findings and Future Risks

Findings from the Technical Update provide some clarity on the potential future risks to water supply in Colorado:

- Per capita baseline system demand has decreased from 172 to 164 gpcd—a 5 percent reduction in demands, mainly due to conservation efforts.
- The Adaptive Innovation scenario (warmer climate offset by new technology and increased conservation) shows a 13 percent decrease in gpcd (from 164 to 143 gpcd) compared to current conditions. This highlights how social values that prioritize water conservation and water-saving technologies could help mitigate impacts from climate change and population growth.
- While per capita usage is expected to decrease in all scenarios but Hot Growth, overall statewide municipal and industrial water demand is projected to increase from 35 percent in Weak Economy to 77 percent in Hot Growth over current demands.
- On average, approximately 80 percent of the overall agricultural diversion demand is currently met (and 20 percent is unmet) on a statewide basis, though this varies in each basin.
- Increasing temperatures and longer growing seasons due to climate change will increase agricultural water demand. However, the overall statewide agricultural water demand is expected to decrease because agricultural lands are projected to come out of production due to urbanization, water transfers, and/or groundwater sustainability.
- Projected future streamflow in most locations across the state show potentially drier conditions in the late summer months under scenarios with climate change, and peak runoff may shift as much as one month earlier, potentially impacting water right yields.
- Under climate change scenarios, earlier snowmelt and runoff may result in possible mismatches between peak flow timing, species' needs, and life history cues. Drier conditions in late summer months could increase risk to fish due to higher water temperatures and reduced habitat, causing stress, crowding, and increased predation.
- Ecosystems and recreational boating opportunities are currently adversely impacted by higher temperatures and periodic low flows and may diminish further in climate-impacted scenarios that see more consistent temperature increases and more variable precipitation and runoff conditions.
- In mountainous regions, risks to environmental and recreational attributes may vary. Streams in the headwaters, especially those that are already depleted by out-of-basin water transfers, may see increased risk to environmental and recreation resources that may be exacerbated by climate change; however, some streams may be sustained by reservoir releases, which can help moderate risk in scenarios with climate change, especially when purposefully managed to mitigate such risks. In addition to reservoir releases, there are additional tools that provide for species recovery, habitat replacement and protection, and re-timing of flows that can help mitigate climate change risks to the environment and recreation.

Challenges

Colorado's water future is faced with several challenges. While the analysis of future demand and supply can change by scenario, several specific challenges are developing due to expected growth and climate change. These challenges include:

- **Providing adequate water supply to meet needs across sectors and geographic areas:** This challenge encompasses the reality that water in Colorado is not available in quantities to meet all needs at all times. Meeting increased municipal water needs must be balanced with maintaining agricultural uses and maintaining streamflows for environment and recreation uses. This challenge also recognizes that water must be managed, conserved, stored, and conveyed to meet local demand, which requires significant investment in infrastructure, operations, and maintenance. Funding at the scale needed to provide the necessary infrastructure can be a secondary challenge.
- **Protecting Colorado's environment to maintain and improve our water resources:** Colorado's watersheds are impacted by the complex interactions of forest, wetland, and headwater stream health, along with human impacts to those systems. Protecting our watersheds helps ensure high-quality water resources are available for all uses. There are several successful models of managing water resources in ways that provide for development and protection of other resources and species.
- **Meeting Colorado's interstate compact obligations while preserving supplies for future demand:** Each of Colorado's major rivers is subject to obligations imposed by interstate decrees or compacts. These compacts and decrees are unique in their application and context but in some cases may have implications for future water management.

The statewide challenges described above are shared and often amplified on a basin scale. They are discussed further in Chapters 4 and 5. Tools and specific actions to address these challenges are discussed in Chapters 5 and 6, respectively.

LEGAL FRAMEWORK FOR WATER

Colorado's water law developed as settlers in the Colorado Territory learned the realities of Colorado's semi-arid climate and snowmelt hydrology, and sought to establish stable communities and economies based on mining and agriculture. As the Colorado Supreme Court said in 2001, "The objective of the water law system is to guarantee security, assure reliability, and cultivate flexibility in the public and private use of this scarce and valuable resource." [21] Our legal framework forms the backdrop and context for how we will address our shared water challenges.

Projects and strategies for securing our water future must be consistent with:

- **The Colorado Doctrine**
- **Colorado's obligations to neighboring states**
- **Applicable federal, state, and local regulations**

Principles of Colorado Water Law

The foundation of Colorado's water law is the "prior appropriation system," which is the framework for establishing one water user's priority over that of another. The framework was needed in the arid western United States to divert and transport water long distances from its source and protect older established water rights from new uses in times of shortage. This was a departure from the riparian water laws common in the eastern United States and Europe.

THE PRIOR APPROPRIATION SYSTEM

The prior appropriation system can be simply described by breaking it down, word by word:

Prior: In times of short supply, those who establish a water right earlier are permitted to divert and use their water before those who establish one later; this is the essence of the "prior appropriation system," often described as "first in time, first in right."

Appropriation: Appropriation is the act of placing available surface water or tributary groundwater to a beneficial use at a specified location and in a specific amount appropriate to the need and use; lacking such specifics, the claim is considered speculative and is not allowed.

System: Colorado has seven water courts across the state, with jurisdiction over all water matters within their assigned drainage basin boundaries. Water rights are property rights, and may be sold, inherited, or used as collateral for a loan. A right's place of use, point of diversion, or type of use may be changed in a process overseen by the water court to ensure that other water rights are not injured.

Prior appropriation allocates water during times of scarcity, is predictable and provides certainty to water users, and establishes the ability for flexibility. The prior appropriation doctrine has proven that it can stand the test of time.

> "WHAT PRIOR APPROPRIATION DOES REALLY WELL IS PROVIDE CERTAINTY... WE KNOW THAT WHEN THERE IS NOT ENOUGH WATER THOSE AT THE FRONT OF THE LINE GET THEIR WATER. THAT CREATES PREDICTABILITY AND CERTAINTY. HISTORICALLY, IT HAS ALSO PROVIDED OPPORTUNITY.
>
> — TOM ROMERO, *DU law professor*

[21] Hobbs, Gregory J., **Reviving the Public Ownership, Anti-Speculation, and Beneficial Use Moorings of Prior Appropriation Water Law**. University of Colorado Law Review, 2012.

The Colorado Doctrine

Colorado formalized the prior appropriation system in the 1860s with a set of principles known as the Colorado Doctrine:

- All surface and groundwater in Colorado are public resources for beneficial use by public agencies and private persons.
- A water right is a right to use a portion of the public's water resources—a "usufructuary" right.
- Water rights owners may build facilities on the lands of others, either by agreement or with just compensation, to divert, extract, or move water from a stream or aquifer to its place of use.
- Water rights owners may use streams and aquifers for the transportation and storage of water.

Beneficial Use

Beneficial use includes both the purpose for which water is diverted and efficiency of use. Diverted water must serve a purpose economically, socially, or hygienically. Recognized beneficial uses are defined by statute and have changed with public values. Historically, beneficial use focused on domestic and agricultural use, but today includes municipal, industrial, wildlife, recreational, and other uses. Beneficial use includes a notion of wise use, without waste.

WHERE TO FIND MORE INFORMATION

Colorado water law is a fascinating and deeply complex topic. Much has been written about its origins, evolution, principles, and application. Below are a few resources that provide more detailed information on Colorado's water law and administrative framework:

- 2015 Colorado Water Plan Section 2.1
- Citizen's Guide to Colorado Water Law - Water Education Colorado
- Synopsis of Colorado Water Law, Division of Colorado Water Resources
- Water Rights | Division of Water Resources

> "I THINK OUR GENERAL ASSEMBLY AND WATER USERS WILL CONTINUE TO DEVELOP DIFFERENT WAYS OF MANAGING AND OPTIMIZING OUR WATER ALL WITHIN THE PRIOR APPROPRIATION SYSTEM.
>
> — KEVIN REIN, *State Engineer, Colorado Division of Water Resources*

ACEQUIAS IN COLORADO

Settlers of the San Luis Valley in southern Colorado brought with them a form of irrigation that was based on principles of equity, shared scarcity, and cooperation. They viewed water as a resource rather than a commodity. These settlers brought the Spanish- and Mexican-influenced tradition of community irrigation ditches known as acequias (pronounced ah-sek-e-ahs), which derives from an Arabic term that translates to "the water bearer."

While acequias may not be unique in their aesthetics and look like a basic irrigation canal, they are unique in their function. Colorado water law is based on seniority, while acequia water allocation is based on equity, need, and seniority. The function of acequias relies on the shared philosophy that "water is so essential to life that it is a communal resource, one which must be shared."[22] Acequias are legally treated as a typical water right within the prior appropriation system in Colorado, but their governance system is distinctive. Participants within an acequia work together to make sure each irrigator's water needs are met. For example, in times of drought, irrigators collaborate to provide equitable distribution of water, and if that is not possible, they share fields. In the past, irrigation fields were planted in narrow strips perpendicular to the ditch systems to ensure that each irrigator would have access to the gravity-fed systems. Acequia governance is run by mayordomos (ditch bosses) and comisionados (commissioners) who are elected via a democratic process to run the water. Each landowner has one vote rather than a voting structure based on the size of land holding.

Acequias are longstanding cultural and legal institutions in Colorado. The oldest water right in Colorado is the 1852 San Luis People's Ditch in the San Luis Valley; however, administration of water rights under Colorado's law of "first in time, first in right" did not officially arrive until 1879.[23] Acequias in the upper Rio Grande basin are fundamental to the historic Hispanic agricultural settlements, especially on the Culebra River in the San Luis Valley. Currently, there are more than 100 acequias recognized in Colorado. Customs of fairness, need, and user-wide participation in ditch maintenance are prominent today in acequias systems.

[22] Acequia Assistance Project – Getches-Wilkinson Center – For Natural Resources, Energy, And the Environment

[23] Hicks, Gregory A., and Devon G. Peña. Sin agua no hay via – Colorado's Acequias – A Water Democracy. Water Education Colorado. Citizen's Guide to Colorado Water Law – Fifth Edition. Justice Hobbs. 2004.

Obligations to Neighboring States

Colorado is a headwaters state, meaning that the major rivers flow to downstream states on both sides of the Continental Divide. Initially, Western states sought to resolve water issues through litigation before the U.S. Supreme Court. Realizing that litigated outcomes were less predictable and potentially unfavorable to Colorado, the state's water leaders turned to negotiated agreements with neighboring states, under the Compacts Clause of the U.S. Constitution.

Colorado's interstate compacts, agreements, and decrees differ from each other, including the obligations defined to downstream states, and are shaped by the hydrology and physical realities across our state. The terms for compacts and agreements were negotiated by the states. For compacts and agreements, terms are whatever the parties decided they would be. For example, some specify the amount of water that must be delivered to the downstream state, others limit the amount that can be diverted or consumptively used, and still others simply assert protection of existing uses. Many compacts establish an administrative body to operate and account as required by the agreement. Decrees are orders from the Court, under which all parties must comply. In Colorado, DWR is generally responsible for ensuring that Colorado meets its interstate compact or decree obligations.

The table below summarizes the various decrees, compacts, and agreements that govern the major interstate streams in Colorado today. The table is not a comprehensive list. Colorado has entered into numerous other interstate agreements and memoranda of understanding (rather than formalized compacts) that describe how waters are to be managed between Colorado and other states.

	COMPACT OR DECREE	PARTIES	DESCRIPTION
EAST SLOPE	**Arkansas River Compact** *1948*	*Colorado, Kansas*	Protected uses in place at time of the compact and allowed for future additional uses in Colorado and Kansas only to the extent that waters of the river are not "materially depleted." It apportioned water of the Arkansas River to the states by way of specifying operations of John Martin Reservoir, rather than by assigning an allowable consumptive amount to each state or requiring a delivery amount from Colorado to Kansas. Established an interstate agency, the Arkansas River Compact Administration, to administer the compact, set operating procedures for John Martin Reservoir, and investigate compact violations.
EAST SLOPE	**Republican River Compact** *1942*	*Colorado, Nebraska, Kansas*	Established an undepleted flow from all the tributaries within the basin and the main Republican River, based on a 10-year study period. Allocated consumptive use out of each tributary basin to the three states. Colorado was granted consumptive use of 54,100 acre-feet, split across the North Fork, Arikaree River, South Fork, and Beaver Creek subbasins. Provided for the allocations to be adjusted if the undepleted flow, at the subbasin level, turned out to be more than 10 percent different from those calculated at the time of the compact.
EAST SLOPE	**South Platte River Compact** *1923*	*Colorado, Nebraska*	Between April 1 and October 15, Colorado must deliver 120 cubic feet per second (cfs) at the Julesburg gage and is obligated to maintain the required flow by curtailing diversions junior to June 14, 1897, within Water District 64. There are no restrictions on Colorado's use of South Platte River flows from October 15 through April 1.
NORTH SLOPE	**Laramie River Decree** *1957*	*Colorado, Wyoming*	This is not a compact but a Supreme Court order, which vacated earlier decrees (1922, 1940) and set forth the following apportionment of Laramie River waters: Colorado may divert 49,375 acre-feet of water from the Laramie River each calendar year, of which no more than 19,875 acre-feet may be for use outside the Laramie River basin, and no more than 1,800 acre-feet diverted for use within the basin may be diverted after July 31. Water used within the State of Colorado is limited to irrigation use as specified in the decree. There is no restriction on the type of use for water delivered outside the basin.
NORTH SLOPE	**North Platte Decree** *2001*	*Colorado, Wyoming, Nebraska*	This is not a compact but a stipulated settlement decree that replaces the original decree entered in 1945, as modified in 1953. The decree provides that Colorado may divert water from the North Platte River and its tributaries to irrigate up to 145,000 acres of lands in Jackson County. It also provides that Colorado may store up to 17,000 acre-feet annually for such irrigation purposes. The decree limits exports out of the basin to 60,000 acre-feet in any 10-year period. The decree does not limit Colorado's use for domestic, municipal, and stock watering consumption, nor does it affect apportionment of the Laramie River Decree.

	COMPACT OR DECREE	PARTIES	DESCRIPTION
WEST SLOPE	**Colorado River Compact** *1922*	*Colorado, New Mexico, Utah, Wyoming, Arizona, California, Nevada*	Established the Upper Basin (Colorado, New Mexico, Utah, and Wyoming) and the Lower Basin (Arizona, California, and Nevada). Each Basin is apportioned in perpetuity the exclusive beneficial consumptive use of 7.5 million acre-feet annually. The Compact requires the Upper Basin States to not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75 million acre-feet in any period of 10 consecutive years. The Compact also sets forth requirements for how the Upper and Lower Basins will meet any obligations to Mexico. The Compact affirmed the states' authority to regulate appropriation, use, and distribution of water within their boundaries. The Compact is regarded as the cornerstone of the "Law of the River," a body of compacts, decrees, and other legal documents concerning allocation, development, exportation, and management of the waters of the Colorado River.
	Upper Colorado River Compact *1948*	*Colorado, New Mexico, Wyoming, Utah*	Allocates the Upper Basin's 7.5 million acre-feet apportionment among the four Upper Basin States based on percentages of available water per year, and 50,000 acre-feet per year to the portion of Arizona that drains above Lees Ferry. The Upper Colorado River Basin Compact also created the Upper Colorado River Commission and, among other powers, authorized the Commission to make findings with respect to the necessity for and the extent of curtailment of use required, if any, pursuant to Article IV of the Upper Basin Compact. It also allocates consumptive uses of interstate tributaries in the Upper Division States (Little Snake River, Henry's Fork River, Yampa River, and the San Juan River and its tributaries).
	Animas-La Plata Project Compact *1969*	*Colorado, New Mexico*	Established that the right to divert and store water from the La Plata and Animas Rivers in either Colorado or New Mexico, for use in New Mexico, shall be of equal priority with rights granted by Colorado state courts for uses of Animas and La Plata River waters within Colorado. New Mexico's use counts toward its allocation of water under the Upper Colorado River Compact. The two states entered this compact to move forward with the Animas-LaPlata Federal Reclamation Project.
	La Plata River Compact *1922*	*Colorado, New Mexico*	Established two administrative gaging points, the La Plata River at Hesperus, Colorado, and the Interstate station, a stateline gage. The Hesperus gage is approximately 30 miles above the Interstate station. Both Colorado and New Mexico have unrestricted use of water from December 1 through February 15. During the rest of the year, if Interstate Station flows fall below 100 cfs, Colorado must deliver to the stateline half the amount of the Hesperus gage flow. For the purpose of the compact, the Hesperus flow is deemed to be the flow in the gage plus the sum of concurrent upstream diversions. Interstate Station flows are deemed to be the flows in the Interstate gage, plus half the concurrent diversions by the Enterprise and Pioneer Canals. These two diversions are in Colorado but serve approximately equal acreage in Colorado and New Mexico.
SOUTH SLOPE	**Rio Grande Compact** *1938*	*Colorado, New Mexico, Texas*	Colorado's delivery obligation at the Lobatos gage near the state line varies each year depending on annual Rio Grande flows at Del Norte, where the river leaves the San Juan Mountains and enters the broad San Luis Valley, and the sum of annual Conejos River flows at the Mogote gage, plus Los Pinos River flows near Ortiz and San Antonio River flows at Ortiz from April to October. The higher the flow, the larger percentage of the flow Colorado must allow to flow past the state line with New Mexico. The Compact sets forth flexible accounting rules such that Colorado can accrue limited debits and credits. It can fall behind the obligation delivery or exceed the obligation delivery. This system of debits and credits is facilitated by the existence of Elephant Butte and Caballo Reservoirs in New Mexico. Because the annual obligation depends on the annual streamflow, the Division Engineer must forecast flows for the year and strive to curtail diversions at a level that will satisfy the Compact delivery without overdelivering.
	Costilla Creek Compact *1944, amended 1963*	*Colorado, New Mexico*	Sets the amount of water to be delivered to users in Colorado and New Mexico based on water availability and lays out how to allocate surplus flows and storage in post-compact reservoirs. Usable capacity in Costilla Reservoir (in New Mexico) is allocated 36.5 percent to Colorado and 63.5 percent to New Mexico.

WHERE TO FIND MORE INFORMATION

- 2015 Colorado Water Plan Section 2.
- **Water Education Colorado Citizen's Guide to Colorado's Interstate Water Compacts, 3rd Edition**
- **Colorado Division of Water Resources: A Summary of Compacts and Litigation Governing Colorado's Use of Interstate Streams**
- **Law & Policy | DNR CWCB**
- **Interstate Compacts | Division of Water Resources**

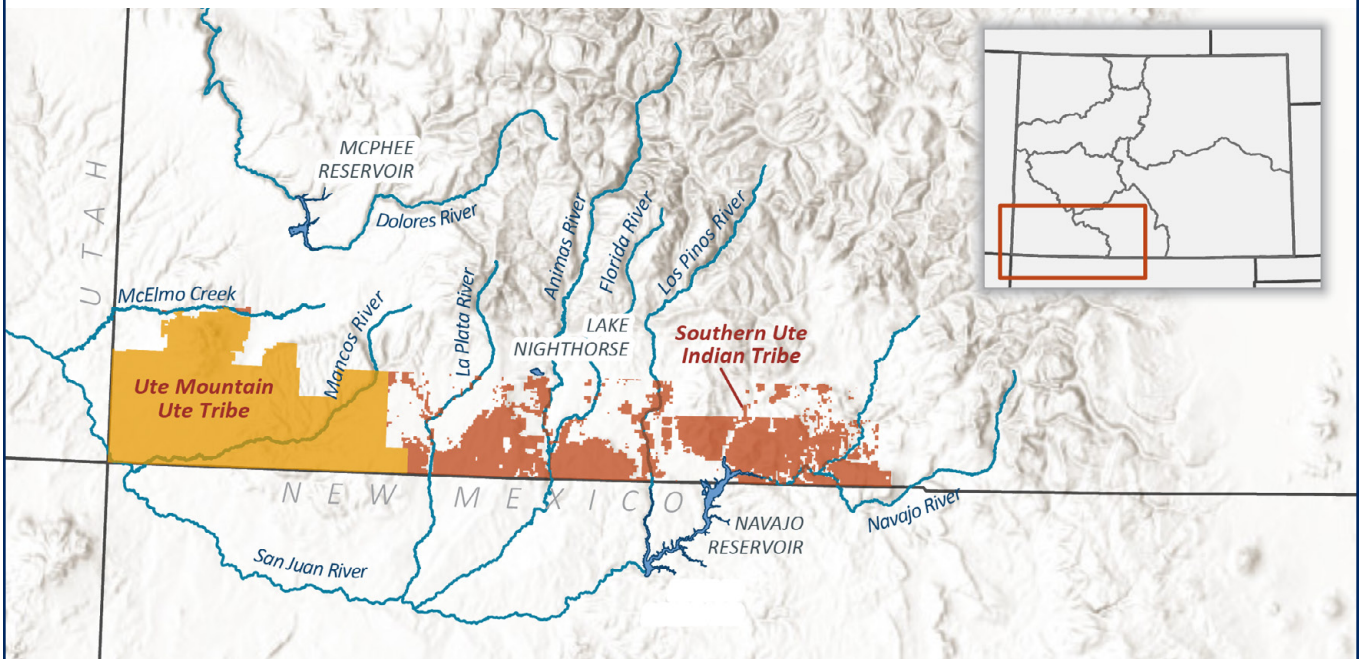
Colorado has two federally recognized Tribes, the Southern Ute Indian Tribe (SUIT) and the Ute Mountain Ute Tribe (UMUT). Tribal reserved water rights of these Tribes were made absolute as part of the Colorado Ute Indian Water Rights Final Settlement Agreement (December 10, 1986) with the entry of the consent decrees in state court on December 31, 1991. The parties to the 1986 Settlement Agreement agreed that the Tribes may change their "reserved water rights from the types of use, places of use, amounts, times of use or location of points of diversion" if the Tribes and the U.S. file an application for a change of water rights in state water court. Further, the parties agreed that the Tribes may sell, exchange, lease, use, or otherwise dispose of any of its water rights within the state, so long as such uses comply with state and federal law, interstate compacts, and international treaties. These unique characteristics of the federal reserved water rights allow the Tribes to "grow into" their water rights without having to define the future use type or location.

In 2018, when the State of Colorado updated projected water demands to support the planning scenarios investigated for the Technical Update,[24] the Bureau of Reclamation (BOR) had nearly completed, but not yet published, the Tribal Water Study (it was published in December 2018). Both SUIT and UMUT participated in the Tribal Water Study and identified their current use of federal reserved water rights as well as their projected full use of federal reserved water rights under various scenarios through 2060. Note that although a similar approach to represent changing climate and values was used to define future scenarios for the Tribal Water Study, they do not directly translate to the five planning scenarios developed for the Colorado Water Plan. Furthermore, the purpose of the Tribal Water Study was to understand how future use of water rights by the 10 participating Colorado River Tribes could potentially impact the entire Colorado River system. The SUIT and UMUT did not estimate demands, location of use, use type, or timing

Water is the giver and sustainer of life. The Creator instilled in the First Peoples the responsibility of protecting the delicate, beautiful balance of Mother Earth for the benefit of all living creatures. Native American people embrace the stewardship of water and lead from a spiritual mandate to ensure that this sacred water will always be protected, available, and sufficient for cleansing, for growing and cooking food, and for sustaining native wildlife and plants.

"Water is life" is the basis of the vision of the Ten Tribes Partnership.

[24] For more information, refer to Volume 2 Section 4 of the Technical Update



of development. As such, even after the Tribal Water Study was published, these non-specific future uses could not be incorporated into water availability analyses or included as projects in the BIP update.

> IT IS GOOD TO REACH OUT TO EACH TRIBE. THEY TOO WILL BECOME PARTNERS FOR THE FUTURE AND FOR HOW WE ARE GOING TO MOVE FORWARD THROUGH THIS DROUGHT. WHETHER IT IS ENVIRONMENTAL, AGRICULTURAL WATER, OR RECREATION OR MUNICIPAL OR INDUSTRIAL. ALL OF THESE AREAS ARE PRIORITIES FOR TRIBES THAT ARE PART OF THE COLORADO RIVER BASIN.
>
> — MANUEL HEART, *Chairman, Ute Mountain Ute Tribe*

The Tribal federal reserved water rights have the potential to play an important role in not only addressing water management issues for the Tribes themselves, but also serving the greater interests of the community of Southwest Colorado. Furthermore, the special nature of Tribal water rights may provide opportunities in the future that other water rights do not allow. Both SUIT and UMUT are members of the Southwest Basin Roundtable and recognize the importance of planning for future water use in the Southwest Basin. To that end, each of the Tribes are pursuing a "Federal Reserved Water Rights Options Study." The purpose of the studies is to explore viable options to develop their unused federal reserved water rights and identify specific near-term uses, including uses from storage in the Animas–La Plata Project. As specific uses are identified, separate projects will spin off for further analyses that explore more detailed economic benefits, infrastructure needs, and marketing opportunities. Based on further analyses, viable projects identified will be included in future updates to the Project Database and may be included in more detail in future water availability analyses.

The SUIT government organization includes a Water Resources Division that provides for the management, conservation, and use of the Tribe's water resources, including strategic planning for the continuing development of water resources to benefit the Tribal membership. The UMUT Tribal Council formed a Water Resources Committee in 2021, with a primary goal of establishing a Water Resources Department that will assist the Tribal Council in managing and developing their water resources. Building the capacity to develop a UMUT Water Resources Department is included in the Project Database.

In addition to the Tribal federal reserved water rights, both Tribes also have "non-reserved" water rights within the Colorado water rights system. The UMUT owns four ranches with non-reserved water rights in the Southwest Basin and the Pinecrest Ranch and associated water rights in the Gunnison Basin. The continued beneficial use, development, and diligence of the water rights on the four ranches will also be explored as part of the UMUT Water Rights Option Study, and specific projects related to the ranches will be included in future Project Database updates.

The SUIT and UMUT are part of the Ten Tribes Partnership, a coalition of Colorado River basin Tribes that have come together to claim their seat at the table and raise their voices in the management of the Colorado River. Water is sacred to the Colorado River Tribes.

Irrigated Lands below the Sleeping Ute Mountain
Photo credit: Eric Whyte - Ute Mountain Ute Tribe Farm & Ranch Enterprise

Recent Developments in Law and Administration

Water law and administration are not static. Colorado's institutional framework includes flexibility to respond to new and unique circumstances through changes in statute or court rulings, or through amending policy, guidelines, and protocols. Here is a sampling of actions since the last Water Plan that have revised or added specificity to the institutional environment in which Colorado operates.

Developments in water law and administration help inform the Water Plan's vision and actions for reducing risk and meeting Colorado's future water needs

Enhancement of Voluntary Loans Process for Instream Flows (HB 20-1157).
Earlier legislation allowed for irrigation water rights to be loaned to other irrigators or to CWCB for instream flow use in 3 out of 10 years, without adversely affecting future historical use claims. This bill expanded terms under which rights may be loaned to CWCB for instream flow use, allowing loans in 5 of 10 years, and over three 10-year periods.

First Increment Extension for the Platte River Recovery Implementation Program.
The Platte River Recovery Implementation Program began in 2007, and it provides Endangered Species Act compliance for water-related projects in the Platte River Basin. An amendment of the Platte River Recovery Implementation Program Cooperative Agreement was signed by BOR and the governors of Colorado, Wyoming, and Nebraska, committing resources to extend the program through 2032.

Republican River Compact Compliance.
The Compact Compliance Pipeline was built by the Republican River Water Conservation District to assist the State in compact compliance by providing augmentation water to downstream states. Supplies from the pipeline, which became operational in 2014, allow wells to continue pumping while maintaining compliance with the compact. Retirement of irrigated acreage in the South Fork Republican River basin is also required; Colorado will retire at least 10,000 acres by 2024 and an additional 15,000 by the end of 2029.

Agricultural Water Protection Water Right.
In 2016, HB 16-1228 created a law that allows the owner of an absolute decreed irrigation water right used for agricultural purposes to change that water right to an "Agricultural Water Protection Water Right." After the change is decreed, the owner may lease, loan, or trade up to 50 percent of the historical consumptive use to another water user for a new use. The State Engineer must approve that new use. This law applies only in the South Platte and Arkansas Basins. The State Engineer, in consultation with CWCB and stakeholders, developed rules and the Statement of Basis and Purpose for the rules.

Over-appropriation declaration for the Yampa River above Little Snake.
In January of 2022, DWR declared portions of the Yampa River mainstem above the Little Snake River as "over-appropriated." An over-appropriated stream system is one in which at some point of the year the water supplies of a stream system are insufficient to satisfy all the decreed water rights within that system. The designation serves as notice that water may not be available at times to junior surface water rights and that well permits may not be issued without augmentation plans to replace out-of-priority depletions to the river.

Anti-speculation workgroup.
A workgroup was formed by the DNR pursuant to SB 20-048 to explore strengthening water anti-speculation law. Completed in August 2021, the workgroup's report identified eight concepts that could be effective in reducing speculation on a large scale. However, each concept had drawbacks, such that the group did not recommend any.

Rio Grande River Compact Litigation – Texas v. New Mexico and Colorado.
Texas claims that New Mexico violated the Rio Grande River Compact by allowing downstream New Mexico users to siphon off water below Elephant Butte Reservoir and reduce streamflow available to Texas. In 2018, the U.S. Supreme Court allowed the suit to proceed. Texas named Colorado as a party because it is a signatory to the Compact.

Colorado River Issues and Developments.
Historic drought and depletions that exceed supplies in the Colorado River Basin have driven a wide variety of efforts to manage water supplies and plan for an uncertain future. The Colorado River Issues and Development schematic on the following page describes these efforts and notes how the efforts do and do not relate to one another.

Rio Grande Basin Groundwater Rules and Regulations.
The Groundwater Rules and Regulations in the Rio Grande Basin were decreed in 2015 (15CW3024). The rules require well owners to mitigate injury to streams caused by well pumping and take action to bring aquifers to sustainable levels.

Formation of Subdistricts in the Rio Grande Basin.
Water users in the Rio Grande basin have formed water management subdistricts; there are now seven subdistricts operating in the basin. The subdistricts are a community solution comprised of groups of well owners working to replace injurious stream depletions and improve aquifer conditions in compliance with the Groundwater Rules and Regulations in the Rio Grande Basin.

Stormwater Detention and Water Rights.
In 2015, SB 15-212 determined that water detention facilities designed to mitigate the adverse effects of stormwater runoff do not materially injure water rights. Additionally, SB 22-114 included fire suppression ponds in this protection.

Drought Contingency Planning

In 2019, the seven Colorado River Basin states completed and signed drought contingency plans (DCP) for the Upper and Lower Basins. The DCP is designed to help stabilize the Colorado River system and to reduce the risk of Colorado River reservoirs declining to critically low levels. **The DCP will expire at the end of 2025.**

UPPER BASIN DCP

Upper Basin DCP measures include:

- **Drought Response Operations Agreement (DROA):** Purpose is to protect critical target elevations at Lake Powell. The DROA contemplates potential operational adjustments to the timing and volume of water released from Glen Canyon Dam. It also contemplates releases from Flaming Gorge, Aspinall Unit, and Navajo Reservoirs. The DROA further provides for recovery of any released storage water in subsequent years.
- **Demand Management Storage Agreement:** Authorizes the Upper Division States to store up to 500,000 acre-feet of additional water in Colorado River Storage Project reservoirs that can only be released for the purpose of assisting the Upper Division States in maintaining compliance with the Colorado River Compact. Such water would be created through an Upper Basin Demand Management Program, which would involve temporary, voluntary, compensated reductions in consumptive use in the Upper Basin. All Upper Division States must agree such a program would be feasible to establish a program before one may be set up. All Upper Division States, including Colorado, are currently conducting feasibility investigations.
- **Weather Modification:** Continued use of cloud seeding across Utah, Colorado, and Wyoming to augment snowpack.

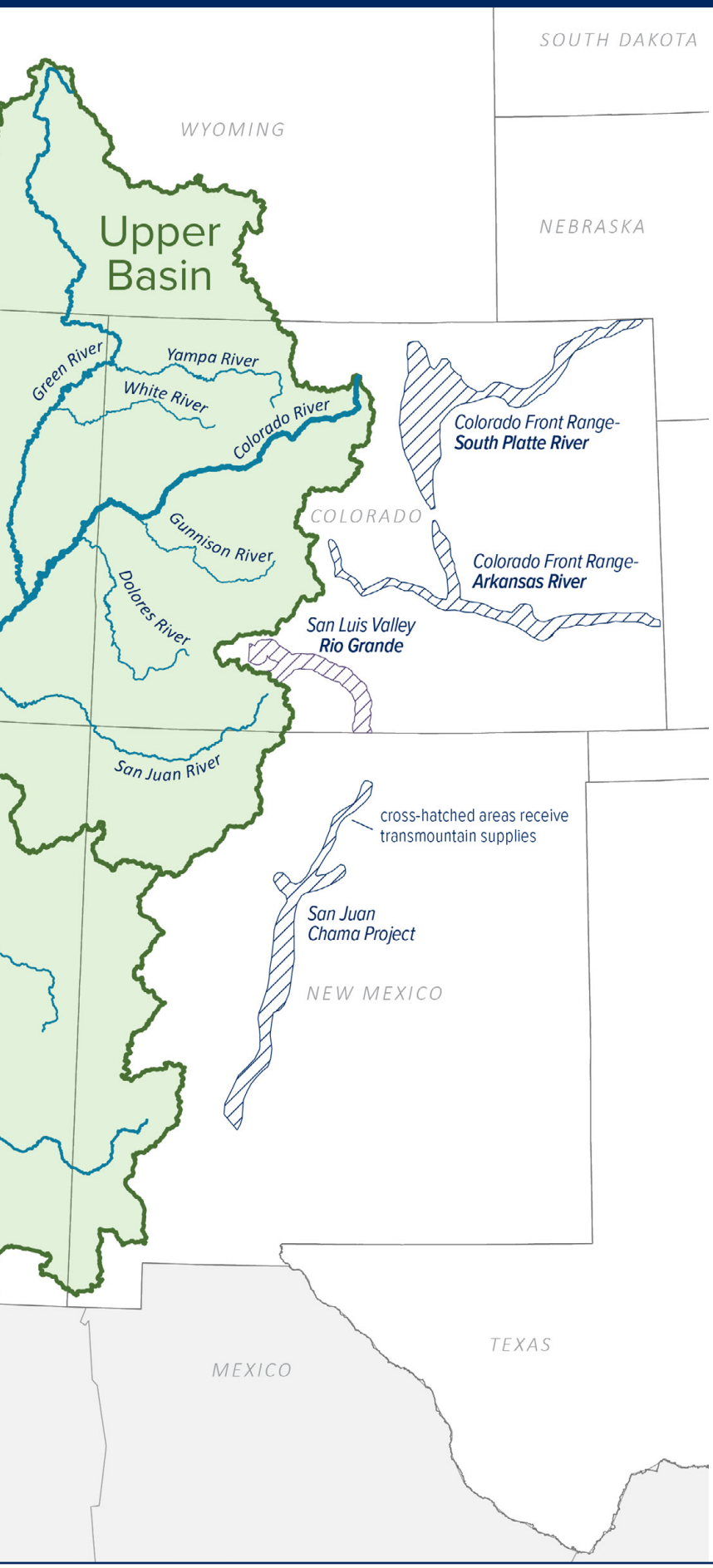
LOWER BASIN DCP

Lower Basin DCP measures include:

- Tiered reductions to water deliveries to Lower Basin States and Mexico based on predetermined Lake Mead elevations.
- Incentives and provision of storage for additional conservation of Colorado River water supplies.

Lower Basin shortages were declared by BOR for the first time starting in 2022.

Link for more information:
Colorado River Basin | DNR CWCB



Measurement Rules

A measurement rulemaking process is underway

The DWR initiated the rulemaking process in the Yampa, Green, White, and North Platte basins (and will likely expand to other western slope basins) to provide guidance on installing measurement devices. Measurement devices are currently required by state law, and the administrative rules resulting from this public process will establish standards for accurate measurement and reporting of diverted or stored water.

Transmountain Diversions

Also known as transbasin diversions, these projects divert water across watershed boundaries. In Colorado, 27 diversions transport approximately 580,000 acre-feet of water annually from one of the state's four major river basins to another. Historically these diversions have helped Colorado make the most of its Colorado River allocation by moving it around the state and putting available water to beneficial use. However, these projects have not been without basin-of-origin impacts, which continue to be considered today.[25]

Post-2026 Reservoir Operations

In response to several years of prolonged drought in the Colorado River Basin and depleted storage levels in Lake Powell and Lake Mead, the 2007 Guidelines were developed to coordinate operations of the two reservoirs and define shortage criteria for the Lower Division States. These guidelines will expire at the end of 2025 and efforts are underway to determine what will come next for post-2026 operations at Lake Powell and Lake Mead. Colorado is represented by the governor appointee to the Upper Colorado River Commission in these interstate discussions.

[25] Coleman, Caitlin. Citizen's Guide to Colorado's Transbasin Diversions. Water Education Colorado. 2014.

ADDITIONAL DEVELOPMENTS THAT INFORM THE WATER PLAN

Since the 2015 Water Plan, a wide variety of legislation, funding programs, and work groups were initiated that were either a result of the 2015 Water Plan or that inform the vision and actions that are included in the Water Plan update (see Chapter 6). This timeline depicts these items and events. CWCB led or contributed to nearly all of the items on the timeline, and it illustrates CWCB's continual engagement with partnering agencies and stakeholder groups in efforts to implement the Water Plan.

2015

Advancing Direct Potable Reuse (DPR)

DPR featured prominently in the first Water Plan and several CWCB funded projects have centered on it since 2015.

Colorado Water Loss Initiative

This program is part of a strategic objective from the Colorado Water Plan: to support water management activities for all water providers.

Priority Environmental and Recreational Rivers and Watersheds

The priority rivers and watersheds, or "Focus Area maps," were developed by each basin to serve as a snapshot of baseline conditions.

Stream Management Plans and Integrated Water Management Plans

SMPs and IWMPs encourage effective project implementation and on-the-ground actions.

2016

Passage of HB 16-1005

The "rain barrel bill," passed in 2016, allowed single-family residences to install two rain barrels up to 110 gallons total.

Implementation of SB 14-103

Requires that only low-flow EPA WaterSense approved indoor fixtures can be sold.

2017

Colorado Growing Water Smart

A joint program of the Sonoran Institute and Lincoln Institute of Land Policy brought Growing Water Smart workshops to Colorado.

Formation of the Water and Land Use Planning Alliance

CWCB and the Colorado Department of Local Affairs (DOLA) formed the Alliance in December 2017. The group emerged from another project, the Colorado Water and Growth Dialogue, with the core group of people forming the Alliance.

Water Plan Grants

In 2017, Colorado's General Assembly first made funds available for CWCB to help implement the Water Plan through its grant programs.

Inter-agency Lean Permitting Handbook

The Colorado Water Supply Planning and Permitting handbook was developed in 2017 to foster more efficient water project permitting.

2018

Regulation 84 Expansion

Eighteen additional uses for recycled water were approved, including irrigation uses for edible crops and industrial hemp.

Ten Tribes Water Study

The Ten Tribes Partnership Tribal Water Study was released.

Implementation Working Group

The CWCB initiated BIP updates by launching an Implementation Working Group to develop guidance.

Ongoing

State Financial Assistance

Various forms of financial assistance are available to support multi-benefit irrigation infrastructure and water conservation projects.

Population Growth/Declining Use

Colorado's population continues to grow, but per capita use has declined due to municipal water conservation efforts.

2019

Proposition DD

Colorado voters approved Proposition DD, taxing legal sports betting to support projects that align with the Water Plan.

Passage of HB 19-1231

This bill added requirements for energy and water efficiency for fixtures and appliances sold in Colorado.

Technical Update Released

The Technical Update included updated analyses and tools that support the Water Plan.

2020

Passage of HB 20-1095

This bill requires local jurisdictions to incorporate water efficiency into their comprehensive plan if their plan contains a water element.

Adoption of Updated Colorado Resiliency Framework

DOLA updated the Colorado Resiliency Framework in 2020, which includes partnerships with CWCB.

Expansion of Colorado Department of Agriculture Programming

The 2020 legislative session provided several beneficial programs for the Colorado Department of Agriculture.

ATM Status Update

A report called Alternative Transfer Methods (ATM) in Colorado, Status Update was released in July 2020.

Fluvial Hazard Zone Program

This technical tool helps communities identify, map, and plan for natural hazards such as erosions, sediment deposition, and other dynamic river processes.

Natural Working Lands Task Force

The state's Natural Working Lands Task Force was formed.

2021

Forest Health "*State of the Science*"

The Forest Health Study is an assessment of the state of the science around watershed and forest-health-related issues that impact water quality and water quantity.

Water Equity Task Force

The task force was formed in 2021 to craft guiding principles around EDI for the Water Plan update.

Agricultural Stimulus

The General Assembly approved $76 million of stimulus to support agricultural industries in Colorado.

2022

Passage of SB 22-028

Provides $60 million to incentivize the purchase and retirement of irrigated acreage in the Republican and Rio Grande Basins.

Passage of HB 22-1151

Provides $2 million to CWCB to allocate to eligible entities for specific water-wise landscaping and turf replacement programs.

Passage of HB 22-1379

Provides $15 million for projects that reduce wildfire risk and improve watershed health and $5 million to cover costs of applying for federal money.

Passage of HB 22-1316

Provides $8.2 million for Water Plan implementation, $7.6 of which is from sports betting.

Passage of SB 22-158

Provides $6 million for conservation programs designed to protect threatened or endangered native species.

Basin Implementation Plans

Eight BIPs developed by basin roundtables and the online Project Database was released.

New Direct Potable Reuse Regulations Adopted

Water Quality Control Commission added new DPR rules to Colorado Primary Drinking Water Regulation 11.

CWCB'S Water Leadership

The State of Colorado's Executive, Legislative, and Judicial Branches all play pivotal roles in supporting Colorado's water future. The CWCB, as part of the Executive Branch under DNR, maintains and implements the Colorado Water Plan. Through several funding mechanisms, including Colorado Water Plan grants, CWCB is able to support many of the projects Colorado needs to fulfill the vision of the Water Plan.

Water management in Colorado is complex and includes many stakeholders, including regulatory agencies, quasi-governmental organizations, water providers, ditch companies, constitutionally mandated boards, and nongovernmental organizations, which play significant roles in water-related initiatives and projects. Similarly, joint partnerships with universities, regional entities, commissions, Tribes, and federal partners all support many water-related issues in Colorado. Many of these groups work with CWCB to coordinate the management of water in the state. CWCB's role in convening and collaborating across groups allows it to play a lead role in state water policy.

CWCB's Policy and Programmatic Leadership

As the primary state agency charged with maintaining and implementing the Colorado Water Plan, all of CWCB's programs and activities reflect this important goal. Its mission is to conserve, develop, protect, and manage Colorado's water for present and future generations.

CWCB Funding, Grants and Loans

Funding local water projects is one of CWCB's most important functions. The CWCB's fund portfolio includes the Construction Fund, Severance Tax Perpetual Base Fund, and the Water Plan Implementation Cash Fund. Revenue for these funds comes from a combination of revolving loan fund principal and interest, State treasury interest, Federal Mineral Lease revenue, severance tax revenue, and sports betting taxes. These sources of revenue allow CWCB, with legislative and board direction, to fund low-interest loans and grants for projects that advance and implement aspects of the Colorado Water Plan. The CWCB also receives revenue from other sources, including interest from loans it provides, which is the primary source of funding for CWCB to manage its programs, staff, and grants.

The primary CWCB grant programs are Water Supply Reserve Fund grants, which are administered through the basin roundtables; Public Education Participation and Outreach (PEPO) grants, which support a dedicated liaison for each roundtable to support education and outreach efforts; and Colorado Water Plan grants. A full list of CWCB grant and loan program information can be found on **CWCB's funding web page,** and an overview of the types of funded projects are listed here:

EXAMPLE CWCB GRANT PROJECT TYPES*	EXAMPLE CWCB LOAN PROJECT TYPES
New water storage, raw water supply, planning, water conservation, and agricultural projects; collaborative water sharing agreements; watershed and recreation projects; water education and innovation.	New or rehabilitation of aging and existing raw water storage and delivery facilities.

** Many of the grant categories and the types of projects they can fund are defined by legislation.*

The Colorado Water Plan Grant Program was developed to make progress on implementing the objectives of the 2015 Water Plan. This and other grant programs are a way that CWCB works with partners and stakeholders across the state to implement projects that advance the Water Plan. From 2021 to 2022, CWCB streamlined and consolidated many of its grant programs into Colorado Water Plan grants. The legislature described the types of projects to be funded with Colorado Water Plan grants as:

- **Water storage and supply:** Includes development of additional storage, artificial recharge into aquifers, and dredging existing reservoirs to restore the reservoirs' full decreed storage capacity for multi-beneficial projects, collaborative water sharing agreements, and projects identified in BIPs to address the water supply and demand gap.
- **Conservation and land use planning:** Includes long-term strategies for conservation, land use, water efficiency, reuse, and drought planning.
- **Engagement and innovation:** Includes water education, outreach, and innovation efforts.
- **Agricultural projects:** Includes technical assistance or project/program funding for agricultural projects.
- **Watershed health and recreation projects:** Includes projects that promote watershed and environmental health and recreation.

Chapter 6 provides numerous examples of projects that partners and stakeholders can pursue within the categories listed above that align with and implement the vision of the Colorado Water Plan.

Other Funding Sources

SOURCES THAT SUPPORT CWCB

The CWCB receives revenue from sources other than those described previously to manage its programs, staff, and grants. Sources range from fund-dependent federal support for flood-related initiatives to one-time legislative appropriations from taxes to periodic stimulus funding to funding appropriated through state ballot measures. Examples include:

- **Special Legislative Appropriations:** In any year the legislature may appropriate funds outside of the annual Projects Bill. These are often provided to fund special programs or projects.
- **State Stimulus Funding:** One-time General Fund investments when monies are available and allocated through the legislature.
- **State Ballot Measures:** State ballot measures that go to the voters can provide additional funding to agencies. For example, in 2019, Proposition DD legalized sports betting and generated tax revenue to support water projects.

Funding From Other State Agencies

Colorado's approximately 200 state agencies provide many additional grant and loan programs that cover a wide range of needs. While CWCB primarily focuses on raw water, other groups like CDPHE can fund drinking water improvements. Many groups do not focus on water but can support water in indirect ways (e.g., Colorado State Forest Service, Colorado Outdoor Recreation Industry Office).

SOURCES OUTSIDE OF CWCB

Many potential funding sources outside of CWCB are available for water projects depending on the project type. For example, many aspects of drinking water, water treatment, or stormwater projects are often not eligible for CWCB funding and are better suited for other programs, including those supported by CDPHE, Colorado Water Resources and Power Development Authority, Department of Local Affairs, National Rural Water Association, Rural Community Assistance Corporation, U.S. Department of Agriculture - Rural Development, and CoBank, among others. Each agency and organization is set up differently and are funded in a variety of ways that sometimes include tax-generated revenues, severance taxes, federal dollars, or other mechanisms.

OTHER FUNDING INITIATIVES

Local, state, and federal funding initiatives can help meet the needs of water users and stakeholders. **Many times, these additional funding sources can be leveraged for match funds or could otherwise augment money CWCB can provide.** These include things like:

- **Local Ballot Measures** – Since 1998, local water districts and counties have approved several ballot measures to fund conservation, water education, stream health, storage, and agriculture.
- **State Stimulus** – One-time General Fund investments when monies are available and allocated through the legislature.

- **Federal Stimulus** – These include bills such as:
  - *American Rescue Plan Act (ARPA).*
  - *Infrastructure Investment and Jobs Act (IIJA) or Bipartisan Infrastructure Law (BIL)* – that includes direct funding for drinking water and wastewater through revolving funds; and funding for water supply, conservation, and restoration through existing federal programs administered by the U.S. Bureau of Reclamation.
  - *Inflation Reduction Act* - providing direct federal spending, tax adjustments, and grants to state agencies, local governments, and other entities.

OTHER FUNDING TOOLS

- **Revenue Bonds** – Frequently issued by water providers to raise funds for capital projects.
- **Environmental Impact Bonds** – A revenue bond that shifts risk to private investors that can be effective in maximizing water supply benefits of water efficiency and conservation incentives.
- **State Revolving Fund Loans** – Colorado's Water Pollution Control Revolving Fund and the Drinking Water Revolving Fund offer low-cost loans to public water providers for water supply and water pollution control infrastructure projects.

All grant, loan, staffing and other funds that are legislatively approved for CWCB are subject to approval at different levels from the CWCB Board, the CWCB Director, or the Director of the Department of Natural Resources.

COLORADO **WATER FUNDING NEEDS**

Background: In the 2015 Water Plan, a summary of basin water project costs estimated over $2 billion in need. However, the summary data was incomplete (noted as "forthcoming" with more information to be provided in future BIP updates). In the same section of the 2015 Water Plan a larger $20 billion estimate was cited to more broadly capture project costs that could: a) meet the municipal and industrial gap: b) maintain water delivery infrastructure; c) explore alternatives to buy and dry; d) support active water conservation; and e) address environment and recreational needs. Further, in 2015 a potential $3 billion ($100 million per year) of additional funding needs by 2050 was estimated to help CWCB leverage funds in ways that could meet the full $20 billion.

2022 BIP Update Information: The estimated costs of known water projects identified during the BIP update in the CWCB Project Database totaled over $20 billion, which is similar to the 2015 Water Plan. The database provides a range of projected near-term and long-term project needs (see Chapter 4 for more detail). The costs associated with projects identified in the BIPs will likely have various funding mechanisms. A portion of these costs will be covered by CWCB through their grants and loan programs, while many projects will be funded through user fees, private investment, federal partners, or other agencies. It is important to note that some projects identified in the BIPs are conceptual and may not move forward to implementation. The number and scale of projects needed to lower Colorado's water risk will vary depending on future conditions and may shift from sector to sector. Given match requirements, CWCB's anticipated cost-sharing through grants and loans will also vary depending on whether a project is a planning or construction effort.

Anticipated CWCB Funding Needs: Given all these factors, it is anticipated that CWCB's grant and loan programs will be asked to fund between $1.6 and $6.1 billion, or an average of $3.85 billion over the next 30 years. Of this $3.85 billion, CWCB's existing funding sources could cover approximately $2.35 billion (which includes projections of additional Water Plan grant funds from Proposition DD), assuming those funding sources are sustained at their expected levels. **This leaves an expected Water Plan funding gap of $1.5 billion, approximately $50 million per year through 2050, that CWCB would need to meet the identified project demands.**

While the $1.5 billion in needed funding represents CWCB's funding gap there are other state needs associated with funding water projects (e.g., water treatment) and water adjacent projects (e.g., forestry). For example, CDPHE, DOLA and the Colorado Water Resources and Power Development Authority have cited a $14 billion need in their combined 2022 Drinking Water Revolving Fund Intended Use Plan, and Colorado Division of Forestry has cited a $4.2 billion need to treat just the top 10 percent of Colorado's most critical forests. That alone would require $18.2 billion in additional needs on top of CWCB's $1.5 billion (totaling $19.7 billion). When factoring in other agencies like DWR and Colorado Parks and Wildlife (CPW), there is a clear need for state funding of at least $20 billion.

The state-estimated funding gap is conservative and represents a responsible path forward for achievable funding that can help advance state and local water projects. There is almost certainly a greater need that is larger than the amounts identified in the Project Database due to a variety of factors, including additional projects not identified by stakeholders, inflation, and increasing cost of construction. For project proponents there is likely an equal need for full funding or matching funds. However, some of this need will be met through rates, assessments, and other fees.

The statute that guides CWCB as it pertains to adopting and updating the State Water Plan also created the Water Plan Implementation Grant Program (37-60-106.3 (6), C.R.S.). This legislation articulates a set of criteria the CWCB Board shall evaluate for each eligible project grant application. The criteria are also reflected in **CWCB's Colorado Water Plan grant** criteria and guidelines, including considering alignment with: a) applicable BIPs; b) the anticipated start date; c) gives preference to projects that have multiple benefits, multiple purposes, and involve multiple stakeholders; and d) references additional criteria for state support from the 2015 Water Plan, which are described below.

Since 2015, the State has also created **The Colorado Water Supply and Permitting Handbook** (handbook). The handbook should be considered as the starting point for project proponents that need to know what permitting is required. The handbook includes a discussion of an array of permitting, licensing, review, certification, and mitigation plans. Collectively, the Water Plan grant criteria, the criteria for state support, and the handbook stand as the guiding documents for ensuring projects conform with the intent of the Water Plan, legislation, and any required permitting.

For a project to be eligible for State of Colorado support, any required permitting or similar approval must be secured or appropriately contemplated in a project grant application or other request for support. Certain water project proponents are expected to engage in developing state fish and wildlife mitigation plans, when required by statute. However, not all projects will require permitting. Those that do should invest in pre-permitting work (e.g., initial studies, stakeholder involvement, engaging state agencies) to ensure the success of the project.

PRE-PERMITTING WORK (INITIAL STUDIES AND STAKEHOLDER INVOLVEMENT)

If a project proponent is seeking state technical or financial support for initial planning, baseline environmental studies, alternatives analysis, feasibility studies, or initial stakeholder involvement, priority will be given to projects that meet the goals of the BIPs, have an identified project proponent, meet an identified need, and have a defined start time (e.g., can be built within the next 15 years).

STATE SUPPORT FOR PROJECTS ALIGNED WITH COLORADO'S WATER VALUES

A project proponent can voluntarily qualify for state support in the form of state engagement, facilitation, or funding (e.g., grants, loans, special funding)* by ensuring the project aligns with Colorado's water values (see Chapter 1) and the overall Water Plan. The State adopts the criteria from the 2015 Water Plan by reference, as found in the linked document below, as the criteria for determining alignment with the Water Plan. The criteria are summarized as follows:

- The project proponent demonstrates a commitment to collaboration that includes multiple participants and project impacts that have the ability to provide multiple benefits, and multipurpose project development.
- The project proponent addresses an identified water gap, risk, or need identified in the Water Plan, Technical Update, and/or a BIP.
- The project proponent demonstrates sustainability as it pertains to environmental and recreational interests, water conservation, water quality, economic and social impacts, maximizing beneficial use, partnerships with local government, and conforms with water law.
- The project proponent establishes the fiscal and technical feasibility of the project including the total cost and local investment or contribution.

Link for more information about advancements on efficient permitting and state support for projects **found here.**

**Projects supported by state funding do not always imply the project is endorsed by the State.*

CWCB Organization

The CWCB has 15 directors. Ten voting directors are appointed by the Governor and serve three-year terms. Eight of the voting directors represent the state's major water basins: South Platte, North Platte, Arkansas, Rio Grande, Gunnison/Uncompahgre, Colorado Mainstem, Yampa-White-Green, and the Southwest. The ninth voting director represents the Metro Denver region, and the tenth Ex-Officio voting director is the Executive Director of the DNR. There are five Ex-Officio non-voting directors: the directors of CWCB, DWR, CPW, and Colorado Department of Agriculture, and the Colorado Attorney General. Key CWCB director functions are to direct and approve CWCB grants and loans and weigh in on critical policy issues.

The CWCB has six sections with approximately 50 staff members who work to advance the Water Plan in each of their respective areas as summarized below. Details on the sections and their ranges of work are on CWCB's website: **cwcb.colorado.gov**.

Beginning in 2023 the Water Plan Grant Program was awarded funds to support four regional project managers that would live and work in each of the following regions: South and North Platte basins, the Arkansas Basin, the Southwest and Rio Grande, and the Colorado, Gunnison, and Yampa-White-Green basins. These regional coordinators will provide local capacity-building through coordination and planning with stakeholders for project identification, grant writing, and evaluating grant applications.

Finance - Manages the Construction Fund and the Severance Tax Perpetual Base Fund.

- These two funds provide money for loans, grants, and CWCB operations.
- Staff review applications and feasibility studies and make recommendations to the Board.
- After approval by the Board, staff process loan/grant contracts, manage construction disbursements, and maintain collateral and loan repayments.

Administration and Operations
Responsible for internal administration functions, including:

- Budget
- Accounting
- Purchase orders and contracts
- Personnel
- General office management and reception
- Process improvement and strategic planning

Stream and Lake Protection
Implements the Instream Flow (ISF) and Natural Lake Level Program (ISF program) under four areas:

- Appropriations of new ISF water rights
- Acquisitions of water for ISF use
- Legal protection of ISF water rights
- Monitoring of streamflow conditions and ISF water rights

Interstate, Federal, and Water Information
Manages programming related to interstate stream management, cooperative water policy-related efforts involving federal agencies, and implementing technical and informational resources for water users and stakeholders.

- Monitors and provides policy support for the State's involvement related to interstate compacts, negotiations, and other matters.
- Supports interstate and federal partnerships that involve programmatic, collaborative approaches to water management (i.e., endangered species recovery programs, Selenium Management Program).
- Coordinates and manages the CDSS to provide information and technical assistance to Colorado water users.
- Manages various programs and projects related to the goals and actions identified in the Colorado Water Plan.

Water Supply Planning
Implements programs in six primary areas:

- Maintaining the Colorado Water Plan
- Supporting basin roundtables and the Interbasin Compact Committee
- Education, innovation, and equity
- Grant management
- Agricultural viability
- Water conservation, climate, and drought planning

The CWCB partners with federal, state, and local partners on many watershed protection initiatives, including those related to flood, fire, and drought. This includes work with Federal Emergency Management Agency, U.S. Forest Service, the Colorado Division of Homeland Security and Emergency Management, the State Forester, and other partner agencies and groups to mitigate disasters and recover from them. Additionally, partner agencies such as the Forest Health Advisory Committee, the Colorado Forest Alliance, the Rocky Mountain Restoration Initiative, and the Watershed Health Investment Partnership work together on larger forest health issues. These groups frequently coordinate with DNR and CWCB on programs like the Wildfire Action Program (COSWAP) that reduce fuel loading, increase community resilience, and protect life, property, and infrastructure.

Watershed and Flood Protection
Implements programs in four primary areas:

- Floodplain management
- Floodplain mapping
- Flood mitigation, response, and recovery
- Watershed restoration

The CWCB, like all state agencies, plays a role in supporting EDI. The addition of equity principles to the Water Plan and having CWCB staff focused on EDI are important steps; however, the challenges are much bigger and extend beyond CWCB, especially on topics like drinking water, access, or zoning. The CWCB proudly supports and includes principles from the Water Equity Task Force in this document. The CWCB also supports CDPHE's Climate Equity Framework and continues to coordinate with CDPHE and other agencies on issues related to environmental justice (EJ). The CWCB will continue to support the agencies that more directly drive change while also including a call to action in the Water Plan to support the water needs of all people, including urban and rural residents and Tribal partners.

WATER RESOURCES AGENCIES

Water Resources Partnerships

Water development projects require collaboration and coordination. Water development occurs under multiple agencies' jurisdictions depending on geography and nature of the development. Those that wish to implement a water project in Colorado must have permits, licenses, contracts, certifications, or other approvals from numerous local, state, and federal governmental entities. Partnerships with and among agencies at all levels of government are critical to ensure that the State can identify and address environmental issues in a timely and effective manner. Partnerships among water users and agencies can be beneficial in creating multi-benefit projects that leverage several sources of funding. In addition to federal, state, and local partnerships, Colorado recognizes the importance of engaging with Tribal Nations as fellow sovereigns and partners in managing water resources for the benefit of all users. This section provides an overview of the entities typically involved in permitting and funding, and the State's role in planning.

FEDERAL

Federal entities have several roles that relate to water management issues in Colorado. As land managers, federal agencies provide land-use authorizations for water projects that occupy federal lands. In addition, federal agencies must comply with numerous federal laws to issue permits and other authorizations for any water projects. All significant federal actions also require compliance with the National Environmental Policy Act (NEPA).

The United States Department of Agriculture (USDA)/Natural Resources Conservation Service (NRCS) provides farmers and ranchers with financial and technical assistance to implement conservation practices and projects, including water conservation.

The United States Environmental Protection Agency comments on NEPA documents and reviews the USACE's Clean Water Act 404 permits.

The Federal Energy Regulatory Commission (FERC) is responsible for licensing non-federal hydropower projects.

The United States Army Corps of Engineers (USACE) is responsible for Clean Water Act (CWA) Section 404 permitting related to placing dredged or fill material in U.S. waters, including jurisdictional wetlands. It is also responsible for approving the use of federally owned flood control and water supply facilities.

The United States Bureau of Reclamation built and now manages several water supply and hydropower projects. In Colorado, these include Blue Mesa Reservoir, the Fryingpan-Arkansas Project, and the Closed Basin Project. The BOR is responsible for contracting water out of these federal projects, and these federally owned facilities.

The United States Fish and Wildlife Service (USFWS) regulates actions affecting threatened or endangered species listed under the Endangered Species Act (ESA). This agency is responsible for determining whether a project exceeds the bounds of any programmatic biological opinions regarding further water development. In addition, under the Fish and Wildlife Coordination Act, federal agencies responsible for coordinating federal NEPA compliance must consult with the USFWS regarding a project's potential effects on threatened and endangered fish and wildlife species.

The United States Forest Service (USFS) manages national forests and grasslands and has substantial land holdings in Colorado. The USFS assumes the lead agency role under NEPA in certain situations.

The United States Bureau of Land Management (BLM) manages substantial public-land holdings within Colorado and assumes the lead agency role under NEPA in certain situations.

The United States National Park Service (NPS) manages substantial land holdings within Colorado for national parks, monuments, recreation areas, and historic sites. The NPS assumes the lead agency role under NEPA in certain situations.

STATE

The CWCB is the primary state agency responsible for statewide water planning. Water planning determines the types of water projects and quantity of water needed to support Colorado's growing population. Other state agencies and supporting, constitutionally-established organizations have a critical role in planning, participating in permitting processes, water administration, and other water-related aspects of project development.

The Colorado Water Quality Control Division (WQCD) is housed within CDPHE and monitors and reports on the state's water quality. The agency reviews water quality certifications under Section 401 of the CWA and regulates water quality throughout the state.

The CWCB is a division within the Colorado DNR. The CWCB helps protect and develop the waters of the state, sets water policy and planning through the Water Plan, and has a role in funding project studies and implementation.

The Division of Water Resources is responsible for water administration, including well permitting and dam safety. DWR also maintains stream and diversion measurement data to support water administration.

Great Outdoors Colorado (GOCO) is a political subdivision of the State that uses State lottery proceeds to help fund conservation and recreation projects, many of which impact water.

Colorado Outdoor Recreation Industry Office (OREC) provides a central point of contact, advocacy, and resources at the state level for the diverse constituents, businesses, and communities that rely on the continued health of the outdoor recreation economy.

Colorado DOLA is a state agency that coordinates on many planning programs with CWCB, including the Colorado Resiliency Office, the Community Development Office, and the SDO.

Colorado Parks and Wildlife is a division within the Colorado DNR. CPW reviews Fish and Wildlife Mitigation Plans, also known as 122.2 plans, under Colorado's state statutes. CPW also consults with the USFWS under the Fish and Wildlife Coordination Act.

The Colorado Attorney General's Office advises and represents the State of Colorado and state agencies in legal proceedings and advises on legal matters.

Water Quality Control Commission (WQCC) is the administrative agency responsible for developing specific water quality policy in Colorado.[26]

The Colorado Department of Agriculture (CDA) serves to strengthen and advance Colorado agriculture while fostering responsible stewardship of the environment and natural resources. The Agricultural Drought and Climate Resilience Office of the CDA serves an important function for water supply planning.

Colorado Water Resources and Power Development Authority (CWRPDA) is a quasi-governmental agency that provides state and federal funding in the form of loans and grants to Colorado governmental agencies to finance water, wastewater, hydropower, and forest health infrastructure projects.

[26] In addition to the Colorado Primary Drinking Water Regulations and other federal requirements, CDPHE provides additional details on actions it will take in WQCC Policy 98-2, "A Guide to Colorado Programs for Water Quality Management and Safe Drinking Water."

Apples hanging on the branches
Photo credit: Kent Vertrees, Friends of the Yampa

LOCAL

Colorado's local governments have considerable authority in making water development and management decisions. Colorado's counties and municipalities exercise a broad range of powers, which state law explicitly delegates to them, to address the needs of respective constituents. Generally, counties have discretionary powers to provide services, including water and sewer, and to operate districts for irrigation and recreation, among other uses.

In 1974, the Colorado General Assembly enacted HB 74-1041 that established "1041 powers," which allow local governments to maintain control over development projects. Development may only proceed if it is consistent with the local communities' environmental and developmental goals as outlined in their 1041 regulations, and a permit for a specific water project that does not meet the standards of the local regulations may be denied.

Where to find more information on 1041 powers:

2015 Colorado Water Plan Section 9.1 and 9.4

Link for **1041 Regulations in Colorado | Department of Local Affairs**

Furthermore, the State constitution authorizes municipalities and counties to adopt home-rule charters, which provide even greater autonomy and flexibility to address local problems. State law also provides local governments with authority specific to land use and water planning.

Colorado law allows voters to create many types of local special districts, which are governing entities that oversee specific services, such as fire protection, water, and sewer. Special districts related to water use and planning include:

<table>
<tr><td>Water Districts: Supply water for domestic and other public and private purposes and provide reservoirs, treatment works, and facilities.</td><td>Metropolitan Districts: Provide two or more of a variety of services, including parks and recreation, wastewater, and water.</td><td rowspan="2">Water Conservancy Districts and Water Conservation Districts: Both of these organizations build and administer water projects; interface with federal agencies; and administer the repayment of project capital, operations, and maintenance costs. They share information and coordinate efforts among agencies, political subdivisions, private citizens, and businesses concerning the conservation, protection, and development of Colorado water. Conservation districts generally have a broad focus and are established by the state legislature. Conservancy districts address more local needs and are established by public petition.</td></tr>
<tr><td>Sanitation Districts: Provide for storm and/or sanitary sewers, flood and surface drainage, treatment and disposal works and facilities, solid waste disposal facilities or waste services, and equipment.</td><td>Drainage and Flood Control: Assist local governments with multi-jurisdictional drainage and flood control challenges and provide project funding.</td></tr>
<tr><td rowspan="2">Conservation Districts: Provide local technical and financial support to private landowners to improve soil health, post-fire recovery, and water quality and water delivery through relationships with NRCS and other state/federal agencies.</td><td>Irrigation Districts: Provide for land irrigation and drainage work necessary to maintain irrigation.</td><td>Groundwater Management Districts: Adopt rules and regulations to help administer groundwater within the districts.</td></tr>
<tr><td>Park and Recreation Districts: Provide park and recreational facilities and programs.</td><td>Water and Sanitation Districts: Provide both water and wastewater services.</td></tr>
</table>

State Plans Vary in Scope but Often Intersect

State plans vary in scope but often intersect. Many State agencies have their own plans that focus on or touch water, but their plans may focus broadly or more specifically on an agency's internal goals and needs. The Water Plan's relationship to other agencies' plans is complementary. The Water Plan must work in conjunction with other agencies' plans to help them achieve their goals without getting in their way. The same is true for how other agencies work with the Water Plan. Strong collaboration is needed among agencies and stakeholders to achieve this.

Examples of State Plans in Comparison to the Water Plan

PLAN CHARACTERISTCS	COLORADO WATER PLAN	RESILIENCY FRAMEWORK	NATURAL WORKING LANDS STRATEGY	CPW 2019 STRATEGIC PLAN	CDPHE WQCC POLICY 98-2	COLORADO FOREST ACTION PLAN
Informed by an agency's capacity	●	●		●	●	●
Promotes local action to achieve a vision	●	●	●			
Identifies cross-agency actions	●	●				
Includes water topics	●	●	●	●	●	●
Grants are central to implementation	●					
Lead agency can regulate				●	●	
Lead agency constructs projects				●		●

CHAPTER 4

BASIN CONTEXT

Irrigation ditch, Photo credit: Rio de la Vista

BASIN FRAMEWORK

The Colorado Water Plan is supported by the collaborative framework created in 2005 through the Colorado Water for the 21st Century Act (HB 05-1177). The Act established two stakeholder groups that focus on local and statewide water issues:

COLORADO WATER FOR THE 21ST CENTURY ACT

Interbasin Compact Committee

The IBCC, which includes representatives from basins across the state, was created to facilitate interbasin discussions and negotiations between roundtables.

Public Education, Participation, and Outreach Working Group

Originally noted in HB 05-1177 as a working group of IBCC, the PEPO work group focuses on water-related education and outreach, and it has expanded to include members of IBCC, liaisons from each basin roundtable, and educators.

Basin Roundtables

Nine basin roundtables were established to collaborate on basin-specific issues.

The CWCB directors and staff play a significant role in supporting these grassroots groups and local project development in several ways. The CWCB manages the Water Supply Reserve Fund (WSRF) and coordinates with roundtables as they recommend and advance WSRF grants to the CWCB for board approval and/or provide letters of support for Colorado Water Plan grants (see Chapter 3). The CWCB also provides targeted logistical support, coordination, and funding for basin roundtable meetings as well as providing funds for basin recorders to help maintain compliance with open meetings laws. Staff coordinate cross-basin discussions with basin roundtable chairs, PEPO, IBCC and, at times, larger statewide events that bring together all these stakeholders. Additionally, CWCB funds IBCC and its meetings, supports the IBCC chair, and helps facilitate IBCC discussions and initiatives.

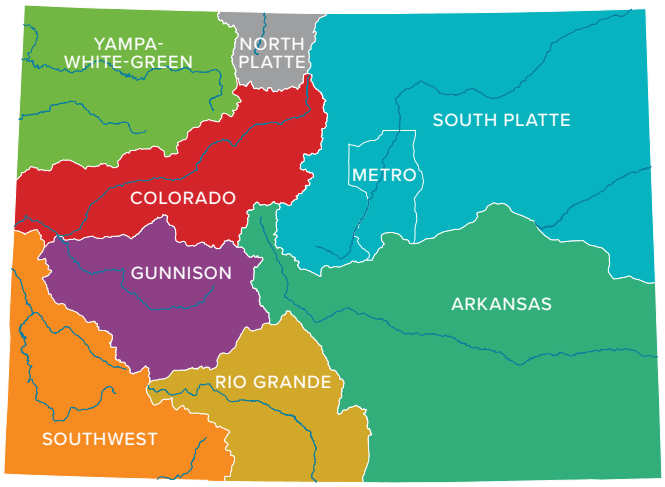
The grassroots approach of the basin roundtables, IBCC, and PEPO, which annually engages hundreds of stakeholders across diverse sectors and regions, enables residents in each basin to share their vision for Colorado's water future. The process produces informed discussions, provides a forum for building consensus, generates momentum for Colorado water planning and education, and supports local water project development.

This chapter provides a snapshot of each roundtable's BIP, describes **common BIP themes,** and **summarizes basin-identified projects** for meeting future water needs.

Link for more information on **Basin Roundtables | DNR CWCB**

Basin Roundtables

The nine basin roundtables represent each of the state's eight major river basins and the Denver metropolitan area. They are comprised of volunteers who represent a wide range of water-related perspectives, including municipal, environmental, agricultural, recreational, and industrial interests. The roundtables provide a forum for stakeholders to discuss water issues and find collaborative solutions. Another important function of the roundtables is to encourage and foster projects that help meet current and future water needs across all sectors of water use. The basin roundtables accomplish this by making grant recommendations to the CWCB's WSRF and endorsing projects for Colorado Water Plan grants.



In 2014, the basin roundtables produced the first drafts of their BIPs. Through the basin roundtable process, representatives from the business community, local government, and water users, as well as stakeholders representing the environment, agriculture, recreation, and various industries, contributed to each BIP. The BIPs from the nine basin roundtables provided foundational information to the first Colorado Water Plan, which was published in 2015. In 2022, the basin roundtables finalized updates to their BIPs, which are summarized in this chapter.

Interbasin Compact Committee

The IBCC provides an important, diverse, and balanced forum for policy input across Colorado and has helped shape numerous planning initiatives through a focused discourse on the major policy challenges within and across the nine basin roundtables.

The IBCC is a 27-member committee made up of:

- Two members appointed by each of the nine roundtables
- Six members appointed by the Governor who come from "geographically diverse parts of the state" and have expertise in environmental, recreational, local governmental, industrial, and agricultural matters
- One member appointed by the chairperson of the Senate Ag. Committee
- One member appointed by the chairperson of the House Ag. Committee
- The IBCC Chair, who is appointed by the Governor

The 27 members of IBCC represent every basin and take into account nearly every water perspective in Colorado. Since its formation, IBCC has developed statewide strategies for meeting potential water gaps, created the planning scenarios that were used as the basis for the Technical Update, and negotiated guidance on future transmountain diversion (TMD) projects (also known as the Conceptual Framework. See next page for a description). Recently, IBCC worked to develop stronger communication links among PEPO, the roundtables, and IBCC.

Link for more information on **Interbasin Compact Committee | DNR CWCB**

"THE INTERBASIN COMPACT COMMITTEE HAS SERVED MANY SPECIFIC ROLES OVER THE YEARS, BUT **MOST BROADLY, HAS STOOD AS A UNITED THINK TANK** TO BRING THE SELF-INTERESTS OF BASINS AND STAKEHOLDERS BACK TO THE STATEWIDE LENS—WHERE MOST OF OUR SELF-INTERESTS ARE IN FACT COMMON TO THE GREAT STATE OF COLORADO.

— JOHN STULP, *2017 IBCC Annual Report*

COLORADO'S CONCEPTUAL FRAMEWORK

Prior to the 2015 Water Plan, Front Range roundtables identified a need for a balanced program to preserve options for future development of Colorado River water, while western slope roundtables expressed great concern regarding additional development of Colorado River water involving a new TMD. The Colorado Conceptual Framework seeks a path forward that considers the option of developing a new TMD and addresses the concerns of basin roundtables, stakeholders, and environmental groups. It represents consensus from IBCC to address both Front Range and western slope concerns about a TMD. The framework presents seven principles to guide future negotiations among proponents of a new TMD, if it were to be built, and the communities it would affect. The principles identify areas of statewide concern and state the issues and realities proponents of a new TMD should expect to address. Below are the seven guiding principles:

Conceptual Framework Principles

1. Eastern slope water providers are not looking for firm yield from a new TMD and the project proponent would accept hydrological risk for that project.
2. A new TMD would be used conjunctively with eastern slope supplies, such as interruptible supply agreement, Denver Basin Aquifer resources, carry-over storage, terminal storage, drought restriction savings, and other non-western slope water sources.
3. To manage when a new TMD would be able to divert, triggers are needed.
4. A collaborative program that protects against involuntary curtailment is needed for existing uses and some reasonable increment of future development in the Colorado River System, but it will not cover a new TMD.
5. Future western slope needs should be accommodated as part of a new TMD project.
6. Colorado will continue its commitment to improve conservation and reuse.
7. Environmental resiliency and recreational needs must be addressed both before and conjunctively with a new TMD.

Link for more information on Colorado's Conceptual Framework: **waterinfo.org | Conceptual Framework**

Public Education, Participation, and Outreach

The PEPO Workgroup helps:

- Create a process to inform, involve, and educate the public on IBCC activities and progress
- Create a mechanism by which public input and feedback can be relayed to IBCC
- Educate IBCC and basin roundtable members about water issues

The PEPO workgroup members update with information from basins' PEPO liaisons—the basin-specific person, people, and/or contractor which some basins have developed to support local engagement. The PEPO workgroup also helps support and inform larger conversations with basin PEPO liaisons and other members of the water education community. The latter includes working with groups like Water Education Colorado, Colorado Watershed Assembly, and the Colorado Water Center.

Roundtables that have developed education and outreach committees work with PEPO liaisons to develop annual plans for outreach, education, and engagement in their basins.

Since the publication of the 2015 Water Plan, PEPO funding has increased to up to $300,000 annually across the state through PEPO grant funding that was created in 2021.

Each year, basins are eligible for grant funding for a coordinator, and there are also limited funds available for working with CWCB on statewide initiatives around education and outreach that help support collaborative engagement across basins and shared education resources.

Link for more information on **IBCC Public Education, Participation & Outreach Workgroup | DNR CWCB**

Kids in green forest stream, Photo credit: Rachel Zancanella, DWR

The Arkansas Basin is the largest basin in Colorado. Its varying landscape—from forest to grasslands—supports a mix of agriculture, mining, and recreational opportunities.

KEY ACHIEVEMENTS

Project successes helped local communities while improving local water resources and the environment. Successes include:

- Arkansas River Watershed Collaborative
- Monarch Pass Forest and Watershed Health Project
- John Martin Reservoir Permanent Conservation Pool
- Arkansas River Homestake Diversion Rehabilitation
- Arkansas Lease-Fallowing Tool

ARKANSAS BASIN

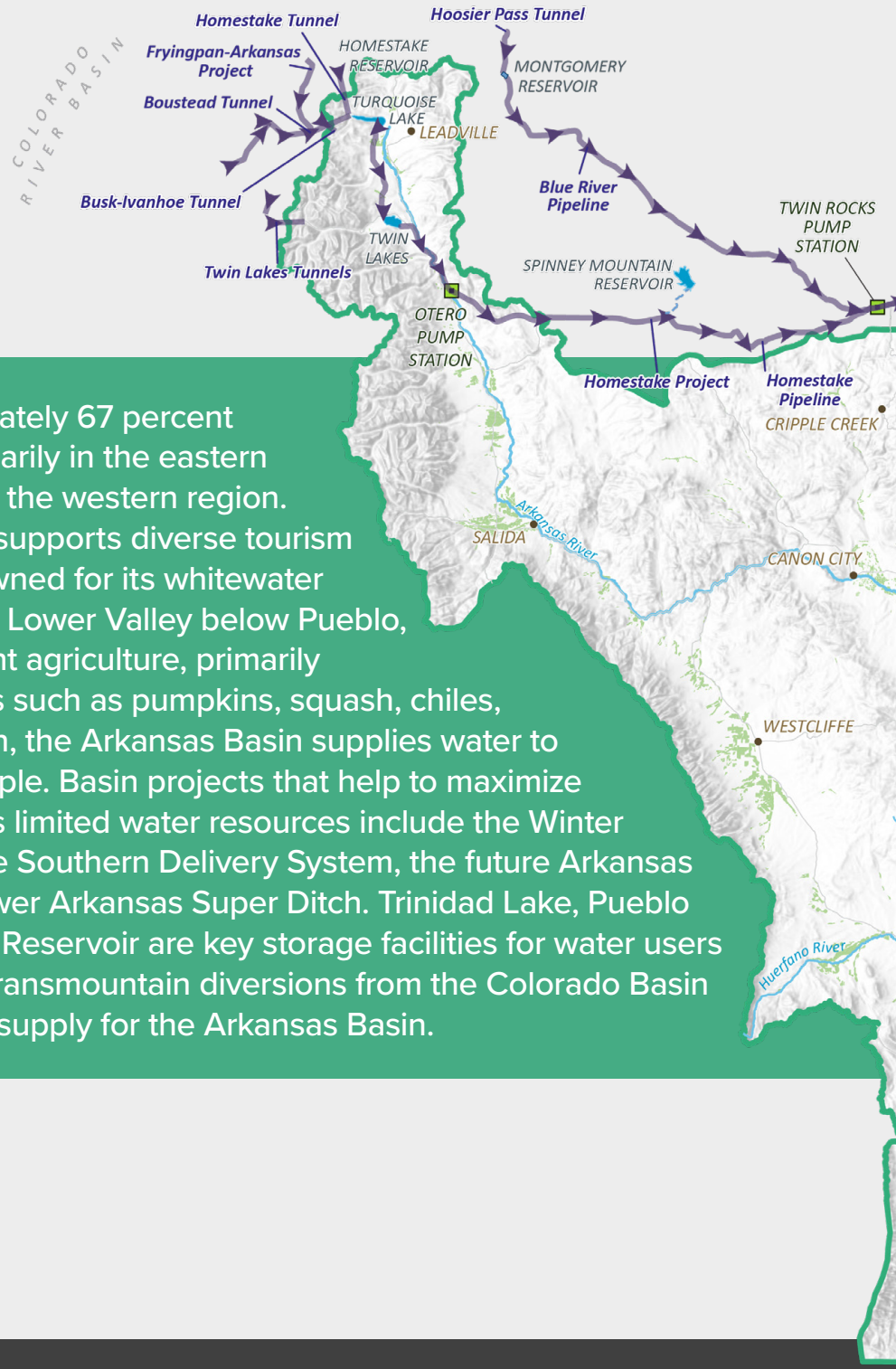
Basin Overview

The Arkansas River is a major tributary to the Mississippi River, originating in the central mountains of Colorado near Leadville. Elevations in the headwaters reach more than 14,000 feet. The river first flows south through a relatively narrow valley to the town of Salida where it enters Bighorn Sheep Canyon. Continuing in a southeasterly direction, it enters the Great Plains near Pueblo. From Pueblo, the basin widens significantly, extending as much as 150 miles north to south as the river travels east to the Kansas state line. Its southside tributaries gather water from the east side of the high Sangre de Cristo Mountains, and northside tributaries drain the High Plains to the north. Elevation of the river as it leaves Colorado is approximately 3,300 feet. The Arkansas Basin within Colorado is the largest basin in the state, covering more than a quarter of Colorado.

Basin Overview Facts

- At the Arkansas River's headwaters, annual precipitation ranges from 25 to 60 inches per year, most of which occurs as snow. Middle elevations receive between 15 and 25 inches of precipitation per year, which decreases to 8 and 12 inches in the lower basin.
- TMDs provide an important supply of water to the Arkansas Basin, and much of this water can be reused to extinction.
- The upper Arkansas River, from the headwaters through Bighorn Sheep Canyon, supports significant tourism and outdoor recreation. A 102-mile reach of the river is designated as a Gold Medal fishery, and Browns Canyon is one of the most popular whitewater rafting destinations in the United States.
- A wide variety of crops are grown on more than 220,000 acres of irrigated acreage in the Lower Arkansas River Basin, including the well-known Rocky Ford Cantaloupe.
- The High Plains aquifer in the eastern portion of the basin is considered a "Designated Basin" by the State of Colorado, meaning users rely primarily on groundwater for their supply. The High Plains aquifer is the major source of irrigation water for southeast Colorado.

For more information on the Arkansas Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

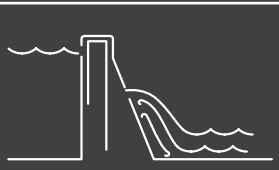


Grassland covers approximately 67 percent of the Arkansas Basin, primarily in the eastern portion, while forests cover the western region. The Upper Arkansas River supports diverse tourism and recreation and is renowned for its whitewater rafting and kayaking. In the Lower Valley below Pueblo, the river supports significant agriculture, primarily fodder crops and row crops such as pumpkins, squash, chiles, and melon fruits. In addition, the Arkansas Basin supplies water to approximately 1 million people. Basin projects that help to maximize beneficial use of the basin's limited water resources include the Winter Water Storage Program, the Southern Delivery System, the future Arkansas Valley Conduit, and the Lower Arkansas Super Ditch. Trinidad Lake, Pueblo Reservoir, and John Martin Reservoir are key storage facilities for water users and flat-water recreators. Transmountain diversions from the Colorado Basin are an important source of supply for the Arkansas Basin.

Water Resources Development Timeline

1880

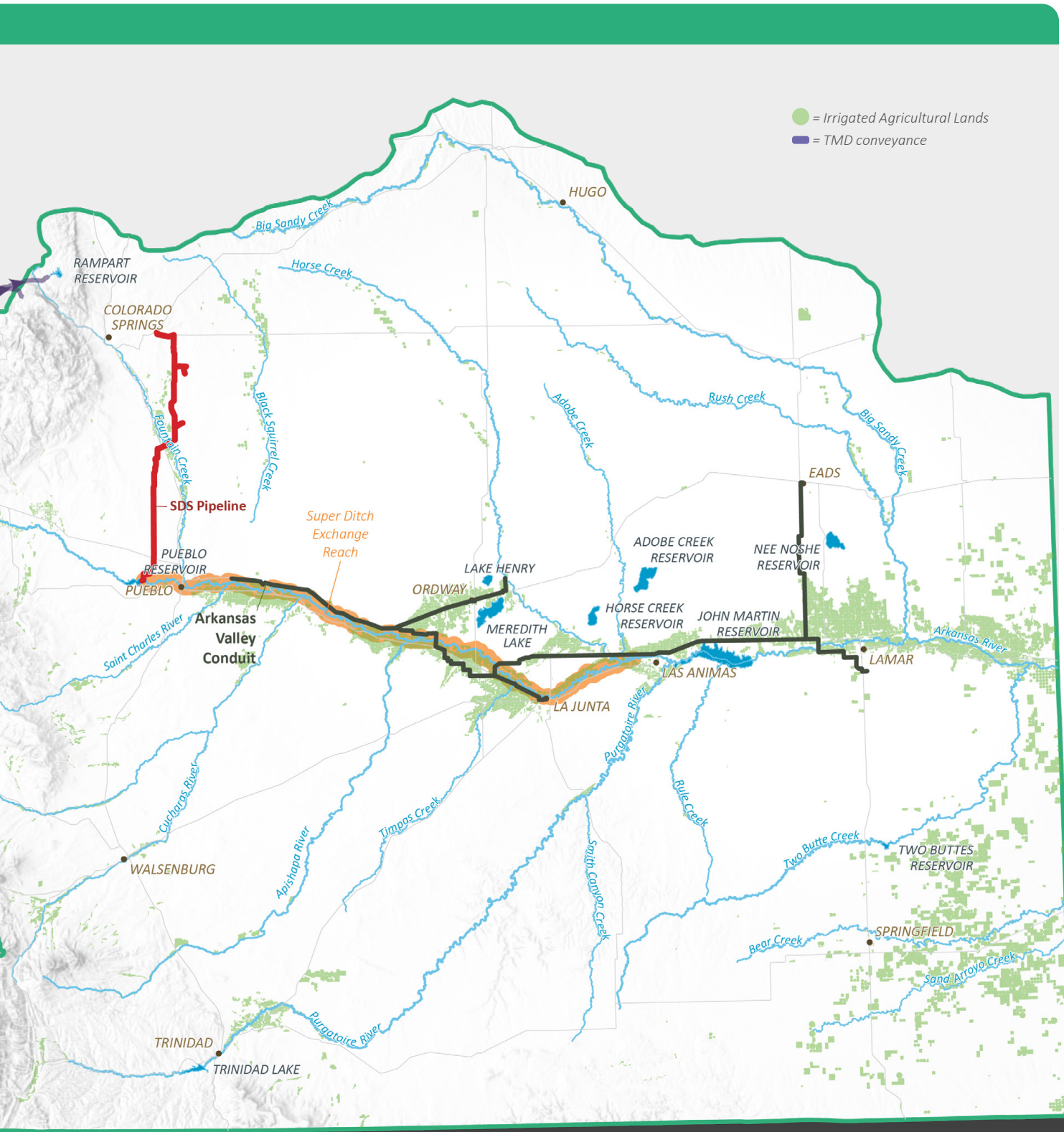
In 1880, the Otero Canal Company built the Ewing Ditch near Tennessee Pass, west of the Continental Divide, to convey water from the Eagle River Basin to a tributary of the Arkansas River. The diversion, now owned by the Pueblo Board of Water Works, was the state's first transmountain diversion.[1]



1948

The Arkansas River Compact of 1948 apportions the waters of the Arkansas River between Colorado and Kansas while providing for the operation of John Martin Reservoir. The John Martin Dam construction was also completed in 1948.

[1] Water Education Colorado. 2014. Citizen's Guide to Colorado's Transbasin Diversions.



1959

In 1959, after years of political lobbying by Arkansas Basin stakeholders, work began on the Fryingpan-Arkansas Project. Today the project delivers water for 265,000 acres of agricultural lands and supplies municipalities in the Colorado Springs area.[2]

1962

The Arkansas Valley Conduit was authorized by Congress in 1962 as part of the Fryingpan-Arkansas Project.

1970s

The Pueblo Dam and Reservoir were constructed between 1970 and 1975 as the terminal storage feature for the Fryingpan-Arkansas Project.

1980s

In the 1980s, large changes of irrigation water rights occurred in the Twin Lakes Reservoir and Irrigation Canal Company due to pressure to develop adequate water supplies for growing populations. This resulted in the dry up of 45,000 acres in Crowley County alone.

1999

By 1999, the City of Aurora had purchased approximately 95% of the Rocky Ford Ditch.[3]

[2] Colorado Water Conservation Board and Colorado Division of Water Resources. 2011. **Arkansas River Decision Support System Feasibility Study**.

[3] Arkansas Basin. **Aurora Water Virtual Tour**

Basin Challenges

The Arkansas Basin faces several challenges meeting water needs of agriculture and growing communities as well as maintaining flows in rivers. Important among them is the Arkansas River Compact, which constrains the ability of the basin to develop additional water supplies. Also, the basin is challenged by sometimes large fluctuations in hydrologic conditions from year to year. Challenges identified in the BIP are:

KEY CHALLENGES

- **Water-short basin**
- **Complex hydrology and extreme hydrologic conditions**
- **Complicated water rights administration**
- **Declining groundwater levels**
- **Increased demand for augmentation water**
- **Reliance on imported supplies**

AGRICULTURE

- Concerns over permanent agricultural transfers and the effects on rural economies are substantial in the lower portion of the Arkansas Basin downstream of Pueblo Reservoir.
- Collaborative solutions such as the Super Ditch and ATM pilot projects, while difficult to design and decree, are necessary to forestall or minimize loss of irrigated acreage in agriculture.

WATERSHED

- Concerns over water quality span protection of aquatic species in the Upper Basin to improving drinking water in the Lower Basin.
- Careful management of the environmental and recreational demands that are expected to increase with population growth, given that environmental and recreational demands depend on transmountain supplies, municipal storage, and agricultural demands.
- Managing impacts of fires and floods on an increasing frequency and spatial scale.

MUNICIPAL AND INDUSTRIAL

- Replacing municipal water supplies that depend on the non-renewable Denver Basin aquifers and declining water levels in designated basins is becoming critical, exacerbated by continued growth in groundwater-dependent urban areas.
- Rural areas within the Arkansas Basin have identified water needs but face challenges in marshalling resources to identify and implement solutions.

COMPACTS, ADMINISTRATION, AND REGULATORY

- All uses not in priority must be augmented through a decreed plan of augmentation to prevent injury to senior water rights and the Compact. Increasing irrigation efficiency, i.e., conversion from flood to center-pivot irrigation for labor and cost savings, will require 30,000 acre-feet to 50,000 acre-feet of augmentation water in the coming years.
- The Arkansas River Compact creates complexity in water rights administration.

CROSS-SECTOR CHALLENGES

- The majority of surface storage reservoirs in the Arkansas Basin were constructed between 1890 and 1930. Many of these facilities need repair or restoration.
- Agricultural water interests have faced encroachment by municipal demands, while environmental and recreational water demands have increased significantly.
- Water management is challenged by extreme or uncertain conditions, influenced by the over-appropriated water supply, reliance on imported water, complex hydrology and water administration, and extreme hydrologic conditions. Maintaining imported water supplies that are increasingly at risk is critical to meeting future demand.

Goals and Strategic Vision for the Future

The Arkansas Basin goals describe the specific things the basin needs to do to meet its future water-related needs, while the strategic vision considers the goals, challenges, and proposed basin projects to concisely describe a long-term strategy for meeting those needs. More specifically, the strategic vision aims to help make progress toward the basin goals and ensure that projects supported and funded through the Arkansas Basin Roundtable align with the goals. The basin goals and strategic vision are described below.

Goals

Through a collaborative process, the Arkansas Basin Roundtable identified its goals and their associated actions. Goals are organized into the following five categories: Storage, Municipal and Industrial, Agriculture, Environmental and Recreational, and Watershed Health.

ARKANSAS BASIN ROUNDTABLE GOALS

AGRICULTURE GOALS

- Support projects within and outside the Arkansas Basin that will help meet the basin's agriculture water supply gap, maintain existing supplies, better manage vulnerable supplies, and maximize use of water users' entitlements
- Sustain a productive agricultural economy in the Arkansas Basin that sustains viable rural, agricultural-based communities
- Provide augmentation water as needed to support increased farm efficiencies
- Support the development of viable ATM/ water-sharing projects between agriculture and municipal interests to mitigate the impacts of drought, provide risk management for agriculture and municipal interests, and facilitate responsible and sustainable water-sharing arrangements
- Sustain recreational and environmental activities that depend on habitat and open space associated with farm and ranch land

MUNICIPAL AND INDUSTRIAL GOALS

- Meet the projected municipal supply gap in each Arkansas Basin subregion
- Support regional efforts for cost-effective solutions to local water supply gaps
- Reduce municipal users' groundwater dependence on unsustainable aquifers
- Develop collaborative solutions among municipal, agricultural, and environmental and recreational users of water, particularly in drought conditions

WATERSHED HEALTH GOALS

- Maintain, improve, or restore critical water supply watersheds that could affect Arkansas Basin water uses and environmental and recreational values
- Improve water quality as it relates to the environment and/or recreation

ENVIRONMENT AND RECREATION GOALS

- Support projects and programs within and outside the Arkansas Basin that protect environmental and recreational water supply needs, and collaborate with municipal and ag users to enhance environmental and recreational values
- Maintain or improve native fish populations, restore habitat for fish species, and maintain or improve recreational fishing opportunities
- Maintain or improve boating opportunities, including rafting, kayaking, and other non-motorized and motorized boating
- Maintain or improve aquatic, riparian, and avian habitat (including wetlands) that would support environmental features and recreational opportunities

STORAGE GOALS

- Continue to develop storage opportunities to support Arkansas Basin needs[4]
- Develop alluvial and designated basin aquifer storage in gap areas[4]
- Promote multiple uses at existing and new storage facilities

[4] Subject to the constraints of the Arkansas River Compact

Strategic Vision for the Future

The Arkansas Basin Roundtable developed a strategic vision for the future to provide an overview of strategies for how basin needs will be met in the future. These strategies, listed below, can be viewed as major categories of activities that align with basin goals and the projects needed to make progress toward meeting future water shortages:

- Support project implementation
- Support collaboration and partnerships
- Target funding to meet basin goals
- Maximize economic impact of basin dollars spent
- Perform vulnerability assessments to identify need

The Arkansas Basin, as an importing and exporting basin with interbasin and interstate obligations, must meet its present and future water supply gaps by maximizing the use of native and imported water.

Salida Colorado - In-Channel Recreation, Photo credit: Arkansas Basin Roundtable

Demand, Supply, and Potential Water Needs

Municipal and Industrial

Between the years 2015 and 2050, the basin population is projected to grow between 64 percent and 67 percent, which will drive increased diversion demand for municipal and industrial purposes. Maintaining TMD supply is critical to meeting municipal and industrial needs.

Agriculture

Several planning scenarios projected less agricultural demand than the current demand, mainly due to reduced irrigated acres and resulting decreased irrigation water requirement due to urbanization, transfers of agricultural water rights to municipal uses, and declining aquifer levels in the Southern High Plains. However, remaining irrigated acres may experience higher irrigation water requirements per acre as a result of climate change.

Environment and Recreation

The Flow Tool fostered an improved understanding of potential streamflow-related risks (both existing and projected) to environmental and recreational attributes in the upper region of the Arkansas Basin. Flow Tool results indicated that projected changes in climate will put environmental and recreational projected flows, ecology, and attributes at risk.

Climate-impacted scenarios project an increase in municipal and industrial demands and risks to ecological resources even though basinwide agricultural demand is anticipated to reduce across scenarios; balancing water needs is crucial to meet future demands.

The Colorado Basin is a region of diverse natural systems, outstanding beauty, and extensive recreational opportunities.

KEY ACHIEVEMENTS

A variety of project successes support the Colorado Basin's needs while protecting valuable resources. Those projects include:

- 2015 basinwide top projects
- Grant funds provided by the roundtable
- Stream management plans and integrated water management plans

COLORADO BASIN

Basin Overview

The Colorado Basin encompasses approximately 9,830 square miles. It is among the largest watersheds in the state. The basin varies greatly in terms of topography, climate conditions, land use characteristics, population growth, economic base, and geology.

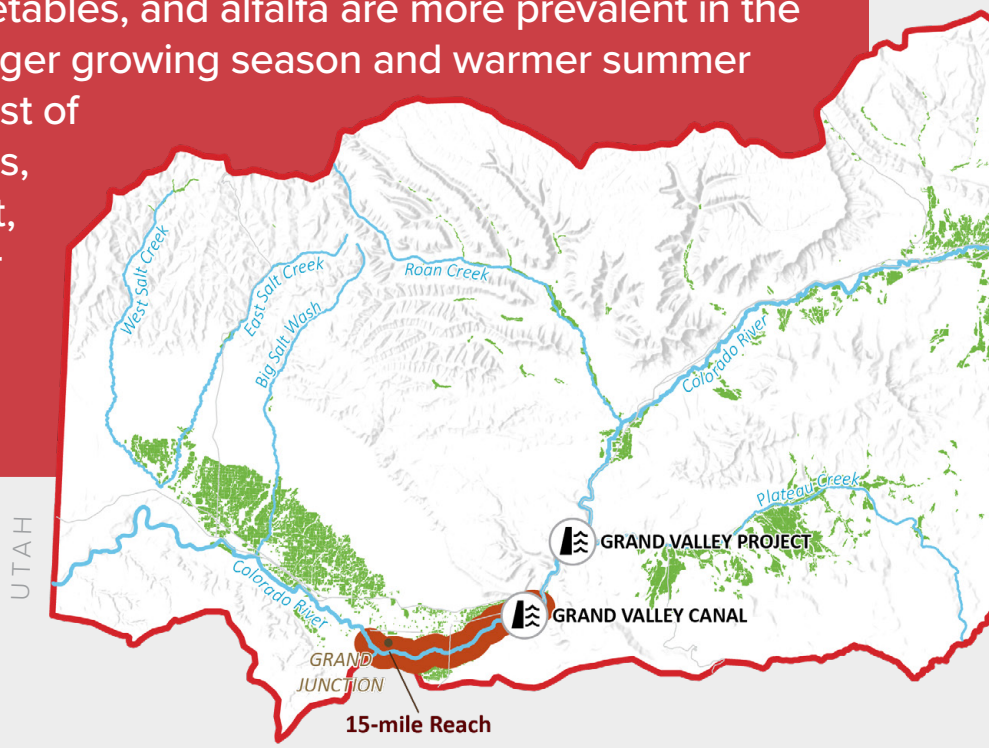
The Colorado Basin extends from Rocky Mountain National Park to the Utah state line within Colorado. Mountainous upper reaches gradually give way to a series of canyons and gentler terrain as the river flows along the Interstate 70 corridor toward Grand Junction and the Utah border. Snowpack in the elevations above 9,000 feet is an important water source for human use on both sides of the Continental Divide in Colorado. This water is also important for downstream water users. As much as 70 percent of the river's water flows out of the state.

Basin Overview Facts

- The Colorado Basin's mountains receive an average annual precipitation of approximately 60 inches per year, and snowpack in the high country is an important water source. Many tributaries are fed by spring snowmelt, which results in peak runoff occurring in May and June.
- Groundwater plays a modest role in the Colorado mainstem basin's water supply. Both the ready availability of good-quality surface water and the lack of highly transmissive aquifers worked against development of the groundwater resource.
- A substantial portion of the basin is made up of federally owned land. Of the almost 6 million acres in the basin, almost half is owned by the USFS. Rangeland controlled by the BLM is the second-most predominant land use. Livestock grazing, recreation, hunting, energy, and timber harvest are the primary uses of the federal lands.
- Tourism is the predominant industry in the headwaters counties (Grand, Eagle, Summit, and Pitkin) with world-class visitor attractions, including ski resorts, boating and Gold Medal fishing, national parks, and wild and scenic status-eligible rivers.
- Agriculture is part of the basin's historic culture. Ranching and livestock production are typical agricultural activities in the upper reaches, while the Grand Valley has a long history of fruit and vegetable production.
- Water providers in the South Platte and Arkansas Basins export approximately 480,000 acre-feet each year from the Colorado Basin for eastern slope agricultural, municipal, and industrial uses.

For more information on the Colorado Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

The Colorado Basin is renowned for its ample outdoor recreation activities, such as Gold Medal fishing and diverse agriculture across the basin. Large ranching operations dominate agriculture in the Colorado Basin's higher elevations, particularly around the towns of Kremmling, Collbran, and Rifle. Farming regions focused on the cultivation of fruits, vegetables, and alfalfa are more prevalent in the lower basin due to a longer growing season and warmer summer temperatures. The largest of these farming operations, the Grand Valley Project, irrigates about a quarter of the 206,700 acres irrigated in the entire basin.



Water Resources Development Timeline

1882

In 1882, the Grand Valley Canal was established as the most senior water right in the basin.

1909

In 1909, operations began at the Shoshone Hydroelectric Plant, located in Glenwood Canyon. The plant has a maximum capacity of 15 megawatts produced by two 9-foot-tall turbines.

1917

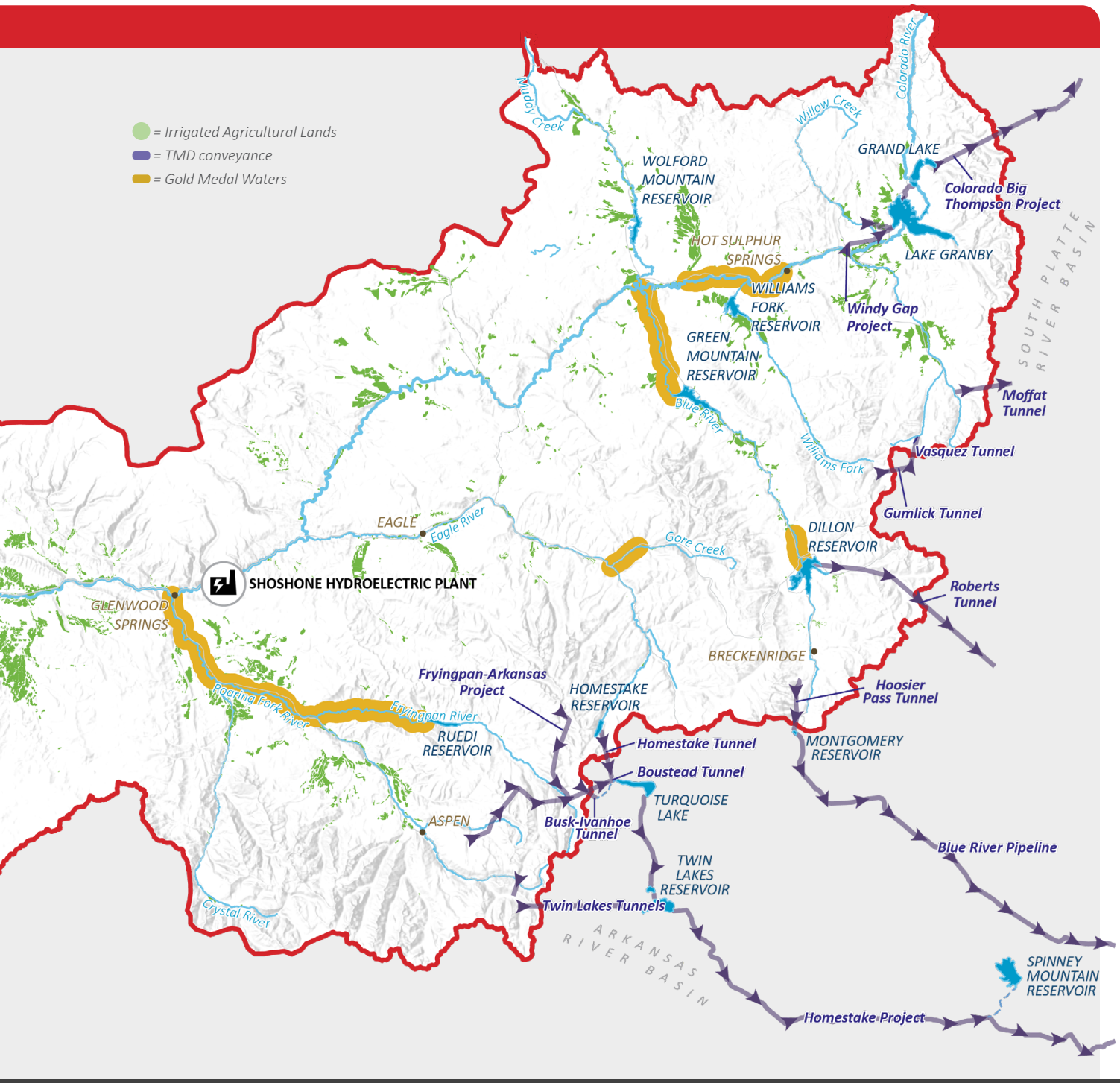
In 1917, the Grand Valley Project opened as one of the earliest projects enabled under the Reclamation Act of 1902. The project serves the lands above Grand Valley Canal service area and on Orchard Mesa.

1922

In 1922, the seven Colorado River Basin states entered into the Colorado River Compact. This Compact allocated the consumptive use of the river between the Upper Basin and Lower Basin. Additional compacts and agreements were developed over time, as discussed in Chapter 3.

1930s

In a service tunnel for the early 1930s, two significant events occurred. Denver Water repurposed a service tunnel for Moffat Tunnel to deliver water from the Fraser River Basin to the South Boulder Creek. In 1937, the Colorado River Water Conservation District (River District) was formed by the Colorado General Assembly to advocate for and develop water resources for the benefit of western Colorado. The advent of the River District was a direct result of the difficult negotiations over the Colorado-Big Thompson (CBT) Project. Negotiations resulted in the construction of Green Mountain Reservoir, a project on the Blue River to compensate western slope water users for the export of water via the Adams Tunnel.



1952

In 1952, Colorado Springs Hoosier Tunnel opened to convey water from the Blue River Basin and middle fork of the South Platte to the Arkansas Basin. In 1959, Denver Water's Williams Fork Reservoir was completed to replace out-of-priority diversions to provide for western slope water rights.

1960s

The 1960s saw several new TMDs. In the early 1960s, the Fryingpan-Arkansas Project was authorized, which resulted in the transmountain Boustead Tunnel and Ruedi Reservoir to serve municipal and irrigation needs in the Arkansas Basin. In 1964, Denver Water began operating Dillon Reservoir and the Robert's Tunnel, which moves water from the headwaters of the Blue River in Summit County to the South Platte River. In 1967, the Homestake Project was completed. The project was a joint undertaking of the Cities of Aurora and Colorado Springs to export water from the upper Eagle River to the Arkansas and South Platte Basins.

1985

In 1985, the Windy Gap Project was completed for Northern Colorado entities, using CBT facilities on a space-available basis.

1995

In 1995, Wolford Mountain Reservoir was completed. The reservoir was a collaboration among the Colorado River District, Denver Water, and Northern Water to benefit the western slope in the face of additional exports.

1999

In 1999, the 15-mile Programmatic Biological Opinion was established to protect four species of endangered fish in the Grand Valley area.

Basin Challenges

The Colorado Basin faces several key issues and challenges pertaining to competing resources for agriculture, tourism and recreation, protection of endangered species, and potential for Colorado River Compact administration. Challenges identified in the BIP are:

KEY CHALLENGE

The Colorado Basin will need to balance competing resources with a limited water supply. The protection of endangered species, sustaining the basin's agricultural economy, and managing forests for improved resiliency and health throughout the watershed are all major challenges.

AGRICULTURE

- Despite the importance of agriculture, continued urbanization of agricultural lands could reduce irrigated acres in the Colorado Basin.
- The value of agriculture in the basin is often understated; it is a critical component of the basin's economy.

WATERSHED

- In an uncertain future, maintaining flows that support environmental and recreation uses is vital. These are major drivers in the Colorado Basin and are important for economic health and quality of life.

MUNICIPAL AND INDUSTRIAL

- Development of conditional transmountain water rights and potential full use of existing transmountain diversions is a concern, and the effect on in-basin supplies in the Colorado Basin must be considered.

COMPACTS, ADMINISTRATION, AND REGULATORY

- There is concern over severe and sustained drought and the potential effects to in-basin supplies and potential compact administration. Demand management per the DCP is an issue of concern in the basin.

CROSS-SECTOR CHALLENGES

- Selenium and salinity are water quality concerns in parts of the basin.
- Since 2000, the Colorado Basin has been experiencing historic extended drought. The effects of drought and climate change affect water supply availability, ecosystems, industry, and agriculture. There are concerns with dry soil moisture conditions, earlier runoff, and aridification.
- The Colorado Basin faces the challenge of balancing water exports from the basin and the need to provide for in-basin demands with limited supplies.
- Forest and watershed health is a basinwide challenge, especially given the impacts of recent wildfire activity. Insect infestations, avalanches, and sustaining riparian health are also challenges.

Ongoing collaboration through the Upper Colorado River Endangered Fish Recovery Program will be important to protecting this resource for all who rely on it.

See Chapter 5 description of Endangered and Threatened Species Recovery Programs for more information.

Goals and Strategic Vision for the Future

Colorado Basin themes guide the short-term vision and support the long-term goals for the basin, while the strategic vision can be applied to meet multiple goals across the Colorado Basin Roundtable's six themes described below. More specifically, the strategic vision ensures that projects supported and funded through the Colorado Basin Roundtable align with the goals. In the process of reviewing themes and strategies, stakeholders wanted to recognize the importance of funding, education, climate change, and basinwide collaboration and partnership. These concepts are woven throughout the themes and strategic vision.

Goals

The Colorado Basin Roundtable developed six themes in its 2022 BIP, which are supported by goals. The themes represent the Colorado Basin Roundtable's desired outcome or vision, and the basin roundtable supports and funds actions or activities related to the themes. The six themes are connected and interrelated and contain undercurrents of funding, education, climate change, and collaboration.

COLORADO BASIN ROUNDTABLE THEMES

- Protect and restore healthy streams, rivers, lakes, and riparian areas
- Secure safe drinking water
- Sustain agriculture
- Develop local water-conscious land use strategies
- Ensure dependable basin administration
- Encourage a high level of basinwide conservation

Strategic Vision for the Future

Strategies are general actions and pathways identified to meet and support the goals for the Colorado Basin. Strategies are intended to answer the question "How can the basin make progress toward its goals and achieve its vision?". Strategies include:

- Fund the BIP
- Support and promote legislation, policies, and agreements that align with the goals
- Use the IWMP mechanism to reduce risks and enhance benefits across all sectors
- Implement projects that support goals
- Plan for uncertainty in water supply
- Address the gap
- Integrate PEPO Plan with the BIP Update
- Use the Colorado Basin Roundtable's Next Steps Committee to support, foster, and implement these strategies

The Colorado Basin Roundtable vision focuses on providing much-needed water supply while supporting the local economy and protecting valuable resources.

Maroon Bells near Aspen Colorado, Photo credit: Colorado Basin Roundtable

Demand, Supply, and Potential Water Needs

Municipal and Industrial

The Colorado Basin includes about 6 percent of the statewide population. Between the years 2015 and 2050, the population is projected to increase between 48 percent to 88 percent. Municipal demand is projected to increase for all scenarios. The diversion demand projections for all future scenarios are similar.

Agriculture

Urbanization is expected to impact agricultural-based communities. Nearly 14,000 acres of irrigated land is expected to be urbanized, with one-third of that expected to occur within the Grand Valley Project and Grand Valley Irrigation Company service areas. Losses of irrigated area may drive basinwide irrigation water demand down while a warmer future climate drives diversion demands up.

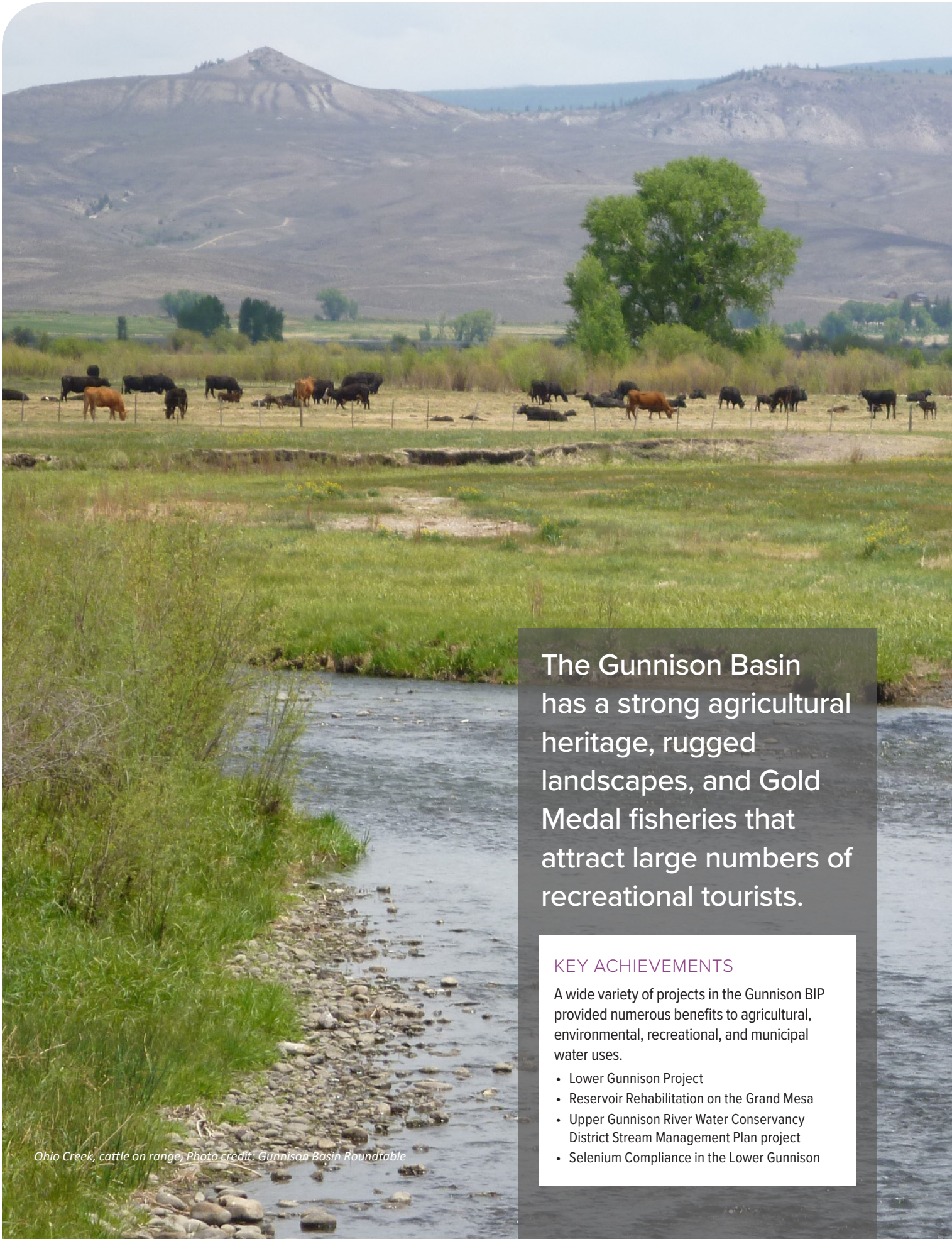
Environment and Recreation

Flows are projected to be variable depending on impacts of climate change. Decreased peak flows across the basin create risks for riparian/wetland plants and fish habitat. Instream flows and recreational in-channel diversions may not be met if June-August flows decrease due to climate change.

Water Supply and Storage

Available water supplies vary by location. Flows are projected to be available each year, though the amounts will vary annually and across scenarios (available flows under the scenarios impacted by climate change are less than in other scenarios). Storage in the Colorado Basin is critical to minimizing gaps.

Climate-adjusted scenarios project a reduction in flows and available water; storage in the Colorado Basin is critical to minimizing future gaps.



Ohio Creek, cattle on range, Photo credit: Gunnison Basin Roundtable

The Gunnison Basin has a strong agricultural heritage, rugged landscapes, and Gold Medal fisheries that attract large numbers of recreational tourists.

KEY ACHIEVEMENTS

A wide variety of projects in the Gunnison BIP provided numerous benefits to agricultural, environmental, recreational, and municipal water uses.

- Lower Gunnison Project
- Reservoir Rehabilitation on the Grand Mesa
- Upper Gunnison River Water Conservancy District Stream Management Plan project
- Selenium Compliance in the Lower Gunnison

GUNNISON BASIN

Basin Overview

The Gunnison Basin encompasses 8,000 square miles in western Colorado extending from the Continental Divide to the confluence of the Gunnison and Colorado rivers near Grand Junction. The Gunnison River is a major tributary of the Colorado River.

The Gunnison River begins at the confluence of the East and Taylor rivers, which are tributaries with headwaters in the Elk and West Elk mountains to the north and the Sawatch Range to the east. Cochetopa and Tomichi Creeks, flowing out of the Cochetopa Hills and San Juan Mountains to the south, join the river at Gunnison. At the upper end of its 53 miles are the reservoirs of the Aspinall Unit (Blue Mesa, Morrow Point, and Crystal). Below the reservoirs is the 14-mile Black Canyon of the Gunnison National Park. Below the canyon, the river crosses into the Colorado Plateau where the North Fork of the Gunnison joins the mainstem and passes the Grand Mesa. Separating the Gunnison Basin from the mainstem Colorado, the Grand Mesa rises a vertical mile to 11,000 feet, which provides dramatic variation in climate and vegetation over a short distance.

The Uncompahgre River is the last major tributary to the Gunnison. It rises among 13,000- and 14,000-foot peaks in the vicinity of Ouray and flows nearly due north. The river valley forms a relatively broad alluvial plain that contains the towns of Montrose, Olathe, and Delta. Beyond the Uncompahgre confluence, the Gunnison River flows northwest to Grand Junction and gains flows from both the Grand Mesa to the east and the Uncompahgre Plateau.[5]

Basin Facts

- Annual precipitation averages more than 40 inches in the high mountains but less than 10 inches in the lower Gunnison and Uncompahgre Valleys.[5]
- Surface water hydrology is snowmelt-driven, with the majority of runoff occurring in two or three months of the year.
- The Gunnison River contributes one-fifth to one-sixth of the overall Colorado Basin's total annual flow leaving the state (considering the mainstem and other basin rivers like the Yampa, White, and those in the Southwest Basin).
- Agricultural use accounts for the majority of water consumption within the basin. More than 250,000 acres are irrigated, which waters pastures, orchards, wine grapes, commodity grains, forage crops, and vegetables.
- Livestock production is an important economic driver, with numerous cow/calf operations using irrigated lands as an important base of operations. In fact, beef production accounts for more than $110 million in yearly economic output (2016 number).[6]
- A recent study determined total economic contributions of water-related recreation activities were $461 million in 2019.[7]
- Hydropower generation is an important nonconsumptive use of surface water throughout the entire basin and has historically used more than 3 million acre-feet per year.

For more information on the Gunnison Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

[5] Boyle Engineering Corporation. 2003. Colorado River Return Reconnaissance Study.

[6] Department of Natural Resources, Division of Minerals and Geology. 2003. Colorado Geological Survey

[7] BBC Research and Consulting, ERO Resources, and Headwater Corporation. 2020. **Upper Basin Demand Management Economic Study in Western Colorado**.

The Gunnison Basin is home to the Black Canyon of the Gunnison National Park and Curecanti National Recreation Area, which are some of the top tourist destinations in the state. Agriculture is the principal consumptive use and accounts for 97 percent of water diversions. Two reservoirs, Taylor Park and Ridgway, are used to store water for supplemental irrigation water supply and release for fish flows. Paonia, Crawford, Silverjack, Gould, Overland, and Fruitgrowers Reservoirs are primarily used for irrigation.[8] The Redlands Power Canal, operated by the Redlands Water and Power Company, exports up to 850 cfs of water to the Colorado Basin for irrigation and power generation.

Water Resources Development Timeline

1909

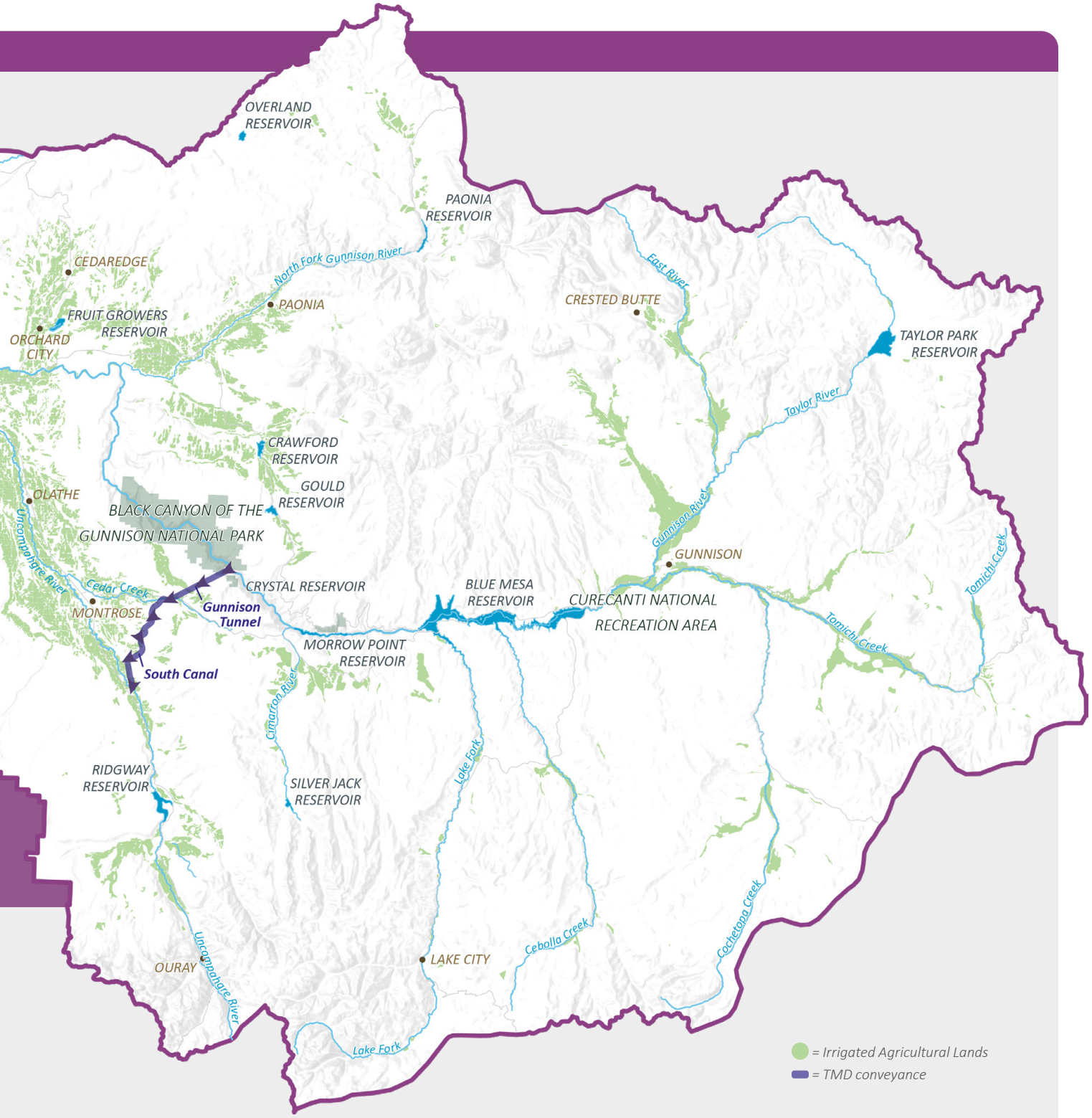
In 1909, the Gunnison Tunnel was completed.[9] The tunnel serves the Uncompahgre Project and brings approximately 390,000 acre-feet annually from the Gunnison River to supply irrigators and municipalities in the tributary Uncompahgre River Basin.

1922

In 1922, the seven Colorado River Basin states entered into the Colorado River Compact. This Compact allocated the consumptive use of the river between the Upper Basin and Lower Basin. Additional compacts and agreements were developed over time, as discussed in Chapter 3.

[8] Colorado Decision Support System. 2004. Gunnison River Basin Information.

[9] American Society of Civil Engineers. 2022. **Historic Landmarks Gunnison Tunnel.**



1956

In 1956, the Colorado River Storage Project Act (CRSPA) was passed. Three reservoirs in the basin–Blue Mesa, Morrow Point, and Crystal–comprise the Aspinall Unit of the CRSPA. CRSPA reservoirs were constructed to allow the Upper Basin states to develop their Colorado River Compact apportionment while meeting their Compact obligations. CRSPA reservoirs also provide important hydroelectric power generation.

2008

In 2008/2009, the Black Canyon of the Gunnison National Park Federal Reserved Water Right was finalized. The water rights decree mandates base instream flow plus a 1-day peak flow, both in amounts to be determined annually according to a formula based on inflows to Blue Mesa Reservoir.[10]

[10] Upper Gunnison Water Conservancy District. 2022. **Black Canyon of the Gunnison National Park Federal Reserved Water Right – UGRWCD**

Basin Challenges

Protecting existing water uses is the unwavering goal and main challenge in the Gunnison Basin. Water users and managers must address how to use the limited water resources to maintain agriculture while providing water for growing municipalities and meeting nonconsumptive needs like environmental, recreation, and hydropower. Stretching water supplies to meet multiple needs will be made more difficult by climate change. Challenges identified in the BIP are:

KEY CHALLENGE

In the Gunnison Basin, stakeholders will need to manage water demand from agriculture and growing communities while also maintaining sufficient flows for endangered species, water-based recreation, and hydropower generation for a range of climate-impacted scenarios.

AGRICULTURE

- Addressing agricultural water shortages across the basin is a significant challenge.
- Lack of financial resources for new infrastructure projects and rehabilitation of aging infrastructure is a major barrier to improved water management.
- Loss of productive agricultural land to other uses remains a concern in many areas.
- Climate-driven change adds risk and uncertainty to agricultural productivity and development.
- Tourism is important in the headwaters, but agriculture is dominant in the Uncompahgre Valley. A rapid influx of retirees and growth in the Uncompahgre Valley may dramatically change land uses in the area.

WATERSHED

- Regulatory drivers associated with the ESA and CWA create a complex set of environmental issues related to water quality, water quantity, and associated impacts to fish and wildlife habitat.
- There is a need for better watershed health-management tools to mitigate wildfire risk and sedimentation in streams.
- Environmental and recreational flows may be met less often in climate-impacted scenarios, especially in reaches with increased consumptive needs.
- Protecting existing supply infrastructure after wildfire is a concern that has not been adequately addressed.

MUNICIPAL AND INDUSTRIAL

- Population growth in the headwater regions will require additional water management strategies.
- Development of irrigated lands around urban areas will continue in all planning scenarios. There are legal and administrative challenges to using water from the converted agricultural lands to fill municipal gaps.
- Climate-driven changes to hydrology may impact the reliability or resiliency of historical municipal supplies.

COMPACTS, ADMINISTRATION, AND REGULATORY

- Successfully resolving endangered species issues on the Colorado River and meeting environmental needs in a manner that does not adversely impact existing uses remains a challenge.
- Changes in the operations of CRSPA reservoirs could impact the Gunnison Basin. Protecting existing uses in the basin is a major concern.

Goals and Strategic Vision for the Future

The Gunnison Basin goals describe the specific things the basin needs to do to meet its future water-related needs, while the strategic vision considers the goals, challenges, and proposed basin projects to concisely describe a long-term strategy for meeting those needs. More specifically, the strategic vision helps advance progress toward the basin goals and ensures that projects supported and funded through the Gunnison Basin Roundtable align with the goals. The basin goals and strategic vision are described below.

Goals

The Gunnison Basin Roundtable developed goals that are consistent with the goals of the Colorado Water Plan and seek to promote a healthy and diverse economy into the future. Nine basin goals were identified. Of the nine, one goal–protect and maintain existing water uses in the Gunnison Basin–is primary. The other eight goals support this primary goal, as shown below. Each of the goals contain corresponding "key components," which are specific actions that will help the basin roundtable achieve its basin goals.

GUNNISON BASIN ROUNDTABLE GOALS

- Protect existing water uses in the Gunnison Basin
- Discourage the conversion of productive agricultural land to all other uses within the context of private property rights
- Improve agricultural water supplies to reduce shortages
- Identify and address municipal and industrial water shortages
- Quantify and protect environmental and recreational uses
- Maintain or, where necessary, improve water quality throughout the Gunnison Basin
- Describe and encourage relationships among agricultural and environmental recreational water uses
- Restore, maintain, and modernize critical water infrastructure
- Create and maintain active, relevant, and comprehensive public education, outreach, and stewardship processes involving water resources in the six sectors of the Gunnison Basin

Strategic Vision for the Future

The Gunnison Basin Roundtable developed a strategic vision that outlines specific strategies on which the basin roundtable will focus near term. These key strategies, listed below, provide a roadmap for meeting basin goals:

- Implement projects
- Leverage funding opportunities
- Expand weather modification programs
- Improve infrastructure
- Protect environmental and recreational values
- Prepare for climate change

The Gunnison Basin Roundtable strives to protect existing water by balancing municipal, agricultural, environmental, and recreational water needs.

Wildflowers in open range, Photo credit: Gunnison Basin Roundtable

Demand, Supply, and Potential Water Needs

Municipal and Industrial

Population growth (by approximately 100,000 people) is the primary driver for the increased municipal and industrial demands across planning scenarios as per capita water use is projected to decrease for every scenario except Hot Growth.

Agriculture

A warmer and drier future climate is projected to result in increased water supply gaps. Diversion demands are expected to decrease in three of the five planning scenarios due to reduction in irrigated land from urbanization and the adoption of water-saving agricultural technologies.

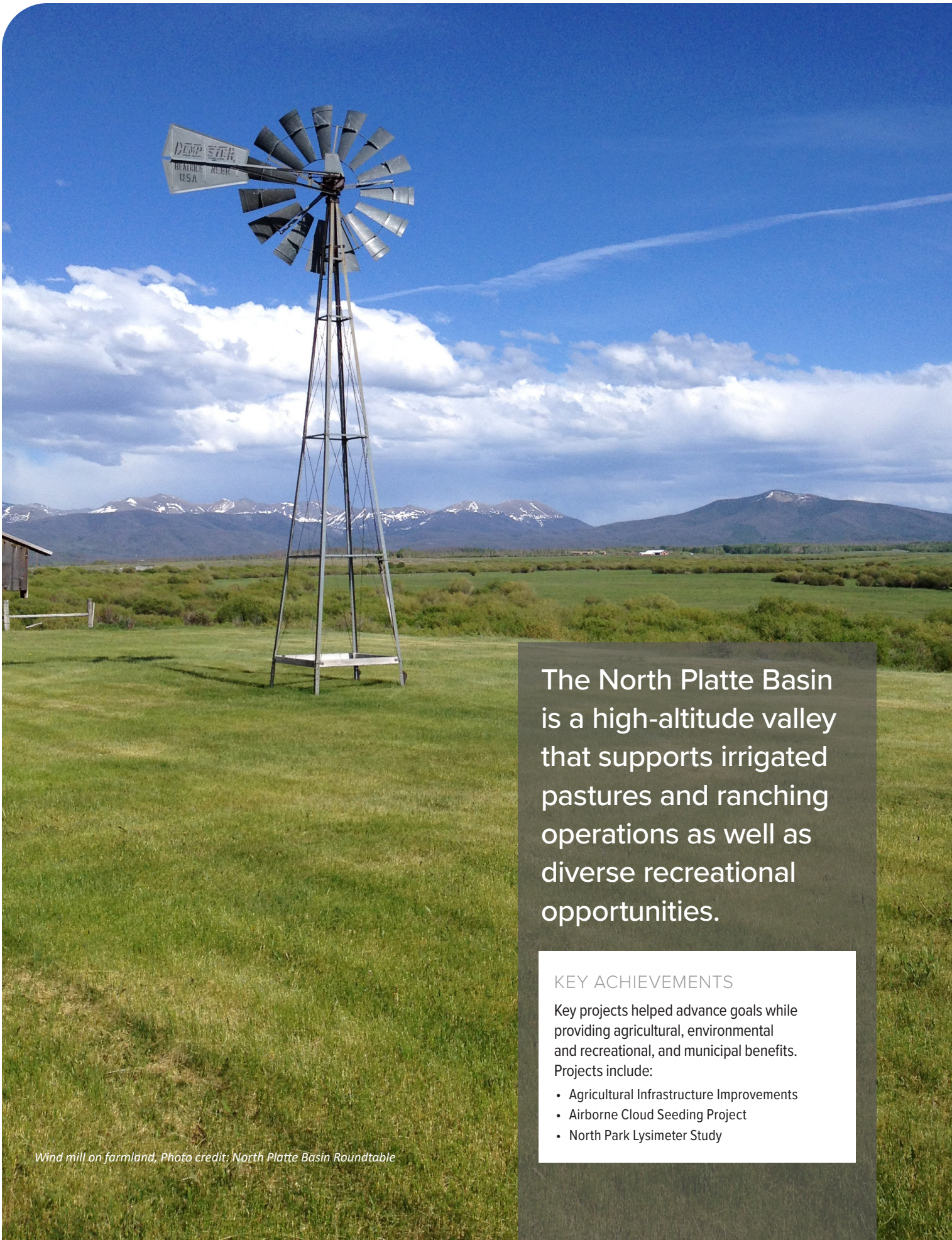
Environment and Recreation

Future environmental and recreational risks include riparian/wetland plants and fish habitat ecological impacts due to climate change. Identifying these risks helps facilitate discussions about projects or strategies that can be implemented to reduce the risks.

Water Supply and Storage

While climate-impacted scenarios show lower amounts of water in storage during dry periods than non-climate-impacted scenarios, storage levels generally recover back to baseline levels after dry periods.

Conservation and efficiency measures can help mitigate issues associated with growing municipal and industrial demands, higher water supply gaps (especially in future scenarios with climate change), and risks to ecological attributes.



Wind mill on farmland, Photo credit: North Platte Basin Roundtable

The North Platte Basin is a high-altitude valley that supports irrigated pastures and ranching operations as well as diverse recreational opportunities.

KEY ACHIEVEMENTS

Key projects helped advance goals while providing agricultural, environmental and recreational, and municipal benefits. Projects include:

- Agricultural Infrastructure Improvements
- Airborne Cloud Seeding Project
- North Park Lysimeter Study

NORTH PLATTE BASIN

Basin Overview

The North Platte Basin, also known as North Park, is a high-altitude valley covering about 2,000 square miles in north-central Colorado. It includes all of Jackson County and the small portion of Larimer County in the Laramie River watershed.

The North Platte Basin drains the north-central portion of Colorado and consists of the North Platte River and two major tributaries: the Laramie River and Sand Creek. The North Fork, Grizzly Creek, Michigan River, Canadian River, and Illinois River are tributaries that flow into the North Platte River in Colorado. Sand Creek and the Laramie River are divided from North Park by the Medicine Bow Mountains, which form the east rim of North Park. They flow northward out of Colorado and join the North Platte River in Wyoming.

Water use in the basin is dominated by irrigated pastures associated with ranching operations. The basin also has a major wildlife refuge in addition to numerous public lands and recreational opportunities.

Basin Facts

- The North Platte Basin is sparsely populated. The largest town in the basin, Walden, is centrally located in Jackson County. It has a population of approximately 600, and it serves as the basin's central hub. Jackson County has approximately 1,400 permanent residents; however, visitors to the region for hunting, fishing, and recreational opportunities expand the population, particularly during summer.
- The North Platte Basin relies on ranching and outdoor recreation, especially hunting, as its main industries. The Arapaho National Wildlife Refuge, as well as other federal land and State Forest State Park, provide excellent fishing, hunting, and wildlife viewing areas.
- Water use in the basin is dominated by irrigated pasture grass, with more than 400 irrigation ditches diverting from the mainstem and numerous tributary streams throughout the basin. Total irrigated area based on 2016 estimates is approximately 113,600 acres, consisting of 110,200 acres in North Park and 3,400 acres in the Laramie River watershed.
- With average annual precipitation in the mountains of approximately 40 inches per year, the many tributaries in the basin are fed by spring snowmelt that results in peak runoff in May and June. Streamflow decreases rapidly throughout the summer and is considerably lower by September and through the winter months.
- The basin's water use is governed by: Nebraska v. Wyoming Equitable Apportionment Decree (2001), The Wyoming v. Colorado (1957) decision, and Colorado's Plan for Future Depletions of the Platte River Recovery Implementation Program (2006).

For more information on the North Platte Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

In the North Platte Basin, ranching is a way of life, with grass hay primarily grown to support cattle operations. Hunting, fishing, and recreational opportunities are plentiful and support a strong tourism industry. There are two Gold Medal water designations—Delany Butte Lakes, and North Platte River from the southern boundary of the Routt National Forest downstream to Wyoming. The Arapaho National Wildlife Refuge is in the heart of the basin. It provides important habitat for waterfowl, migratory birds, and local wildlife. The North Platte Basin is home to the only state forest in all of Colorado. In addition, the North Platte and Laramie River basins export water to the South Platte Basin for agricultural, municipal, and industrial purposes.

Water Resources Development Timeline

1945

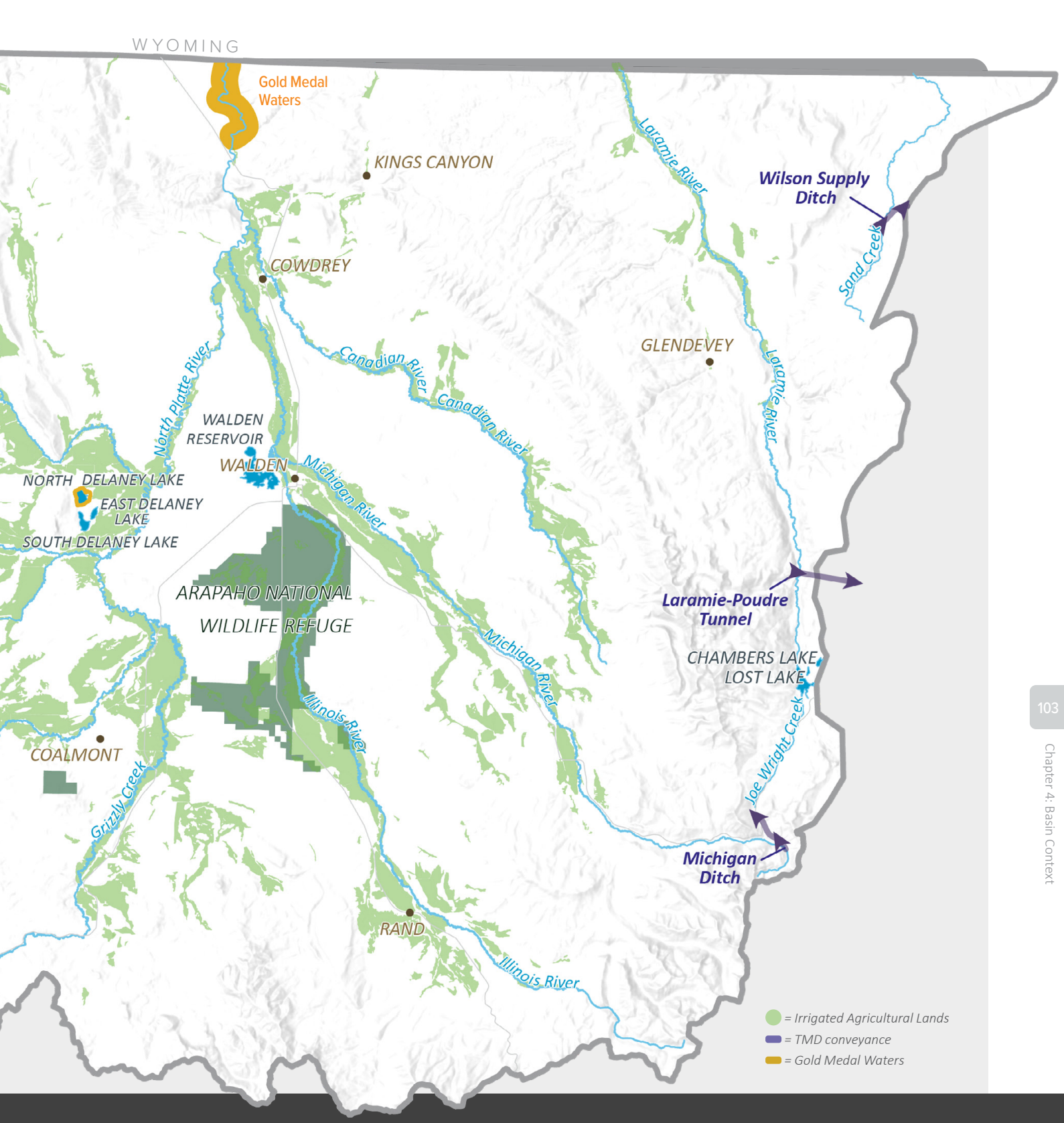
In 1945, the Nebraska v. Wyoming decree was issued after 11 years of litigation. The decree made an equitable apportionment of the water use among Colorado, Wyoming, and Nebraska.

1957

In 1957, the Wyoming v. Colorado decision established the rights of Colorado and Wyoming to water in the Laramie River and limits Colorado's total diversions and exports from the basin.

1967

In 1967, the Arapaho National Wildlife Refuge was established to provide suitable nesting and rearing habitat for migratory birds. The 23,634-acre refuge supports diverse wildlife habitats, including sagebrush steppe uplands, grassland meadows, willow riparian areas, and wetlands.



2001

In 2001, the Nebraska v. Wyoming settlement package, a comprehensive agreement between Colorado, and Nebraska resolving outstanding issues and laying out a program for future cooperation and oversight, was approved. The agreement limits the amount of available storage supplies and lands that can be irrigated on the North Platte Basin as well as exports from the basin.

2006

In 2006, the Colorado's Plan for Future Depletions of the Platte River Recovery Implementation Program (PRRIP) was finalized. The PRRIP uses land, water, and funding components to protect critical habitat located in Nebraska and provide ESA compliance for water projects in Colorado, Nebraska, and Wyoming.

Basin Challenges

The North Platte Basin faces several key issues and challenges pertaining to water management, endangered species, and resource development. Challenges identified in the BIP are:

KEY CHALLENGE

The North Platte Basin will need to balance limits to consumptive uses and endangered species issues with sustaining the basin's agricultural economy and protecting forest and overall watershed health.

AGRICULTURE

- Gaining a better understanding of the basin's consumptive uses and high-altitude crop coefficients
- Increasing agricultural demands and unmet needs by 8 to 14 percent due to potential climate change, though agronomic practices and technological improvements may offset these effects
- Developing water supplies to serve additional irrigated area while maintaining compliance for endangered species
- Maintaining and replacing aging agricultural infrastructure to preserve existing uses, increase efficiencies, and put additional acreage into production

WATERSHED

- Maintaining healthy rivers through the strategic implementation of projects that meet prioritized environmental and recreational needs
- Monitoring and enhancing forest health and management efforts as it relates to forest beetle kill and potential wildfires in the basin
- Peak runoff timing potentially occurring earlier in the year with climate change, which poses potential risks to trout fisheries

MUNICIPAL AND INDUSTRIAL

- Increasing economic development and diversification through strategic water use and development
- Developing water supplies, such as storage and augmentation plans, for future industrial opportunities

COMPACTS, ADMINISTRATION, AND REGULATORY

- Maintaining compliance with the equitable apportionment decrees on the North Platte and Laramie Rivers that quantify the amount of available water and lands that can be irrigated
- Continue collaborative approach to providing for the needs of endangered species while protecting existing uses
- Promoting water-rights protection and management through improved streamflow-gaging data

Goals and Strategic Vision for the Future

The North Platte Basin goals describe the specific things the basin needs to do to meet its future water-related needs, while the strategic vision considers the goals, challenges, and proposed basin projects and concisely describes a long-term strategy for meeting those needs. More specifically, the strategic vision aims to help make progress toward the basin goals and ensures that projects supported and funded through the North Platte Basin Roundtable align with the goals. The basin goals and strategic vision are described below.

Goals

The North Platte Basin Roundtable developed goals and supporting processes that promote a productive economy, efficient and effective infrastructure, and a strong environment. Eight basin goals were identified. The principal objective underlying the goals is the maximum beneficial use of water allowable under the Equitable Apportionment Decree while maintaining compliance with the PRRIP. Each goal contains a realistic and attainable process for achieving a successful outcome, which are actions that will help the basin achieve its goals.

NORTH PLATTE BASIN ROUNDTABLE GOALS

Maintain and maximize the consumptive use of water permitted in the Equitable Apportionment Decree and the baseline depletion allowance in Colorado's Plan for Future Depletions

Increase economic development and diversification through strategic water use and development

Continue to restore, maintain, and modernize critical water infrastructure to preserve current uses and increase efficiencies

Maintain healthy rivers and wetlands through the strategic implementation of projects that meet prioritized environmental and recreational needs

Describe and quantify the environmental and recreational benefits of agricultural use

Promote water rights protection and management through improved streamflow gaging data

Enhance forest health and management efforts for wildfire protection and beetle kill impacts to watershed health

Support the continued development of local municipal infrastructure and water supplies

Strategic Vision for the Future

Project implementation is the primary strategy of the North Platte BIP for addressing basin goals. The BIP included project implementation strategies, which are discrete steps to take projects from conception to completion. These implementation strategies typically involve two primary categories of action prior to project completion: securing project acceptance and demonstrating project feasibility. The strategies are:

- Implement projects
- Address constraints to project implementation

The table to the right summarizes strategies to overcome constraints related to securing project acceptance and demonstrating project feasibility to allow implementation of projects proposed for the North Platte Basin.

The North Platte Basin Roundtable prioritizes sustaining agricultural development while protecting endangered species, developing resources, and maintaining healthy forests and watersheds.

Project Constraints and Implementation Strategies

CATEGORY	CONSTRAINT	STRATEGIES
PROJECT ACCEPTANCE	*Conflict*	**1. Partnerships** **2. Cooperative Strategies**
	Perception	**3. Public Education and Outreach** **4. Incentive-based Programs**
	Regulations	**5. Cooperative Strategies** **6. Regulatory Streamlining**
PROJECT FEASIBILITY	*Cost*	**7. Creative Funding Mechanisms**
	Water Availability	**8. Water Availability Analyses** **9. Water Administration Strategies**
	Constructability	**10. Project Constructability Analyses**

North Platte, Photo credit: North Platte Basin Roundtable

Demand, Supply, and Potential Water Needs

Municipal and Industrial

Between the years 2015 and 2050, the population is projected to range from a 22 percent decrease in population to an increase of 8 percent. Also, relatively small municipal and industrial demands reflect the rural nature of this basin, and there is little anticipated municipal growth.

Agriculture

Technology improvements will increase irrigation efficiency, and there will be an increase of irrigated land due to planned projects. Climate impacts will increase the agricultural gap by 8 to 16 percent, which is a potential risk to this economic driver. Loss of irrigated land due to urbanization is minor in Adaptive Innovation and Hot Growth.

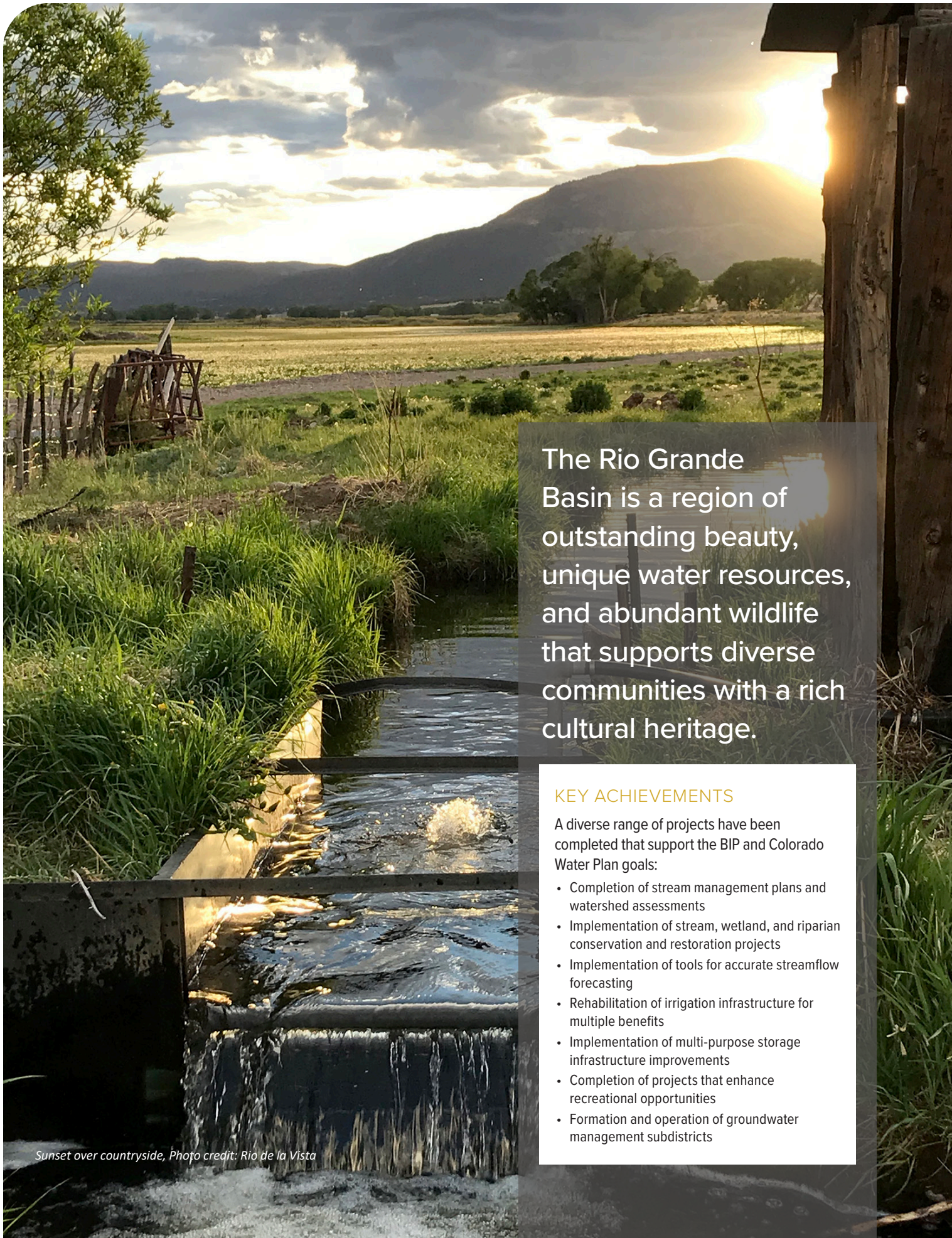
Environment and Recreation

The Flow Tool results indicated that projected changes in climate will put environmental and recreational projected flows and attributes at risk. Climate change may lessen the risk for maintaining riparian/wetland plants and fish habitat due to greater peak flows earlier in the spring. Earlier peak flows lead to lower flows in the summer and fall and thus impact fishery health.

Water Supply and Storage

Water is projected to be available in most years but varies greatly depending on snowpack and runoff. Climate-impacted conditions are projected to shift the peak flow earlier in the year, which may lead to increased agricultural gaps later in the irrigation season. Basinwide storage supplies are projected to vary but will generally remain viable and similar to current conditions.

Agricultural demands are anticipated to increase, and climate-impacted scenarios present larger gaps in addition to risks to environmental attributes; however, basinwide storage supplies will generally remain similar to current conditions.



Sunset over countryside, Photo credit: Rio de la Vista

The Rio Grande Basin is a region of outstanding beauty, unique water resources, and abundant wildlife that supports diverse communities with a rich cultural heritage.

KEY ACHIEVEMENTS

A diverse range of projects have been completed that support the BIP and Colorado Water Plan goals:

- Completion of stream management plans and watershed assessments
- Implementation of stream, wetland, and riparian conservation and restoration projects
- Implementation of tools for accurate streamflow forecasting
- Rehabilitation of irrigation infrastructure for multiple benefits
- Implementation of multi-purpose storage infrastructure improvements
- Completion of projects that enhance recreational opportunities
- Formation and operation of groundwater management subdistricts

RIO GRANDE BASIN

Basin Overview

The Rio Grande Basin is surrounded by three mountain ranges: the Sangre de Cristo to the east, the Culebra Range to the southeast, and the San Juan Mountains to the west, and is bound by the Colorado-New Mexico state line to the south. Between these mountain boundaries and the state line lies the San Luis Valley, a unique geographic feature. The San Luis Valley is a high-elevation desert with an average elevation of approximately 7,500 feet and average annual precipitation of less than 8 inches.[11] Despite the low precipitation on the valley floor, agriculture has long been the basis of the Rio Grande Basin's economy. Snowmelt runoff and summer storms from the surrounding mountains supply the vast majority of water to streams and aquifers, which support irrigated agriculture, recreation, municipal and industrial uses, and important riparian and wetland ecosystems. The extensive riparian and wetland habitats support over 160 species of birds, including the entire Rocky Mountain Population of greater sandhill cranes.

The northern third of the Rio Grande Basin is a closed basin, meaning runoff from the surrounding mountains and diversions from the Rio Grande recharge the basin's groundwater aquifers, rather than contribute to the surface water flow of the Rio Grande. Irrigated agriculture in the Rio Grande Basin relies heavily on well pumping from the aquifers as well as surface deliveries supplied by the Rio Grande, Conejos River, and other streams. These diversions are applied directly to crops and, due to the nature of the basin's hydrogeology, contribute to recharge of the unconfined and confined aquifers.

The Rio Grande Basin also has a long history of water resources development and holds many of the oldest adjudicated water rights in Colorado, including acequias. The Rio Grande Basin is made up of diverse communities with a rich cultural heritage. Many historic and traditional water uses and management practices continue today. The Rio Grande Basin Roundtable is committed to cultivating a culture of accessibility and inclusivity that reflects the basin's diverse communities and values.

Basin Overview facts

- The San Luis Valley is a high-elevation desert that receives less than 8 inches of precipitation per year. Precipitation is more abundant in higher elevations surrounding the valley.
- Water diverted for irrigation from streams is fed by snowmelt. Dry-year runoff can be eight times less than average. Reservoirs store water from streams and release water when irrigators need it most.
- Groundwater is an important water supply in the San Luis Valley; however, the supply is declining.
- Agriculture is the primary economic driver in the basin, with roughly 520,000 acres of irrigated land. Potatoes are one of the primary crops grown in the basin, making it the second-largest fresh market potato growing region in the nation.
- Watershed planning has targeted rehabilitation of aging infrastructure, restoration of natural stream channels, and improved recreational access to the river.
- The basin's thriving tourism industry is water and snow dependent, and its 2 million acres of public land, which includes the Rio Grande National Forest, Great Sand Dunes National Park and Preserve, several wilderness areas, wildlife areas and refuges, and the Wolf Creek Ski Area, attracts thousands of visitors to the region annually.

For more information on the Rio Grande Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

[11] **San Luis Valley - Colorado Encyclopedia**

The Rio Grande Basin's borders are defined by the Colorado–New Mexico state line on the south, the La Garita range on the north, the San Juan Mountains on the west, and the Sangre de Cristo and Culebra mountains on the east. Between these mountains lies the San Luis Valley, a large intermountain valley that is part of the larger Rio Grande rift. The northern third of the basin is a closed basin, meaning runoff from the surrounding mountains and diversions from the Rio Grande recharge the basin's groundwater aquifers, rather than contribute to surface water of the Rio Grande. Reservoir storage is limited but critically important for basin water users. The basin supports a strong agricultural economy, with roughly 520,000 acres of irrigated land and Colorado's oldest water right. Recreational opportunities abound, due in part to abundant wildlife supported by extensive wetlands and riparian areas.

Water Resources Development Timeline

1852

In 1852, the San Luis People's Ditch made its first use of water and is the oldest water right in Colorado. Still used today to irrigate more than 2,000 acres of land with water diverted from the Culebra Creek, the ditch is the oldest community irrigation ditch in Colorado.

1900

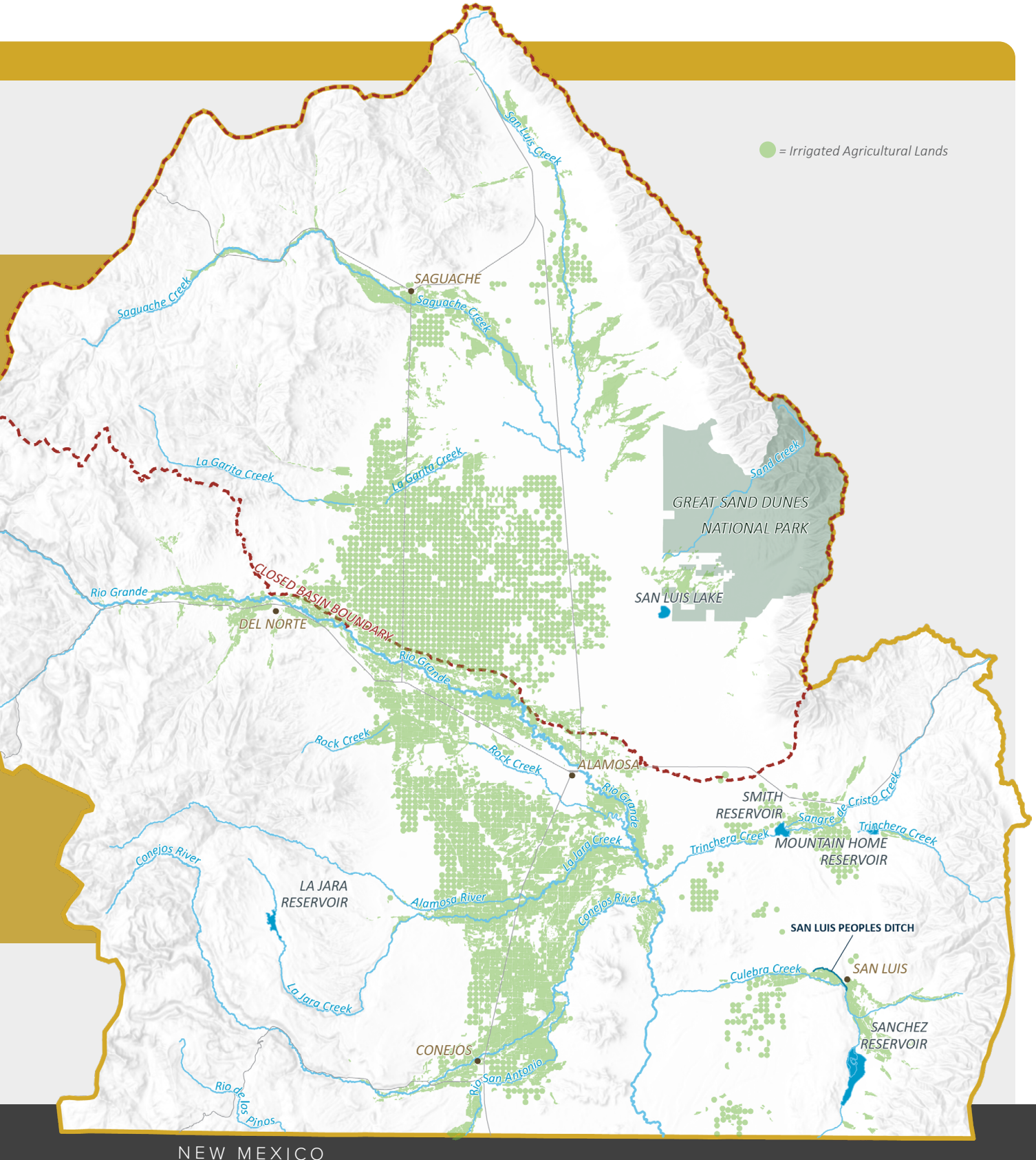
Surface streams in the San Luis Valley were over-appropriated in approximately 1900.

1938

The interstate Rio Grande Compact of 1938 among Colorado, New Mexico, and Texas equitably apportions the waters of the Rio Grande above Fort Quitmas, Texas. The volume of water that Colorado and New Mexico must deliver varies annually based on streamflow at designated index gages.

1963

The Amended Costilla Creek Compact of 1963 equitably apportioned the waters of Costilla Creek between Colorado and New Mexico.



1972

In 1972, Congress authorized the Closed Basin Project, which consists of numerous wells and canals that deliver water to the Rio Grande. Project deliveries help the State of Colorado meet its compact commitments, enhance wildlife in protected areas, and allow for greater diversions upstream where the water is needed for irrigation.

1972

The State imposed a moratorium on the construction of new high capacity wells in the confined aquifer and aquifers tributary to the Rio Grande.

1981

The State imposed a moratorium on the construction of new high capacity wells in the unconfined aquifer of the San Luis Valley closed basin.

2004

Senate Bill 222 passed, requiring sustainable use of Rio Grande Basin aquifers. Following SB 222, the Rio Grande Basin implemented Groundwater Measurement Rules, Confined Aquifer Rules, and formation and management of groundwater management subdistricts.

2015-2021

Well Rules and regulations were submitted (2015), approved by water court (2019) and came into effect (2021).

Basin Challenges

Water management challenges in the Rio Grande Basin are centered around aquifer sustainability, maintaining and providing surface and groundwater supply for existing uses and new growth, and operating within the constraints of the Rio Grande Compact. Challenges identified in the BIP are:

KEY CHALLENGE

Balancing surface and groundwater supply and demand.

AGRICULTURE

- Diminishing supplies that call for reduced pumping as a result of unsustainable groundwater use in the unconfined aquifer.
- Mitigating potential economic fallout of the projected reduction in irrigated acres.
- The scope and financial resources needed to replace and improve aging and inefficient irrigation infrastructure.

WATERSHED

- Changing conditions of the watershed, including stream and wetland degradation, affect water supply, with direct impacts to environmental, recreational, and agricultural attributes.
- Water-dependent wildlife species are being considered for, or are already listed as, “threatened” or “endangered” under the ESA.

MUNICIPAL AND INDUSTRIAL

- Most cities and towns are supplied by groundwater wells and must comply with the State Engineer’s Well Rules and Regulations.
- Growth of commercial uses throughout the basin, new homes near Alamosa, and second homes in the surrounding mountains are creating a need for additional water supplies and well augmentation.
- Resources are needed to upgrade aging municipal infrastructure and to comply with water quality standards.

COMPACTS, ADMINISTRATION, AND REGULATORY

- The continued operation of the Rio Grande Compact and water rights administration under changing and variable hydrologic conditions.

CROSS-SECTOR CHALLENGES

- Achieving confined and unconfined aquifer sustainability, as defined by statute and the Division 3 groundwater use rules, within the timeline established by the State Engineer and local groundwater management plans.
- Prolonged and lingering drought, wildfires, beetle kill, ecosystem degradation, climate change, extreme weather, flooding, and dust-on-snow impacts on timing and amount of water supply. These large disturbances can cause severe and lasting impacts on watershed health, including current and future decreases in average streamflow and water tables.
- The need for updated and additional storage, and the costly and time-consuming permitting process of these water projects.
- Increased pressure for transmountain water exports.
- Adequate funding for project implementation.

Goals and Strategic Vision for the Future

The Rio Grande Basin goals describe a long-term vision for the basin and ultimately strive for a resilient and healthy watershed and economy for generations to come. The strategic vision for the future focuses on near-term progress towards these goals, ensuring that projects supported and funded through the Rio Grande Basin Roundtable align with the goals. The basin goals and strategic vision are described below.

Goals

The Rio Grande Basin Roundtable developed goals that are consistent with the Colorado Water Plan and strive for healthy watersheds, sustainable aquifers, and vibrant thriving communities.

RIO GRANDE BASIN ROUNDTABLE GOALS

Healthy watersheds that provide critical ecosystem services, are resilient to disturbances, and benefit from ongoing efforts to protect water sources, improve water quality, maintain connected ecosystems, and enhance aquatic, riparian, wetland, and upland habitat.

Aquifers with sustainable supplies of groundwater for farmers and ranchers, towns, and wildlife habitat.

Vibrant and resilient agricultural, recreational, municipal, and industrial economies that support thriving communities.

Water administration that is adaptive, flexible, and creative while complying with state statutes and the doctrine of prior appropriation, and fully utilizing Colorado's entitlements under the Rio Grande and Costilla Creek Compacts.

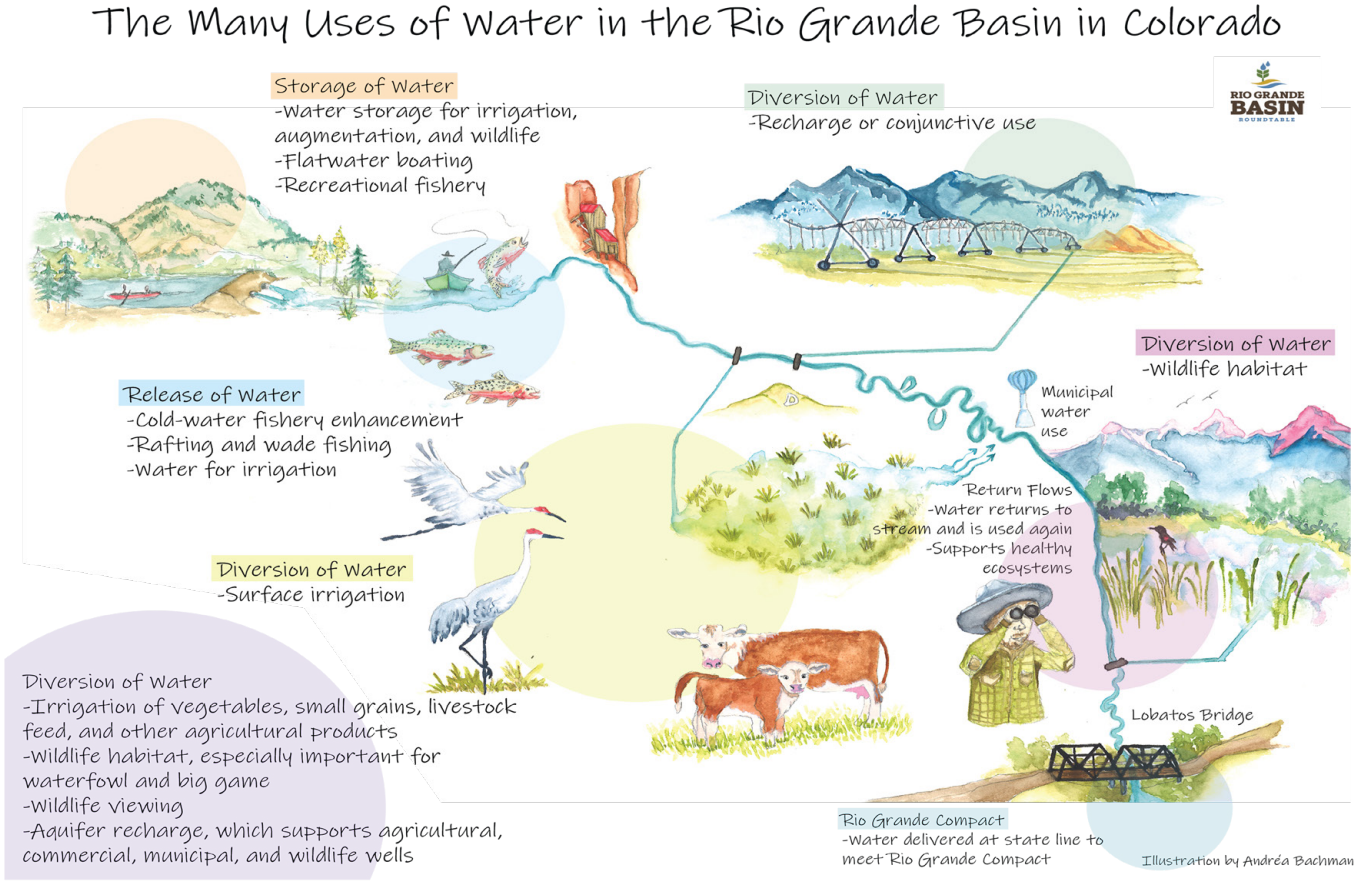
Engaged and informed citizens who understand the scope and urgency of local, state, and regional water issues and participate in robust and diverse educational opportunities.

Strategic Vision for the Future

The Rio Grande Basin faces significant water resources management challenges now and into the future. To help meet the basin's water needs, the Rio Grande Basin Roundtable developed specific strategies that work toward a vision of achieving a sustainable water future for a variety of water users and uses. Basin stakeholders recognize that water can meet multiple needs as it flows through the Rio Grande Basin, as illustrated below. Therefore, implementation of future strategies will require continued coordination, innovation, and a focus on achieving multiple benefits. The Rio Grande Basin Roundtable will pursue the following strategies:

- Support flexible and adaptive water management
- Implement diverse and multi-purpose projects
- Address agricultural supply gaps through increased efficiency and by upgrading water storage and other agricultural infrastructure
- Support environmental and recreational attributes through habitat conservation and restoration
- Conduct municipal water infrastructure upgrades
- Implement projects to meet potential future water supply gaps

To help meet the basin's current and future water needs, the Rio Grande Basin Roundtable, stakeholders, and the community will employ adaptive strategies that promote resilience and allow for flexible water-sharing agreements, within the context of Colorado's water laws.



The Many Uses of Water in the Rio Grande *(illustration by Andréa Bachman)*

Demand, Supply, and Potential Water Needs

Municipal and Industrial

Between the years 2015 and 2050, the Rio Grande Basin population is projected to change between an 8 percent decrease in population to an increase of 46 percent. The anticipated population growth is the main driver for the modest increases in municipal and industrial demands in the planning scenarios.

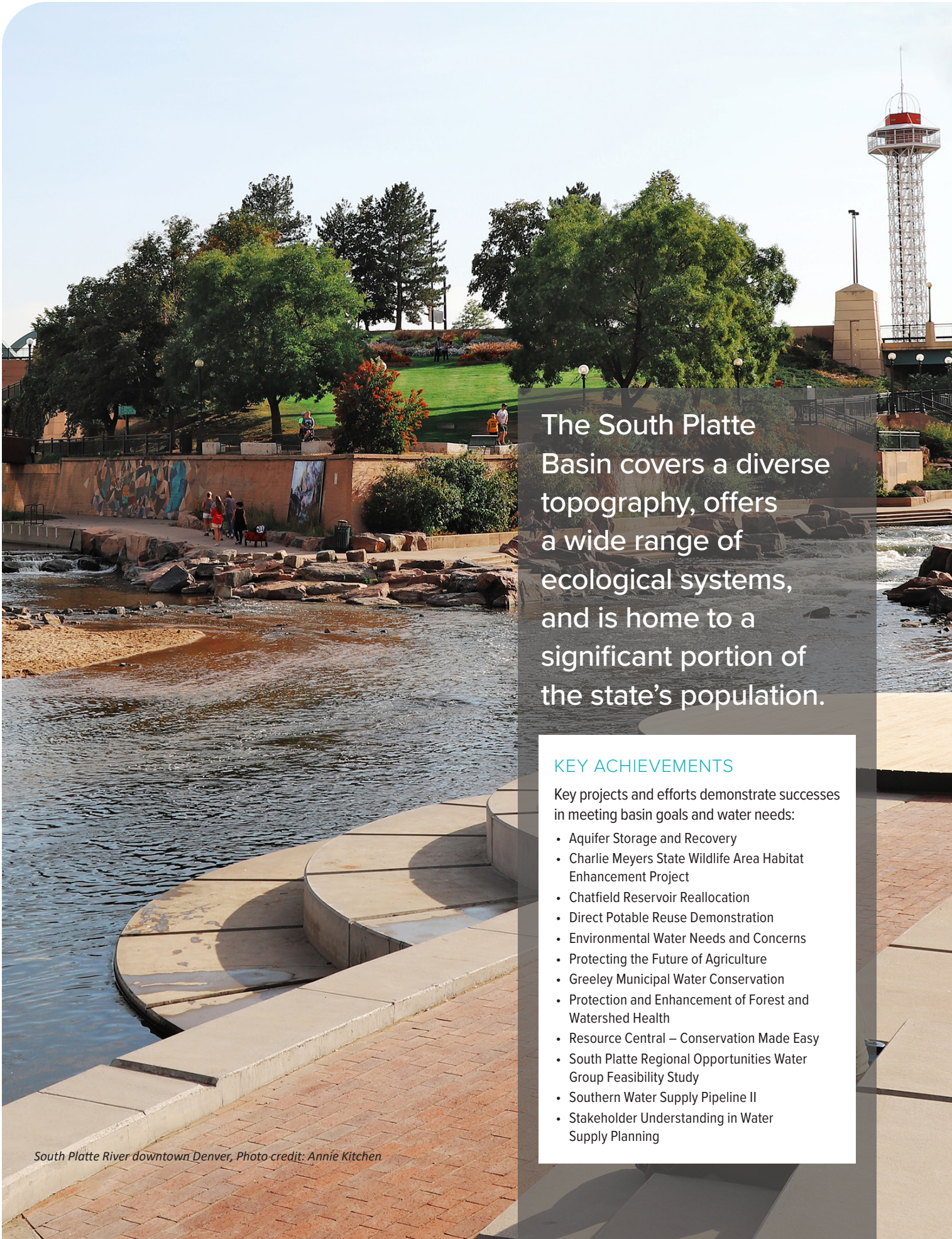
Agriculture

All future scenarios of basinwide agricultural demands are lower than baseline because of irrigated acreage reductions required to meet aquifer sustainability requirements. Agricultural water users in the basin recognize that the baseline gap reflects current deficit irrigation practices; therefore, the agricultural water strategies for the basin focus on preventing future increases in the existing gap.

Environment and Recreation

Climate change and altered hydrology are expected to impact environmental and recreational attributes. Spring runoff peak flows are expected to occur earlier in the future along with potential lower flows in the late summer. This shift could increase risk for cold-water fish species and adversely affect spawning windows. The shift will likely impact recreational fishing and boating opportunities. Finally, these changes in hydrologic conditions will decrease water availability for a variety of wetland and riparian habitats.

Climate-impacted scenarios project increased variability in water supplies, which will have impacts on all water uses and will require collaborative water management strategies.



South Platte River downtown Denver, Photo credit: Annie Kitchen

The South Platte Basin covers a diverse topography, offers a wide range of ecological systems, and is home to a significant portion of the state's population.

KEY ACHIEVEMENTS

Key projects and efforts demonstrate successes in meeting basin goals and water needs:

- Aquifer Storage and Recovery
- Charlie Meyers State Wildlife Area Habitat Enhancement Project
- Chatfield Reservoir Reallocation
- Direct Potable Reuse Demonstration
- Environmental Water Needs and Concerns
- Protecting the Future of Agriculture
- Greeley Municipal Water Conservation
- Protection and Enhancement of Forest and Watershed Health
- Resource Central – Conservation Made Easy
- South Platte Regional Opportunities Water Group Feasibility Study
- Southern Water Supply Pipeline II
- Stakeholder Understanding in Water Supply Planning

SOUTH PLATTE BASIN

Basin Overview

The South Platte Basin is Colorado's most industrialized and populous basin, and with more than 850,000 irrigated acres also has the greatest concentration of irrigated agricultural lands in Colorado. Approximately 70 percent of Colorado's population resides in the South Platte Basin, and the Front Range area of the basin is Colorado's economic engine. The combined South Platte and Metro basins (including the Republican River Basin) covers approximately 27,700 square miles in northeast Colorado. The largest cities in the basin are Denver, Aurora, and Fort Collins.

The topography of the South Platte Basin is diverse and originates in the mountain streams along the northern portion of the Front Range. After emerging from the forested mountains southwest of the Denver metropolitan area, the main stem moves north through the Denver urban area, then east across the High Plains, which is mainly grassland and planted/cultivated land. Major tributaries include Bear Creek, Boulder Creek, Cherry Creek, Clear Creek, St. Vrain Creek, Big Thompson River, and the Cache la Poudre River. The South Platte River crosses the Colorado-Nebraska state line near Julesburg and merges with the North Platte River in southwestern Nebraska to form the Platte River.

The Republican River drains approximately 7 percent of the state's area in northeastern Colorado. The area is mostly agricultural, with more than 550,000 irrigated acres. Some water supply in the basin comes from the Republican River and its tributaries, but the primary source of water is groundwater from the Northern High Plains Aquifer, also known as the Ogallala Aquifer.

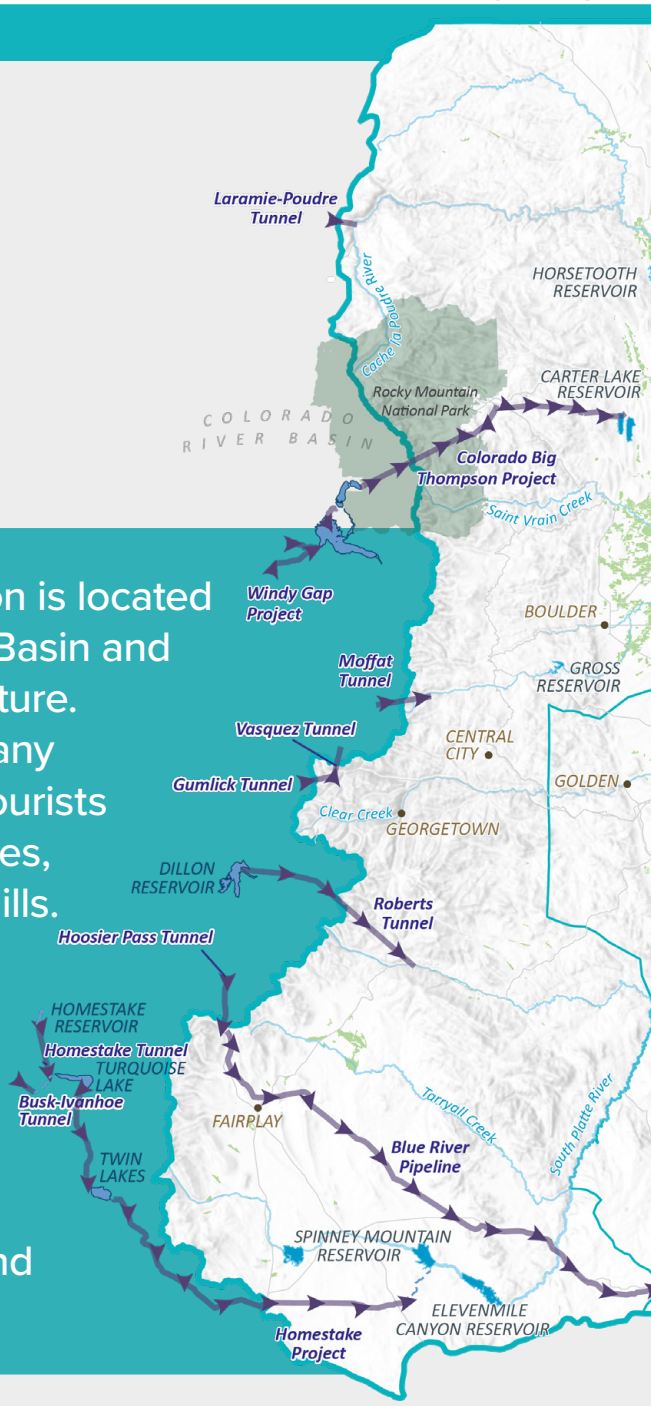
Basin Overview Facts

- In general, most of the precipitation falls as rain in the late spring and as snow during winter, with dry conditions in between. The average October-April precipitation in the basin varies from 3 inches in the lower plains to 22 inches in the mountains, and 6 and 15 inches, respectively, for the plains and mountains during May-September.
- The hydrology of the South Platte Basin is highly variable, with about 70 percent of the annual streamflow occurring during spring runoff.
- The amount of diversion exceeding native flow highlights the return flow-dependent nature of the basin's hydrology and the basinwide efficient use and reuse of water supplies.
- Groundwater resources of the South Platte Basin consist primarily of a relatively shallow unconfined alluvial aquifer along the mainstem and tributaries and the deeper, confined Denver Basin aquifers below some areas of the basin. The Republican River Basin is underlain by the High Plains or Ogallala aquifer, which is one of the largest aquifer systems in the United States.
- Several communities in the southern Denver metropolitan area are growing rapidly and rely on nonrenewable groundwater (Douglas and Arapahoe counties).
- Urban business and industry within the basin drive the majority of the state's overall economy. The basin is also the highest-producing basin in the state in terms of the value of agricultural products sold.
- The basin supports a wide range of ecological systems and important water-dependent recreational and ecological attributes. Coloradans and tourists regularly enjoy the recreational opportunities provided by the basin's many environmental features.

For more information on the South Platte Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

SOUTH PLATTE BASIN OVERVIEW

Approximately 70% of the state's population is located along the Front Range in the South Platte Basin and it is projected to continue to grow in the future. Rocky Mountain National Park is one of many places in the basin that draws locals and tourists into the great outdoors. Gold Medal fisheries, rafting, and skiing abound along the Foothills. With more than 850,000 irrigated acres, the South Platte River Basin irrigates the most acreage of any basin in the state. Irrigation and municipal water demands in the basin require significant storage, groundwater pumping, and transmountain imports from the West Slope to manage and supplement in-basin supplies.



Water Resources Development Timeline

1800s

In the late 1800s, agricultural water rights for irrigation and storage began to be developed throughout the South Platte Basin.

1923

In 1923, Colorado and Nebraska formalized the South Platte River Compact, which appropriates the rights to use water in the South Platte River and Lodgepole Creek.

1928-1936

Built in 1928, Moffat Tunnel was the largest railroad tunnel in the Western Hemisphere. In 1936, Denver Water began diverting water through a pipeline in the Moffat Tunnel for transmountain use, conveying water via South Boulder Creek and Gross Reservoir to meet Front Range water demands.

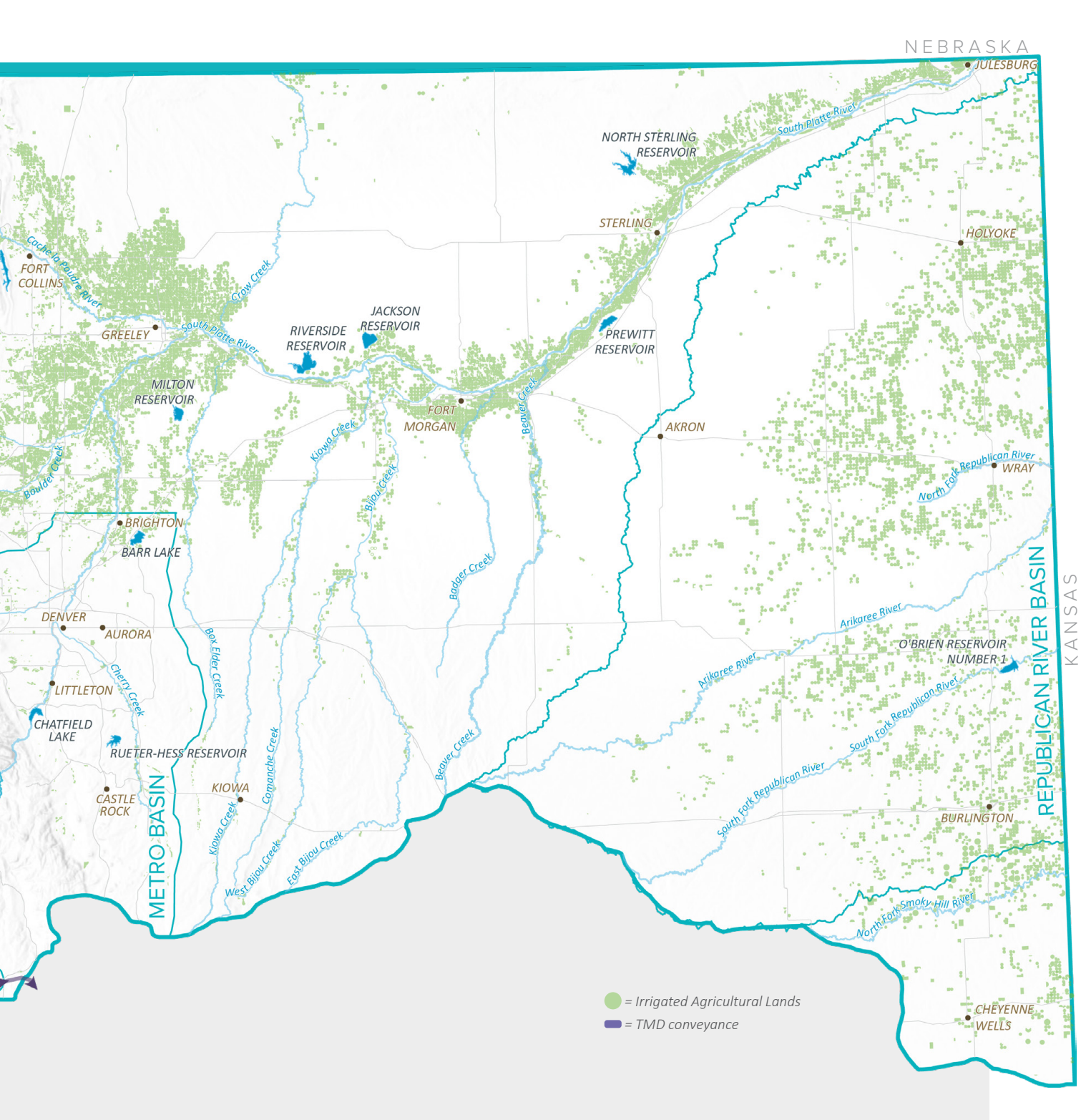
1937

Colorado–Big Thompson Project was authorized in 1937 by Franklin D. Roosevelt. Construction began on Green Mountain in 1938 and continued for the next 20 years. The project was originally built to generate hydropower and meet agricultural demands, but the population growth along the Front Range has shifted demands to municipal and industrial uses.

1943

Following drought in the 1930s and a flood to the Republican River basin in 1935, Colorado, Kansas, and Nebraska negotiated the Republican River Compact in 1943 to apportion the basin's water supply among the three states.[12]

[12] Republican River Compact Administration. 2022.



1956

Harold D. Roberts Tunnel construction began in 1956 to transport Colorado River water from Dillon Reservoir through the Roberts Tunnel and to the North Fork of the South Platte River. Water supplies conveyed across the Continental Divide help meet Front Range water demands.

1967

In 1967, the Homestake Project was completed. The project was a joint undertaking of the Cities of Aurora and Colorado Springs to export water from the upper Eagle River to the Arkansas and South Platte Basins.

1985

In 1985, Senate Bill 5, also known as the Denver Basin Rules, provided the legal framework for how groundwater in the Denver Basin should be allocated.

2002

In 2002, the Republican River Compact's Final Settlement Stipulation was signed, which included detailed accounting procedures and a jointly developed groundwater model.

2007

In 2007, PRRIP began. The program works to assist in the recovery of four target species while providing water users with regulatory certainty and ESA compliance.

Basin Challenges

Water users and managers in the South Platte and Republican River basins currently face many challenges meeting municipal, industrial, and agricultural water needs while maintaining or enhancing environmental and recreational resources. These challenges can lead to conflicts that force water users to make difficult choices in meeting their existing and future needs. Challenges identified in the BIP are:

KEY CHALLENGE

Challenges in the South Platte and Republican River basins are related to water scarcity. Growth, coupled with existing scarcity and future uncertainty, will stress already-overallocated water resources. On a positive note, scarcity has led to many creative water supply solutions and opportunities.

AGRICULTURE

- Many groundwater irrigators rely on alluvial aquifer recharge for augmentation supply, but high groundwater tables have presented challenges in some areas. Also, recharge supplies sometimes go unused and could potentially be optimized.
- Urbanization and permanent transfer of agricultural supplies for municipal and industrial use will decrease irrigated lands and impact the agricultural economy and open space.
- Financial resources are needed to maintain or replace aging irrigation infrastructure.
- The rapid increase in value of water rights makes it difficult to acquire additional irrigation supplies and increases “buy and dry” pressure.

WATERSHED

- Protection of watersheds and the forests within them requires management of large areas of land that may be owned or managed by multiple entities and may be difficult to access.
- While funding assistance programs exist, they do not fully meet the need for watershed and environmental and recreation project planning and implementation.
- Climate change may degrade watershed health, increase the risk of wildfire, impair water quality, and increase risk to environmental and recreation attributes.
- Additional data are needed to evaluate the health of streams and watersheds more completely and identify ways to improve conditions.
- Identifying environmental and recreational flow needs is challenging because of technical issues and lack of data, and also due to overlapping and sometimes competing environmental and recreation needs.

MUNICIPAL AND INDUSTRIAL

- Reuse is an important source of supply, and strides are being made to overcome technical, regulatory, and public acceptance obstacles that currently hinder expanding water reuse.
- Improving municipal and industrial water use efficiency will remain a key element of water resources management, but significant future gains will require continued, concerted efforts.
- While the Denver Basin aquifer can be a viable water supply, it is challenged by uncertainty in statutory allocation of water and declining water levels that may limit its use to only drought resilience in some areas.
- Financial and regulatory uncertainty are impacting the successful implementation of long-planned water projects, which may exacerbate future shortages in the basin.

COMPACTS, ADMINISTRATION, AND REGULATORY

- The Republican River Basin will continue to be challenged with Republican River Compact compliance and maintaining economic prosperity as basin groundwater continues to be mined.
- Significant time and money are needed to comply with federal, state, and local permitting; prepare federal agency-led environmental impact statements; and finalize regulatory decisions and mitigation.

AGRICULTURE

- An aging workforce and steep costs for entry into agriculture present challenges to industry sustainability.
- Decreased water availability in the future due to declining aquifer levels in the Republican River Basin and designated basins, as well as diminished surface supplies from climate change, will impair farmers' ability to fully irrigate crops.
- Urban agriculture faces several challenges (some of which are similar to rural agriculture), but the primary challenge is access to affordable land.

WATERSHED

- Traditional metrics for monitoring stream health are outdated or difficult to monitor.
- Increased water use in other sectors can reduce water available to environmental and recreational attributes and create additional risk.
- Loss of irrigated land from urbanization and water transfers can have negative effects on migratory birds, wildlife movement corridors, wetland/riparian habitat, water quality, and floodplains, especially if revegetation is inadequate and local return flows are not maintained.
- While environmental issues have been a focus in recent years, ignoring them can increase, for example, wildfire or water quality risks.

MUNICIPAL AND INDUSTRIAL

- Aquifer storage and recovery is a promising water storage strategy, but complications of water quality and available infrastructure and land need to be overcome.
- Water quality will be a challenge as increased use of native South Platte surface water will lead to water treatment and brine disposal issues.
- Water supplies will be needed to meet growing municipal and industrial demands that will occur beyond the current Technical Update planning horizon of 2050.

COMPACTS, ADMINISTRATION, AND REGULATORY

CROSS-SECTOR CHALLENGES

- Competition for scarce water supplies is driving up water costs and posing challenges to meeting future municipal, industrial, and agricultural water needs while protecting and enhancing the environmental and recreation opportunities. Climate change may exacerbate this challenge.
- Water supply solutions and strategies can have unintended consequences for other water users in the basin. For example, return flows, driven by the use and successive reuse of water, are a fundamental characteristic of supply in the South Platte River Basin. Efficiency improvements (whether municipal or agricultural), reuse, and watershed health projects involving recharge can reduce or change the timing of return flows that supply downstream water users of all sectors.
- Basin stakeholders will need to continue focusing on the requirements of the PRRIP as additional native South Platte supplies are developed to meet current and future needs.
- Collaborative multipurpose regional projects, while attractive, can be challenging to implement due to limited or dispersed sources of supply; permitting, regulatory, and institutional issues; longer project development timeframes; and increased public involvement.
- Climate change creates substantial uncertainty and may increase water demands in all sectors, reduce overall supply, and create resiliency challenges that need to be considered in current planning.

The PRRIP is a collaborative stakeholder driven process that provides ESA compliance for water users throughout the basin while ensuring the protection of threatened and endangered species. In 2019, the First Increment of the program was extended for an additional 13 years by BOR, Colorado, Wyoming, and Nebraska.

Goals and Strategic Vision for the Future

The goals jointly developed by the South Platte and Metro Basin Roundtables strive to protect and enhance all water uses as well as educate the public. The strategic vision for the South Platte and Metro Basin Roundtables focused on four elements when shaping opportunities to address challenges. The South Platte and Metro Basin Roundtables spent considerable effort reviewing the themes, goals, and measurable outcomes from their 2015 BIP; updating them to reflect current conditions; and creating better alignment between the goals and supporting strategies and measurable outcomes.

SOUTH PLATTE AND METRO BASIN ROUNDTABLE GOALS

- Encourage implementation of projects
- Maximize development of native South Platte supplies
- Maintain and promote municipal and industrial conservation and efficiency
- Maintain and promote reuse
- Maintain and improve irrigated agriculture
- Protect and enhance watershed function
- Protect and enhance environmental attributes
- Protect and enhance recreational attributes
- Support collaborative development and management of supply options outside of the South Platte Basin
- Utilize scenario planning to better manage uncertainty of future water needs
- Broaden South Platte communications, outreach, and education programs
- Improve efficiency and effectiveness of water project permitting

Strategic Vision for the Future

The strategic vision considers the goals, projects, and desired water future for the basin and concisely describes the strategies needed to meet future challenges. The strategic vision for the South Platte and Metro Basin Roundtables focuses on four elements:

- Meeting the municipal supply gap
- Protecting irrigated agriculture
- Protecting and enhancing watersheds
- Implementing projects

Creative and collaborative water supply solutions are needed to support northeast Colorado's growing water needs in the face of scarcity and an uncertain future.

Demand, Supply, and Potential Water Needs

Municipal and Industrial

Between 2015 and 2050, the South Platte Basin population is projected to grow 42 percent to 70 percent. The areas of the South Platte River Basin that are outside of the Metro Region are projected to grow at a faster pace in all scenarios. While per capita water use rates are projected to decrease, overall municipal and industrial water demand is projected to increase due to population growth.

Agriculture

Due to urbanization, water transfers, and groundwater sustainability, the amount of irrigated land in the South Platte and Republican Basins is anticipated to decrease in the future. Climate change may increase on-farm shortages due to increased irrigation demand and lower irrigation water supply.

Environment and Recreation

The Flow Tool, applied to eight basin locations, suggests that climate change may reduce future streamflows and shift snowmelt runoff patterns to earlier in the year. Altered streamflow regimes will increase risk to a wide variety of environmental and recreational attributes.

Water Supply and Storage

Water supplies in the South Platte Basin vary substantially based on location. Analysis of two important locations in the South Platte River Basin showed available supplies periodically during wet periods. Increasing demands could draw storage down to lower levels, leading water providers to develop additional supplies or boost reserves.

Municipal, industrial, and agricultural gaps are projected to occur in all scenarios; the persistent nature of the gaps point to a need for projects that provide firm yield, and meeting demand will need to be balanced with environmental and recreational needs.

Mineral Creek Silverton CO. Photo credit: Danielle Snyder

The Southwest Basin has diverse and vibrant communities, varied natural systems, agricultural heritage, exceptional beauty, and extensive recreational opportunities.

KEY ACHIEVEMENTS

A wide variety of projects achieved results that support the Southwest Basin Roundtable's goals. Water Supply Reserve Fund grants supported:

- Agricultural projects ranging from infrastructure improvements to investing in innovative management practices, measurement stations, and reservoir studies.
- Municipal and industrial projects ranging from water supply studies to waterline extensions and improvements, development of raw water supplies for municipalities, and infrastructure development to previously unserved communities.
- Environmental and recreational projects, including stream management plans and restoration.
- Innovative and multipurpose action-driven projects that support multiple goals in the Southwest Basin.

SOUTHWEST BASIN

Basin Overview

The Southwest Basin consists of nine subbasins of the San Juan and Dolores Rivers. It covers an area of approximately 10,169 square miles in the southwest corner of Colorado. Both rivers have their headwaters in the San Juan Mountains.

The Dolores River forms the northerly portion of the Southwest Basin, flowing generally northwest and crossing the Utah state line near Gateway, Colorado. Its biggest tributary is the San Miguel River, which extends from the vicinity of Telluride along the southwest perimeter of the Uncompahgre Plateau to its confluence with the Dolores River in western Montrose County. The terrain of the Dolores River Basin consists of high plateaus with deeply incised canyons and dry arroyos. Elevations in the Dolores River Basin range from about 14,200 feet near the Dolores River headwaters to 4,100 feet at its confluence with the Colorado River in Utah.

San Juan River flows southwest into Navajo Reservoir, which straddles the Colorado-New Mexico state line. Downstream of the reservoir, it continues through New Mexico and Utah before reaching the Colorado River. Six streams flow south and west out of Colorado before they join the San Juan River: the Piedra, Pine, Animas (including the Florida River), La Plata, and Mancos Rivers and McElmo Creek. Elevations in the San Juan River system range from more than 14,000 feet in headwater areas of the Animas and Los Pinos Rivers down to approximately 4,600 feet near the Four Corners area. The San Juan Basin is characterized by rugged terrain, including mesas, terraces, escarpments, canyons, dry washes (arroyos), and mountains.[13]

Basin Facts

- Average annual precipitation ranges from more than 40 inches per year in the San Juan Mountains to less than 13 inches per year near the Colorado-Utah state line.
- The Dolores/San Juan/San Miguel Basin generally has high-quality surface water except in the headwaters of the Animas River near Silverton and the Dolores River near Rico due to mining impacts.
- The Dolores River accumulates naturally occurring salt as it traverses the Paradox Valley, which is actively managed by BOR.
- Locals and visitors enjoy a variety of recreational activities in the basin, including hiking, skiing, soaking in hot springs, and exploring the lands of ancient peoples.
- The Upper San Juan River and its tributaries flow through the Ute Mountain Ute Reservation and the Southern Ute Indian Reservation.
- Agriculture and ranching dominate the lower elevations of Dolores, San Miguel, and Montrose Counties while tourism and recreation have become more prevalent in the region as the Animas, Piedra, Dolores, and San Miguel Rivers offer both fishing and rafting opportunities.[13]
- Natural gas and oil have been extracted from deep wells within the Dolores/San Juan/San Miguel Basin for years, and a recent interest in coalbed methane gas has resulted in a new energy boom in the region.[13]
- Both SUIT and UMUT are pursuing viable options to develop their unused federal reserved water rights. Colorado has water rights settlements with both Tribes.

For more information on the Southwest Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**

[13] Department of Natural Resources, Division of Minerals and Geology. 2003. Colorado Geological Survey.

The Southwest Basin is comprised of nine individual subbasins, each with its own unique hydrology. Water users in the La Plata Subbasin, for example, routinely experience shortages, whereas streamflow supplies in the Animas Subbasin can meet demands year-round. Locals and visitors enjoy a variety of recreational activities in the basin, including hiking, skiing, soaking in hot springs, and exploring the lands of ancient peoples. The SUIT and UMUT, the only two Tribal reservations in Colorado, call the Southwest Basin home. Lake Nighthorse, part of the Animas-La Plata Project, stores water for use by SUIT, UMUT, Navajo Nation, and municipalities in both Colorado and New Mexico.

Water Resources Development Timeline

1922

In 1922, the seven Colorado River Basin states entered into the Colorado River Compact. This compact allocated the consumptive use of the river between the Upper Basin and Lower Basin. Additional compacts and agreements were developed over time (see Chapter 3).

1922

The 1922 La Plata River Compact apportions La Plata River water between Colorado and New Mexico.

1941

In 1941, the Southwestern Water Conservation District was formed.

1968

In 1968, the San-Juan Chama Project was completed. The project delivers transmountain water from subbasins of the San Juan River in Colorado to the Rio Grande in New Mexico.

1977

In 1977, construction of the Dolores Project began. The Dolores Project delivers water from the Dolores River to the Four Corners region. McPhee Reservoir and several canals provide irrigation supplies to more than 60,000 acres while also meeting municipal and industrialn eeds for small communities in the area.

1988

In 1988, the Colorado Ute Indian Water Rights Settlement Act settled the reserved water-rights claims of SUIT and UMUT concerning quantity, priority, and administration on all streams that cross the two Tribes' reservations. More information on Tribal water rights can be found in Chapter 3.

1992

In 1992, the San Juan River Basin Recovery Implementation was established with the goal of fully recovering the Colorado pikeminnow and razorback sucker in the San Juan River Basin. The program manages non-native fish populations, restores habitat, and works with BOR to manage Navajo Reservoir releases to improve streamflow.

2013

In 2013, the Animas-La Plata Project was completed. The project was authorized in 1968 under the Colorado River Basin Project Act and incorporated into the Ute Indian Water Rights Settlement Act in 1988.[14] It provides diversion and storage of flows for use by both SUIT and UMUT and municipalities in both Colorado and New Mexico.

[14] U.S. Bureau of Reclamation. Projects and Facilities: **Animas-La Plata Project**

Basin Challenges

The Southwest Basin faces several water resources challenges to balancing agricultural uses while supporting environmental and recreational values—all of which support the economic and aesthetic values that support a high quality of life. Water quality is also a major concern. Each Tribal area and subbasin represents distinct communities and landscapes with its own social, economic, and environmental values, challenges, and opportunities. Challenges identified in the BIP are:

KEY CHALLENGE

Balancing agricultural uses while supporting environmental and recreational values—all of which support the economic and aesthetic values that support a high quality of life.

AGRICULTURE

- The Cortez and Dove Creek area traditionally has had a strong agricultural community that was supplemented by energy production. Recent population growth due to retirees moving to the area has caused urbanization of these irrigated lands and altered traditional agricultural practices.
- Drought has severely impacted available supplies in McPhee Reservoir, which is a part of BOR's Dolores Project. Portions of the McElmo Subbasin rely on the return flows of this transbasin water and may be impacted in the future by changes upstream due to climate change or changes in agricultural practices.
- Persistent drought conditions and new drought projections do not suggest improvement to existing agriculture demand gap and show increased gaps.

WATERSHED

- Drought and large, uncontrolled forest fires have had a devastating effect in many areas of the Southwest Basin. Forest health initiatives are needed for community wildfire protection, increased watershed resiliency, water quality protection, and source water protection planning, and to mitigate negative impacts from past forest management practices.
- A full understanding of environmental and recreational water supply needs continues to lag behind the understanding of agricultural, municipal, and industrial water supply needs within most areas of the Southwest Basin.
- Providing sufficient water supplies for environmental and recreational uses while allowing consumptive use to continue.
- Drought and warming climate trends have an impact on the number of recreation days on the river, significantly affecting businesses that depend on river recreation. These same trends have a significant impact on aquatic habitat, particularly cold-water fisheries, as stream temperatures increase both in magnitude and duration.
- Balancing the needs of communities and water users with environmental protection.

MUNICIPAL AND INDUSTRIAL

- The Pagosa Springs-Bayfield-Durango corridor is rapidly growing while experiencing areas of localized water shortages. This area is transitioning from oil and gas, mining, and agriculture to tourism and recreation, and to retirement or second-home communities.
- Developing sufficient infrastructure to deliver municipal and industrial water where it is needed is a challenge. Existing reservoirs storing municipal and industrial water lack infrastructure to deliver water to treatment plants and distribution systems.

COMPACTS, ADMINISTRATION, AND REGULATORY

- All nine subbasins are tributary to the Colorado River and, therefore, fall under the Colorado River Compact and Upper Colorado River Basin Compact.
- In addition to the Colorado River Compact, the La Plata Subbasin is also subject to the daily requirements per the La Plata River Compact. The La Plata River is over-appropriated, which complicates meeting multiple compact requirements.
- Increasing water scarcity associated with climate change will create additional pressures.




AGRICULTURE	WATERSHED	MUNICIPAL AND INDUSTRIAL	COMPACTS, ADMINISTRATION, AND REGULATORY
	• There is need for consistent improvement of water quality impairment due to historic mining operations, natural geology, water temperature variability, and nonpoint source pollution. The Animas Subbasin is home to the Bonita Peak Superfund Site.		

CROSS-SECTOR CHALLENGES

- The Southwest Basin has a mix of recreation and tourism activities, along with a strong desire to maintain agriculture in the subbasins.
- Balancing current water uses and practices with impending drought impacts brought on by a changing climate is a challenge and may affect all sectors of water use.
- Increased population growth in many communities, due partly to increased second home purchases and retirees relocating, puts pressure on water supplies and agricultural urbanization. New residents to the area may lack understanding of water use and supply availability in the Southwest Basin.
- There is uncertainty existing on potential impacts from SUIT and UMUT growing into their full allocations of currently unused water supplies.
- Southwest Basin communities currently rely heavily on grant funding for projects due to the rural nature of the communities.
- Maintenance and replacement of aging water infrastructure is expensive.

Goals and Strategic Vision for the Future

The Southwest Basin goals describe the specific things the basin needs to do to meet its future water-related needs, while the strategic vision considers the goals, challenges, and proposed basin projects to concisely describe a long-term strategy for meeting future basin needs. More specifically, the strategic vision helps make progress toward the basin goals and ensures that projects supported and funded through the Southwest Basin Roundtable align with the goals. The basin goals and strategic vision are described below.

Goals

The Southwest Basin's seven goals are proposed to meet potential future water gaps with a planning horizon of 2050. The goals reflect activities completed since the 2015 BIP, new challenges faced by water users in the Southwest Basin, and new areas of interest for the Southwest Basin Roundtable.

SOUTHWEST BASIN ROUNDTABLE GOALS

- Balance all needs and reduce conflict
- Maintain agricultural water needs
- Meet municipal and industrial water needs
- Meet recreational water needs
- Meet environmental water needs
- Promote healthy watersheds
- Manage risk associated with the Colorado River Compact

Strategic Vision for the Future

The Southwest Basin Roundtable developed a strategic vision that outlines specific strategies where the Southwest Basin Roundtable will focus efforts in the near term. During the process, the basin roundtable acknowledged that geographic, political, economic, and legal complexities lead to unique challenges. As such, the basin roundtable developed principles to guide its future actions and BIP implementation. The principles center on:

- Cooperation and collaboration
- Role and regional position
- Legal acknowledgments
- Challenges and threats
- Project implementation

Southwest Basin goals and strategic vision are centered around balancing water needs of all sectors and reducing conflict.

Demand, Supply, and Potential Water Needs

Municipal and Industrial

The Southwest Basin currently includes about 2 percent of the statewide population, which is projected to grow between 16 percent and 161 percent between 2015 and 2050. The Southwest Basin is projecting the largest percentage increase in population in the state, which would result in increased municipal and industrial demand in all future scenarios. The highest future projected gap is in Hot Growth

Agriculture

The Southwest Basin is home to a diverse set of agricultural demands. Urbanization in the Southwest Basin will likely have a limited impact in the future. Hydrologic scenarios impacted by climate change severely affect agricultural water supplies, but with implementation of efficiencies and innovative technologies these impacts can be reduced.

Environment and Recreation

Along many tributaries in the Southwest Basin, spring runoff peak flows are projected to occur sooner for the climate-impacted scenarios compared to the peak for Baseline, Business as Usual, and Weak Economy. The risk to peak-flow-related riparian/wetland plants and fish habitat is currently high and may increase under climate-impacted scenarios. Streamflows throughout the Southwest Basin and the recreational in-channel diversion on the Animas River may not be met in many years under climate-impacted scenarios.

Water Supply and Storage

Basinwide storage supplies vary widely and are especially impacted in the Hot Growth scenario. Available flows are projected to diminish, and peak flows could occur earlier in the runoff season under planning scenarios with climate change impacts.

Climate-impacted scenarios project a reduction in flows and available water; projects that provide firm yield and increased conservation and efficiency are crucial for balancing future water needs.

Green area with stream, Wollery Ditch
Photo credit: Kent Vertrees, Friends of the Yampa

The Yampa-White-Green Basin has a rich agricultural heritage and vast natural landscapes that support a strong tourist economy.

KEY ACHIEVEMENTS

Numerous benefits achieved through diverse project successes, including:

- Yampa Integrated Water Management Plan
- White River Integrated Water Initiative
- Agricultural Improvement Projects
- White River Algae Research Project

YAMPA-WHITE-GREEN BASIN

Basin Overview

The Yampa-White-Green (YWG) Basin covers approximately 7,660 square miles in northwestern Colorado. The basin landscape is diverse and includes steep mountain slopes, high plateaus, canyons, and broad alluvial valleys. The forested mountain ranges are covered with snow in the winter, which melts into streamflow during spring and summer. Livestock, grazing, and recreation are the predominant land uses.

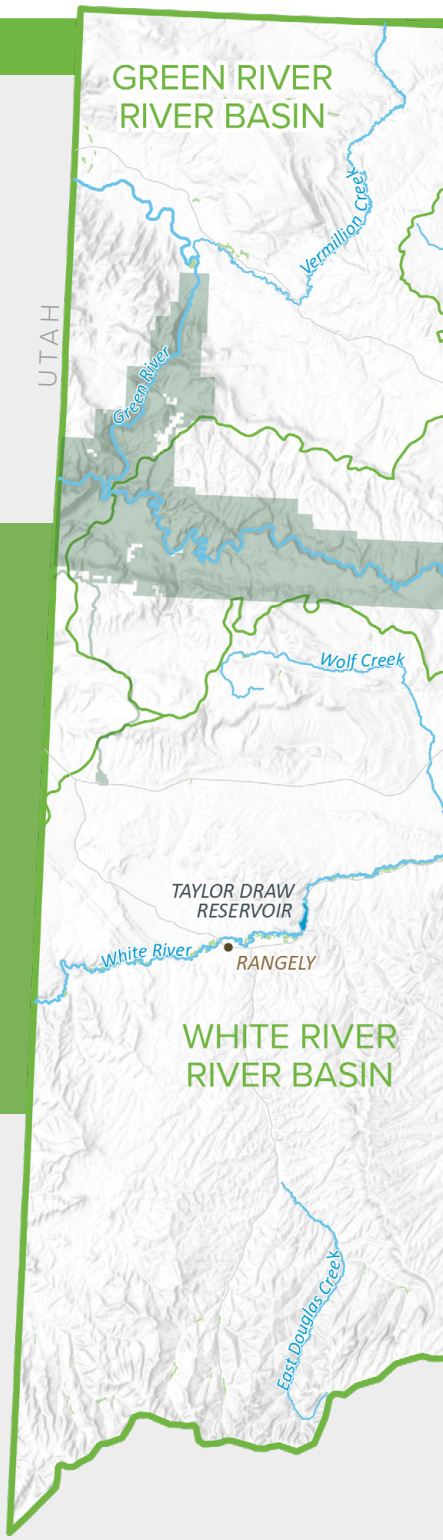
The Yampa River is the largest tributary to the Green River, originating in the Park, Gore, and Flat Tops Ranges and flowing generally north to Steamboat Springs, then west for more than 140 miles to its confluence with the Green River a few miles upstream of the Colorado-Utah state line. The lower end of the Yampa River flows through Dinosaur National Monument, where it becomes a meandering desert river. The White River Basin lies between the Yampa and Colorado River Basins. The White River's North and South forks each begin in the highlands of the Flat Tops formation at about 11,000 feet and flow west, meeting near Buford, Colorado. Rising in the Wind River Range of Wyoming, the Green River flows south through the Green Basin in Wyoming, through Flaming Gorge into Utah, and enters Colorado just south of the northwest corner of the state.

The region has a rich agricultural heritage and a strong tourist economy based on snow sports, boating, fishing, and hunting. Environmental assets include wilderness areas, endangered fish species, and vast natural landscapes. The YWG Basin also contains some of the richest deposits of fossil fuels in the nation.

Basin Facts

- Average annual precipitation varies from more than 60 inches near Rabbit Ears Pass and more than 40 inches in the Flat Tops to approximately 10 inches near the state line.
- Agriculture is a primary focus in the Yampa Basin. Irrigated acreage in the basin consists primarily of high mountain meadows and cattle ranches in the upper reaches along tributaries and the mainstem of the Yampa River.
- Approximately 60 percent of the irrigated acres in the White Basin are concentrated along the river near the Town of Meeker. The remaining acreage is located along tributaries and spread along the lower mainstem. Grass pasture is the dominant crop, and alfalfa is also grown. These forage crops support cattle grazing and ranching operations, which is a major economic driver.
- Steamboat Springs and Craig are the major population centers in the Yampa Basin, with 12,900 and 8,900 residents, respectively. Rangely and Meeker are the major population centers in the White Basin, with about 2,400 residents each.
- The Green River formation within the Piceance Basin of Garfield and Rio Blanco counties is the most significant deposit of oil shale in the world.
- The Yampa and White Basins contain diverse and rich environmental and recreational resources that support activities such as rafting, kayaking, tubing, fishing, and flatwater recreation. Steamboat Lake is the basin's only designated Gold Medal fishery.

For more information on the Yampa-White-Green Basin, see the Basin Implementation Plan available at: **Basin Implementation Plans | Colorado Department of Natural Resources**



In the YWG Basin, ranching is a way of life, with grass hay primarily grown to support cattle operations. Steamboat Springs is a popular tourism destination, and its population is expected to grow driven by summer and winter recreational activities. The Yampa, White, and Green Rivers provide critical habitat for the humpback chub, bonytail, Colorado pikeminnow, and razorback sucker. These four endangered fish species are the focus of the Upper Colorado River Endangered Fish Recovery Program.

Water Resources Development Timeline

1880

In 1880, the earliest rights in White River Basin irrigation rights were appropriated, and the first general adjudication was completed in 1889.

1922

In 1922, the seven Colorado River Basin states entered into the Colorado River Compact. This compact allocated the consumptive use of the river between the Upper Basin and Lower Basin. Additional compacts and agreements were developed over time (see Chapter 3).

1967

In 1967, Steamboat Lake was developed by CPW and proponents of the Hayden Power Plant.

1974

In 1974, Elkhead Reservoir was constructed by CPW and Yampa Participants, a consortium of power providers.

1980

In 1980, the Yamocolo Reservoir was completed by the Upper Yampa Water Conservancy District, which also completed the Stagecoach Reservoir in 1989.

2005

In 2005, the Final Programmatic Biological Opinion on the Management Plan for Endangered Fishes in the Yampa River Basin was finalized. The plan promotes the recovery of four listed endangered fish species, which include the bonytail, Colorado pikeminnow, humpback chub, and razorback sucker.

2018

In 2018, the Yampa River experienced its first water rights call due to low water conditions in the lower stretch of the river near Dinosaur National Monument.

Basin Challenges

Key future water management issues for the YWG Basin include gas and oil shale development; addressing water resources needs for agriculture, tourism, and recreation; and protecting endangered species. Challenges identified in the BIP are:

KEY CHALLENGE

Balancing traditional economic activities with emerging consumptive demands while meeting environmental and recreational needs is the overarching challenge in the basin.

AGRICULTURE

- Agricultural producers would like to increase irrigated land by 14,805 acres but lack finances to do so.
- Agriculture in the White Basin does not have reservoir/ supplemental supplies, which can cause late-season shortages.
- Agriculture is vulnerable to climate change due to the expected changes in hydrology and the increase in crop irrigation requirements due to warming temperatures.

WATERSHED

- Stream temperatures and increasing nutrient loads are emerging water quality concerns. Increasing stream temperatures on the Yampa River have resulted in a 303(d) impaired stream listing. Benthic algae in the White River can reach uncharacteristic and nuisance levels.

MUNICIPAL AND INDUSTRIAL

- The high degree of uncertainty surrounding oil shale development and related water demands are a challenge.
- In the Yampa Basin, the planned closure of coal-fired electric generation stations is a serious economic and social challenge.
- Population growth and future anticipated and unanticipated needs are a concern, and adequate storage, along with strong municipal conservation measures, must be coordinated with drought plans to adequately address the situation.

COMPACTS AND ADMINISTRATION

- While the population is rapidly growing in the Steamboat Springs area, the YWG Basin as a whole is not developing as quickly as other portions of the state. Concerns have arisen over protecting existing uses and future uses in the basin, especially in the event of compact administration.

CROSS-SECTOR CHALLENGES

- Agriculture, tourism, and recreation are vital components of this basin's economy. As the needs of communities and industry grow, competition among sectors could increase.
- Wildfire frequency and severity is increasing in the western United States. Because wildfires have the potential to impact a watershed's water quality and quantity, water managers are joining efforts to improve forest health and create more wildfire-resistant landscapes.
- Drought impacts and their effects, potentially exacerbated by climate change, have continued to grow (the mainstem of the Yampa River saw its first-ever senior water rights call in 2018). It now appears this will be a major focus of basin water planning, particularly with respect to compact matters and possible new Colorado Basin initiatives.

Continued implementation of a successful Upper Colorado River Endangered Fish Recovery Program is vital to ensuring protection of existing and future water uses.

See Chapter 5 description of Endangered and Threatened Species Recovery Programs for more information.

Goals and Strategic Vision for the Future

The YWG Basin goals describe the specific things the basin needs to do to meet its future water-related needs, while the strategic vision considers the goals, challenges, and proposed basin projects to concisely describe a long-term strategy for meeting those needs. More specifically, the strategic vision helps make progress toward the basin goals through understanding potential management strategies and supporting project implementation. The basin goals and strategic vision are described below.

Goals

Eight basin goals were initially developed for the 2015 YWG BIP, and the basin roundtable continues to support these goals. The underlying principle of the goals is to maintain and protect historical water use and protect water supplies for future in-basin needs. The goals ultimately seek to promote a sustainable and diversified economy supported by a healthy river.

YWG BASIN ROUNDTABLE GOALS

Protect the YWG Basin from compact curtailment of existing decreed water uses and some increment of future use

Restore, maintain, and modernize water storage and distribution infrastructure

Protect and encourage agricultural uses of water in the basin within the context of private property rights

Improve agricultural water supplies to increase irrigated land and reduce shortages

Identify and address municipal and industrial water shortages

Quantify and protect environmental and recreational water uses

Maintain and consider the existing natural range of water quality that is necessary for current and anticipated water uses

Develop an integrated system of water use, storage, administration, and delivery to reduce water shortages and meet environmental and recreational needs

Strategic Vision for the Future

Meeting future water needs and implementing projects are the primary strategies of the YWG Basin Roundtable to achieve basin goals. To explore possible options for meeting future water needs, the basin roundtable modeled three alternative management strategies. They are:

- **Alternative 1:** Agricultural Efficiencies
- **Alternative 2:** New Releases from Existing Storage
- **Alternative 3:** Enlarged/New Reservoirs

Results from the model are intended to help the YWG Basin Roundtable understand the trade-offs of the alternative management strategies. The details in the 2022 BIP can help guide stakeholders on implementation to maximize benefits and minimize risks.

In addition, project implementation is a key strategy. Through partnerships and multi-benefit projects, the basin can firm existing supplies, develop new supplies, and enhance environmental and recreational attributes.

The Yampa-White-Green Basin Roundtable will promote a sustainable and diversified economy while supporting a healthy river.

Green area with streams, Photo credit: Kent Vertrees, Friends of the Yampa

Demand, Supply, and Potential Water Needs

Municipal and Industrial

The combined YWG Basin currently includes less than 1 percent of the statewide population and about 17 percent of the statewide industrial demand. Municipal and industrial gaps in the White Basin are larger than in the Yampa Basin because the White Basin lacks access to storage.

Agriculture

Agriculture is a primary focus, and future urbanization of irrigated lands is expected to be limited. The YWG Basin Roundtable identified an additional 14,805 acres that could be brought into production in the Yampa Basin. Agriculture currently experiences gaps in the late irrigation season that are anticipated to increase under a warmer climate and be exacerbated by increased crop irrigation requirements.

Environment and Recreation

The Flow Tool results projected highly variable peak flows. Projected decreases in mid- and late-summer flows create risk for fish from loss of habitat and increased water temperatures. In climate-impacted scenarios, instream flows will likely not be met during some summer and winter months, and recreational in-channel diversions could be impacted.

Water Supply and Storage

Available water supplies in the Yampa and White Basins vary in the planning scenarios and are primarily driven by climate-change assumptions. Scenarios with climate-adjusted conditions result in increased agricultural, municipal, and industrial gaps, and increased risks to environmental and recreational uses. Stakeholders will need strategies to mitigate/adapt to the increased risks.

Climate-impacted scenarios present a reduction in flows and available water; stakeholders will need strategies to mitigate/adapt to the increased risks.

The BIPs were developed in a collaborative process by basin stakeholders and focused on the current and future water needs of each basin, the vision for how individuals and organizations can meet future needs, and the goals and projects that provide a pathway to success. The content developed in the BIPs inform the Water Plan update. The basin-specific challenges, goals, and strategic visions roll up into a set of common themes that highlight issues applicable to multiple basins or even statewide. Because our basins are all different, the BIPs included their own unique challenges, goals, and strategic vision elements that reflected local conditions.

Common Themes

The basins' challenges highlight their most important concerns moving into the future. The information below summarizes the common challenges, goals, and future visions described in the BIPs. The information from the BIPs inform Water Plan Chapters 5 and 6, which present a holistic view of the shared challenges and tools for mitigating risk across the state and present specific actions that can be accomplished during this Water Plan cycle.

Basin Challenges

Balancing future risk while meeting needs across sectors and complying with interstate compacts and agreements is an important concern. Competition for limited supplies contributes to future risk. Solutions for meeting challenges include water storage, efficiency and conservation programs, and flow enhancement and maintenance tools. A resilient planning approach can result in equitable solutions to balancing future water-related risk.

Uncertain climate conditions present a broad range of challenges. Climate change may result in extended drought and aridification that affect water users in different ways, such as reduced streamflow, changing growing seasons, and altered supply and demand patterns. Reducing climate change risk will require collaborative solutions across all four action areas – Robust Agriculture, Vibrant Communities, Thriving Watersheds, and Resilient Planning.

Loss of agriculture and reduction in irrigated acres due to water transfers and urbanization is a concern for many basins. Agriculture is often an important value in the community and contributes to the local economy. The use of tools such as Collaborative Water Sharing Agreements (CWSA) can help achieve a balance between maintaining agriculture and meeting other water uses. The Robust Agriculture action area focuses on the economic viability and resiliency of the agricultural sector.

Funding and development of water projects is a significant concern for many stakeholders. Communities and other stakeholders face increased costs for water, and some lack funding for project implementation, which impacts their ability to mitigate future risk. In addition, inefficient regulatory processes centered on permitting present an additional hurdle that can increase costs and uncertainty for project implementation. Collaboration, multi-purpose projects, and creative funding strategies can help overcome this challenge. All four action areas address this multi-sector challenge.

Watershed and forest health is a key issue across the state. Impacts from disturbances or natural disasters such as wildfires, floods, and beetle kill affect our ecosystem and water supply. Our forest health, water quality, and endangered species protection and recovery programs are impacted by these disturbances. Flow enhancement programs, watershed planning, natural hazard planning, restoration projects, CWSAs, and environmental programs help address watershed health challenges. The Thriving Watershed action area focuses on addressing the issue.

Basin Goals and Strategic Vision

The goals identified by basin roundtables describe specific ways in which needs across all water use sectors will be met, and their strategic vision provides a broad view of how basin goals will be reached. Many of the goals and strategic visions presented in the BIPs had common themes and characteristics. Chapter 5 describes the types of common or shared tools that can be used in achieving the goals and strategic vision of the basins.

COMMONALITIES AMONG BIP GOALS AND STRATEGIC VISIONS
Meet future municipal and industrial water needs (i.e., meet the gap)
Sustain agriculture and a productive agricultural economy
Maintain, protect, and restore healthy rivers, lakes, wetlands, watersheds, and forests
Implement projects that reduce the risk of future shortages and seek, where possible, multi-purpose opportunities
Implement water conservation and efficiency strategies
Maintain and improve water quality
Enhance resiliency by considering climate change, planning for uncertainty, and addressing vulnerabilities
Restore, maintain, and modernize critical water infrastructure
Broaden education, outreach, and participation
Collaborate and build partnerships
Comply with interstate compacts and agreements

Differences

Local and regional conditions drive specific challenges and needs for each basin. The information below summarizes some of the local drivers and challenges that influence the differences in goals and strategic visions described in the BIPs.

Source of Supply: Sources of water supply and hydrology are unique to each basin. For example, the Rio Grande and Republican Basins are challenged by declining groundwater supplies, and the Arkansas Basin faces challenges from very limited surface water supplies as well as declining groundwater supplies. Eastern slope basins rely on native supplies and TMDs from western slope basins.

Future development concerns: Population growth and associated increased water demand and risks to agriculture are a big concern on the eastern slope and drive eastern slope goals, strategic visions, and projects. Future growth is a concern in western slope basins (though not as acute), as are concerns about eastern slope growth and the impact on western slope supplies and ecosystems.

Industrial Demands: The significance of industrial water demand and the future of industry varies across the basins. The YWG Basin faces an economic and social challenge due to the closure of its coal-fired power generation facilities, whereas other basins' industrial demand may be relatively small and somewhat stable in the future.

Interstate Compacts: Various decrees, compacts, and agreements govern the major interstate streams in Colorado. A summary of Colorado's interstate compacts and agreements are summarized in Chapter 3.

The Water Plan's foundation is in its grassroots approach and basin-developed input. Common themes and differences across basins inform the overarching challenges the state faces, solutions to address them, and actions.

Potential Costs of Basin Identified Projects

An ongoing critical data need has been to develop a better understanding of the full scale of costs related to water projects that would help Colorado meet its future water demands. Knowing the scope of the costs helps CWCB better prepare for incoming grant and loan requests to support these projects. Prior summaries of expected basin-identified project costs were cited in the 2015 Water Plan, but they did not reflect the full scope of project costs, as many cost details were not available and were flagged as "forthcoming."

Efforts to Enhance Project Cost Data

Basin roundtables conducted stakeholder outreach during the 2022 BIP update process to gather and update project cost data as well as 20 other data sets for projects identified by stakeholders in each basin. A wide variety of projects were identified by basin stakeholders. Projects reflect all sectors of water use and include agricultural, environmental, municipal, and recreation projects. Project implementation timelines also varied. Some projects are almost ready to be started, some are being planned for implementation in the foreseeable future, and some projects are highly conceptual and may be implemented in the distant future and perhaps differently than currently imagined (if at all). Some of the identified projects will use additional water, but many projects will not, such as water conservation programs, stream restorations, education and outreach, and studies.

Projects identified by the roundtables generally focused on infrastructure, restoration activities, and programs that reduce the risks associated with potential future water shortages and changes in hydrology. Consistent with the intent of the database to focus on water supplies, water distribution, and wastewater projects were not included. Potential costs for environment/recreation enhancements and aging agricultural infrastructure projects are included to the extent that stakeholders provided cost data, but additional projects in these areas are likely needed.

Basin roundtables categorized local projects using an initial "tiering" approach that aimed to demonstrate the readiness of projects. The CWCB's on-line Project Database archived the initial data, and the database allows for simple sorting of projects based on the level of project readiness as determined by the time the project states it may be advancing and the completeness of required data fields. Projects are listed as "ready," (1 year) "short-term" (2-5 years), "mid-term" (5-10 years), or "long-term" (longer than 10 years). Because projects listed may be conceptual or may otherwise not advance, this tool is only intended as a high-level planning tool to understand potential funding needs and is expected to receive minor updates annually.

Some projects listed in the Project Database are only conceptual, and they range in readiness level. Projects listed in this database are also not guaranteed to be approved or funded. This is intended as a planning tool to look at a range of potential ideas. Additionally, projects do not generally include other basin needs that touch on things like water treatment, wastewater, etc.

> BASIN PRIORITIES CAN ALIGN PROJECTS THAT BENEFIT ALL STAKEHOLDERS BUT FUNDING IS A CHALLENGE.
>
> — STEVE ANDERSON, *CWCB*

Summary of Cost Data

Cost estimates of basin projects from the past and current Water Plan show a consistent need for about $20 billion in funding—providing justification for ongoing funding needs for CWCB to help advance these efforts. However, only some of total funding need will come to CWCB. For example, not all of the potential projects identified (especially those that are conceptual) may advance, other grant funds (e.g., federal) may be pursued, and customer fees or private investment will fund a portion of the viable projects. Matching requirements for grants ensure that only a portion of the total costs funded through grants will be provided by CWCB (see Chapter 3 for an explanation of "Colorado's Water Funding Needs").

While it was not possible to identify every project necessary to meet Colorado's future water demands, the work of the basin roundtables and stakeholders represents a large step forward in better understanding costs of potential future projects. The basin roundtables and stakeholders identified more than 1,800 potential future projects.

Project Costs Identified in the Basin Implementation Plans	
BASIN	COSTS OF POTENTIAL PROJECTS
Arkansas	$3,636,800,000
Colorado	$4,083,500,000
Gunnison	$1,524,800,000
North Platte	$6,400,000
Rio Grande	$164,500,000
South Platte / Metro / Republican	$9,869,500,000
Southwest	$791,900,000
Yampa / White / Green	$667,300,000
TOTAL:	**$20,744,700,000**

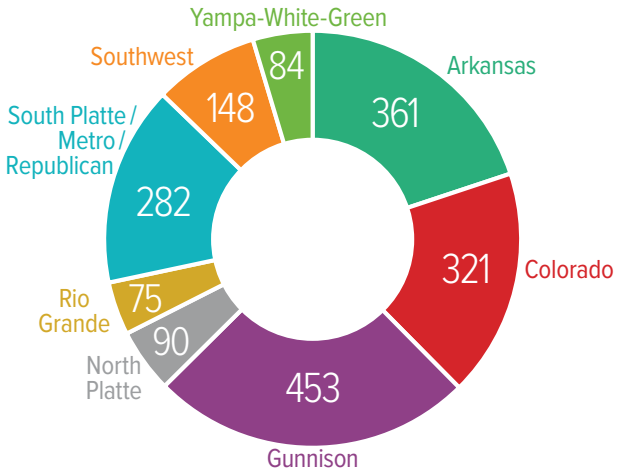
The CWCB promotes and plays a role in funding projects throughout the state. The State of Colorado does not build water projects, and instead partners with local water providers and stakeholder groups to develop and implement water projects. The CWCB provides funding in the form of grants and loans to entities like water providers, watershed groups, and ditch companies, who are the key stakeholders that develop water projects. More information on CWCB's role in funding projects and funding challenges is in Chapters 3 and 5.

Access CWCB's on-line Projects Database at
Project Database | Force.com

Breakdowns of project data for each individual basin are in the BIPs

See the Basin Implementation Plans at:
Basin Implementation Plans | Colorado Department of Natural Resources

Number of Projects in each Basin



50% OF PROJECTS ARE MULTI-PURPOSE

While single purpose projects play an important role in meeting water needs, CWCB encourages collaborative projects that serve several purposes. Half of the projects identified in the BIPs are multi-purpose.

CHAPTER 5

CHALLENGES and TOOLS

> “THERE IS A VERY REAL RISK OF PERMANENT DRY UP OF AGRICULTURAL LAND... WHEN WE SEE THE MARKET PULL, WATER IS SO VALUABLE YOU’LL FIND THE MARKET IS DRIVING THOSE DECISIONS BEFORE POLICY AND POLITICS CAN CATCH UP.
>
> — KATE GREENBERG
> *Colorado’s Commissioner of Agriculture*

CHALLENGES and RISKS

Colorado water users face a wide variety of water-related challenges and risks. Some of these are sector specific (e.g., agricultural, environmental, or municipal) and may be more regionally or locally focused; however, even local issues can have cascading impacts that affect all sectors and Colorado as a whole. Some examples include:

AGRICULTURAL DRY-UP

The purchase and permanent transfer of agricultural water rights – widely known as "buy and dry"—impacts Colorado's statewide economy and food security as well as local, rural communities.

ENVIRONMENTAL CONCERNS

A unique and outstanding characteristic of Colorado is its natural environment. Water quality, watershed health, and ecosystem resilience challenges must be addressed considering increasing water demands and a changing climate, which could lead to habitat degradation. This risk has the potential to increase if agricultural, municipal, and industrial water needs clash with environmental and recreational water needs.

MUNICIPAL WATER SUPPLY GAPS

The Technical Update projected future water supply gaps for municipalities if they do not implement strategies and projects to meet future demands. Both large and small municipal water providers will be challenged to meet potential gaps. Some small communities adjacent to larger municipalities are faced with high population growth but lack the water supply to support it.[1]

Chapter 5 provides an overview of challenges and tools. More detail is available at the **CWCB Website**

[1] American Society of Civil Engineers. 2020. **Colorado 2020 Infrastructure Report Card**.

> CLIMATE CHANGE IS WATER CHANGE.
>
> — BRAD UDALL
> *Climate Research Scientist, Colorado State University*

Identifying and understanding sector-specific challenges is critical for reducing risk and meeting future water needs.

However, many risks Colorado faces are broad, multifaceted, and apply to all sectors of water use. These include:

Climate Changes and Climate Extremes

In Colorado, climate change presents a broad range of challenges across all water use sectors. The underlying analysis in the Water Plan highlights the impacts of continued warming and deep drought years (see Chapter 3 for more details). Adapting to a warmer climate and more flood, fire, and drought years will require a commitment to climate adaptation.

Water Quantity

Colorado's water supply consists of both surface water and groundwater sources, and the availability of these supplies depends on complex interactions among geography, weather, laws, and regulations—all of which influence how much water is available for beneficial uses. Colorado's largest "reservoir" of water is its snowpack. Streamflows created by melting snow provide water to agriculture, the environment, recreation, and municipalities. Snowmelt timing does not always fit with water demand timing. In addition to seasonal variability, multi-year droughts and wet periods can present challenges. Increasingly, Colorado hydrology is reflecting more arid conditions, which present even greater challenges in stretching our available water supplies to meet growing demands. Managing water supplies and demands in the face of variable hydrology has been a significant challenge since water development began in Colorado. Wise and thoughtful water resources planning and management is critical to meet Colorado's projected future needs, recognizing that up to 740,000 additional acre-feet of water could be needed to meet future municipal and industrial demands alone. Statewide agricultural gaps may increase from 2.6 million to nearly 3.5 million acre-feet by the year 2050. Future potential reductions in streamflow may significantly increase risks to environmental and recreational attributes. Chapters 3 and 5, the Technical Update, and the BIPs provide descriptions of potential future changes in water supplies statewide and in each basin.

The Technical Update estimates that 230,000 to 740,000 additional acre-feet of water could be needed to meet future municipal and industrial water demands alone. Statewide agricultural gaps are estimated to increase from 2.6 to 3.5 million acre-feet by 2050, while future potential reductions in streamflow may significantly increase risks to environmental and recreational attributes.

Water Quantity/ Water Quality Nexus

Low flows can create or exacerbate water quality problems by:

- **Raising water temperature, which decreases dissolved oxygen while raising the metabolic rates of fish; increases solubility of salts, metals, and other toxins; and promotes algal blooms**
- **Increasing salinity as groundwater becomes a larger proportion of streamflow**
- **Increasing concentrations of total suspended solids or pathogens as flow of the receiving streams becomes smaller**

CLIMATE-RELATED **IMPACTS**

In Colorado, climate change presents a broad range of challenges across all water use sectors. The **2015 Colorado Climate Plan** identified a host of potential climate-related impacts that are also reflected in some of the Water Plan's underlying modeling. It's important to note that:

- Colorado has warmed in the last 30 years and temperatures may rise an additional 2.5°F to 5°F by 2050.
- Runoff timing will shift an additional 1 to 3 weeks earlier by 2050 due to increased temperatures.
- Future decreases in annual streamflow may occur in all of Colorado's river basins.
- Nearly all projections show higher winter precipitation by 2050, but there is less agreement for other seasons.
- Most projections of Colorado's spring snowpack show declines by 2050 due to warmer temperatures.
- Most projections indicate that heat waves, droughts, and wildfires will be more frequent and severe by 2050.

Water Quality

As the economy and population grow and land uses change, water quantity demands will increase, and water quality could be stressed by factors such as nonpoint source pollution, elevated stream temperatures, post-wildfire impacts to water quality, and other impacts of climate change. Currently, approximately 30 percent of Colorado's streams and lakes do not meet applicable water quality standards for one or more classified uses (agriculture, water supply, recreation, or aquatic life).[2] Waters that do not attain water quality standards (also called impaired waters) affect our ability to use water for domestic water supply, agriculture, aquatic life, and recreation. They also adversely impact water and wastewater providers' ability to treat water for drinking, or to discharge back into streams, respectively. The most common causes of river and stream impairments include manganese, arsenic, and sulfate, and temperature is a growing concern. For lakes and reservoirs, the leading causes of impairment include arsenic, selenium, and temperature. Notably, new or revised water quality standards are continually adopted by WQCC through established regulatory procedures as emerging contaminants are identified and as science changes our understanding of impacts of specific parameters on human health and aquatic life. When streams and lakes do not meet water quality standards, they are identified as impaired and WQCD is required to develop a pollutant budget called a total maximum daily load (TMDL). This pollutant budget is the foundation for restoration planning and identifying actions necessary to improve water quality so that water quality standards are attained. TMDL development and restoration planning are informed by stakeholder input. However, there are times when more immediate water quality actions are needed. For example, CPW may authorize emergency closure of fishing waters in the state when it is determined that environmental conditions in these waters are such that fishing could result in unacceptable levels of fish mortality. Low streamflows and dissolved oxygen levels as well as high stream temperatures are some of the criteria used by CPW to make decisions about mandatory or voluntary fishing closures on rivers and streams.

Creating a balance between increasing quantity demands and water quality protection and restoration requires ongoing dialogue with all Coloradans and collaboration at all levels of government. Traditionally, Colorado has managed water quality and quantity separately based on different constitutional, statutory, regulatory provision, and the mission and function of individual agencies. For example, as a policy agency with no regulatory authority, water quality planning and management is not under the direct control of CWCB. While there is significant coordination across agencies, each state agency is often simultaneously working on multiple priorities that are critical to its mission. Continued investment in ongoing partnerships, as well as finding new ways to coordinate that help align work and create synergies with projects and funding, will be key to creating mutually beneficial policies and practices.

Funding Shortfalls

Investing in long-term and resilient supply, delivery, and environmental restoration projects is critical to Colorado's future. Colorado faces challenging fiscal conditions for water projects. Financing long-term, sustainable water supply and infrastructure projects requires a collaborative effort. Funding is also needed to support sustainable management strategies for reducing demand. Local water providers often use customer water rates and tap fees as the primary source of funding

Approximately 30 percent of Colorado's streams and lakes do not meet applicable water quality standards for one or more classified uses.

Tapping into Water Quality

The CWCB's role as a policy agency focuses largely on water resources and does not play a regulatory role in monitoring or enforcing water quality. Water quality regulations for stormwater runoff, streamflow, reservoirs, treatment plants, and drinking water fall to CDPHE's WQCD and WQCC. The CWCB partners with CDPHE on specific projects and initiatives where water quality and water quantity issues overlap.

> "WE CAN'T FUND ALL THE PROJECTS WITH GRANTS SO WE NEED EDUCATIONAL EFFORTS TO HELP LOOK AT ALL THE WAYS TO FUND THE PLAN.
>
> — ROBERT SAKATA, *CWCB*

[2] Colorado Department of Public Health and Environment. 2022. **Integrated Water Quality Monitoring and Assessment Report**.

> WE NEED TO WORK TOGETHER ON THE LOCAL, STATE, AND FEDERAL LEVEL TO ADDRESS OUR FOREST HEALTH CHALLENGES. MORE THAN 24 MILLION ACRES OF FOREST IMPACT OUR WATER SUPPLY. OUR ROLE AS A HEADWATERS STATE DEPENDS ON COLORADO'S FORESTED WATERSHEDS. IT IS CRITICAL FOR US TO ACT WITH URGENCY.
>
> — DAN GIBBS, *Executive Director, Department of Natural Resources*

where the end user is directly connected with costs and investments; however, smaller communities bring in less money from these rates and fees, which puts them at a disadvantage in generating revenue. Environmental and recreation projects are needed, but funding assistance is often required for planning and implementation. Natural hazards from wildfire, drought, and flooding events are costly, both in the short term and years after a disturbance. Preparedness is also costly. For example, about 10 percent of Colorado's forests are estimated to need $4.2 billion to address forest health, wildfire risk, and threats to forested water supplies.[3] That's on top of water project needs identified in the Water Plan and other agency needs for issues like regulation and enforcement. Adequate funding for all sectors of Colorado's water projects will require pooling of funds and resources. Multi-purpose projects can engage many different types of stakeholders and offer the potential to use multiple funding sources. Chapter 3 provides more information on funding needs and funding sources for water projects.

Aging infrastructure

The expected volume of water needed to meet Colorado's future municipal, agricultural, and environmental needs is dependent on existing infrastructure. Part of those needs will go unmet if current conveyance, treatment, and storage systems are impaired. Replacing aging infrastructure continues to be a high priority that will need support from private investment, rate payers, and other sources. Infrastructure improvements are not only needed in the municipal sector, but agricultural as well. A recent survey by the Colorado Cattlemen's Association found that the condition of irrigation water delivery infrastructure was the second-most important concern of agricultural producers after water shortage concerns. Improving delivery infrastructure is costly.[4] Additionally, updates to aging infrastructure provide an opportunity to improve diversion efficiency while also mitigating hazards to the recreating public and restoring ecosystem health and connectivity.

Regulatory and Legal Constraints

Federal, state, and local regulatory and legal requirements sometimes create project development and implementation challenges. Some options to meet water supply needs are very complex and need detailed planning and technical analyses to adequately address federal, state, and local requirements. Project permitting can be very expensive and time consuming due to the complexity of projects, the challenges in understanding and reducing environmental impacts, and the condition of many aquatic systems. Colorado's legal framework for water rights can also create challenges for water users. Water rights proceedings are conducted through the judicial system and can be costly and time consuming for both water project proponents and participating parties that could be impacted. Strategies to reduce risk (e.g., rainwater harvesting, improved conveyance efficiencies) can raise water rights issues. Creating regulatory, legal, and process efficiencies and flexibility while maintaining the protections that regulatory processes provide will be a continuing challenge that affects all water use sectors.

Cross-agency Permitting Handbook

The Colorado Water Supply Planning and Permitting Handbook, published in 2017, helps project proponents consider regulatory issues in initial planning phases so that projects meet permitting requirements more efficiently. The handbook was developed in partnership with several agencies, including CWCB, CPW, and CDPHE.

[3] Colorado State Forest Service. 2020. **Colorado Forest Action Plan**.

[4] Ag Water NetWORK, Colorado Cattlemen's Association. June 2019. **Results of the 2019 Survey of Colorado Agricultural Producers on Watershed and Stream Management Plans**.

Forest Health

Most of Colorado's water supply comes from forested watersheds that are home to a wide variety of plant, animal, and fish species and also provide recreational and economic benefits. Colorado has opportunities to improve and maintain healthy forests. Adaptive forest management practices need to be implemented to protect water supplies and improve the overall health of Colorado's watersheds. Pre-wildfire planning and mitigation efforts, which may include implementation of nature-based solutions, are opportunities to reduce risk and lower the costs associated with potential threats to forest health. Our capacity to predict potential effects that wildfire and climate change may cause in our forests is limited, and more research is needed to understand potential impacts to forest ecosystems and water supplies. Forest health is described further in Chapter 6, Thriving Watersheds.

Inclusive Public Engagement

Risks associated with important issues such as climate change, potential future water shortages, and natural hazards require that Coloradans be educated and ready to act on water-related challenges. Coloradans must collaborate on adaptive planning and ensure education and outreach efforts are inclusive. This will provide Coloradans the opportunity to understand what is at stake and participate in equitable, diverse, and inclusive solutions.

Data and Research Gaps

A deeper understanding of climate change impacts and how to use science and data to inform decision making is needed across every sector. In many cases, gaps exist in data collection, storage, and accessibility that, if addressed, could better inform actions.

In the future, Colorado will need to find ways to balance risk and maximize benefits by focusing on collaborative efforts, projects, and strategies that consider the needs of multiple users. This will be especially pertinent as demands increase and as already-scarce supplies are more fully used. Building resilience, or the ability to quickly recover from a disruptive event or disturbance without loss of services, is crucial for reducing risks in an uncertain future.

RESPONDING TO RISKS ACROSS **ACTION AREAS**

The Water Plan focuses on the four action areas of Vibrant Communities, Robust Agriculture, Thriving Watersheds, and Resilient Planning. The areas are interconnected, and many challenges span the four action areas and drive how the Water Plan will work to shape Colorado's water future.

Overcoming our shared challenges will require a large portfolio of tools at multiple scales. While some tools to address our challenges are sector specific, many of the tools can be applied across all water use sectors. A set of tools is highlighted in the next section that have proven to be effective in addressing our water challenges and set the stage for how stakeholders and CWCB can use individual or combinations of tools to address specific action areas.

TOOLS

"Tools" are strategies and projects typically used to collaborate and meet water needs across Colorado

Colorado water managers and stakeholders typically use a certain set of tools or solutions to meet water needs. Chapter 5 includes descriptions of these tools. These tools will be useful in completing many actions and achieving the vision for meeting Colorado's future water needs.

Many tools or solutions are available for meeting current and future water needs and achieving the vision for each of the four action areas. Solutions are implemented at various geographic levels, for a variety of purposes, and by a wide variety of agencies, organizations, and water users. Some solutions are institutional in nature or may be implemented at a statewide level. New legislation, regulatory or policy changes, and education programs are examples of higher-level institutional solutions. Solutions also occur at a very local level, and these may include new storage facilities, efficiency improvements on an irrigation ditch, or implementation of a recreational in-channel diversion water right (RICD) on a stream running through a town.

Solutions can be implemented statewide, at local levels, or anywhere in between. For example, education and outreach programs can be implemented across Colorado or could be focused on a specific municipality. Solutions may be developed by institutions and then implemented by local water users. For example, Colorado's ISF and natural lake level (NLL) program was created by Colorado's legislature in 1973, and it is used to preserve and improve the conditions of specific streams and lakes.

A wide variety of tools are described in this section. The accompanying illustration provides some general perspective on the type and scale of tools, but this can vary as noted earlier.

INSTITUTIONAL TOOLS are often implemented at a statewide level or are conceptual strategies that can be applied to nearly any challenge. These tools may address significant statewide barriers to achieving water-related goals, enhancing collaboration, and supporting public knowledge of water issues.

PLANNING TOOLS are frequently implemented on a regional level by stakeholder groups, water conservancy districts, or other regional organizations. Regional planning solutions often rely on decision support tools and/or collaborative processes to creatively address competing water needs.

ON-THE-GROUND TOOLS are projects that local water managers use to deal directly with water at a local level. These projects are implemented at a variety of scales by water providers, watershed groups, ditch companies, and in some instances, state agencies.

BROAD SOLUTIONS

SPECIFIC SOLUTIONS


PUBLIC OUTREACH AND EDUCATION


FUNDING


POLICY AND REGULATORY CHANGES


COLLABORATION GROUPS


WATERSHED PLANNING


CLIMATE ADAPTATION


INNOVATION


EQUITY


ENDANGERED AND THREATENED SPECIES RECOVERY PROGRAMS


NATURAL HAZARD PLANNING


LAND USE AND WATER PLANNING INTEGRATION


DATA COLLECTION AND SHARING


WATER STORAGE


CONVEYANCE INFRASTRUCTURE


WATER EFFICIENCY AND CONSERVATION PROGRAMS


WATER REUSE


COLLABORATIVE WATER SHARING AGREEMENTS


STREAM/WATERSHED RESTORATION AND ENHANCEMENT


FLOW ENHANCEMENT AND MAINTENANCE

ICONS

Each TOOL is assigned an icon. The icons appear alongside Water Plan actions and text that consider these the solutions.

The tools described below are proven strategies that agencies, water users, and stakeholders implement to overcome challenges.

The CWCB plays a role in implementing all of these solutions. Chapter 3 provides a description of CWCB's programs, work areas, and ongoing efforts to help conserve and protect Colorado's water resources. Chapter 6 describes the ways stakeholder can use these tools for action and the ways CWCB and supporting agencies will take specific actions that advance the vision of the Water Plan.

PUBLIC OUTREACH AND EDUCATION

The State of Colorado and water stakeholders recognize the importance of public outreach and education. An educated public is necessary for developing sustainable grassroots solutions and gaining public and political support for implementing water solutions. Outreach creates public awareness of policies and processes, and education promotes a deeper understanding of these topics. Both are prerequisites to public engagement. Outreach, education, and public engagement across diverse geographies, cultures, and age groups help Coloradans access accurate information and empower them to participate in stakeholder decision-making processes.

The CWCB plays an important role in outreach, education, and engagement in several ways, including promoting wise water use, supporting local and regional water groups, promoting all of the tools and action areas in the Water Plan, and using the Water Plan itself as an educational tool. Additionally, CWCB directly funds outreach for many projects through grants including supporting IBCC and basin roundtable PEPO liaisons across the state (see Chapter 4).

In the future, CWCB will continue to aid in research, coordinate efforts, and provide funding and guidance for water education, outreach, and participation in projects statewide.

EXAMPLES

Water Educator Network.
Water Education Colorado's Water Educator Network supports and connects Colorado's education and outreach professionals dedicated to advancing their understanding about water issues.

Public survey
In 2021, CWCB conducted a public survey to better understand the public's perception of Colorado water issues.
Public Opinions, Attitudes, and Awareness about Water in Colorado: 2021 Survey and Focus Groups

Link for more information on CWCB's **IBCC Public Education, Participation, & Outreach Workgroup | DNR CWCB**

FUNDING

Many existing state funding sources and programs can assist in meeting Colorado's long-term needs. The CWCB's grants and loan program funds infrastructure development, studies, environmental restoration, and recreation enhancement projects. Funding awards emphasize regional, multi-purpose collaborative, and multi-benefit projects, and projects that consolidate services where practical, feasible, and acceptable. Although CWCB's grants and loan programs cannot solely meet the state's financial water needs, they can help bridge funding gaps when combined with other sources.

The CWCB recognizes that water providers are responsible for their short- and long-term capital investments, which include consumer incentives for conservation and efficiency, operation and maintenance costs, and customer base. Revenue bonds and/or Environmental Impact Bonds issued by water providers are mechanisms available to finance water infrastructure investments, including large-scale investments in turf replacement and other water use efficiency and conservation incentives. Customer water rates and tap fees could be the primary source of funding where the end user is directly connected with the costs and investments. Water providers can seek collaborative, multi-purpose projects, which provide opportunities to combine financial resources and solve complex water supply challenges.

Funding can be raised through public initiatives and through water conservancy and conservation districts. In addition, state and federal stimulus funding can help meet the needs of water users and stakeholders. Chapter 3 includes a more detailed description of CWCB and other sources of funding that can be used to meet water needs in all sectors of use. Chapter 6 provides examples of actions partners can take to implement the Water Plan and the ways actions map to the five major funding categories of the Colorado Water Plan Grant Program.

Link for more information on CWCB's grants and loan programs: **Funding | DNR CWCB**

POLICY AND REGULATORY CHANGES

Colorado's General Assembly and boards with policy and regulatory authority lead efforts to effect changes that provide or foster solutions to the state's pressing water resources issues. Policy and regulatory changes can affect all sectors of water use. These types of changes can be far reaching and can create impactful solutions for meeting Colorado's water challenges. Recent examples of policy and regulatory changes are provided below, but this is by no means a comprehensive list (see Chapter 3 for a timeline of additional policy and regulatory changes that informed the direction of the Water Plan)

- **Non-functional turf:** In 2022, multiple state and local initiatives focused on non-functional turf: 1) HB 22-1151 authorized CWCB to develop a 3-year funding program to support removal of non-functional turf; 2) CWCB developed an exploratory analysis of non-functional turf removal savings;[5] 3) Aurora and Castle Rock passed ordinances restricting the use of turf; 4) A group of water providers that use Colorado River water signed an agreement to increase conservation, reuse, and non-functional turf removal—the latter by 30 percent.[6]

Chapter 3 provides more information on how CWCB works with state agencies and other partners on policy and regulatory issues

[5] BBC Research & Consulting. **Exploratory Analysis of Potential Water Savings, Costs, and Benefits of Turf Replacement in Colorado. 2023**.

[6] The Metropolitan Water District of Southern California. **Press Release: Water Agencies Unite and Commit to Reducing Demands on Colorado River**. November 16, 2022.

- **Water efficiency in comprehensive plans:** HB 20-1095 requires local jurisdictions to incorporate water efficiency into their comprehensive plan if that plan contains a water element.
- **More efficient fixtures and appliances:** HB 19-1231 added requirements for energy and water efficiency for fixtures and appliances sold in Colorado.
- **Additional uses for recycled water:** CDPHE's recent Regulation 84 changes now allow for reclaimed water to be used for crop and tree irrigation, edible and non-edible hemp irrigation, toilet and urinal flushing, and oil and gas operations, in addition to many other previously approved uses.
- **Rulemaking for DPR:** In October 2022, WQCC took preliminary action to incorporate DPR rules into Colorado's Primary Drinking Water Regulation (Regulation 11). The new rules set minimum standards and oversight for DPR to ensure consistency and ensure a thorough public outreach process for new projects. Through several CWCB grants, varied groups of stakeholders, including a national expert panel, created a DPR regulatory framework for Colorado, which led to the 2022 rulemaking. The revised regulation is expected to become effective in early 2023.
- **Graywater reuse:** As a result of legislation, WQCC adopted graywater control regulations (Regulation 86). As part of CDPHE's triennial review, a stakeholder process for gathering feedback on rulemaking began in 2022.
- **Allowance for rain barrels:** HB 16-1005, passed in 2016, allows single-family residences to install two rain barrels up to 110 gallons total.
- **Agricultural Water Protection Water Right:** HB 16-1228 allows the owner of an agricultural water right to change the use of that right and lease, loan, or trade up to 50 percent of the historical consumptive use to another water user for a new use.
- **Instream flows:** HB 20-1157 enhanced use of loaned water on instream flow reaches on a temporary basis. The CWCB conducted rulemaking on steps for reviewing and accepting loaned water.
- **Instream flows:** HB 20-1159 allows the State Engineer to confirm ISFs are subject to existing uses not previously confirmed by court decree.
- **Instream flows:** HB 20-1037 allows CWCB to augment streamflows with water previously decreed for augmentation.
- **Instream flows:** SB 18-170 provides a water court process by which releases may be made from a reservoir and protected for mitigation purposes under a CWCB approved fish and wildlife mitigation plan.

Statutory and regulatory changes can take time to occur. For example, legislation can potentially take multiple sessions of the General Assembly to pass, depending on the scope and content of legislation and other legislative priorities. Legislative, policy, and regulatory changes require votes or decisions by multiple people, and sometimes agreement can be hard to reach. Nonetheless, policy and regulatory changes are an important tool for meeting Colorado's current and future water challenges.

> "THE CERTAINTY, RESILIENCY, AND SECURITY FOR COLORADO IS INCREDIBLY IMPORTANT AND IS REFLECTED IN ALL THE WORK WE'RE DOING.
>
> — REBECCA MITCHELL, *CWCB Director*

COLLABORATION GROUPS

Collaboration through inter-agency and interdisciplinary approaches that define clear roles and responsibilities can help in prioritizing water issues from planning to implementation. The Water Plan identifies the need to address risks to water supply and watershed health with coordinated planning across boundaries. Regional and local, place-based collaborative groups are a vital component to successfully approaching these multi-scale efforts.[7] While there is significant diversity in the forms and functions of Colorado collaboratives, they are generally comprised of people representing government agencies, nonprofits, businesses, or independently working together to decide how to use and manage natural resources such as land and water. There is also a need to expand access to collaborative groups and encourage new membership that better represents the demographic of Colorado communities. Collaboration often means partners pool their resources and create shared goals, processes, and structures to support their new, joint work. Collaborative groups explore, prioritize, deliberate on, and implement the solutions they have developed together.[8] Collaboration can be particularly useful for addressing problems that:

- Have too high of a cost for one entity to carry alone
- Cross ownership or management boundaries
- Have high levels of uncertainty, missing information, or are viewed differently by participating stakeholders
- Involve tradeoffs and balancing the needs of different water users
- Fail to be resolved with other approaches, like litigation

The CWCB recognizes the need to strengthen institutional connections to achieve identified actions that are outside of CWCB's direct control. Formal collaboration with other organizations and agencies will help reconcile management strategies and identify mutually beneficial policies and practices.

EXAMPLE

Basin roundtables are important collaborative groups that work together to meet Colorado's water challenges.

The nine basin roundtables representing the state's eight major river basins and the Denver metropolitan area were formed in 2005 to facilitate discussions on water management issues and encourage locally driven collaborative solutions. See Chapter 4 for more information on each basin and a summary of BIPs developed by the basin roundtables.

> "AS WE PLAN FOR OUR FUTURE IN COLORADO WE MUST RESIST ANY TEMPTATION FOR OUR COMMUNITIES TO BE PITTED AGAINST ONE OTHER. WE MUST PURSUE A PATH OF COLLABORATION AND SHARED COMMITMENT TO INNOVATION AND PROBLEM SOLVING.
>
> — PHIL WEISER, *Colorado Attorney General*

Link for more information on CWCB's basin roundtables: **Basin Roundtables | DNR CWCB**

[7] Kooistra C and J Sanderson. 2021. **Situation Assessment for a Network of Forest Collaborative Groups in Colorado**. Final report prepared by the Center for Collaborative Conservation, Colorado State University, Fort Collins, Colorado.

[8] Huayhuaca C and Reid R. 2019. **Center for Collaborative Conservation: The Atlas of Collaborative Conservation in Colorado.**

Link for more information on CWCB's Watershed Protection and Restoration Program: **Watershed Protection and Restoration | DNR CWCB**

Colorado SMP Webpage: Nuts and bolts (the link provides information on both SMPs and IWMPs)

WATERSHED PLANNING

A watershed is an area of land that connects and drains rain or snow into rivers, lakes, and wetlands. These areas include our snow-capped mountains and forests, which supply water for drinking, agriculture, and industry, and provide recreational opportunities. Watersheds provide vital ecosystem services, such as habitat, carbon sequestration, and water supply filtration. Healthy watersheds with healthy riverscape structure and function are resilient, and resilient ecosystems are able to absorb repeated disturbances (e.g., fires, floods, droughts) and adapt to change without fundamentally changing the services (e.g., flow regime) on which society and the environment depend. The health of forests, streams, and the larger watershed ecosystem is critical to its ability to absorb shocks and stresses.

Watershed management planning is broadly defined as a strategy that provides assessment and management information for a geographically defined watershed. It is a flexible framework that can be applied to a single or range of issues. Successful watershed management requires coordinated planning across political boundaries and organizations. For example, while CWCB does not directly fund forest thinning, stream management planning partnerships between CWCB and forestry could leverage funds that include forest thinning to help achieve multiple goals and ultimately enhance river health. Similarly, coordinated efforts that leverage funds to enhance river corridors for recreation can help creatively support both watershed health and recreation.

Watershed management planning is used by a variety of private, public, and non-profit institutions across Colorado to address a range of watershed needs from water quality improvements in urban waterways to enhancing recreational uses in high mountain streams. Effective watershed management planning considers a range of perspectives from diverse voices. Common tools and best practices for evaluating stream health are emerging as the number of watershed plans are developed. While the flexibility to use different tools can be beneficial, the core functions like hydrology, hydraulics, geomorphology, water quality, biology, and recreation are transferable and provide a common link across plans. Finding similarities, identifying successes, and sharing resources can help make planning easier, more effective, and inclusive.

EXAMPLE FRAMEWORKS FOR WATERSHED PLANNING

Stream Management Plans
SMPs are data-driven assessments of river health that help communities prioritize how to protect or enhance environmental and recreational assets in their watershed.

Integrated Water Management Plans
Similar to SMPs, the IWMP framework focuses on water management practices, streamflow, and resulting effects to ecosystems and water uses. IWMPs are more broad than SMPs and consider a wider array of needs and larger groups of stakeholders, including water rights owners and riparian landowners.

Upper Culebra Watershed Assessment
The **Upper Culebra Watershed Assessment** was completed in 2022 to evaluate watershed conditions within the Culebra River basin and develop projects and strategies to address watershed health concerns. The assessment approach is based on community-identified areas of concern and is evaluating a broad range of technical topics from water and streams to forest health. The areas of the assessment include riparian habitat, aquatic habitat, flow regimes, water quality, forest health, geology/geomorphology, infrastructure, and safety and emergency management. In addition, historic and current land use was assessed through one-on-one interviews and historic documents – this allowed for engagement with the acequia community in the region. The assessment received funding from CWCB, Colorado Watershed Assembly, San Luis Valley Conservation Fund, Trinchera Blanca Foundation, Costilla County Conservation District, Sangre de Cristo National Heritage Area, and Colorado Department of Agriculture.[9]

[9] Lopez, Judy. Upper Culebra Watershed Assessment. **Rio Grande Basin Roundtable Newsletter. Volume 6. Issue 3.**

CLIMATE ADAPTATION

A warmer and potentially drier future climate will have cascading impacts for Colorado's towns, farms, cities, and people. Additionally, these impacts will likely mean increased frequency and severity of floods, fires, droughts, and other events. How Colorado prepares, responds, and recovers to both the acute and chronic impacts will be key to addressing Colorado's future water needs. While many plans focus on reducing or capturing carbon (climate mitigation), many efforts increasingly need to focus on adapting to future changes (climate adaptation). Colorado will need to focus on practical drought solutions, wildfire mitigation, flood preparedness, and water supply and demand strategies that are adaptable to changing hydrology.

Links for more information on:

- Climate trends that will require adaptation: **Climate Change in Colorado**
- Climate vulnerabilities and opportunities for adaptation: **Colorado Climate Change Vulnerability Study**
- CWCB's Climate Program: **Climate | DNR CWCB**

> "THINK ABOUT CLIMATE MITIGATION AND LOOK THROUGH THE LENS OF CLIMATE ADAPTATION TO HELP CITIZENS AROUND THE STATE BE READY FOR A DRIER FUTURE.
>
> — CELENE HAWKINS, *CWCB*

INNOVATION

Creative, collaborative, and innovative solutions will be needed to lower our future water supply risks as our population grows and the climate warms. Strong investments in research can lead to breakthrough advancements in efficient water use. Advancing innovation is not always easy. Challenges to fostering innovation can include the inability to create open dialogues with the business community, legal or regulatory barriers to innovation, or lack of support for research and development. Identifying how state agencies like CWCB can better support innovation, start-ups, and a wide variety of partnerships to help develop new technologies and pilot new ideas, will be key to advancing water-savings technologies and innovative ideas. The CWCB plays a key role in advancing innovation, and the Water Plan includes actions that foster innovative concepts.

> "PRIORITIZE AND INCENTIVIZE CREATIVE PROJECTS. THINK THROUGH THE USE OF EVERY SINGLE DROP.
>
> — HEATHER DUTTON, *CWCB*

EQUITY

The population of Colorado is on the rise and projected to increase by 20 percent by 2040, with minorities being 40 percent of the overall population.[10] Inclusive water planning builds resilience to respond to water challenges and advances equitable outcomes for all Colorado communities. Colorado has made progress toward regionally inclusive and collaborative water planning through the 2005 Water for the 21st Century Act, followed by the 2015 Water Plan, which further recognized that all water uses are interconnected and of equal value. However, the state recognizes that there are deep, unaddressed societal and institutional issues that pose significant barriers to advancing equity in water policy decisions. Addressing equity issues in water policy decisions will require bringing in a larger range of voices. Understanding that many of these challenges extend to other agencies, Tribes, regulatory considerations, and broader policy, CWCB's initial step will require proactive engagement and inclusion of individuals and communities that have not traditionally been involved in water planning. Historically, Tribes have not had the resources, support, or ability to develop their water rights. Additional information on Tribal water rights can be found in Chapter 3.

RECENT EXAMPLES OF EQUITY-RELATED ACTIVITIES

Equity Principles

In the lead-up to the Water Plan update, a 21-member Water Equity Task Force was established to help develop guiding principles for the Colorado Water Plan. This adds to other state work, including CDPHE's Climate Equity principles and the Environmental Justice Action Task Force Advisory Board. Together, multiple state agencies must consider how to better address EDI in all planning, including water planning.

State Equity Office

The Statewide Equity Office, created in 2022 by HB 22-1397, will provide best practices, resources, and guidance for state agencies in offering equitable services to the residents of Colorado as well as providing an accepting and diverse environment for State employees.

Environmental Justice

The CWCB works with CDPHE on EJ issues and has incorporated EJ into actions described in Chapter 6. According to the EPA, EJ is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

> "WE DON'T ALL START OFF AT THE SAME BASELINE. WE DON'T ALL HAVE THE SAME RESOURCES. BUT WE SHOULD CONSIDER EQUITY IN THINKING ABOUT HOW COMMUNITIES AND PRODUCERS ACROSS THE STATE ARE SUPPORTED TO GET TO WHAT THEY NEED TO THRIVE.
>
> — JESSICA BRODY, *CWCB*

[10] Colorado State Demography Office

In addition to these interstate recovery programs, Colorado-driven fish and wildlife recovery programs are essential tools for protecting sensitive species before they are federally listed as threatened or endangered. Two examples include the Colorado River Cutthroat Trout Conservation Strategy[11] and the Conservation and Management Plan for the Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker.[12]

Link for more information on CWCB's Endangered Species Programs: **Endangered Species | DNR CWCB**

ENDANGERED AND THREATENED SPECIES RECOVERY PROGRAMS

Many of Colorado's water projects are likely to have a "federal nexus," meaning that they involve federal funding, federal permitting or licensing, use of federal lands, or a federal program. The existence of a federal nexus often triggers the need for ESA processes to evaluate whether a project is likely to jeopardize the continued existence of listed threatened or endangered species or result in the destruction or adverse modification of critical habitat. To mitigate these effects, Colorado participates in three recovery programs designed to protect and recover stream-dependent endangered and threatened species in various river basins while providing regulatory certainty and ESA compliance for water users. As a result, these programs encourage cooperative water management and habitat restoration.

Upper Colorado River Endangered Fish Recovery Program.
Initiated in the 1980s, the UCEFRP Partners in this program are working toward the recovery of three endangered fish species—the bonytail, Colorado pikeminnow, and the razorback sucker—and one threatened fish species, the humpback chub. Partners include the states of Colorado, Wyoming, and Utah as well as multiple non-profits, water users, and federal agencies. In 2021, the humpback chub was reclassified from Endangered to Threatened—a major win for the Partners.
Upper Colorado River Endangered Fish Recovery Program

San Juan River Basin Recovery Implementation Program.
The SJRIP was established in 1992 to recover the Colorado pikeminnow and the razorback sucker while allowing water development and management activities to continue in the San Juan River Basin. Because the basin is part of the Upper Colorado River Basin, the UCEFRP and the SJRIP operate in parallel. SJRIP partners include the states of Colorado and New Mexico; the Tribal governments of Navajo Nation, Jicarilla Apache, SUIT, and UMUT; multiple federal and non-profit agencies; and other water users.
San Juan River Basin Recovery Implementation Program

Platte River Recovery Implementation Program.
The PRRIP, established in 2007, was formed to support the recovery of four target species by enhancing, restoring, and protecting habitat in the Platte River in Nebraska while providing ESA compliance for water projects in Colorado, Nebraska, and Wyoming. The target species are the piping plover, least tern, whooping crane, and pallid sturgeon. Partners include the states of Colorado, Wyoming, and Nebraska, water users, and multiple federal and environmental agencies. In 2021, the USFWS announced that the interior least tern was fully recovered and officially removed from the endangered species list.
Platte River Recovery Implementation Program

[11] CRCT Conservation Team. 2006. **Conservation Agreement for Colorado River Cutthroat Trout (Oncorhynchus clarkii pleuriticus) in the States of Colorado, Utah, and Wyoming**. Colorado Division of Wildlife, Fort Collins.

[12] Utah Department of Natural Resources. 2006. **Range-wide Conservation Agreement and Strategy for Roundtail Chub (Gila robusta), Bluehead Sucker (Catostomus discobolus), and Flannelmouth Sucker (Catostomus latipinnis)**.

NATURAL HAZARD PLANNING

Wildfire, drought, and flood events can be catastrophic and extremely costly, both in terms of dollars spent and in the loss of other systems whose costs cannot be quantified or replaced, such as ecosystem services. Colorado has seen a rise in severe and extreme events over the last two decades in part because of climate change. Without resilient planning, scientists expect many natural hazards to increase in frequency and intensity with a warming climate, which would result in increasing economic damages and ecosystem losses. Pre-hazard mitigation and planning are opportunities to reduce risk and lower costs associated with natural hazards.

TOOLS FOR NATURAL HAZARD PLANNING

FACE:Hazards – The Future Avoided Cost Explorer (FACE) tool is an interactive dashboard that quantifies current and future risk from flood, drought, and wildfire across multiple sectors of Colorado's economy, quantified as expected annual damage expressed in dollars. **FACE:Hazards | DNR CWCB**

Drought planning guidance – The CWCB assists water users and local planners across the state in resiliency planning and response to drought. This includes sharing drought monitoring data and providing guidance on how to develop a local drought plan. **Drought Assistance | DNR CWCB**

Wildfire Ready Watersheds – This CWCB program aims to provide a mitigation framework for communities to assess the susceptibility of their water resources and critical infrastructure to post-wildfire impacts.
CWCB Wildfire Ready Watersheds

Colorado Fluvial Hazard Zone Mapping Program – The CWCB developed a technical protocol to help communities identify, map, and plan for natural hazards associated with erosion, sediment deposition, and other dynamic river processes.
CWCB FHZ

Although natural hazard events rarely unfold exactly as predicted, post-hazard risks can be mitigated ahead of time if communities have prepared by reducing some risks with the tools available to them.

Forest Health Planning Tools

The CWCB developed a list of models, tools, and funding sources concerning forest health.

Link to the forest health planning tools document: **Forest Health Study: 10 Takeaways to Inform the Colorado Water Plan**

LAND USE AND WATER PLANNING INTEGRATION

Historically, land use and water planning decisions have been made in a disconnected manner. Land planners (Planning Commissions, City Councils, and County Commissioners) make decisions about future developments that rely on water. Meanwhile, water planners often project supplies and demands in separate and disconnected analyses from land planners. Land use patterns have a strong influence on water demand. Subsequently, communities that implement a thoughtful land use and water planning nexus can more easily plan for and regulate future growth while providing adequate water supplies. As Colorado grows, integrated land use and water planning must be considered the minimum standard for moving forward.

Integration of Land and Water Planning Mantra:

"BUILD IT WATER SMART FROM THE START"

Integrated land use and water planning can be a tool for protecting community water supplies, meeting future water demand, protecting water quality and riparian corridors, and/or establishing the appropriate location, pace, intensity, and sustainability of development. With that vision, efforts to develop resources to help support integrated planning were supported by CWCB, including the following:

RESOURCES TO HELP SUPPORT INTEGRATED PLANNING

Growing Water Smart Workshops – Colorado Growing Water Smart (CGWS) builds the capacity of local jurisdictions to plan and implement strategies for the integration of land use and water planning.

Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts – This CWCB guidebook assists water providers in integrating land use planning into their water efficiency plan.

Breaking Down Silos Webinar Series – The CWCB and DOLA created a series of webinars targeted at Colorado water providers and local government planners. Topics ranged from integrating water efficiency into comprehensive plans to zoning codes and planned unit developments.

The integration of land use and water planning is a crucial step when considering a secure water future for Colorado. Most of Colorado's communities are growing, and intentional and sustainable growth requires careful consideration.

Link for more information on CWCB's Land Use Program: **Land Use | DNR CWCB**

Link to: **Integrating Water Efficiency into Land Use Planning in the Interior West: A Guidebook for Local Planners**

DATA COLLECTION AND SHARING

Data collection and sharing is an important technological tool to advance our knowledge and understanding of drivers that impact our water resources and potential future water supplies and demands. A wide variety of entities statewide collect and make data available online through mapping tools that provide easy access to, and understanding of, data.

The CWCB's decision support system and modeling software use data to help water users better manage our state's water resources. A decision support system is an interactive information system that analyzes large volumes of data for informing decision making. The State uses decision support systems for planning and management of water supplies for each of Colorado's major water basins.

The DWR collects water resources data and makes it available online through the CDSS, a joint effort of CWCB and DWR, which contains:

- Data, mapping, and analytical tools and models to assist the State and stakeholders in water resources planning and management.
- Historical data and information about streamflow, diversions, climate, water rights, call records, well permits, aquifer properties, and groundwater levels all stored in a comprehensive database named Hydrobase.
- Analytical resources, such as an online map viewer, data processing and graphing tools, crop consumptive use models, and surface water and groundwater models.

Software is available to download through CDSS for surface water or groundwater modeling, processing time series data, and estimating consumptive use. The software is used by water managers and planners across the state.

Although CDSS does not provide an exact solution to any water challenge, it provides a range of answers. By having reliable and accurate data, better decisions are made in water management.

Links for more information:

- **Colorado's Decision Support System**
- Web-based GIS application that provides water feature information in the form of an interactive map of Colorado: **Map Viewers | Colorado's Decision Support System**
- Software available for surface or groundwater modeling: **Software | Colorado's Decision Support System**

The CWCB is proud that CDSS was named a Bronze Winner of the 2018 Horizon Interactive Award.

The Horizon Interactive Award is a prestigious web design award that recognizes excellence in interactive media production. The competition receives thousands of entries from all over the world.

WATER STORAGE

Water storage helps meet the year-round needs of agriculture, municipalities, recreation, and the environment. While snowpack is Colorado's greatest storage "facility," reservoirs hold water to be released during heightened demand or periods of drought. Nearly half of Colorado's storage capacity is located on the western slope in the Colorado River Basin and its tributaries.

Storage is comprised of both surface and underground storage. Surface water storage includes reservoirs and gravel pits and relies on water infrastructure, such as pumps, tunnels, and ditches, to convey water across the landscape. Underground storage includes alluvial and bedrock aquifers that offer potentially significant groundwater storage capability.

To support the water needs in Colorado, it is important to recognize that storage is an important tool to manage and share conserved water and address the challenges of a changing future climate. Most storage projects, however, were developed in the middle of the last century, and the construction of both new infrastructure and storage has remained relatively static over the last 30 years.

Future storage projects will include new storage facilities but should also work to increase capacity of existing reservoirs, address a diverse set of needs, involve partners, be increasingly innovative, or rely on technologies such as aquifer, storage, and recovery (ASR). Additionally, water managers will need to be more agile in responding to changing future conditions so that storage can be more rapidly added to Colorado's water portfolio while maintaining strong environmental health.

While storage is a critical element for managing Colorado's future water supplies, new storage projects can be contentious and may face permitting hurdles and uncertainties affecting supply.

Link for more information on CWCB's involvement in storage projects: **Storage Projects | DNR CWCB**

CONVEYANCE INFRASTRUCTURE

Conveyance infrastructure is critically important for meeting Colorado's water needs. While storage projects are important for capturing available supply, conveyance infrastructure moves the water from reservoirs, streams, and aquifers to where the water is needed using pipes, pumps, diversion structures, headgates, and ditches. Conveyance is critical for agricultural purposes in moving water from streams and irrigation wells to farm fields. In a municipal setting, conveyance infrastructure moves water from storage reservoirs to water treatment plants, from treatment plants to homes, and from homes to wastewater treatment facilities.

Often, the most expensive components of a water development project are the conveyance facilities. Water may need to be transported over many miles from its source to end use, which results in high material costs, extensive land or easement purchases, and potentially lengthy and expensive permitting processes. While conveyance infrastructure is often buried and out of sight, it represents a significant investment and an important component of how we get water.

Much of Colorado's agricultural conveyance infrastructure was constructed decades ago, and efforts are underway across the state to upgrade and maintain the infrastructure. The BIPs included many examples of projects with conveyance infrastructure upgrades. The scale of the aging infrastructure issue is large, and a future challenge will be funding all the aging agricultural infrastructure needs across Colorado. Incorporating additional benefits into structure improvements, such as fish and/or boat passage and recreational access, can enhance resiliency and potentially bring additional sources of funding. Collaboration with environmental and recreational interests before and after a project can help ensure that improvement projects meet their intended purposes.

Conveyance infrastructure will continue to be important in managing water supplies in the face of changing hydrology. Collaborative approaches to developing conveyance infrastructure will be important in the future to minimize cost and to maximize resilience in the face of uncertainty.

EXAMPLES

La Plata West Water Authority Raw Water Pipeline.
La Plata West Water Authority was one of the first to use water from the Animas-La Plata Project via a newly constructed raw water delivery system to Lake Durango's treatment plant, completed in 2019. Future expansions of the treated water system continue, with the initial phase of 32 miles of pipeline completed at the end of January 2020.

The Southern Delivery System.
The 50-mile Southern Delivery System water pipeline began delivering Arkansas River water from Pueblo Reservoir to Colorado Springs and Fountain in 2016.

Southern Water Supply Pipeline (Phase II).
Started in the 1990s and completed in 2020, Northern Water constructed a 20-mile pipeline from Carter Lake south to Boulder Reservoir Water Treatment Plant. This project provides raw water for several communities.

WATER EFFICIENCY AND CONSERVATION PROGRAMS

Water conservation in municipal and agricultural settings has been and will be important strategies as Colorado seeks to meet our water needs. Conservation strategies in each water sector have different considerations, as described below.

Municipal Conservation and Efficiency

Municipalities, special water districts, and other water providers have progressed in water conservation over the last 20 years. Water efficiency savings can reduce water demands and provide a buffer against drought. Municipal water conservation can help providers reduce the amount of costly system expansions needed in the future. In addition to water supply benefits, municipal water conservation can improve water quality, improve aquatic habitat, and ease the burden of political and regulatory requirements. The importance of municipal conservation and efficiency continues to grow as Colorado's population increases and climate change increases uncertainty in water supplies.

In Colorado, water providers that deliver more than 2,000 acre-feet of water annually are required to have a CWCB-approved Municipal Water Efficiency Plan. While many water providers have adopted best practices such as water loss management, water conservation is tightly linked to human behavior. An effective water conservation program often has a strong education component, incentives to drive innovation, right pricing to facilitate efficient water use, and regulatory components to create water efficient development as well as to reduce water waste.

The CWCB recognizes municipal water conservation and efficiency will be an important tool for reducing water use. Water conservation programs are relatively less expensive ways to reduce water demand through water efficiency and will be a critical implementation strategy to optimize water supply in Colorado.

CWCB has seen communities reduce water use by:

- **Reducing non-functional turf – establishing turf buy-back programs and enacting comprehensive landscape ordinances that limit new turf to functional spaces.**
- **Limiting water loss – engaging in best practice-based water loss control and management through robust water loss audits and comprehensive analysis.**
- **Establishing water budget rate structures and conservation oriented tap fees—encouraging sustainable water management through right sizing the connection to the water system while charging the appropriate amount based on what is needed.**

Agricultural Conservation and Efficiency

Water conservation and efficiency in agriculture often considers the balance between the environment and becoming more efficient and resilient by reducing non-beneficial water use without affecting agricultural productivity.

Discussions about agricultural water use and efficiency can be complicated because of incomplete understandings of agricultural water systems. In many parts of the state, a large part of the agricultural and environmental water supplies are provided by "return flow," and these flows can be affected by water efficiency strategies. For more information on return flow, see Chapter 3.

Benefits of agricultural conservation and efficiency can include increased crop production, reduced vulnerability to drought, enhanced flows for the environment and recreation, and improved water quality. In many cases, better irrigation efficiency results in water application that is more in sync with plant demands (both in timing and amount), which results in fully utilizing and consuming the available supply.

Agricultural conservation and efficiency will be an important tool to stretch water supplies to help meet future needs and maximize the economic benefit of agricultural lands for irrigators and rural communities.

Link for more information on CWCB's Urban Water Efficiency Programs: **Urban Water Efficiency | DNR CWCB**

WATER REUSE

Water reuse occurs when return flows from one use are treated and reused for another beneficial purpose such as agriculture and landscape irrigation, drinking water, groundwater replenishment, industrial processes, or environmental restoration, among others. For water users with legally reusable water supplies, water reuse can provide alternatives to existing water supplies and be used to enhance water security, sustainability, and resilience within Colorado water law.

In Colorado, most reuse systems focus on non-potable uses through Colorado's Regulation 84, which sets water quality standards for reclaimed water for non-potable uses such as landscape irrigation, crop irrigation, and commercial and industrial processes. The use of "graywater," regulated under Regulation 86, is another means by which water may be reused for non-potable uses. Graywater is wastewater reused on-site for specific approved uses after being collected within a building from bathroom and laundry room sinks, bathtubs, showers, and laundry machines. However, there continues to be significant challenges to implementing graywater technology, including difficulty of retrofitting existing buildings, general lack of interest on the part of local governments to enact local graywater ordinances, lack of interest from developers, and concerns that property owners could be resistant to operating and maintaining a graywater system within their residences.

There is growing interest in water reuse for augmenting potable water supplies in Colorado. Surface water quality standards and Safe Drinking Water Act requirements for potable treatment control this reuse (which also drives discharge permit limits from water reclamation facilities). Increasingly common are intentional, indirect potable reuse (IPR) projects, which involve adding treated wastewater to an environmental buffer, such as a lake or stream, before the water is diverted and treated at a drinking water facility. DPR is when drinking water is produced through a series of treatment processes using a source containing treated wastewater that has not passed through an environmental buffer. While there are no active DPR projects in Colorado, WQCC recently modified Colorado's Regulation 11 Primary Drinking Water Regulations, to allow for DPR.

Widespread development of potable reuse and allowance of different uses for reuse water will be an important facet of meeting future water needs, but Colorado needs to continue making progress in overcoming these challenges, in which public education and outreach will play a key role.

REUSE HIGHLIGHTS

Graywater Pilot Study: At present, CWCB is funding a 40-home pilot project with built-in graywater systems and advanced household leak detection. All units should be installed and operational by the end of 2022, and subsequent study and analysis will demonstrate the amount of demand reduction per household.

PureWater Colorado Mobile Demonstration Project: Funded by a grant from CWCB, Colorado Springs Utilities and its partners designed and constructed an advanced water purification system inside of a mobile trailer using treated wastewater from the JD Phillips Resource Recovery Facility to produce potable water. The DPR trailer was used by Colorado Springs Utilities in 2021 and 2022 for public education and outreach, operator training, and treatment process refinement. Looking forward, the trailer is owned by the Colorado School of Mines and can be used by utilities across the state for these and other purposes, to advance the science and community engagement for potable reuse.

DPR Rule: In October 2022, WQCC adopted changes to Colorado Primary Drinking Water Regulations (Regulation 11) to govern DPR after a rigorous stakeholder process led by WQCD.

Link for more information on CWCB's Reuse Programs: **Reuse | DNR CWCB**

COLLABORATIVE WATER SHARING AGREEMENTS

CWSAs, formerly known as ATMs, are innovative and flexible water use agreements between two or more users, typically involving agricultural, municipal, or environmental users. CWSAs provide a temporary, voluntary, and compensated alternative approach to the "buy and dry" method that occurs when a water provider purchases senior agricultural water rights, formally changes the water's designated use through water court, and permanently removes the water from farmland. While the focus of CWSAs has primarily been an alternative to "buy and dry" activities involving municipalities and agriculture, they can be more broadly applied. A CWSA could periodically use agricultural supplies to boost streamflows for environmental or recreational uses. They can also encompass opportunities in which agriculture is not the source of supply. For example, municipalities could temporarily lease supplies to meet agricultural, environmental, or recreational needs.

New Terminology: CWSA

Despite being in use since the early 2000s, water users have expressed interest in moving away from the term "alternative transfer method." Many in the Colorado water community view ATMs narrowly and as being focused almost entirely on the temporary dry-up of agriculture to meet Front Range municipal water needs.

A survey conducted by WaterNow Alliance suggested that a term describing a more comprehensive suite of water sharing/ leasing activities would be acceptable.

The CWCB will, in the future, refer to these types of agreements as "collaborative water sharing agreements" to better reflect the broad set of water-sharing tools and approaches that are currently used and may be used in the future.

The CWCB and other stakeholders have taken important steps to encourage CWSA development, building on direction from the Water Plan. Despite ongoing support at the state level for CWSA development, the adoption of CWSAs remains hampered by several long-standing barriers, such as the lack of infrastructure to deliver water from CWSAs to a new use, lack of accessible information on potential impacts or benefits, the cost of development and implementation, and ability to address the diverse needs of all parties to a deal. The status of CWSAs, a list of barriers and solutions to those barriers, suggested criteria for defining CWSAs, and other recommendations are being considered by CWCB and are described in a report entitled **"Alternative Transfer Methods in Colorado, Status Update, Framework for Continued Support, and Recommendations for CWCB Action,"** published in July 2020.

CWSAs are an essential tool to meeting future water needs. They are flexible, adaptable, and innovative alternatives that allow all water sectors to benefit and meet future demands.

> "GIVE AG BETTER CHOICES THAN TO SELL OUT TO BIG CONGLOMERATES.
>
> — CURRAN TRICK, *CWCB*

Link for more information on CWCB's Water Sharing Agreement Program: **Water Sharing Agreements | DNR CWCB**

Stream restoration resources are diverse and reflect the wide-ranging approaches used and expertise required. The U.S. Departments of Agriculture and Interior developed a guide to the various techniques and schools of thought on stream restoration to help users educate themselves for specific projects.[13]

Link for more information on CWCB's Watershed Protection and Restoration Program: **Watershed Protection and Restoration | DNR CWCB**

STREAM/WATERSHED RESTORATION AND ENHANCEMENT

Projects that restore, maintain, or enhance Colorado's environmental and recreational values and that achieve long-term sustainability and environmental resiliency are an important part of Colorado's water future. An ecosystem's resilience is a measure of its ability to absorb changes and recover after disturbance. Resilient river systems require seasonal flow fluctuations and provide complex and connected aquatic and riparian habitats needed to sustain stable, diverse, abundant, and reproducing populations of aquatic and riparian species. To promote resiliency, stream restoration projects should consider the effects of drought, climate change, and aridification, which include decreased supply, changes in water temperature, and changes in runoff magnitude, duration, frequency, rate of change, and timing. Additional benefits of stream restoration include drought and flood resilience, increased forage for wildlife, balanced patterns of erosion and deposition, wildlife resilience, floodplain connectivity, and improved water quality and habitat.

Stream restoration strategies often are influenced by the degree to which streams, floodplains, and watersheds have been developed or altered by human activities. Restoration or enhancement tools are used to take on a variety of initiatives based on the specific needs of stream and watersheds, such as flow improvements, floodplain restoration, and stream habitat improvements. Recreational enhancements, such as stream accessibility improvements, can often be incorporated into projects. Two examples of common approaches to stream restoration include:

- **Process-based Restoration:** Process-based restoration aims to restore dynamic watershed and stream characteristics that reflect those in minimally impacted systems. This type of restoration project can improve water quality, habitat, and steam resilience. Process-based restoration projects benefit streams and protect clean water supplies for municipalities and agriculture.
- **Form-based Restoration:** When there is not room to restore the footprint that a river could occupy or influence in a wide variety of flow conditions due to development and infrastructure, a form-based restoration approach can be used to restore as much of the river's former footprint and functions as possible. Form-based restoration projects seek to restore or enhance water quality and fish habitat and abundance, and they also increase the stability of banks and stream channel beds.

Nature-Based Solutions

Nature-based solutions are actions to protect, sustainably manage, or restore natural or modified ecosystems as solutions to societal challenges, like mitigating water insecurity and climate change risk.[14] Examples of nature-based solutions include protection or conservation of natural areas, reforestation, restoration of wetlands or other habitats, or sustainable management of farms or forests. These actions can increase resilience to threats like flooding and wildfire and can slow climate change by capturing and storing carbon dioxide. Nature-based solutions can be considered in many of the tools suggested in the Water Plan including watershed management, natural hazard planning, and stream/watershed restoration.

Nature-based solution example: Protecting and supporting existing beaver populations and their habitat where appropriate is a desirable management tool in many forested areas to protect flow regimes, balance healthy patterns of sediment erosion and deposition, and improve aquatic habitat. Utah State University's Beaver Restoration Assessment Tool (BRAT) is a planning tool to help resource managers assess the potential for use of beavers as a stream conservation and restoration agent over watersheds.

[13] Yochum, Steven E., Reynolds, Lindsay V. 2020. Guidance for Stream Restoration. U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management; Forest Service National Stream & Aquatic Ecology Center Technical Note TN-102.5. Fort Collins, Colorado.

[14] Olander, Lydia, Laymon, Krystal, Tallis, Heather. November 2022. The White House Washington. **Opportunities to Accelerate Nature-based Solutions: A Roadmap for Climate, Progress, Thriving Nature, Equity, and Prosperity**. A Report to the National Climate Task Force.

Alternative Wild and Scenic Management Plans are stakeholder-driven processes that provide for the permanent protection of "outstanding remarkable values" but provide more flexibility for water users than the Wild and Scenic federal designation. While Alternative Wild and Scenic Management Plans are not a flow enhancement and maintenance tool by themselves, they can use ISFs to achieve their goals.

Links for more information on:

- CWCB's Recreational In-channel Diversion Program: **Recreation | DNR CWCB**
- CWCB's Instream Flow Program: **Instream Flow Program | DNR CWCB**
- CWCB's Wild and Scenic Rivers Fund: **Wild and Scenic Rivers Fund | DNR CWCB**

FLOW ENHANCEMENT AND MAINTENANCE

Climate change, increased stream alterations, and depletions to meet consumptive water needs will continue to impact the flow regime of Colorado streams. In the face of these challenges, it will become increasingly important to ensure that there are sufficient streamflows to meet environmental and recreational needs. There are a suite of flow enhancement and maintenance tools that can be used to alter or maintain the amount and timing of flow in a stream to protect or improve the natural environment and/or recreational opportunities. Some key examples include:

- **Recreational in-channel diversion water rights** are water rights for recreational boating on natural streams. Only local governmental entities can apply for RICDs, which are required to have control structures like constructed whitewater park features. Flows associated with RICDs are limited to the minimum streamflow necessary for a reasonable recreational boating experience in and on the water. The CWCB reviews all applications for RICDs on behalf of the State. The RICD legislation was established in 2001 and amended in 2006.

Instream Flows and Natural Lake Level Water Rights

ISF and NLL water rights protect streamflow in specific reaches of streams and water levels in natural lakes. The CWCB appropriates these non-consumptive water rights on behalf of the people of Colorado to preserve the natural environment. Any person or entity can make a recommendation to CWCB to appropriate a new ISF or NLL water right. The CWCB prioritizes ISF recommendations that focus on streams important for threatened, endangered, and imperiled native species or important recreational sport fisheries. Since the Colorado General Assembly authorized the program in 1973, the CWCB has secured ISF water rights on over 1,700 stream segments covering more than 9,800 miles of stream, and NLL water rights on 482 natural lakes.

Willing water right owners can also voluntarily donate, lease, or sell their water rights to CWCB for ISF use. When a water right is acquired for ISF use, it retains its priority date, providing CWCB with a more senior water right to preserve or improve streamflows. There are several different acquisition tools that range from short-term and temporary agreements to long-term and permanent arrangements:

- **Expedited Temporary ISF Lease - allows for ISF use for up to one year for a maximum of 120 days in a calendar year.**
- **Renewable Temporary ISF Lease - allows for ISF use for up to 5 years in a 10-year period, for not more than 3 consecutive years for up to 120 days in a calendar year.**
- **Long-Term ISF Lease - allows lease or donation of water rights for ISF use over an extended period of time.**
- **Permanent ISF Donation or Purchase - permanently changes the water right to allow ISF use.**
- **Protected Mitigation Releases - allows owners of new or enlarged storage rights to contract with the CWCB to release and protect water necessary to minimize or mitigate impacts to fish and wildlife resources.**
- **Streamflow Augmentation Plan - allows previously quantified and changed water rights to be used to augment streamflows.**

The CWCB has completed more than 35 voluntary water acquisition transactions.

- **Non-diversion agreements** allow water users to consume less water without injuring their water rights. The unused water that results from these agreements remains in the stream. One example of a non-diversion agreement is the Colorado River District's promotion of water conservation measures. The passage of SB 13-019 (and now codified at CRS 37-92-305(3)(c)) directs the water court in Colorado Water Divisions 1, 2, 3, 4, 5, and 6 not to consider any decrease in water use as a result of certain water conservation programs, thereby protecting the historical consumptive use calculation should the water right owner ever seek a change for use for the right.
- **Cooperative reservoir release programs** provide stakeholders with a framework for collaborative integration of dam operations and downstream resource protection and management. Cooperative reservoir releases can help boost hydropower generation, help meet existing instream flow needs, and provide additional flows for sensitive aquatic species. Water managers and reservoir operators can obtain input from environmental and recreation stakeholders regarding the timing and ramping-up and ramping-down rates of reservoir releases so that releases enhance or at least minimize adverse impact to rivers, aquatic species, and recreational flows. Through adaptive management, regular communication, and by maintaining a historic database of releases, they can refine practices and continually improve the impact that reservoir releases have on aquatic health.
- **Collaborative Water Sharing Agreements**, described earlier in this document, can also serve as an important flow enhancement and maintenance tool.

> "OUR OUTDOOR RESOURCES ARE THE FOUNDATION OF OUR STRONG ECONOMY AND A KEY CONTRIBUTOR TO THE COLORADO WAY OF LIFE.
>
> — HEATHER DISNEY DUGAN
> *Acting Director, Colorado Parks and Wildlife*

15 Mile Reach near Grand Junction on the Colorado River Provides Critical Habitat for Four Rare Native Fishes —

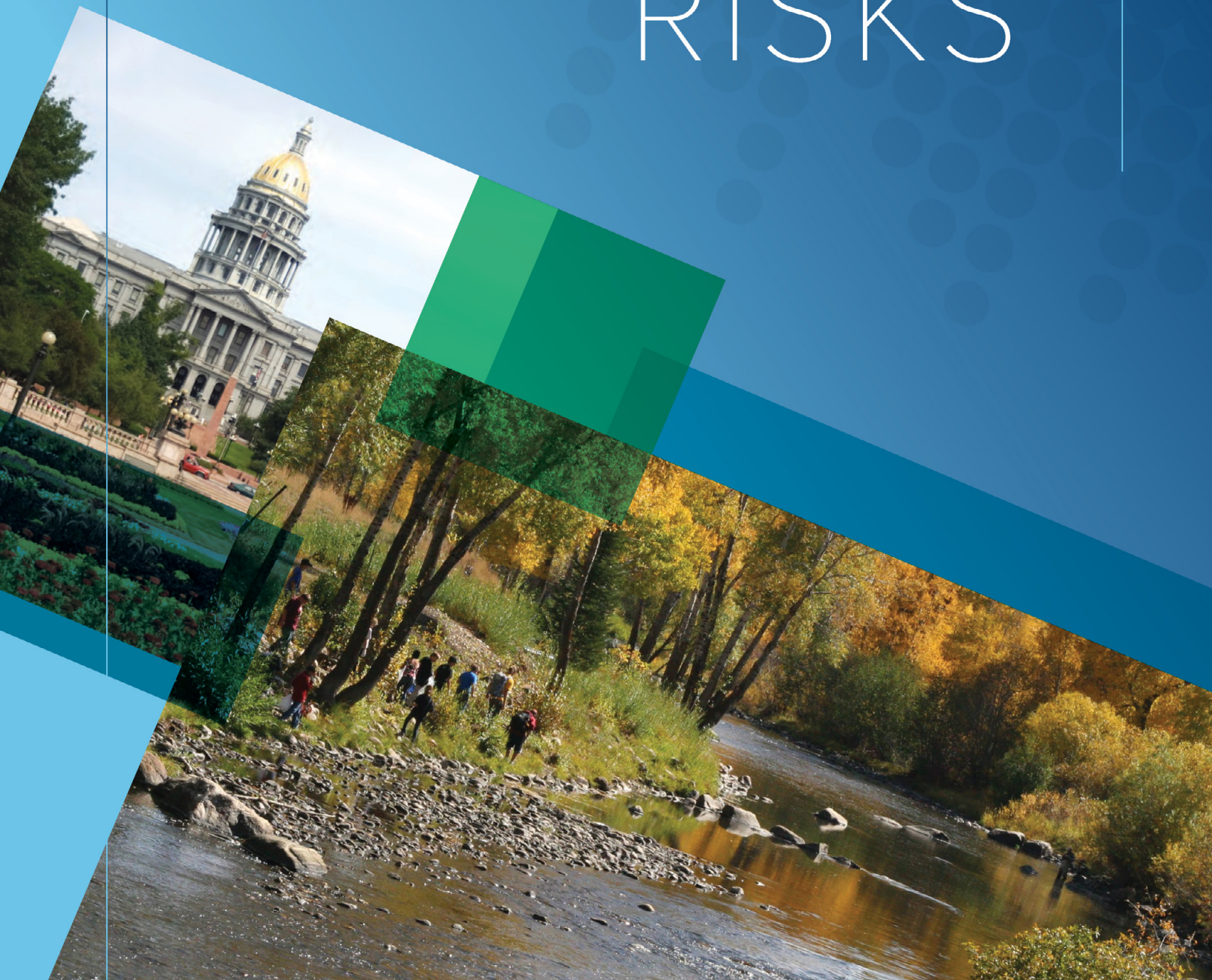
the bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker —that are listed as either federally threatened or endangered. In addition to long-term supplies secured to augment streamflows for listed fish, CWCB has partnered with multiple entities including the Colorado River Water Conservation District, Colorado Water Trust, Garfield County, and Ute Water Conservancy District to further enhance flows in the 15-mile reach using leased water from Ruedi Reservoir. These multi-benefit releases generate hydropower, help meet the existing instream flow rates, and provide additional flows to achieve the U.S. Fish and Wildlife Service flow targets as part of the Upper Colorado River Recovery Program.

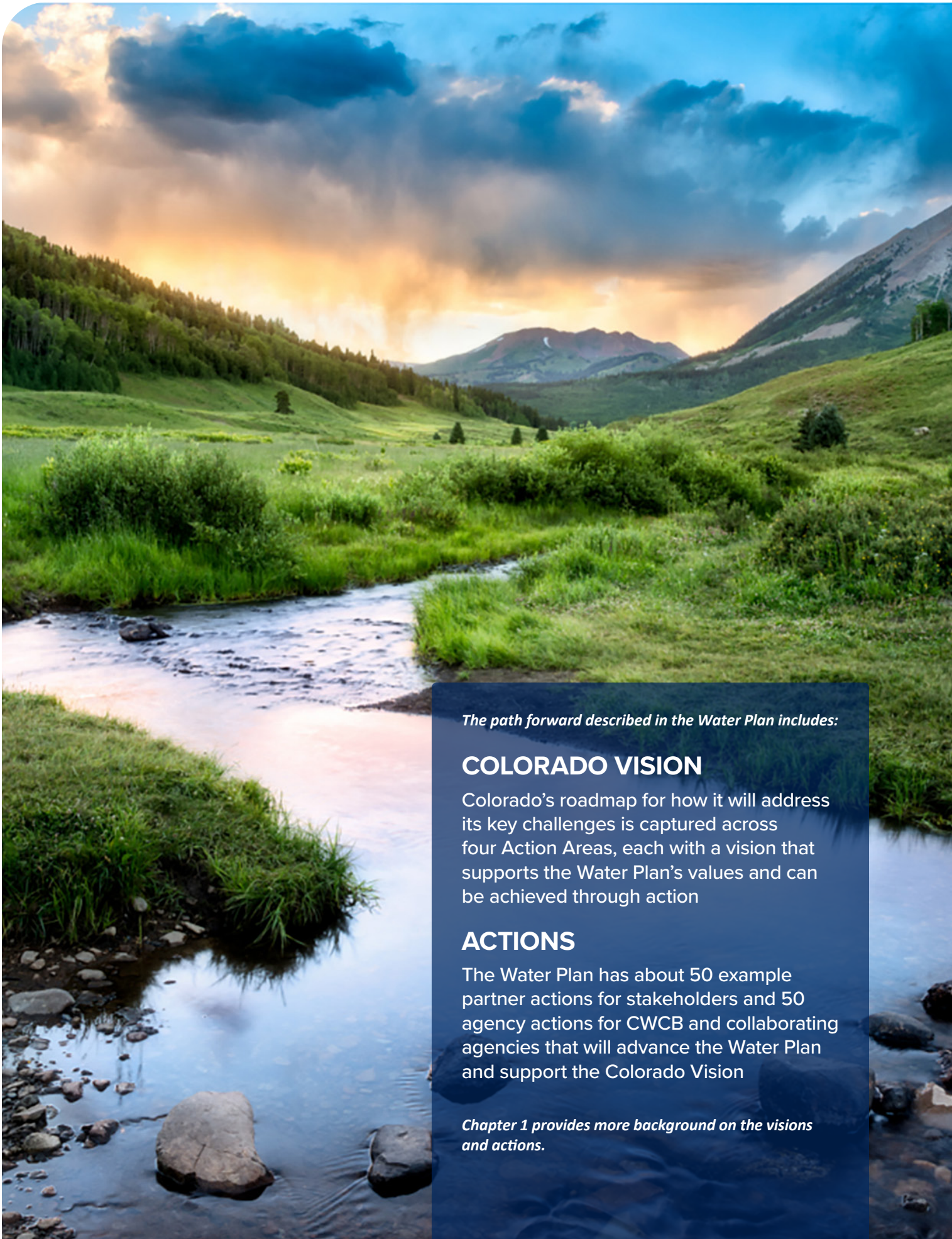
INNOVATIVE STRATEGIES **TO MEET WATER CHALLENGES**

The tools described in Chapter 5 include both established and innovative strategies that Coloradans implement to meet water challenges. They are the tools that can be deployed in the actions described in Chapter 6 that seek to achieve the Water Plan's vision for meeting future water needs.

CHAPTER 6

VISION and ACTIONS for ADDRESSING COLORADO'S RISKS





The path forward described in the Water Plan includes:

COLORADO VISION

Colorado's roadmap for how it will address its key challenges is captured across four Action Areas, each with a vision that supports the Water Plan's values and can be achieved through action

ACTIONS

The Water Plan has about 50 example partner actions for stakeholders and 50 agency actions for CWCB and collaborating agencies that will advance the Water Plan and support the Colorado Vision

Chapter 1 provides more background on the visions and actions.

The most important aspect of the Water Plan is the vision it provides for how Coloradans will meet water challenges and the actions that stakeholders and CWCB along with other state agencies can take in the near term to help the vision become a reality. **The State cannot achieve this vision alone – it takes all of us.**

Chapters 1 through 5 of the Water Plan laid the foundation for the visions and actions described in Chapter 6. They provided information on: a) the structure of the Water Plan; b) Colorado's water resources and water-related risks; c) local challenges and costs of projects needed to meet needs throughout the state; d) and a general description of the tools or solutions that Colorado has at its disposal to meet challenges shared by all sectors of water use. Chapter 6 describes the path forward.

The Water Plan is organized around four **action areas (Vibrant Communities, Robust Agriculture, Thriving Watersheds, and Resilient Planning)**. The areas help functionally organize topics, but these areas are interconnected and interdependent. For each action area, Chapter 6 describes:

COLORADO VISION

The vision for how Colorado can achieve greater resilience in each of the four actions areas by 2050.

PARTNER ACTIONS

Partner actions identify examples of opportunities for individuals and communities to help achieve the vision. These are actions that the CWCB cannot do alone and will require effective engagement at different scales. Examples of project-level partner actions are organized by topics that align with CWCB's Colorado Water Plan grant project categories (as shown in the table below):

WATER PLAN FUNDING CATEGORY	PARTNER ACTION CATEGORY
Water Storage and Supply Projects **Water Sharing Agreements**	***Thoughtful Storage*** *Storing water and creating reliable supplies for farms and communities and multi-purpose benefits for the environment and recreation* ***Meeting Future Water Need*** *Providing supply, improving water management, and lowering risk for all sectors*
Conservation and Land Use Projects	***Wise Water Use*** *Using water more efficiently and creating multi-benefit projects* ***Healthy Lands*** *Creating landscapes that will be healthy and productive in a warmer and drier future*
Engagement and Innovation Activities	***Effective Engagement*** *Fostering information sharing, education, and innovation at the state and local level*
Agricultural Projects	***Robust Agriculture*** *Supporting all aspects of Robust Agriculture partner actions*
Watershed Health and Recreation Projects	***Thriving Watersheds*** *Supporting all aspects of Thriving Watersheds actions*

AGENCY ACTIONS

Agency actions are work that CWCB in collaboration with other state agencies will complete during the current Water Plan cycle to help move Colorado toward the vision. Beyond the four action areas, the Water Plan includes an additional 10 actions CWCB will complete that are more general or administrative and do not correspond to a specific action area. In total, 50 agency actions are identified.

Link for more information on CWCB's grants and loan programs: **Funding | DNR CWCB**

VIBRANT COMMUNITIES

Vibrant communities are economic and cultural centers, spaces for innovation, where Coloradans live, play, and work.

VISION:

Holistic water management is essential for creating vibrant communities that balance water supply and demand needs to create a sustainable urban landscape. Colorado communities need resilient water supplies, water-conscious and attractive urban landscapes, planning that integrates land use and water solutions, and residents who understand the importance of water to their lives and economy. An integrated One Water ethic is necessary to create the transformative change needed to meet the moment and the future.

PARTNER ACTIONS:

Thoughtful Storage: Water storage plays a critical role in many communities by creating reliable supplies and places to recreate

Meeting Future Water Need: Communities need to conserve and provide for future demands in the face of growing water scarcity

Wise Water Use: Water efficiency, conservation, and reuse should be prioritized and will help communities stretch their water supplies and be more resilient in the future

Healthy Lands: Landscapes should be built for a warmer and drier future and managed to optimize water efficiency

Engaged Partners: Partner engagement at different scales is critical to the implementation of a One Water approach

Integration with Other Water Sectors: Supply and One Water strategies should seek to support the agricultural economy and a healthy environment and prepare for extremes

AGENCY ACTIONS: **1.1 to 1.10**

ROBUST AGRICULTURE

Robust agriculture supports a sustainable agricultural economy and culture where farms and ranches are profitable and a high quality of life for farming communities is maintained.

VISION:

Agriculture not only provides food and fiber, but it is also important to Colorado's culture, heritage, and economy, and it faces unprecedented challenges. Innovations are needed to sustain irrigated agriculture, including strategies to stretch available water supplies, increase resiliency, enhance food production, and maintain profitability. Water supplies for Colorado's urban growth should not come at the expense of our rural communities through indiscriminate buy and dry methods. Collaborative partnerships among agriculture, environmental groups, and municipal water providers should be used to create multi-purpose projects that help keep irrigated lands in production and maintain ecosystem services.

PARTNER ACTIONS:

Thoughtful Storage: Storage projects are often out of reach financially for individual producers, and developing partnerships for multi-purpose storage projects will be key

Meeting Future Water Need: Modernization of farming and ranching infrastructure can increase water efficiency and protect the agricultural economy and irrigated acres

Wise Water Use: New technologies and low-water-use crops can enhance profitability while stretching available water supplies

Healthy Lands: Agriculture can increase water use efficiency, protect its economy, and provide ecosystem and other benefits

Engaged Partners: Partnerships are needed to help prevent buy and dry of agricultural lands

Integration with Other Water Sectors: Smart growth can not only reduce the impact of urbanization but may provide opportunities for agricultural production

AGENCY ACTIONS: **2.1 to 2.10**

The Vision for Colorado is built upon Colorado's water values and recognizes that the action areas are often not distinct, but are intertwined and need shared support

THRIVING WATERSHEDS

Thriving watersheds are healthy watersheds. Healthy watersheds are resilient, which means they are able to adapt to change without fundamentally altering the services upon which society and the environment depend.

VISION:

Colorado's watersheds hold the future of our water supply security. Comprehensive water resources planning should incorporate conditions of forests, streams, wetlands, and wildlife habitat. As our state's water source, the health of watersheds affects agriculture, downstream communities, recreation, tourism, and ecosystem function. Colorado will continue to follow a shared stewardship ethic to plan and implement multi-benefit projects to enhance the health of our watersheds.

PARTNER ACTIONS:

Thoughtful Storage: Innovative water storage operations can meet intended needs and provide flexible delivery of flows for critical habitat and recreation interests

Meeting Future Water Need: Efforts to improve stream health and infrastructure efficiency benefit all water use sectors while enhancing the environment and recreation opportunities

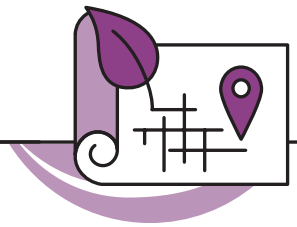
Wise Water Use: Resilient systems recognize social, ecological, and economic connections

Healthy Lands: Shared stewardship improves watershed health and resilience across multiple jurisdictions

Engaged Partners: Agencies and stakeholders need to plan together, prioritize together, and act together

Integration with Other Water Sectors: Efforts to improve stream health or function often benefit other water sectors

AGENCY ACTIONS: **3.1 to 3.10**



RESILIENT PLANNING

Resilient planning applies forward-thinking solutions to create strong equitable communities that are able to effectively respond to water-related challenges.

VISION:

Water security is critical to the quality of life, environment, and economy of Colorado. The future is uncertain, and Colorado needs to be adaptive and resilient to face the challenges ahead. Water security roadmaps, inclusively developed at a local level and informed by strong state leadership, can identify acute and chronic risks to water supply, integrate local planning strategies, prioritize collaborative solutions, and build adaptive capacity and resilience.

PARTNER ACTIONS:

Thoughtful Storage: Storage can help communities develop reliable water supplies while mitigating natural hazard risk

Meeting Future Water Need: One Water approaches can meet needs, enhance water quality, and build resiliency

Wise Water Use: Raising awareness and improving accessibility to water efficiency programs is a cornerstone of solving water challenges

Healthy Lands: Adaptive strategies are needed for climate change resilience

Engaged Partners: Creative solutions supported by thoughtful and efficient government are needed and can promote sustainability and resiliency

Integration with Other Water Sectors: Coloradans need to work alongside each other to build solutions together

AGENCY ACTIONS: **4.1 to 4.10**

Colorado vision for

VIBRANT COMMUNITIES

CREATE TRANSFORMATIVE CHANGE

Holistic water management is essential for creating vibrant communities that balance water supply and demand needs to create a sustainable urban landscape. Colorado communities need resilient water supplies, water-conscious and attractive urban landscapes, planning that integrates land use and water solutions, and residents who understand the importance of water to their lives and economy. An integrated One Water ethic is necessary to create the transformative change needed to meet the moment and the future.

Vibrant communities are economic engines, culture and recreation centers, and spaces for innovation. Our communities come in different sizes, from large metropolitan areas that are highly urbanized to small rural towns that are closely connected to surrounding agricultural or forested areas. From small towns to large cities, we need to prepare for the future with renewed and accelerated commitments to saving water by adopting water efficiency practices, implementing conservation programs, and controlling water loss. We also need to provide climate-appropriate greenspaces and access to healthy waterways in urban settings to enhance the quality of life for our residents. Communities need to invest in cutting-edge strategies that address current challenges and build future resilience that will help us adapt to a warmer climate and reduce per capita water use. Colorado's legal and regulatory framework has flexibility to implement cutting-edge strategies, but it can also be refined through established legislative and regulatory processes to better accommodate our needs.

What is a One Water ethic?

One Water is a movement, a shift in thinking, and the future of how we manage our water resources with practical and bold ideas coming together in a collaborative way. While water knows no boundaries, how we manage and regulate water is highly fragmented—requiring inter-disciplinary solutions that create more equitable, sustainable, and resilient communities. The Water Research Foundation defines One Water as "an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs."

One Water encourages collaboration among all agencies with roles related to water resources. Its overall goal is to create a common framework for reliably managing water systems to meet public and environmental needs while reducing costs, improving resilience, and enhancing community livability. Since most One Water projects aim to address water supply and demand challenges in a localized setting, they include a variety of site-specific components, such as water recycling, graywater reuse, and rainwater harvesting, which may be incorporated into land use planning.

For example, the **Denver One Water Plan** represents the guiding principles for a shared water vision in Denver. It provides sustainable solutions that include the entire water cycle through deliberate policies, consistent approaches, and streamlined inter- and intra-organizational partnerships.

While this is a positive direction, our towns, cities, and counties need to increasingly view comprehensive and long-term planning through a One Water lens. Water should be included in every city and county's comprehensive plan in ways that embrace the One Water ethic and support inclusion in water and land use planning at the local level.

Growth and climate change drives needs while funding, infrastructure, regulation, codes, and laws can enable or constrain project development.

Matching the right water type to the right use while focusing on water conservation and integrated water and land use planning.

Alternative water supplies associated with One Water include: Water Rain/Stormwater, Wastewater, Groundwater, Drinking Water, Surface Water, and Reuse Water.

SUPPORT FOR ACTION

Addressing our challenges for Vibrant Communities will require creative solutions that also adhere to the State's laws and regulations for water rights and water quality. In addition, the agency actions in the Water Plan help create support tools that partners across the state can use to advance their own actions. Specifically, agency actions 1.1 through 1.10 and contributing general actions build baseline support for future local partner action.

The state legislature and the CWCB support these efforts through the Colorado Water Plan Grant Program. The areas of partner actions generally align with the CWCB's Colorado Water Plan Grant Program that has legislatively-established funding areas for agriculture, conservation and land use, engagement and innovation, environment and recreation, and water storage and supply. In many cases, CWCB loans or other grant funding sources provided by federal and state agencies or other groups noted in Chapter 3 (also see Chapter 3 Framework for State of Colorado Support for Water Projects) are also available and can support work within and beyond the scope of Water Plan grants. In some cases, funds from different sources can be used to fulfill matching requirements.

Examples of these "partner actions" are highlighted below, followed by details on supporting agency actions.

PARTNER ACTIONS

While CWCB provides funding opportunities, identifies research needs, and collaborates with partners, it cannot achieve Colorado's vision for Vibrant Communities alone. Below are several ways that Colorado water users and leaders can see themselves and participate in the Colorado Water Plan. In many cases, grant funding is available to help explore additional work in the areas below.

Thoughtful Storage

Colorado communities need water supplies that provide clean, reliable drinking water and irrigate landscapes that are attractive and resilient. For many communities, water storage plays a critical role in creating reliable supplies given Colorado's highly variable climate. Water storage will also be important to manage risk as we move toward a future that may include increased temperatures, shorter and more intense runoff seasons, and extreme weather events. Water storage projects will need to be implemented in many ways and for many purposes:

- **Strategically located storage facilities that meet multiple needs:** Small storage facilities are useful for providing water when and where it is needed. They can be less impactful on the environment and can meet multiple, local needs.
- **Storage to meet growth and future uncertainty:** Colorado's population is growing, and additional storage is needed to meet our future increases in demand. Additional storage can occur through constructing new reservoirs, using underground aquifers, fully using existing storage, and rehabilitating existing, aging reservoirs and allowing them to store the amounts originally intended. Storage projects or operations that meet multiple needs are strongly encouraged.
- **Innovative surface and groundwater storage:** Some existing reservoirs can be expanded to store more water with less environmental impact than a new reservoir. Groundwater aquifers can be used to store water without the evaporative losses that occur in lakes and reservoirs.

Meeting Future Water Needs

Economic cycles impact population growth, but overall, our population will continue to grow and drive increased demand. While Colorado's recent efforts to save water though efficiency and conservation have kept water demands steady in spite of growth, water demands are projected to increase, and our water supplies will be stretched. Communities need to adapt now to growing water scarcity and must use water in increasingly efficient ways to meet multiple needs.

- **Supplies that provide reliable and safe drinking water:** Municipal water providers are challenged with developing reliable and safe water supplies to meet growing needs while considering associated impacts on the environment, agriculture, and recreation. Water providers will continue to implement storage, conservation, and reuse projects and will likely continue pursuing acquisition of senior agricultural water rights and TMDs to meet future water needs. Consideration should be given to how these strategies may

affect flow in streams, and where possible, designed to increase resiliency for consumptive and nonconsumptive uses alike. Where possible, collaborative water supply projects should be developed that meet multiple needs, including those of the environment, recreation, and agriculture ensuring that water conservation and CWSAs are among the first alternatives. Utilizing CWSAs maintains local food production and helps cities weather droughts, and they should be implemented at increasingly larger scales.

- **Optimize investments in infrastructure and increase efficiency and conservation:** Municipal water providers need to make the right investments in infrastructure to handle the uncertainties of the future. Planning that accounts for future uncertainty is critical to understanding the potential range of future demands and investing in the right infrastructure at the right time to not over- or under-build. Reducing water loss and implementing conservation programs can help municipalities reduce demand and reduce, delay the need for, or downsize additional infrastructure.
- **Proper and accurate monitoring of water use and reduction in water loss:** Water systems should be as efficient as economically possible, and water losses in distribution systems and private plumbing should be minimized through consistent water loss auditing, third party validation, component analysis, leak detection, and timely repairs. Thoughtful system monitoring and investments in new technologies can be used to more accurately account for the water that is sent to customers and can also help reduce water loss (e.g., advanced metering infrastructure, or "AMI", or other approaches).

Wise Water Use

Communities need to continue advancing programs and planning that strive for ever-greater levels of indoor and outdoor water efficiency. Colorado water supplies are stressed and will be even more so in the future. Cities will need to build and redevelop with an eye toward densification and creative water-savings techniques that use green infrastructure. Water efficiency and conservation programs, reuse, and rate structures that encourage water savings are strategies that will help communities stretch their water supplies and be more resilient in the future.

- **Implementing water-saving measures:** Water conservation and efficiency is fundamental to Colorado's success, and investing in water conservation campaigns, incentives, and technologies is critical. Establishing partnerships with the business community can create and promote innovative new technologies for water efficiency and tracking water use. New construction can acquire certifications with rating systems, such as EPA WaterSense®-labeled homes or Water Efficiency Rating Scores, that integrate highly efficient indoor use and resilient landscaping as a part of sustainable design that realizes both energy and water savings.
- **Investments in One Water and reuse:** Projects that embrace One Water principles from green infrastructure to reuse must be increasingly and strategically used. Where possible, investments in recycling water via potable, non-potable, and graywater reuse will help ensure water is used fully. Reusing water when legally allowable is key. Customer equity issues should be considered to ensure quality water is provided via reuse.
- **Rate structures (water budgets, water conservation focused tiered rate structures):** Conservation-oriented rate structures and water budgets that use tiered rates to incentivize water efficiency and penalize water waste should be pursued. Rate structures must also consider equity concerns.

Healthy Lands

Increasing temperatures will have significant impacts to Colorado communities, especially when it comes to outdoor water use for irrigation. Combined with more severe droughts and long-term aridity, many of Colorado's current urban landscapes will be unsustainable in a warmer and drier climate. Colorado must start building the landscapes of the future today by identifying and planting the types of vegetation that are reflective of local natural landscapes, can thrive under warmer and drier conditions, and potentially only need irrigation one day per week or less. Irrigation efficiency should be maximized on existing and new water-wise landscapes. Open spaces should be preserved as urbanization occurs to maintain ecosystem benefits and biodiversity. Green spaces like parks, gardens, and stream corridors that provide community benefits for health, shade, habitat, and food need to be prioritized over seldom-used or nonfunctional turf areas that require irrigation and provide little to no additional benefit.

- **Planning for and creating low-water-use landscapes:** Zoning regulations, land use codes, utility rate structures, conservation-oriented tap fees, state and federal funding assistance, effective landscape transformation programs, utility-financed programs, and other tools must work together to drive water conservation but also address the underlying issues that drive water use.
- **Holistic planning for urban landscapes that improve quality of life:** Urban vegetation helps improve the quality of life in cities by creating an attractive landscape, increasing shade, and reducing the heat island effect that often disproportionately impacts historically marginalized communities. Thoughtful planning can help connect people to nature through shared greenspaces with climate-appropriate vegetation, flood-tolerant green infrastructure, and access to waterways. Community investments in stream habitat restoration, watershed protection, and recreational in-channel diversions are important for urban quality-of-life enhancements.
- **Urban agriculture:** Local foods can be produced in urbanized areas in several ways. As urbanization occurs,

existing agricultural lands are sometimes enveloped by cities. In other cases, underused urban lands can be used for agricultural purposes. Urban agriculture can preserve open space, draw closer connections between urban residents and agriculture, and potentially provide water conservation and stormwater benefits in some settings. Land use codes could be updated to foster urban agriculture.

Partner Actions Rely on Effective Engagement and Education at Different Levels

Partner engagement is critical to the success of the Water Plan. Partners do not just include the typical stakeholders that engage in water issues – partners include all Coloradans. Partner engagement needs to occur at different scales—from the federal and state levels down to local government and individual residents, as described below:

- **Government:** State, county, and city governmental entities as well as water districts and water conservancy/conservation districts should leverage resources and coordinate public education and awareness campaigns that focus on topics like water efficiency and reuse. Local projects that explore and research emerging strategies, pilot programs, and new ways of doing more with less help demonstrate strategies that others can implement. Local building or land use codes and ordinances should promote indoor and outdoor water use efficiency.
- **NGOs, business:** NGOs, academia, and others engage residents, advance research on water issues, and need funding. Public-private partnerships should be supported that focus on research and other joint efforts. The business community should be engaged to promote innovation and identify new technologies for conserving and tracking water use.
- **Residents:** All Coloradans should be conscious of their "water footprint" and adopt a water-saving ethic. Every resident should have the opportunity to engage in water issues, know their local water sources, and understand how to conserve. Engagement helps promote inclusion and larger support for water. Inclusive outreach and education tailored to meet regional needs and diverse populations and age groups will need to be conducted to achieve this objective.

INTEGRATION ACROSS **ACTION AREAS**

The partner actions noted above and the agency actions that follow often relate to one or more of the other action areas of the Water Plan. Water uses in Colorado's communities connect to other communities and to watersheds and agriculture. Collaboration is needed across action areas to identify these interconnections when considering strategies for meeting water needs. Here are some of the ways Vibrant Communities connects to the other action areas:

ROBUST AGRICULTURE

Actions that preserve or promote agriculture, both within and adjacent to municipal boundaries, help maintain open space, create educational opportunities for both urban and rural residents, and provide for local food production. More efficient water use and additional storage in communities can delay or prevent the need to acquire and transfer agricultural water supplies. Collaborative water sharing agreements between farms and cities can help enhance municipal resilience.

THRIVING WATERSHEDS

Many of Colorado's communities are located along streams and rivers. Preserving, enhancing, and restoring streams in urban corridors and protecting their flows can provide environmental and recreational benefits as well as provide attractive landscapes, shade, and water quality benefits for urban residents. Efficient use of water supplies in communities can benefit the environment if more water is left in streams or if municipal water operations can be flexible and enhance streamflows.

RESILIENT PLANNING

Improving urban stream corridors can reduce flood risk, improve habitat, and create green spaces, which will help urban residents adapt to a potentially warmer future climate with higher flood risk. Education and outreach that considers varied ethnicities will be important to building resilience and gaining support for actions.

AGENCY ACTIONS

The CWCB and partnering agencies will take the following actions to support and advance Colorado's vision for Vibrant Communities. Each action identifies a lead agency, and in most cases, one or more collaborating agencies. The lead agency is directly responsible for completing an action. Collaborating agencies will partner to successfully complete the action by providing guidance or actively staying informed. Both lead and collaborating agencies envision using existing staff and available resources. Collaborating agencies may provide more leadership or support if additional resources become available. In addition, other agencies may be consulted as needed or if resources become available.

1.1 Define, benchmark and institutionalize water-saving communities

Lead Agency: CWCB

Collaborating Agencies: DOLA; CDPHE

Related Action Area:
Not applicable (N/A)

What defines a water-saving community is not always clear, and yet the goal of achieving increased water savings is imperative. Cities and towns need to better understand what is feasible to conserve and for what they should be aiming. This can be achieved in part by identifying targets for achieving savings through programmatic efforts, controlling system water loss, integrating with land use planning, and incentivizing sustainable water consumption. Evaluating the suite of opportunities that can help build this future state is critical to understanding how communities can institutionalize water efficiency. The CWCB will fund and participate in the development of a framework that includes target metrics and definitions for water-saving communities. Doing so will set a benchmark for resilience that can drive municipal water operations, planning, and management. Developing a framework that provides a range of targets for water-saving communities and identifying solutions that can help future-proof communities will build additional resilience into municipal operations, planning, and management. The framework will include expanding links between land use planning and water planning and include prioritizing inclusion of water planning in comprehensive plans. It will also include building conservation strategies and tools into traditional planning disciplines and measuring ongoing progress toward decreased indoor and outdoor water use through programmatic efforts.

TOOLS used for this action

- Water efficiency and conservation programs
- Land use and water planning integration
- Policy and regulatory changes
- Public outreach and education

THE COLORADO WATER AND LAND USE PLANNING ALLIANCE

This group has convened stakeholders and educated policy makers since 2017

CWCB and DOLA jointly convened The Colorado Water and Land Use Planning Alliance (the Alliance) in late 2017. The Alliance is an informal multi-stakeholder group of representatives from state agencies, local governments, universities, advocacy organizations, research organizations, and other interested parties who come together collaboratively to develop resources, provide technical assistance, and track progress on water and land use integration across Colorado. The Alliance has effectively convened stakeholders and educated policy makers to advance objectives that carry forward from the 2015 Water Plan to ensure Coloradans would live in communities that have incorporated water-saving actions into land use planning. Going forward, the Alliance will continue to be a forum for important policy discussions about water and land use planning integration, as well as a testing ground for best practices learned on the ground that advance holistic planning with a One Water focus.

1.2 Enhance municipal water efficiency reporting and data integration

Lead Agency: CWCB

Collaborating Agencies: DOLA

Related Action Area: N/A

Since 2012, Colorado has required water utilities that serve 2,000 acre-feet of water or more to report on water use and water conservation efforts. Refining the database that houses this information to maximize its use in evaluating trends and projecting future needs for Colorado Water Plan updates is key. It is also important to maximize the value of the reported data to water providers in terms of integrating reporting with local water conservation and drought planning documents—two related planning efforts that are reported to CWCB.

The CWCB will undertake a holistic review of the reporting database, key data sets that are most critical, and ways that data can be more seamlessly integrated into updates for both water efficiency plans and drought plans. Also, CWCB will evaluate enhancements to guidance documents that can streamline information in ways that increase participation from both larger and smaller utilities and allow CWCB to better coordinate grant and outreach opportunities. Continuing to refine reporting and increasing accuracy can provide more meaningful data for utilities and for trend analyses that will inform the Technical Update. As part of this effort, evaluating common metrics for reporting and data gaps should be discussed to create greater consistency in reporting and analysis.

TOOLS used for this action

- Land use and water planning integration
- Water efficiency and conservation programs
- Data collection and sharing

WATER USE REPORTING

Water utilities that annually supply 2,000 acre-feet of water to customers are required to report water usage data pursuant to House Bill 10-1051 (often referenced as "1051 reporting"). The data collected via 1051 reporting is important for understanding current water usage, the impacts of water conservation and efficiency, and making more accurate forecasts of future water use.

1.3 Drive enhanced water loss tracking to help address future water needs

Lead Agency: CWCB

Collaborating Agencies: DOLA; CDPHE

Related Action Area:
■ Resilient Planning

Water loss continues to account for a significant portion of municipal water use in the state. As infrastructure ages, real losses (leaks) and apparent losses (meter inaccuracies, data handling errors) increase, and valuable water resources and revenue are lost. Minimizing water loss through comprehensive water loss control and management is critical for maintaining the fiscal, operational, and water resources fitness of water utilities statewide. Through past efforts of the Colorado Water Loss Initiative, CWCB has helped advance base level and more advanced water loss analyses across a wide variety of water utilities with varying levels of expertise.

Reinforcing current progress and increasing adoption of advanced water loss best practices will require CWCB to develop a third phase of the Colorado Water Loss Initiative. The goal would be to not only train more utilities on how to track and manage water loss but to explore creating capacity for third-party validators to provide independent analysis and verification of water loss. Impartial third-party validators can help support utilities in finding deeper savings in areas they may otherwise underestimate or overlook. Advancing this work should also consider ways that utilities, technology, and outreach can be leveraged to help utilities not only reduce water loss but help end users more actively implement water loss control practices and directly influence utility investments to reduce system losses.

TOOLS used for this action

Water efficiency and conservation programs

Data collection and sharing

Land use and water planning integration

COLORADO WATER LOSS INITIATIVE

The goal of the Colorado Water Loss Initiative (CWLI) is for participating water utilities to learn how to apply the methodology to their water system and to achieve a complete and transparent water loss audit (as measured by Level 1 validated scores). At present, CWCB is implementing Phase II of the CWLI which builds on the very successful Phase I where 53 water providers were trained in basic water loss methodology. The CWLI is using the industry standard M36 AWWA water loss control and management methodology.

In Phase II, CWCB is carrying out a comprehensive program of basic and advanced training in water loss management, ranked and prioritized technical review, and technical assistance for approximately 70 water providers across the state. This 24 to 30 month program includes multiple “touch points” for establishing principles and practice as well as reinforced understanding, culminating in direct technical assistance based on the water provider’s needs. This phase goes beyond audits and assists the water providers in targeting interventions. Water loss was identified in the Technical Update as a significant factor in the municipal and industrial gap.

1.4 Coordinate funding opportunities for conservation, safety, and aging infrastructure

Lead Agency: CWCB

Collaborating Agencies: CDPHE; DOLA; CDA; DWR; CPW

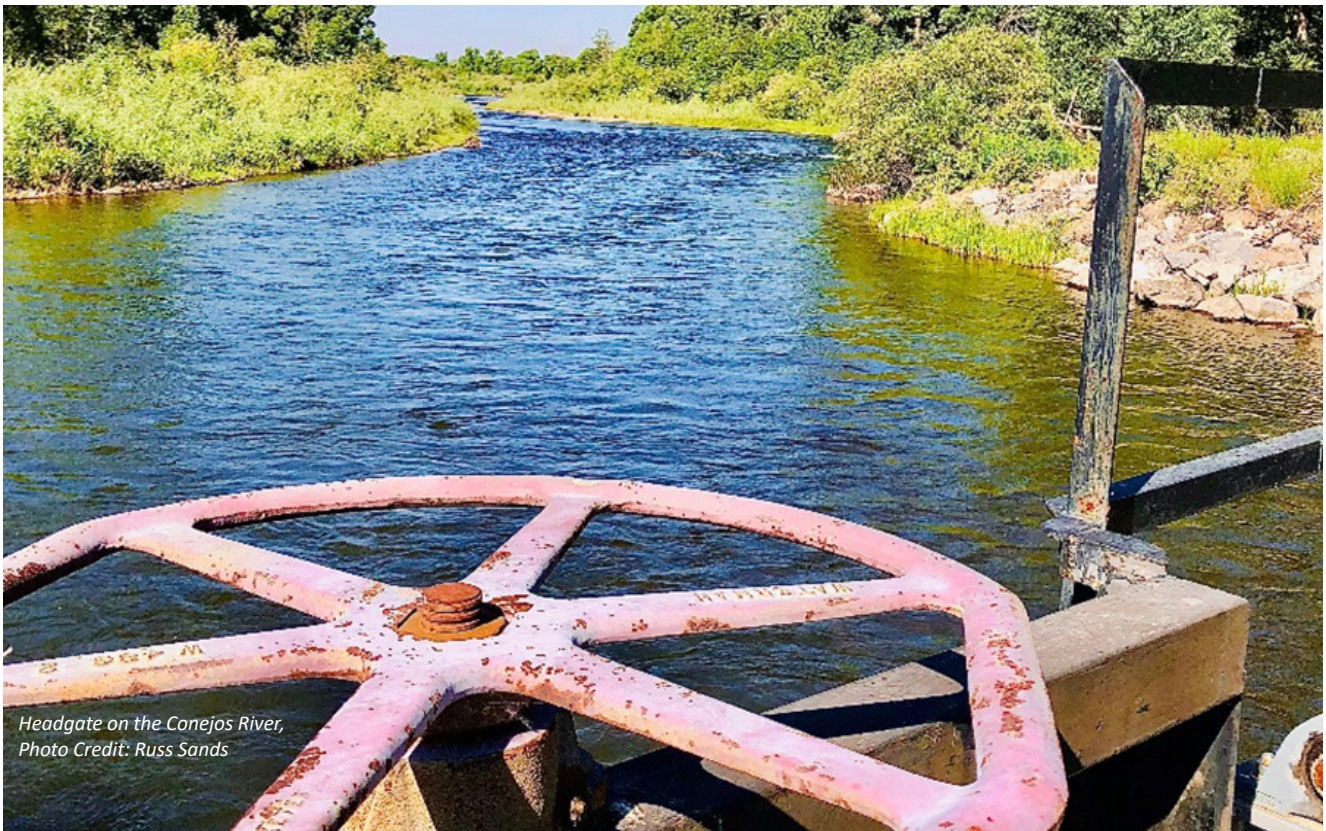
Related Action Area:
- Robust Agriculture
- Resilient Planning

Aging infrastructure is an ongoing challenge, especially for smaller communities where system water loss, treatment, and water metering are major issues. These communities are often extremely susceptible to system water issues that are exacerbated by climate extremes like flood and drought. Coordination among the state agencies that provide water quality and quantity funding opportunities ensures funds are targeted to priority projects and leveraged more effectively.

The CWCB, CDPHE, and DOLA will work to increasingly coordinate outreach efforts with each other. These efforts will work to promote grant and loan opportunities, introduce shared training opportunities, and support shared messaging that can be used across agencies based on needs that have been highlighted by the basin roundtables. This aims to strengthen local understanding that water loss and water leaks can contribute to water quality issues and that attaining effluent temperature standards can also support stream restoration efforts. In addition, cross-agency coordination with DWR can also help evaluate and identify aging dam infrastructure. Once identified, this could be used to create an overlay that helps focus where to encourage communities to use grants and targeted spending to address dam safety issues.

TOOLS used for this action

- Funding
- Public outreach and education
- Conveyance infrastructure
- Collaboration groups
- Equity



Headgate on the Conejos River, Photo Credit: Russ Sands

1.5 Strategically expand water reuse and develop a water reuse progress report

Lead Agency: CWCB

Collaborating Agencies: CDPHE

Related Action Area: N/A

The CWCB, CDPHE, groups like WateReuse Colorado, and many other stakeholders have worked intensively over the past seven years to develop the technical background necessary to advance DPR and to increase the uses allowed for under Regulation 84 Reclaimed Water (i.e., non-potable reuse). Where possible, CDPHE and CWCB will continue to coordinate shared approaches to managing workloads and work together on future stakeholder discussions. In addition to the implementation needs of Regulation 84 and Regulation 86 (Graywater), CWCB supported CDPHE in the leadup to the 2022 DPR rulemaking and will continue to support CDPHE as they begin to administer the new DPR rule.

CDPHE and CWCB will collaborate on how to prioritize and support resulting projects (or pilot projects) that help advance reuse initiatives that further the goals of the Water Plan through strategic planning, grant making, and state revolving funds. Specifically, CWCB can continue to play a key role in supporting DPR projects that actualize the new DPR rulemaking and work toward institutionalizing DPR as a safe and necessary tool to meet future water challenges. The CWCB will develop a report on reuse best practices that summarizes effective projects that have been developed and promotes the responsible and targeted adoption of reuse that will seek to identify barriers and opportunities. The resulting Water Reuse Progress Report will identify progress to date on regulations for direct potable reuse as well as nonpotable reuse, implementation and barriers to reuse of water across Colorado, potential customer equity issues with different reuse strategies and ways to overcome them, reuse project benefits including quantifying reductions in potable and source water demand, and will investigate next steps to broader implementation of potable and non-potable reuse in Colorado.

TOOLS used for this action

- Policy and regulatory changes
- Public outreach and education
- Collaboration groups
- Water reuse
- Innovation

REGULATION 84 *(Reclaimed Water Control Regulation)*

Regulation 84 establishes requirements, standards, and concentration limits for the use of reclaimed water from a centralized treatment facility. The uses for reclaimed water include certain industrial applications, landscape irrigation, certain commercial applications, fire protection, toilet and urinal flushing, and certain commercial and non-commercial agricultural irrigation applications (including trees, non-food and edible crops, and edible and non-edible hemp).

REGULATION 86 *(Graywater Control Regulation)*

Regulation 86 regulates the use of graywater. Graywater sources may include water discharged from bathroom and laundry-room sinks, bathtubs or showers, and laundry machines. Because graywater can carry some human pathogens, this regulation sets standards for using graywater for non-drinking water purposes such as subsurface irrigation or toilet flushing.

DIRECT POTABLE REUSE

In October 2022, the WQCC adopted changes to Colorado Primary Drinking Water Regulations (Regulation 11) to govern DPR after a rigorous stakeholder process led by the WQCD The new rules set minimum standards and oversight for DPR to ensure consistency and ensure a thorough public outreach process for new projects.

1.6 Promote outdoor One Water strategies for integrated land use planning

Lead Agency: CWCB

Collaborating Agencies: CDPHE; DOLA

Related Action Area: N/A

Communities should use One Water strategies to achieve local goals related to meeting current and future water needs, environmental and water quality protection, community connection to waterways, and other local water management goals. This includes an increased focus on minimizing outdoor water use. Traditionally, water planners have taken a "water in, wastewater out" approach to water management. This compartmentalized approach overlooks the potential of alternative sources of water, such as groundwater, rainwater, and recycled or reused water, to be included in a water supply future. To incorporate these other sources requires a shift from thinking about one project at a time to thinking more holistically (i.e., taking a One Water approach and thinking about the impact of one water source on another and thinking about the potential synergies among our water system operations). Understanding the core principles behind One Water and how it can be applied to landscapes is key to unlocking additional tools for outdoor communities and urban planning that inherently make those cities better able to respond to extremes like drought and flooding.

Working with the One Water Leaders (OWL) group based in the Denver One Water Plan, CWCB staff will identify examples of functional Colorado projects, focusing on best practices in municipal design, and identifying the latest research. This will leverage the work done by other cities and engage cities looking to become OWLs. Through this work CWCB will develop an interactive report to help identify the practical opportunities for incorporating One Water principles outdoors across Colorado. This will build from previous work that CWCB has funded, as well as the latest research on functional green infrastructure, irrigation efficiency and alternative water sources, and developer incentives. This effort will also seek to incorporate proper management and design of natural systems in urban waterways that consider the documented social and health benefits of green space in the urban environment and the ability for green infrastructure to contribute to the sustainability and livability of Colorado communities.

TOOLS used for this action

- Land use and water planning integration
- Water efficiency and conservation programs
- Water reuse
- Public outreach and education
- Climate adaptation

An example of previous CWCB-funded work includes **Growing Water Smart Metrics: Tracking the Integration of Water and Land Use Planning**

COLORADO GROWING WATER SMART

The CWCB has funded the CGWS program, a project of the Sonoran Institute, with multiple Water Plan grants since 2017. The Babbitt Center for Land and Water Policy has also been a partner and funder of the program. The program consists of a two to three day intensive workshop where water planners, land use planners, and elected officials create an action plan for integrating water and land use planning. The program provides training, ongoing technical assistance, and other resources that allow communities to understand the range of land use planning tools, align growth and development with forecasted water supplies, and engage their community to build support for needed plans and policies.

Since 2017, CGWS has trained staff and elected officials from 52 communities representing 62 percent of Coloradans (over 3.9 million people). The CGWS program was awarded the American Planning Association Colorado Honor Award for Sustainability & Environmental Planning in 2019.

What makes this program especially impactful is that it empowers policymakers and leaders. Graduates of the CGWS workshops often go on to work with WaterNow Alliance and Western Resource Advocates' Project Accelerator or join CWCB's and DOLA's Colorado Water and Land Use Planning Alliance. There is also growing synergy and relationship building between the CGWS program and the basin roundtables, which fosters connection and partnership and builds networks and knowledge bases to respond to the risks of drought and climate change.

1.7 Identify turf replacement options that support transformative landscape change

Lead Agency: CWCB

Collaborating Agencies: DOLA

Related Action Area:
■ Resilient Planning

Traditional landscaping in the United States often includes large expanses of turf grass, historically originating from wetter climates such as the eastern United States and Europe. In Colorado's semi-arid climate, however, many turf grasses require a large amount of supplemental irrigation to survive and thrive. Vast swaths of non-functional turf grass with high irrigation water requirements are unsustainable in Colorado's increasingly arid climate.

Understanding the best strategies for transformative landscape change to reduce water use while maintaining resilient, livable, and aesthetically pleasing outdoor environments will require the creation of a Colorado standard for landscapes. This will include removing nonfunctional turf, identifying turf replacement plant material options, and evaluating how to sustain long-term water savings.

Replacing nonfunctional irrigated turf with water-wise landscaping is an ongoing topic of interest as supported by Colorado's General Assembly in HB22-1151. Pursuant to that statute, CWCB will develop and administer a turf replacement program by July of 2023.

Beyond the requirements in statute, CWCB will actively conduct and support research on turf replacement best practices, alternative tools for driving turf replacement, addressing underlying irrigation concerns, and identifying the optimal low-water replacement materials that could be sustained on as little as one day of efficient irrigation per week.

CWCB will use information and data it collects through its turf replacement program to create a handbook that explores study findings and compares the potential for municipal tools like water rate structures, water budgets, incentives, and land use codes to aid this transformation. The CWCB will coordinate with key partners to find pathways for achieving effective outcomes that explore both retrofit and new construction standards. This will include evaluating the role and capacity of landscapers as well as contractors, developers, municipalities, and other groups to support this transformation.

CWCB will also engage experts to evaluate alternative landscape plant material options that include medium to low-water-using native species and/or well-adapted plant species and analyze ways that a range of other landscape challenges such as stormwater management, heat impacts, defensible space from fire, and pollinator support might be addressed through a Colorado-specific landscape standard.

TOOLS used for this action

- Water efficiency and conservation programs
- Collaboration groups
- Public outreach and education
- Equity
- Policy and regulatory changes

WHAT IS NON-FUNCTIONAL TURF?

Part of developing a Colorado standard for landscape would include defining what is and is not functional turf grass. Generally, the term "turf" is often associated with water-intensive grasses, however, not all turf is technically high water-using. The intent of turf removal is really aimed at trying to target removal of high-water using grasses (e.g., Kentucky Bluegrass)—especially where they are providing little value. But defining "low-value" can also be challenging. In the context of this discussion, the focus is on removing high-water-using turf on slopes, in medians, or other locations where alternatives like low-water vegetation, mulch or hard-scapes may reduce water use. At the same time, turf can serve an important function (functional turf), such as high-traffic areas that are used for recreation (e.g., sports fields), municipal operations (e.g., parks, stormwater swales), or for other critical operations.

WHY CREATE A COLORADO STANDARD?

States like Nevada or California have made important strides in low-water landscapes; however, the standards and programs used in those states cannot always be easily replicated in Colorado due to important differences in our climates. Nevada or Southern California's evaporation and transpiration rates (evaporative loss from plants) are significantly higher than Colorado's. Much of Colorado's native vegetation surrounding metropolitan areas is grassland, not desert shrubland. Colorado also experiences meaningful seasonal variation in temperature and precipitation. Additionally, Colorado has many native and well-adapted plant materials that provide ecological benefits, societal value, and cooling effects. Often turf removal in other states uses rock, gravel, or other materials that inevitably make landscapes hotter and may not support irrigation that sustains trees—exacerbating warming through the heat island effect.

1.8 Develop a statewide spatial landscape feasibility assessment for supply and demand drivers

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area:
Robust Agriculture

Several existing tools and spatial data are used to inform water planning across Colorado. Temperature, snowpack, and soil moisture drive water availability, and though there are existing resources both at the regional and statewide scale to model these drivers, new and improved technology, including Airborne Snow Observatory (ASO) or regional soil moisture measurement, show promise for using remote sensing tools like light detection and ranging (LiDAR) and other technologies to significantly improve the reliability of water supply forecasts across Colorado. These types of tools have been used successfully at a regional scale but could potentially be even more useful if deployed on a statewide scale.

Similarly, water use projections are critical for planning the size and scale of infrastructure to store, treat, and distribute water to our communities. At present, there are several ongoing efforts in Colorado to use spatial technology to help model water demands by looking at pervious and impervious surfaces; types of landscape, vegetation, land use, and housing; and other drivers of outdoor water use in communities. This remote sensing work helps collect more-consistent data and gives water providers a better understanding of how land use and landscapes impact water use.

The CWCB will conduct a feasibility study of scaling this work across the state that includes costs, which drivers and scales would be most useful to evaluate, where data can be housed, and how findings could be used to help refine water supply availability and demand forecasting. This work can also include exploring intersections with other community efforts, including protecting urban forests, supporting urban waterways, reducing turf, and evaluating connectivity and access to water.

TOOLS used for this action

- Land use and water planning integration
- Data collection and sharing
- Innovation

At present, there are ongoing efforts in Colorado that offer insights into where CWCB could leverage work and add value:

Colorado State University (CSU) and Denver Regional Council of Governments (DRCOG): These groups use spatial technology to assess and measure water demand as it relates to land use type. CSU is creating a methodology for several special districts and water providers to assess how to estimate demands through land use, and DRCOG is mapping its region to include land use type and pervious/impervious area. These kinds of projects will make data more consistent and help water providers understand current water demands and predict future demands more accurately. Stakeholder feedback during the Water Plan scoping period suggested that the State should maintain a land use and water demand database of this sort, help standardize the types of data and formats, and allow ease of access.

Colorado Airborne Snow Measurement (CASM): The CASM group, which includes utilities irrigation districts, and NGOs, is supporting ASO technology to measure snowpack. The ASO uses paired airborne LiDAR and imaging spectrometer sensors coupled with a snow dynamics model to measure snow depth and albedo and retrieve snow water equivalent (SWE, or the liquid depth of water stored in the snowpack) across large river basins at a high spatial resolution. The resulting data provides high-elevation snowpack measurements with detail, accuracy, and decision-support value in water management. The added value of these measurements to the water community has been demonstrated through a multitude of pilot flights in Colorado and California. In a 2019 pilot flight series in the Blue River watershed with Denver Water—during a time when the SNOTEL stations in the watershed had melted out—ASO data provided an accurate volume estimate of 115,000 acre-feet of water remaining in the high elevations. This provided Denver Water's operations manager the information needed to accurately reduce Dillon Reservoir levels to account for the incoming runoff, which in turn allowed downstream reservoir operators and other Colorado River reservoir operators to re-time outflows and cancel Coordinated Reservoir Operations (CROS) that could have otherwise led to downstream flooding and lost water supply. Expanding ASO data collection to cover municipal source water basins on both sides of the continental divide and throughout the state would apply a value-added method to maximizing use of water supplies. Having accurate knowledge of the volume of the water stored in the snowpack in these headwaters provides water managers the information needed to remove much of the "guesswork" from operational decisions.

1.9 Develop a study for new and existing water storage opportunities

Lead Agency: CWCB

Collaborating Agencies: CDPHE; DWR

Related Action Area:
Robust Agriculture

Storage continues to be a critically important tool for meeting current and future water needs and providing flexible management of surface water supplies that are increasingly stressed and altered due to climate change. Storage is also pivotal to managing conserved water and facilitating large-scale implementation of collaborative water sharing agreements. Future storage projects will need to be increasingly collaborative and multi-purpose to the extent possible. New storage projects will have to innovatively identify how to expand existing facilities and minimize evaporation losses while also minimizing environmental impacts. Strategies that store water underground will also need to be considered. Identifying strategies on how storage can be developed quickly, responsibly, and adaptively needs greater research.

The CWCB will leverage existing work, such as the Handbook for Colorado Water Supply Planning and Permitting, DWR's Colorado Dam Safety Guidelines documents, the Technical Update, Basin Implementation Plans, the Colorado-New Mexico Regional Extreme Precipitation Study, DWR's Reservoir Enlargement Assessment Project (authorized in 2022 legislation), and other research. The study will also consider the experiences of local governments, communities that have recently permitted and/or negotiated water storage projects, and state agencies involved in permitting water storage projects such as the WQCD, which issues 401 certifications. Ultimately, CWCB will analyze the best opportunities for increasing surface water storage in existing facilities through sediment removal, storage reallocation, dam improvements/enlargements, new surface water storage facility construction, and the use of groundwater aquifer recharge to enhance storage. The final report will include a discussion of where and how to partner with local entities to increase storage through a variety of means. The final report may include opportunities that defer the need for increased storage, such as alternatives like water conservation and CWSAs. The analysis will include conclusions from existing studies, new evaluations, and a review of ongoing permitting challenges and solutions.

Denver Water's Strontia Springs Dam on the South Platte River in Waterton Canyon.

Photo credit: Matt Lindburg

TOOLS used for this action

- Water storage
- Natural hazard planning
- Innovation
- Data collection and sharing
- Conveyance infrastructure

1.10 Create a positive discussion space for tough conversations on analyzing transmountain diversion projects in the Technical Update

Lead Agency: CWCB

Collaborating Agencies: CDPHE; DWR

Related Action Area:
- Robust Agriculture
- Thriving Watersheds
- Resilient Planning

TOOLS used for this action

- Data collection and sharing
- Policy and regulatory changes
- Collaboration groups
- Innovation

TMDs are important but controversial water supply projects. While TMD projects exist throughout the state, they play a significant role in providing water supplies for East Slope water users. To meet growing East Slope demand, some water providers have established plans for additional TMDs, and they are in various levels of development from conceptual design to construction. East Slope water providers would like to preserve the ability to develop new TMDs in the future, while West Slope stakeholders are greatly concerned about additional development of West Slope water and the resulting impacts on their environment and available supply. Currently, many water users are interested in understanding and analyzing potential effects of TMDs that are existing or are actively being pursued. Analyzing the effects of these TMDs can be problematic if they are undergoing a permitting process or are in litigation.

For these reasons, the Technical Update conducted a high-level assessment of TMDs but stopped short of a detailed analysis. While ongoing litigation, interstate compact considerations, and modeling constraints may still present challenges in future Technical Updates, tough conversations about potential analyses of TMDs must occur.

To better understand the potential effects of TMDs that exist and are actively being pursued, the CWCB will facilitate stakeholder discussions prior to the next Technical Update. The discussions will be conducted in a way that provides opportunities for positive and impactful conversations that result in mutual understanding of differing constraints and needs. New methodologies that are developed and agreed to can be applied in the next Technical Update (tentatively scheduled for completion in 2029). If successful, this process could be applied to encouraging thoughtful discussions on other sensitive issues such as collaborative water sharing agreements or augmentation needs for environmental projects.

Link for more information on Colorado's Conceptual Framework: **waterinfo.org | Conceptual Framework**

THE CONCEPTUAL FRAMEWORK

The Water Plan includes a Conceptual Framework with seven principles to guide future negotiations between proponents of a new TMD, if it were to be built, and the communities and watersheds that would be impacted. The Conceptual Framework remains an important tool for guiding negotiations for future TMDs if or when they are contemplated. See Chapter 4 for a description of the Conceptual Framework's seven principles.

Colorado vision for

ROBUST AGRICULTURE

SUSTAIN PROFITABLE PRODUCTION

Agriculture not only provides food and fiber, but it is also important to Colorado's culture, heritage, and economy, and it faces unprecedented challenges. Innovations are needed to sustain irrigated agriculture, including strategies to stretch available water supplies, increase resiliency, enhance food production, and maintain profitability. Water supplies for Colorado's urban growth should not come at the expense of our rural communities through indiscriminate buy and dry methods. Collaborative partnerships among agriculture, environmental groups, and municipal water providers should be used to create multi-purpose projects that help keep irrigated lands in production and maintain ecosystem services.

Maintaining robust and prosperous agriculture in Colorado will require facing unprecedented challenges like drought, urbanization, diminishing surface water supplies, and shrinking groundwater resources. Agriculture is a critical part of the state's economy and supports the vitality of rural areas in ways that include everything from job creation and local tax base to providing wildlife habitat and food production for both local uses and exports. Preserving agricultural productivity and reducing the number of acres that are coming out of production are critical to Colorado. Doing so will require a renewed commitment to recognizing the many benefits agriculture brings, partnering with agriculture, and working to find innovative, flexible, and collaborative strategies that maintain or even increase economic outputs.

What is sustainable agriculture and why is it important to Colorado?

Agriculture plays a critical role in Colorado's economy and culture. Our agriculture contributes $47 billion to our state's economy each year and supports businesses directly and indirectly, especially in our rural communities. Irrigated agricultural areas and infrastructure supports habitat and provides open space and recreational opportunities. However, agriculture is coming under increasing pressure with population growth and decreasing water supplies. In spite of these pressures, our agricultural economy and culture need to be sustained. Sustainability means increasing profitable farm income, promoting environmental stewardship, enhancing the quality of life for farm families and communities, and increasing the production of food. Finding ways to maintain or increase agricultural economic output with fewer acres and less water will be critical. The Technical Update projected potential irrigated acreage losses of 400,000 to 500,000 acres, and even more could occur as our population grows. While it is inevitable that some irrigated land will come out of production due to urban growth, to stabilize declining groundwater supplies, and through voluntary sales of agricultural water rights for other uses, saving 100,000 acres of irrigated land through CWSAs, conservation easements, and increased irrigation efficiency will be a significant step toward sustaining agriculture and the rural economies it supports.

SUPPORT FOR ACTION

Addressing our challenges for Robust Agriculture will require creative solutions that also adhere to the State's laws and regulations for water rights and water quality. In addition, the agency actions in the Water Plan help create support tools that partners across the state can use to advance their own actions. Specifically, agency actions 2.1 through 2.10 and contributing general actions build baseline support for future local partner action.

The state legislature and the CWCB support these efforts through the Colorado Water Plan Grant Program. The areas of partner actions generally align with the CWCB's Colorado Water Plan Grant Program that has legislatively-established funding areas for agriculture, conservation and land use, engagement and innovation, environment and recreation, and water storage and supply. In many cases, CWCB loans or other grant funding sources provided by federal and state agencies or other groups noted in Chapter 3 (also see Chapter 3 Framework for State of Colorado Support for Water Projects) are also available and can support work within and beyond the scope of Water Plan grants. In some cases, funds from different sources can be used to fulfill matching requirements.

Examples of these "partner actions" are highlighted below, followed by details on supporting agency actions.

PARTNER ACTIONS

The agricultural industry involves individual producers, corporations, and associated private and public providers of support services. These entities have a long history of coming together in partnership to support cooperative projects, outreach, education, and planning. In many cases, grant funding is available to help explore additional work in the areas below.

Thoughtful Storage

While large storage projects may often be out of reach financially for individual producers, developing partnerships for multi-purpose storage projects will be the key to providing water for the benefit of the agricultural sector.

- **Storage to protect and enhance existing agricultural uses under future uncertainty:** The Technical Update predicts that spring runoff in many areas of the state will experience reduced peaks that occur earlier in the season. This will impact the historical pattern of water available for storage and irrigation delivery. Storage can benefit farmers by allowing them to deliver water at the most beneficial time for the crop versus being limited to seasonally available streamflow.
- **Storage to provide supply and flexibility for augmentation plans:** Many irrigators rely on groundwater pumping, but associated streamflow depletions must be augmented to prevent injuring senior water rights. Storage provides a source of replacement supply that can be used to augment streamflow when necessary to prevent injury to other water rights.
- **Strategic and smaller storage facilities that meet multiple needs:** New storage projects at strategic locations many not need to be large to enhance or re-time water supplies to achieve maximum benefit. Often, these smaller storage facilities create operational flexibility while providing ecosystem services and environmental benefits such as new wildlife habitat or recreational opportunities.

> "WATER IS OUR LIFEBLOOD IN AGRICULTURE, BUT WATER IS OUR LIFEBLOOD OF THE ENTIRE SOUTHWEST. WITH AGRICULTURE USING MOST OF THE WATER, I THINK IT'S OUR JOB TO BE PART OF THE SOLUTION. IT IS ALL OF OUR FUTURE.
>
> — PAUL BRUCHEZ, *CWCB*

Meeting Future Water Needs

Rehabilitation and modernization of farming and ranching infrastructure can help agriculture be more efficient and protect our existing agricultural economy and irrigated acres. It often requires investment in additional infrastructure to support agriculture that could include building greater internet connectivity in rural areas to facilitate use of modern technologies. Reduction in supplies due to climate change means that producers may have to do more with less. Finding ways to efficiently use available supplies will support these efforts.

- **Rehabilitation of agricultural storage facilities:** Many of Colorado's storage facilities were built almost a century ago, and issues such as degradation of dams and sedimentation within the reservoir are resulting in less storage capacity. Efforts to repair and rehabilitate these aging facilities could help water users fully utilize existing water rights and store additional supplies.
- **Replacing diversion structures:** Inefficient diversion structures can prevent irrigators from diverting all of the water to which they are entitled. In addition, many structures block the passage of fish and recreational boats. Replacing aging and inefficient diversion structures, and where possible enhancing their design, can provide additional supplies to irrigators while benefiting habitat and recreation on rivers and streams.
- **Measurement of agricultural uses:** Measuring uses is an important tool for water management and water conservation. Access to data on water delivery and use can help producers make improvements toward more efficient and effective water use to maximize productivity.

Wise Water Use

Reduced agricultural area does not always need to result in reduced economic output. Colorado agriculture is a significant contributor to Colorado's economy and finding ways to maintain this value will involve investing in agricultural innovation and supporting producer adaptation to water supply constraints. Some strategies may include transitioning to high-value crops or less-water-intensive crops, collaborative water sharing agreements, and developing new economic opportunities for producers.

The next generation of farmers and ranchers are facing a new era of aridity that will require new investment and creativity. This may include investments in protected agriculture (e.g., greenhouses), more efficient irrigation, renewable energy, alternative crops (e.g., hemp, quinoa), drought-resilient animals, and innovative technologies. A growing and important part of our food system is agriculture occurring in or adjacent to urban areas that provide locally produced food. Supporting all agricultural producers and the diverse types of agriculture operations is critical to a robust agricultural future in Colorado.

Farms in groundwater-dependent areas such as the Rio Grande Basin and Republican River Basin are actively taking agriculture out of production to meet compact obligations and stabilize groundwater levels. Supporting these communities as they work to find solutions that help transition to more sustainable water use involves not just providing funding but supporting planning efforts to build a robust agricultural future with increased ecosystem and community benefits.

- **Conveyance efficiency improvements:** Improvements to agricultural diversion and conveyance infrastructure can increase water delivery to farms and increase predictability of deliveries. The benefits of these improvements must be weighed against the reliance on return flows by water users and riparian areas.
- **On-farm efficiency improvements:** Improvements in irrigation efficiencies can reduce labor costs and result in more water delivered to the crop at the right time, which would result in higher yields. Like conveyance improvements, these benefits may impact return flows.
- **Lower water use cropping:** Economic drivers may mean a change in crop type for producers who frequently experience water shortage. Innovation in crop genetics and crop selection may provide a more profitable and resilient commodity than traditional Colorado crops. Alternatively, deficit irrigation combined with investments in soil health can be viable approaches.

Healthy Lands

Irrigated land not only provides food and fiber to people and animals, but creates return flows that support streamflow for fish passage, habitat and food for riparian species, and other environmental benefits. Promoting multi-purpose projects that support agriculture, water quality, and water conservation generate a multitude of shared benefits for agricultural, environmental, and recreational water uses. For example, using tools such as conservation easements to preserve irrigated lands can provide financial benefits to farms and ranches while supporting both the environment and working agriculture.

- **Soil heath and effective use of water:** Healthy soils can increase the resiliency of agricultural systems including water use efficiency, which can benefit crop growth and may increase profitability.

- **Natural working lands and greenhouse gas emissions:** Improved management of farm and range lands through strategies like rotational grazing and cover cropping has the potential to make working lands a sink rather than a source of greenhouse gas emissions. Colorado's Strategic Plan for Climate-Smart Natural and Working Lands informs these efforts.
- **Reducing erosion and improving water quality:** Management practices such as conservation tillage, contour farming, and buffer strips can reduce on-farm erosion and improve water quality.

Partner Actions Rely on Effective Engagement and Education at Different Levels

As Colorado grows, its cities are expanding. This has frequently led to the sale and dry-up of agriculture lands for water supply purposes or as urban footprints expand. Buy and dry of agricultural water rights has cascading impacts to jobs, local tax base, businesses that support agriculture, and other adverse economic outcomes. Cities have opportunities to identify how they can grow with agriculture. Finding opportunities to keep agricultural lands in production that are in or adjacent to cities are increasingly needed.

- **Government:** Agriculture is intrinsically tied to quality of life in Colorado. Government recognition and promotion of the industry's importance (including for our Tribes) through public engagement and non-agricultural partnerships will help educate people on agriculture, promote local food production, and support the industry through the tough challenges it faces.
- **Quasi-governmental entities, ditch companies, acequias, commodity and trade organizations:** Entities like water conservancy and conservation districts and ditch companies can conduct outreach campaigns on various water issues, such as alternatives to buy and dry transfers or strategies to build agricultural resilience, and provide support to irrigators that seek grant funding for water-related project development and implementation. Collaborative groups from acequias to CSU Extension and many more already support the agricultural sector, and engagement among these groups can help bring the Water Plan vision to fruition.
- **Residents:** Providing pathways for success to the next generation of farmers will help sustain the agricultural workforce and may attract new people to the industry.

INTEGRATION ACROSS **ACTION AREAS**

The partner actions noted above and the agency actions that follow often relate to one or more of the other action areas of the Water Plan. All areas of the Water Plan are interconnected, and projects need to consider multi-purpose, multi-benefit solutions. Here are some of the ways Robust Agriculture connects to the other action areas:

VIBRANT COMMUNITIES

Water-sharing partnerships can support multiple uses with programs to provide water to different users at different times. These programs reserve water for agricultural use during normal hydrologic years but are activated to increase supplies for municipal use during times of shortage.

THRIVING WATERSHEDS

Water conservation and efficiency improvements for agriculture have the potential to benefit the environment and recreation sectors by providing fish or boat passage, especially when coupled with diversion structure and other improvements. Agricultural best management practices can benefit farms while improving water quality. CWSAs with agriculture can be established to boost streamflow and create environmental and/or recreational benefits.

RESILIENT PLANNING

Supporting projects for building resilience, such as projects to help all water use sectors through times of drought, allows the agricultural industry to remain viable over the long term, which benefits all of Colorado.

AGENCY ACTIONS

The CWCB and partnering agencies will take the following actions to support and advance Colorado's vision for Robust Agriculture. Each action identifies a lead agency, and in most cases, one or more collaborating agencies. The lead agency is directly responsible for completing an action. Collaborating agencies will partner to successfully complete the action by providing guidance or actively staying informed. Both lead and collaborating agencies envision using existing staff and available resources. Collaborating agencies may provide more leadership or support if additional resources become available. In addition, other agencies may be consulted as needed or if resources become available.

2.1 Expand agricultural water conservation, education, and peer-to-peer programs that enhance innovation

Lead Agency: CWCB; CDA

Collaborating Agencies: N/A

Related Action Area:
■ Resilient Planning

Interactive classes are an effective way to equip producers with knowledge and strategies for improving farm and ranch productivity and resilience. Peer networks can increase the adoption of new practices and technology that advance water efficiency and conservation. This type of programming and community building is especially important for new or beginning farmers in a time when many producers are retiring, and new owners and operators are facing unprecedented challenges in water availability.

The CWCB and partners will develop a strategy for expanding agricultural water conservation education and peer-to-peer programming into all major river basins in the state, as well as in unique agricultural systems as needed, like acequias, Tribal water uses, or urban farming. Programming curriculum will include regionally-appropriate water conservation and resilience strategies that may include but are not limited to drought preparedness, irrigation efficiency, water conservation, regenerative agricultural practices, drought-resilient crops and forages, water right abandonment law, and new revenue opportunities.

TOOLS used for this action

- Public outreach and education
- Water efficiency and conservation programs
- Collaboration groups
- Climate adaptation
- Data collection and sharing

2.2 Integrate capacity-building efforts to support agriculture

Lead Agency: CWCB; CDA

Collaborating Agencies: N/A

Related Action Area:
Resilient Planning

Creating a robust and resilient agricultural future in Colorado will require supporting the development of the next generation of agricultural producers and professionals that work in agriculture (e.g., ditch company employees, watershed coordinators, CSU Extension educators). New and diverse perspectives are needed to help solve the many Colorado agricultural challenges. Including new and young farmers and people from previously under-represented groups in agriculture and water is necessary to reach a prosperous agricultural future.

The CWCB and partner agencies, including CDA, will coordinate capacity-building and workforce development efforts. This will include, but is not limited to, increasing and diversifying outreach about the Water Plan Grant Program and coordinating with CDA to identify barriers and opportunities to support new and young farmers through grant programs, internships, and support groups.

TOOLS used for this action

- Public outreach and education
- Collaboration groups
- Equity
- Innovation
- Climate adaptation

2.3 Expand the scale of collaborative water sharing agreements

Lead Agency: CWCB; CDA

Collaborating Agencies: N/A

Related Action Area:
Resilient Planning

CWSAs are one tool that can be used to maintain agricultural productivity that also benefit municipal, environmental, and recreational users. While momentum on CWSAs has been building through groundbreaking and innovative efforts, significant barriers to implementation remain.

The CWCB will foster the use of CWSAs through grant making and convening conversations about CWSAs with the goals of facilitating knowledge sharing between current and potential CWSA participants, attracting new and diverse CWSA participants, and moving toward larger-scale projects with lower transaction costs. The CWCB will actively support innovative and emerging CWSA concepts while still supporting proven strategies, such as coupling CWSAs with conservation easements. The CWCB will expand partnerships with organizations that have local connections to water users, with the goal of these partners facilitating more CWSA projects and building relationships and trust among water users in municipal, environment, and recreation sectors. The CWCB will develop online resources to increase public awareness about CWSAs and tracking CWSA progress.

TOOLS used for this action

- Collaborative water sharing agreements
- Public outreach and education
- Collaboration groups
- Land use and water planning integration
- Innovation

2.4 Streamline collaborative water sharing agreement guidance across agencies

Lead Agency: CWCB; DWR

Collaborating Agencies: CDA

Related Action Area:
- Vibrant Communities
- Thriving Watersheds
- Resilient Planning

Multiple state agencies are involved in collaborative water sharing agreements. For example, CWCB may provide a grant for assisting with projects, but DWR plays a critical role in administering water rights and reviewing administrative water change-of-use procedures. Increasing communication and improving resources shared between CWCB and other state agencies would help promote CWSA projects.

The CWCB will work with state agencies, including DWR, on developing a CWSA tool box that will help align and streamline guidance on CWSAs across state agencies. The tool box will include guidance on the lease-fallow tool, agriculture-to-agriculture water leases, interruptible water supply agreements, and other information DWR and project partners need to move CWSA projects forward. The CWCB and DWR will also work to develop a more effective means to track CWSA development and implementation, such as through the CDSS.

TOOLS used for this action

- Collaborative water sharing agreements
- Policy and regulatory changes
- Public outreach and education
- Data collection and sharing

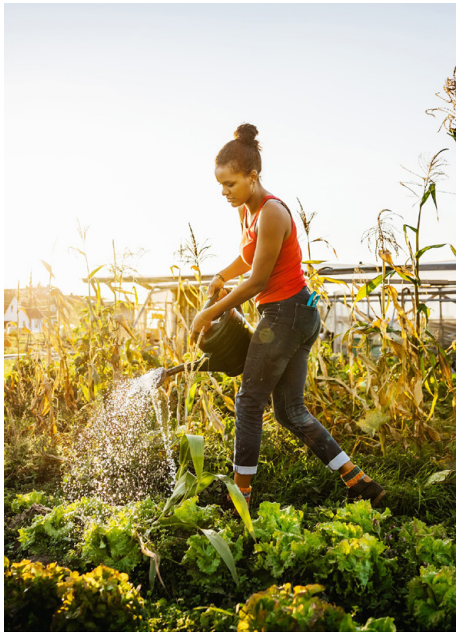
Agriculture outside of Denver Metro area. Photo credit: Annie Kitchen

2.5 Support the integration of robust agriculture into local government planning

Lead Agency: CWCB; CDA

Collaborating Agencies: DOLA

Related Action Area:
- Vibrant Communities
- Resilient Planning



Many of the services provided by agriculture align with local government goals, such as providing jobs, local food, open space buffers between communities, scenic views, and ecosystem diversity. Purposeful incorporation of agricultural considerations into resilience planning can enhance these goals.

The CWCB and local government partners will create and promote a framework of agriculture-informed educational materials that help integrate robust agriculture into local government planning. The goal is to help inform planners and developers who may not have the expertise needed to realize impacts of planning decisions on agriculture. This effort will include, but is not limited to, assembling lessons from communities that have successfully maintained agricultural productivity, considering the needs of agriculture in planning (e.g., agricultural equipment transportation or worker housing), integrating urban agriculture, and preserving irrigated land and open space in areas that are pressured by urbanization. This effort will also explore how to encourage CWSAs or long-term reliable water leasebacks with farmers to maintain irrigation on municipal-owned lands and identify barriers and opportunities for municipalities to best manage land purchased in water transactions.

TOOLS used for this action

- Policy and regulatory changes
- Public outreach and education
- Land use and water planning integration
- Collaboration groups
- Equity

2.6 Assess the economic opportunities of avoided buy and dry to communities, ecosystems, and recreation

Lead Agency: CWCB

Collaborating Agencies: CDA; CPW; DOLA

Related Action Area:
- Vibrant Communities
- Thriving Watersheds

Agriculture is a critical component of the state's economy and has many subsequent impacts on other state values like open space and wildlife habitat. While the connection between agriculture and other economic sectors and rural quality of life is acknowledged, the intricacies of these relationships are rarely realized before the irreversible impacts of buy and dry are set in motion. Where there are changes to agriculture, especially when buy and dry occurs, there can be negative impacts on the local economy, ecosystem services (e.g., wetland habitat or food sources for wildlife), and recreation opportunities.

The CWCB and partners will research the primary and secondary impacts of agriculture on rural vitality, including economic outputs, jobs, tax revenue, quality of life, and impact of agriculture on environmental and recreational resources. The goal is to help CWCB, local governments, and stakeholders proactively understand and quantify the potential direct and indirect impacts of reducing irrigated acres or converting agricultural lands to other urban or industrial use. The report on this research will explore equitable solutions for water users that include, but are not limited to, assessing the services agriculture provides for cultural, environmental, and recreational values, and identifying programs, strategies, or policies to actively protect these values. The report will also include strategies to help agriculture maintain existing and vulnerable supplies and will look at potential multi-purpose projects to support both agricultural and environmental/recreational values.

TOOLS used for this action

- Data collection and sharing
- Policy and regulatory changes
- Equity
- Innovation
- Climate adaptation

BESSEMER FARMLAND CONSERVATION PROJECT

Nearly a third of the Bessemer Ditch water rights is owned by Pueblo Board of Water Works (Pueblo Water). The Bessemer Ditch irrigates lands in Pueblo County that produce chiles, corn, watermelons, onions, pinto beans, and a variety of organic produce. While Pueblo Water currently leases the water rights back to farmers, it will eventually be needed for municipal purposes. Transferring the water out of agriculture will create risks for farm families, rural communities, and the local economy. The Palmer Land Trust developed an innovative solution to lessen future economic risk by creating a strategy for focusing remaining Bessemer Ditch water supplies on the most productive lands. The strategy uses an innovative legal framework in the water rights decree that allows moving water from marginally productive farmland to the most productive land.[1]

[1] Palmer Land Trust, 2021. **Bessemer Farmland Conservation Project**

2.7 Engage federal and state partners to streamline assistance for groundwater-dependent regions

Lead Agency: CWCB; CDA

Collaborating Agencies: DWR

Related Action Area:
- Vibrant Communities
- Resilient Planning

The potential for negative environmental and socio-economic impacts from groundwater depletion is significant in several areas of the state. Federal funding is a critical source of assistance for irrigators faced with reducing their water use in groundwater-dependent basins; however, federal programs can involve substantial paperwork, coordination, and management activities that present a barrier to accessing assistance.

The CWCB will spearhead an effort to make better and more efficient use of federal assistance. This will involve outreach to producers, local water conservancy districts, and other organizations to discuss barriers to accessing federal assistance. The CWCB will then engage federal agencies to explore ways to communicate, support, and/or streamline requirements of existing conservation programs, such as the Environmental Quality Incentives Program (EQIP) and Conservation Reserve Enhancement Program (CREP), NRCS, and BOR's WaterSMART. These engagements will identify how policies and funding procedures can be improved and will result in an improved process and understanding for water conservancy/conservation districts and local stakeholders in attaining federal assistance. In addition, CWCB will consider how $60 million in funding from the recently-created Groundwater Compact Compliance and Sustainability Fund (SB 22-028) can complement funding from the federal sources listed above to benefit groundwater users in the Republican and Rio Grande Basins.

TOOLS used for this action

- Funding
- Policy and regulatory changes
- Collaboration groups
- Natural hazard planning
- Climate adaptation

Center pivots in the San Luis Valley, Photo credit: Dan Downing

2.8 Streamline agricultural infrastructure funding

Lead Agency: CWCB; CDA

Collaborating Agencies: CPW

Related Action Area:
- Vibrant Communities
- Thriving Watersheds
- Resilient Planning

Infrastructure repairs and upgrades can help keep agricultural lands in operation, aid producers in more efficiently diverting water for beneficial uses, and provide other benefits such as improved fish passage. New infrastructure and storage projects are needed by agricultural producers to address current and potential future water shortages. Lack of financial resources for new infrastructure projects and rehabilitation of aging infrastructure is a major barrier to improved water management. Colorado agricultural producers have identified a lack of knowledge about grant opportunities and their requirements, inability to secure matching funds, and shortage of grant writing or grant management expertise and experience as key barriers to attaining funding for agricultural infrastructure improvement projects.

The CWCB, in partnership with other agencies and organizations, will support agricultural producers seeking infrastructure funding. This could include, but is not limited to, coordinating grant-writing workshops, connecting water users to resources and organizations to help with grant writing, or creating a framework for irrigation infrastructure assessments to help ditch companies, water conservation partnerships, and producers identify needed improvements, costs, and potential solutions.

TOOLS used for this action

- Public outreach and education
- Funding
- Policy and regulatory changes
- Collaboration groups
- Equity

2.9 Assess agricultural impacts and best practices for water quality protection

Lead Agency: CWCB; CDA

Collaborating Agencies: CDPHE

Related Action Area:
- Vibrant Communities
- Thriving Watersheds

Agricultural producers, state agencies, and research institutions have taken a proactive approach to monitor, research, outreach, and develop best management practices that can improve agricultural water quality. Producers around the state are working to address water quality concerns or deal with poor water quality themselves by investing in adaptive farming and ranching practices like planting buffers and cover crops, switching from flood to sprinkler irrigation, switching to salt-tolerant crops that require minimum or no-till systems, or rotational grazing. Identifying current and future water quality concerns and solutions is important both for minimizing water quality impacts from farming operations to all water use sectors and for managing on-farm water supplies to maintain profitable, sustainable agriculture.

The CWCB, with partner organizations and institutions such as Colorado State University, will research data and knowledge gained about the impacts of on-farm management practices on water quality. The Water Quality Control Division's Nonpoint Source Program can provide foundational information for this effort. The research will result in a report that identifies key knowledge gaps to address in future research projects and discusses emerging challenges and solutions for agricultural water quality that CWCB can help address.

TOOLS used for this action

- Watershed planning
- Data collection and sharing
- Public outreach and education
- Stream/watershed restoration and enhancement

2.10 Integrate soil health, water conservation, and adaptive practices that increase economic outputs with less water use

Lead Agency: CDA

Collaborating Agencies: CWCB

Related Action Area:
- Thriving Watersheds
- Resilient Planning

Colorado, in response to aridification, periodic and intense drought, and declining groundwater supplies in some basins, must increase focus on promoting soil and water conservation to sustain agricultural production. Pairing soil and water conservation strategies with positive production and economic outcomes is essential for increased adoption.

In partnership with CWCB, CDA will assess impacts to water use and economic opportunities that accompany emerging soil and water conservation strategies (i.e., reduced tillage or low-water crops). The CWCB and partner organizations and stakeholder advisory groups will identify and create a strategic plan for supporting the most promising opportunities to maintain or increase economic output together with soil and water conservation. This effort will reflect the diversity of Colorado's agricultural producers and the diversity of the food, fiber, feed, and animal operations in the state. Research related to this action will help reinforce the connections between soil health and water conservation.

TOOLS used for this action

- Innovation
- Watershed planning
- Public outreach and education
- Policy and regulatory changes
- Water efficiency and conservation programs

COLORADO STAR PLUS

The **CDA's Star Plus program** encourages voluntary adoption of soil health practices, including no or low till, cover crops, crop rotation, and incorporating livestock. These practices are good for farmers' and ranchers' bottom lines, the soil, and the environment. The STAR Plus program builds on Colorado's strong history of land and water stewardship by ensuring the sustainability of our soils, improving drought resilience, increasing agricultural productivity, and promoting sustainable agriculture across Colorado and the West. The program will increase the capacity of conservation districts and other entities to provide technical assistance, which will reduce the risk of trying new practices via incentive payments. The STAR Plus program also provides education, outreach, communication, and peer-to-peer learning.

Colorado vision for

THRIVING WATERSHEDS

ENHANCE WATERSHED HEALTH

Colorado's watersheds hold the future of our water supply security. Comprehensive water resources planning should incorporate conditions of forests, streams, wetlands, and wildlife habitat. As our state's water source, the health of watersheds affects agriculture, downstream communities, recreation, tourism, and ecosystem function. Colorado will continue to follow a shared stewardship ethic to plan and implement multi-benefit projects to enhance the health of our watersheds.

Thriving watersheds are healthy watersheds. Healthy watersheds are resilient, and resilient ecosystems are able to absorb repeated disturbances (e.g., fires, floods, and droughts) and adapt to change without fundamentally changing the services (e.g., flow regime, sediment regime, and wood regime) upon which society and the environment depend.

We all live, work, and play in a watershed. Watersheds connect us. Sustaining healthy watersheds, which include the forests, rivers, and habitat within them, is critical to Colorado's tourism, our resilience, and our water supply. Our watersheds face major challenges from natural disasters, increasing aridity, growing water demands, and other factors that strain our environment. Watershed health should be considered at all phases of comprehensive water supply planning and project implementation. Rather than implementing a patchwork of watershed health projects, our efforts must increasingly seek to create more opportunities for larger, landscape scale watershed restoration projects and multi-benefit projects that meet the needs of many water users as well as the environment.

What is shared stewardship and how can it integrate planning across watersheds?

The National Association of State Foresters says shared stewardship aims to set a "foundation for shared decision making" that brings multiple partners together. In addition to forestry issues, Colorado's watershed planning needs to find synergies to bring efforts like stream management planning, watershed planning, and forest health improvement into greater alignment with other local and federal planning that may share similar goals (e.g., hazard planning). Restoring just 10% of Colorado's 24 million acres of forest that need the most urgent attention to address forest health, wildfire risk, and water supplies is expected to require $4.2 billion. The Colorado Water Plan calls for $1.5 billion in additional funding for CWCB (see Chapter 3), and additional project needs at the local scale will require even more. Gathering these plans into a single mapping tool that identifies where various plans exist and seeks to find common goals will be critical to helping leverage dollars and align local planning so that river health priorities can be advanced through integration. The goal is that at least 80% of the 94 subbasins (using the Hydrologic Unit Code [HUC] 8 level) in Colorado have active and integrated plans with a pipeline of projects that support environmental and recreational needs.

The Shared Stewardship Agreement: While shared stewardship is a mindset, it is also a specific agreement that includes the U.S. Department of Agriculture, U.S. Forest Service, and State of Colorado. The Shared Stewardship agreement broadly focuses on managing Colorado's forests for ecological restoration, recreation, protecting water resources and infrastructure, conserving fish and wildlife, engaging diverse stakeholders, and promoting healthy and safe communities. The Shared Stewardship approach brings together national, regional, state, Tribal, and local stakeholders to plan together, prioritize together, and act together.

Link for more information **Shared Stewardship in Colorado | DNR**

SUPPORT FOR ACTION

Addressing our challenges for Thriving Watersheds will require creative solutions that also adhere to the State's laws and regulations for water rights and water quality. In addition, the agency actions in the Water Plan help create support tools that partners across the state can use to advance their own actions. Specifically, agency actions 3.1 through 3.10 and contributing general actions build baseline support for future local partner action.

The state legislature and the CWCB support Thriving Watershed efforts through the Colorado Water Plan Grant Program. The areas of partner actions generally align with the CWCB's Colorado Water Plan Grant Program that has legislatively-established funding areas for agriculture, conservation and land use, engagement and innovation, environment and recreation, and water storage and supply. In many cases, CWCB loans or other grant funding sources provided by federal and state agencies or other groups noted in Chapter 3 (also see Chapter 3 Framework for State of Colorado Support for Water Projects) are also available and can support work within and beyond the scope of Water Plan grants. In some cases, funds from different sources can be used to fulfill matching requirements.

Examples of these "partner actions" are highlighted below, followed by details on supporting agency actions.

PARTNER ACTIONS

While the CWCB provides funding, develops adaptable watershed tools and frameworks, and engages in institutional collaboration, there are several watershed health areas that will need diverse participation. The CWCB collaborates with and relies on local stakeholders to work across sectors, assess needs and priorities of their watersheds, and implement projects. Below are several ways to engage in watershed health at the individual, regional, or statewide level. In many cases, grant funding is available to help explore additional work in the areas below.

Thoughtful Storage

A key component to achieving or maintaining a thriving watershed is to provide adequate streamflows that support critical habitat for wildlife and protect recreational interests. While water storage projects impact streams, they can also provide flexibility in delivering the necessary flows and timing of flows to priority streams.

- **Streamflow enhancement (retiming and releases):** Releases from water storage can enhance streams during critical low-flow periods for aquatic life, can help address water temperature issues during low-flow periods, and can help bolster critical high-flow periods to maintain stream habitat or riparian corridors.
- **Nature-based solutions:** Established best practices for nature-based solutions that support healthy forests, watersheds, and their natural water infrastructure such as floodplains and wetlands can attenuate flood flows, boost late-season low flows, and improve ecosystem health and water quality.
- **Flows for boating and flatwater recreation:** Water storage provides the ability to augment or re-time streamflows in ways that enable water managers to provide recreational flows to communities. Storage projects often provide opportunities for flatwater recreation.

Meeting Future Water Needs

Water demands for growing cities and agriculture are expected to increase, which will continue to strain available water supplies for environmental and recreational needs. Furthermore, climate change will add uncertainty to future precipitation amounts, as well as runoff rates, timing, and volumes. Integrated planning and multi-use projects are needed to meet water demands across all sectors of water use, and efforts to improve stream health or function often benefit all water users.

- **Rehabilitate streams to improve habitat, reduce erosion, and meet needs:** Flow enhancement projects and projects that reconnect streams with their floodplains can improve stream and riparian habitat as well as water quality for the benefit of all water sectors. Collaborative water sharing agreements can be established to provide flows during times of shortage. Stream management plans and integrated water management plans are collaborative efforts that can identify projects and needed flows for stream rehabilitation that consider all of the benefits that a stream provides to local users.
- **Improving fish passage through replacement of agricultural headgates:** Retrofitting or replacing agricultural diversions and headgates

that have historically inhibited fish passage can increase habitat connectivity for fish and can also lead to improved water use efficiency for the agricultural user. Boat passage can also be improved on streams with agricultural and recreational users. Stakeholders can, in advance, prepare fish and/or boat friendly reconstruction designs for diversion structures that are vulnerable to flood or other damage.

- **Increase access to recreational opportunities:** An inclusive approach to outdoor recreation initiatives and water planning processes can increase representation and diversity. Projects that improve boat access and boat ramps can greatly increase access to recreational opportunities in the state. Recreational in-channel diversion water rights can protect flows for water-based recreation. Other strategies, such as increasing awareness within the recreational community regarding low head dams, can greatly improve boating safety and can increase boating interest. Thoughtful planning should balance increased access opportunities with watershed/habitat protection.

LOW HEAD DAMS

Low head dams typically range from 1 to 15 feet high. Water runs over them continuously, and they span from one riverbank to the other. These dams create dangerous recirculating currents that are not always readily apparent, catch recreators off-guard, and can trap them underwater. American Whitewater has compiled a GIS list of over 1,000 low head dams in Colorado, which can be used by stakeholders to identify those that are risky for boaters and should be replaced.

Link for more information on DNR's low head dam safety program: **Colorado Low Head Dams | DNR**

Wise Water Use

A direct relationship exists among the natural environment, people, and resilience. Recognizing the social, ecological, and economic connections among forests, riparian corridors, and river systems is critical to understanding that our water systems depend on the health of natural systems. Watershed health and resource use is strongly linked to water supply and natural hazard risks. Building resilience through careful planning and wise development can help us adapt to future flood, fire, and drought conditions and lower risks to humans, watersheds, and wildlife.

- **Streamflow and lake level protections for environmental needs:** The CWCB can appropriate water rights for instream flows and natural lake levels to preserve the natural environment to a reasonable degree, which is an important tool for preserving and enhancing streams and ecosystem health. Voluntary water acquisitions can also be used to improve streamflows to benefit streams and habitat. Instream flows help maintain recreational fisheries and flows for recreation.
- **Create greater drought, fire, and flood resilience:** Stream and watershed restoration efforts should strive to incorporate multiple opportunities, benefits, and funding sources where possible. Specific ecosystems such as headwaters, floodplains, and wetlands can be evaluated and prioritized using watershed-specific metrics. Stronger projects and strategies emerge when local decision makers prioritize projects by balancing science, funding, risks, and values.
- **Invasive phreatophyte and species removal:** Invasive phreatophytes (deep-rooted, water intensive vegetation like Russian Olive and Tamarisk) and other invasive species can fundamentally alter stream channels and systems by preventing floodplain connectivity, creating sediment deposition, altering the nutrient cycles of riparian areas, and consuming large amounts of water. Local removal efforts can complement stream or riparian improvements but large-scale efforts to remove these species requires effective management across jurisdictions.

Healthy Lands

Effective watershed management requires collaboration across multiple scales and geographies. Shared stewardship is an approach to planning for improvement of watershed health and resilience across management jurisdictions. It brings together national, regional, state, Tribal, local governments, and stakeholders to plan, prioritize, and act together. From state agencies to local watershed collaboratives, the goal must be to jointly work backward from the desired end results and focus on high-value, prioritized opportunities to address risk and create opportunities to enhance stream and watershed health.

- **Forest health improvements:** Efforts to improve or maintain healthy forests can create watersheds that are resilient to natural disasters, provide high-quality water supplies, and can help stabilize forest carbon. Identifying and implementing projects in fire-prone forests to protect critical water supply infrastructure from sedimentation and debris flow will be important for building resilience.
- **Reconnecting floodplains and nature-based solutions:** Projects that reconnect floodplains to waterways and restore wetlands and riparian habitat along headwater streams can increase drought, fire, and flood resilience and provide environmental benefits. Beaver reintroduction and construction of beaver mimicry structures are examples that support these strategies. These kinds of projects improve the natural environment, but they also help provide clean water supplies for both municipalities and agriculture.
- **Improving riparian and aquatic habitat:** Resilient river systems require seasonal flow fluctuations and provide complex and connected aquatic and riparian habitats that sustain stable, diverse, abundant, and reproducing populations of aquatic and riparian species. Efforts to improve riparian and aquatic habitat are important to the recovery of native and imperiled species.

Partner Actions Rely on Effective Engagement and Education at Different Levels

Partner and stakeholder engagement is a critical element of successful watershed planning efforts that focus on river health (e.g., SMPs, IWMPs, etc.). Plan development and implementation should be tailored to local stakeholder values, the unique characteristics of watersheds being evaluated, and a real-time evaluation of current conditions that may shift assumed priorities. Projects identified through stakeholder-based watershed planning efforts are often grant-funded and show how local prioritization efforts lead to project advancement. Participation of partners at all levels is necessary to assess, prioritize, and implement watershed improvement projects.

- **Government:** Governmental organizations are well-suited to provide resources that further a community's understanding of how watershed health fits into the statewide approach to water management. Education and outreach campaigns focused on topics such as river health at a municipal level or understanding where your water comes from can be an effective tool. Governmental organizations can often provide resources in the form of grants.
- **Non-governmental organizations:** Critical partners in watershed planning like NGOs can often help with efforts such as data collection, project implementation, analysis, and education. They can often form strong, trust-based relationships with communities.
- **Residents:** Engaging local residents in thriving watersheds can be achieved through activities such as community science and local watershed groups. Watershed planning relies heavily on the site-specific knowledge and ideas of individuals. Engaging with residents who are not traditionally involved in watershed planning will be key.

INTEGRATION ACROSS **ACTION AREAS**

The partner actions noted above and the agency actions that follow often relate to one or more of the other action areas of the Water Plan. All areas of the Water Plan are interconnected, and projects need to consider multi-purpose, multi-benefit solutions. Here are some of the ways Thriving Watersheds connects to the other action areas:

VIBRANT COMMUNITIES

The development of multi-benefit projects that enhance environmental and recreational uses can often enhance municipal supply or improve the quality of life in urban areas. For example, restoring urban stream corridors can provide recreational opportunities, improve habitat, enhance landscape aesthetics, and reduce flooding potential. Improving the quality of stormwater runoff from urbanized portions of watersheds can benefit fish and help protect clean water supplies for downstream water users.

ROBUST AGRICULTURE

Efforts to increase fish habitat connectivity and recreational boat passage or improve stream health can have benefits for agricultural users through infrastructure improvements and implementing stream restoration. Shared efforts to improve water quality can benefit multiple sectors. CWSAs can be implemented to enhance flows for environmental and recreational purposes.

RESILIENT PLANNING

An ecosystem's resilience is a measure of its ability to absorb changes and return to similar levels after disturbance. Efforts made to improve watershed and forest health will increase the ecosystem's ability to effectively respond to environmental changes and natural disasters and enhance water security and quality for downstream communities.

Agency Actions

The CWCB and partnering agencies will take the following actions to support and advance Colorado's vision for Thriving Watersheds. Each action identifies a lead agency, and in most cases, one or more collaborating agencies. The lead agency is directly responsible for completing an action. Collaborating agencies will partner to successfully complete the action by providing guidance or actively staying informed. Both lead and collaborating agencies envision using existing staff and available resources. Collaborating agencies may provide more leadership or support if additional resources become available. In addition, other agencies may be consulted as needed or if resources become available.

3.1 Develop Colorado River Health Assessment Framework (CoRHAF)

Lead Agency: CWCB

Collaborating Agencies: CDPHE; CPW

Related Action Area: N/A

Stream health assessments are a key component of SMPs and IWMPs. To meet requests from various stakeholders implementing these plans and help bridge a critical knowledge gap, CWCB will develop a new guidance document and workbook that will reside on coloradosmp.org. The framework will help stakeholders approach stream health assessments from a common knowledge base, support local values, and provide a successful approach to completing the assessments. This guidance document will provide an overview of the various concepts for evaluating stream health, engaging stakeholders in the process, and evaluating core data needs related to hydrology, geomorphology, biology, ecology, and regulatory context at watershed and stream-reach scales – information useful for technical experts that would make decisions on prescriptive assessment methodologies. The CoRHAF will be the framework that supports stakeholder engagement and planning that recognizes community values as an important factor in conducting stream health assessments that might normally be based on data and regulatory framework alone.

TOOLS used for this action

- Stream/watershed restoration and enhancement
- Flow enhancement and maintenance
- Watershed planning
- Collaboration groups
- Innovation

East River near Crested Butte, Colorado
Photo credit: Matt Lindburg

3.2 Create a comprehensive stream construction guide

Lead Agency: CWCB

Collaborating Agencies: CPW

Related Action Area:
Vibrant Communities

The CWCB will create a supplemental construction guide for contractors and operators that aims to improve the quality, function, and aesthetic of construction work in stream corridors. The CWCB will develop and release a construction guide that will reinforce the need for an environmental ethic of stewardship in stream corridor work. The guide will include lessons learned and examples from successful stream restoration projects around the state. Work done in stream corridors should first seek to avoid interference. If deemed necessary, work conducted in stream corridors should come with a high standard to re-naturalize the site.

Finished projects should aim to blend into the natural surroundings. This means thinking beyond the black and white lines on an engineering drawing, using knowledge and skills as a contractor and/or operator to observe how natural sections of stream corridors look and function, and recreating that appearance and functionality as much as possible. Variation and non-uniformity are important themes. Streams are not straight lines and do not have perfect dimensions or consistent spacing. Techniques for remediating the site to maximize its potential for revegetation after heavy equipment leaves will also be a feature of this practical planning tool. The guide will serve as a living document that can be adapted and updated over time with new types of guidance (e.g., boat ramps, fish passages, etc.)

Stream enhancement construction in the Charlie Meyers State Wildlife Area Habitat Enhancement Project.

Photo credit: Matt Kondratieff, Colorado Parks and Wildlife

TOOLS used for this action

- Watershed planning
- Flow enhancement and maintenance
- Stream/watershed restoration and enhancement
- Public outreach and education
- Innovation

3.3 Create a Wildfire Ready Watersheds framework

Lead Agency: CWCB

Collaborating Agencies: CSFS (Colorado State Forest Service)

Related Action Area:
Vibrant Communities

The CWCB will immediately develop a strategy to address post-wildfire impacts. Wildfire Ready Watersheds is a strategy and program developed by CWCB that provides a proactive approach to address post-wildfire impacts before disaster strikes. Impacts are defined as risks posed by post-fire hazards to community values, such as water supply, life and property, and transportation corridors. Common post-fire hazards include increased runoff, debris flows, hillslope erosion, water quality impairments, flooding, and associated sediment erosion and deposition. The mission of Wildfire Ready Watersheds is to assess the susceptibility of Colorado's water resources, communities, and critical infrastructure to post-wildfire impacts and advance a framework for communities to plan and implement mitigation strategies to minimize these impacts—before wildfires occur.

Wildfire Ready Watersheds focuses on creating a statewide post-fire susceptibility analysis as well as a framework that communities can use for watershed-scale planning to address post-fire hazards. Elements of the framework could also be used for communities after wildfires occur, but the focus of Wildfire Ready Watersheds is to mitigate those hazards before major events happen. The susceptibility analysis includes data collection, data development, analysis, mapping, and reporting. This effort will rely on existing and new statewide datasets for wildfire hazards as well as critical values/assets, such as protecting water supplies, at-risk populations, and other infrastructure layers. The goal is to inform a susceptibility analysis that evaluates post-fire hazards and informs pre-wildfire decision making. This will serve to further an understanding of which watersheds will be most susceptible to post-wildfire impacts and where community stakeholders should focus their efforts in their wildfire mitigation efforts.

TOOLS used for this action

- Natural hazard planning
- Watershed planning
- Policy and regulatory changes
- Data collection and sharing
- Innovation

3.4 Develop a scenario planning methodology for forest health to inform water planning

Lead Agency: CWCB

Collaborating Agencies: CSFS

Related Action Area:
- Resilient Planning

As identified in CWCB's forest health white paper, water supply and watershed planning can be strengthened by developing forest health scenarios that focus on long-term (landscape level) forest structure change that could be practically integrated with the CDSS modeling tools.

The Technical Update does not include a forest health driver in its methodology, but including this driver could provide a more robust projection of potential future water supply and environmental risks. CWCB commits to creating a science-based process that involves stakeholder input to develop a range of forest health scenarios and to identify data gaps that require further research in order to integrate forest health in the planning scenarios considered in future Technical Updates. This will be an important and critical step to help evaluate and mitigate future risks as they relate to the forest-water-climate nexus.

TOOLS used for this action

- Data collection and sharing
- Land use and water planning integration
- Public outreach and education
- Innovation

3.5 Expand the Fluvial Hazard Zone Mapping Program

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area:
- Vibrant Communities
- Resilient Planning

The primary objective of Fluvial Hazard Zone (FHZ) mapping is to identify areas that are vulnerable to fluvial geomorphic hazards from riverine erosion, sedimentation, and channel movement and to determine where avoidance and mitigation measures should be focused. FHZ mapping is a science-based method that can be used to define areas that need protection, where mitigation measures can be implemented to protect downstream infrastructure, and to prioritize areas for restoration.

The CWCB will further develop the FHZ Program to support state and local community needs by providing guidance on connecting FHZ mapping to stream management, watershed restoration, and Wildfire Ready Watersheds planning. This can be backed with guidance videos to support technical training as well as general support for communities seeking to use FHZ maps for stream corridor, infrastructure, or natural resource planning. Guidance should also reference infrastructure, land-use practices, and pre- and post-flood mitigation of fluvial hazards. This expansion of the FHZ Program will continue to build from its beginnings as a hazard mapping tool to an expanded recognition of the multitude of benefits these maps can provide to communities looking to manage healthy stream corridors and natural water infrastructure. The CWCB has been and will continue to coordinate FHZ efforts with the State Hazard Mitigation Plan update being conducted by the Colorado Department of Public Safety.

TOOLS used for this action

- Data collection and sharing
- Public outreach and education
- Watershed planning
- Flow enhancement and maintenance
- Natural hazard planning

3.6 Enhance use of Water Plan grant funding for watersheds, environment, and recreation

Lead Agency: CWCB

Collaborating Agencies: CPW, OREC

Related Action Area:
■ Resilient Planning

The Water Plan Grant Program can better support a holistic view of watershed health in terms of recognizing and equally funding environmental projects, watershed projects, applicable forest health projects, and recreation. One way to improve the process is enhanced coordination with CPW and other state agencies in reviewing grant applications and data sharing. Early feedback maximizes potential benefits while mitigating potentially detrimental aspects of projects.

The CWCB will engage with other agencies and help build capacity for groups interested in watershed health-related and recreation-focused studies and projects through Water Plan grants. A variety of example watershed health projects are described in the partner actions for Thriving Watersheds. Recreation-focused project studies may include evaluating user days; enhancing river access; studying recreational uses and flow needs; studying economic impacts of recreation and reduced recreation due to low flows/high water temperatures; reducing hazards from low-head dams, low bridges, and dangerous diversions; and supporting studies for protecting and enhancing flows for recreation and recreational in-channel diversions.

Clear Creek Rafting tours on Clear Creek.
Photo credit: Colorado River Outfitters Association

TOOLS used for this action

- Stream/watershed restoration and enhancement
- Funding
- Watershed planning
- Public outreach and education

The Del Norte Riverfront Project was a community-led effort to improve public access, create recreation infrastructure, and enhance aquatic and riparian habitat along the Rio Grande in Del Norte. The overall purpose of the project was to create connectivity between the communities and visitors of the San Luis Valley and the river that sustains them. The new Riverfront Park includes a whitewater playwave, boat ramp, fish habitat structures, pedestrian river access, parking area, an Americans with Disabilities Act accessible picnic shelter, and interpretive signage. In addition to receiving funding from a variety of sources, the Del Norte Riverfront Project was awarded a Colorado Water Plan grant. The project has provided a significant positive benefit to the community of Del Norte and the greater San Luis Valley by creating a welcoming, safe space for community members, boaters, and anglers, while also improving river health.

3.7 Reduce barriers to participation in the Instream Flow Program

Lead Agency: CWCB

Collaborating Agencies: DWR, CPW

Related Action Area:
- Vibrant Communities
- Resilient Planning

Improving support for those interested in using the ISF Program is one of the best ways to meet environmental flow needs, increase resiliency, and protect or enhance aquatic habitat - especially in the face of climate change. The CWCB will create a guidance document that describes legislative tools currently available for the voluntary donation, sale, or lease of decreed water rights to help support the natural environment. This will help develop new partnerships, support local participation, and enhance public understanding of the ISF Program. The document will include examples of successful collaborative projects and provide guidance for initiating and navigating the process.

The CWCB will also provide support and technical expertise for entities interested in determining environmental flow needs by developing educational tools, such as instructional videos on flow evaluation methods like R2Cross, training workshops, and revised field and program manuals. The CWCB will work to lower barriers by enhancing access to the equipment, such as flow measuring devices and survey equipment, necessary to perform evaluations. These efforts will lead to a better understanding of environmental flow needs that can be incorporated into future planning and projects.

More information on the ISF Program is in Chapter 5.

TOOLS used for this action

- Public outreach and education
- Endangered and threatened species recovery programs
- Collaboration groups
- Flow enhancement and maintenance
- Collaborative water sharing agreements

Adult Razorback Sucker
Photo credit: Melanie Fischer

In the face of significant climate stress, the CWCB remains committed to acquiring senior water rights offered on a voluntary basis for ISF use to address the needs of Colorado's rivers and lakes.

3.8 Develop an interagency watershed planning platform

Lead Agency: CWCB

Collaborating Agencies: CPW; CSFS; CDPHE

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Resilient Planning

Building on the collective experience and work of multiple agencies in planning stream, watershed, floodplain, and forest restoration efforts, CWCB will work with partner agencies to develop a common watershed planning platform to help state agencies and the public evaluate local priorities by providing and, where possible, integrating multiple mapping efforts into a single watershed hub for planning information. This includes CWCB identifying how the platform would integrate **CWCB's focus area mapping tool** with other planning tools, such as the Water Quality Control Division's **Nonpoint Source Priority Dashboard** and the **Healthy Watershed Assessment and Watershed Rapid Assessment Program**. It also includes identifying how these efforts can integrate with the Colorado State Forest Service's **Colorado Forest Atlas**; CPW datasets, including the high-priority habitat GIS layers; The Colorado Natural Heritage Program's wildlife biodiversity mapping; and the Colorado Wetland Information Center's **Watershed Planning Toolbox**.

There may also be opportunities to incorporate elements of interagency EJ mapping tools, such as **Colorado EnviroScreen**. Agencies aim to scope this project through interagency coordination and will work to find the initial budget with CWCB, consider stakeholder input needs, and create a plan for next steps that move toward implementation.

TOOLS used for this action

- Data collection and sharing
- Collaboration groups
- Watershed planning
- Stream/watershed restoration and enhancement
- Innovation

3.9 Create a framework for prioritizing stream health with local stakeholders

Lead Agency: CWCB

Collaborating Agencies: CPW

Related Action Area:
- Resilient Planning

The CWCB has traditionally funded 100 percent of the locally identified SMPs and IWMPs that have come in for funding. As of 2021, there were 26 approved SMPs across Colorado. These management plans, developed at the local level, should focus on stream and recreational health and make it a priority. Prioritizing the next geographic regions for management plans (e.g., project implementation) is important, yet what defines local prioritization and how prioritization should occur is not well understood. This results in lost time during planning and has spurred requests for state-level planning to determine priorities. However, local projects need local input, and a static list of priorities is not responsive to shifting hydrology and other impacts from fire, flood, and drought. Developing a process by which local decision makers and stakeholders can evaluate what they prioritize is critical to not only be responsive to shifting risks but also to capturing opportunities that might arise to leverage funding in areas that may not be the first priority but that provide the most significant return on investment for water users and the ecosystem.

The CWCB and the River Network will engage stakeholders to develop a framework that helps identify the range of considerations for evaluating priorities when projects advance and will help support stronger projects coming in. This effort will be supported by other guidance and tools CWCB has developed and is creating. The CWCB will use this information to promote management plans in the identified watersheds and will work with NGOs and other stakeholder groups with experience in management plans to initiate and complete planning processes collaboratively with local water users and to foster implementation of projects identified in planning processes.

TOOLS used for this action

- Watershed planning
- Public outreach and education
- Policy and regulatory changes
- Stream/watershed restoration and enhancement

3.10 Integrate and facilitate access to water-dependent, native species data

Lead Agency: CWCB

Collaborating Agencies: CPW

Related Action Area:
■ Resilient Planning

Successes in the recovery and preservation of water-dependent, native species (which include aquatic and riparian species that depend on the presence of flowing water) is highly reliant on the ability to access and use data related to stream reach and upland area habitats, range and migration corridors, nesting sites, important riparian communities, and conservation areas; however, data can often be difficult to obtain or find. Water-dependent, native species data is currently held by several entities, including CPW, federal agencies, local watershed groups, and endangered and threatened species recovery programs.

The CWCB will coordinate with endangered and threatened species recovery programs and groups like the Colorado Natural Heritage Program to develop a roadmap that explores ways to better collect, store, and share data that could help support work geared toward the preservation and recovery of water-dependent, native species. As part of this effort, CWCB will explore and catalog existing data collection and storage methods to better understand the needs. This could include exploring possible options for storing data, pathways for increasing data collection, barriers to data, and support tools that can be used. Facilitating access to this data will assist in prioritizing projects and other watershed planning efforts.

TOOLS used for this action

- Endangered and threatened species recovery programs
- Data collection and sharing
- Flow enhancement and maintenance
- Stream/watershed restoration and enhancement

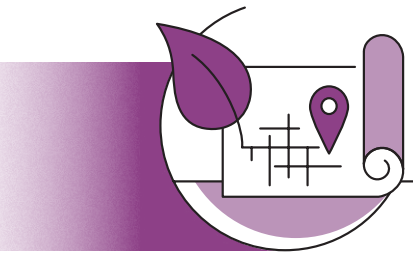
STREAM MANAGEMENT PLAN RESOURCE LIBRARY

The Stream Management Plan Resource Library provides users and interested parties with a variety of resources to assist in formulating their own stream management plan. The CWCB will continue to facilitate data sharing and build upon this effort to further assist work geared toward the preservation of water-dependent, native species.

Link for more information on the **Stream Management Plan Resource Library**

FISH BARRIER PROJECTS

Fish barrier projects are critical to native species conservation and recovery actions by protecting native populations from predators, reducing competition for food, and limiting potential for hybridization and disease. In many cases, they are a key tool that helps avoid the listing of fish species under the Endangered Species Act. Access to the data described in this action can help stakeholders better identify and prioritize projects.



Colorado vision for

RESILIENT PLANNING

BUILD WATER SECURITY

Water security is critical to the quality of life, environment, and economy of Colorado. The future is uncertain, and Colorado needs to be adaptive and resilient to face the challenges ahead. Water security roadmaps, inclusively developed at a local level and informed by strong state leadership, can identify acute and chronic risks to water supply, integrate local planning strategies, prioritize collaborative solutions, and build adaptive capacity and resilience.

Colorado's water supplies are vulnerable to risks from climate change, aridification, and the threat of natural disasters, which can disproportionately impact vulnerable communities. An equitable response to address these vulnerabilities requires every person to be at the table. State and local agencies will need to build awareness and engagement in water issues among all Coloradans, especially those that have been historically left out of our water planning processes. This type of inclusive mass engagement is needed to build our state's resilience across all sectors of water planning.

Coloradans need supportive governmental policies and equitable funding opportunities to help build water-related resilience. Strategic decisions and actions are required to minimize future risks to Coloradans while staying flexible in our responses to new challenges and opportunities. Risks and uncertainties make it critical to increase our resiliency and build comprehensive adaptation strategies for water. State and local planning efforts need to focus on practical adaptive measures, supportive government actions, evaluation of disproportionately impacted areas, and prioritizing resilience using the Colorado Resiliency Framework.

Link for more information on the **Colorado Resiliency Framework**.

What is a water security roadmap?

Input from stakeholders on drought resilience will be required to evaluate how local water projects and plans align with both vulnerability mapping and locally informed asset maps. The goal of creating regional "water security roadmaps" aims to drive toward larger coalition building and planning, not just at the local or county scale, but at the basin or even cross-basin scale. This work can expand on CWCB's efforts to create Wildfire Ready Watershed tools by applying its general framework and approach to increasingly urban and rural settings to explore drought impacts – recognizing some issues may intersect with wildfire concerns that impact water storage and conveyance. This work can also leverage DOLA's two-year regional **Resilience Roadmap** effort and the resiliency prioritization criteria in the Colorado Resiliency Framework.

The specific details of the water security roadmaps will need to be developed as part of a larger CWCB Drought Resilience Toolkit. However, this concept recognizes that drought conditions (like water) do not stop at city or county lines. One goal of this work will be to draw links between the tools from comprehensive countywide planning and the more varied scales of water supply planning to identify synergies in water scarcity planning. This aims to support all counties and regions including those with limited planning resources so all of Colorado's 64 counties benefit.

Making deeper connections: For the first time, the Water Plan highlights EDI, education, climate resilience, and supportive government policies in a connected way. Resilient planning focuses on institutional, policy-driven planning efforts and offers a new way to view these linked topics. As with most topics in the Water Plan, CWCB as a policy agency can highlight a need, such as increasing equity discussion, but cannot resolve the issues on its own. Elevating these important topics together in the Water Plan sets an expectation for increasingly inclusive planning and project implementation not just for today but for the years ahead.

SUPPORT FOR ACTION

Addressing our challenges for Resilient Planning will require creative solutions that also adhere to the State's laws and regulations for water rights and water quality. In addition, the agency actions in the Water Plan help create support tools that partners across the state can use to advance their own actions. Specifically, agency actions 4.1 through 4.10 and contributing general actions build baseline support for future local partner action.

The state legislature and the CWCB support these efforts through the Colorado Water Plan Grant Program. The areas of partner actions generally align with the CWCB's Colorado Water Plan Grant Program that has legislatively-established funding areas for agriculture, conservation and land use, engagement and innovation, environment and recreation, and water storage and supply. In many cases, CWCB loans or other grant funding sources provided by federal and state agencies or other groups noted in Chapter 3 (also see Chapter 3 Framework for State of Colorado Support for Water Projects) are also available and can support work within and beyond the scope of Water Plan grants. In some cases, funds from different sources can be used to fulfill matching requirements.

Examples of these "partner actions" are highlighted below, followed by details on supporting agency actions.

PARTNER ACTIONS

While CWCB provides funding opportunities, identifies research needs, and collaborates with partners, it cannot achieve Colorado's vision for Resilient Planning alone. Below are several ways that Colorado water users and managers can see themselves and participate in the Colorado Water Plan. In many cases, grant funding is available to help explore additional work in the areas below.

Thoughtful Storage

Storage can play a key role in building resiliency and mitigating risk to life and property from natural hazards. Storage can help communities maintain or develop reliable water supplies in the face of shifting runoff patterns and longer or deeper droughts due to climate change. Storage is critical to lowering risk associated with floods, which may become more severe in the future.

- **Flood storage for extremes:** Climate change and urban growth may increase flood risk to property and lives. Flood control structures should be maintained, rehabilitated, or enhanced to provide flood protection according to regulations and standards.
- **Protecting storage from effects of wildfire, debris flow:** Critical storage facilities for water supply are often located in forested areas and need to be protected from sediment and debris flows that result from wildfire. Studies to identify forest areas with critical water supply infrastructure and that are vulnerable to wildfire will be needed to develop plans for protecting infrastructure. Projects that enhance connections between headwater streams and floodplains can improve stream and watershed health and reduce risks from wildfire, flooding, and drought.
- **Storage to build drought resiliency:** Storage, whether on the surface or in groundwater aquifers, provides a way to capture supplies during wet periods for use during dry times. Storage will have an increasingly important role in the future if wet periods occur less frequently (but more intensely) and dry periods last longer. Water releases from storage can benefit all sectors of water use.

Meeting Future Water Needs

In the context of resilient planning, meeting future water needs can mean several things. It means using One Water approaches to planning resilient water supplies while maintaining and enhancing overall water quality. It means taking action to prepare for and mitigate risk from natural hazards that can impact people and property but also impact critical water supply infrastructure.

- **Integrated planning:** Planning studies of water supply, demand, and needed infrastructure that consider a range of uncertain future conditions will help water providers develop supplies and facilities that are resilient and adaptable.
- **Green infrastructure:** Green infrastructure for managing stormwater, such as rain gardens, green roofs, and vegetated swales can slow runoff and improve its quality while creating green spaces in urban areas. Repairing and protecting functioning ecosystems can mitigate risk from natural hazards.
- **Multi-purpose projects for building resiliency:** Multi-purpose projects that benefit more than one sector promote flexibility in operations and responsiveness. Multi-purpose projects better address water supply challenges across municipal, agricultural, environmental, and recreation sectors as they occur. Operational

flexibility and the potential to meet multiple needs can build resiliency in the face of uncertain future challenges. Resiliency can also be enhanced by CWSAs, which provide financial benefits for agriculture and water supplies that build resiliency in other sectors.

Wise Water Use

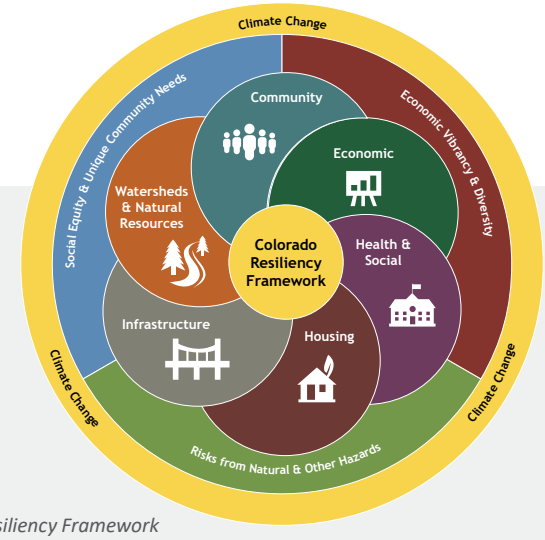
Every Coloradan needs to use water wisely. Education and outreach are needed to equip Coloradans to take action to conserve water. Education and outreach opportunities need to spur new thinking, connect people to solutions, and invite the next wave of innovation. In addition, Coloradans need to be educated in an inclusive way about opportunities to participate in strategies to conserve water and programs to assist with implementing conservation measures.

- **Accessible water conservation programs and incentives:** Water conservation and incentive programs are sometimes not used because residents do not know about them, cannot afford them, or are unable to effectively use them. These programs can have greater reach and impact if they are translated, and a focus is placed on residents who are not typically engaged in water issues. Water conservation should be seen as an adaptive measure toward greater drought resilience.
- **Water efficiency and drought plans:** Actionable water efficiency and drought plans should be developed by every municipality and/or water provider. Plans should include trackable metrics and strategies that are implementable and appropriate for the community.
- **Conservation-oriented outreach and education:** Education and outreach programs that focus on water conservation programs, outdoor water use, and incentives can foster greater adoption and save water. They can also raise the public's general awareness of their water footprint and the importance of water supply projects and funding efforts.

Healthy Lands

Climate change will create a multitude of interconnected issues that impact our working lands and how we plan for the future. Coloradans need adaptive planning processes to better prepare for, respond to, and recover from climate change impacts. Multi-pronged solutions should be explored that support not just water, but also clean energy goals, local food strategies, natural hazard planning, economic vitality, and funding that maximize the effectiveness of cross-sector resources.

- **Pre- and post-hazard planning for critical infrastructure:** Planning and implementing projects that protect critical water supply infrastructure from sedimentation and debris flow in the aftermath of wildfire is important for creating resilience in water supplies. Pre-hazard planning and implementation can help prevent impacts from wildfire, and post-hazard planning can help minimize the negative impacts from wildfire after it has occurred.
- **Support for natural and working lands:** Strategies that consider carbon-smart land management such as increasing soil organic matter, decreasing soil loss, enhancing forest health, and maintaining climate-appropriate urban greenspaces and can foster carbon sequestration and help contribute to Colorado's greenhouse gas reduction goals. Natural climate solutions can be supported and leveraged through a variety of State programs, including the Colorado Resiliency Framework, State Wildlife Action Plan, Drought Mitigation Plan, Forest Action Plan, and land use planning efforts led by the Department of Transportation.
- **Coordinating on forest health and understanding forest hydrology:** The health of Colorado's forests is important to runoff quantity and quality. Projects that restore forest health over large geographic areas will likely require coordinated efforts across federal, state, and local agencies and a variety of stakeholders. As Colorado looks to the future, additional research is needed to project how runoff quantity and quality from our forested watersheds may change in response to future disturbances and/or restoration.



Resiliency Framework
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The updated 2020 Colorado Resiliency Framework says the key to achieving resilient and sustainable communities is to consider the following six resiliency planning sectors as an integrated framework: community, economic, health and social, housing, infrastructure, and watersheds and naturals resources. The dial graphic displays the notion that all planning sectors are influenced by how a community values social equity and unique community needs, economic vibrancy and diversity, and hazard risks. Surrounding those planning sectors are three external rings that identify shared challenges that permeate all of the sectors. Enveloping the planning sectors and cross-cutting themes is climate change. Coloradans face increasing vulnerabilities due to climate change, such as more frequent and intense natural disasters, increasing aridification (long-term water supply decrease), and the many social challenges and inequities that arise when dealing with increasing complexity across these systems.

Partner Actions Rely on Effective Engagement and Education at Different Levels

Raising awareness and helping all Coloradans recognize our water scarcity issues will be important to addressing our challenges. Education is the key to bridging perceived divides across the western and eastern slopes, rural and urban populations, and diverse people. Public education around water must be increased, and outreach efforts should be increasingly inclusive. The State should work with local governments to support common messaging that increases awareness of water challenges and helps all Coloradans understand the critical importance of funding, collaboration, and multi-purpose projects.

- **Government:** Drought and water supply resilience can be promoted through embedded local/county/regional water resilience coordinators. Improved messaging and coordination across state, local, and county government agencies can help maximize state resources. Pilot initiatives, contests, or other strategies can create opportunities for safely testing new methods, technologies, or approaches to addressing water challenges. Community certification or recognition programs, training and project development, technical support, funding, and project implementation can all be considered and supported across state agencies.
- **Quasi-governmental entities, nongovernmental organizations:** While NGOs and government groups can often support innovation, creative opportunities to innovate and engage new partners is needed. Often, NGOs or non-profits can help support expanding connections. This can include working with the business community to identify adaptive technologies, identifying insights on adaptive practices by engaging Indigenous partners and cultures, or working with students on innovation challenges. Innovation incubators can be developed to foster innovation around critical Colorado natural resource issues (water, wildfire, forest health) through education, technology accelerators, etc. Water providers, NGOs, and others can implement coordinated water projects, help disseminate grant application information and apply for grants, and seek opportunities to align with other local initiatives to leverage funding and advance the dialogue around water (e.g., connection to local foods, equity, natural hazards, energy). Skill-building programs, such as leadership development or capacity building, can be supported by CWCB grants.
- **Residents:** Water career paths for all levels of income and people can be advanced through STEM (i.e., science, technology, engineering, and mathematics) and other educational opportunities, such as project-based learning and service opportunities for water-related issues. Education programs on risks associated with natural hazards and solutions for mitigating risks can be developed with a focus on people in disproportionately impacted communities.

INTEGRATION ACROSS **ACTION AREAS**

The partner actions noted above and the agency actions that follow often relate to one or more of the other action areas of the Water Plan. All areas of the Water Plan are interconnected, and projects need to consider multi-purpose, multi-benefit solutions. Here are some of the ways Resilient Planning connects to the other action areas:

VIBRANT COMMUNITIES

Water rates can be developed that support low-income communities. Water planning can include focused outreach to disproportionately impacted communities to build greater ability to meet water challenges. Ways to build more inclusivity can be explored to advance equitable community resilience and input. Access to adaptive opportunities and shared resources can be increased. Tap fees and development incentives can be encouraged that promote water savings and smart growth.

ROBUST AGRICULTURE

Rural communities and farmers can be specifically engaged in planning discussions or education programs alongside municipal water providers or residents to help bridge the urban/rural divide. On-farm efficiency improvements that provide resilience in a changing climate can help maintain agricultural profitability and support keeping local food in production. CWSAs with agriculture can provide water supplies for a variety of uses and increase economic resiliency for agricultural producers.

THRIVING WATERSHEDS

Maintaining a balance between recreation activities and watershed health is important. Outdoor recreation opportunities (especially related to water) can be supported and promoted in communities that have historically not participated in these activities. Timed entry to parks can be established to help preserve the natural environment, including protecting riparian areas and waterways from overuse, streambank erosion, etc.

Agency Actions

The CWCB and partnering agencies will take the following actions to support and advance Colorado's vision for Resilient Planning. Each action identifies a lead agency, and in most cases, one or more collaborating agencies. The lead agency is directly responsible for completing an action. Collaborating agencies will partner to successfully complete the action by providing guidance or actively staying informed. Both lead and collaborating agencies envision using existing staff and available resources. Collaborating agencies may provide more leadership or support if additional resources become available. In addition, other agencies may be consulted as needed or if resources become available.

4.1 Create a capacity-building hub to provide accessible educational opportunities

Lead Agency: CWCB

Collaborating Agencies: CDA; DOLA

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

An interactive online education resource can help reduce access barriers to water education for Coloradans. Creating a central place for CWCB's educational resources on key water issues can facilitate learning and enhanced implementation. Collaborating with other organizations and agencies with expertise and on-the-ground knowledge will help engage more Coloradans in understanding water issues and solutions.

The CWCB will develop an online educational hub that can serve as a resource for training on critical water issues for stakeholders or individuals who would like to take actions that implement the vision of the Water Plan. Starting with key sector-specific areas where a need for more education has been identified (e.g., collaborative water sharing agreements, river health methodologies, resilience planning, and water conservation), the hub will reinforce topics that are foundational to the Water Plan.

The hub will provide training modules and resources that can be expanded over time. Identifying how training can be developed to bolster existing and new certifications will be evaluated, as will opportunities to create accessible, affordable, and bilingual resources. These resources can act as an important robust pipeline for those from traditional and non-traditional educational backgrounds with knowledge of critical water issues to enter the industry.

TOOLS used for this action

- Data collection and sharing
- Public outreach and education
- Funding
- Equity

> "CONNECT PEOPLE TO RESOURCES. CREATE KNOWLEDGE SHARING, BEST PRACTICES TO ENCOURAGE CONVERSATIONS. WE CAN FACILITATE A SPACE TO PLANT SEEDS IN PEOPLE'S MINDS AND ENHANCE CONVERSATIONS. — GREG FELT, *CWCB*

4.2 Support the long-term stability and impact of Basin Roundtables

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

The basin roundtables serve a critical function in Colorado's water planning by convening recurring stakeholder meetings at which local water issues are examined and approving grant requests for local projects. The roundtables' grant-making ability through the WSRF relies on severance tax funds, which have declined significantly in recent years. As basin roundtables attempt to advance local projects, funding certainty, clarity on the best opportunities and processes for advancing projects, and additional basin outreach around projects and basin needs are all important to support.

The CWCB will seek to sustain the annual roundtable funding of at least the $300,000 per basin, the additional $25,000 for a roundtable PEPO coordinator, and will manage or identify ways to leverage any special funding that is made available. The CWCB will also work with PEPO representatives, basin roundtables, and IBCC members to identify the best ways to help advance local projects.

To help provide clarity on basin roundtable operations and strategies for advancing local projects, CWCB will work with the basin roundtables to develop a grassroots, universal handbook that addresses common basin wide questions around funding processes and other questions basin roundtables have had. This handbook will provide consistent information on key processes and funding that can be used to onboard new basin roundtable members. The CWCB will support diverse engagement as well as continue to support and leverage other shared roundtable resources, such as educational resources, audio equipment, and PEPO support.

Making the handbook and the education tools accessible, including language translation where possible, will help engage more community members and work toward greater inclusion. This in turn supports the roundtables as laid out in the founding legislation – to facilitate continued discussion within and between basins on water management issues, and encourage locally-driven collaborative solutions to water supply challenges. Supporting the basin roundtables in reflecting the diverse cultures and backgrounds of their local communities in their membership and engagement is increasingly important to ensuring long-term impact of roundtables and bringing forth strong collaboration and solutions to water issues.

TOOLS used for this action

- Public outreach and education
- Funding
- Collaboration groups
- Policy and regulatory changes
- Equity

WATER FOR THE 21ST CENTURY ACT

Established in 2005 through HB 05-1177 (the "Water for the 21st Century Act"), the nine Colorado basin roundtables represent each of the state's eight major river basins and the Denver metropolitan area. The basin roundtables serve an essential role by providing letters of support for Water Plan grants and directly funding local projects through the WSRF grant program. They also identify local water planning needs and advance education and outreach efforts through their respective BIPs that inform the Water Plan.

4.3 Create a collaborative Colorado Water Plan education and outreach campaign

Lead Agency: CWCB

Collaborating Agencies: CDPHE; CPW; DOLA

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

Many public outreach and messaging efforts have been launched since the 2015 Water Plan to raise awareness about the importance of water to Colorado. Building on the momentum and efforts of past messaging campaigns, a state-led and Water Plan-branded water education messaging effort will be critical in building awareness around the key water issues Coloradans are facing.

As part of the Water Plan update, CWCB will develop and brand a statewide education and outreach campaign to help reinforce the critical issues and opportunities that the Colorado Water Plan brings to light. This work will include looking at recent state surveys across agencies to help identify knowledge gaps and messaging opportunities that will help reinforce and build on local water knowledge. An interagency tool box of materials will be developed, along with a public outreach campaign that can help organizations, stakeholders, and other partners enhance public awareness. These partnerships and collaboration will help unite CWCB and the nine basin roundtables in sharing consistent, clear, bilingual, and accessible messaging to educate the public on Colorado's most critical water issues.

TOOLS used for this action

- Public outreach and education
- Collaboration groups
- Equity

Rio Grande Basin Tour. Photo credit: Rio Grande Basin Roundtable

4.4 Support an interagency environmental justice mapping working group

Lead Agency: CDPHE

Collaborating Agencies: CWCB; DOLA

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

As many state agencies undertake work focused on EJ and EDI, it is important that these efforts are not carried out siloed and separate in different agencies' work plans. The strength of these tools and resources depends on interagency learning and collaboration.

The CWCB will work with other agencies, such as CDPHE, in assembling an interagency EJ and equity working group focused on identifying tools to support disproportionately impacted (DI) communities. One example of this type of mapping tool is CDPHE's **Colorado EnviroScreen** tool, which is an interactive environmental justice mapping tool that identifies communities with the greatest environmental health risks statewide. The Colorado EnviroScreen and other interactive mapping tools can be used in drought and watershed planning as well as in grant funding to evaluate and prioritize the greatest needs in especially vulnerable communities, and where funding can make the greatest impact. Leveraging this interagency work and CDPHE-led Environmental Justice Action Task Force, CWCB will build on the Water Equity Task Force's work in engaging broader and new communities, including communities of color and low-income communities in water discussions and planning.

TOOLS used for this action

- Public outreach and education
- Data collection and sharing
- Collaboration groups
- Land use and water planning integration
- Equity

WATER EQUITY TASK FORCE

In March of 2021, CWCB, DNR, and the Governor created a Water Equity Task Force with a single mission: to help CWCB identify guiding principles around EDI that could inform the Water Plan update. The year-long, 21-member Task Force consisted of nine members from each of the nine basin roundtables, nine members from the community in each of those basins, one member from each of Colorado's two federally recognized Native American Tribes—the SUIT and UMUT—and a member representing the Acequia community.

The Water Equity Task Force concluded its work and met its mission in creating the following guiding principles:

1. Promote diversity in career pathways in water-related fields through education and engagement.
2. Promote collaboration, new voices, and greater community engagement in water discussions.
3. Recognize and address elements of the rural-urban divide but focus on creating the rural-urban opportunity.
4. Expand grant opportunities to new audiences.
5. Support basin roundtables in facilitating broad community engagement and collaborative solutions.

Though the Task Force concluded after four meetings and one public workshop, the critical work it has charted will continue. One connected effort is being led by CDPHE in advancing several EJ initiatives in which CWCB is involved.

The Environmental Justice Act (HB 21-1266) was signed into law in July 2021, creating the following entities administered by the CDPHE: the Environmental Justice Action Task Force, Environmental Justice Advisory Board, and Environmental Justice Ombudsperson. The Environmental Justice Action Task Force included 22 members across Colorado and submitted comprehensive recommendations about environmental justice to the Legislature, Governor, and CDPHE in November 2022. A Statewide Equity Office was also created by the legislature in 2022 after the passage of HB 22-1397.

4.5 Convene workshops on water and climate vulnerability, adaptation, and resilience

Lead Agency: CWCB

Collaborating Agencies:
CDPHE; CDA; DOLA

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

Climate change will have major impacts on both water quality and water availability in Colorado and it is imperative to identify not only the vulnerabilities to climate change but how those impacts may be disproportionately impacting different communities and people. While multiple agencies work on water quality and water quantity issues at the State, the average Coloradan is not aware of agency delineations between water quality and water quantity issues.

The CWCB will host at least two workshops across the state working with groups such as Western Water Assessment to develop a table-top exercise that can help the State better understand how climate impacts stress water and communities. This effort will help uncover how those impacts are being experienced and where there are disproportionate impacts in communities.

As part of this work, CWCB will consult with other State agencies to identify any additional support or participation that agency partners could provide at these workshops. The resulting feedback will help inform State agency support tools, grant making, and can support an update to the **Colorado Climate Change Vulnerability Study**. Additionally, this work can help State agencies understand the specific issues the public may feel are best supported by interagency partnerships to provide water quality and water quantity expertise at targeted outreach events.

TOOLS used for this action

- Public outreach and education
- Collaboration groups
- Equity
- Climate adaptation
- Innovation

4.6 Develop an interagency framework for increasing grant funding access and opportunities

Lead Agency: CWCB

Collaborating Agencies:
CDPHE; CDA; DOLA

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

Grant making is one of the most effective ways a non-regulatory agency like CWCB can encourage EDI considerations in water projects and programs across the state. Increasing accessibility and reducing barriers to applying to CWCB's grant programs is an ongoing effort important to advancing the mission of CWCB and Colorado Water Plan. The CWCB is continuing to evaluate how capacity can be developed, which was recently supported by the legislature in HB 22-1379.

The CWCB will convene discussions with groups like the Environmental Justice Advisory Board, Outdoor Equity Council, and GOCO to share educational opportunities, identify mechanisms to leverage grant funding across agencies (e.g., allow funding from one agency to serve as match funding for grant requests to another agency), and explore ways to increase accessibility of applications and review processes, all with the goal of using this information to develop a set of best practices for grant-making efforts.

Initially this effort will be focused through an EDI lens; however, the best practices and tools will be scalable to speak to larger state grant-making efforts. This effort will build on the **local community funding guide** published by DOLA and will explore where joint meetings or interagency meetings might produce cross-training that leads to greater collaboration.

Ultimately, this would result in a best practices report that highlights interagency opportunities. The pilot group for this work would involve state agencies or political subdivisions (e.g., GOCO) who have made efforts to integrate EDI principles into their grant-making.

TOOLS used for this action

- Public outreach and education
- Funding
- Collaboration groups
- Data collection and sharing
- Equity

4.7 Update scenarios

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

The 2015 Colorado Water Plan set an adaptive management framework for future planning activities by describing five potential futures, or scenarios. Each scenario estimated different potential water demand and supply conditions based on drivers such as climate change, population projections, social values, agriculture, and municipal needs. Scenario planning provides flexibility in responding to various future conditions rather than trying to predict the future by looking at the past. Often the differences between scenarios help highlight areas where adaptive measures can help avoid future impacts.

The CWCB will revisit and revise the scenarios in the Water Plan based on targeted stakeholder input, best-available science, and trends in drivers that affect water supplies and demands. This effort will consider adjustments to assumptions in specific scenarios to test future impacts and ensure that information is updated in time for the next Technical Update and, ultimately, future Water Plans.

TOOLS used for this action

- Public outreach and education
- Collaboration groups
- Data collection and sharing
- Climate adaptation

4.8 Update climate adaptation-related decision support tools

Lead Agency: CWCB

Collaborating Agencies: DOLA; CDPHE; DHESM

Related Action Area: N/A

Over the last decade, CWCB and other state agencies have developed a suite of climate-related decision support tools, including the **Climate Change in Colorado Report**, the **Colorado Climate Change Vulnerability Study**, and the **Future Avoided Cost Explorer (FACE hazards)**. These tools provide information on historic and future climate conditions, impacts, and vulnerability, and offer ideas for adaptation. The findings and underlying data often inform CWCB water supply planning and other statewide planning documents, including the **Colorado Resiliency Framework** and the **Colorado Climate Plan**. Given recent extreme events, climate model updates, climate and economic volatility, and a better understanding of the inequities of climate change, much of the information in these tools is now out of date.

The CWCB will support the update of the Climate Change in Colorado Report and explore the potential for updating the Colorado Climate Change Vulnerabilities Study, FACE hazard, and other related tools in the coming years. The CWCB will update these tools in collaboration with other agencies and partners and consider any related public feedback such as exploring opportunities to incorporate data from CDPHE's Colorado EnviroScreen and Climate Equity Data Viewer EJ mapping tools. Additionally, CWCB will explore how to improve the accessibility, usability, and uptake of these tools so they speak to a broader audience of Coloradans.

TOOLS used for this action

- Data collection and sharing
- Policy and regulatory changes
- Public outreach and education
- Climate adaptation
- Equity

4.9 Create innovation challenges and explore an innovation accelerator

Lead Agency: CWCB

Collaborating Agencies: CDA; OEDIT

Related Action Area:
- Vibrant Communities
- Robust Agriculture
- Thriving Watersheds

To spur innovation and technological advances across the state, CWCB will collaborate with key partners to convene a series of contests or "innovation challenges" for each of the four action areas of the Water Plan: Thriving Watersheds, Robust Agriculture, Vibrant Communities, and Resilient Planning. The goals of these challenges will be to mobilize local partners, inspire and elevate innovative approaches, encourage use of CWCB's and other grant programs, and foster implementation of Water Plan actions.

The CWCB will strategically build coalitions for each innovation challenge to identify partners, designate appropriate funding, leverage grant funding, or otherwise support and develop the contest scope. This work may include identifying public-private partnerships that can help bring increased attention, funding, and community engagement to these competitions. Conceptual examples of this work could include developing a "river health challenge" for municipalities with urban waterways in each of Colorado's eight major river basins, a water efficiency innovation challenge in the agricultural sector, a water conservation challenge for cities and towns, or a contest to showcase practical adaptation measures to reduce impacts from climate stressors. The CWCB would help facilitate conversations around these programmatic ideas and either directly manage, co-manage or participate on an executive planning committee to lead the agreed-upon challenges.

Additionally, to support larger innovation efforts and partner with the business community, CWCB will work with the collaborating organizations, business leaders, and NGOs to explore opportunities for the development of a Colorado Innovation Accelerator. This effort would investigate ways that CWCB and other agencies could support emerging ideas and technologies by convening stakeholders, creating or opening market pathways to test new technologies, making resources available to innovators, sharing funding opportunities, and fostering partnerships that could spur water innovation in Colorado.

TOOLS used for this action

- Data collection and sharing
- Collaboration groups
- Equity
- Policy and regulatory changes
- Innovation

4.10 Create a drought resiliency toolkit that can be used to support local planning for water security

Lead Agency: CWCB

Collaborating Agencies: DOLA; CDPHE; DHESM

Related Action Area:
- Vibrant Communities
- Robust Agriculture

Colorado's warming climate is expected to bring increased aridity and challenges around water security. As these trends persist, there will still be drought years with more extreme impacts that present both new challenges and new opportunities. The CWCB leads ongoing work to update Colorado's drought mitigation and response planning as part of the State's **Enhanced State Hazard Mitigation Plan**. The CWCB also provides technical and funding support for local drought plans as well as supporting ongoing information sharing through the **Water Availability Task Force** - a workgroup whose standing meetings provide updates on current conditions. However, drought support resources will increasingly need to be centralized, accessible, and supportive. The CWCB will develop a drought resilience toolkit with several core components that can inform and ultimately support the creation of county-level "Water Security Roadmaps" as described in the Colorado Vision for Resilient Planning. The drought resilience toolkit will be refined through an initial stakeholder process, but the main components include:

- A statewide susceptibility analysis to inform a drought-ready communities framework that communities can use to evaluate drought risk to life, safety, property, infrastructure, and water supplies at a county scale. This may include targeted data collection, data development, mapping, and reporting that will leverage ongoing statewide efforts, including CWCB watershed mapping for wildfires—recognizing the interconnects between fire and drought.
- A drought-ready communities framework that can guide local community discussions on how to use the drought toolkit to help communities prioritize drought planning and risk-mitigating projects. It will outline best practices for drought planning and recovery.
- A set of Colorado case studies that describe how farms and cities are taking steps to adapt to drought. The case studies will illuminate successful paths forward and provide examples of projects that can scale/expand to provide increased drought resilience to Colorado.
- A review and centralization of the most accessed web resources for drought monitoring, mapping, financial support information, and increase general accessibility and functionality of planning resources.

The drought resilience toolkit will be a central resource that can be scaled to create county-level water security roadmaps. These roadmaps can support local leaders in advancing county-level integration of water and land use planning. This would also establish a process for helping county officials identify the most significant regional drought challenges and project opportunities. The intent of this work will be to address rural and urban water security, including considerations for disproportionately impacted communities.

TOOLS used for this action

- Public outreach and education
- Climate adaptation
- Natural hazard planning
- Land use and water planning integration
- Equity

HAZARD READY COLORADO: DROUGHT, FIRE, AND FLOOD

Drought Ready Communities builds, in part, from the framework set by CWCB's Wildfire Ready Watersheds initiative and will leverage but also expand those mapping efforts to focus on drought. In both cases, process elements that support local planning will be developed to provide Colorado-specific resources. Combined with other CWCB tools, this work can collectively support holistic planning around drought, wildfires and floods.

> "WE NEED TO PREPARE FOR THE NEW NORMAL IN RURAL AND URBAN COMMUNITIES.
>
> — JACKIE BROWN, *CWCB*

GENERAL WATER PLAN ACTIONS

While the Colorado Water Plan is organized around four action areas, it includes 10 additional agency actions that are more general in nature and do not focus on a particular action area even as they support them all. Each action identifies a lead agency, and in some cases, one or more collaborating agencies. For this section, CWCB is the lead agency – the agency directly responsible for completing an action. Collaborating agencies are also sometimes noted that will help successfully complete the action by providing guidance or actively staying informed. Both lead and collaborating agencies envision using existing staff and available resources. Collaborating agencies may provide more leadership or support if additional resources become available. In addition, other agencies may be consulted as needed or if resources become available. The additional 10 general Water Plan actions are described below.

5.1 Update the Analysis and Technical Update to the Colorado Water Plan

Lead Agency: CWCB ***Collaborating Agencies:*** N/A ***Related Action Area:*** N/A

The first step in updating the Colorado Water Plan begins with evaluating baseline data to determine existing and then future water demands. As part of this analysis, key drivers and trends will be analyzed to evaluate major changes over time, as well as existing and new tools. As part of this effort, technical advisory groups will be assembled to help review the methodologies and assumptions in the modeling.

TOOLS used for this action

Data collection and sharing

5.2 Update the Basin Implementation Plans

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area: N/A

Data from the next Technical Update (a statewide water supply planning initiative) will be used to evaluate basin trends and will inform the next update to the BIPs. The standardization of BIP strategies and the creation of an ongoing and separately maintained Project Database will help streamline the BIP update process and reduce the basin roundtables' level of effort. BIP updates will use the Technical Update data to adjust basin challenges, updated goals and objectives and their strategic vision for the future.

TOOLS used for this action

- Public outreach and education
- Collaboration groups
- Data collection and sharing

5.3 Update the Colorado Water Plan by 2033

Lead Agency: CWCB

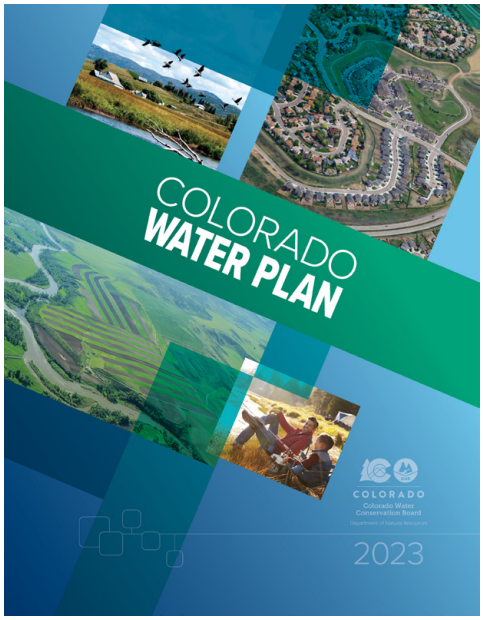
Collaborating Agencies: N/A

Related Action Area: N/A

The update process allows the Colorado Water Plan to stay responsive to changing conditions, evaluate changing conditions, and create buy-in on the pathways that lead to greater water resilience. Using the data outputs from the Technical Update, elements of the BIP updates, and other stakeholder input, a comprehensive update to the Colorado Water Plan will be completed. As was done before, ongoing stakeholder engagement and a public comment period will help inform the Water Plan update.

TOOLS used for this action

- Public outreach and education
- Policy and regulatory changes



5.4 Support Colorado's Commissioner in the negotiations for the post-2026 reservoir operations

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area: N/A

The Colorado River Basin has faced challenging hydrology and prolonged drought over the last 20 or more years. The 2007 Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead (Interim Guidelines) outlined agreements for coordinated reservoir operations, including storage levels at which shortages would trigger action. The signing of Drought Contingency Plans in 2019 built on to the Interim Guidelines and created additional triggers, actions, and the ability for the Upper Basin to contemplate a Demand Management (DM) program that would accommodate storing up to 500,000 acre-feet in the Upper Basin through 2026 that can be released to assist in maintaining compliance with the Colorado River Compact. These plans were interim in nature so that the states comprising the Upper Colorado River Basin would have an opportunity to learn from operations and consider the most appropriate next steps based on lessons learned and hydrology. The Interim Guidelines expire in 2026. Colorado's governor-appointed Upper Colorado River Commissioner will represent Colorado's water users in the negotiation for new operating guidelines.

Colorado's commissioner will provide updates and seek input from stakeholders, water users, Tribal representatives, the NGO community, and others on the status of negotiations.

TOOLS used for this action

- Policy and regulatory changes
- Collaboration groups
- Natural hazard planning

5.5 Support ongoing efforts related to the Demand Management Feasibility Investigation

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area: N/A

The CWCB Board is evaluating whether a demand management (DM) program is feasible and advisable for Colorado. Even if Colorado made a supportive feasibility finding for a DM program, the other Colorado River Upper Basin states would also need to make a feasibility finding before a program could be established. DM is just one tool in the toolkit. The Upper Basin Demand Management Storage Agreement expires in 2026.

Colorado is evaluating other options that may protect Colorado water users and increase Colorado's resiliency that do not depend on other states. In any case, ongoing investments in efficiency, water conservation, and tools that create greater flexibility and resilience are critical to Colorado's water future. CWCB will work to explore options that could feed into a "drought resiliency toolkit" as described in the agency actions for Resilient Planning. This may dovetail with other actions in the Water Plan to increase adaptation to a new aridity and resilience in the deepest drought years.

TOOLS used for this action

- Policy and regulatory changes
- Collaboration groups
- Natural hazard planning
- Water efficiency and conservation programs
- Climate adaptation

5.6 Meet Colorado's existing water shortages through collaborative multipurpose projects

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area: N/A

Colorado's ability to develop the little water that is available must be matched by a willingness to identify thoughtful solutions that address the needs of cities, farms, streams, and people. Thoughtful solutions should consider strategies for developing partnerships and meeting a variety of headwaters community, local, and regional needs simultaneously, especially when water supply projects serve communities outside of where water supplies originate. Increasingly, those solutions need to not just bring stakeholders to the table but ensure their concerns are fairly evaluated and funded in ways that strive to support agriculture, municipal, and environmental sectors while embracing the spirit of the Colorado Water Plan. The sum of the economy is not made up by one sector; it is the collective value that agriculture, watersheds, and city centers bring that feeds and finances Colorado. There will continue to be single-purpose projects that need to be funded, and many of those efforts will seek private investment, loans, and grant funding; however, grant funding will become increasingly competitive, especially in lean times where multiple needs must be met with fewer dollars. The projects that best support all areas of the state will inevitably receive funding if their projects meet multiple purposes and provide multiple benefits to Colorado.

TOOLS used for this action

- Policy and regulatory changes
- Public outreach and education
- Collaborative water sharing agreements
- Collaboration groups
- Climate adaptation

5.7 Strategically fund the Colorado Water Plan and find opportunities to leverage funding

Lead Agency: CWCB

Collaborating Agencies: CDA; CDPHE; DOLA; CSFS

Related Action Area: N/A

The basin roundtables worked to create a list of local project needs during the 2014 and 2022 BIP development and update processes. In both cases, the total costs identified were significant—most recently in excess of $20 billion. The portion of those projects that would likely be seeking CWCB funding is about 25 percent of that once private investment, match, and outlying projects that may be funded outside of grants are removed. At the same time, the costs of projects identified during the BIP update process do not fully account for all water or water adjacent needs. The full spectrum of water funding needs from partner agencies like CDPHE, CDA, Water and Power Authority, and DNR's Division of Forestry should be evaluated to see where funding can be leveraged and co-supported through Water Plan funding and CWCB.

As part of this work, CWCB will increasingly look for options to strategically fund the most critical and beneficial projects that help stretch the impact of those funds (projects that are referenced as a part of a previously vetted public planning effort and those efforts that seek to leverage funding that support cross-agency goals). For example, to invest in watershed restoration at the scale necessary to protect watersheds, Colorado must develop and support innovative funding strategies. The Colorado State Forest Service should partner with CWCB and the Division of Fire Prevention and Control (DFPC) to develop innovative funding mechanisms to address this funding gap.

TOOLS used for this action

- Funding
- Policy and regulatory changes

5.8 Identify collaborative survey efforts

Lead Agency: CWCB

Collaborating Agencies: DOLA; CRO; CDPHE; CDA

Related Action Area: N/A

The CWCB, CDPHE, CDA, DOLA, and Colorado Resiliency Office (CRO) perform intermittent survey work to help gauge public understanding and help guide education/outreach needs around water issues. The CWCB's most recent survey was done in 2013 (a summary of findings was noted in the Technical Update). In fall of 2021, CWCB released a new survey that will help gauge change in perceptions over time. Analysis of the questions in the 2021 CWCB survey that pertain to water quality could be helpful to CDPHE. CDPHE is undergoing a similar survey process, which may include opportunities to compare findings and evaluate future processes. Similarly, CDA conducts agricultural attitudes surveys every 5 years that ask questions on water issues, DOLA conducts land use surveys every 5 years that incorporate land use/water planning integration questions, and CRO does a survey of local governments every 2 years. Ideally, information from these agency surveys could support each other and be staggered to eliminate survey redundancy and frequency.

Link for a **summary of findings from the Technical Update**

TOOLS used for this action

- Public outreach and education
- Data collection and sharing
- Collaboration groups
- Innovation

PUBLIC OPINIONS, ATTITUDES, AND AWARENESS ABOUT WATER IN COLORADO: 2021 SURVEY AND FOCUS GROUPS

The CWCB conducted a statewide survey of public opinions, attitudes, and awareness about water in Colorado. The survey and study were, in part, an update to similar research conducted from 2012 to 2013. The survey results were presented on a statewide basis, and were also broken down across six regions to identify local trends. Over 2,100 surveys were gathered. Several takeaways from the survey are described below:

- Only 31% of respondents correctly identified that farms and ranches use the most water
- The top five concerns of respondents were:
  1. Quality of water in your home
  2. Amount of water for Colorado's cities and towns
  3. Amount of water available for Colorado's farms and ranches
  4. Water quality in our rivers, lakes and streams
  5. The condition of underground water pipes, dams and other water utility infrastructure
- 68% of respondents disagreed that Colorado has enough water for the next 40 years
- 90% of respondents agreed that we can manage Colorado's water use by careful development of homes, businesses, and infrastructure
- 89% of respondents agreed that we need to take action in advance to reduce water use and/or increase water supply to continue to grow Colorado's economy in the future

Click here to access the survey report.

5.9 Identify opportunities for integrated water quantity and water quality efforts to better mitigate future risk

Lead Agency: CWCB

Collaborating Agencies: CDPHE

Related Action Area: N/A

The CWCB will evaluate interagency research needs and potential gaps in fully understanding how climate change will impact water quantity (water shortages) and water quality. The goal will be to develop best practices for shared adaptive strategies that could help mitigate effects from warming and challenged hydrologies through the lens of co-benefits to water quality and quantity.

Findings will be integrated into a set of best practices as identified through the work and promoted across agencies. This could potentially lead to collaborative working groups and/or research work where CWCB partners with CDPHE and DOLA to fund and support various initiatives. A coordinated workshop between CWCB and CDPHE should be explored to help discuss these concepts.

This work should be expanded to coordinate with DOLA's resilience work and look to evaluate collaboration that supports the creation of resilient and sustainable community programs across Colorado's 64 counties. The goal is to help spur local water quality and quantity planning, project development, and overall integration with local planning efforts that all support enhanced community resilience.

TOOLS used for this action

- Watershed planning
- Policy and regulatory changes
- Collaboration groups
- Climate adaptation
- Conveyance infrastructure

5.10 Develop annual operational plans that identify targeted work for CWCB

Lead Agency: CWCB

Collaborating Agencies: N/A

Related Action Area: N/A

While the agency actions in the Colorado Water Plan focus on ways CWCB can strategically advance and support multiple initiatives, there will inevitably be multiple-year efforts that intertwine with the Water Plan and require CWCB attention and resources. Sequencing and focusing work priorities annually provides a key check-in that allows CWCB to be strategic, track progress, and also be responsive to changing needs. The CWCB should identify specific strategies that help address needed short-term work and other CWCB projects that are not identified in the Colorado Water Plan. Additionally, evaluating the progress of the Water Plan, grant programs, and other needs at annual CWCB board meetings will help ensure strategic sequencing of Water Plan implementation and determine where overlaps exist with project development and funding. For example, annual focus or targets could be considered at CWCB's annual Finance Committee meetings.

TOOLS used for this action

- Data collection and sharing

CHAPTER 7

MOVING FORWARD—TRACKING PROGRESS and UPDATING THE WATER PLAN

TRACKING PROGRESS

The Colorado Water Plan is a living document and is meant to be broad and flexible enough to adapt to changing conditions, major drivers, and significant events over time. The plan addresses today's water challenges, but it is also an adaptive framework that provides agility in the face of future uncertainty. Tracking progress and regularly updating the plan are important to understanding how our water landscape is changing and how the Water Plan needs to adapt.

TRACKING WATER PLAN ACTIONS

The Water Plan includes 50 agency actions that CWCB and supporting agencies will advance and that CWCB will track. Sequencing of these actions will be flexible and evaluated annually. Advancement of partner actions will generally be tracked through grants, loans, and other CWCB funded projects, acknowledging that many more actions will stem from and/or support the Water Plan than are within CWCB's ability to track (e.g., private investment, federal funding, projects funded through other state agencies). Annual updates of the Project Database will give the CWCB an additional tool to track progress on projects completed without CWCB support.

TRACKING PROJECT FUNDING

Funding projects through grants and loans is an important function of CWCB. Grant and loan funding will be tracked and regularly reported to the CWCB Board. Summary information in CWCB board meeting packets and other required reports (e.g., Water Supply Reserve Fund annual report) include information such as total funded amounts and project information. The CWCB has modernized its grant and loan intake process through an on-line submission portal and database that will aid reporting.

TRENDS IN WATER RESOURCES DRIVERS

The CWCB will assess trends in drivers that will impact Colorado's water future during cyclical Technical Updates. During the updates, data and drivers that impact our future water supplies and demands will be assessed to understand how conditions are changing, where resources may need to focus, and how well the state is progressing toward honoring its values and meeting the Colorado vision for each action area (See Chapter 6). For some drivers, long-term trends cannot be properly assessed over short periods with certainty. For example, population, climate, per capita water savings, economic, and hydrologic trends require years of data to identify statistically significant trends.

The overall process to update the Water Plan occurs over several years. The CWCB has received and considered stakeholder feedback regarding the process moving forward, including when to initiate the process, ways to streamline the process, and the most important areas for future focus. The CWCB and stakeholders alike have expressed a desire to build in more time for implementation prior to starting the next update. As a result, in the foreseeable future, the Water Plan will be updated on a 10-year cycle, with the next update projected for completion in 2033.

The Water Plan Update Process

Colorado recognizes the evolutionary nature of water resources planning and implementation. The two are not mutually exclusive and occur simultaneously at several scales. Colorado's cyclical, statewide planning is made up of these three phases.

PHASE 1

Analysis and Technical Update
Foundational data sets that describe our current and future water supplies and needs

PHASE 2

Basin Plan Update
Local planning conducted by basin roundtables that provide grassroots input to the Water Plan

PHASE 3

Comprehensive Water Plan Update
Update to the visions and actions in the Water Plan itself

Several steps are needed to complete each update cycle of the Water Plan. A process for the next update is described below. With each update, CWCB will seek to improve and streamline the process, and a description of the lessons learned from the current process is provided with each of the general steps.

Strategic Implementation

Throughout the Water Plan update cycle, CWCB will focus on strategic implementation. Examples include:

- Prioritizing projects that have confirmed funds and deadlines.
- Working with the CWCB Board to explore operational plans.
- Coordinating with collaborating agencies and partners to leverage opportunities.
- Supporting legislative actions that arise and direct or inform CWCB.
- Securing funds to complete agency actions and continuing progress.
- Advancing partner actions through CWCB grants, loans and special funds.
- Sequencing interdependent agency actions that help advance future processes.

KEY LESSONS LEARNED

- Between updates, include time to focus on actions
- Allow time for trends, science, and technology to develop prior to new analysis
- Pause between updates to allow for other state processes to advance, some of which may have long-term implications (e.g., interstate negotiations)
- Focus on actions that, when completed, build a platform for next steps

Technical Update (2025–2029)

The last Technical Update used Technical Advisory Groups (TAGs) to help develop methodologies and assumptions used in basin analyses. The TAG process will be repeated in the next Technical Update. Stakeholders and water/natural resource experts who are familiar with Colorado's river basins, analysis methodologies, and modeling will be critical to evaluating and updating planning scenarios, assumptions, and processes used in the next Technical Update. Creating this space for key stakeholders to be involved in TAGs helps better inform the data and streamline the process for updating BIPs. Once completed, the next Technical Update will provide a platform for understanding how things may have changed over time and how that informs our response. To facilitate a streamlined process, a list of the key Technical Update findings will be identified and delivered to basin roundtables so they can evaluate if the findings substantially alter their goals and implementation strategies.

KEY LESSONS LEARNED

- Build time for focusing on action in between updates
- Complete scientific studies that forecast future conditions on important drivers like climate and population and extend planning horizons
- Spend more time on methodology and results discussions with basin experts
- Identify key data findings for basin roundtables to use in updating their goals and vision

Ongoing Project Tracking and BIP Update (2029–2031)

The Project Database is a high-level planning tool for the State to better understand potential basin projects and funding needs. While not all of these projects will be developed or need CWCB funding, the Project Database can be updated annually outside of the BIP update process. The BIP update can then primarily focus on basin goals and strategies, reducing the level of effort needed to update the plans. Future BIP updates can focus on challenges, goals, and strategic vision for the basin (a BIP strategy document). This simplifies the process for basin roundtables; reduces the time, intensity, and cost of the effort; and allows future BIP updates to be as short or shorter than the 2022 BIP Volume 1 documents. In addition, these components offer the most valuable input for informing the Water Plan update.

KEY LESSONS LEARNED

- Basin project updates should occur annually rather than during cyclical BIP updates
- Targeting BIP update elements that go into the Water Plan update is high value
- BIP content about context and history already exist and should not need much focus
- Focusing basins on how/if technical findings on water shortages alter their goals is key
- Focusing on key challenges and strategies for solving them should be the focus of BIP updates

Water Plan Update (2031–2033)

Updating the Water Plan includes scoping, writing, and reviewing the plan. Carving out time for broad stakeholder input is helpful to seeing how the Water Plan can support local planning and grant making. It can also help CWCB identify the areas in which it can support collaborative actions that work toward larger goals. The Water Plan update included a process to define actions using sideboards, or limiting criteria. Actions in the plan must be SMART (strategic, measurable, actionable, realistic, and time-bound) and something CWCB can complete within the update cycle. Actions should be consistent with Colorado laws and regulations and not create unnecessary legal conflict. Actions may also be included that involve other agencies, provided that partnerships can be built, and agencies are able to commit to those actions. The Water Plan also provides a vision for Colorado's water future and needed strategies. These are often beyond CWCB's direct ability to fully implement and need the participation of all Coloradans.

KEY LESSONS LEARNED

- Gathering public input along the way and at specific intervals helps ensure the Water Plan update is inclusive and relevant
- CWCB may not be able to act on all the suggestions it receives but can make statements of support if appropriate
- Agency actions are things CWCB can achieve in the update cycle
- CWCB needs to set the vision for future work even if it can't do the work alone
- The Water Plan is a bridge to action or framework that invites others to participate with examples that are shown in the partner actions, which are supported by the CWCB's Water Plan Grant Program, CWCB Loan Program, etc.

LOOKING FORWARD:
A BRIDGE TO ACTION

The Colorado Water Plan sets the **statewide vision for water management** and creates a **framework for action**.

For the State, the Water Plan serves as a call to action through shared leadership, and active partnerships that will be critical to advancing needed solutions.

Coloradans must come together across diverse groups and geographies to implement actions that will move us closer to a more resilient water future.

Education and outreach engages the public, partners, and leaders in integrated water planning to conserve and protect water for current and future generations.

For more information on CWCB, current initiatives, and ways to get involved, visit **cwcb.colorado.gov**

GLOSSARY

- **Aquifer storage and recovery (ASR)** is a water resources management technique for actively storing water underground during wet periods for recovery when needed, usually during dry periods by way of artificial recharge and well extraction.[1]
- **Basin Implementation Plans (BIP)** provide critical input to the Colorado Water Plan. BIPs were developed by basin roundtables and demonstrate how each basin roundtable plans to meet its future municipal, industrial, agricultural, recreational, and environmental needs. The BIPs identify projects and methods to meet future water needs and develop goals and measurable outcomes, needs, constraints, and opportunities in each basin. Data and information from the Technical Update are used by basin roundtables to update their BIPs.
- **Buy and dry** is the process of buying agricultural water rights and subsequently using the water rights for another purpose (typically for municipal or industrial use). The formerly irrigated agricultural lands are "dried up" and no longer irrigated by virtue of the water transfer.
- **Collaborative water sharing agreements (CWSA)** formerly known as alternative transfer methods (ATM), are innovative and flexible water use agreements between two or more users, typically involving agricultural, municipal, or environmental users. CWSAs are voluntary, temporary, and compensated agreements.
- The **Colorado River Health Assessment Framework (CoRHAF)** helps stakeholders approach stream health assessments from a common knowledge base, support local values, and provide a successful approach to completing the assessments. CoRHAF is described in more detail in Agency Action 3.1.
- Water **conservation** is the minimization of water loss or waste. The goal of water conservation is to use only the amount of water necessary to complete a task or meet a need. Water conservation can be achieved through policies, programs, and practices designed to encourage the use of less water.
- **Consumptive use** is 1.) Any use of water that permanently removes water from the natural stream system; and 2.) water that has been evaporated, transpired, incorporated into products, plant tissue, or animal tissue and is not available for immediate reuse.[2]
- **Demand** in a water use context is the amount of water needed to satisfy the needs of agricultural crops or the amount of water requested by municipal or industrial users.
- **Depletions** are the removal of water from surface or groundwater systems at a rate that exceeds that of recharge.
- **Direct potable reuse (DPR)** is defined by CDPHE as a series of processes that produce finished drinking water utilizing a source containing treated wastewater that has not passed through an environmental buffer (e.g., discharged to a natural stream, etc.).[3]
- A **Diversion** is the removal of water from its natural course or location by canal, pipe, well, or any other means.
- **Diversion demand** in the context of the Technical Update analyses is (1) the amount of water that needs to be diverted or pumped to meet the full crop irrigation water requirement for agriculture; or (2) the portion of distributed water attributable to uses typical of municipal systems, including residential, commercial, light industrial, non-agricultural-related irrigation, firefighting, and non-revenue water.
- **Ecosystem function** relates to the natural processes and interactions between plants, animals, and micro-organisms that occur in ecosystems that affect the conditions and sustainability of the environment.

[1] United States Geological Survey (USGS), **California Water Science Center, Aquifer Storage and Recovery**, 11/20/2018.

[2] Colorado State University Extension, **Glossary of Water Terminology**. Fact Sheet No. 4.717. Crop Series | Irrigation.

[3] Colorado Department of Public Health & Environment (CDPHE), **Direct Potable Reuse Policy**, 10/25/2022.

- Water **efficiency** refers to strategies or technologies that facilitate using less water to accomplish an activity. Low-flow toilets and showerheads are examples of technologies that increase water efficiency. Water efficiency improvements are typically accomplished via engineered products or solutions.
- **Emerging contaminants** are synthetic or naturally occurring chemicals or any microorganisms that are not commonly monitored in the environment but have the potential to enter the environment and cause known or suspected adverse ecological and/or human health effects.[4]
- **Environmental Impact Bonds** are a special type of revenue bond that shifts risk to private investors and can be an effective financing mechanism for maximizing the water supply benefits of water use efficiency and conservation incentives while minimizing the public risk of implementing this strategy to manage water supplies.[5]
- **Environmental justice (EJ)** is the right for all people to have the right to breathe clean air, drink clean water, participate freely in decisions that affect their environments, live free of dangerous levels of toxic pollution, experience equal protection provided by environmental policies, and share the benefits of a prosperous and vibrant pollution-free economy.
- An **equitable, diverse, and inclusive (EDI)** environment is one where all people whatever their gender, race, ethnicity, religion, national origin, age, sexual orientation, gender identity, citizenship status, education, disability, socio-economic status, or any other identity, feel valued and respected.
- **Floodplain alluvial aquifer storage** is where water is recharged into the alluvial aquifer via recharge ponds or wetlands to act as temporary storage that can offset groundwater depletions, attenuate runoff hydrographs, and help sustain wetland or riparian ecosystems.
- **Forest Health** is a measure of the processes and factors that lead to ecological sustainability and the degree to which forests meet human needs**.**
- A **form-based restoration** approach can be used to restore as much of the river's former footprint and functions as possible when there is not room to restore the footprint that a river could occupy or influence in a wide variety of flow conditions due to development and infrastructure. Form-based restoration projects seek to restore or enhance water quality and fish habitat and abundance, and they also increase the stability of banks and stream channel beds.
- **Framework**, in the context of the Water Plan, is used to describe either a real or a conceptual structure to serve as a support or guide for resolution to a problem or challenge.
- **Gaps**, in this document, are calculated as the difference between the amount of water available to meet agricultural or municipal and industrial diversion demands and the full diversion demand. In the context of the Water Plan, gaps are a measure of risk that water shortages may occur in the future if actions are not taken to mitigate the risk. While gaps were calculated for the agricultural, municipal, and industrial sectors, risks in other water sectors were estimated in different ways as described in the Technical Update and Water Plan.
- **Graywater** is household wastewater (e.g., from a sink, bath, laundry) that does not contain serious contaminants (as from toilets).
- **Green infrastructure** filters and absorbs stormwater where it falls. It includes the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters.[6]
- **Headwaters communities** include unincorporated areas in counties located in Colorado's mountainous or "high country" regions, which are often where water supply projects have been or may be constructed in the future.

[4] Paul E. Rosenfeld, Lydia G.H. Feng, 16 - Emerging Contaminants, Editor(s): Paul E. Rosenfeld, Lydia G.H. Feng, Risks of Hazardous Wastes, William Andrew Publishing, 2011, Pages 215-222.

[5] WaterNow Alliance & Western Resource Advocates. **Financing the Future: How to Pay for Turf Replacement in Colorado**, 24-26.

[6] U.S. Environmental Protection Agency. **What is Green Infrastructure?** 3/31/2022.

- The **incremental gap** (agricultural) quantifies the degree to which the agricultural gap could increase beyond what agriculture has historically experienced under water shortage conditions.
- **Instream flows (ISF)** are non-consumptive in-channel water rights. In 1973, the Colorado General Assembly authorized CWCB to appropriate and acquire water rights for ISFs for the purpose of preserving and improving the natural environment.
- **Integrated water management plan (IWMP)** framework focuses on water management practices, streamflow, and resulting affects to ecosystems and water uses. IWMPs are broader than stream management plans and consider a wider array of needs and larger groups of stakeholders, including water rights owners and riparian landowners.
- **Land conservation** is generally understood to refer to policies and practices that protect natural land and habitats or return developed land to its natural state. In some contexts, including in this document, the term is also used to refer to maintaining and protecting historical farm and pasture lands.
- **Natural and working lands** are made up of a variety of land use types from forests, wetlands, and grasslands to agricultural and developed lands. The lands can be managed strategically to sequester carbon and enhance ecosystem health as part of the nature-based solutions.
- **Natural hazard planning** is a set of actions and investments that aim to mitigate the impacts of natural hazards such as wildfire, drought, and flooding. Planning includes pre-hazard mitigation activities and hazard response coordination.
- **Natural lake level (NLL)** is a CWCB water right that protects volumes and elevations in naturally occurring lakes to preserve the natural environment.
- **Nature-based solutions** are actions to protect, sustainably manage, or restore natural or modified ecosystems as solutions to societal challenges, like mitigating water insecurity and climate change.[7] Examples of nature-based solutions include protection or conservation of natural areas, reforestation, restoration of wetlands or other habitats, or sustainable management of farms or forests. These actions can increase resilience to threats like flooding and wildfire and can slow climate change by capturing and storing carbon dioxide. Nature-based solutions can be considered in many of the tools suggested in the Water Plan including watershed management, natural hazard planning, and stream/watershed restoration. While there are many terms that are sometimes used interchangeably or in conjunction with Nature-Based Solutions (e.g., natural climate solutions, natural storage, distributed storage, low tech restoration/structures), the Water Plan does not further define or delineate these terms.
- **Non-functional turf**, also known as nonessential turf, is located in areas that receive little if any use (e.g., solely ornamental grass such as that used in medians, tree lawns).
- **One Water Ethic** is an integrated planning and implementation approach to managing finite water resources for long-term resilience and reliability, meeting both community and ecosystem needs. The One Water Ethic is described in more detail in Chapter 6.[8]
- **Process-based restoration** aims to restore dynamic watershed and stream characteristics that reflect those in minimally impacted systems. This type of restoration project can improve water quality, habitat, and steam resilience. Process-based restoration projects benefit streams and protect clean water supplies for municipalities and agriculture.[9]
- **Resiliency** is the ability of water systems to adapt and continue providing adequate levels of service in the face of changing circumstances and drivers.

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[7] Olander, Lydia, Laymon, Krystal, Tallis, Heather. November 2022. The White House Washington. **Opportunities to Accelerate Nature-based Solutions: A Roadmap for Climate, Progress, Thriving Nature, Equity, and Prosperity**. A Report to the National Climate Task Force.

[8] The Water Research Foundation, One Water Implementation: A Path to Reliability and Resiliency for Water Utilities, Webcast, 1/30/2017.

[9] Timothy J. Beechie, David A. Sear, Julian D. Olden, George R. Pess, John M. Buffington, Hamish Moir, Philip Roni, Michael M. Pollock, **Process-based Principles for Restoring River Ecosystems**, BioScience, Volume 60, Issue 3, March 2010, Pages 209–222.

- **Recreational in-channel diversion (RICD)** water rights are for recreational boating on natural streams. Only local governmental entities can apply for RICDs, which are required to have control structures like constructed whitewater park features. Flows associated with RICDs are limited to the minimum streamflow necessary for a reasonable recreational boating experience in and on the water.
- **Scenario planning** is a strategic planning process that acknowledges that the future is uncertain, identifies the drivers that affect water supplies and demands, and envisions alternative water futures that reflect the potential variability of drivers. Adaptive management plans can be developed to meet future needs identified in the scenarios.
- **Stream management plans** (SMPs) are data-driven assessments of river health that help communities prioritize how to protect or enhance environmental and recreational assets in their watershed.
- **Stream restoration** is the manipulation of the physical, chemical, and biological characteristics of a stream with the goal of returning natural/historic functions to a former or degraded aquatic resource.[10]
- **Technical Update** is a short-hand way to reference the Analysis and Technical Update to the Colorado Water Plan. The Technical Update is similar to Colorado's past Statewide Water Supply Initiative (SWSI) efforts but with important differences (see Section 3 of the Technical Update for a comparison to prior SWSI efforts).
- **Water Conservancy Districts and Water Conservation Districts** are located throughout Colorado. The purpose and difference between these organizations can sometimes be confused. Both organizations build and administer water projects, interface with federal agencies, and administer the repayment of project capital and operations and maintenance costs, as well as transit information and coordinate efforts among agencies, political subdivisions, and private citizens and businesses concerning the conservation protection and development of Colorado water. However, conservation districts tend to have a broader focus, and are established by the state legislature. Conservancy districts address more local needs and are established by public petition.[11]
- **Watershed health** is broadly defined as a measure of ecosystem structure and function. Structure refers to species richness (characterized by abundance and diversity), inorganic and organic resources, and physical attributes (including habitat complexity). Function refers to ecosystem processes such as the hydrologic cycle, nutrient cycling, energy flow, and succession. Functional, healthy watersheds are resilient (they are able to absorb and recover from disturbances), infiltrate snowmelt and rain, store and filter it in the soil, and yield clean water to streams and groundwater.[12]

[10] Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. **A Function-Based Framework for Stream Assessment and Restoration Projects**. US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC, EPA 843-K-12-006.

[11] Rio Grande Basin Roundtable, **Water Terms**.

[12] J.E. Williams, C. A. Wood, and M.P. Dombeck, Watershed Restoration: Principles and Practices (Bethesda, MD: American Fisheries Society, 1997), 2-3.