COLORADO
Colorado Water Conservation Board
Department of Natural Resources

1313 Sherman Street, Room 718
Denver, CO 80203

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Jared Polis, Governor
Dan Gibbs, DNR Executive Director
Lauren Ris, Acting CWCB Director

TO: Colorado River Drought Task Force

FROM: Colorado Water Conservation Board

DATE: July 25, 2023

SUBJECT: Transmittal of CWCB Demand Management Feasibility Investigation Body of Work

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BACKGROUND

On Thursday, July 20, 2023, the CWCB Board voted to convey to the task force the Demand Management work products. The Board's hope is that this body of work serves as a constructive, collaborative foundation for the task force's discussions. The attached memo provides an introduction and framework through which to consider these products.

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- Water Rights Administration and Accounting Workgroup

Summary of Inter-Basin Compact Committee Discussions Regarding Equity

- This document summarizes the IBCC's discussions of the concept of equity, defined here as "sense of fairness." Effectively, the IBCC was an additional, de facto Demand Management workgroup, tasked with considering the equity issue.

CWCB Demand Management Step II Work Plan

- After completing the 2019 Work Plan, the CWCB adopted the Step II Work Plan to analyze key outstanding questions and priority issues. The Step II Work Plan directed development of a Framework to consider potential implementation options, and framed the inquiry into feasibility as including questions relating to achievability, worthwhileness for Colorado, and advisability of any potential program.

Demand Management Framework

- The Framework document considers the key components and issues associated with a Demand Management program by utilizing an A-B-C structure for implementation at different levels of complexity. This was designed to be a tool to generate discussion about the feasibility of various components of a potential program.

Input Received on Demand Management Framework

- The CWCB conducted extensive stakeholder outreach, including workshops, public meetings, listening sessions, an online survey, and comment letters.

Demand Management Literature Review

- Consultants reviewed existing literature, similar conservation programs throughout the West, and other relevant documentation for the topics of:
    - Agricultural Impacts
    - Economics & Local Government
    - Education & Outreach
    - Environmental Considerations
    - Funding
    - Monitoring & Evaluation

Demand Management FAQs

- The *Frequently Asked Questions* document was prepared to assist the public in better understanding the potential Demand Management program.

CWCB Demand Management Decision Making Roadmap

- The CWCB Board adopted the decision-making roadmap to guide the Board's process for evaluating if, when, and whether any potential Demand Management program is advisable, feasible, and worthwhile for the state of Colorado.

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Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Lauren Ris, Acting CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Amy Ostdiek

DATE: July 20, 2023

SUBJECT: Agenda Item 16: Demand Management Feasibility Investigation Update

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Staff recommendation:

Staff recommends that the resources, research, and materials documenting the Colorado Water Conservation Board's expansive Demand Management Feasibility Investigation to date, including this memo, be conveyed to the Colorado River Drought Task Force created by Senate Bill 23-295.

Background:

General Demand Management Background

The Upper Division States of the Colorado River Basin (Colorado, New Mexico, Utah, and Wyoming) are currently investigating the feasibility of a potential Demand Management program. Demand Management is the concept of temporary, voluntary, and compensated reductions in consumptive use. The Demand Management Storage Agreement, one element of the 2019 Drought Contingency Plan (DCP), provides the authorization for the Upper Division States to store water created pursuant to a Demand Management program in Lake Powell. This agreement expires in December 2025. The purpose of a potential Demand Management program would be to ensure ongoing compliance with the 1922 Colorado River Compact.

Any water created as part of a potential Demand Management program could only be stored in the Initial Units (Aspinall Unit, Flaming Gorge, and Navajo Reservoirs) and could only be released at the direction of the Upper Colorado River Commission for purposes of ensuring ongoing compliance with the 1922 Colorado River Compact. The Upper Division States have always complied with the Colorado River Compact. Whether a program is established and how such a program would operate are still open questions. Each Upper Division State must make an initial determination that Demand Management is feasible before moving forward with creating a potential program.

Pursuant to C.R.S. § 37-60-106 *et seq.*, the mission of the Colorado Water Conservation Board is to conserve, develop, protect, and manage Colorado's water for present and future generations. In carrying out this mission, CWCB is the agency leading the investigation into whether Demand Management is feasible for Colorado.

The Colorado Water Conservation Board's 2019 Work Plan

Following adoption of the DCP in March 2019 and after significant discussion by the Board and key stakeholders, the CWCB Board adopted the 2019 Work Plan to help guide the initial stage of the feasibility investigation. This Work Plan is attached hereto as Exhibit A.

Pursuant to the 2019 Work Plan, the primary focus at this time was identifying key threshold issues associated with a potential Demand Management program. At the Board's direction, staff convened eight workgroups, each comprised of 10-15 water users, subject-matter experts, community leaders, key stakeholders, and Tribal representatives. Each workgroup had a particular subject matter focus, which included:

- Agricultural Impacts
- Economic Impacts & Local Governments
- Education & Outreach
- Environmental Considerations
- Funding
- Law & Policy
- Monitoring & Verification
- Water Rights Administration & Accounting

The Interbasin Compact Committee also served as a de facto workgroup and provided valuable input to the CWCB. A full roster of each workgroup is attached hereto as Exhibit B. Each workgroup held several meetings throughout 2019-2020. All meetings were open to the public and provided opportunities for public input. Staff provided regular updates to the Board and received guidance and input throughout the implementation of the 2019 Work Plan. A summary of work completed pursuant to the 2019 Work Plan is available in the July 2020 update to the Board, attached hereto as Exhibit C.

The Colorado Water Conservation Board's Step II Work Plan and Framework

Based on the input received from these workgroups over the course of a year, and following Board discussion through workshops and Board meetings, the Board adopted the Step II Work Plan in November 2020, attached hereto as Exhibit D. In this Work Plan, the Board directed staff to develop a framework of a Demand Management program, to be used to generate discussion about potential Demand Management program design and a range of potential implementation options.

Staff presented the draft framework in March 2021. This framework was designed to provide a broad range of implementation options for a potential Demand Management program. It incorporates input received from all workgroups and additional public input received throughout the course of the Demand Management Feasibility Investigation. This Framework is attached as Exhibit E.

Following development of this Framework, staff and the CWCB Board engaged a wide range of stakeholders to solicit feedback on the framework, including through workshops, updates, and other outreach as detailed in the Step II Work Plan. Staff provided regular updates to the Board throughout implementation of the Step II Work Plan.

From March - June 2021, staff conducted public outreach regarding the framework, including:

- *Six workgroup meetings:* Staff held meetings with six of the workgroups previously convened pursuant to the 2019 Work Plan to receive input on whether workgroup members' input is adequately captured in the framework.
- *Nine Basin Roundtable meetings:* Staff presented to and requested input from the nine Basin Roundtables.
- *IBCC meetings and input:* Staff presented to the Interbasin Compact Committee on the framework and solicited specific input on the Framework.
- *Three public workshops:* Staff hosted three public workshops to receive input on the framework, each focused on specific subject matters.
- *Public listening session:* Staff hosted a public listening session to receive additional input on the framework.
- *EngageCWCB Survey:* Staff developed an informational website and a survey soliciting feedback on the framework.
- *Demand Management informational video:* Staff worked with a consultant to develop an informational video regarding Demand Management to reach those who may be interested but have been unable to attend previous meetings or may not otherwise be involved in the discussion at this time.
- *Additional presentations as requested*: In addition to the above-referenced items, staff also presented the framework and provided opportunities for discussion and input upon request.
- *Written input*: Staff also invited written comments relating to the framework.

All input received on the Framework is attached as Exhibit F.

Additionally, during this time the literature review was completed pursuant to the 2019 Work Plan and the Step II Work Plan direction to "[a]nalyze and learn from existing, ongoing, and/or new programs and projects." The completed literature review is attached hereto as Exhibit G. The process was designed to collect information to inform the Board's discussion and process for the Demand Management Feasibility Investigation in July 2021 and beyond.

Throughout this process, staff also worked with a team of consultants to achieve the following public outreach and engagement tasks, pursuant to the Step II Work Plan:

- Developed a communications toolkit designed to assist Demand Management messaging, provided electronically to the Board members. This toolkit included a FAQ document attached hereto as Exhibit H.
- Developed strategies to make better use of various communications networks, including but not limited to social media, improved graphics and informational documents, a Demand Management-specific state email address, the EngageCWCB website, and use of informational videos.
- Developed a database of stakeholders who have provided input, attended meetings, or otherwise shown interest in the Demand Management Feasibility Investigation, which has been used to distribute information and solicit feedback on the ongoing investigation.
- Ongoing and continued engagement with Tribal Nations regarding Demand Management and the Framework on a sovereign-to-sovereign basis.

Key Themes

Throughout the course of this work, several key themes emerged and remain prevalent:

- Any potential program would be temporary, voluntary, and compensated, and would not envision permanent dry-up of agricultural lands.
- A potential Demand Management program should be viewed as equitable and proportional.
- Any potential program should be designed to minimize and mitigate on-farm and off-farm agronomic impacts, as well as adverse impacts to communities.
- Non-injury to water rights holders and non-participants is an important component of any potential Demand Management program.
- Any such program should be appropriately timed to align with water users' operational decisions.
- In considering or operating any potential Demand Management program, the process should be collaborative and transparent.
- There are key legal issues associated with a potential Demand Management program, such as the definition of beneficial use under Colorado law, as well as the definition of Compact compliance, among others.
- Quantification, measurement, monitoring, and verification must be honest, accurate, and defensible, while also as simple and flexible as possible.
- A Demand Management program could provide opportunities for projects with net environmental benefits that may not be available under potential Compact administration.
- Appropriate guidance for potential participation by the Tribal Nations must be considered.

Decision-Making Roadmap

In the Step II Work Plan, the Board adopted a lens through which to make decisions relating to Demand Management feasibility. The Work Plan breaks the feasibility question into three sub-questions:

(1) *Achievability:* The focus of this inquiry is whether it is technically possible to achieve a functioning Demand Management program within Colorado, and contemplates questions such as whether it is possible to verify and track water conservation, whether there are mechanisms available to track environmental benefits and impacts, whether it is possible to develop an appropriately robust outreach plan for a potential Demand Management program, and whether a funding source may be available.

(2) *Worthwhile for Colorado:* The focus of this inquiry is whether - even if a program is technically achievable – a program is worthwhile from Colorado's perspective. The scope of this question includes whether a Demand Management program may be established in a way that is proportional and equitable and avoids or mitigates unacceptable adverse impacts within the state.

(3) *Advisability:* The focus of this inquiry is whether it is advisable for Colorado to make a feasibility determination within the broader context of Colorado River issues and strategy. This is a determination that will likely incorporate input from other states

and the Upper Colorado River Commission, and therefore will be an evolving analysis. Given the quickly changing circumstances and ongoing investigation by the Upper Colorado River Commission, this determination would likely be made at the point in time after the first two questions are considered.

Within this context, in Fall 2021, the Board adopted a Decision-Making Roadmap, attached hereto as Exhibit I, which was designed to assist the Board in progressing in the Demand Management Feasibility Investigation. This roadmap is iterative and flexible in nature and was designed to allow the Board to progress in an appropriate manner based on information received.

In November 2021, the Board acknowledged that while the CWCB had developed a broad range of information and resources regarding the feasibility of a potential Demand Management program, additional information was needed before any determinations could be made, including but not limited to:

- Information from other Upper Division States about tools available to achieve monitoring and verification needs, how they would view accounting for a Demand Management pool, and additional issues that would require agreement pursuant to the Demand Management Storage Agreement before any feasibility determinations may be made.
- Additional experiential information gained through implementation of the Drought Response Operations Agreement, unilateral actions taken by the Bureau of Reclamation, and ongoing discussions with the Basin States and Tribal Nations.
- Analysis of intra-state legal issues and potential barriers to a potential Demand Management program.

The Board recognized that the information above could help inform whether a potential Demand Management program may be worthwhile and advisable from Colorado's perspective.

Since November 2021, the State has gained significant operational experience and information regarding various components of Colorado River management. In this time, the Bureau of Reclamation also initiated a NEPA Process to develop a Supplemental Environmental Impact Statement designed to modify operations at Lake Powell and Lake Mead to respond to low reservoir levels and potential future dry years.

Additionally, the Upper Colorado River Commission implemented the System Conservation Pilot Program (SCPP) in 2022-2023, which is also a program involving temporary, voluntary, compensated reductions in consumptive use in the Upper Colorado River Basin. The SCPP has less stringent monitoring, verification, and other requirements because conserved water becomes system water, rather than being shepherded to and stored in the Initial Units. The SCPP is estimated to have conserved less than 3,500 acre-feet of water in Colorado. The UCRC is currently compiling "lessons learned" from implementation of SCPP in 2022-2023, and this information may help to inform the Demand Management Feasibility Investigation.

It is important to understand that Demand Management is only one potential tool in the toolkit in addressing issues on the Colorado River. It is also important to note that the situation on the Colorado River is quickly evolving, and all information and experience gained may influence Colorado's perspectives on whether Demand Management is an appropriate tool to deploy at this time.

Staff believes that the information contained in this memo, the Exhibits attached hereto, and all of the information developed throughout the course of CWCB's Demand Management Feasibility Investigation to date will be helpful context for the Colorado River Drought Task Force, and others engaged in the discussion about Demand Management.

Exhibit A:

CWCB 2019 Demand Management Work Plan

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Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Brent Newman, Interstate, Federal, & Water Information Section
Karen Kwon, Colorado Office of the Attorney General

DATE: March 21, 2019

AGENDA ITEM: **28. Colorado River Drought Contingency Planning and Demand Management**

Background

Since January 2018, CWCB staff and members of the Attorney General's Office have been conducting a series of outreach presentations across Colorado regarding drought contingency planning efforts underway in the Colorado River Basin. Consistent with direction from the Board, these efforts have served dual purposes: to educate and inform interested water rights holders and other stakeholders about the status of ongoing efforts to develop drought contingency plans in the Upper and Lower Colorado River Basins, and to solicit feedback from Colorado water users regarding the concept of demand management as a potential tool for avoiding compact administration in the event of continued drought or worsening hydrology.

At the September 2018 Board meeting, staff provided an update on ongoing outreach efforts, the relationship between ongoing interstate efforts to implement DCPs in the Upper and Lower Basin, and the evaluation of demand management as a tool within Colorado. The Board heard comment from a variety of water managers, stakeholders, and members of the public regarding opinions, challenges and opportunities presented by potential implementation of demand management.

At the October 4, 2018 Special Meeting, the Board directed staff to continue this outreach, including providing information about the recently released Drought Contingency Plan (DCP) documents. The Board also directed staff to prepare a "draft policy statement" for Board review at the November meeting, to guide the assessment, feasibility analysis, and potential implementation of a demand management program within Colorado.

At the November 15, 2018 Board meeting, the Board unanimously approved "Support and Policy Statements Regarding Colorado River Drought Contingency Plans, Demand Management, and Compact Administration," which set out the Board's policy to:

> "Develop the state's position and approach on whether and how to develop any Upper Basin Demand Management Program that could potentially be implemented within

> Colorado consistent with state law to avoid or mitigate the risk of involuntary compact curtailment and to enhance certainty and security in the Colorado River water supply."

This policy statement also laid out a strategy for formulating the state's demand management position, identifying several elements for investigation and vetting through a thorough public review process. The statement also provides initial sideboards for such an investigation, informed by Board discussion and water user input to that point.

Since November, staff has been working with the Attorney General's Office on a draft scope of work for demand management feasibility investigation. At the January Board meeting, staff presented a draft outline with initial thoughts for a 2019 Work Plan. As part of this agenda item, staff will report out on outreach efforts since January, provide an update on DCP progress, and walk the Board through the elements of the draft scope of work. The scope of work will identify a more formal outreach and public input procedure, working groups to investigate individual elements of demand management feasibility, and objectives to meet in calendar year 2019.

This work will focus on demand management considerations within Colorado, and will continue on a parallel track with interstate efforts led by the Upper Colorado River Commission. CWCB staff will also participate in those efforts, in close coordination with Colorado's Commissioner and staff from neighboring Upper Basin states.

Staff recommendation

Staff recommends that the Board approve the 2019 Work Plan and direct staff to begin the action items identified immediately.

DRAFT

2019 WORK PLAN FOR INTRASTATE DEMAND MANAGEMENT FEASIBILITY INVESTIGATIONS

I. INTRODUCTION

It has never been necessary to administer Colorado's Colorado River Basin for compact compliance. Hydrology in the 21st century, however, has revealed it prudent to prepare for contingencies that consider the prospect of protecting target elevations at Lake Powell as well as the increased risk of compact administration going forward. As part of this effort, the State of Colorado has demonstrated a coordinated approach among Colorado's Commissioner to the Upper Colorado River Commission, the Colorado Water Conservation Board, and the Attorney General's Office to support and endorse the documents and agreements that comprise the Colorado River Drought Contingency Plans for both the Upper and Lower Colorado River Basins. Such support and coordination have come about only after careful consideration, collaboration and consultation with water users and other interested stakeholders throughout the state.

Within the Drought Contingency Plan documents is the authorization to store, free of charge, in the Initial Units of the Colorado River Storage Project, water that is conserved under a demand management program if approved by the Upper Colorado River Commission and each of the Upper Division States (Colorado, New Mexico, Utah, and Wyoming). The term "demand management" loosely refers to the intentional conservation of water for the purpose of helping assure compliance with the Colorado River Compact, and in so doing, avoiding the need to implement mandatory water administration strategies to fulfill the Upper Basin's compact obligations. The storage authorization, as set forth in the Drought Contingency Plan documents, does not require or mandate development or implementation of any demand management program. It merely secures the opportunity for the Upper Division States to store any water conserved under such a program should the Upper Colorado River Commission and Upper Division States ever determine it is advisable and feasible to promote and protect their interests in the Colorado River water supply.

Prior to declaring its support for the package of Drought Contingency Plan documents, staff from the CWCB and Attorney General's Office conducted extensive outreach and consultation with water users and other interested stakeholders to build a knowledge base regarding the current conditions in the Colorado River Basin and the inner workings of the law of the Colorado River. Additionally, they sought input and feedback on issues and concerns related to the concept of demand management that are important and integral to any considerations going forward. The CWCB subsequently issued the "Support and Policy Statements Regarding

Colorado River Drought Contingency Plans, Demand Management, and Compact Administration" (Support and Policy Statement) that outlines, among other things, the minimum criteria through which the state will investigate the feasibility of any demand management activities in Colorado.

The following 2019 Work Plan is a follow up to the CWCB's Support and Policy Statement. It outlines, in general terms, the next steps that the CWCB staff will take, in conjunction with the Defense of the Colorado River Subunit at the Attorney General's Office (funded by the CWCB), and with the involvement of other relevant state agencies and interested stakeholders to identify and evaluate whether and how demand management measures may be taken to help assure continued compact compliance, and thereby promote greater certainty and security in the Colorado River water supply for constituents throughout the state.

II. PROPOSED TENTATIVE 2019 WORK PLAN

a. **Purpose** - The purpose of this work plan is to set forth a process for helping develop Colorado's position regarding whether and how any Colorado River Demand Management Program could or should operate within Colorado. Guided by the CWCB Support and Policy Statement, specific focus will be on measures that can be taken within Colorado in the 2019 calendar year to effectively and efficiently utilize staff, resources and meaningful water user and other stakeholder engagement to flesh out various elements of interest and concern related to demand management activities within Colorado. It is also intended to help inform any investigative processes facilitated by the Upper Colorado River Commission.

b. **Tasks**

   i. **Initial Issue Identification** – The concept of demand management may be simple to describe, but assessing its utility and how it could be implemented in a manner that respects considerations important to Colorado and remains consistent with state and federal laws is no small task. There are a number of issues that the Upper Colorado River Basin will need to assess as a whole in contemplating whether to develop a demand management program, and others that may be specific to Colorado. This task centers on identifying and prioritizing the primary legal, technical and policy issues related to demand management that Colorado may deem important to evaluate as part of any feasibility investigation. This effort may be informed by collaborating and coordinating with Colorado's Commissioner and counterparts in other Upper Division States, consulting and discussing topics with water users and other interested stakeholders, and reaching out to

experts in specific fields who may have a familiarity and perspective on Colorado River matters that can add value and substance to the overall feasibility investigation.

ii. **Establish Workgroups** – This task contemplates creating specific workgroups to effectively evaluate various issues related to the demand management feasibility investigation in Colorado. Each workgroup will be guided by the criteria set forth in the Support and Policy Statement in formulating a meaningful scope of work, budget and timeline for Fiscal Year 2019/2020. They will be facilitated by staff at the CWCB or Defense of the Colorado River Subunit at the Attorney General's Office to coordinate the flow of information between workgroups and to the Project Management Team (PM Team) as appropriate. Participants from other state agencies, water user or stakeholder groups, and entities with relevant expertise may be invited to participate as needed to help develop and assess the feasibility investigations, keeping in mind the need to maintain an effective and efficient process. Probable workgroups at this time include:

*<u>*Law and Policy*</u> – Review and analyze laws, rules and regulations and relevant policy considerations to inform the range of state and federal legal and policy frameworks to follow for demand management implementation within Colorado. This workgroup will also coordinate with the PM Team: (1) to help inform the legal and policy questions raised by other workgroups as they investigate specific elements of demand management feasibility within Colorado; and (2) to assist in developing reporting and educational materials.

*<u>*Monitoring and Verification*</u> – Research, develop, and test (as needed) various methods available or needed to measure and verify the volume of conserved consumptive use under any demand management program. This workgroup will also work with the PM Team to further examine factors related to lead time, costs and staff resources required to model, pilot or otherwise meaningfully investigate various monitoring and verification considerations for implementing demand management within Colorado.

*<u>*Water Rights Administration and Accounting*</u> – Research and test (as needed) various methods or practices available or required to (1) assist in administering water rights as a result of demand management activities within Colorado; and (2) account for volume

of conserved water as it is transported and stored at one of the Colorado River Storage Project's Initial Units. Tasks for this workgroup will include, but not be limited to, examination of unique administration practices and identifying actions that may incentivize or obstruct demand management participation in each water division. This workgroup will also work with the PM Team to further examine factors related to lead time, costs and staff resources required to model, pilot or otherwise meaningfully investigate water rights administration and accounting considerations for implementing demand management within Colorado

*<u>*Environmental Considerations*</u> – Research, test (as needed), and identify potential environmental impacts that may need to be considered in any demand management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of existing environmental rules and regulations, and identification of short-term and long-term environmental considerations. This workgroup will also work with the PM Team to note potential environmental mechanisms and considerations that could incentivize or obstruct demand management participation in various parts of the state.

*<u>*Economic Considerations*</u> – Research, test (as needed), and identify potential economic impacts that may need to be considered in any demand management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of both primary and secondary economic impacts and short-term and long-term economic considerations. This workgroup will also work with the PM Team to note potential mechanisms and considerations that could economically incentivize or obstruct demand management participation in various parts of the state.

*<u>*Funding*</u> – Research, test (as needed), and identify potential funding sources for costs associated with implementation of a demand management program, including but not limited to, costs related to implementation and administration of such program within Colorado.

*<u>*Education/Outreach*</u> – Develop public outreach strategies and materials regarding the topic of demand management within Colorado. In addition, this workgroup will coordinate with the PM Team to develop consistent and informative workshops and

presentations that are intended to engage with water rights holders and other interested stakeholders on the topic of demand management.

iii. **Conduct Workshops** – In addition to utilizing workgroups, the work plan contemplates CWCB staff, with the assistance of the Defense of the Colorado River Subunit at the Attorney General's Office, regularly developing and conducting public workshops to maintain open lines of communication with the public at large, provide updates and information, and receive feedback and input regarding the status of demand management feasibility investigations involving the state. Such workshops would not take the place of additional outreach efforts deemed helpful to the collaborative process. Instead, they serve to set a meaningful benchmark for which anyone interested can learn and better understand the content and status of feasibility investigations.

iv. **Evaluate and Report** – This task contemplates the PM Team preparing regular reports to the CWCB on the progress and results of investigations conducted in Calendar Year 2019. These reports may include, but are not to be limited to, noting key findings or gaps in information identified as a result of investigations, and identifying options and issues for the CWCB to consider in formulating the state's position on demand management feasibility. Also included would be a final status report on the work conducted pursuant to this work plan after Calendar Year 2019 has concluded.

v. **Project Management** – This task contemplates establishing a PM Team comprised of representatives within the Department of Natural Resources and the Attorney General's Office to facilitate the work to be conducted consistent with this work plan. To this end, the PM team will coordinate the workgroups and facilitate the distribution of information between workgroups as needed, manage funding for the feasibility investigations, prepare status reports and recommendations for the CWCB, and coordinate with Colorado's Commissioner and counterparts at the UCRC regarding demand management considerations throughout the Upper Basin.

III. **TENTATIVE TIMELINES – subject to change – TBD following clarification of status of DCP and Upper Basin Coordination.**

April 2019: First Quarterly Workshop (TBD)

May 2019: UCRC Listening Workshop-4 States effort - TENTATIVE

June 2019: Workgroup SOWs completed and Update to UCRC

July 2019: Second Quarterly Workshop held (TBD); Update to CWCB Board

September 2019: Third Quarterly Workshop held (TBD)

November 2019: Fourth Quarterly Workshop held (TBD); Update to CWCB Board and UCRC

December 2019: Workgroup Investigation Progress reports or deliverables submitted to PM Team

January/March 2020: Draft/Final Progress Reports of Workgroup Investigations submitted to CWCB Board of Directors

IV. DELIVERABLES – TBD following clarification of status of DCP and Upper Basin Coordination.

Each Workgroup is tasked with submitting to the PM Team:

(1) Quarterly budget/expense reports (July; September; November)

(2) Draft Status/Progress Report of Findings and Conclusions to the PM Team no later than December 15, 2019.

V. ESTIMATED RESOURCES / COSTS for 2019 - TBD following clarification of status of DCP, Upper Basin Coordination, CWCB funding opportunities.

Exhibit B:

2019 Demand Management Workgroup Roster

DM 2019 Work Plan
Workgroups Roster
June 10, 2019

Law and Policy
Facilitator: Karen Kwon
Staff Support: Brent Newman/Amy Ostdiek
Andy Mueller
Jim Lochhead
Bennett Raley
John McClow
Taylor Hawes
Anne Castle
Beth Van Vurst
Lee Miller

Monitoring and Verification
Facilitator: Michelle Garrison
Support: Brian Macpherson
Kelley Thompson
John Currier
Kevin Lusk
Tom Simpson
Luke Gingrich
Laura Berlanger
Perry Cabot
Cary Denison
Gerry Knapp
Robert Sakata
Carrie Padgett

Water Rights Administration and Accounting
Facilitator: Lain Leoniak
Support: Mike Sullivan/Kevin Rein/Ryan Gilliom
Frank Kugel
Rick Marsicek
Drew Peternell
Kyle Whitaker
Dick Wolfe
Steve Witte
Cleave Simpson

Environmental Considerations
Facilitator: Lauren Ris/Linda Bassi
Support: Brandy Logan/Jojo La
Kathy Kitzman
Maria Pastore
Melinda Kassen
Abby Burk
Matt Rice
David Graf
Al Pfister
Torie Jarvis
Mely Whiting
Karen Wogsland

Economic Considerations and Local Government
Facilitator: Amy Moyer
Support: Amy Ostdiek
Chris Treese
Alex Davis
Seth Clayton
Sean Cronin
Kathy Chandler-Henry
Barbara Biggs
Steven Ruddell
Patti Wells
Liesel Hans
Karn Stiegelmeier
Kelly Romero-Heaney

Funding
Facilitator: Anna Mauss
Support: Russ Sands
Ted Kowalski
Dave Bennett
Pat Wells
Aaron Citron
Dick Brown
Keith McLaughlin
Alan Matlosz

Education and Outreach
Facilitator: Brent Newman
Support: Megan Holcomb
Jim Pokrandt
Todd Hartman
Chris Woodka
Andy Schultheiss
Hannah Holm
Doug Kemper
Laura Spann
Lisa Darling

Agricultural Impacts
Facilitator: Alex Funk
Support: Andrew Rickert/Erik Skeie
Dave Kanzer
Alan Ward
Eric Wilkinson
John Stulp
Cindy Lair
Mark Harris
Aaron Derwingson
Paul Bruchez
Travis Smith
Allen Distel
Ken Curtis
Tom Gray

Exhibit C:

July 2020 Demand Management Update

Demand Management Feasibility Investigation Update
Report to the Colorado Water Conservation Board
July 2020

Executive Summary

The Upper Division States of the Colorado River Basin are currently investigating the feasibility of a potential Demand Management program. Demand Management is defined as temporary, voluntary, and compensated reductions in consumptive use. The Demand Management Storage Agreement, one element of the Drought Contingency Plan (DCP) finalized by the Colorado River Basin States in 2019, provides the authorization for the Upper Division States to store water created pursuant to a Demand Management program in Lake Powell. The water would only be used for Compact compliance purposes at the direction of the Upper Colorado River Commission. Whether a program is set up and how such a program would operate are still open questions. Each Upper Division State must make an initial determination that Demand Management is feasible before moving forward with creating a potential program.

The Colorado Water Conservation Board is Colorado's agency charged with setting the State's water policy, and is therefore the agency with authority to determine whether Demand Management is feasible for Colorado. Following adoption of the DCP in March 2019, the CWCB Board adopted the 2019 Work Plan to help guide the initial stage of this feasibility investigation, to take place in Fiscal Year 2019-2020. The Work Plan had three primary components: (1) establish workgroups comprised of subject-matter experts and key Colorado River stakeholders, which were directed to meet publicly at least four times in Fiscal Year 2019-20, and to identify key threshold issues for board consideration; (2) regional workshops designed to facilitate the public discussion around Demand Management and provide opportunities for CWCB staff updates on the feasibility investigation; and (3) continued education and outreach. In addition, the Board directed staff to facilitate a literature review, currently underway by consultants hired following a Request for Proposal process.

The purpose of this Report is to provide an update of work done pursuant to the 2019 Work Plan. This report will assist the CWCB Board in considering the key threshold issues associated with a potential Demand Management program. The purpose of the report is not to provide guidance on next steps of the feasibility investigation. However, it may help shape the discussions and decision-making about the next phases of Colorado's feasibility investigation. While the complete report provides a full summary of workgroup discussions and other work, below is a summary of each workgroup's main discussion points, a summary of discussions of the Interbasin Compact Committee relating to equity, and an update on the ongoing discussions with Tribes.

Agricultural Impacts

- To encourage agricultural participation, a potential program must be viewed as equitable and proportional while remaining voluntary; furthermore, it must be adequately communicated that the potential program is necessary to achieve the objectives set out in the Upper Basin Drought Contingency Plan and will serve as an insurance policy against mandatory curtailment.
- In designing a potential program, care must be given to program design to minimize and mitigate on-farm and off-farm agronomic impacts such as reductions in crop yield and soil erosion, including the provision of technical assistance and information; furthermore, the program should account for secondary economic impacts and evaluate potential benefits.
- Non-injury to water right holders and non-participants is critical and can be achieved through the possible consideration of utilizing existing change of water use approval processes and providing additional mitigation expenses to agricultural water providers to account for potential operational impacts.
- Structuring the potential program application, review, and the contracting process should consider alignment with the timing of when producers make critical operational decisions and allow for some operational flexibility; furthermore, payments should consider all potential impacts including both agronomic and operational changes.
- In considering the design of a potential Demand Management program, current programs in place similar to a potential Demand Management program, such as the Federal Conservation Reserve Program and Colorado Fallow-Leasing Pilot Program should be further analyzed; furthermore, pilot and demonstration projects could be useful in better understanding potential impacts and effects of temporary irrigation reductions and should be explored with an effort to capture the potential diversity of projects.

Economic Impacts and Local Government

- Any potential Demand Management program will be voluntary; those who do not wish to participate should not do so.
- In designing any potential Demand Management program, the initial goal should be to “do no harm,” meaning to minimize and mitigate any adverse impacts to communities. A number of factors should be considered in analyzing this question, including but not limited to the type of water use, the duration of the Demand Management program, the length of individual project participation, and the geographic location and concentration of projects.
- Any potential program should create benefits for individuals, the community, and the economy wherever possible. Potential benefits may include avoidance of Compact administration actions, increased revenue to local economies, environmental benefits, and opportunities to improve long-term management of water and land.
- A number of process considerations should be taken into account when considering how to assure no harm is done to communities where possible, or mitigated if there is harm.
- In operating a potential Demand Management program, the process should be transparent and collaborative.

Education and Outreach

- Workgroup members identified many challenges in helping the State explore threshold questions related to communication, education, and outreach needs around a potential Demand Management program.
- In lieu of assisting with a communication plan for the active "investigation" process or a future program, the workgroup focused their expertise around priority considerations should the CWCB elect to continue with feasibility, project pilots, or full program development.
- While it is essential to develop a communications plan well before a Demand Management program is enacted, content substance is needed to proceed in which common terms are defined across workgroups and state partners, clear frames are developed to help unite messaging across stakeholder groups, and essential content from FY19-20 workgroups are considered by CWCB and incorporated into an agreement on a Demand Management program’s general (initial/draft) shape.
- At this stage, there is a branding problem, as different stakeholders have different ideas of what a program may look like, how it can be explained, and how often communication is carried to individuals’ direct communities.
- This workgroup recommends immediate messaging discussions to identify shared priority framing. Several guiding examples are presented in the workgroup's final deliverable.
- Throughout the investigation, workgroup members identified the need to help stabilize communication chains, the need for extra transparency, and the need to maintain an open line for all users to communicate concerns and ideas to/from CWCB and to/from one another.

Environmental Considerations

- A Demand Management program could provide opportunities for projects with net environmental benefits that would not be available under potential Compact administration.
- A Demand Management program should not harm the environment, should build in considerations to minimize adverse environmental effects, and should incentivize projects that provide net environmental benefits.
- A Demand Management program should use the suggestions in the Environmental Considerations document to evaluate project environmental benefits and impacts without creating an unnecessarily burdensome process for applicants. The suggestions should also be used as part of the criteria to prioritize projects. Potential environmental benefits are location and project specific and would need to be evaluated on a case-by-case basis.
- A Demand Management program should identify project impacts and benefits to environmental resources including changes to flow regimes, instream flows, water quality standards, critical habitat, management/planning documents, and conservation needs and strategies if evaluation tools are readily available and applicable (for a more detailed list of potential resources impacted, see Environmental Considerations document).
- Research and data gaps exist for evaluating environmental benefits and impacts, such as information on changes to hydrology, return flows, and wetlands. Streamlined approaches and methods are needed to make these assessments.

Funding

- The funding workgroup initially identified a number of questions to help frame the conversation around funding a potential Demand Management program, including how much funding would such a program require.
- To help quantify potential funding needs, workgroup members discussed factors that could affect a Demand Management program and built scenarios around them.
- The factors included: volume of water needed, cost of potential program (i.e. $/acre-foot), percent of water savings expected from a Demand Management program (versus funded investments in infrastructure), acute or chronic need, year by which water is needed, and reservoir storage options.
- Workgroup members came up with a preliminary list of funding ideas noting that not one concept, but rather a portfolio (potentially paired with a reverse auction model) would be beneficial: statewide tax (income, sales, property), regional tax, statewide fee, Bureau of Reclamation contribution, hydropower user fee, export user fee (i.e. Front Range water user rate increase).
- Even with a diverse portfolio, COIVD-19 fundamentally changed the calculus and workgroup members expect we will likely see transformations in many water use sectors and the larger economies of the Western US if hydrology continues to deteriorate and Compact Administration becomes necessary.

Law and Policy

- There are several open legal and policy questions relating to a potential Demand Management program, and the conclusions drawn could impact how a program operates and whether it works within existing law. These key legal and policy issues include, but are not limited to:
    - Would participation in a potential program be considered a beneficial use under Colorado law?
    - What is the definition of Compact compliance?
    - How is program eligibility determined?
    - How is conserved consumptive use defined for purposes of participation in a potential program?
    - What is the appropriate definition of “temporary” in the context of a potential Demand Management program?
    - What is the appropriate procedure for project review and approval?

Monitoring and Verification

- Quantification, measurement, monitoring, and verification must be honest, accurate, and defensible.
- Participation and monitoring and verification must be protective of other water users.
- Participation must result in added water to the system.
- Participation and monitoring and verification must be as simple, easy, and flexible as possible while still meeting the first three principles.

Water Rights Administration and Accounting

- Any potential program should take into consideration the appropriate process for changing the use of a water right from its current use to Demand Management.
- The question of whether Demand Management is a beneficial use of water should be considered before a potential program is established.
- Changes in administration and accounting for storage should be considered in establishing a potential program.
- Appropriate scrutiny for any program should be balanced against the need for ease and flexibility.

Interbasin Compact Committee

- The Interbasin Compact Committee functioned as a *de facto* workgroup focused on the issue of equity relating to Demand Management.
- The discussion focused on two main questions:
    - How should equity be defined?
    - Is it possible to create an equitable Demand Management program?

- Though there were not clear answers to these questions, there was consensus that this is an important topic and that the discussion should continue.

Ongoing Discussions with Tribes

- In addition to the workgroups, the Project Management Team has had ongoing discussions with the two federally recognized Indian tribes in Colorado - the Southern Ute and Ute Mountain Ute Tribes.
- These discussions have been held at a government-to-government level and therefore, no reports have been published relating to these meetings at this time.
- Tribal Councils of both Tribes are supportive of continued participation in the investigation of the development of a potential Demand Management program.

Colorado's Demand Management Feasibility Investigation Update

Report to the Colorado Water Conservation Board
July 2020

Contents

Table of Attachments

I. Introduction

The Colorado River Basin has faced twenty years of challenging hydrology, and there is significant uncertainty relating to future hydrologic conditions. Recognizing the need for increased flexibility in managing the Colorado River System, the Upper Division States developed a plan designed to allow the States to consider and explore innovative options for maintaining certainty in water supply. One potential tool, as identified in the Drought Contingency Plan, is Demand Management - temporary, voluntary, and compensated reductions in consumptive use. Colorado is currently investigating the feasibility of such a program.

The purpose of this report is to summarize for the Colorado Water Conservation Board (CWCB or Board) the work accomplished to date pursuant to the 2019 Demand Management Work Plan (Work Plan), as adopted in March 2019. The Work Plan directed staff to report to the Board on progress made in Fiscal Year 2019-2020. To this end, this report summarizes the work completed in the first year of the investigation in an effort to help inform potential next steps to consider in the feasibility investigation. The report is separated into six sections: (1) Introduction; (2) Common Themes; (3) Workgroups: A Deeper Dive; (4) Regional Workshops; (5) Education and Outreach; and (6) Future Planning.[1]

A. What is Demand Management?

Demand Management contemplates the temporary, voluntary, and compensated reduction in consumptive use in the Upper Colorado River Basin. In March 2019, the seven Colorado River Basin States executed a suite of agreements called the Drought Contingency Plan (DCP). The DCP includes Upper and Lower Basin elements.[2] It is beyond the scope of this report to summarize each agreement, but for purposes of this report, the relevant agreement is the Demand Management Storage Agreement (DMSA).[3] The DMSA authorizes the storage of up to 500,000 acre-feet of water in the Colorado River Storage Project Act Initial Units if and when a Demand Management program is set up in the Upper Basin.[4] The DMSA does not require that a Demand

[1] This report should not be interpreted as support on behalf of the CWCB, workgroup members, or the organizations for which they work, for any of the positions or concepts discussed by the workgroups or as asserting any legal or policy positions. Rather, this report is intended to summarize information discussed by the workgroup members, in their individual capacities, as well as the feasibility investigation to date.

[2] Pursuant to the 1922 Colorado River Compact, the Colorado River Basin is divided into the Upper and Lower Basins. Upper Division States include Colorado, New Mexico, Utah, and Wyoming. Lower Division States include Arizona, California, and Nevada. The 1922 Colorado River Compact is an element of a body of law referred to as the Law of the River, which affects interstate and international use, management, and allocation of water in the Colorado River system. The Law of the River includes the 1922 Colorado River Compact, the 1944 Mexican Water Treaty, the 1948 Upper Colorado River Basin Compact, several United States Supreme Court decisions, the Supreme Court Decree in *Arizona v. California*, and numerous other federal statutes and regulations. The 1948 Upper Colorado River Basin Compact established the Upper Colorado River Commission (UCRC or Commission), comprised of the Upper Division States.

[3] Additional information relating to the DCP and the agreements can be found at https://www.usbr.gov/dcp/index.html.

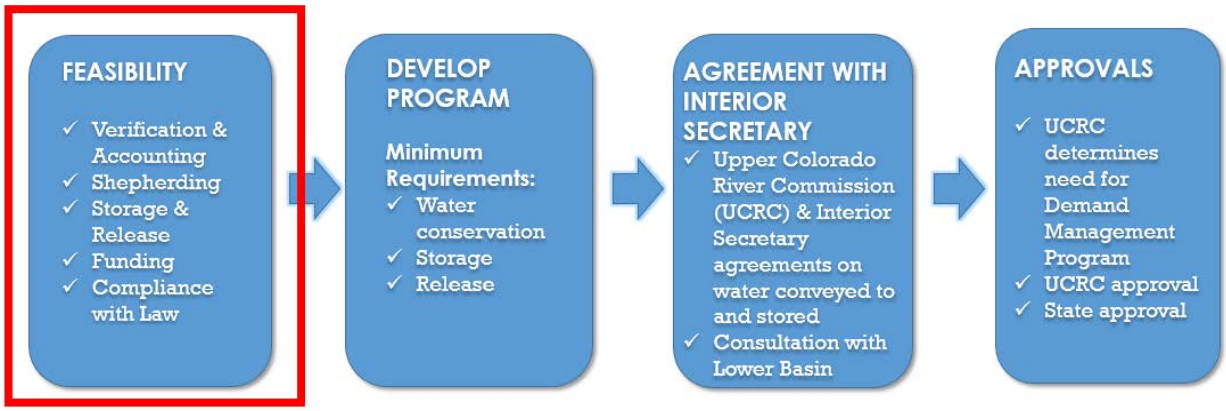
[4] The Colorado River Storage Project Act of 1956 (CRSPA) facilitated the development of water in the Upper Colorado River Basin, and included authorization to construct, operate, and maintain four Initial Units of the

Management program be established. Rather, it provides the legal mechanism to store water conserved under a Demand Management program if, and only if, the Upper Division State Commissioners to the Upper Colorado River Commission (UCRC) agree to the feasibility and requirements of such a program after consulting with the Lower Division States and reaching agreement with the Secretary of the Interior on specific operations and determine there is a need for such a program. If no program is established, the storage space will not be used. The minimum requirements of the DMSA are highlighted below.

1. Minimum Conditions and Requirements for Establishment of a Program

The DMSA sets forth a set of sequential steps for considering and approving any Demand Management program.[5] This section provides a summary of those elements. Currently, the Upper Division States are in the initial stage of the process (Feasibility), and must make a finding of feasibility before moving on to the additional requirements.

Below is a visual representation of the steps that must be taken, as explained below, before a potential demand management program could be implemented.



a) Feasibility

Pursuant to the DMSA, the Upper Division States must first investigate the feasibility of developing and implementing a potential Demand Management program, and must reach consensus on the following items, among other things not specifically delineated in the DMSA, before moving to the next stage of developing a program:

- Verification of and accounting for the actual volume of conserved consumptive use;

Colorado River storage project, which consist of dams, reservoirs, power plants, transmission facilities, and appurtenant works of the Aspinall Unit (formerly the Curecanti Unit), Flaming Gorge, Navajo (dam and reservoir only), and Glen Canyon.

[5] The Demand Management Storage Agreement is available at https://www.usbr.gov/dcp/docs/final/Attachment-A2-Drought-Managment-Storage-Agreement-Final.pdf

- Conveyance of the conserved consumptive use to appropriate destinations, and accounting for associated conveyance losses;
- Providing for storage at and release from the Colorado River Storage Project Act Initial Units of any conserved consumptive use;
- Administration of an Upper Basin Demand Management program;
- Funding of an Upper Basin Demand Management program; and
- Compliance with federal and state laws within each Upper Division State;

States are currently in the Feasibility analysis stage, and this report was developed as part of Colorado's process of analyzing the feasibility of a Demand Management program.

b) Program Development

If the Upper Division States agree that an Upper Basin Demand Management program is feasible, noting all requisite elements in the section above, they then may develop the framework for a potential Demand Management program, which must include the following requirements, at a minimum:

- Water conserved will only be recognized as part of a Demand Management program if:
  - The source of conserved water is Upper Colorado River System water or imported water[6];
  - The water is conserved, stored, and released for the specific purpose of helping the Upper Division States assure continued compliance with Article III of the Colorado River Compact[7] ;
  - If Upper Colorado River System water (as opposed to imported water), the water must have been beneficially and consumptively used under valid water rights prior to being conserved as part of an Upper Basin Demand Management program;
  - If Upper Colorado River System water (as opposed to imported water), the water must have been physically available for diversion in the year it was conserved, and would have been beneficially and consumptively used within a state or states of the Upper Division but for the conservation for the benefit of an Upper Basin Demand Management program; and

[6] Imported Water is defined in the DMSA as water introduced to the Upper Colorado River System from outside the Colorado River System for the specific purpose of augmenting the supplies available for, or storing water as part of, an Upper Basin Demand Management program.

[7] Article III(a) of the 1922 Colorado River Compact apportions the exclusive beneficial use of 7,500,000 acre-feet per year to the Upper Basin and Lower Basin, respectively. Article III(b) apportions an additional one million acre-feet of water to the Lower Basin. Article III(c) states that any water owed to Mexico shall first be supplied to waters surplus over and above the aggregate of the quantities specified in (a) and (b), and if such surplus is insufficient for this purpose, assigns the burden of deficiency equally among the Upper Basin and Lower Basin. It further requires the Upper Division States to deliver at Lee Ferry water to supply half of the deficiency. Article III(d) states that the States of the Upper Division shall not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series beginning with the first day of October. Please see the Colorado River Compact to view the additional elements of Article III, available at https://www.usbr.gov/lc/region/g1000/pdfiles/crcompct.pdf

    - The conserved or imported water has arrived at a CRSPA Initial Unit after accounting for any conveyance and associated losses.
- Any conserved or imported water to be stored in a CRSPA Initial Unit for the purposes of an Upper Basin Demand Management program shall be subject to:
    - Assessment of its proportionate share of evaporation during storage;
    - Available unfilled storage capacity;
    - An annual creation limitation at the CRSPA Initial Units combined. This volumetric limit is to be determined as part of the feasibility investigation;
    - A maximum combined storage limitation of 500,000 acre-feet at the CRSPA Initial Units;
    - Reduction, in any year in which water flows over or through the spillway at Glen Canyon Dam, by the amount of that flow on an acre-foot for acre-foot basis up to the full amount of water stored under an Upper Basin Demand Management program; and
    - Annual verification by the Upper Division States, through the Commission, and the Secretary of Interior, of the volume of conserved water created, conveyed, and stored at the CRSPA Initial Units.
- Any conserved water stored and released from a CRSPA Initial Unit under an Upper Basin Demand Management program shall:
    - Be accounted for consistent with the provisions in the section above and in this section;
    - Through the year 2057, not be released or cause a different release from Lake Powell than would have otherwise occurred under the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead ("2007 Interim Guidelines") or post-2026 operational rules.[8] This provision survives termination of the DMSA through 2057; and
    - Be subject to release from any of the CRSPA Initial Units only at the request of the Commission to help assure continued compliance with Article III of the Colorado River Compact. This provision survives termination of the DMSA through 2057.

c) Upper Basin Demand Management Program Approval

If and when the Upper Division States reach agreement on the framework and operation of a potential program, a number of agreements, consultations, and approvals must occur before any Demand Management program may be finalized and made operational, including:

- Upper Colorado River Commission (UCRC) findings: the UCRC must make findings that Demand Management activities are necessary to help assure continued compliance with Article III of the Colorado River Compact;

[8] The Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead, available at https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

- Agreement and consultation: Through the UCRC, the Upper Division States and the Secretary of Interior must enter into agreements regarding the methodology, process, and documentation for verification and accounting for the creation, conveyance, and storage of conserved water to be stored in and released from a CRSPA Initial Unit as part of a Demand Management program. Consultation (on a consensus basis) with the Lower Basin States is required before entering into such agreements;
- UCRC approval: The UCRC must approve the Upper Basin Demand Management program; and
- State approval: Each Upper Division State must approve the Upper Basin Demand Management program

d) Additional Considerations: Post-2025

On December 31, 2025, both the DMSA, except for those provisions that survive termination of the DMSA, and the 2007 Interim Guidelines are set to expire. A potential Demand Management program is tied directly to operations of Lake Powell and Lake Mead because water created as part of a Demand Management program would not be subject to release pursuant to the terms of the 2007 Guidelines. Therefore, it is difficult to analyze how a potential Demand Management program would operate without knowing what future operations of the two major reservoirs will look like. This section of the DMSA provides that a position has not been formally expressed relating to the implementation of a potential Demand Management program after 2025.

B. Status of the Demand Management Feasibility Investigation

Each Upper Division State must make a finding that Demand Management is feasible before they initiate discussions to design and set up a program or take any of the following steps to establish a potential program. Each State is currently conducting this feasibility analysis.

Below are updates on the other Upper Division States' feasibility investigations:

- Wyoming: State personnel are managing demand management discussions with the public, but the University of Wyoming Extension Office has been hired to provide logistical support.[9] In September 2019, Wyoming held a meeting with key stakeholders (roughly 25 individuals were in attendance) in the basin, where State staff provided an explanation of and an update on the demand management feasibility investigation. During the late fall 2019, four public meetings were held at locations across the basin, as well as one meeting in Cheyenne. During these public meetings, four specific topic areas were identified that warranted in-depth discussion. Wyoming has formed four corresponding focus groups of roughly 12 people each to explore and discuss each of these issues. These groups have not yet met, as meetings are in abeyance until they may occur in person, which has not been possible to date due to the COVID-19 pandemic.

[9] Information and updates relating to Wyoming's demand management activities can be found here: http://www.uwyo.edu/uwe/wy-dm-ucrb/index.html#add

There is hope the groups can meet in early fall 2020. Ultimately, a draft report with information and possible recommendations from water users is expected by the end of the year.

- New Mexico: In January 2020, State staff held an in-person meeting with stakeholders, including informational items and an update on the UCRC's RFP. They held a second stakeholder meeting in April 2020 for those unable to attend the January meeting. New Mexico continues to engage with organizational stakeholders, providing updates and hearing feedback.
- Utah: State personnel are leading Utah's feasibility investigations. They have considered the issues and challenges relating to a potential program, and are currently contemplating how a potential Demand Management program may relate to Utah's new water banking legislation.[10] Trout Unlimited is also engaged in the investigation, and while the information developed in these efforts may help inform the State's position, they are distinct from the State's efforts. Utah intends to conduct broader stakeholder outreach in the future.

In addition, the UCRC issued a Request for Proposals seeking technical assistance in considering the feasibility of Demand Management. Contracts for this work have not yet been executed. Funds received from the Bureau of Reclamation for this effort must be expended by September 30, 2022.

C. Colorado's Demand Management Feasibility Investigation

Throughout the seven-state negotiations on the DCP, the Board received updates and feedback from CWCB staff, counsel from the Colorado Attorney General's Office, and interested water users and stakeholders. As a result of these updates and as a condition of its support for the DCP, the Board adopted the following policies and plans to direct the State's Demand Management feasibility investigation:

1. November 2018 Support and Policy Statement

In November 2018, after several briefings on what became the key elements of the DCP and in particular the DMSA, and before the DCP was finalized in March 2019, the Board adopted the Support and Policy Statement regarding Colorado River Drought Contingency Plans, Demand Management, and Compact Administration, which outlined the Board's support for the DCP agreements and forthcoming Demand Management feasibility investigation. This Policy Statement was developed with significant input and collaboration with key stakeholders and water users across the state, and as ultimately adopted, incorporated most of the feedback received.

[10] More information can be found at: https://le.utah.gov/~2020/bills/static/SB0026.html

The Support and Policy Statement identified the CWCB's responsibility and authority as the State's water policy agency to evaluate and implement mechanisms for the effective management of water within the State, including the Colorado River. The Support and Policy Statement also recognized that water rights holders and other stakeholders have a vital interest in understanding the elements and conditions of any potential Demand Management program in Colorado, as well as the State's intentions in investigating any such program.

Following this statement, the Board further outlined a strategy for formulating the State's position regarding Demand Management in the Colorado River Basin. This included direction to:

- Convene a process to identify and evaluate the issues the State must address as part of any potential Demand Management program;
- Operate within, and subject to, the terms of the DMSA;
- Engage in activities that further the goals expressed in Colorado's Water Plan, with specific consideration given to the principles and collaborative efforts set forth in Chapter 9.1 and Principle 4 of the Conceptual Framework in Chapter 8;
- Investigate voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System for the specific purpose of helping assure compact compliance;
- Prioritize avoidance of disproportionate negative economic or environmental impacts to any single sub-basin or region within Colorado while protecting the legal rights of water rights holders. The Board committed to working with water rights holders and stakeholders to assess the feasibility of and promote mechanisms for obtaining roughly proportionate contributions of water consumptively used from the Colorado River System to a Demand Management program over a given timeframe from participants on each side of the Continental Divide;
- Comply with applicable state law, including, but not limited to the no injury rule;
- Consider and be fully informed by the input and considerations of water rights holders and stakeholders potentially impacted by a potential Demand Management program, and institute public review process for any such proposed Demand Management program; and
- Work with Colorado's Commissioner to the UCRC, the other Upper Division States, and the Department of Interior, to investigate and potentially develop a Demand Management program that considers and incorporates Colorado's Demand Management approach, and to ensure that water conserved within Colorado under any potential Demand Management program is not diverted and consumptively used by any other state

Additionally, the Board adopted a Compact Administration Policy Statement, stating that in the case that a potential Demand Management program is insufficient to ensure ongoing compliance with the Colorado River Compact, the Board would encourage and collaborate with the Division of Water Resources to engage in timely and extensive public outreach regarding development of any alternative measures or rules for compact compliance administration to fully inform and seek input from state water rights holders and stakeholders, noting that the goal would be to achieve

general consensus within the state, although it is not required. Further, the policy stated that it should not be understood as constraining the Division of Water Resources' lawful administration of water rights in Colorado to meet compact obligations.

The Support and Policy Statement is attached to this report as Attachment A.

2. The 2019 Work Plan

After the DCP was finalized in March 2019, the Board adopted the 2019 Demand Management Work Plan, which provided the framework and guidance for the initial stage in Colorado's Demand Management feasibility investigation. This Work Plan was informed by and consistent with the Support and Policy Statement the Board previously adopted. Like the policy statement discussed above, the Work Plan was developed with significant input and collaboration with key stakeholders and water users across the state.[11]

The Work Plan established a Project Management Team (sometimes referred to as the PMT or PM Team), comprised of representatives within the Department of Natural Resources (DNR) and the Attorney General's Office. The Work Plan directed the Project Management Team to implement the work plan and provide status reports and recommendations to the CWCB Board. The Work Plan covers only the initial stage of the feasibility investigation, through June 2020, at which point the Project Management Team was to seek additional guidance from the Board on the next steps of Colorado's feasibility investigation.

The Work Plan included three key components: establishing workgroups, hosting regional workshops, and engaging in continued education and outreach. The Work Plan directed that workgroups be established, comprised of subject matter experts on Colorado River issues. The workgroups were formed following an application process, with each of the workgroups directed to focus on a particular aspect of Demand Management. They were not directed to make any specific recommendations to the Board or suggestions as to how a particular Demand Management program should be designed. Rather, the workgroups were charged with identifying and framing important considerations for the Project Management Team to convey to the Board as it considers next steps in the feasibility investigation. The workgroups began meeting in August 2019 and were directed to meet at least four times before July 1, 2020. The eight workgroups ultimately established included the following:

- Agricultural Impacts
- Economic Considerations and Local Government
- Education and Outreach
- Environmental Considerations
- Funding
- Law and Policy

[11] These discussions were held at the CWCB Board's March and May 2019 meetings.

- Monitoring and Verification
- Water Rights Administration and Accounting

All Workgroup meetings were open to the public and provided an opportunity for public comment. Summaries on progress made by the workgroups are included in the following sections of this report.

In addition to the workgroups, the Project Management Team has had ongoing discussions with the two federally recognized Indian tribes in Colorado - the Southern Ute and Ute Mountain Ute Tribes ("Tribes"). These discussions have been held at a government-to-government level and therefore, no reports have been published relating to these meetings. Tribal Councils of both Tribes are supportive of continued participation in the investigation of the development of a potential Demand Management program. Additional detail relating to these discussions is provided in the following section.

The Work Plan further directed the Project Management Team to conduct regional workshops throughout the course of the feasibility investigation, designed to provide an opportunity for public engagement and feedback on the ongoing work. Additionally, the Work Plan emphasized the importance of continued education and outreach throughout the feasibility investigation. Neither workgroup meetings nor regional workshops were intended to supplant the continuation of outreach and education to groups around the state, but rather augment and increase communication with particular focus on those who request it and those who may not otherwise be engaged in the discussion. The Work Plan and subsequent update identifying workgroup participants are attached to this report as Attachment B.

II. The 2019 Work Plan to Date: Common Themes

The Interbasin Compact Committee (IBCC) met jointly with the Demand Management workgroups in March 2020. At the meeting, the workgroups had an opportunity to meet individually, as well as with other workgroups and as a larger group. As individual groups, they focused largely on identifying the core values of the groups, as well as the uncertainties that may impact whether those values can be achieved in a potential Demand Management program. This section highlights the key values that the workgroups identified, as well as the common themes that emerged throughout the course of the initial stage of the feasibility investigation. These themes were further developed as the workgroups identified several cross-cutting issues throughout their discussion. Members had a fair amount of cross-pollination in various formats, including attending other workgroups' meetings, providing lists of issues for other workgroups to consider, sharing various work products among workgroups, and meeting directly with other workgroups.

At the March joint meeting, the workgroups were asked to develop through facilitated discussion two lists of items—(1) key values or concerns that they have related to a possible Demand Management program and (2) important uncertain factors that could impact how well a Demand

Management program would perform relative to their key values. Next, each workgroup prioritized each list by individually assigning stickers to those values and uncertainties of most interest.[12]

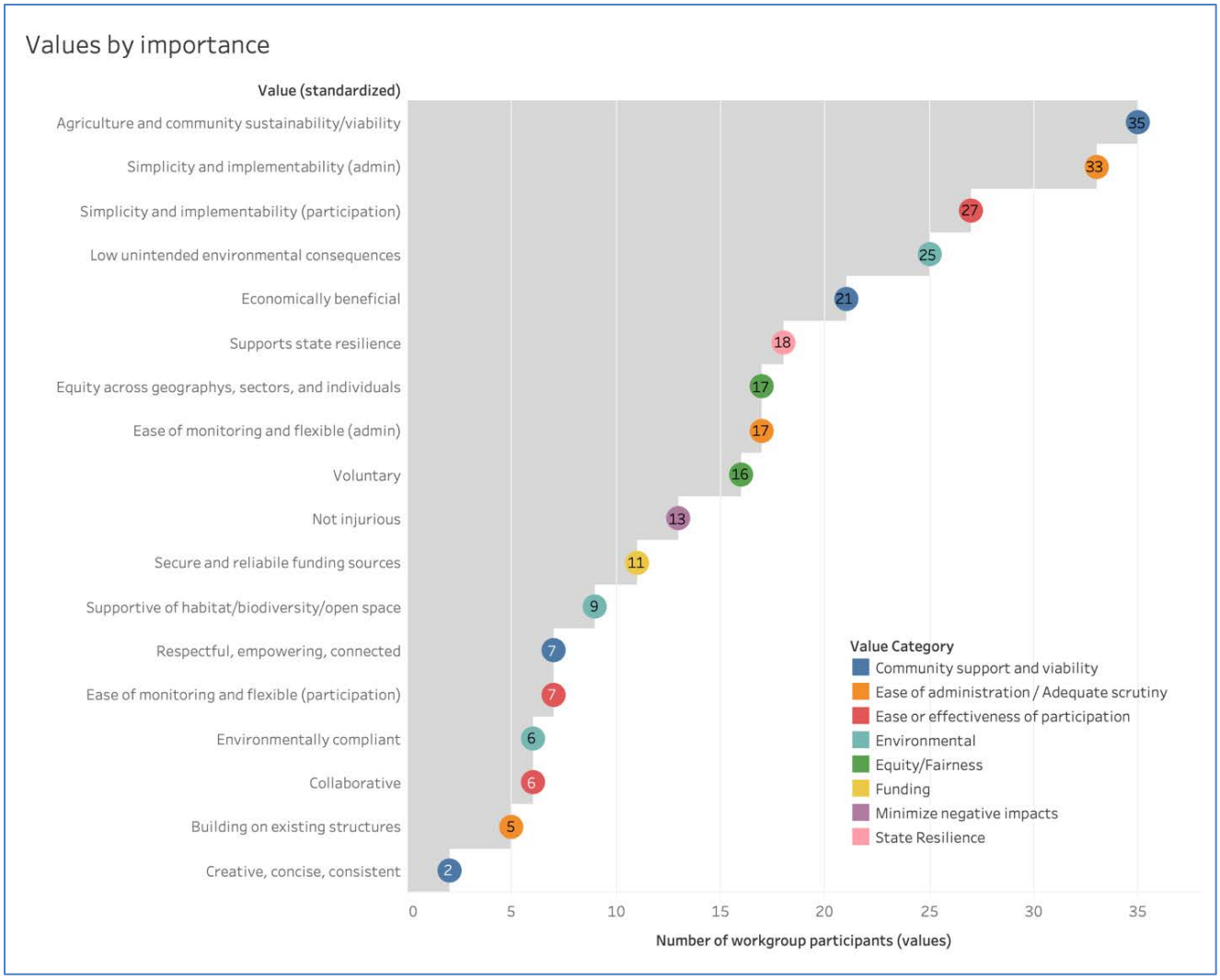
Next, the data were evaluated and a consolidated summary developed about the values and key uncertainties. An interactive tool was developed to summarize the findings from this work. Below are two visualizations summarizing the values identified by participants. The first categorizes by both the workgroup (columns) and categories defined to group similar values. The number within each symbol indicates how many workgroup participants indicated that the value was important to them. This visualization indicates significant overlap in values across the workgroups--many participants identified the same values as important. For example, most workgroups show concern about participation and equity. Three workgroups—Agricultural Impacts, Economic Impacts and Local Government, and Environmental Considerations—were mostly concerned with outcome-related values and less so with administrative and funding concerns. One interesting finding is that while the Agricultural Impacts and Economic Impacts and Local Government Workgroups emphasized values associated with community support and viability, there is also indication of the importance of some environmental goals associated with habitat and open space. The Environmental Workgroup focused on environmental-related values, understandably, but also highlighted equity and fairness values as well as a few related to the administration of the program.

[12] David G. Groves, Ph.D., with RAND Corporation, a consultant hired by CWCB, assisted in facilitating this discussion and developing this portion of the report.

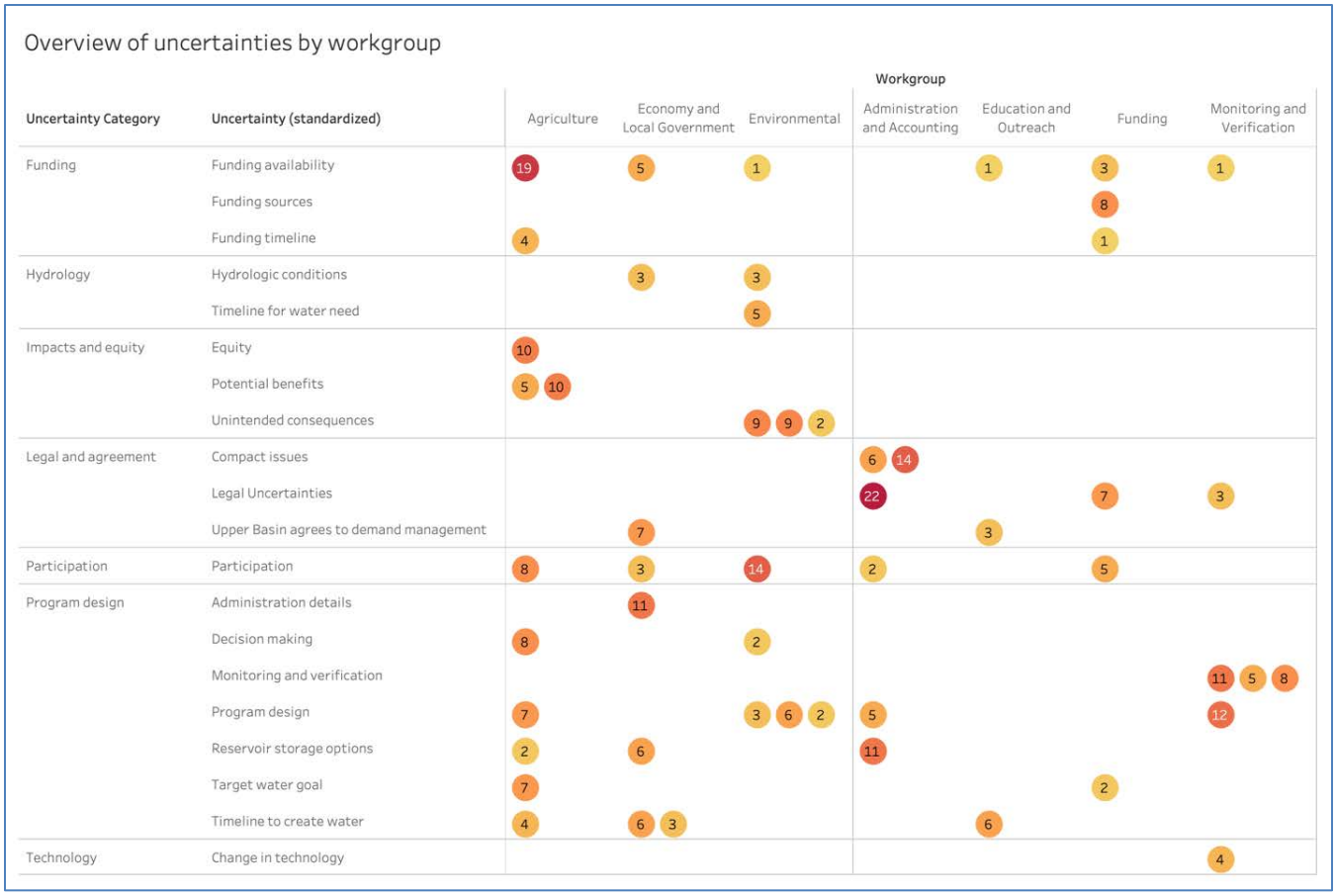
Overview of values by workgroup

Value Category	Value (standardized)	Agriculture	Economy and Local Government	Environmental	Administration and Accounting	Education and Outreach	Funding	Monitoring and Verification
		Workgroup						
Community support and viability	Agriculture and community sustainability/viability	26, 9						
	Creative, concise, consistent					1, 1		
	Economically beneficial	6	15					
	Respectful, empowering, connected					3, 2, 2		
Equity/Fairness	Broad participation	14	7	12		4		1, 6
	Equity across geographys, sectors, and individuals		2	5			3, 4, 3	
	Voluntary	6, 10						
Minimize negative impacts	Not injurious				13			
Environmental	Environmentally compliant			6				
	Low unintended environmental consequences			1, 17, 7				
	Supportive of habitat/biodiversity/open space	1, 5		2, 1				
Ease or effectiveness of participation	Collaborative		6					
	Ease of monitoring and flexible (participation)				7			
	Simplicity and implementability (participation)		12, 8		7			
Ease of administration / Adequate scrutiny	Building on existing structures							5
	Ease of monitoring and flexible (admin)			3	5			4, 5
	Simplicity and implementability (admin)				3, 9			7, 14
Funding	Secure and reliabile funding sources						5, 6	
State Resilience	Supports state resilience			5	5		8	

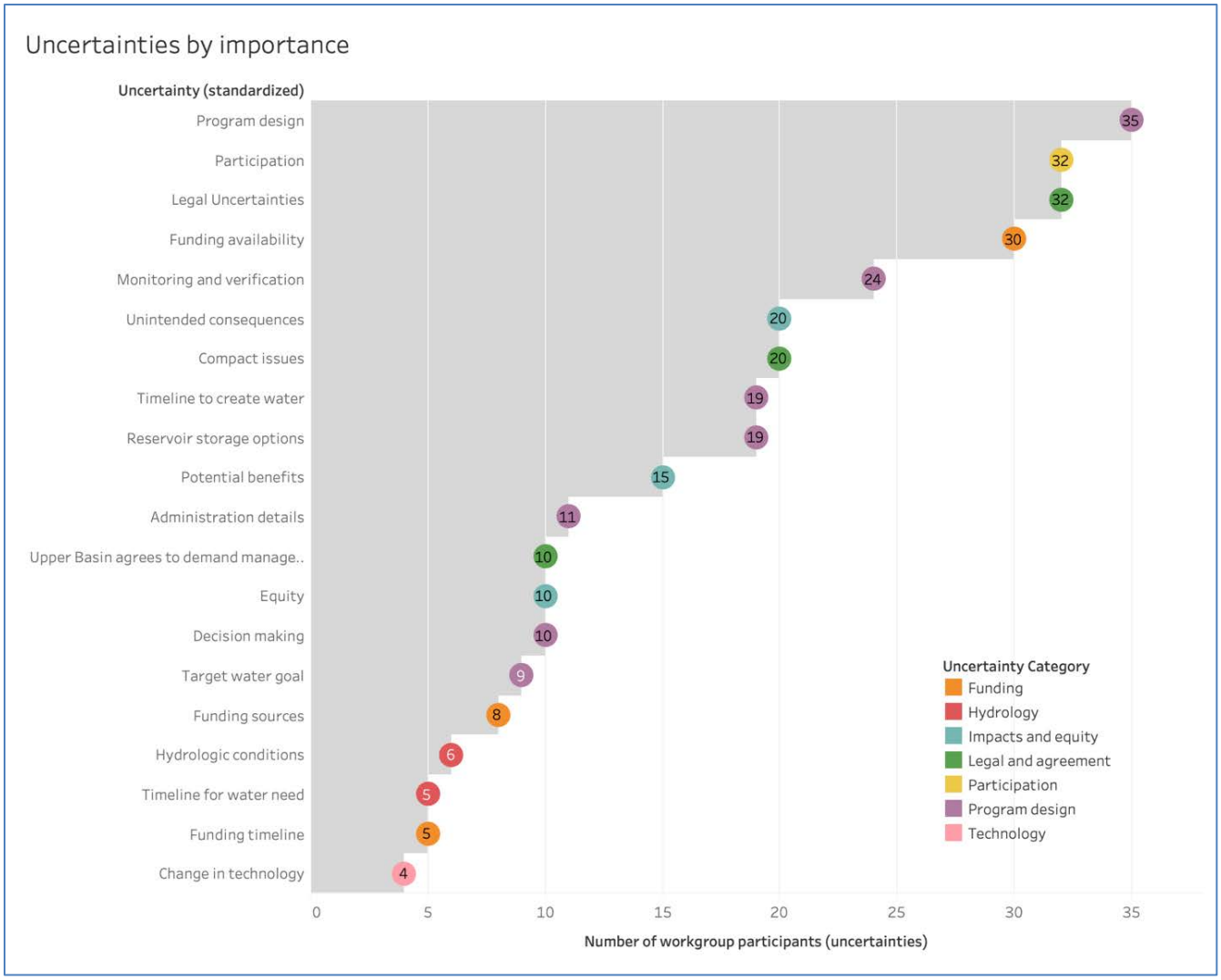
The next visualization below ranks the values overall by simply counting the number of respondents who indicate importance across all workgroups. Agriculture and community sustainability is the highest ranked value, followed by values associated with ease of participation and then environmental values.



Next, key uncertainties were considered. Using the same format as for values, the figure below summarizes the key uncertain drivers of concern to the workgroup participants. Again, we see much commonality across the workgroups. Many are concerned with funding availability. The amount and type of participation was also a key uncertainty, as it touches on the critical values highlighted above. There were also many uncertainties related to the program structure that were identified. Some of these reflect concerns about how the program would be designed. Others reflect uncertainties that would affect how the program performs.



These findings are further reinforced by the visualization below, which ranks the uncertainties by participant response. These results also highlight the concerns around legal uncertainties, monitoring and verification, and unintended impacts from the program.



Additional context regarding workgroup discussion of the key values identified, as well as other common issues and themes that have arisen in workgroup discussions, is below.

A. Community Viability and Local Benefits

Discussion in many groups focused on the need to ensure local impacts are considered in the development of any potential Demand Management program. Key impacts to evaluate at the local level include long-term sustainability and agricultural viability. There was recognition among the workgroup participants that a Demand Management program may provide benefits to participants, communities, and local economies, and help the State maintain compact compliance. However, a program may also create unintended secondary negative impacts. Many groups indicated that coordination with local communities will be essential to fully understand and address potential impacts. Although the avoidance of negative impacts is preferred, workgroups identified the need to consider potential mitigation in circumstances in which negative impacts may not be avoided.

B. Participation and Project Design: Simplicity and Flexibility

Many workgroups focused on developing sets of mechanisms, criteria, or programmatic elements that may be considered in developing a potential Demand Management program. These included, for example, mechanisms for monitoring various types of project activity, or environmental considerations that may be considered for particular projects. Although many groups were able to identify robust sets of potential criteria, they also acknowledged that analysis of those criteria for individual projects could become burdensome for the applicant and/or administrator of a program. In many cases, these groups recognized some type of cost-benefit analysis would need to occur in weighing the need for sufficient scrutiny and review with the concerns of creating an overly burdensome procedure that may discourage participation or create an inefficient or expensive program.

C. Creation of a Net-Positive Program: State Resilience and Increased Benefits

If a Demand Management program were to be implemented in Colorado, it would be strictly voluntary: nobody would be forced to participate in a program. Therefore, presumably participants would only participate if they determine it is in their best interests to do so. Moreover, many workgroups indicated that a potential Demand Management program could provide benefits to the State as a whole, including an increased ability to weather varying hydrologic conditions with greater certainty that the State will be able to maintain compact compliance and increased predictability in water management. In various iterations, the workgroups spoke of statewide resilience as an important value that a Demand Management program could further.

Nonetheless, several groups recognized the potential for unintended adverse impacts depending upon the level of participation in a particular region or sector. This led many to refer to Demand Management as a potential burden. Faced with this characterization, many workgroups were compelled to consider a potential Demand Management program as a “net-positive” for the State, and viewed their charge as considering potential mechanisms and designs that could create a net-positive program. In addition, there was recognition that though the purpose of a potential Demand Management program would be to ensure compact compliance, there may be tangential environmental, recreation, and other benefits. There was a strong desire among the workgroups to better understand those potential benefits or impacts.

D. Equity and Fairness

The November 2018 Support and Policy Statement directed that throughout the feasibility investigation, CWCB prioritize “avoidance of disproportionate negative economic or environmental impacts to any single sub-basin or region within Colorado while protecting the legal rights of water rights holders.” It further indicated that the Board would work to promote mechanisms for “obtaining roughly proportionate contributions of water” to a potential Demand

Management program from participants on both sides of the Continental Divide. This concept has been referred to as "equity" throughout the initial Demand Management discussions. However, the precise definition of equity and methods for achieving it have not been agreed upon or fully developed.

Although the question of equity has been a part of many Demand Management discussions, including those of many workgroups, the IBCC has been tasked with specifically analyzing the question of equity, and has acted as an additional workgroup with a focus particularly on the question of equity. This is discussed in greater detail in the following section.

E. Funding Uncertainties

One workgroup was specifically tasked with considering funding issues associated with a potential Demand Management program. However, many groups indicated that they believe it will be important to identify secure and reliable funding sources, and to understand the various options available. Many workgroups also identified the novel challenges this element presents given the COVID-19 pandemic and associated economic impacts.

F. Data Gaps

Many workgroups acknowledged that significant data gaps remain relating to a potential Demand Management program and discussed mechanisms for answering some of the outstanding questions. In some cases, additional research or legal analysis may be the most appropriate approach. However, many workgroup participants acknowledged that pilot or demonstration projects may be helpful in adding to the knowledge base, particularly relating to impacts of particular types of conservation projects that have not been widely tested or researched. The Agricultural Impacts group, in particular, was interested in development of a pilot program. Other workgroups echoed this sentiment.

The funding appropriated for the current stage of the feasibility investigation cannot be used for pilot programs. However, this may be a consideration moving into the next phase of the investigation. When considering potential pilot programs, it is important to note that any water created in such a program would become "system water." In other words, the Upper Division States would have no mechanism to protect such water, and it would therefore be subject to release to the Lower Basin pursuant to the terms of the 2007 Guidelines. The ability of the Upper Division States to store water and hold it for release for Compact compliance purposes only becomes available if all Upper Division States move through the steps of setting up a Demand Management program, as described in Section I.A.1.

G. Demand Management versus Compact Administration

Throughout the Demand Management discussion, the question of a potential compact administration on the Colorado River frequently arose. The purpose of any Demand

Management program would be to avoid compact administration. Demand Management presents a potential opportunity to proactively save water that could legally only be used for compact compliance purposes, and could only be released at the direction of the Upper Colorado River Commission. Nonetheless, some have expressed that it is difficult to assess the feasibility and advisability of a potential Demand Management program without knowing precisely what compact administration would look like. Some also express concern that a potential Demand Management program would "turn into" curtailment, or some sort of involuntary program. On the contrary, any Demand Management program would be strictly voluntary. No individual would be forced to participate in a program, if it were to be set up. However, whether sufficient water could be created through a Demand Management program to avoid compact administration in the Upper Basin is an open question, dependent on variable hydrology and other conditions that cannot always be predicted. Therefore, though Demand Management may be effective in reducing the need for or extent of a compact administration, we cannot be certain it will forever obviate the need for compact administration. Though related in some ways, Demand Management and compact administration are distinct concepts that should be understood as such.

III. The Workgroups: A Deeper Dive

The Board directed the workgroups to identify and analyze the key threshold issues associated with a potential Demand Management program. The workgroups were designed to provide a forum for a grassroots discussion and initial analysis of the concept of Demand Management, with the Project Management Team directed to report findings to the Board for further consideration. The workgroup meetings were designed to encourage frank, candid discussions about the various topics implicated by the concept of Demand Management. While the Project Management Team coordinated staff from the CWCB and Attorney General's Office to facilitate the meetings, the intent was to provide opportunities for the participants to have open-ended discussion that allowed for meaningful issue spotting. All workgroup meetings were open to the public and provided an opportunity for public comment.

Each Workgroup met at least four times, and some met more frequently. Each workgroup developed summaries and key takeaways from their meetings, which are attached to this report. Below is a summary of discussions of each workgroup, as well as explanations of the various products developed by the workgroups.[13]

A. Agricultural Impacts

The 2019 Work Plan, as originally drafted and presented to the Board at the March 2019 meeting, did not include an Agricultural Impacts Workgroup. The intention in the Project Management Team's drafting of the plan was that each of the workgroups would focus on

[13] The products developed by the workgroups should not be interpreted as support on behalf of the CWCB, workgroup members, or the organizations for which they work, for any of the positions or concepts discussed by the workgroups or as asserting any legal or policy positions. Rather, the documents are intended to summarize information discussed by the workgroup members, in their individual capacities.

agricultural impacts and issues, through their various lenses. However, pursuant to Board direction, this workgroup was added, though a formal charge was never developed. The group focused broadly on potential agricultural impacts and issues associated with a potential Demand Management program.

The Agricultural Impacts Workgroup held its first meeting in August 2019. At the initial meetings, the group focused on key threshold-level agricultural impacts issues, including the assessment of potential regional economic and ecological impacts of a Demand Management program. The Workgroup discussed various positive and negative agronomic effects that may arise from implementation of conservation activities, including changes in crop yield, soil health, and operational considerations. The group agreed that proportional program participation and avoidance of undue burden on a specific water right holder, economic sector, or geographic location would be key to building agricultural community support, and further discussed the value of developing a set of guiding criteria and principles of a potential Demand Management program speaking to these issues. Other critical issues identified included avoiding impacts of reduced return flows and material injury to water right holders, the provision of technical assistance, and the role of irrigation providers and managers in program implementation.

Throughout the initial meetings, the group heard presentations on other voluntary, temporary, and compensated conservation efforts that could inform considerations for a potential Demand Management program such as alternative transfer methods (ATMs). The Workgroup also acknowledged and discussed the significant data gaps that remain. The group thought it would be beneficial to learn more about potential effects of various conservation practices, including the implications for long-term crop production and returning fallowed land back to production. The group agreed that at some point, pilot programs could help inform some of the open questions relating to agricultural impacts of potential Demand Management activity. The group also showed interest in what ultimately became an ATM project organized by workgroup members Paul Bruchez and Aaron Derwingson. This ATM project, funding for which was approved by the CWCB Board in March 2020, is designed to analyze potential water conservation and agronomic viability issues associated with reducing irrigation on high altitude irrigated pasture. This project will likely yield information that will be helpful to the ongoing feasibility investigation.

The group identified some key themes and issues that were identified throughout the course of the workgroup meetings. The Workgroup also developed a framework for potential future pilot programs, noting that while current funding cannot be used to design or implement a pilot program, the Workgroup believed a pilot program may warrant further consideration in the next stages of the feasibility investigation. These documents, as well as meeting reports, are attached as Attachment C.

B. Economic Impacts and Local Government

The Economic Impacts and Local Government's Workgroup charge per the 2019 Work Plan was as follows:

Research, test (as needed), and identify potential economic impacts that may need to be considered in any Demand Management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of both primary and secondary economic impacts and short-term and long-term economic considerations. This workgroup will also work with the PM Team to note potential mechanisms and considerations that could economically incentivize or obstruct Demand Management participation in various parts of the state.

This workgroup first met in August 2019, and initially focused on identifying the various possible economic impacts to communities associated with a potential Demand Management program. The group also considered the role that local governments may have in managing the impacts. The Workgroup further considered the benefits of developing parameters for participation in a potential program that would be designed to minimize adverse impacts and maximize benefits of any program. The group also expressed interest in better understanding the mechanisms for pricing of water.

Throughout the course of their discussions, workgroup members expressed concern about the rhetoric used when discussing Demand Management, including but not limited to, the reference to Demand Management as a burden. The group expressed a desire to shift towards viewing a potential Demand Management program as a tool with potential benefits. Like other Workgroups, the group noted that additional research would be helpful to better understand issues such as soil health, impacts of fallowing or deficit irrigation on high elevation agricultural operations, impacts to communities and different economic sectors, and impacts to wildfire risk. The group also identified social justice as a potential issue in a Demand Management program.

The group developed a summary of principles and issues that may be important to consider if establishing any potential Demand Management program. This summary was informed by two guiding principles: (1) do no harm; and 2) if a program is established, design a program that creates benefits. The group also developed a list of process considerations to keep in mind to further these principles. The group's summary as well as reports from meetings are attached as Attachment D.

C. Education and Outreach

The Education and Outreach Workgroup's charge per the 2019 Work Plan was as follows:

Develop public outreach strategies and materials regarding the topic of Demand Management within Colorado. In addition, this workgroup will coordinate with the PM Team to develop

consistent and informative workshops and presentations that are intended to engage with water rights holders and other interested stakeholders on the topic of Demand Management.

This workgroup held its first meeting in August 2019, and focused on how to identify potential target audiences for Demand Management communications. It also focused on the current perception of and communication challenges associated with the workgroup process and feasibility investigation in general. The Workgroup also considered the Demand Management process as a whole, including a potential Demand Management program to be set up in the future. In their initial meetings, the workgroup articulated the importance of messaging Demand Management as a potential resilience tool to address future uncertainty, and as an opportunity for creation of a "net positive" water management approach. The group agreed that education and outreach efforts should be inclusive of all voices and efforts should be made to reach all audiences. To successfully accomplish such outreach, the group also noted the importance of understanding the obstacles and challenges that persist.

The group further considered the varying mechanisms for reaching key stakeholders across the state, recognizing the need to cater education and outreach strategies to location and type of water user. Additionally, this workgroup discussed the importance of distinguishing between outreach needs through the initial stages of the feasibility investigation and outreach needs that may arise if and when a program is set up.

The workgroup developed a document identifying the key education and outreach considerations associated with a potential Demand Management program. This document and the group's reports are attached as Attachment E.

D. Environmental Considerations

The Environmental Considerations Workgroup's charge per the 2019 Work Plan was as follows:

Research, test (as needed), and identify potential environmental impacts that may need to be considered in any Demand Management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of existing environmental rules and regulations, and identification of short-term and long-term environmental considerations. This workgroup will also work with the PM Team to note potential environmental mechanisms and considerations that could incentivize or obstruct Demand Management participation in various parts of the state.

The Environmental Considerations Workgroup first met in August 2019. The group recognized that the primary purpose of any potential Demand Management program would be to help avoid the need for curtailment in the state. However, in accomplishing this goal, the Workgroup emphasized that a program has potential to create either environmental benefits or impacts, depending on how the program is structured and how projects are selected and implemented. To help inform these considerations, the group further discussed potential tools for identifying and

measuring possible environmental impacts of a Demand Management program. The workgroup also evaluated existing information related to conserved consumptive use programs but found that few of these studies included environmental assessments or had sufficient information in order to do so. The group also identified environmental rules and regulations that may need to be considered in a potential Demand Management program, including the Endangered Species Act, Migratory Bird Treaty Act, Clean Water Act, and others.

The group focused on considerations to help identify Demand Management projects that could provide environmental benefits. The group developed a document summarizing key elements to consider in setting up a potential Demand Management program, including the type of information needed to analyze environmental benefits or impacts, important resource considerations, program-wide issues, and a list of potential tools for these assessments. Additionally, the group considered hypothetical Demand Management projects in an effort to consider specific benefits, impacts, and other considerations associated with particular project elements. These documents, as well as the group's reports, are attached as Attachment F.

E. Funding

The Funding Workgroup's charge per the 2019 Work Plan was as follows:

Research, test (as needed), and identify potential funding sources for costs associated with implementation of a Demand Management program, including but not limited to, costs related to implementation and administration of such program within Colorado.

The Funding Workgroup held its first meeting in August 2019, and largely focused on the question of the amount of money needed for any potential Demand Management program, and potential sources of those funds. Because the funding question is tied to the type of program and how it functions, the Workgroup also considered how a potential program may be administered, and some broader questions about how a program may be designed. These questions begged other questions, such as the value of water and the timeframe over which funding would need to be developed. The group quickly identified that it would be helpful to work within certain parameters to frame the discussion and developed conceptual scenarios to assist in considering various funding issues and options. The key drivers they identified in considering potential scenarios included: volume of water needed, cost of a potential program (cost per acre-foot), percentage of water savings expected from a potential Demand Management program, timeframe of the potential program, and reservoir storage options.

The group's following meetings focused on analyzing potential outcomes relating to these key uncertainties, and identifying potential funding sources based on what a potential program would look like under various circumstances. The group's final meeting took place in the midst of the COVID-19 pandemic, which impacted the group's analysis of funding options available, as reflected in their work product. A visual representation of the key uncertainties the Workgroup

considered as drivers for potential funding sources, and the group's reports are attached as Attachment F.

F. Law and Policy

The Law and Policy Workgroup's charge per the 2019 Work Plan was as follows:

Review and analyze laws, rules and regulations and relevant policy considerations to inform the range of state and federal legal and policy frameworks to follow for Demand Management implementation within Colorado. This workgroup will also coordinate with the PM Team: (1) to help inform the legal and policy questions raised by other workgroups as they investigate specific elements of Demand Management feasibility within Colorado; and (2) to assist in developing reporting and educational materials.

The Law and Policy Workgroup held their first meeting in December 2019. The group waited to hold their initial meeting until other workgroups had time to meet and identify key topics for the Law & Policy Workgroup to consider. Their first meeting focused on developing a list of key legal and policy issues associated with a potential Demand Management program. The initial list included: legal definitions of critical terms, purpose and goal, water management and administration, governance, funding, equity/neutrality, hybrid considerations, and tribal considerations. As the group began to analyze these points, the group acknowledged that the DMSA, as well as CWCB Board's November 2018 Support and Policy Statement and further positions adopted by the Board, provide legal parameters that guide and constrain how a potential program may operate.

Based on this initial list of threshold issues, the group analyzed various legal and policy issues associated with a potential Demand Management program and ultimately developed the following documents:

- Legal disclaimer
- Policy framework, which identifies the key elements of the DMSA and CWCB's policies relating to Demand Management
- Beneficial use analysis, which analyzes whether actions taken under a potential Demand Management program can be considered a beneficial use pursuant to Colorado law
- Compact compliance analysis, which considers potential definitions of compact compliance within the context of a potential Demand Management program
- Conserved consumptive use analysis, which analyzes potential definitions of conserved consumptive use as contemplated in the context of a potential Demand Management program
- Eligibility analysis relating to participation in a potential Demand Management program
- Temporary definition analysis, identifying potential definitions of "temporary" for purposes of participation in a potential Demand Management program

- Project Review and Approval Process analysis

These documents and the group's reports are attached as Attachment H.

G. Monitoring and Verification

The Monitoring and Verification Workgroup's charge per the 2019 Work Plan was as follows:

Research, develop, and test (as needed) various methods available or needed to measure and verify the volume of conserved consumptive use under any Demand Management program. This workgroup will also work with the PM Team to further examine factors related to lead time, costs and staff resources required to model, pilot or otherwise meaningfully investigate various monitoring and verification considerations for implementing Demand Management within Colorado.

The Monitoring and Verification Workgroup held their first meeting in September 2019, with the recognition that much work has been done already on monitoring and verification issues associated with conserved consumptive use projects. Therefore, the group primarily focused on hearing presentations on and discussing previous efforts, such as the System Conservation Pilot Program and Colorado Water Court change case best practices.[14] The group also discussed innovative methods to estimate agricultural consumptive use such as remote sensing and streamlined State tools. The group acknowledged that there are additional challenges associated with monitoring and verifying conserved consumptive use for trans-basin diversions. A common theme throughout this group's discussion was the challenge of balancing the need for flexibility, low cost, and ease of administration of a potential program with the need for adequate scrutiny to ensure projects meet the necessary criteria of the program and to avoid injury to other water users.

Ultimately, the group focused on the key distinctions among monitoring and verification for various types of projects. The group developed documents outlining the monitoring and verification considerations and potential approaches for various project types, focusing primarily on trans-mountain diversion and agricultural projects. The group also analyzed monitoring and verification issues relating to hypothetical projects. These documents, as well as the group's reports, are attached as Attachment I.

H. Water Rights Administration and Accounting

The Administration and Accounting Workgroup's charge was as follows:

Research and test (as needed) various methods or practices available or required to (1) assist in administering water rights as a result of Demand Management activities within Colorado; and

[14] For more information on the System Conservation Pilot Program: http://www.ucrcommission.com/system-conservation-pilot-program/

(2) account for volume of conserved water as it is transported and stored at one of the Colorado River Storage Project's Initial Units. Tasks for this workgroup will include, but not be limited to, examination of unique administration practices and identifying actions that may incentivize or obstruct Demand Management participation in each water division. This workgroup will also work with the PM Team to further examine factors related to lead time, costs, and staff resources required to model, pilot, or otherwise meaningfully investigate water rights administration and accounting considerations for implementing Demand Management within Colorado.

The Administration and Accounting Workgroup first met in November 2019, after giving most of the other workgroups an opportunity to initiate discussions and identify issues they would like the Administration and Accounting workgroup to consider. The Workgroup noted the significant existing knowledge base relating to administration and accounting of conservation programs, and early efforts focused primarily on familiarizing themselves with the extent and status of that existing knowledge base. Specifically, the group heard presentations on the Rio Grande Water Conservation District's conservation efforts; the System Conservation Pilot Program; and CWCB's Agricultural Water Transfer Methods (ATM) program. The group discussed similarities and differences between these and other programs and noted the administration considerations that may also arise with a potential Demand Management program.

In their next two meetings, the Administration and Accounting Workgroup focused on developing and analyzing hypothetical Demand Management projects with the intention of working through how administration might be able to work on the ground. The hypotheticals included combinations of factors including, but not limited to, the type of water right owner, type of use, and priority date of the water right. The group provided feedback on the key issues to be considered relating to administration issues, including the process for changing the use of a water right from its current use to demand management; the question of whether demand management may be considered a beneficial use of water; analysis of key points in the Board's Support and Policy Statement; the question of who has the authority to secure water for a beneficial use; storage and administration and accounting of such storage in the Aspinall Unit; and issues and mechanisms for future analysis. The report detailing these issues as well as the Workgroup's reports, are attached as Attachment J.

I. Interbasin Compact Committee – Equity

In addition to the eight workgroups, the IBCC essentially served as an additional workgroup focused on the issue of equity. The concept of equity originated from the Board's November 2018 Support and Policy Statement and 2019 Work Plan, discussed above. Discussions about equity focused primarily on avoiding adverse impacts to any one sector, region, or type of water user across the state. However, the definite parameters of this nebulous concept and mechanisms for ensuring any Demand Management program is equitable have proven difficult to define.

Though the IBCC was specifically charged with considering this issue, the other workgroups also had several discussions about equity. In an effort to facilitate these cross-cutting discussions,

a joint IBCC/Demand Management Workgroup meeting was held in Denver March 4-5, 2020. The IBCC had several other discussions about equity, as well. However, IBCC members recognized that this important discussion should continue throughout the course of the feasibility investigation. A summary of IBCC's discussions relating to equity is attached as Attachment K.

J. Ongoing Discussions with Tribes

CWCB staff have met several times with the Tribes to discuss the willingness and interest in supporting the feasibility of the development of a Demand Management program in Colorado. These discussions have led to, as have most discussions with the workgroups, general questions about how the program would work. Other topics of importance are similar to those of the workgroups, including what parameters for participation in a potential program would be, funding source and amount of funding available, eligibility to participate, necessary legislative changes to move water as part of a potential Demand Management proram, and how defining factors for qualified participants may be designed. Similar to the Monitoring and Verification and Law and Policy workgroups, the Tribes are interested in identifying the legal impediments to participation, storage water as a consumptive use, and what constitutes conserved consumptive use.

The Tribes are interested in the possibility of participating in the Demand Management workshop to take place with the Board.

IV. Regional Workshops

The Project Management Team facilitated two regional workshops. Although the group hoped to hold an additional workshop before June 2020, COVID-19 public health restrictions made it impossible to hold an in-person meeting. Summaries of each regional workshop are below.

A. Regional Workshop I: August 22, 2019, Steamboat Springs

The first regional workshop was held at the Colorado Water Congress summer conference in Steamboat Springs on August 22, 2019. This took place before several workgroups had met for the first time. As such, it served as a kickoff to the process and was largely designed as a listening session. After hearing a brief presentation from State staff on the concept of Demand Management, participants provided feedback on the key issues or questions they identified relating to a potential demand management program. The key issues identified included:

- Community impacts: how can we create a "net positive" program if one is developed?
- Monitoring and verification: how will we adequately track the water conserved as part of a program?
- Proportionality and equity: how are these concepts defined, and how do we ensure these goals are met within a fully voluntary program?
- Scale and parameters of a potential program: how much water would Colorado contribute to a potential program?

- Environmental benefits: How can we track and maximize potential environmental benefits of a program?

B. Regional Workshop II: January 29, 2020, Westminster

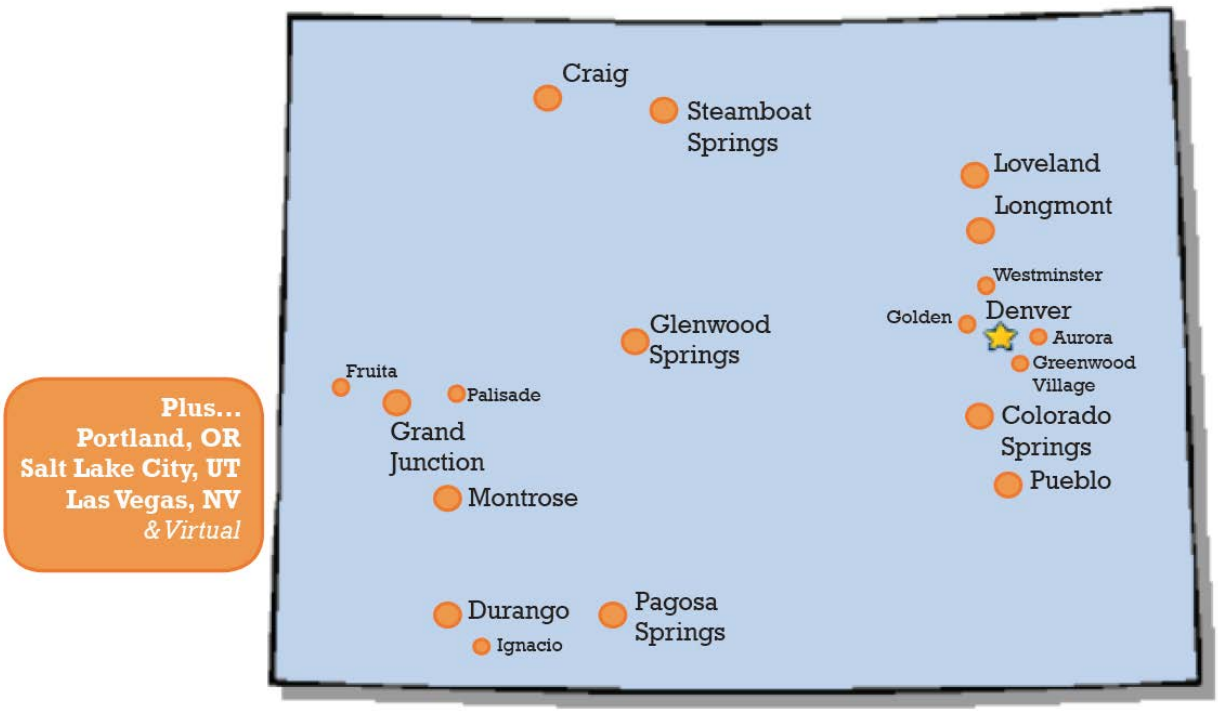
The second regional workshop was held at the Colorado Water Congress winter conference in Westminster on January 29, 2020. The Project Management Team provided an update on the feasibility investigation to date and key themes identified by workgroups, then facilitated a group exercise in which attendees considered the following questions and assigned spokespeople to report the groups' responses. Each question and key discussion notes are provided below.

- What is the best way to reach people who may not have heard about Demand Management and/or are not otherwise involved in the discussion?
    - *It is important to reach people who own the water rights.*
    - *This is not an issue unique to Demand Management. Identify the target audience, and mechanisms for reaching them.*
- What are the biggest misunderstandings around Demand Management and how may we address them?
    - *The largest misconception is that it is a foregone conclusion, and that it would be forced.*
- What are potential funding mechanisms?
    - *Fees to water users; withdrawal fee to all users; hydropower; federal funding.*
    - *Must consider education and outreach needs associated with funding issues.*
- What is the root of the perception that Demand Management is a burden?
    - *Broad concern that the impact of such a program would disproportionately impact certain types of water users.*
    - *The underlying issue is in framing of the issue.*
- How would you define temporary in the context of Demand Management?
    - *Begin by considering existing definitions of temporary in place for other programs.*
    - *"Not permanent" – even if a program itself is permanent, participation is not.*
- How can we best achieve a net positive impact from Demand Management for communities and the State?
    - *Sharing of the pain, so that no one group feels like it is the "loser."*
    - *Agricultural producers could receive a reliable stream of income, and a potential Demand Management program could benefit the entire economy.*
    - *Marrying water and energy benefits could be helpful.*
    - *Compensation is a benefit to participants, and a better alternative to curtailment.*
- What are the data gaps associated with Demand Management?
    - *The issue of how good is "good enough" for Colorado, and for the program is an open question.*
    - *There is a need for granularity, and consideration of soil and crop types, and on-the-ground considerations.*
    - *Open questions remain relating to shepherding issues.*

- What are the key threshold issues associated with Demand Management?
    - *Whether the existing statutory and legal structure is sufficient, and can accommodate a Demand Management program.*
- What are potential mechanisms for measuring potential environmental benefits?
    - *The most obvious benefit is that there will be more water in streams that otherwise would not have been there. However, timing and location are important considerations. Note that environmental benefits may be temporary since participation would be temporary.*
    - *Reliance on work done by other entities in considering environmental benefits.*

V. Education and Outreach

Neither the workgroup meetings, nor the regional workshops, supplanted the need for continued education and outreach. State staff conducted extensive education and outreach throughout the course of the 2019 Work Plan. This included both proactively engaging various stakeholder groups and others, while also being available to discuss Demand Management and providing information in response to all requests. Staff provided updates to various groups at least twice every month of the feasibility investigation, and sometimes up to five or more presentations were given in a month. They were spread across the State. The discussions focused on providing background relating to the DCP and Demand Management, status updates on the feasibility investigation, and providing adequate time for open discussion and questions and answers. Continued education and outreach will be a key element of the feasibility investigation. Staff are committed to continuing to conduct education and outreach on a remote basis as needed, given the current COVID-19 pandemic. The following map shows where staff presented to stakeholder groups and interested members of the public. In many cases, staff presented on multiple occasions in the same location.



In addition to in-person outreach, CWCB has increased its digital coverage of agency activities, including Demand Management. Throughout the feasibility investigation, CWCB has announced workgroup and workshop events via the agency's website calendar and bimonthly newsletter; provided live coverage of workshops through social media; and detailed updates along the way through multiple press releases and newsletter blurbs.

CWCB staff has also been committed to providing ample opportunity for public engagement and comment on the process. An e-mail address was established specifically to receive public comment on the feasibility investigation (demandmanagement@state.co.us). Members of the public were also invited to attend all workgroup meetings and provide comment. Below is a summary of key public comments received throughout the process.

- Concern that given hydrologic conditions, there should be more urgency in setting up a demand management program;
- Questions relating to the concept of voluntariness: though voluntary at the participant level, concerns remain as to tenant issues, community impacts, and voluntariness of municipal participation;
- Proportionality and equity need to be further defined and assured in any program to be set up;
- Concerns about setting up a market for water, and creation of incentives for increased participation in a perceived water market; and
- Desire to ensure any potential program adequately considers and accounts for potential injury to other water users

VI. Literature Review

In this initial stage of Colorado's feasibility investigation, the Board also directed a Request for Proposals be issued for a literature review and identification of data gaps. Consultants were selected and contracted in April 2019, and the following elements were awarded as follows:

- WestWater Research: Agricultural Impacts; Funding; Economic Impacts and Local Governments
- SGM: Environmental Considerations; Monitoring & Verification; Facilitation; Project Management
- CDR: Education & Outreach

The consultants have reviewed the reports and feedback from the workgroups and have also attended workgroup meetings to get a sense of the priorities and threshold issues identified. The consultants hold weekly check-ins and are in close communication with members of the Project Management Team and will continue working to produce a report on their literature review and identification of data gaps for the Board. The funding appropriated for this effort has been extended through June 2021. Therefore, the consultants have additional time to analyze the work to date by the workgroups and consider Board input in identifying key issues for consideration.

VII. Future Planning

This Report is intended to provide the Board with a summary of the work performed to date pursuant to the 2019 Work Plan adopted by the Board in March 2019. It is not designed to provide recommendations as to next steps, or to provide direction as to the ultimate question of feasibility. However, staff anticipates continuation of work with consultants on the literature review, which will assist in further analyzing the various issues identified by the workgroups. Going forward, the recent cut in funds allocated to Demand Management due to COVID-19 budget impacts may reduce options available for next steps in the feasibility investigation. Of the $1.7 million originally allocated for the initial stage of the feasibility investigation, $866,000 was returned to the General Fund in order to backfill the revenue shortfall for Fiscal Year 2019-20. While we expect work to continue, funding availability will be a consideration going forward.

Staff looks forward to discussing this report and the work of the workgroups in greater detail with the Board at the July meeting and subsequent Demand Management workshop.

Attachment A

CWCB Board's November 2018 Support and Policy Statement

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

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John Hickenlooper, Governor

Bob Randall, DNR Executive Director

Rebecca Mitchell, CWCB Director

November 15, 2018

SUPPORT AND POLICY STATEMENTS

REGARDING COLORADO RIVER DROUGHT CONTINGENCY PLANS, DEMAND MANAGEMENT AND COMPACT ADMINISTRATION

Since 2000, the certainty and security of the Colorado River water supply have been called into question. The entire Colorado River Basin is currently in the worst hydrologic cycle in the historic record. Between 2000 and 2018, the Basin has experienced the driest year on record (2002), and the driest consecutive two-year period on record (2012 and 2013). It has also experienced above-average runoff only five out of 19 years, and withstood a decline in storage levels at the two largest reservoirs in the Colorado River Basin – Lake Mead and Lake Powell – to less than half of full capacity. Further, recently published data indicate a likely continuation of the trend of reduced flows and increased demand throughout the Colorado River Basin. Regardless of whether this is an extended drought or the new normal hydrology, the potential impacts to the state and its citizens could be significant.

The importance to Colorado of its namesake river cannot be overstated. Originating as snowfall high in the Colorado mountains, water from the Colorado River is put to wide range of uses by agricultural, municipal, tribal, industrial, and non-consumptive water rights holders across the state. The Colorado River is an irreplaceable resource for the entire state.

Continued drought or worsening water supply conditions in the Upper Colorado River Basin could increase the risk of: (a) Lake Powell storage declining below critical elevations to maintain operational functionality; and (b) mandated curtailment of the exercise of water rights to maintain compliance with the Upper Colorado River Basin and Colorado River Compacts. Both risks could have serious implications for Colorado.

Faced with this reality, Colorado's Commissioner to the Upper Colorado River Commission and staff at the Colorado Water Conservation Board and Attorney General's Office have been working with the other Colorado River Basin States, the Federal Government, and relevant stakeholders to develop a Drought Contingency Plan (DCP) that can help minimize and mitigate the risks associated with consistently below average water supplies in the Colorado River Basin. The DCP is comprised of several agreements, involving the Secretary of Interior, the Upper Basin states, the Upper Colorado River Commission, and the Lower Basin states. The DCP as a whole establishes the provisions and framework within which the seven Basin States may act in conjunction with the Secretary of the Interior to mitigate risks of extended drought, while protecting their respective rights and interests consistent with the "Law of the Colorado River."

The DCP documents were posted in final review draft form on the CWCB's website on October 9, 2018. The seven basin states and the Department of Interior are currently in the process of vetting the DCP agreements with the public. Before the DCP agreements would be implemented in either the Upper or Lower Colorado River Basin, it is anticipated that they would be authorized by Congress and executed by the relevant signatory parties.

The Upper Basin DCP includes, among other things, a Drought Response Operations Agreement and a Demand Management Storage Agreement. The Drought Response Operations Agreement directs management of the Initial Units[1] consistent with existing operational permitting, and is intended to reduce the risk of Lake Powell declining below minimum power pool elevation. If Lake Powell were to drop below minimum power pool elevation, it would become financially and physically difficult to maintain existing water uses, compact compliance obligations, and hydropower generation. The Demand Management Storage Agreement is intended to help assure compact compliance and reduce the risk of mandatory curtailment by securing the ability to store water at the Initial Units at no charge for compact compliance purposes.

The Upper Basin DCP agreements do not certify, warrant or otherwise guarantee that a demand management program will be established in the Upper Basin. The agreements only provide an opportunity for the Upper Division States (Colorado, New Mexico, Utah, and Wyoming) to use available storage space at the Initial Units only if an approved Upper Basin demand management program is established. Such use would be free of charge and the water stored would not be subject to release under the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations of Lake Powell and Lake Mead. Before any demand management program could be implemented in the Upper Basin, each state and the Upper Colorado River Commission must evaluate the feasibility of demand management concepts, reach agreement on a number of key points, and provide formal approvals.

Demand management activities that could be promoted in Colorado as a result of the DCP would likely involve intentionally reducing consumptive uses from the Colorado River System, and storing the conserved water at the Initial Units to help assure the Upper Basin's continued compact compliance. Any such actions require careful consideration of the impacts to individuals, communities, and local economies.

As the agency authorized to consider and establish the state's water policy, the Colorado Water Conservation Board has a responsibility to evaluate and implement mechanisms for the effective management and wise administration of the Colorado River within Colorado. Specifically, it is the express responsibility and within the purview of the Board to:

i. devise and formulate methods, means, and plans for bringing about the greater utilization of the waters of the state (C.R.S. 37-60-106(1)(c) (2017));
ii. gather data and information looking toward greater utilization of the waters of the state (C.R.S. 37-60-106(1)(d));

[1] The Initial Units refer to the units authorized under the Colorado River Storage Project Act, including Glen Canyon Dam, Flaming Gorge, Aspinall Unit (comprised of Blue Mesa, Morrow Point and Crystal Reservoirs), and Navajo Reservoir.

iii. cooperate with the other states and Federal Government for the purpose of bringing about the greater utilization of the waters of the state of Colorado (C.R.S. 37-60-106(1)(e));
iv. formulate and prepare drafts of state and federal legislation designed to assist in securing greater beneficial use and utilization of the water of the state and protection from flood damages (C.R.S. 37-60-106(1)(g));
v. investigate and assist in formulating a response to the plans, purposes, procedures, requirements, law, proposed laws, or other activities of the federal government and other states which affect or might affect the use or development of water resources of this state (C.R.S. 37-60-106(1)(h)); and
vi. foster the conservation of the water of the state by the promotion and implementation of sound measures to enhance water use efficiency in order to serve all the water needs of the state and to assure the availability of adequate supplies for future uses, and that necessary water services are provided at a reasonable cost. (C.R.S. 37-60-106(i)(r)).

In fulfilling its statutory obligations, the Board also recognizes that water rights holders and other stakeholders have a vital interest in understanding the elements and conditions of any possible demand management program in Colorado, as well as the state's intentions in investigating and potentially pursuing such a program within Colorado, in order to ensure that their rights, respective interests, and communities are valued and protected.

At the January 2018 meeting, the Board directed staff to proactively engage in a state-wide discussion regarding demand management. Since that time, CWCB staff has initiated outreach with interested water rights holders and stakeholders and robust discussions about the concept of demand management, and has developed a greater understanding of various perspectives, concerns, and considerations regarding demand management within Colorado.

The Board has also heard directly from interested water rights holders and stakeholders on demand management considerations via letters and public testimony at its September 2018 meeting.

With this contextual background, the Colorado Water Conservation Board sets forth the following Support and Policy Statements Regarding Colorado River Drought Contingency Plans, Demand Management, and Compact Administration.

STATEMENT OF SUPPORT

The Colorado Water Conservation Board expressly endorses the collective efforts of the seven Colorado River Basin States and Federal Government to plan and prepare for drought contingencies in the Colorado River Basin. Furthermore, the Board joins with Colorado's Commissioner to the Upper Colorado River Commission to present its full support for finalizing the Colorado River Basin Drought Contingency Plan documents in substantial conformance with the final review draft documents posted on the CWCB website on October 9, 2018, and for obtaining appropriate Congressional authorization of the DCP.

DEMAND MANAGEMENT POLICY STATEMENT

In consideration of the past, present and potential future hydrologic conditions confronting the Colorado River Basin, and in light of the above considerations, it will be the Colorado Water Conservation Board's policy to:

(1) Develop the state's position and approach on whether and how to develop any Upper Basin Demand Management Program that could potentially be implemented within Colorado consistent with state law to avoid or mitigate the risk of involuntary compact curtailment and to enhance certainty and security in the Colorado River water supply.

Furthermore, in formulating the state's demand management position, it will be the Board's strategy to:

(2) Convene a process to identify and evaluate the issues the state must address as part of any potential demand management program to be considered in Colorado and the Upper Basin.

(3) Operate within, and subject to, the terms and conditions of the interstate Upper Basin Demand Management Storage Agreement (Agreement Regarding Storage at Colorado River Storage Project Act Reservoirs Under an Upper Basin Demand Management Program), including, but not limited to, the express understandings that:

a. Any water conserved under an Upper Basin Demand Management Program will be stored at the Initial Units without charge;
b. Any water conserved and stored under an Upper Basin Demand Management Program will be solely for the purpose of helping assure compliance with the Colorado River Compact;
c. Any water conserved and stored under an Upper Basin Demand Management Program shall not be released from Lake Powell except at the request of the Upper Colorado River Commission for the exclusive purpose of helping assure compact compliance; and
d. Any water conserved and stored under an Upper Basin Demand Management Program will be subject to evaporation assessments and volumetric limitations.

(4) Engage in activities that further the goals expressed in Colorado's Water Plan, with specific consideration given to the principles and collaborative efforts set forth in Chapter 9.1 and Principle 4 of the Conceptual Framework in Chapter 8.

(5) Investigate voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System for the specific purpose of helping assure compact compliance. Consistent with the Upper Basin Demand Management Storage agreement, the Board may also join the UCRC and other Upper Basin States in any evaluation of importing of waters from outside the natural Colorado River watershed to augment the Upper Colorado River System for compact compliance purposes.

(6) Prioritize avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders. The Board will work with water rights holders and stakeholders to assess the feasibility of and promote mechanisms for obtaining roughly proportionate contributions of water consumptively used from the Colorado River System to a Demand Management program over a given timeframe from participants on each side of the Continental Divide.

(7) Comply with applicable state law, including, but not limited to, the requirement that no action related to demand management cause material injury to other water rights holders.

(8) Consider and be fully informed by the input and considerations of water rights holders and stakeholders potentially impacted by application of demand management strategies within Colorado, and institute a public review process for any such proposed demand management program.

(9) Work with Colorado's Commissioner to the Upper Colorado River Commission to cooperate with the other Upper Division States of Wyoming, Utah, and New Mexico, as well as the Department of the Interior, to investigate and potentially develop a regional demand management program that considers and incorporates Colorado's demand management approach, and to ensure that water conserved within Colorado under any demand management program is not diverted and consumptively used by any other state.

COMPACT ADMINISTRATION POLICY STATEMENT

The Board understands that:

1) Investigation and development of an Upper Basin Demand Management Program will require resolving numerous technical, legal, economic, and policy questions with multiple water rights holders and stakeholders over an extended period of time; and

2) Continuation of the current trend in the Colorado River Basin's hydrologic cycle could hasten the time when formal action may be needed to accomplish compliance with the Colorado River Compact,

If the quantity of conserved water made available through the demand management strategies described in this policy is not sufficient to ensure Colorado's compliance with the Colorado River Compact, it will be the Board's policy to:

Encourage and collaborate with the Division of Water Resources to engage in timely and extensive public outreach regarding development of any alternative measures or rules for compact compliance administration to fully inform and seek input from intrastate water rights holders and stakeholders with interests in the Colorado River. Such process would be with the goal, but not the requirement, of achieving general consensus within the state, without constraining the Division of Water Resources' lawful administration of water rights in order to meet Colorado's compact obligations.

Attachment B

CWCB Board's 2019 Demand Management Work Plan and Update

COLORADO
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Jared Polis, Governor

Dan Gibbs, DNR Executive Director

Rebecca Mitchell, CWCB Director

TO: Colorado Water Conservation Board Members

FROM: Brent Newman, Interstate, Federal, & Water Information Section
Karen Kwon, Colorado Office of the Attorney General

DATE: March 21, 2019

AGENDA ITEM: **28. Colorado River Drought Contingency Planning and Demand Management**

Background

Since January 2018, CWCB staff and members of the Attorney General's Office have been conducting a series of outreach presentations across Colorado regarding drought contingency planning efforts underway in the Colorado River Basin. Consistent with direction from the Board, these efforts have served dual purposes: to educate and inform interested water rights holders and other stakeholders about the status of ongoing efforts to develop drought contingency plans in the Upper and Lower Colorado River Basins, and to solicit feedback from Colorado water users regarding the concept of demand management as a potential tool for avoiding compact administration in the event of continued drought or worsening hydrology.

At the September 2018 Board meeting, staff provided an update on ongoing outreach efforts, the relationship between ongoing interstate efforts to implement DCPs in the Upper and Lower Basin, and the evaluation of demand management as a tool within Colorado. The Board heard comment from a variety of water managers, stakeholders, and members of the public regarding opinions, challenges and opportunities presented by potential implementation of demand management.

At the October 4, 2018 Special Meeting, the Board directed staff to continue this outreach, including providing information about the recently released Drought Contingency Plan (DCP) documents. The Board also directed staff to prepare a "draft policy statement" for Board review at the November meeting, to guide the assessment, feasibility analysis, and potential implementation of a demand management program within Colorado.

At the November 15, 2018 Board meeting, the Board unanimously approved "Support and Policy Statements Regarding Colorado River Drought Contingency Plans, Demand Management, and Compact Administration," which set out the Board's policy to:

> "Develop the state's position and approach on whether and how to develop any Upper Basin Demand Management Program that could potentially be implemented within

> Colorado consistent with state law to avoid or mitigate the risk of involuntary compact curtailment and to enhance certainty and security in the Colorado River water supply."

This policy statement also laid out a strategy for formulating the state's demand management position, identifying several elements for investigation and vetting through a thorough public review process. The statement also provides initial sideboards for such an investigation, informed by Board discussion and water user input to that point.

Since November, staff has been working with the Attorney General's Office on a draft scope of work for demand management feasibility investigation. At the January Board meeting, staff presented a draft outline with initial thoughts for a 2019 Work Plan. As part of this agenda item, staff will report out on outreach efforts since January, provide an update on DCP progress, and walk the Board through the elements of the draft scope of work. The scope of work will identify a more formal outreach and public input procedure, working groups to investigate individual elements of demand management feasibility, and objectives to meet in calendar year 2019.

This work will focus on demand management considerations within Colorado, and will continue on a parallel track with interstate efforts led by the Upper Colorado River Commission. CWCB staff will also participate in those efforts, in close coordination with Colorado's Commissioner and staff from neighboring Upper Basin states.

Staff recommendation

Staff recommends that the Board approve the 2019 Work Plan and direct staff to begin the action items identified immediately.

DRAFT

2019 WORK PLAN FOR INTRASTATE DEMAND MANAGEMENT FEASIBILITY INVESTIGATIONS

I. INTRODUCTION

It has never been necessary to administer Colorado's Colorado River Basin for compact compliance. Hydrology in the 21st century, however, has revealed it prudent to prepare for contingencies that consider the prospect of protecting target elevations at Lake Powell as well as the increased risk of compact administration going forward. As part of this effort, the State of Colorado has demonstrated a coordinated approach among Colorado's Commissioner to the Upper Colorado River Commission, the Colorado Water Conservation Board, and the Attorney General's Office to support and endorse the documents and agreements that comprise the Colorado River Drought Contingency Plans for both the Upper and Lower Colorado River Basins. Such support and coordination have come about only after careful consideration, collaboration and consultation with water users and other interested stakeholders throughout the state.

Within the Drought Contingency Plan documents is the authorization to store, free of charge, in the Initial Units of the Colorado River Storage Project, water that is conserved under a demand management program if approved by the Upper Colorado River Commission and each of the Upper Division States (Colorado, New Mexico, Utah, and Wyoming). The term "demand management" loosely refers to the intentional conservation of water for the purpose of helping assure compliance with the Colorado River Compact, and in so doing, avoiding the need to implement mandatory water administration strategies to fulfill the Upper Basin's compact obligations. The storage authorization, as set forth in the Drought Contingency Plan documents, does not require or mandate development or implementation of any demand management program. It merely secures the opportunity for the Upper Division States to store any water conserved under such a program should the Upper Colorado River Commission and Upper Division States ever determine it is advisable and feasible to promote and protect their interests in the Colorado River water supply.

Prior to declaring its support for the package of Drought Contingency Plan documents, staff from the CWCB and Attorney General's Office conducted extensive outreach and consultation with water users and other interested stakeholders to build a knowledge base regarding the current conditions in the Colorado River Basin and the inner workings of the law of the Colorado River. Additionally, they sought input and feedback on issues and concerns related to the concept of demand management that are important and integral to any considerations going forward. The CWCB subsequently issued the "Support and Policy Statements Regarding

Colorado River Drought Contingency Plans, Demand Management, and Compact Administration" (Support and Policy Statement) that outlines, among other things, the minimum criteria through which the state will investigate the feasibility of any demand management activities in Colorado.

The following 2019 Work Plan is a follow up to the CWCB's Support and Policy Statement. It outlines, in general terms, the next steps that the CWCB staff will take, in conjunction with the Defense of the Colorado River Subunit at the Attorney General's Office (funded by the CWCB), and with the involvement of other relevant state agencies and interested stakeholders to identify and evaluate whether and how demand management measures may be taken to help assure continued compact compliance, and thereby promote greater certainty and security in the Colorado River water supply for constituents throughout the state.

II. PROPOSED TENTATIVE 2019 WORK PLAN

a. **Purpose** - The purpose of this work plan is to set forth a process for helping develop Colorado's position regarding whether and how any Colorado River Demand Management Program could or should operate within Colorado. Guided by the CWCB Support and Policy Statement, specific focus will be on measures that can be taken within Colorado in the 2019 calendar year to effectively and efficiently utilize staff, resources and meaningful water user and other stakeholder engagement to flesh out various elements of interest and concern related to demand management activities within Colorado. It is also intended to help inform any investigative processes facilitated by the Upper Colorado River Commission.

b. **Tasks**

   i. **Initial Issue Identification** – The concept of demand management may be simple to describe, but assessing its utility and how it could be implemented in a manner that respects considerations important to Colorado and remains consistent with state and federal laws is no small task. There are a number of issues that the Upper Colorado River Basin will need to assess as a whole in contemplating whether to develop a demand management program, and others that may be specific to Colorado. This task centers on identifying and prioritizing the primary legal, technical and policy issues related to demand management that Colorado may deem important to evaluate as part of any feasibility investigation. This effort may be informed by collaborating and coordinating with Colorado's Commissioner and counterparts in other Upper Division States, consulting and discussing topics with water users and other interested stakeholders, and reaching out to

experts in specific fields who may have a familiarity and perspective on Colorado River matters that can add value and substance to the overall feasibility investigation.

ii. **Establish Workgroups** – This task contemplates creating specific workgroups to effectively evaluate various issues related to the demand management feasibility investigation in Colorado. Each workgroup will be guided by the criteria set forth in the Support and Policy Statement in formulating a meaningful scope of work, budget and timeline for Fiscal Year 2019/2020. They will be facilitated by staff at the CWCB or Defense of the Colorado River Subunit at the Attorney General's Office to coordinate the flow of information between workgroups and to the Project Management Team (PM Team) as appropriate. Participants from other state agencies, water user or stakeholder groups, and entities with relevant expertise may be invited to participate as needed to help develop and assess the feasibility investigations, keeping in mind the need to maintain an effective and efficient process. Probable workgroups at this time include:

*<u>*Law and Policy*</u> – Review and analyze laws, rules and regulations and relevant policy considerations to inform the range of state and federal legal and policy frameworks to follow for demand management implementation within Colorado. This workgroup will also coordinate with the PM Team: (1) to help inform the legal and policy questions raised by other workgroups as they investigate specific elements of demand management feasibility within Colorado; and (2) to assist in developing reporting and educational materials.

*<u>*Monitoring and Verification*</u> – Research, develop, and test (as needed) various methods available or needed to measure and verify the volume of conserved consumptive use under any demand management program. This workgroup will also work with the PM Team to further examine factors related to lead time, costs and staff resources required to model, pilot or otherwise meaningfully investigate various monitoring and verification considerations for implementing demand management within Colorado.

*<u>*Water Rights Administration and Accounting*</u> – Research and test (as needed) various methods or practices available or required to (1) assist in administering water rights as a result of demand management activities within Colorado; and (2) account for volume

of conserved water as it is transported and stored at one of the Colorado River Storage Project's Initial Units. Tasks for this workgroup will include, but not be limited to, examination of unique administration practices and identifying actions that may incentivize or obstruct demand management participation in each water division. This workgroup will also work with the PM Team to further examine factors related to lead time, costs and staff resources required to model, pilot or otherwise meaningfully investigate water rights administration and accounting considerations for implementing demand management within Colorado

*<u>*Environmental Considerations*</u> – Research, test (as needed), and identify potential environmental impacts that may need to be considered in any demand management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of existing environmental rules and regulations, and identification of short-term and long-term environmental considerations. This workgroup will also work with the PM Team to note potential environmental mechanisms and considerations that could incentivize or obstruct demand management participation in various parts of the state.

*<u>*Economic Considerations*</u> – Research, test (as needed), and identify potential economic impacts that may need to be considered in any demand management program within Colorado. Tasks for this workgroup will include, but may not be limited to, consideration of both primary and secondary economic impacts and short-term and long-term economic considerations. This workgroup will also work with the PM Team to note potential mechanisms and considerations that could economically incentivize or obstruct demand management participation in various parts of the state.

*<u>*Funding*</u> – Research, test (as needed), and identify potential funding sources for costs associated with implementation of a demand management program, including but not limited to, costs related to implementation and administration of such program within Colorado.

*<u>*Education/Outreach*</u> – Develop public outreach strategies and materials regarding the topic of demand management within Colorado. In addition, this workgroup will coordinate with the PM Team to develop consistent and informative workshops and

presentations that are intended to engage with water rights holders and other interested stakeholders on the topic of demand management.

iii. **Conduct Workshops** – In addition to utilizing workgroups, the work plan contemplates CWCB staff, with the assistance of the Defense of the Colorado River Subunit at the Attorney General's Office, regularly developing and conducting public workshops to maintain open lines of communication with the public at large, provide updates and information, and receive feedback and input regarding the status of demand management feasibility investigations involving the state. Such workshops would not take the place of additional outreach efforts deemed helpful to the collaborative process. Instead, they serve to set a meaningful benchmark for which anyone interested can learn and better understand the content and status of feasibility investigations.

iv. **Evaluate and Report** – This task contemplates the PM Team preparing regular reports to the CWCB on the progress and results of investigations conducted in Calendar Year 2019. These reports may include, but are not to be limited to, noting key findings or gaps in information identified as a result of investigations, and identifying options and issues for the CWCB to consider in formulating the state's position on demand management feasibility. Also included would be a final status report on the work conducted pursuant to this work plan after Calendar Year 2019 has concluded.

v. **Project Management** – This task contemplates establishing a PM Team comprised of representatives within the Department of Natural Resources and the Attorney General's Office to facilitate the work to be conducted consistent with this work plan. To this end, the PM team will coordinate the workgroups and facilitate the distribution of information between workgroups as needed, manage funding for the feasibility investigations, prepare status reports and recommendations for the CWCB, and coordinate with Colorado's Commissioner and counterparts at the UCRC regarding demand management considerations throughout the Upper Basin.

III. **TENTATIVE TIMELINES – subject to change – TBD following clarification of status of DCP and Upper Basin Coordination.**

April 2019: First Quarterly Workshop (TBD)

May 2019: UCRC Listening Workshop-4 States effort - TENTATIVE

June 2019: Workgroup SOWs completed and Update to UCRC

July 2019: Second Quarterly Workshop held (TBD); Update to CWCB Board

September 2019: Third Quarterly Workshop held (TBD)

November 2019: Fourth Quarterly Workshop held (TBD); Update to CWCB Board and UCRC

December 2019: Workgroup Investigation Progress reports or deliverables submitted to PM Team

January/March 2020: Draft/Final Progress Reports of Workgroup Investigations submitted to CWCB Board of Directors

IV. DELIVERABLES – TBD following clarification of status of DCP and Upper Basin Coordination.

Each Workgroup is tasked with submitting to the PM Team:

(1) Quarterly budget/expense reports (July; September; November)

(2) Draft Status/Progress Report of Findings and Conclusions to the PM Team no later than December 15, 2019.

V. ESTIMATED RESOURCES / COSTS for 2019 - TBD following clarification of status of DCP, Upper Basin Coordination, CWCB funding opportunities.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 718
Denver, CO 80203

June 10, 2019

Demand Management 2019 Work Plan – Update #1

The Colorado Water Conservation Board (CWCB) Project Management Team plans to release periodic updates on progress and accomplishments relating to the 2019 Work Plan for Intrastate Demand Management Feasibility Investigations. This document will serve as the first of these updates.

The Path Forward: Director Mitchell released a statement on the future of the demand management feasibility investigation, providing highlights of the current and upcoming steps that CWCB staff will be taking to implement the 2019 Work Plan. It includes opportunities for engagement, outlines the processes in place to inform the Board of ongoing demand management work, and information about upcoming events. Director Mitchell's letter can be found on the new "Demand Management Feasibility" section on the front page of the CWCB website or by clicking here.

First Regional Workshop Scheduled: The first regional workshop has been scheduled for Thursday, August 22nd. This workshop will be held in conjunction with the summer conference of Colorado Water Congress, at the Steamboat Grand Hotel in Steamboat Springs, Colorado. More information about CWC's Summer Conference can be found here.

Workgroups Update: As outlined in the 2019 Work Plan, CWCB staff has reached out to subject matter experts on various elements that must be considered relating to any potential demand management program within Colorado, and invited them to serve on a Demand Management Feasibility Investigation Workgroup. The purpose of these workgroups is to help CWCB staff identify and frame the complex issues associated with demand management feasibility for public and Board consideration. A roster of workgroup membership is attached to this Update.

Upcoming Events: Colorado River Drought Contingency Planning and demand management feasibility investigation will be on the agenda at the following events:

- Colorado Water Congress' POND Committee: Rockies v. Padres game June 13th in Denver. More information can be found here.
- Upper Colorado River Commission Demand Management Stakeholder Workshop: Friday, June 21st in Salt Lake City, UT. Information, agenda, and registration information can be found here.
- Four West Slope Basin Roundtables Joint Meeting: June 20 in Grand Junction. Registration here.
- As always, keep an eye on basin roundtable agendas. Drought Contingency Planning and demand management feasibility are frequent topics. Roundtable schedules and agendas are available here.

For questions, comments, or more information, visit the CWCB website or email demandmanagement@state.co.us.

DM 2019 Work Plan
Workgroups Roster
June 10, 2019

Law and Policy
Facilitator: Karen Kwon
Staff Support: Brent Newman/Amy Ostdiek
Andy Mueller
Jim Lochhead
Bennett Raley
John McClow
Taylor Hawes
Anne Castle
Beth Van Vurst
Lee Miller

Monitoring and Verification
Facilitator: Michelle Garrison
Support: Brian Macpherson
Kelley Thompson
John Currier
Kevin Lusk
Tom Simpson
Luke Gingrich
Laura Berlanger
Perry Cabot
Cary Denison
Gerry Knapp
Robert Sakata
Carrie Padgett

Water Rights Administration and Accounting
Facilitator: Lain Leoniak
Support: Mike Sullivan/Kevin Rein/Ryan Gilliom
Frank Kugel
Rick Marsicek
Drew Peternell
Kyle Whitaker
Dick Wolfe
Steve Witte
Cleave Simpson

Environmental Considerations
Facilitator: Lauren Ris/Linda Bassi
Support: Brandy Logan/Jojo La
Kathy Kitzman
Maria Pastore
Melinda Kassen
Abby Burk
Matt Rice
David Graf
Al Pfister
Torie Jarvis
Mely Whiting
Karen Wogsland

Economic Considerations and Local Government
Facilitator: Amy Moyer
Support: Amy Ostdiek
Chris Treese
Alex Davis
Seth Clayton
Sean Cronin
Kathy Chandler-Henry
Barbara Biggs
Steven Ruddell
Patti Wells
Liesel Hans
Karn Stiegelmeier
Kelly Romero-Heaney

Funding
Facilitator: Anna Mauss
Support: Russ Sands
Ted Kowalski
Dave Bennett
Pat Wells
Aaron Citron
Dick Brown
Keith McLaughlin
Alan Matlosz

Education and Outreach
Facilitator: Brent Newman
Support: Megan Holcomb
Jim Pokrandt
Todd Hartman
Chris Woodka
Andy Schultheiss
Hannah Holm
Doug Kemper
Laura Spann
Lisa Darling

Agricultural Impacts
Facilitator: Alex Funk
Support: Andrew Rickert/Erik Skeie
Dave Kanzer
Alan Ward
Eric Wilkinson
John Stulp
Cindy Lair
Mark Harris
Aaron Derwingson
Paul Bruchez
Travis Smith
Allen Distel
Ken Curtis
Tom Gray

Attachment C

Agricultural Impacts Workgroup Documents:

1. Summary
2. Pilot Concept
3. Reports

Demand Management: Agriculture Impacts Workgroup
Final Report to the Colorado Water Conservation Board

Background and Agricultural Impacts Workgroup Charge

At the March 2019 Colorado Water Conservation Board ("CWCB") Meeting, the CWCB Board directed CWCB staff to establish an agricultural impacts workgroup in addition to those workgroups identified in the FY 2019 Work Plan ("Work Plan"). A formal charge was never developed for the agricultural impacts workgroup, but it focused broadly on evaluating possible agricultural impacts and issues associated with a potential demand management program.

Agricultural impacts workgroup CWCB facilitation staff includes Alexander Funk, Erik Skeie, and Andrew Rickert. Agricultural workgroup membership includes Cindy Lair, Travis Smith, Ken Curtis, Aaron Derwingson, Dave Kanzer, Alan Ward, Eric Wilkinson, John Stulp, Paul Bruchez, Mark Harris, Tom Gray, and Allen Distel.

Altogether, the agricultural impacts workgroup convened five times during the FY 2019 Work Plan period. CWCB held three in-person meetings (e.g., Delta, Glenwood Springs, and Denver), and two meetings were held virtually in response to state guidelines regarding COVID-19.

Agricultural Impacts Workgroup Threshold Issues

The Agricultural Impacts workgroup ("Workgroup") identified several threshold issues for CWCB Board consideration concerning the potential development of a voluntary, temporary, and compensated demand management program ("DMP") in Colorado. These key threshold issues are as follows:

- **Tension Between Equity & Voluntary –** A recurring theme throughout the workgroup discussions is that any potential DMP must be equitable, while also being voluntary and universally accessible. From the perspective of the workgroup, equity means that a possible DMP implementation must not cause any disproportionate impacts to any single geographic region, river basin, economic sector, or water right holder. Also, equitable, means that there is proportional participation and access from all regions, sectors, river basins in the State that receive Colorado River water. In particular, the workgroup underscores that eastern slope/Front Range participation is critical for programmatic acceptance and participation.

  At the same time, the workgroup noted the tension between equity and voluntary. For example, a requirement for achieving diverse DMP participation by basin or region could be contrary to the program's required voluntariness. Likewise, cropping patterns could limit enrollment or certain types of crops (i.e., perennial vs. annual). Research indicates that fallowing irrigated grass hay fields could have more significant, long-term agronomic impacts as compared with fallowing annual crops, posing a potential barrier to participation and opportunity.

  Overall, such potential restrictions and limitations on participation while equitable, in terms of avoiding disproportionate impacts, generate questions on program accessibility and opportunity. Ultimately, the workgroup agreed that a potential DMP could not force participation of a particular basin or economic sector. It may be necessary to phase new basins or economic sectors into the program gradually and recognize that both market and social considerations will influence participation. If equity measured by any metric is to be achieved in a voluntary DMP, it may be necessary to incentivize participation and volunteerism through increased

compensation to potential program participants, thus increasing the overall cost of a potential DMP.

- **Secondary Economic Impacts –** Intentional agricultural water conservation that reduces agricultural output results in potential economic impacts, including both direct economic effects on the farmer or rancher (e.g., importing supplemental feed) and secondary, indirect potential regional economic impacts such as lower spending on agricultural inputs (e.g., equipment, fertilizer) and subsequent possible changes in business spending and jobs. Secondary economic effects for a given region or basin depend on many variables.

  The potential impact on local government services resulting in a potential reduction in property taxes due to a shift from irrigated to non-irrigated parcels is a related, concern, although, (1) it is unclear whether these property tax changes would occur as a result of temporary fallowing and (2) current Colorado property taxation policy does not differentiate between full- and limited-irrigated crops.

  Conversely, a properly structured DMP may provide an agricultural producer the opportunity to diversify operational income and improve the continuing economic health and sustainability for the agricultural producer's operations. The diversity of income and improved economic health of participating producers may, in turn, be an economic benefit to the local community and economy. Altogether, the workgroup agreed that any potential DMP should be structured to maximize opportunities and benefits while also taking into account, and potentially mitigating, secondary economic impacts to rural, agricultural communities resulting from any verifiable, direct, indirect, or induced economic losses due to DMP implementation.

- **Further Research on Negative and Positive Agronomic Impacts –** Additional research on both the positive and negative agronomic impacts of reduced irrigation and temporary fallowing is needed. These agronomic impacts and benefits may include changes in yield, forage quality, soil health, recovery, weeds, animal feed supplies, realized revenue sources, and the health and sustainability of agricultural operations. Additional research is necessary to inform program design features, including the creation of programmatic criteria to minimize adverse agronomic effects, optimize agronomic benefits, and structuring incentive payments.

  Generally, the current research finds that many agronomic effects are subject to both site-specific conditions such as crop type, soil characteristics, elevation, and climate, timing and extent of water stress, and management decisions. For example, alfalfa generally shows full recovery when irrigation is returned following limited irrigation, while grass hayfields may require at least two years of full irrigation to recover. Research to date also finds that limited irrigation may provide some agronomic benefits such as improved quality of forage, including higher protein content. Future agronomic research should assess the broader economic impacts on the regional supply chain, such as reduced hay production on livestock operations and contractual arrangements.

- **Technical Assistance & Outreach Capacity –** The availability of technical assistance and outreach is necessary to support DMP participation and to build capacity through trusted agricultural and water resource management entities. As evidenced in previous demand management-type programs and pilots, technical assistance and outreach capacity are critical in providing potential program participants with timely information, assisting potential participants with program applicability, contracting, and monitoring and

verification. Technical assistance may be beneficial in providing information to program participants on best management practices to minimize agronomic impacts such as weeds, dust, and topsoil erosion that potentially arise with conservation activities.

Outreach to county commissioners, agricultural water providers, water conservation and conservancy districts, agricultural organizations, and other key stakeholders is also likely to be critical in supporting the implementation of a potential DMP.

Associated issues and concerns to address include, but are not limited to, (1) the identification and selection of appropriate entities to provide technical assistance (e.g., Colorado State University Extension, conservation districts, conservancy districts, non-governmental organizations, Colorado Department of Agriculture, Natural Resources Conservation Service), (2) types of information necessary for informed decision making and management, (3) information sharing with potential program participants (e.g., online resources, conservation plans, guides, peer workshops, etc.), and (4) sources of funding to support technical assistance and capacity building.

- **Addressing Impacts of Reduced Return Flows and Protection from Material Injury –** How a potential DMP (1) prevents reduced return flow impacts, (2) prevents material injury to other water right holders, and (3) avoids broader effects to non-program participants are critically important threshold issues. At the same time, the workgroup also understands that traditional legal, material injury determinations can lead to lengthy review processes that can significantly increase program transaction costs, increase program implementation times, and yet do not adequately address the broader concerns regarding impacts to non-participants.

  Additional considerations for the CWCB Board on these matters include use of existing resources such as the Colorado Lease Fallow Tool (LFT), which was developed to simplify and streamline the evaluation of historic depletions and return flows, to inform terms and conditions to avoid material injury may be helpful and demonstrated. Alternative transfer methods projects, such as the Catlin Canal Fallowing-Leasing Pilot, can provide examples of expedited water transfer application and approval processes that avoid injuring other water rights holders, including non-participating ditch shareholders.

- **Role of Water Providers and Managers –**Irrigation water providers and managers such as private mutual ditch companies, water conservancy and conservation districts, the Bureau of Reclamation, Tribal interests, and related entities must have a defined role in a potential DMP. Such water management entities maintain certain restrictions on water use and changes of use within their service areas. These restrictions may include, but are not limited to, transfers, water use within a service area, and requiring conditions to avoid material injury to other users and system operations, and maintaining oversight/approval over changes. Federal and Tribal projects, likely require further consultation regarding project approval and honor agency and Tribal protocols and practices. Therefore, DMP design and implementation will likely require the involvement and engagement of water management entities to be successful.

  Previous pilot projects such as the Grand Valley Water Users Association Conserved Consumptive Use Pilot Project demonstrate the value of having agricultural water management entities engaged in temporary agricultural fallowing programs. The CWCB Board should consider how best to encourage participation and engagement of water management entities, including consideration of entity by-laws, consultations with Federal and Tribal partners, and perhaps even delegating some DMP programmatic

roles to these entities to encourage participation and incorporation of programmatic criteria consistent with particular service areas.

- **Infrastructure:** There is a need for significant investments in infrastructure to meet the potential requirements of, and accomplish the goals of the DMP. Possible infrastructure improvements/additions include but are not limited to, the installation of flumes and other measuring devices necessary to measure historical diversions, return flows, and consumptive use. Additionally, augmentation structures to replace return flows to avoid material injury, and structural improvements to assist with water delivery and shepherding are essential components to facilitate a potential DMP and to minimize associated impacts. Water delivery and management entities may require additional infrastructure or administrative requirements to account for DMP participation more effectively. Failure to address the potential infrastructure issues may present an equity challenge, as water rights holders or providers with sufficient infrastructure or resources needed to address these concerns may more easily participate in a potential DMP to the disadvantage of others.

- **Funding:** Securing adequate, sustainable funding is a critical threshold issue to the successful development and implementation of a potential DMP. Compensation for program participation is an essential equity driver as funding may be needed to help invest in and to mitigate potential agronomic and secondary impacts and ideally encourage more active diverse DMP participation. Without adequate, sustainable funding, there will likely be no incentive for an agricultural producer and water managers to participate in the DMP. Ideally, funding for the potential DMP will be secured through diverse sources. Furthermore, equity of funding is critical to the creation of a meaningful and successful DMP. Equity of funding means that funding should be available to all interested participants without bias or favoritism. Ultimately, any potential DMP must make agronomic business sense to the agricultural producer.

Additional issues that may present potential barriers or consideration for individual DMP participants and projects include:

- **Federal Crop Insurance:** The United States Department of Agriculture (USDA) Risk Management Agency does not issue crop insurance for limited-irrigation crops. A producer intending to implement limited crop irrigation cannot insure it as an irrigated asset. More information and conversation with USDA are needed to better understand if and how crop insurance may be a potential barrier to program participation.

- **Absentee landowners** – Many farms and ranches in Colorado have absentee landowners and are farmed by long-term lease tenants. Additional economic impacts may affect tenant producers if the landowner decides to participate in demand management activities without collaborating with the lease tenant. A key issue then is whether a potential DMP should include guidelines or additional requirements that provide a mechanism for landowners and tenants to maintain a beneficial relationship and avoid displacing tenant farmers and ranchers.

- **Conservation Easements:** Another issue raised by the workgroup is that many conservation easements that preserve working agricultural lands include restrictions on the ability to remove water from the protected property for other uses such as compact compliance. The CWCB Board should consider this potential implication and

involve key land management stakeholders, including Colorado Parks and Wildlife, Great Outdoors Colorado, USDA, and land trusts in addressing this concern.

Proposed Actions for CWCB Consideration

- **Program Framing –** The CWCB, as the State's water policy agency, should develop a messaging framework regarding a DMP to address common concerns, build trust, and encourage participation. Public perception of the need for a DMP, and acceptance by the agricultural community for a DMP are likely to be critical in achieving adequate agricultural participation levels. Several members of the workgroup find that the CWCB should promote the DMP as an "insurance policy," and that there must be a consideration to whether agricultural participation in a voluntary, temporary, compensated DMP will be sufficient to make a difference to stave off mandatory compact curtailment.

  Due to problematic long-term trends in supply and demand that indicate on-going imbalances and the timeframe needed to develop agricultural conservation programs, the CWCB should design the DMP as a long-term program, available under dry, normal, and wet conditions.

  The workgroup also underscores that in discussing the DMP, CWCB should be clear about the DMP's purpose (i.e. "done for the right reasons," "not serving as a backdoor to permanent dry-up of irrigated agriculture," "not a new source of water for the Lower Basin and elsewhere.") and that the DMP allows for maintaining compact compliance/reservoir levels while allowing for continued consumptive use. Ideally, DMP considerations will also appropriately inform the renegotiation of the 2007 Interim Guidelines.

- **Guided market vs. free-market program** – A significant and essential element that the CWCB Board must consider as part of a voluntary, compensated DMP is a mechanism to adequately fund and facilitate water user participation in such a program. An adequate funding source is even more critical to program success to achieve "equity" goals and objectives. The workgroup agreed that a potential DMP would likely need to be a "managed market" coordinated by a "market-maker" to ensure equity and to avoid a "run" on, or by, any specific region or sector and associated potential disproportionate impacts or benefits. At the same time, the market-maker would recognize that participation in a voluntary, temporary, and compensated DMP is ultimately market-driven and informed by free-market/economic conditions. The market maker would be responsible for meeting any imposed "equity" targets by providing the necessary economic incentives to solicit and secure the required participation to achieve the equity targets through a market-driven system.

- **Programmatic Criteria and Guidelines –** The workgroup supports further consideration by the CWCB of the adoption of DMP goals and guidelines that would minimize or eliminate adverse agricultural effects, maximize potential net benefits, and encourage agricultural sector participation/opportunity, and ultimately "do no harm." Some possible criteria for additional consideration are as follows:

  - ***Equitable, proportionate program participation –*** A potential DMP must be fair and provide for proportionate program participation while remaining voluntary. Such criteria that may be further considered by the CWCB may include:

- Geographic/basin quotas or caps (e.g., based on number of participants, acreage);
- Ensuring proportional participation by Western Slope and Front Range water users, senior/junior water right holders, economic sectors;
- Limiting participation to active farm operators and agricultural producers with a recent documented history of agricultural practices within a certain number of years; and
- Setting acreage requirements and enrollment limitations per operation (for example, minimum acres operated to participate, a maximum acreage cap, or temporary fallowing may not exceed a certain percentage of a single irrigated farm).

The example goals and guidelines provided above are to maintain agricultural viability during participation in the potential DMP. The CWCB should discuss all of the above equity considerations among key Federal, Tribal, State, and local government entities and water conservancy or conservation districts. These equity goals may serve as guidelines or as a floor that the DMP manager could then supplement or modify to address more basin or location-specific concerns. Ultimately, the agricultural impacts workgroup agreed that many of these goals/considerations should be locally-driven and therefore, may vary by region and may be site-specific within established guidelines.

- ***Structuring agricultural producer and water provider payments.*** The group discussed incentive payments (e.g., cost per-acre foot or payment per action). The workgroup suggests that participant payments should be determined via negotiation between participants or the DMP managing entity within overarching guidelines and limitations, using standard parameters provided by the market-maker, managing entity, and/or technical service provider. These parameters may include compensation for lost productivity in both the year of reduced irrigation and long-term recovery, the adoption of best management practices to mitigate agronomic impacts, costs associated with idle equipment and labor, other operational expenses such as a need to purchase supplemental feed or reduce the size of cattle herds, and disrupted business relationships.

  In addition to producer-specific compensation, a potential DMP would also compensate agricultural water providers such as mutual ditch companies for minimizing and mitigating any operational, administrative, and transactional costs associated with changes in operations due to shareholder participation in the DMP and to provide additional technical capacity if the agricultural water provider is engaged in the program on a ditch-wide or regional basis.

- ***Mitigate on-farm and off-farm agronomic impacts*** – Agronomic impacts will likely be site-specific. A potential DMP should provide technical resources, advice, and guidance to program participants to mitigate the agronomic effects such as weeds, pests, and soil erosion and to improve recovery times to achieve full or increased productivity levels. A potential consideration would be for a technical service provider to work with each program participant and, where applicable, agricultural water providers. Technical service providers can assist in developing management plans for the enrolled farm and ranch parcels that identify applicable best management practices, which may include, but not be

limited to, the establishment of a cover crop or other erosion control measures, weed control, and crop recovery practices. Additional considerations may include offering potential DMP participants pre-process consulting with a technical service provider who can provide the producer with information regarding potential agronomic impacts and revenue projections based on their local conditions and operation. The CWCB should consider pursuing additional information on best management practices for managing farms and ranches experiencing reduced irrigation and provide such information equitable to all interested participants.

- ***No material injury to other water rights holders or impacts to non-participants; no intent of abandonment and consumptive use analysis –*** A potential DMP must not cause material injury to water right holders or adverse effects on non-participants. The CWCB should develop, define, and apply required judicial or regulatory processes to ensure protection from legal and material injury and minimize related adverse impacts on non-participants. All DMP participants must receive protection against abandonment. Water right administrators and regulators (i.e., commissioners, referees, and judges) must not consider any decrease in water use resulting from participation in a potential DMP in determining the amount of historical consumptive use in any related legal or administrative proceeding.

- ***Operational flexibility & management –*** Care should be taken to ensure that the timing of the application, review, and approval process align with when producers make decisions. Contracting must be flexible to account for specific operations and economic conditions. Previous demand management type programs and pilots have provided some flexibility in allowing program participants to select appropriate agricultural conservation techniques suitable for their unique operations. Contracting should occur with adequate timing to allow for a producer to make critical operational decisions and to provide for some adjustments to changing economic conditions each growing season. Efforts should be made to expand technical assistance to help participants navigate the DMP application/contracting process and access to decision-making tools, such as the Colorado State Extension Agricultural Lease Evaluation Tool (AgLET), to estimate impacts to crop yield, production costs, and participation revenues. Also, the potential DMP should consider requirements to notify water providers when there is participation in their service areas, providing water providers and managers adequate time to make operational adjustments if necessary.

- ***Minimize regional, socioeconomic impacts –*** Any potential DMP should account for and minimize adverse socioeconomic regional effects. Possible mitigation strategies may include further incentivizing selective temporary fallowing of marginal agricultural lands versus prime agricultural lands, allowing for the option of alternative cropping or conserved crop rotations to generate conserved consumptive use water, developing a mitigation fund, and project selection/criteria such as basin enrollment quotas.

- ***Maximization of other programmatic benefits –*** Where feasible, DMP managers and participants should track or highlight potential programmatic benefits such as increased hydropower production, water quality improvements (e.g., salinity, selenium, nutrient load reductions), and environmental and

recreational flow enhancement. Monetizing such benefits of potential DMP implementation may also present an opportunity to generate additional funding to support the rehabilitation and modernization of aging, agricultural infrastructure. CWCB should conduct further research to better understand how comprehensive programmatic benefits may accrue to various sectors and users, providing avenues to "win-win-win" solutions.

- **Successful Program Models –** In considering potential DMP design features/frameworks, the workgroup recommends the CWCB consider successful, voluntary, temporary, and compensated agricultural water conservation programs as possible program models. Such current models include completed alternative transfer method projects in the South Platte, Arkansas, Colorado, and Gunnison Basins. The Agricultural Impacts literature review document provides further examples. Some commonly cited/discussed examples by the workgroup include:
    - ***Grand Valley Water Users Association Conservation Consumptive Use Pilot Project –*** The Grand Valley Water Users Association, as part of the broader System Conservation Pilot Program, offered a temporary agricultural water conservation program for two years to test the mechanisms necessary for a Western Slope irrigation water provider to intentionally reduce consumptive use and gauge producer interest in the opportunity. Key program considerations include setting requirements for program participation to avoid injury and broader socioeconomic impacts and providing program participants with a menu of program activities ranging from full season to partial season fallow.
    - ***Catlin Canal Fallow-Leasing Pilot Project –*** The Catlin Canal Pilot Project was approved by the CWCB Board in 2015, under House Bill 13-1248, to test the feasibility of leasing-fallowing as an alternative to permanent irrigated agricultural dry-up. The Catlin Canal Pilot Project has been operating five years under an expedited administrative approval without injuring other water users. Key program considerations include using the Lease Fallow Tool to simplify and streamline historic consumptive and return flow analysis, the development of a spreadsheet-tool to track parcels fallowed during operation to ensure compliance with statutory limits on the frequency and extent of fallowing and contractual requirements to maintain soil health.
    - ***Conservation Reserve Program –*** The Conservation Reserve Program (CRP) is a land conservation program managed by USDA-Farm Service Agency. The goal of the CRP program is to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are typically 10-15 years in length. In Colorado, CRP has been utilized through a special sub-program known as the Conservation Reserve Enhancement Program ("CREP") in the Rio Grande and Republican River Basins to promote voluntary permanent retirement of a water right to meet compact compliance or groundwater sustainability objectives. Workgroup members highlighted that the Colorado CREP programs' experiences might be informative, or serve as a potential model, for the possible development of a DMP. However, it is essential to note that CREP involves the permanent retirement of irrigated agricultural land, while a potential DMP would not. Key program considerations include enrollment caps based on acreage, sign-up processes, structuring incentive payments to target

enrollment, and requiring land management practices to achieve environmental benefits and avoid soil degradation.

- **Pilot/demonstration projects –** Throughout several workgroup meetings, participants repeatedly called for reliable, trusted information to be gathered from demand management pilot and demonstration projects. The workgroup believes that additional CWCB and partner supported demonstration projects could help address remaining information gaps, expand the diversity of project examples, and demonstrate program success, thus encouraging DMP participation. In particular, the workgroup believes pilot and demonstration projects should seek to address the following issues:
    - Long-term recovery impacts of reduced/limited irrigation on high-elevation hay production operations and interrelated irrigated pasturing of cattle/livestock operations;
    - Secondary off-farm benefits (e.g., water quality, instream flows) and impacts;
    - Impact of reduced irrigation on nearby farms or residential property owner (e.g., groundwater, weed, and pest management);
    - Costs, benefits, and impacts of crop switching and deficit irrigation as demand management activities;
    - Geographic diversity in project selection and participation;
    - Additional related unresolved questions – including how to conduct appropriate managed market systems, addressing undefined overhead costs, and defining technical assistance and outreach needs; and
    - Improving monitoring and verification, administration, ability to deliver water to the state line, Lake Powell, and eligible Colorado River Storage Project reservoirs.

Colorado Water Conservation Board
1313 Sherman St., Room 718
Denver, CO 80203

Dear Board Members,

On behalf of the Agricultural Impacts Demand Management Workgroup, please find attached a conceptual proposal for a Programmatic Pilot for your consideration. It was created to advance the DM investigation by providing potential actions that the CWCB might pursue to inform the next steps.

This proposal builds from the candid and productive conversations among our workgroup and the many folks who joined us, and it is intended to address the specific questions, comments, and concerns that were raised in those discussions. We would suggest that a multi-year Programmatic Pilot is our best opportunity in the systematic exploration of those questions and concerns, as well as those raised by other workgroups and interested parties.

A two phased approach is described in the proposal with the intent to enable groups across all water sectors and geographies that rely on water from the Colorado River basin to dig deeper into these issues at an appropriate pace and work through local conditions and tough issues. The suggested Pilot would engage in multiple activities to directly address questions posed by many perspectives, hopefully leading to a programmatic approach that meets multiple objectives identified by State, agriculture, and other economic and resource communities.

We recognize that Demand Management is a challenging and controversial subject. However, recent experience and current science related to the imbalance between Colorado River water supply and demand clearly indicate that there is an urgent water supply challenge in the Colorado River Basin. The Ag Impacts Workgroup strongly supports additional actions be taken to address this challenge through the continued use of pilot projects to further explore and evaluate potential demand management activities.

As the work continues on demand management, the members of the Ag Impacts workgroup remain committed to finding creative solutions to current and future water challenges that support critically important and productive agriculture and its multiple benefits for all Colorado now and in the future.

Demand Management: Programmatic Pilot

Goals: Building on the work of the CWCB Demand Management (DM) Workgroups and other efforts to date, a focused programmatic pilot is a potential important next step that would help test technical and non-technical components of statewide water conservation and advance multiple goals, including:

- Informing the timeline and process for the State of Colorado, the CWCB, and other stakeholders to determine the feasibility of a demand management program.
- Outlining the necessary components and criteria for implementation of a demand management program, including what level of DM is feasible/desirable given cost, available funding, Compact risk, secondary impacts, and other considerations.
- Providing critical information on demand management and other related elements for the upcoming negotiations on the Interim Guidelines.
- Informing and developing additional structure to a potential DM program via multiple projects in diverse geographies that support common, well-defined goals and objectives.

Note, while the workgroup's focus is on agriculture, the programmatic pilot approach should also accommodate municipal and industrial projects, including projects involving transmountain diversions.

Key steps:

- CWCB establishes a 3-year programmatic pilot, supporting a "learning by doing approach" where the State, water users, and other stakeholders can systematically ***test*** a programmatic approach to demand management, ***evaluate*** the outcomes, and ***inform*** next steps and a potential future program based on lessons learned.
- Determination of Feasibility: The ultimate determination of demand management feasibility as outlined in the Demand Management Storage agreement involves the UCRC, DOI, and the Upper and Lower Division States. However, the ability to store and account for water savings during this programmatic pilot would help advance Colorado's understanding of multiple aspects of a demand management program, potentially generating interest from a broad array of water users. The State of Colorado and the CWCB can use this programmatic pilot as an opportunity to make their own findings and advocate for allowing Colorado to store consumptive water savings, not only in Lake Powell and CRSP facilities but possibly in other private/public facilities in Colorado during this 3 -year pilot.
- Recognizing that the unprecedented budget challenges the State is currently facing impacts their potential to fund further work, stakeholders should discuss the top priorities for a potential programmatic pilot. Furthermore, a programmatic pilot could be structured to provide Phase 1 funding for project development in differing geographies and water use sectors and due diligence, and Phase 2 funding for actual implementation.

Program Structure:

- Participation in the program is open to any qualifying water users within Colorado that beneficially uses water diverted from the Colorado River or its tributaries. As a goal, the

program seeks to encourage program participation that would provide opportunities for participation from multiple geographies while avoiding disproportionate impacts to any community, basin, or region.
    - Program will strive for a roughly proportional distribution of funding across geographies.
    - Program goal will be to develop projects from multiple water use sectors, including agriculture, municipal, and industrial sectors, in multiple geographies, at multiple scales.
    - Program will provide an equitable opportunity for all water users to participate
    - Clearly defined and described participation eligibility
    - Universal and legally supported protections for participating entities and their water rights against forfeiture and reduced HCU.
    - Providing support though funding and capacity for project due diligence.
- Eligible entities will be invited to submit proposals that describe:
    - General project description and structure
    - Proposed water use reductions and estimated volume of CCU
    - Proposed operational mechanism for how water savings can remain in, or be returned to, the river or storage facility for administration
    - Proposal for monitoring and verification
    - Timeframe (1-3 years)
    - Total cost, including use of any matching funds
- Additional project criteria should include:
    - How the project will assess, address and/or mitigate, as needed the environmental, recreational and agricultural criteria, including impacts to return flows and irrigation-influenced wildlife habitat
    - How the project will address community and regional criteria, including potential secondary impacts?
    - Other factors TBD (e.g. ranking of proposals related to how the project addresses other priority questions from DM workgroup process, innovative methods for generating water savings, etc.)
- Program goal will be to coordinate with SEO to administer water rights from participating projects for Compact security purposes.
- An advisory committee that includes representatives from across geographies, water use sectors, and other interest groups will evaluate and rank proposals based on the above factors.
- The State should consider technical assistance via provider and consultant support to manage program/process and evaluate program effectiveness, benefits, impacts.

Work Group Meeting Report Out

Work Group: Agricultural Impacts Meeting #1 **Date:** August 8. 2019

Meeting Topics:

Agenda topics included: background on demand management and drought contingency planning; process and expectations of the work groups; initial issue identification; and public comment.

The group spent the majority of the meeting identifying the key big-picture issues associated with agricultural impacts of a potential demand management program and discussing the scope of the workgroup's future discussions.

Key Take Aways:

The workgroup discussed the need for research on best management practices for managing agricultural lands temporarily fallowed through a potential demand management program. The availability of technical assistance (e.g. conservation districts, Natural Resources Conservation Service, Colorado State University Extension, and other research institutions) to provide information on conservation practices, management techniques, the effects of temporary fallowing on future land management practices and long-term crop production and returning fallowed lands back into production.

The group discussed the connection between other workgroup efforts particularly local governments and economic impacts and the environmental workgroups. Specifically, that there needs to be an assessment of the potential regional economic and ecological impacts of a potential temporary, voluntary, compensated demand management program. There was a consensus to explore development of a program that avoids an undue burden on a specific water right holder, economic sector, or geographic region.

All members of the workgroup voiced support for conducting further scenario planning and conducting pilot projects to help answer questions to these potential issues and inform the investigatory process.

Questions/Concerns to Raise:

The group identified some threshold questions and issues to consider going forward, including:

- How to avoid injury to non-participants on ditch systems and water right holders
- How to structure a potential demand management program to address barriers to participation such as design contracting to fit needs of ag participants
- The need for research on best management practices for managing agricultural lands enrolled in a demand management program and the availability of technical assistance

Additional technical, informational other needs:

The group discussed opportunities to utilize contractor assistance such as conducting a literature review to review results from other programs and investigation efforts, including the System Conservation Pilot Program and various alternative transfer method projects. The workgroup also discussed the need to collect information regarding studies assessing on-farm and operational impacts (e.g. crop yield, forage quality, crop rotations, soil management) associated with temporary fallowing and other conservation practices such as deficit irrigation including the results of studies done by Colorado State University and other research institutions on methods to temporarily reduce irrigated crop consumptive use.

Other:

The group will identify a next meeting date in the November timeframe to be held on the Western Slope

Work Group Meeting Report Out

Work Group: Agricultural Impacts Meeting #2 **Date:** November 4th, 2019

Meeting Topics:

Agenda topics included: review of workgroup report outs for cross-cutting issues, issue identification and prioritization; and overview of voluntary, temporary, and compensated models for a potential demand management program.

The group spent the majority of the meeting hearing presentations on pilot project results and research findings from the System Conservation Pilot Program, Colorado River Water Bank Working Group, and Grand Valley Water Users Association Conserved Consumptive Use Pilot Project. Through these presentations, the workgroup discussed key findings and identified remaining issues to be further explored through the development of a literature review and other methods.

Key Take Aways:

The workgroup reviewed the report outs from the other demand management workgroups. Some of the cross-cutting issues identified included:

- Develop a better understanding of the secondary economic impacts of a potential demand management program and assess strategies/approaches to mitigate potential impacts such as project selection criteria that maximize potential benefits. The workgroup discussed a need for more information on the economic impacts/benefits of a potential demand management program on eastern slope agriculture.
- How will projects address environmental concerns/issues such as return flows and wildlife habitat? Could a potential demand management program be designed to generate "stackable benefits" or provide a source of mitigation for other water projects?
- What role do canal companies play in determining who may participate in the potential demand management program? How will states coordinate methods for determining historical consumptive use? How could an education or outreach component of a potential demand management program encourage participation?

The workgroup spent a portion of the meeting discussing the development of more defined parameters, or guiding principles, to address concerns and encourage participation in a potential demand management program. Some of these parameters included equitability and no material injury to other water users. The workgroup expressed a desire to work with the state DMP contractor to further develop these guiding principles.

The workgroup continued to discuss conceptually developing a framework for potential demonstration projects. The workgroup believes that demonstration projects could help address information gaps such as the impacts of temporary fallowing on high elevation pasture/hay operations and inform overarching program guiding principles and feasibility considerations.

Other:

The agriculture workgroup will convene on March 3rd in Denver, Colorado prior to meeting with other workgroups during the upcoming Interbasin Compact Committee Meeting to be held March 4th and 5th, 2020.

Work Group Meeting Report Out

Work Group: Agricultural Impacts Meeting #3 **Date:** March 3rd, 2020

Meeting Topics:

Agenda topics included: review of workgroup report outs for cross-cutting issues with focus on Monitoring and Verification, issue identification and prioritization; preparation for IBCC meeting.

The group spent the majority of the meeting refining priority issues and threshold questions concerning agricultural impacts associated with a potential demand management program, discussing cross-cutting issues with members of the monitoring and verification workgroup, and discussing the development of a "model" demand management program for further discussion purposes. A key theme of the discussion was that any demand management program should be offered as an insurance policy versus curtailment.

Key Take Aways:

- The group discussed current state funding limitations concerning the development of demand management pilot programs, but agreed that other efforts including the Colorado River Basin Roundtables' Kremmling project assessing agronomic impacts of alternative transfer methods on high elevation hay and pasture operations will be informative.
- The group discussed that east slope participation by both agriculture and municipal water users would be essential in terms of equity under a demand management program. However, the group discussed that east slope projects would potentially present several challenges that would need to be addressed including monitoring and verification and issues concerning Federal approval.
- The group began discussing various parameters or features of a demand management program that would help minimize agricultural impacts and maximize benefits for producers and rural communities. Some of these parameters include modeling a demand management program after the United States Department of Agriculture Conservation Reserve Program, which includes certain enrollment quotas per county and incentive payments to manage the enrolled land to maintain soil health and other environmental attributes. These parameters could be modified under a potential demand management program to set enrollment quotas by river basin, number of participants, or other factors such as a percentage of irrigated acreage for a given geographic region. Discussion also included how to best make participation in a demand management program available to producers who may view the program as an opportunity or benefit and who may otherwise be precluded from participation by potential imposed quotas or limitations. The group also discussed how best to determine pricing for participation including both free market and managed market approaches.
- The group discussed topics to include in an agricultural impacts and benefits literature review including socioeconomic regional effects of demand management and regional land conservation programs, the effects of temporary fallowing and deficit irrigation on high elevation agricultural operations, and alternative transfer method programs.

Other:

The group agreed that a minimum of two more meetings would be useful. Given current public health concerns over COVID-19, these meetings may be held virtually with public access. As a result, there may be more opportunity for different workgroups to meet together. A key focus of the next agricultural impacts meeting will be to discuss each workgroup member's "model" demand management program to minimize agricultural impacts/maximize benefits and/or a collective demand management "model" based on discussions had at the March 4th and 5th IBCC meetings.

Work Group Meeting Report Out

Work Group: Agricultural Impacts Meeting #4 **Date:** May 14th, 2020

Meeting Topics:

Agenda topics included: review of workgroup report outs for cross-cutting issues; issue identification and prioritization; discussion of agricultural impact literature review; and discussion of potential demand management framework and criteria to address agricultural impacts and provide opportunity for agricultural community participation.

The group spent the majority of the meeting refining priority issues and threshold questions concerning agricultural impacts associated with a potential demand management program, discussing cross-cutting issues with members other workgroups, and discussing the development of a "model" demand management program for further discussion purposes and to inform Colorado Water Conservation Board considerations.

Key Take Aways:

- The group discussed topics to include in an agricultural impacts literature review, including socioeconomic regional effects of demand management and regional land conservation programs, the effects of temporary fallowing and deficit irrigation on high elevation agricultural operations, and alternative transfer method programs.
- Building on the conversation from the March Interbasin Compact Committee (IBCC) meeting, the workgroup spent a considerable portion of the meeting discussing a "model" framework and criteria regarding a potential demand management program that would minimize agricultural impacts, while providing benefits to agricultural producers and communities reliant on agricultural production to sustain their economies. Some of the framework considerations discussed by the workgroup include:
    - **Balancing program equity and accessibility, while avoiding disproportionate impacts on any one region, basin, or economic sector.** This goal includes striving for proportional participation in a potential demand management program from both Western Slope agriculture and Front Range municipalities.
    - **Developing a guided DMP program with baseline criteria** designed to minimize and mitigate potential agricultural impacts, while maximizing potential benefits. The potential DMP program would be guided by a "market-maker" that would manage the program with the dual objectives outlined in the Upper Basin Drought Contingency Plan, while maintaining the viability of agriculture and rural communities. Criteria would possibly include setting certain enrollment caps or quotas to avoid significant impacts on particular basins and spread out participation, providing mitigation or financial assistance to impacted agricultural water providers such as ditch companies to offset operational changes due to program participation, and offering technical assistance to program participants to address on-farm and off-farm agronomic impacts.

Other:

The final agricultural impacts meeting under the 2019 Work Plan will be held on June 17th, 2020. The focus of the June meeting will be to review the Agricultural Impact Workgroup's final report to the Colorado Water Conservation Board regarding threshold agricultural issues for further consideration.

Attachment D

Economic Impacts and Local Government Workgroup Documents:

1. Summary
2. Reports

Economic Impacts and Local Government Workgroup
Final Report

A. General Principles

1. Ensure project does not create negative impacts that cannot be mitigated.

2. Support projects that avoid irreparable harm/accomplish goals, while producing some net benefit if possible.

3. Remember that the program is voluntary. Those who do not wish to participate should not do so.

B. "Do no harm" - Minimize and mitigate any adverse impacts to communities.

The following factors should be considered:

1. Type of water use – ag, municipal, industrial, environmental.

2. Consider the duration of the demand management program – shorter program would probably result in temporary or short term effects, which could be mitigated more easily if they were negative.

3. Consider limiting the length of individual project participation.
   a. Projects longer than one year could potentially create negative impacts for some participants.
   b. Impacts of project participation length will vary by, for example, geographic location, type of water use, and crop type.
   c. Direct and secondary economic impacts (positive or negative) may vary depending upon type of hydrologic year occurring before, during or after period of participation (wet or dry year) and will create variation in economic impacts.

4. Consider the positive and negative impacts of geographic location and concentration of projects
   a. Geographic distribution of projects is not inherently valuable, but location of a project may determine whether the project is feasible.
   b. Identify where geographic concentration of projects may cause negative impacts and avoid or mitigate negative impacts where possible.
   c. Geographic concentration might be beneficial in some circumstances, like multiple participants in ditch system.
   d. Projects should have an equitable opportunity to participate in program regardless of geographic location.
   e. Projects in relatively isolated locations may result in different economic impacts from other projects.

5. Potential impacts should be broadly defined.
    a. Impacts not limited to holders of other water rights, i.e. impacts on local governments.
    b. Lessees of water would be impacted by non-use of water right.
        i. What impacts would occur to tenants when water right owners participate and what is appropriate role of the state in addressing those impacts?
        ii. Project application process should identify whether participant has tenants.
    c. Consider the impact of non-resident project participants that lease their lands and the impact of money potentially leaving the local community, including secondary economic impacts of money lost from a community, and tax payer money not returning to the community, among others. This is of particular concern relating to water speculators, noting the State's anti-speculation doctrine.
    d. Funding may have impacts.
        i. If public funds are shifted to DM and away from other State programs there may be negative impacts to the community and State.
        ii. To avoid public funding leaving the local community, program may want to prioritize locally owned projects.
    e. Consider the varying impacts of foregone TMD including the impact of more water being in the river on west slope, but less return flow in the river on the east slope or the user basin which could be significant.

6. Consider the need for additional research or studies to inform analysis of potential adverse impacts including but not limited to:
    a. Potential impacts due to length of participation.
    b. Potential localized impacts of projects and various "tipping points" based on the water use type and duration of the projects.
    c. Options and approaches for mitigation measures or programs.

7. Consider the need for coordination with land use restrictions such as conservation easements.

8. As discussed above, consider concerns relating to participation from nonresident corporate water rights owners.

C. Program should create benefits for community and economy if possible.

The impacts of DM projects need not be adverse. Projects could provide benefits to the affected community. Below are some examples of potential benefits.

1. Avoidance of curtailments. Compact curtailment will cause adverse impacts, and avoidance of curtailment is therefore a benefit. The benefits of avoidance should be identified and explained as part of the DM program.

2. Opportunity to improve long-term management of water and land presented by the pause in normal water use operations.
    a. Opportunity with ag project to switch to organic farming or change cropping patterns.
    b. Opportunity to improve infrastructure, equipment, or fixtures.
    c. Implicates definition of “temporary”.

3. Management for threatened or endangered species.

4. Potential increased revenue to local economies.
    a. Encourage projects where funds to participants make their way to local economies.

5. Increased streamflow.
    a. May support west slope recreational economy and aesthetics with regard to tourism.
    b. Benefit to environment and habitat.
        i. Higher flows may create beneficial impacts to aquatic and riparian habitat in some circumstances.
    c. Additional flow may improve water quality and regulatory compliance via dilution.
    d. Stream management planning occurring around the State can further inform benefits.

6. Understanding complexity of determining benefits.
    a. Rural and urban areas will experience impacts differently.
    b. Programs may need to be tailored to account for varying economic impacts.
    b. Implications of timing on benefits.
        i. High flows may make certain activities more dangerous or less desirable.
        ii. Important to be able to time releases for maximum benefits.
    c. Need a balancing approach and holistic analysis when considering potential benefits and adverse impacts of projects.
        i. Single project may have positive and negative impacts, depending on the subject matter being considered. For example, increased streamflows for recreation, but increased fire danger from drier land.

ii. Nuance of divergent interpretations of positive and negative impacts. 1.a.viii. For example, reducing use of water for mature landscape in municipalities may have a positive impact on volume of water use, but could have a negative economic impact on value of a home and air and water quality.

d. Accommodate as many feasible projects as wish to participate, as long as adverse impacts not created.

D. Utilize a transparent and collaborative process in operating DM program.

1. Manage administrative costs associated with demand management and understand cost-benefit analysis on multiple levels, including on a project basis, as well as on a statewide, and programmatic/basin-scale.
   a. Need high-level administrative organization of program, considering amount of wet water created, management of costs.
   b. Given limited resources, consider cost-benefit analysis at programmatic level and a project/mitigation-of-impacts level.
   c. Direct the program to take these issues into consideration.

2. Engage stakeholders in the process.
   a. Emphasize inclusiveness.
   b. Ensure adequate education/outreach channels are in place.

3. Ensure adequate communication is in place to adequately identify potential impacts and benefits of projects.

4. Ensure adequate transparency of the program through communications and technology.

5. Application process should support goals of program.
   a. Similar application processes are in place in other state programs.
   b. Project applicant should make initial and high level identification in proposal of:
      i. Potential negative impacts and mitigation strategies.
      ii. Potential benefits of project.
      iii. Location within conservancy district.
      iv. Other water rights holders who may be impacted.
   c. Try to minimize burden on applicants.
      i. Provide assistance to applicants in filling out application.
      ii. Make available studies that will inform applicants on particular impacts.

iii. Provide flexibility in process that will encourage innovation in project proposals, while minimizing potential negative impacts of projects.
iv. Develop mechanisms to identify potential impacts and consider implications for process and application.

6. Levels of approval.
   a. CWCB
   b. State Engineer's Office
   c. UCRC

7. Potential levels of review.
   a. Goal to assure that there is local fact-checking of applications and identification of potential impacts.
   b. Provide opportunity for review/comment at local level
   c. General need to incorporate local input in analyzing potential projects
   d. Ensure sufficient review to identify, define, mitigate as needed
   e. Conservancy District analysis/input
   f. County commissioners and city councils
   g. Basin Roundtable review/comment

Work Group Meeting Report Out

Work Group: Economics and Local Government Meeting #1 **Date:** August 9. 2019

Meeting Topics:

Agenda topics included: background on demand management and drought contingency planning; process and expectations of the work groups; initial issue identification; and public comment.

The group spent the majority of the meeting identifying the key big-picture issues associated with economic impacts of a potential demand management program and discussing the scope of the work group's future discussions.

Key Take Aways:

The group discussed the connection between local governments and demand management economics. Specifically, there may be economic impacts to a local community and local government. The local government may participate in managing these impacts.

The group expressed a desire to consider all economic impacts of a potential demand management: positive and negative impacts.

The group brainstormed economic impacts and impacts to communities identifying both impacts to specific sectors (ie tourism, agriculture, open space, etc) and economic considerations when designing a potential demand management program (ie transaction costs, net benefit opportunities, scale, etc).

Questions/Concerns to Raise:

The group identified some threshold questions and issues to consider going forward, including:

- A better understanding of the timing and timeframe of creating demand management water to assess the economic impacts of a potential demand management program.
- Whether and what kind of parameters should be developed in a program to minimize adverse impacts and maximize beneficial impacts on local communities.
- Various methods and considerations for valuing/pricing water.

Additional technical, informational other needs:

The group discussed opportunities to utilize contractor assistance such as conducting a literature review to examine results from other demand management programs and investigation efforts.

Other:

The group will identify a next meeting date in the September - October timeframe to be held in the Denver Metro area

Work Group Meeting Report Out

Work Group: Economics and Local Government Meeting #2 **Date:** November 7. 2019

Meeting Topics:

Agenda topics included: a summary of public comment and the group's first meeting; presentations on the Water Bank Working Group Secondary Economic Impact Study and economic research from the Upper Gunnison, continued discussion of threshold issues, and a discussion on threshold parameters from an economic and local government perspective.

Key Take Aways:

- Rhetoric matters – the group continued to support a shift towards viewing demand management as a tool that includes a discussion of both positive and negative impacts.
- Proportionality and fairness continue to be top of mind, threshold issues.
- Social justice is important to communities. Access to open space, green space, aesthetics, and parks must be considered.

Key Discussion Points:

The group split into two groups to explore screening criteria and threshold parameters from an economic and local government perspective. These discussions will continue to be refined in future meetings, but included:

Group 1 - Parameters	Group 2 - Screening
• Differential compensation (regional + sector) • Transaction costs • Program administration • Proportionality • Property tax designation • Water right priority and firmness • Measuring injury	• Potential Water Savings by Economic Sector • Ability to participate • Water saving potential • Who might be affected (short-term + long-term) • Actions necessaryto mitigate • Costs to mitigate

Additional technical, informational other needs:

- Adding additional capacity to research impacts to soil health, impacts of fallowing or deficit irrigation on high elevation agriculture operations, impacts to communities and different economic sectors, and impacts to wildfire risk.
- Various pricing mechanisms need to be explored to incentivize voluntary participation, ensure proportionality, and minimize costs to the taxpayer.

Other:

The group's next meeting will be held January 29th at the Westin Westminster beginning at 1pm.

Work Group Meeting Report Out

Work Group: Economics and Local Government Meeting #3 **Date:** January 29, 2020

Meeting Topics:

Agenda topics included: a summary of public comment and parking lot issues received from other workgroups; update on scenario planning concept developed in Funding Workgroup, an update on the Water Plan Technical Update provided by CWCB staff, discussion of upcoming IBCC/Demand Management meeting, a discussion of threshold issues, and opportunity for public comment.

Key Discussion Points:

- The group discussed the work of other workgroups, including the Funding workgroup's scenario planning concept/thought exercise.
- There was discussion around how market forces may impact a Demand Management program, and how to consider and account for those issues.
- Discussion returned to issues around definitions, such as the issue of absentee landowners and what constitutes "voluntary" participation. Continued discussion around the concept of equity and importance of recognizing unique basin-by-basin issues.
- The group also discussed data gaps and potential next steps for increasing understanding of temporary, voluntary, compensated programs, including potential pilots.

Key Take Aways & Next Steps:

- The group would like to further develop the concept of scenario planning, and consider ways the group's considerations could fit into the work the Funding workgroup has developed. This will be discussed further at the March IBCC/Demand Management Workgroups meeting.
- There was discussion around how market forces may impact a potential Demand Management program, and how to consider and account for those issues. The group thought a presentation focused on these issues as related to the System Conservation Pilot Program would be helpful.
- Discussion returned to issues around definitions, such as the issue of absentee landowners and what constitutes "voluntary" participation. Further discussion would be helpful in understanding how these concepts interact and how to manage them in a potential Demand Management program.

Other:

The group will meet next at the joint IBCC/Demand Management Workgroups meeting in March and will work on scheduling additional meeting after that.

Work Group Meeting Report Out

Work Group: Economics and Local Government Meeting #4 **Date:** May 11, 2020

Meeting Topics:

Agenda topics included: a summary of public comment and parking lot issues received from other workgroups and update on IBCC joint meeting; revisiting the workgroup's charge; a presentation on the System Conservation Pilot Program; scenario planning discussion; discussion of deliverables and summary of work; next steps; and public comment.

Key Discussion Points:

- The group discussed the System Conservation Pilot Program, including how the program functioned, levels of participation, and impacts of the program. The group also discussed differences in how the SCPP operated and how a potential Demand Management program may operate.
- In recapping the IBCC meeting, the group discussed the scenario planning exercise developed by the Funding Workgroup, ultimately determining the structure provided by that workgroup would not fit directly what this workgroup is hoping to analyze.
- The workgroup moved on to discussion of the key principles and points they'd like to capture with respect to economic impacts and local government issues of a potential Demand Management program and spent much of the meeting time further developing this as a potential work product.

Key Take Aways & Next Steps:

- The group thought it would be helpful to hear more about impacts relating to the SCPP, and has requested a presentation to occur at the next meeting.
- The group will work on the key principles and points and further refine this at the next meeting.

Other:

The group will meet one final time to finalize their message and work product.

Work Group Meeting Report Out

Work Group: Economics and Local Government Meeting #5 **Date:** May 28, 2020

Meeting Topics:

Agenda topics included: a review of other workgroups' progress and draft work products; a presentation on System Conservation Pilot Program Grand Valley research; work on the group's work product document; next steps; and public comment.

Key Discussion Points:

- The group discussed the work products of other workgroups, and staff provided an update on how the report and attached workgroup documents and reports are coming together.
- The group then heard a presentation and had discussion on the System Conservation Pilot Program, particularly Dr. Perry Cabot's research on secondary impacts of participation in the SCPP in the Grand Valley.
- The workgroup spent the majority of this meeting finalizing their work product for inclusion with the July 2020 report to the Board, and discussing outstanding issues of framing.

Key Take Aways & Next Steps:

- The group determined it would be helpful to assign a drafting committee to make final changes to the group's work product. This group was to finalize the group's work product for final review by the larger group.

Other:

This was the final meeting of this workgroup.

Attachment E

Education and Outreach

Workgroup Documents:

1. Summary
2. Reports

Education & Outreach Workgroup
Demand Management Feasibility Investigation
Final Report

Document Objective // In the context of the Colorado Water Conservation Board's investigation into the feasibility of a potential Upper Basin Demand Management program, this document aims to summarize many hours of workgroup conversations related to communications, education, and outreach considerations.

Contents of Final Report	
Section A	Priority Considerations for CWCB
Section B	Messaging and Framing Recommendations
Section C	Information Networks and Public Involvement
Section D	Meeting Summaries and Participation List

Section A // Priority Considerations for CWCB

Workgroup members quickly identified many challenges in helping the State explore threshold questions related to communication, education, and outreach needs around a potential demand management program. This group was asked *not* to develop a communications plan for the feasibility investigation process itself, *nor* to develop a communications plan for a future potential program. In lieu of assisting with structuring communication for the active process or a future program, the workgroup focused their expertise on discussion around priority considerations should the CWCB elect to continue with feasibility, pilots, or program development.

While it is essential to develop a communications plan well before a demand management program is enacted, content substance is needed to proceed in which common terms are defined across workgroups and state partners, clear frames are developed to help unite messaging across stakeholder groups, and essential content from FY19-20 workgroups are considered by CWCB and incorporated into an agreement on a demand management program's general (initial/draft) shape.

Priority Considerations:

- Develop a communications plan with clear target audiences for each clearly defined stages of program development

    - Aim to help each stakeholder group, at the beginning of each phase of program development, answer 'the why' with clarity: "Why are we doing demand management?"
    - Strong need for confident, honest communication at each stage of program concept. Communication plans will look different during feasibility investigation, than in early program development, than during active program management.
        - For example: It is extremely challenging, and perhaps wasted energy, to explain "why" the state is designing a concept that is only a draft for anyone **external** to the workgroup participants.

- Determine target audiences and existing communication channels
    - **Essential first task:** Explore a water industry "network actor map" or social network analysis with the goal of identifying major public facing communicators (individuals and organizations) with strong (well-established) communication pathways, or those with weak (limited audience) pathways
    - Mapping communications networks could help highlight where program participants may have gaps in tools (e.g. computer access)
    - Consider partnering with Water Education Colorado's near term Freshwater News survey efforts (Dec 2020), Statewide Water Education Action Plan implementation work (which includes mapping a network of water educators) or the CWCB Statewide Survey (2021)

- Prioritize transparency and diverse engagement
    - Explore options for web-based public engagement such as collecting public comments, utilizing existing podcasts, radio shows, op eds, or short informational videos to increase program engagement and understanding
    - Consider utilizing a network of messaging ambassadors who have direct lines of communication to and from CWCB (for clarity in questions and messaging) as well as to and from their established communities (those who would engage with a program)

- Define key terms and regularly review message consistency
    - Early need to define common terminology across working groups and for external parallel discussions (e.g. roundtable-centric DM discussions)
    - Find a more inclusive, positive, or engaging term than "demand management"
    - It is essential for there to be an overall positive tone and frame created from each workgroup in order to translate workgroup efforts into a "net positive" program for the state. "Net positive" inherently recognizes (takes ownership of) negative impacts from a potential program which should also be highlighted. DM is an opportunity for "net positive" water management.

- Timing Considerations
    - In the context of current economic and public health conditions, consider when target audiences have bandwidth to engage in new management tools.
    - Consider timing as it relates to other public water-related campaigns (BIP, Water Plan)

Section B // Messaging and Framing Recommendations

The idea of various interests working together as a larger group to explore demand management feasibility presents a new planning paradigm with benefits and challenges. At this stage, a branding problem exists as different stakeholders have different ideas of what a program may look like, how it can be explained, and how often communication is carried to individuals' direct communities. As a result, there are, currently, widely varied framings of a potential program and negative tones within the water community. This workgroup recommends immediate messaging discussions to identify shared, priority framing. Several examples are listed below - many of which can be tied to theme areas in the Water Plan.

People want to know that leadership is moving in a predictable trajectory without changing on a whim. Until CWCB communicates confidence in a program direction for Colorado, messaging will be challenging to control. There is also a need to directly address the elephant in the room: Another state could say "no" and an upper basin DM program would not materialize. However, Colorado could still proceed as a state to address our own resilience and water scarcity challenges and framing can help support this.

Possible Frames:

- Another Tool: A DM program is simply the next step or tool in a long history of successful resilience strategies in Colorado. "One more tool in heavy toolbox of water management"
- Equity frame: DM program helps to share the water shortage burden
- Opportunity "control" frame: DM program can seize Colorado future/destiny
- Common Enemy frame: DM program can build true resilience in face of climate change
- Investment frame: Investment in water security versus the cost of inaction
- Global Leader frame: Colorado is viewed by other states as being able to solve big problems
- Cooperation frame: People expect water to be a huge fight. This is an opportunity to change that narrative.
- Shared limited-resource frame: "The Colorado River is an important source of water for municipal and domestic suppliers on both the West Slope and Front Range."
- Food Security frame: Viable agriculture in Colorado supports food security
- Ecosystem Service frame: Environmental flows are system health and major economic "streams"
- Minimize Risk frame: "A DM program is a way to minimize individual risk and increase water certainty/predictability."

Once a demand management program has been established, consider identifying many statewide "ambassadors of messaging" the CWCB (or communication work group) could regularly communicate with, answer questions, and provide clarification. Demand management representatives in each region, from all sectors, could help with consistent framing while messaging in a way their communities trust, receive, and respond to.

Messaging Considerations:

- Regardless of core statewide framing, different groups require unique, tailored communications centered on clear, positive benefits.
- Success story telling is a key component for communication, including interviewing communities about examples that resulted in avoiding negative impacts through program benefits
- Clear need to reset the story and articulate common goals to overcome early negativity
- A potential DM program will not secure public funds unless the public understands the issue. A variety of frames will need to be used to communicate with different publics about a program's funding needs.
- Look outside the water industry for other programs with similar communications needs/challenges (complex issues that take extensive introduction to frame the issue in order to determine which background information is critical for different publics). E.g. energy sector, coal-plant shut down
- Examine cultural values and lenses to communicate effectively in different spaces
- Message should directly address the "status quo alternative" deterrent to DM participation

Section C // Information Networks and Public Involvement

Throughout the investigation, workgroup members identified the need to help stabilize communication chains, the need for extra transparency, and the need to maintain an open line for all users to communicate concerns and ideas to/from CWCB and to/from one another.

Considerations:

- Until an actual program is pursued, the need to communicate broadly with a public audience, beyond water community, is minimal.
- Need for regular messaging ambassador "check-ins" with all sectors to ensure stakeholders are still in agreement and onboard throughout development stage of a program
- Cross-pollination of communication would break down distrust and keep conversation consistent across regions.
- Building bridges of communications between slopes is necessary to address united statewide PEPO coordination. Regarding PEPO (Public Education Participation & Outreach) meetings, the West Slope has created a network of communications related to DM while the East Slope has yet to create strong messaging and communications tools. There is also fracturing within groups of either Slope (creating smaller segmented groups).
- Educators and communicators will increasingly feel the need to have concrete messaging and tools to disseminate information from a common platform in the future.

Section D // Meeting Summaries and Participation List

Meeting #1 // August 15th, 2019 // Salida Steam Plant // [LINK TO SUMMARY #1]
In attendance: Andy Schultheiss (CO Water Trust), Doug Kemper (CO Water Congress), Hannah Holm (MesaU), Jim Pokrandt (CRD), Laura Spann (SWWCD), Lisa Darling (South Metro), Scott Williamson (WEco), Todd Hartman (Denver Water); CWCB: Brent Newman, Megan Holcomb

Meeting #2 // February 10, 2020 // Denver Botanic Gardens // [LINK TO SUMMARY #2]
In Attendance: Andy Schultheiss (CO Water Trust), Doug Kemper (CO Water Congress), Hannah Holm (MesaU), Laura Spann (SWWCD), Lisa Darling (South Metro), Scott Williamson (WEco), Todd Hartman (Denver Water); CWCB: Megan Holcomb, Ben Wade, Sara Leonard, Amy Ostdiek

Meeting #3 // March 5, 2020 // Sheraton Denver West Hotel // [LINK TO SUMMARY #3]
In Attendance: Andy Schultheiss (CO Water Trust), Hannah Holm (MesaU), Lisa Darling (South Metro), Scott Williamson (WEco), Todd Hartman (Denver Water); CWCB: Megan Holcomb, Ben Wade, Sara Leonard, Amy Ostdiek

Meeting #4 // June 4, 2020 // Virtual // [---ADD LINK---]
In Attendance: Andy Schultheiss (CO Water Trust), Hannah Holm (MesaU), Laura Spann (SWWCD), Lisa Darling (South Metro), Scott Williamson (WEco), Todd Hartman (Denver Water); CWCB: Megan Holcomb, Ben Wade, Sara Leonard, Amy Ostdiek, Jim Pokrandt, (Colo River Dist.), Chris Woodka (SECWCD)

Education & Outreach Demand Management Workgroup (Meeting 1)
Thursday, August 15th, 2019 10 am - 2 pm
Salida Steam Plant (220 W Sackett Ave, Salida, CO 81201)

Meeting Topics:
Agenda topics included updates on the current status of drought contingency planning (presentation by Brent Newman); an overview of the CWCB directive and work plan; discussion of workgroup expectations; initial scope and mission ideation; and public comment period that included a presentation of "Risk Study Phase 3" findings/new questions (by Jim Pokrandt).

Key Takeaways:
The group spent the majority of the meeting identifying key big-picture questions associated with determining potential target audiences for demand management (DM) communications and discussing current perception and communication challenges related to the workgroup process (current) and demand management process as a whole (future).

- Need for message consistency and resources that could include DM is (1) an evolving process, (2) one more resilience tool to address future uncertainty, (3) an opportunity for "net positive" water management.
- Need for extra process transparency and inclusive program development that facilitates the ability for all water users to communicate questions, concerns, and ideas.
- Need to develop a common understanding of phrasing and intention. Words matter.

Questions/Concerns to Raise:
The group identified some threshold questions and issues to consider going forward, including:

- Multiple scales of communication this group *could* address. Decide if the primary goals are to help facilitate communication of the workgroup process, of an active DM program, or engage with and respond to current media outlets.
- Is there a more inclusive, positive, or engaging term than "Demand Management"?
- Aim to help stakeholders answer the why with clarity and transparency: "why are we doing demand management?"

Additional technical, informational other needs:
The group discussed several potential next steps to explore, including the following:

- Explore "Bleiker Consent Building" course for transparent consensus and conflict resolution training.
- Develop a distributable demand management "one-pager" for water users with FAQs.
- Explore options for web-based public engagement such as collecting public comments, utilizing existing podcasts, radio shows, op eds, or short informational videos
- Explore a water industry "systems map" with the goal of identifying major public facing communicators, strongest communication pathways, and strengthening weak communication links

Other:
The group will identify a next meeting date in early 2020.

Education & Outreach DM Workgroup Meeting Report Out

Work Group: Education & Outreach Meeting #2 **Date:** February 10, 2020

Meeting Topics: Agenda items included a recap and summary of the work of other workgroups, a discussion of exercises other workgroups are engaged in, a brainstorming session relating to regional messaging, development of guidance for a literature review, and preparation for the March joint Interbasin Compact Committee/Demand Management meeting.

Key Discussion Points:

- Discussion covered the need for message consistency, stabilizing communication chain, need for extra transparency, open line for all users to communicate concerns and ideas.
- "Ambassadors of messaging" discussion around shifting the conversation about Demand Management to communities at the regional and local levels. Need to have more frequent check-ins among different workgroups, and have workgroup members' organizations support State communications to their respective publics.
- Ongoing efforts discussed relating to surveys of how water educators communicate; mapping communications networks and addressing gaps. Potential for this workgroup's work to inform/be informed by these efforts.
- Discussion around complications of communicating about a concept, not a concrete program.
- The group brainstormed on guidance for literature review.

Key Take Aways & Next Steps:

- Workgroup members will share information and ideas about education and outreach-relevant literature to bring to consultant's attention for inclusion in literature review, including examples outside of water industry.
- Workgroup members to prepare for March IBCC/DM meeting, particularly cross-cutting discussions and issues, asks of other workgroups.

Other:

The group will meet next at the joint IBCC/Demand Management Workgroups meeting in March and will work on scheduling additional meeting after that.

Education & Outreach Demand Management Workgroup (Meeting 3)
March 5th, 2020
Sheraton Denver West Hotel (360 Union Blvd, Lakewood, CO)

Meeting Topics:
Discussion illuminated a continued need for clarity in this workgroup's objectives. There was recognition that it is still too early in the investigation process to clearly define a communication role (external to the workgroup process). First, terms should first be defined by technical-focused workgroups, and intent to continue is needed from the State. Education & Outreach Workgroup expertise can support other workgroups.

Key Takeaways:
- What is the communication frame? Potential frames include: Equity (to share water shortage burden); Opportunity (to seize Colorado future/control destiny); Common Enemy (to develop resilience in face of climate change); Investment (vs cost of in-action)
- Need to define common terms across other working groups and for external parallel discussions (e.g. roundtable-centric DM discussions)
- Need clarity from CWCB on scope/timeframe: Does Ed/Outreach work really begin after this process to assist with consistent and intentional statewide messaging?
- Colorado is viewed by other states as being able to solve big problems - Communication should highlight DM program simply next step in long history of resilience/success
- Echoed in Environmental and Agriculture workgroup discussions: Clear need to reset the story and articulate common goals to overcome early negativity. Need for regular, expected "check-ins" (if a program is to be developed) with all sectors to ensure stakeholders are still in agreement/onboard. People expect water to be a huge fight; this is opportunity to change that narrative. West is over built. Ag is food. Envl flows are system health and major economic "streams." Regardless of core statewide framing, different groups require unique, tailored communications centered on clear, positive benefits.

Questions/Concerns to Raise:
The group identified some threshold questions and issues to consider going forward, including:
- What can the ed/outreach group do to help support other workgroups? If we craft a communication framework or create boilerplate language, there has to be transparency and details (which is more than a "quick fact sheet").
- A potential DM program won't have public funds unless the public understands the issue. Need all useful frames to talk to the public. (e.g environmental considerations front & center in program development; DM one more tool in heavy toolbox of water management)
- It's essential to have communications plan *before* a DM program is decided upon, but need substance to proceed.

Other needs:
- If Ed/Outreach group is to meet again, what is the specific deliverable need? Either from CWCB or other workgroups?

Education & Outreach Demand Management Workgroup (Meeting 4)
June 3, 2020
Virtual meeting

Meeting Topics:
Agenda topics included a discussion of the report going to the Board in July and work products of the other workgroups to be included; discussion of the Education and Outreach Workgroup's final deliverables concepts; a group review of the final deliverables; a discussion of individual needs statements; and public comment.

Key Takeaways:
- The group spent most of the time at this meeting working towards consensus on how to capture the workgroup's work and discussions to date for a final deliverable to go to the board in July, as an attachment to the report to the Board.
- The group focused on the common education and outreach themes they have covered throughout discussions, including communication support and needs for the continued feasibility investigation; consideration of messaging and framing; and existing information networks and public involvement.
- The group identified that it is important to consider the communications needs in relation to timing of the investigation and any potential program. Additionally, the group discussed the ongoing importance of defining the audiences for education and outreach on demand management issues.
- The group also discussed offering individual statements, reflecting individual group participants' specific thoughts outside of the group summary documents, and highlighted the importance of capturing group discussions in an inclusive and holistic manner.

Other:
- This was the final meeting of the Education & Outreach Workgroup.

Attachment F

Environmental Considerations

Workgroup Documents:

1. Summary
2. Reports

Environmental Considerations for Evaluating a Demand Management Program or Project*

June 17, 2020

Introduction

The Environmental Considerations workgroup approached a demand management program as a potentially important tool for the State of Colorado that, if established, could provide environmental benefit. As such, this workgroup examined how to ensure that, if Colorado sets up a program, it have as a secondary goal achieving, as much as feasible, a net environmental benefit over time, and across hydrologic conditions and geographies. Because achieving environmental and other positive impacts from a demand management program will be more difficult with fewer participants, the Environmental Considerations workgroup also encourages a program structured to ensure robust participation.

Background

Colorado is considering whether to set up and participate in a demand management program to reduce consumptive water use in the Colorado River Basin on a temporary, voluntary, compensated basis. The 2019 Colorado River Basin Drought Contingency Plan allows such a program, and also provides for the free storage of up to 500,000 acre-feet of water in Lake Powell of water conserved in a demand management program upon agreement of all Upper Basin states.

While the purpose of a demand management program would be to avoid a compact call, the program, or individual transactions in the program, may have positive or negative effects to Colorado's rivers, fish and wildlife resources. Therefore, the state should explore measures to minimize adverse environmental effects and ways to incentivize environmental benefits. The considerations below describe a framework for exploring individual transactions and the demand management program overall with an aim to protect and result in an overall net benefit to Colorado's rivers, fish (aquatic) and wildlife (terrestrial) resources.

Potential Information Needed (*see note below regarding need to adjust environmental review to the size of a demand management program or project)

- Project location or suite of locations
- Nature of demand management practice(s), e.g., full season/split season fallowing, no call, bypass point of diversion within irrigation system, forego storage, release from storage, etc.
- Duration of demand management practices implementation, i.e., from a single season to as long as program continues.
- Source and amount of water conserved
- Storage implications for storage above or below project
- Environmental resources that may be affected both in the immediate area, or in the watershed, e.g., flow, stream temperature and water quality, affected species, associated irrigation supported wetlands), and extent to which resources affected are a priority for protection by a federal, state or local entity. To answer, must know:
    - The area resources and current water management regime, i.e., known flow needs, current timing and rates of diversion, etc.
    - Whether a federal, state or local entity has identified priority resources, data gaps, including ones that can be filled in a timely way given the demand management program process, and ones that cannot.
      Critical habitat for threatened and endangered species and state species of greatest conservation need including the status and recovery needs of individual candidate, threatened, or endangered species.
- How the proposed project or the demand management program more broadly, may affect these resources.
- Tradeoffs identified in terms of resource impacts, i.e., positive for one but negative for another.
    - May be desirable to have a process that engages relevant stakeholders to validate results
- Predicted changes to a proposed project's environmental outcomes by modifying its design to avoid adverse environmental effects, or if avoidance is not possible, to minimize the adverse effects, and if neither is feasible, to mitigate the adverse effects in the area where they occur, or if mitigation is not possible, to offset or otherwise compensate for the adverse effects.
    - E.g., Evaluate if conserved water could be retimed/left in river or bypassed through ditches, to avoid adverse effects and if not, to mitigate them, or, if there would be unavoidable adverse effects, whether retiming could provide other environmental benefits.
- Measuring impacts, mitigation, offsets or uplift must be done in a "proportional" way so that the evaluation is not so complicated that it dissuades participants because of complexity or cost.

Demand Management Program-Wide Considerations

At a higher, whole program level,

- Operate the demand management program with a goal of no net loss to overall environmental services, recognizing that tradeoffs between birds and fish, or fish and boating, are inherently value-laden/driven.
- Build in incentives for projects that provide net environmental benefits,
  - E.g., projects that include additional non-consumptive uses of enrolled water rights (Instream Flows, recreational in-channel diversions, hydropower, etc.)
  - Encourage partnerships that add environmental value to demand management projects

Potential Resources Impacted

A demand management program may have positive or negative impacts to riverine areas and hydrologically connected wetlands.

A river's flow regime is key for sustaining its biodiversity and ecological integrity. Flows in most western rivers are naturally highly variable. The range of a river's flow magnitude, frequency, duration, timing and rate of change will also encompass extreme hydrologic events, such as floods or low flows, necessary to biodiversity and ecosystem integrity. Changing any one of these components will impact a river's ecologic system, biologically or in other ways. [1] So, by defining flow regimes with these five elements, one can then examine the ecological consequences of specific activities that modify one or more component. [2]

For environmental considerations within each proposed transaction, or the program overall, need to identify and evaluate impacts (positive or negative) to:

- Instream Flows (or other available flow target data for reaches without appropriated Instream Flows)
- Stream Management Plan or Water Management Plan objectives or proposed projects
- Critical habitat and flow recommendations
- State species of greatest conservation need
- Water quality standards, including temperature
- Basin Implementation Plans/Identified Projects and Processes (IPPs)
- Colorado River Cut Throat Conservation Strategy
- Other known community or entity environmental priorities

[1] Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. Poff et al. 2010
[2] The Natural Flow Regime. Poff et al. 1997

Potential Tools

Tools that exist and could be used, or modified for use to help identify environmental benefits appear in this link [https://docs.google.com/spreadsheets/d/1-Jc4JJZ75_Fr03-10MoHyduRJ__FCvr3GD1dHcWVSSY/edit#gid=0] data tool spreadsheet, and include:

- The Colorado Water Plan tech update environmental flow tool
- StateMOD for Instream Flows
- Colorado River Support System for large river target flow
- Colorado Natural Heritage Program data
- State Wildlife Action Plan
- U.S. Fish and Wildlife Service Environmental Conservation Online System
- GIS databases and layers by Colorado Parks and Wildlife, U.S. Fish and Wildlife Service, Colorado Water Conservation Board, and other entities

***NOTE:** These considerations relate to the **substance** of environmental evaluations. As part of setting up a demand management program in Colorado or the Upper Basin, there would need to be a separate conversation about the **process** for evaluating the program, or individual projects, including, for example, how to right-size an environmental considerations review commensurate with the size (volume of water conserved) of an individual project. Any process must designate who would be responsible for an environmental review, whether there would be a dedicated review entity and who would have the responsibility to gather the information required for such a review.

> To assist a demand management program project applicant's ability to consider environmental benefits during their project planning and implementation, the Environmental Considerations workgroup recommends that the state provide an Environmental Considerations checklist and tools on any future demand management Program website. Both the checklist and tools should be readily available for use at an applicant's discretion. The checklist may include items identified in the Potential Resources Impacted. The tools may include the items identified in the Potential Tools.

Attachment: Environmental Considerations Workgroup Hypothetical Exercise Summary

Environmental Considerations Workgroup Hypothetical Exercise Summary

June 17, 2020

A subcommittee of the Environmental Considerations (EC) Workgroup developed four potential hypothetical demand management scenarios for discussion purposes. In developing the hypotheticals, the subcommittee assumed that Demand Management (DM) water would be monitored and tracked. At its June 2, 2020 meeting, the EC Workgroup broke into four subgroups and applied the Environmental Considerations for Evaluating a Demand Management Program or Project, developed by a separate EC Workgroup subcommittee, to the four hypotheticals. Each subgroup answered the following questions for one of the hypotheticals:

1. Identify potential environmental benefits and impacts of each project using the Environmental Considerations document as guidance.
2. Identify any missing factors in the Environmental Considerations document that relate to your hypothetical project.
3. Identity technical issues, data gaps (what are the issues that need more study/analysis), or factors that would require more analysis that relate to your hypothetical project.
4. How burdensome was this project to assess against the Environmental Considerations document?

Full notes from this discussion exercise are available at https://docs.google.com/document/d/1C_2CqRBj5o9_IGH1H3w3k6qgJW0MWZjU8Us-xB2H-zU/edit. The hypotheticals are listed below:

Hypothetical #1

Up to 5,000 AF may be available from Colorado River tributaries in southwest Colorado, mainly for irrigation of row crops. Return flows, compact issues, and shareholder values are also imbedded in this example. For the purposes of the EC workgroup, consider these three discrete outcomes:

1. 5000 AF is available from conserved consumptive use from direct flow rights, with points of diversion primarily in the lower basins, but also scattered up tributaries.
2. 5000 AF is available from conserved consumptive use through non-diversion/ use of storage rights; assume this water is available for release throughout a given water year.
3. A 50/50 split, i.e., 2500 AF is from direct flow water rights and 2500 AF is in storage and available for later release.

Hypothetical #2

Large transmountain diversion water right with post-compact adjudication date, pre-compact appropriation date, with contribution to DM program in foregone eastern slope diversions. This hypothetical is also exploring issues of timing related to implementation of a DM program and its effect on previously stored water. For the purpose of the EC workgroup, we assumed 'large' = 10,000 AF, and that this water was stored in multiple headwater western slope reservoirs, tributary to the Colorado River. Consider:

1. All 10,000 AF of TMD storage to be used in one year.
2. 10,000 AF of TMD storage can be used over a three year period.

Hypothetical #3

500 AF of Eagle River water stored in upstream reservoirs (1991 priority) made available through administration of augmentation plans and via exchange. The Administration and Accounting workgroup hypothetical examines questions of how the exchanges might operate, or how unadjudicated exchanges factor into DM water availability. For this hypothetical, the EC workgroup should consider:

1. 500 AF of water stored in headwater reservoirs available for use without timing restrictions;
2. 500 AF of water stored in headwater reservoirs where the timing of release is affected in dry or average-dry years by lack of exchange potential within the Eagle River basin.

Hypothetical #4

120 AF of pre-compact consumptive use water is made available from seasonal and split-season fallowing in the Upper Gunnison. This water would be available for downstream storage and release from Blue Mesa. The hypothetical presented by Administration and Accounting includes consideration of dependence of junior rights above Blue Mesa on local return flows. For the EC Workgroup to consider:

1. 120 AF of water is available within one specific sub-basin to the Gunnison above Blue Mesa; local availability for instream flow use purposed via foregone diversion in time and place, and 120 AF can be re-released from Blue Mesa within the water year.
2. A total of 120 AF of water is available but split within multiple sub-basins to the Gunnison above Blue Mesa, subject to direct-flow timing restrictions but also available for release below Blue Mesa;
3. 120 AF is NOT much water for instream purposes on larger streams, especially considering potential return flow needs. Is there a 'threshold' value for consideration of DM water for environmental purposes under a headwaters DM program?

After the hypothetical exercise, the EC Workgroup noted that the four subgroups had identified some commonalities when answering the questions for their respective hypotheticals, which are listed below:

Potential Environmental Benefits

- Water released from storage may provide flexibility on timing and more opportunities to manage water releases for different types of benefits, including:
    - Generating flushing flows
    - Benefitting endangered fish
    - Helping meet decreed instream flow rates
    - Addressing late summer low flows and high temperatures
    - Benefitting riparian vegetation
- Potential reductions of selenium loading due to reduced irrigation and split season fallowing.
- Water quality and treatment, including permitting.
- Could offset depletions from someone else's diversion that would have more negative impacts on the stream.
- Potential recreational flow benefits.

Potential Environmental Impacts

- Impacts from changes in return flow pattern could include:
    - Diminished late season flows; potential impacts to critical habitat
    - Impacts to wetlands that were created by the return flows
    - Dry up of upland areas for wildlife
    - If transmountain diversions foregone, loss of return flows on East Slope could result in adverse aquatic and terrestrial impacts in South Platte and Arkansas River basins.
- Possible negative impacts if stored water is released at less beneficial times.
- 15-Mile Reach: Changes to how water is released could affect the benefits that are built into the existing system.
- Increased need to treat drinking water.
- On/off-farm impacts to wetlands and wildlife (food, forage, shelter).

Factors Missing from Environmental Considerations Document

- Understand complexity of the subject water right, e.g., one single point of diversion versus multiple points of diversion.
- Desire to understand any change in operations on future years' reservoir administration and storage and release patterns, and impacts on exchange potential.
- On/off farm wetland delineations.

- How/when timing of release of stored water will occur. Consider maximum timing for beneficial uses, including instream flow use.
- Desire more information about return flow considerations.
- Unknown magnitude and duration (e.g. daily versus seasonal).

Technical Issues or Data Gaps

- Are listed species involved (including terrestrial where applicable, such as sage grouse)? What are the flow needs and timing? Is designated habitat tied to critical habitat?
- Wetlands assessments
- Return flow analyses
- Desire to understand the hydrology in all affected areas. Explore whether any "rules of thumb" can apply for certain geographic areas without detailed analysis.
- Impacts to other reservoir operations, including relatively small, in-basin reservoirs.

How Burdensome Compared to Potential Benefits?

- Desire fast and simple ways to assess return flow impacts.
- Conducting environmental review of considerations could be burdensome to applicants.
- Variable year types could have different environmental benefits and impacts making project planning and assessment difficult
- Resources needed for review of small amount of water may not be necessary
- On/off-farm wetland delineation could be burdensome.

Environmental Considerations Work Group Meeting Report Out

Meeting Number: 1

Date: August 29, 2019

Meeting Topics:

Agenda topics included: background on demand management and drought contingency planning; process and expectations of the work groups; initial issue identification; and public comment.

The group spent the majority of the meeting identifying important issues associated with environmental considerations for a potential demand management program.

Key Take Aways:

The group discussed many different aspects of potential environmental impacts and benefits, such as:

- Will projects with higher environmental benefits be prioritized?
- Can criteria be developed to quickly assess potential environmental benefits or impacts for specific projects?
- How can environmental benefits be measured or quantified to better demonstrate positive impacts?
- How can environmentally beneficial projects be incentivized?
- What are the environmental impacts and benefits associated with potential agricultural demand management activities?
- What type of flows will provide benefits and how will flows be impacted?
- What types of tools may be necessary or available?
- Are there any examples or case studies of demand management that include an assessment of environmental concerns?

Questions/Concerns to Raise:

The group identified some questions and issues to consider going forward, including:

- How to balance equitable distribution of a potential demand management program with desire to prioritize project selection based on environmental benefits.
- How to best learn from previous work and demonstration projects.

Additional technical, informational other needs:

The group discussed potentially having a contractor conduct a number of tasks in a phased approach to better understand the environmental impacts or benefits of a demand management program. This approach could include a literature review of

existing information to understand what is already known, assess information gaps, and prioritize potential benefits through criteria. Next steps could include identifying protection mechanisms and systematic project monitoring efforts.

Other:

The group identified two additional meeting dates and locations on October 30th in Salida and November 22nd in Frisco.

Environmental Considerations Work Group Meeting Report Out

Meeting Number: 2

Date: November 22, 2019

Meeting Topics:

Agenda topics included: an overview of the workgroup processes; a review of other workgroup discussions; an update on the CWCB Demand Management Feasibility Investigation RFP; a summary of the Upper Colorado River Commission's (UCRC) System Conservation Pilot Program (SCPP); next steps; and public comment.

Please note that this meeting was limited to informational presentations only due to inclement weather. The planned agenda discussion items on prioritizing workgroup efforts and potential environmental criteria were delayed until the next Environmental Considerations in-person workgroup meeting.

Key Take Aways:

The group heard updates and presentations related to the following:

- CWCB staff provided an update on the Demand Management Feasibility Investigation, which included a discussion of common themes arising out of workgroup meetings, upcoming Demand Management meetings and events, and a summary of other workgroups' discussions as they relate to the Environmental Workgroup. Upcoming Demand Management events include a regional workshop at the Colorado Water Congress January meeting, the morning of January 29; and the joint IBCC/Demand Management workgroup meeting March 3-4, 2020. The group discussed convening at least two additional Environmental workgroup meetings before July 2020.
- Group members provided updates on their discussions relating to Demand Management that have occurred outside of the workgroup.
- Aaron Derwingson, The Nature Conservancy, presented information on the SCPP including examples from several different projects. The presentation included general information on how the projects worked and what was learned. A summary was also provided on the impacts to streamflows and the environment, when the information was available.

Next Steps

The group discussed the following workgroup tasks:

- Consider which studies and reports should be included in a literature review.
- Review previous studies and information relating to water conservation efforts, as well as existing environmental rules and regulations.

Other:

The group discussed holding the next meeting in February and convening at least two meetings before June 2020.

Environmental Considerations Work Group Meeting Report Out

Meeting Number: 3

Date: April 9, 2020

Meeting Topics:

Agenda topics included: an overview of the workgroup process, the November meeting, and the joint workshops at the Colorado Water Congress and Interbasin Compact Committee; an update on the CWCB Demand Management Feasibility Investigation RFP; a recap of Scenario Planning; a presentation on a preliminary literature review; a discussion of homework on potential environmental impacts, mechanisms, rules and regulations, and research needs or data gaps; a prioritization exercise; and a discussion on criteria.

Key Takeaways:

The group discussed the following topics:

- Developing hypothetical or scenario planning concepts: The group refined uncertainties and values associated with a potential demand management program. CWCB staff will provide updates about other workgroup scenario planning at the next Environmental Considerations meeting.
- Monitoring: The group discussed the potential and need to monitor environmental impacts, including impacts to wildlife, related to agricultural alternative transfer methods projects.
- Relevant literature and potential data gaps related to environmental considerations: The group discussed resources with the most information related to environmental considerations.
- 2019 Demand Management Investigation Work Plan: The group identified broad examples of potential environmental impacts, mechanisms, rules and regulations, and research needs or data gaps through homework documents based on the main issues identified during the group's August 2019 meeting.
- Prioritization: The group discussed the importance of criteria to assess environmental impacts or benefits, as a priority. Exploring ways to incentivize participation was also discussed as a priority. A number of potential resources were identified that could assist in developing criteria. A small subgroup was formed to start summarizing potential criteria from existing literature and sources.

Questions/Concerns to Raise:

The group identified some questions and issues to consider going forward, including:

- Indirect effects to water balance as a result of a potential demand management program.
- Uncertainty of defining impacts of a potential demand management program before knowing what a demand management program would look like.

- The need to understand and learn from agricultural alternative transfer method projects.

Additional Technical, Informational Other Needs:

The group discussed the potential for the contractor to assist with development of initial criteria for assessing environmental impacts and benefits of potential demand management projects, based on existing literature.

Public Comment

- A question was raised about what entity will be tasked with addressing equity.
- There was also a question about the representativeness of the Kremmling alternative transfer method study.

Other:

The group discussed convening at least one and potentially two additional environmental workgroup meetings before July 2020. The group plans to convene remotely on May 7th. The group identified June 2nd as an available date to meet, if needed.

Environmental Considerations Work Group Meeting Report Out

Meeting Number: 4

Date: May 7, 2020

Meeting Topics:

Agenda topics included: a review of the Demand Management workgroup processes and updates about the activities of other Demand Management workgroups, criteria discussion, scenario planning discussion, review of preliminary data and tools, and consultant needs and direction.

Key Takeaways:

The group discussed the following topics:

- Demand Management Review: The group revisited the purpose of a potential Demand Management program to ensure compact compliance. CWCB staff reviewed workgroup tasks such as the need to identify key policy issues and the potential to assess the potential pros and cons of different approaches. Staff also provided updates about other workgroup scenario planning efforts and listed examples of the type of products that other workgroups are generating.
- Criteria Discussion: The subgroup provided an overview of the draft document they produced related to potential environmental considerations for a Demand Management Project. The group agreed that the document describing environmental considerations, needed additional context, and decided to continue to refine the document before meeting again in June.
- Scenario Planning Discussion: The group discussed the efforts of other workgroups and considered a number of different uncertainties that could be used to formulate scenarios. The subgroup will refine hypothetical examples of types of potential Demand Management projects for discussion at the next meeting.
- Preliminary Data and Tools Review: An inventory of potential environmental resources and tools that may be helpful were presented and the group was asked to make suggestions if others should be included.
- Consultant Needs and Direction: Representatives from the Demand Management contractor were introduced. The workgroup asked a number of questions to clarify the purpose of the literature review and the extent of the investigation.

Questions/Concerns to Raise:

The group identified some questions and issues to consider going forward, including:

- Questions about the potential to conduct more technical analyses such as determining how often certain criteria are met in critical habitat or the amount of dry up needed to achieve different volumes of water.
- A general lack of riparian and wetland information was identified as a data gap.

Additional Technical, Informational Other Needs:

The group discussed the potential for the contractor to assist with development of initial criteria for assessing environmental impacts and benefits of potential demand management projects, based on existing literature.

Public Comment

- A suggestion was made for the Environmental Considerations workgroup to use hypothetical project examples rather than scenario planning.

Other:

The group discussed timelines for a subgroup to develop a draft document on hypothetical examples and for revisions to the Environmental Considerations document. The group plans to convene remotely on June 2nd.

Environmental Considerations Work Group Meeting Report Out

Meeting Number: 5

Date: June 2, 2020

Meeting Topics:

Agenda topics included: a review of the Demand Management workgroup process and updates, an update from SGM on the status of the literature review, an environmental considerations discussion, hypothetical projects exercise, and discussion of the workgroup deliverables and next steps.

Key Takeaways:

The group discussed the following topics:

- Demand Management Process: CWCB staff provided an overview of what the Project Management Team's plans to report to the CWCB Board. Staff also provided updates about other workgroup efforts, and notified the group about a Demand Management Workshop to be scheduled in August if schedules permit.
- SGM Update on Literature Review: Staff from SGM presented an update on their work on the literature review focusing on environmental considerations. Most of the studies they have reviewed did not directly measure environmental benefits. Key data gaps include information about the resulting changes to streamflow, which limits assessments of potential environmental benefits or impacts.
- Environmental Considerations Discussion: The subgroup reviewed changes to the document and agreed to accept the changes that were made. Revisions included adding an introduction, adding information from Poff (1997) to the section on potential resources, clarifying certain technical language, and drafting suggestions that would improve the process for applicants to any potential Demand Management program.
- Hypothetical Project Exercise: The subgroup reviewed the four hypothetical projects they developed. The full workgroup broke out into four smaller groups to discuss potential benefits, impacts, missing factors, technical or data gaps, and how burdensome assessments would be compared to potential benefits for each hypothetical project. The full workgroup then reviewed the results and discussed the outcomes.
- Deliverables Discussion: The group discussed two documents to include as deliverables to the CWCB Board: 1) Environmental Considerations, and 2) Environmental Considerations Workgroup Hypothetical Exercise Summary.

Questions/Concerns to Raise:

The group identified some questions and issues to consider going forward, including:

- The workgroup is interested in more information about the timeline for the Board to make decisions.

- The need to more fully understand a project's impact on hydrology, including return flows, is critical to understand potential environmental impacts or benefits.

Additional Technical, and Informational Needs:

The group discussed the need for efficient methods to assess return flows to determine how projects would alter hydrology.

Public Comment

- A member of the public commented that the hypothetical exercise is valuable because it provides important examples for the CWCB to seriously consider before specific Demand Management projects are initiated, and recommended it be included in the final work packet.

Other:

This meeting marks the fifth and final meeting of the Environmental Considerations Workgroup as envisioned under the CWCB's 2019 Work Plan for Intrastate Demand Management Feasibility Investigations.

Attachment G

Funding Workgroup Documents:

1. Summary
2. Reports

DRAFT CONCEPT: Funding Working Group Demand Management (DM) Narrative Scenarios

Narrative Scenario Number	SCENARIO 1	SCENARIO 2	SCENARIO 3	SCENARIO 4	SCENARIO 5
Upper Basin Agrees to DM	NO	YES	YES	YES	YES
Thousands of Acre-feet (KAF) of Water Made Available by:					
• Investment in Other Mechanisms that Support Compact Compliance*	20 KAF	—	—	—	—
• Lease for a DM Program (voluntary, temporary, compensated)**	—	259 KAF	500 KAF	500 KAF	500 KAF *Plus Transit Loss & High Evaporation*
Cost per Acre-foot (AF) of Water	$$$$	$	$	$$	$$$
Interest in DM Lease Program	N/A				
Acute (!) or Chronic (↗)	↗	!	↗	!	↗
Reservoir Storage Options: All CRSP Units vs. Only Powell					
Year To Reach Total KAF	10 YEARS	5 YEARS	10 YEARS	5 YEARS	15 YEARS
Estimated Annual Costs (Including Administrative Support)	$14 M *(Including Interest)*	$11 M	$10 M	$41 M	$40 M
Percent of 500 KAF Storage Pool Filled	0% *(Equivalent to 4% of Storage Pool)*	51.75%	100%	100%	100%
Climate Change & Evaporative Loss					
Population & Tourism					
Economy***	GOOD	POOR	GOOD	VERY GOOD	GOOD

"The DM Funding Workgroup estimated the assumed maximum costs that Colorado might pay for DM were it to have to meet the full DM storage pool allocated under the 2019 Drought Contingency Plan.(500,000 acre-feet). This is shown in scenarios 3 through 5. However, Colorado's 51.75% allocation under the Upper Colorado River Basin Compact could be another basis for estimating costs; this was used in scenario #2. To offer a comparison, if the 51.75% value was applied to the other assumptions in scenarios 3, 4 and 5, the approximate costs in those adjusted scenarios would come down to $5.2 million, $21.5 million, and $21 million a year, respectively."

***Investments in other mechanisms create ownership which, outside of any associated administrative, programmatic or maintenance needs, could make the long-term economics of investment options more attractive when compared to leasing options that could have the same or greater costs in perpetuity. Additionally, investments may create opportunities for reducing risk in ways that leasing may not. For these reasons, the DM Funding Workgroup considered that some level of investment should be considered as a part of any DM scenario to build-in resilience and offset leasing costs over time.*

****The DM Funding Workgroup acknowledges that COVID-19 is a "black swan event" that significantly alters funding discussions for the foreseeable future. The impacts from COVID-19 on the state economy are such that this is the lens that all funding discussions must now be viewed through. Increased volatility in the market results in needing more tools, wider parameters and more flexibility for funding.*

Work Group Meeting Report Out

Work Group: Funding Workgroup, Meeting #1 **Date:** August 8, 2019

Meeting Topics:

Agenda topics included: background on demand management and drought contingency planning; process and expectations of the work groups; initial issue identification; and public comment.

The group spent the majority of the meeting identifying the key big-picture issues associated with funding of a potential demand management program and discussing the scope of the work group's future discussions.

Key Take Aways:

The group discussed a few big-picture questions and issues relating to funding a potential demand management program, such as:

- How much money would a potential demand management program require?
- Where would funds come from, and what are potential pros and cons of various funding sources?
- How would funds for a demand management program be administered?
- What are sideboards and issues surrounding who would be able to participate in a potential demand management program?
- What types of projects would be eligible for funding under a Demand Management program? i.e. front range reuse and infrastructure connected to reductions in transmountain diversions)?
- Can this group consider other investments to address long-term water supply risks (i.e. forest health and watershed treatments)?
- How should water be valued, and what are the factors in making this determination?
- How does equity in participation and administration of a potential demand management program factor in to this discussion?

Questions/Concerns to Raise:

The group identified some threshold questions and issues to consider going forward, including:

- What parameters should be considered in analyzing issues around funding of a potential demand management program?
- What are the mechanisms or factors to be considered in determining how to value water?

Additional technical, informational other needs:

The group discussed potentially having a contractor conduct a literature review of existing information on funding programs similar to a potential demand management program.

Other:

The group will identify a next meeting date in the October – November timeframe to be held in the Denver Metro area.

Workgroup Meeting Report Out

Work Group:
Funding Workgroup Meeting #2 **Date:** December 3, 2019

Meeting Topics:
Agenda topics included: recap of meeting #1, evaluation of "parking lot" comments from other workgroups, a visioning exercise around scenario planning; and a public comment period.

Building from the question raised at the first meeting – What parameters should be considered in analyzing issues around funding of a potential demand management program – the group spent the majority of the meeting brainstorming major factors that could affect a possible demand management program and discussed building scenarios around these factors.

From that effort, a table of five high-level, conceptual scenarios were developed that could be shared with other workgroups to help share some of the high-level issues this group has been wrestling with and to allow an apples-to-apples comparison of analysis of various conceptual planning pathways across DM workgroups. From there, the group began to brainstorm what funding-specific nested scenarios might be developed and what high-level drivers from the Colorado Water Plan's scenarios (e.g. climate change; population growth; economic downturns) might impact any possible solutions. Due to time constraints at this meeting, that next phase of conversation will be teed-up for Funding Workgroup Meeting #3.

Key Take Aways:
The brainstorm session generated a range of categories as a starting point for scenario planning. From a set of scenarios the group will work to identify policy questions to consider related to funding a potential demand management program. The scenarios identified included:

- Volume of water needed
- Cost of potential program (i.e. $/acre-foot)
- Percent of water savings expected from a demand management program (versus funded investments in infrastructure)
- Acute or chronic need
- Year water is needed by
- Reservoir storage options

Additionally, some funding-specific conversations revisited ideas from Meeting #1 surrounding potential tax solution, how to protect funding, etc.

Questions/Concerns to Raise:
The group identified some threshold questions and issues to consider going forward, including:

- How much water can be conserved by replacing existing infrastructure?
- What lessons can we learn from the System Conservation Pilot Program?

Additional technical, informational other needs:
The group discussed potentially having a contractor help refine the scenarios identified. Ideally these scenarios would be broken down into a set for all demand management workgroups to consider and additional scenarios specific to this workgroup.

Other:
The group expects to convene again on January 30, 2020 in Westminster.

Workgroup Meeting Report Out

Work Group:
Funding Workgroup Meeting #3 **Date:** January 30, 2020

Meeting Topics:
Agenda topics included: recap of meeting #2, evaluation of "parking lot" comments from other workgroups and public comments received; scenario planning refinement; and a public comment period.

The five high-level, conceptual scenarios developed at meeting #2 were reviewed to be sure the ideas were captured and to revisit the concepts with the intention of identifying one funding mechanism to vary across all scenarios. David Groves with the RAND Center on Decision Making Under Uncertainty attended the meeting to gather background on the scenarios to help facilitate a conversation with other workgroups at the IBCC/Demand Management meeting in March 2020.

Key Take Aways:
The group came up with a preliminary list of funding ideas noting that not one concept, but rather a portfolio would be beneficial. The group discussed looking for pros/cons and picking one option to run through the scenarios as a next step to help identify strengths and weaknesses in funding options. Ideas listed included: statewide tax (income, sales, property), regional tax, statewide fee, Bureau of Reclamation contribution, hydropower user fee, export user fee (i.e. Front Range water user rate increase).

Questions/Concerns to Raise:
The group identified some threshold questions and issues to consider going forward, including:

- Should the funding workgroup consider funding issues relating to a potential pilot program to take place at some point before a Demand Management program would be set up?
- For conversation with other workgroups – Who (or what sectors) would benefit most from a DM program?

Additional technical, informational other needs:

Other:

Public comment provided additional context around scenario considerations including evaluating and mitigating unintended consequences.

The group will meet again at the IBCC/Demand Management meeting on March 5, 2020 in Denver West.

Workgroup Meeting Report Out

Work Group:
Funding Workgroup Meeting #4 **Date:** May 18, 2020

Meeting Topics:
Agenda topics included: recap of IBCC/Demand Management Workshop; scenario planning review; discussion of funding mechanisms; and a public comment period.

The five high-level, conceptual scenarios developed throughout the year were discussed with rough funding amounts assigned to each scenario with the idea that the group could discuss funding mechanisms for specific scenarios. Considerations that went into the estimated funding amounts included: storage in all Colorado River Storage Project Reservoirs or Lake Powell only, volume of water needed, whether or not evaporative losses or transit losses were considered in the annual cost, administrative costs, whether the participation in a demand management water lease effort would have few to many participants, whether the need was acute or chronic, population trends, tourism trends, and the economy.

Key Take Aways:
The group discussed the considerations that went into the funding estimates including: the cost used for industrial water; the need to compare annualized costs for each scenario; the timeframe (a longer timeline reduces the impacts of transactional costs); the economy and tourism in light of COVID-19 have changed significantly and it is uncertain how long a rebound will take. Even with a diverse portfolio (as discussed at previous meetings) funding would likely fall short. Funding concepts that were mentioned included: user fees, lodging tax, federal sources, ad valorem taxes, risk management fees, and development fees. Any of these funding concepts could be paired with a reverse auction model where sellers bid for the prices at which they are willing to sell their water.

Questions/Concerns to Raise:
The group identified some threshold questions and issues to consider going forward, including:

- COVID-19 has changed the calculus and there will need to be a fundamental change in thinking.
- All funding concepts on the table need to be reconsidered and new taxes are very unlikely to pass at this time.
- Demand management needs to be a top priority of the state in order for the state to find funds to support a program. Tying water to the state's economy could help.
- Concern that the investigation is moving too slowly and that hydrology could force a quicker pace.

Additional technical, informational other needs:

Other:

Public comment provided additional context around costs used in the scenarios and suggestions to look at all viable options.

Attachment H

Law and Policy Workgroup Documents:

1. Disclaimer
2. Policy Framework
3. Beneficial Use Analysis
4. Compact Compliance Analysis
5. Conserved Consumptive Use Analysis
6. Eligibility Analysis
7. Temporary Definition Analysis
8. Project Review and Approval Process Analysis
9. Reports

DISCLAIMER
June 6, 2020

The discussion and proposed definitions contained in these materials do not represent interpretations of existing law by any member of the Law and Policy Workgroup or the organizations with whom they may be affiliated, the state of Colorado, or any of its officials or employees, nor predetermine in any manner the position or interests of the state of Colorado, the Colorado Water Conservation Board, or any demand management workgroup participants or their respective organizations, with respect to interpretation of any interstate compact or other component of the Law of the River.

POLICY FRAMEWORK
FOR DEMAND MANAGEMENT IN COLORADO
(Compiled from Official Statements and Documents)
With Policy Issues and Questions Identified
June 3, 2020

1. Purpose:
   a. Temporarily reduce Consumptive Uses in the Upper Basin or augment supplies with Imported Water, if needed in times of drought, to help assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future.[1]
   b. Avoid or mitigate the risk of involuntary curtailment.
   c. Enhance security and certainty in the state's Colorado River water supply.[2]

2. Demand management (DM) means:
   a. Voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System for the specific purpose of helping assure compact compliance.[3]

      Some outstanding policy issues and questions on meaning of "temporary":
      - *How long is temporary? 5 years? 25 years? Is it necessary to have an upper limit on participation?*
      - *Will the "temporary" requirement allow inclusion of: (a) water freed up from decommissioned power plants; (b) water savings from permanent crop switching; or (c) new reuse or other conservation investments by municipal providers?*
      - *Is the "temporary" requirement primarily intended to: (a) ensure that water users don't need to make a long term commitment to participate, (b) be a prohibition on longer term participation, and/or (c) help prevent permanent dry-up and reduce potential adverse impacts to local communities?*
      - *How can the benefits of investment in permanent reductions of use fit into a demand management program?*
      - *There are multiple possible interpretations here. The draft definition of "temporary" provides a consensus recommendation from the Law and Policy work group on some but not all of these issues.*

   b. Use of imported waters from outside of the natural Colorado River watershed to augment the Upper Colorado River System for compact compliance purposes.[4]

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[1] Agreement regarding Storage at Colorado River Storage Project Reservoirs under an Upper Basin Demand Management Program, May 20, 2019 (DM Storage Agreement), Recital A.4, https://www.usbr.gov/dcp/docs/final/Attachment-A2-Drought-Managment-Storage-Agreement-Final.pdf.

[2] CWCB Support and Policy Statements, Nov. 15, 2018 (CWCB Policy Statement); *see* draft definition of "compact compliance."

[3] *Id.*; *see* draft definitions of "temporary," "compact compliance," "conserved consumptive use"

[4] Id. at Recital A.4 and Section III.A.6. Note that the use of imported water "may also be evaluated" but is not assured as a part of a demand management program.

3. Consistency with Colorado's Water Plan
   a. Further the goals expressed in Colorado's Water Plan, with specific consideration given to the principles and collaborative efforts set forth in Chapter 9.1 and Principle 4 of the Conceptual Framework in Chapter 8.[5]
   b. Chapter 9.1 of Colorado's Water Plan provides in part: The State of Colorado will support strategies to maximize the use of compact water while actively avoiding a Colorado River Compact deficit.[6]
   c. Principle 4 of the Conceptual Framework states: 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 [transmountain diversion].[7]

      Some outstanding policy issues and questions on Principle 4:

      - *How will the demand management program be structured to avoid providing benefit to a new TMD or increasing risk for existing water uses?*
      - *Does the "reasonable increment for future development" need to be further defined? For example, should the increment be quantified and its location designated in the context of a demand management program?*

4. Equity
   a. Prioritize avoidance of disproportionate negative economic or environmental impacts to any single sub-basin or region within Colorado while protecting the legal rights of Colorado water rights holders.

      Some outstanding policy issues and questions on equity:

      - *How will avoiding disproportionate impacts be determined?*
      - *There is a tension between ensuring geographic equity and allowing the free market to govern transactions. Stated differently, there is a tension between allowing water users to participate if they are eligible and interested and potential restraints on participation to ensure that equity goals are met. For example, what if one county or sub-basin happens to have lots of water users interested in voluntarily reducing their water use for DM purposes? Will some be turned down? How will that decision be made?*
      - *How is dispersed participation encouraged or incentivized?*
      - *What are criteria for evaluating negative economic or environmental impacts?*
      - *There are multiple possible interpretations here.*

[5] CWCB Policy Statement.
[6] Colorado's Water Plan, Ch. 9.1, https://dnrweblink.state.co.us/cwcb/0/doc/199522/Electronic.aspx?searchid=69705cbe-d4c1-446a-a4b9-00a411d2dad7.
[7] Colorado's Water Plan, Ch 8, https://dnrweblink.state.co.us/cwcb/0/doc/199506/Electronic.aspx?searchid=80d50cb3-95bf-405c-bfa5-587c633c7136.

b. Assess feasibility and promote mechanisms for obtaining roughly proportionate contributions of consumptively used water from participants on each side of the Continental Divide.[8]

Some outstanding policy issues and questions on measuring contributions:

- *How are municipal savings measured and accounted for over time and in different types of hydrological years? Can a baseline be established against which all contributions to the DM program are measured, adjusted for hydrology?*

5. State law consistency
   a. Comply with all applicable state law.

Some outstanding policy issues and questions on state law compliance:

- *What will the process be for accepting water rights into a DM program where they are used to "assure compact compliance"? Will a new "streamlined" structure be necessary or desirable?*
- *How will injury be determined?*
- *What steps must be taken to ensure no increase in risk of abandonment or reduction in historical consumptive use calculation?*
- *Will new legislative authorization be needed for whatever mechanism is used? Will legislation be required to shepherd DM water? Is a rule-making needed and if so, will it be sufficient?*

   b. Demand management actions shall not cause material injury to other water rights holders.[9]

Some outstanding policy issues and questions on state law compliance:

- How will other water users be protected from injury?
- How will conserved consumptive use be quantified?

   c. Export statute[10] inapplicability

6. Eligible water
   a. "Consumptive Use" means the depletion of water for domestic and agricultural beneficial uses as those terms are defined and referred to in the 1922 Colorado River Compact. It also includes the full amount of water: (i) consumed in association with the production of electrical power other than hydropower; and (ii) diverted from the Upper Colorado River System for which there are no return flows to that system, including, for example, diversions outside the natural Colorado River watershed.[11]
   b. The source of conserved water is Upper Colorado River System water, or Imported Water;
   c. The water is conserved, stored and released for the specific purpose of helping the Upper Division States assure continued compliance with Article III of the Colorado River Compact;

[8] CWCB Policy Statement.
[9] CWCB Policy Statement.
[10] Colo. Rev. Stat. §§ 37-81-101 to -104.
[11] DM Storage Agreement, § III.A.3; *see also* draft definitions of "conserved consumptive use" and "eligibility."

d. For Upper Colorado River System water, the water must have been beneficially and consumptively used under valid water rights prior to being conserved as part of an Upper Basin Demand Management Program;

Some outstanding policy issues and questions on water eligible for DM program:

- *See issues identified above regarding "temporary."*
- *How long will temporary water savings be allowed to continue or receive demand management credit?*
- *How can the DM program be designed to adapt to unanticipated opportunities to provide water to assure compact compliance?*

e. For Upper Colorado River System water, the water must have been physically available for diversion in the year it was conserved, and would have been beneficially and consumptively used within a state or states of the Upper Division but for the conservation for the benefit of an Upper Basin Demand Management Program; and

f. The conserved or Imported Water has arrived at a CRSPA Initial Unit after accounting for any conveyance and associated losses.[12]

7. Operational requirements - demand management water is subject to:

a. Assessment of its proportionate share of evaporation during storage;

b. Assessment of conveyance or transportation losses;

c. Available unfilled storage capacity, meaning the storage space available at a given CRSPA Initial Unit after satisfying the legal storage obligations applicable to that Unit, consistent with applicable water rights administration requirements and decrees;[13]

Some outstanding policy issues and questions on storage locations:

- *How are storage locations other than Lake Powell determined if multiple CRSPA Initial Units are feasible alternatives and the Upper Division states are not in agreement?*

d. An annual creation limitation at the CRSPA Initial Units combined (to be determined as part of the Upper Basin feasibility investigation);

Some outstanding policy issues and questions on setting annual creation volume:

- *Tension between desire to quickly fill DM storage as an insurance policy v. negative impact of larger annual volumes on local economies.*

e. A maximum combined storage limitation of 500,000 acre-feet at the CRSPA Initial Units;

Some outstanding policy issues and questions on setting annual creation volume:

- *See comment above on storage in multiple locations. How will DM storage be allocated across the CRSPA Initial Units?*

f. Reduction in the case of a spill at Lake Powell; and

[12] DM Storage Agreement, § III.B.2.a

[13] *Id.,* § III.A.7.

g. Annual verification by the Upper Division States, through the Upper Colorado River Commission (UCRC), and the Secretary of the volume of conserved water created, conveyed, and stored at the CRSPA Initial Units.[14]
h. Through the year 2057,
   i) Will not be released or cause a different release from Lake Powell than would have otherwise occurred under the 2007 Guidelines or post 2026 operational rules.
   ii) Will be released from any of the CRSPA Initial Units only at the request of the UCRC to help assure continued compliance with Article III of the Colorado River Compact.[15]

8. UCRC required actions
   a. Upper Division states, through the UCRC, must investigate feasibility of Upper Basin Demand Management Program (UB DM Program) and reach consensus on operational parameters, like verification, conveyance, administration and funding.[16]
   b. If the Upper Division states agree that the UB DM Program is feasible and determine to pursue development of the Program:
      i. The UCRC must make finding that demand management activities are necessary to help assure continued compliance with Article III of the Colorado River Compact.
      ii. The UCRC must approve the UB DM Program.
      iii. Upper Division states, through the UCRC, must enter into an agreement with the Secretary of the Interior addressing methodology, documentation and process for verification and accounting for the creation, conveyance and storage of conserved water that is part of a demand management program.[17]

9. Interstate Issues
   a. Ensure that water conserved within Colorado under any demand management program is not diverted and consumptively used by any other state.[18]
   b. Each Upper Division state must approve an Upper Basin Demand Management Program.[19]

      Some outstanding policy issues and questions on interstate approval:

      - *Interstate agreement necessary on triggers, interstate shepherding, evaporation and transportation charges, separate or joint State accounts, use of authorized storage locations other than Lake Powell, seepage and system assessments.*

[14] *Id.,* § III.B.2.b.
[15] *Id.,* § III.B.2.c.
[16] *Id.,* § III.B.1.
[17] *Id.,* § III.B.3.
[18] CWCB Policy Statement.
[19] DM Storage Agreement, § III.B.3.d.

c. The Upper Division states and the Secretary of the Interior must consult with the Lower Division states on: water rights eligible for demand management; verification of and accounting for the volume of conserved consumptive use, and; the methodology, process, and documentation for such verification and accounting.[20]

10. Some other issues not addressed in existing legal framework documents
    a. Tribal
        i. Do Colorado tribes wish to participate and if so, how?
        ii. Will currently unused tribal water rights be included in a DM program and, if so, how will they be treated?
    b. Governance of Colorado program
        i. Who runs a Colorado demand management program if one is established?
        ii. Respective responsibilities of the CWCB and the Office of the State Engineer
        iii. Opportunities for public engagement, advisory committee?

[20] *Id.*, § III.B.3.b; Agreement Concerning Colorado River Drought Contingency Management and Operations (Companion Agreement), May 20, 2019, §§ H.1, H.2, and H.3.

Issue: Does Colorado law recognize compliance with an interstate compact as a beneficial use of water?

1. **Background**
    a. This white paper evaluates whether, and to what extent, delivery or storage of water to be used to comply with the requirements of an interstate compact can be considered a lawful means of making water available for beneficial use under Colorado law.
    b. As discussed herein, the **Arkansas River Compact** equitably apportions the waters of the Arkansas River between Colorado and Kansas and, in so doing, outlines requirements for the delivery of water to the Colorado-Kansas state line. Article IV.D of the Arkansas River Compact provides that "the waters of the Arkansas river . . . shall not be materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas under this Compact by . . . future developments or construction."
        i. The Water Court for Water Division 2 has addressed the use of water for compliance with the Arkansas River Compact in several cases. In one of those cases, LAWMA's augmentation plan approved in Case No. 02CW181, the Court indicated that storage and delivery of water for compliance with this compact is a beneficial use of water.
        ii. In a subsequent matter in which the Court approved the State Engineer's Irrigation Improvement Rules, the Court appears to have assumed, without expressly stating, that compliance with the Compact constitutes beneficial use.
    c. Similarly, the Rio Grande Compact equitably apportions the waters of the Rio Grande between Colorado and the downstream states of New Mexico and Texas. Article III of the Rio Grande Compact contains a schedule of deliveries for Colorado's delivery of water in the Rio Grande at the Colorado-New Mexico state line, measured at or near the Lobatos gaging station.
        i. The Water Court for Water Division 3 approved conditional water rights for the Closed Basin Project in W-3038 for various beneficial purposes, including the delivery of water to the Rio Grande to assist the state of Colorado in meeting its delivery obligations under the Rio Grande Compact. The source of water for the Closed Basin Project is effectively salvaged or developed water from the Closed Basin, an area north of the Rio Grande where the streams do not flow to the Rio Grande or its tributaries. See San Antonio, Los Pinos and Conejos Acequia Association v. Special Improvement District No. 1 of the Rio Grande Water Conservation District, 351 P.3d 1112, 1123 (Colo. 2015). The project water is delivered to the Rio Grande downstream of all diversions in Colorado, and thereby makes more water available for diversion upstream in Colorado by means of substitution. Id. at 1123-24.
        ii. In subsequent agreements between the State Engineer and the San Luis Valley Irrigation District and the Rio Grande Water Users Association, the parties thereto confirmed and agreed that the Rio Grande Reservoir would be used for Compact purposes, and that water that would otherwise be curtailed from water rights for compact delivery could be stored in and released from the Reservoir to aid the state in meeting its delivery obligations under the Compact. To the extent the water was not needed for compact purposes, it would be

retained in Colorado for beneficial use. It is a mechanism to minimize over-delivery under the compact..

d. The **Republican River Compact** equitably apportions the waters of the Republican River among Colorado, Nebraska, and Kansas. Following litigation over Nebraska's compliance with the Compact, the parties entered into a settlement agreement that addressed how groundwater pumping would be incorporated into each state's allocation of water under the Compact.
    i. The Republican River Water Conservation District sought approval from the Division 1 Water Court (for surface water) and from the Ground Water Commission (for designated groundwater) to use its water rights to assist the State of Colorado in complying with its obligations under the Republican River Compact. The Water Court and Ground Water Commission entered orders finding that Compact compliance is a beneficial use of water.

e. The **La Plata River Compact** apportions the waters of the La Plata River (tributary to the San Juan) between Colorado and New Mexico. Under Article II of the Compact, for a majority of the year, one-half of the indexed flow measured at the Hesperus gage must be delivered to the stateline the next day.
    i. The La Plata Water Conservancy District applied for conditional water rights in Long Hollow Reservoir (in Case Nos. 94CW75 and 00CW49), for various beneficial uses, including "for delivery of Colorado's Compact obligations to New Mexico under the La Plata River Compact." The Water Court entered conditional decrees approving that use, and La Plata Water Conservancy District has maintained diligence on these rights since the original decrees were entered.
    ii. Most recently, in Case No. 16CW3005 (decreed in July 2019), the Water Court approved La Plata Water Conservancy District's application for an augmentation plan and exchange, which also relied on the Long Hollow Reservoir water rights (as conditionally approved for Compact compliance purposes) as an augmentation source for maintaining Compact compliance.

2. LAWMA Augmentation Plan (Case No. 02CW181, Water Div. 2)

a. One of the purposes of LAWMA's application in this case was to obtain approval of an augmentation plan to replace stream depletions associated with wells owned and operated by LAWMA's members in a manner that protects Colorado senior surface water rights from injury and assures compliance with the Arkansas River Compact. *Paragraph 12*, 02CW181 Decree.

b. Under the augmentation plan, LAWMA replaces depletions to the waters of the Arkansas River at the stateline as required by the Paragraph IV.D of the Arkansas River Compact. *Paragraphs 23.A, 25.H, 26.I.*

c. *Paragraph 53*: "The application in this case seeks approval of a change of the Subject Water Rights so the water rights may be used to replace stream depletions to stateline flows. This Court has jurisdiction to determine the beneficial uses that may be made of Colorado water rights, *including whether the Subject Water Rights and associated Article II Storage Account Water can be used to replace depletions to stateline flows and can be used for augmentation and replacement purposes*. *The Court finds that the Subject*

Water Rights and associated Article II Storage Account water may lawfully be used to replace depletions to stateline flows under the Compact and may lawfully be used for augmentation and replacement purposes."

i. Article IV.D of the Arkansas River Compact requires that the waters of the Arkansas River must not be materially depleted in usable quantity or availability. The Compact further provides for allocation of water stored in John Martin Reservoir between Colorado and Kansas.
ii. Thus, compliance with the Compact occurs through the replacement of material depletions to stateline flows.
iii. This decree equates "replacement of depletions to stateline flows" with augmentation and replacement as beneficial purposes recognized by Colorado law.

d. Note: this was a consent decree approved by the Water Court, following LAWMA's stipulations with fifteen opposers, with a "no precedent" clause included in Paragraph 71.

3. State Engineer's Irrigation Improvement Rules (Case No. 09CW110, Water Div. 2)

a. In Case No. 09CW110, the Water Court approved the State Engineer's "Compact Rules Governing Improvements to Surface Water Irrigation Systems in the Arkansas River Basin in Colorado."
b. The purpose of these rules was to address reduced return flows/useable stateline flows resulting from changes to more efficient irrigation methods and to further the optimum use of the waters of the Arkansas River system in a manner consistent with preserving the priority system, while also ensuring that Colorado satisfies its Compact obligations. *Paragraph 72.*
c. The Rules authorized the development and approval of Compact Compliance Plans designed to maintain historical seepage loss and return flows as required by the Compact. *Paragraph 59.* Rule 10 provides that Compact Compliance Plans "may include use of water other than the subject water right to prevent a violation of Article IV-D of the Compact, if the other water is imported water or other fully consumable water pursuant to the decree controlling the use of said water." *See also Paragraph 60.* As such, these plans optimize the use of water by allowing applicants to dedicate water to the Plan, other than the water rights that serve their irrigation systems, for the purpose of maintaining historical seepage losses/return flows. *Paragraph 60.* Thus, these plans aim to ensure compliance with the Compact by ensuring that a dedicated water supply is available to prevent a violation of Article IV-D of the Compact.
d. Neither the Rules nor the Water Court's approval of those Rules expressly state that Compact compliance is a beneficial use of water. However, the Rules do require that water be dedicated to Compact Compliance Plans for the purpose of replacing reduced return flows, which in turn maintains useable stateline flows in compliance with the Compact. As such, these Rules, and the Water Court's approval thereof, appear to have assumed that compact compliance constitutes a beneficial use of water.

4. The Closed Basin Project (W-3038, Water Division 3)

a. The Closed Basin Project is a federal reclamation project and the water right for the project was obtained by and is held by the Rio Grande Water Conservation District. The project's water right is decreed for various purposes in conformity with its authorization legislation. The Project's first priority is to deliver water to the Rio Grande to aid the State of Colorado in meeting its delivery obligations under the Rio Grande Compact. W-3038 Decree, pp. 1-2, Paragraph 4(a). The Project obtains its water from the unconfined aquifer within the Closed Basin, and the Water Court for Water Division 3 approved a conditional storage right for the Closed Basin Water Salvage Project in W-3038, which acknowledged that "the primary purpose of [the Project] is to collect and introduce into the Rio Grande River a large volume of water of acceptable quality to assist the State of Colorado in satisfying its obligation under the Rio Grande Compact." Id. These water rights were conditionally decreed in W-3038, after a hearing before the Water Referee, for various beneficial uses, one of which includes providing "supplemental water to meet Colorado's obligation under the Rio Grande Compact and accomplish maximum utilization of Colorado's share of the flows of the Rio Grande River under the Compact." Id. at p.2, Paragraph 4(b); p. 9. A portion of these water rights have since been made absolute.

   i. In *Closed Basin Landowners Ass'n v. Rio Grande Water Conservation District*, the Supreme Court discussed the purposes the Closed Basin Project, as decreed in W-3038. Without significant analysis of the beneficial uses of water approved by this decree, the Court recognized that the Project is intended to deliver water to the Rio Grande to satisfy Colorado's Compact obligations. *See Closed Basin Landowners Ass'n v. Rio Grande Water Conservation District*, 734 P. 2d 627 (Colo. 1987) (discussing the conditional water rights decreed for the Closed Basin Project in the W-3038 Decree, and acknowledging that "[t]he goal of the Closed Basin project is to lower the water table in the sump area by approximately two feet through the construction and operation of over one-hundred shallow wells, and to reduce water losses to evaporation and evapotranspiration. Water salvaged from the sump area is to be delivered to the Rio Grande River to help meet Colorado's obligations to New Mexico and Texas under the Rio Grande Compact.").

   ii. *See San Antonio, Los Pinos and Conejos Acequia Association v. Special Improvement District No. 1 of the Rio Grande Water Conservation District, 351 P.3d 1112, 1123 (Colo. 2015), approving the use of Closed Basin Project Water to replace stream depletions and to assist in meeting Colorado's delivery obligations under the Rio Grande Compact.*

   iii. *See also Tres Rios Decree,* Case No. 91CW29, at 24-25 (discussing water rights decreed for Closed Basin Project for "Project purposes" and the federal authorizing legislation for the Closed Basin Project, establishing three priorities for Project water; "Priority One" of which concerns assisting existing water users on the Rio Grande and Conejos Rivers in meeting their delivery obligations under the Rio Grande Compact). The Court in *Tres Rios* determined that "[t]he history of the Project and its authorizing legislation make clear that Priority One water was not intended to be used, either directly or indirectly, as a source of water for new appropriations." This water instead "can be made available . . . to

existing users on the Rio Grande and Conejos River to meet the rivers' respective obligations under Article II of the Compact.").

b. *See also* Operating Agreement for Rio Grande Reservoir, between San Luis Valley Irrigation District and the Colorado State Engineer (Feb. 3, 1987), which confirmed that the Rio Grande Reservoir "has been utilized for the benefit of all water users diverting from the Rio Grande to aid the State of Colorado in meeting its commitments under the Rio Grande Compact," (p. 1); "use of the Reservoir for Compact purposes is compatible with use of the Reservoir by the District for storage of its decreed water rights," (p.2); and, "[i]f the State Engineer determines that Compact Waters are needed to fulfill Colorado's obligations under the Compact," the District shall release such waters in the amount, and at the rate, directed by the State Engineer, but "[i]f the State Engineer determines that Compact Waters are not required for interstate delivery," he shall relinquish control of such waters for beneficial use by Colorado water users (pp. 3-4). A similar agreement was entered into between the State Engineer and the Rio Grande Water Users Association with similar terms and conditions.

   i. Like the State Engineer's Irrigation Improvement Rules and the water court decree approving those Rules, this agreement does not expressly state that Compact compliance is a beneficial use of water. However, the Agreement acknowledges that water can be released from storage in the Rio Grande Reservoir specifically to satisfy Colorado's compact obligations, which also indicates that the parties to that agreement, including the State Engineer, have assumed that compact compliance constitutes a beneficial use of water.

5. Republican River Compact

a. The Republican River Compact allocates the "virgin water supply" of the Republican River (i.e., the water supply undepleted by the "activities of man") among Colorado, Nebraska, and Kansas. *See Articles II and III*. The Compact makes specific allocations to each state, based upon the average annual virgin water supply that originates in each drainage basin described therein. *See* Article III. The Compact also allocates a specific number of acre-feet for beneficial consumptive use within each state (Colorado is limited to an annual amount of 54,100 acre feet). *See Article IV.*

b. During litigation commenced in 1999 concerning Nebraska's exceedance of its allocated amount of consumption, the Special Master rejected Nebraska's argument that groundwater use should not count toward the state's allocated share of water. The three states then negotiated an agreement that determines how stream flow, pumping, and other factors would be incorporated into calculating each state's allocation. Under the 2003 Final Settlement Agreement that resolved ongoing litigation related to this Compact, the party states adopted a moratorium on new wells, with the exception of wells constructed for the sole purpose of offsetting stream depletions to comply with Compact allocations, provided that the wells do not cause new net depletions to stream flow.

c. Water Court, Water Division 1: In 14CW3135, the Republican River Water Conservation District and Yuma County Water Authority Public Improvement District applied to change the use of ten water rights to add augmentation as a decreed use, and "to assist the State of Colorado to carry out its duty to comply with the limitations imposed on the

State under the Republican River Compact." The decree in this case recognized that the purpose of YCWA is to address an imminent threat to the economic viability of an area within Yuma County due to potential curtailment of irrigation wells and "to assist the State of Colorado's compliance with its obligations under the Republican River Compact."

i. The decree entered in this case was a consent decree following the Applicants' stipulations with several opposers, including the State and Division Engineers). The decree stated that the Applicants "are entitled to a change of water right" (¶ 13) and that the changed uses include augmentation and "to assist the State of Colorado to carry out its duty to comply with the limitations imposed on the State under the Republican River Compact." (¶ 8).

d. Ground Water Commission, Findings and Order – Permit No. 76149-F: The Colorado Ground Water Commission has also approved an application by the Republican River Water Conservation District seeking to change the use of a well to "Republican River Compact Compliance" purposes. The applicants sought to use the well in question as an alternate point of diversion for 58 water rights associated with various well permits. The subject wells are located in the Ogallala aquifer, in the Northern High Plains Designated Basin and the Sandhills Ground Water Management District.

i. The Colorado Ground Water Commission issued its Findings and Order dated June 20, 2013, for Permit No. 76149, approving the use of the well as an alternate point of diversion for the 58 water rights noted above, for the purpose of "Republican River Compact Compliance." (¶ 11).

ii. In accordance with the Commission's Order, the well permit for No. 76149 also recognizes "Republican River Compact Compliance" as the approved use for the well at issue in this case.

iii. Because the RRWCD's application before the Ground Water Commission required the export of designated groundwater outside of the management district's boundaries, the Sandhills Ground Water Management District also had to approve the associated export application. The export application requested approval "to use groundwater under specified groundwater rights outside the boundaries of the district *for the sole purpose of offsetting stream depletions to the Republican River and its tributaries in order to comply with the State of Colorado's allocations under the Republican River Compact and the Final Settlement Stipulation in Kansas v. Nebraska and Colorado*, *No. 126, Original.*" To facilitate the use and delivery of the exported water, the Applicants proposed to build a pipeline from the District to the North Fork of the Republican River. The District issued an order, following a hearing, that approved the export and delivery of designated ground water to the North Fork of the Republican River "for the purpose of offsetting stream depletions that reach the Republican River . . . to comply with Colorado's allocations under the Compact and FSS." (¶ 46).

6. La Plata River Compact

a. The La Plata River Compact apportions the waters of the La Plata River between Colorado and New Mexico, with waters subject to administration on a daily basis during

a majority of the year (from February 15th through December 1st of each year). *See Article II(2).* The Compact requires that one-half of the indexed flow (measured at the Hesperus gage) be delivered to the stateline the next day. *Id.*

b. In Case No. 94CW75, Water Division 7, the La Plata Water Conservancy District filed an application seeking a water storage right for Long Hollow Reservoir, for various beneficial uses including "for delivery of Colorado's compact obligations to New Mexico under the La Plata River Compact." The Water Court entered a decree approving this conditional water right on September 22, 1995. Diligence has been maintained on these water rights since decreed. To date, no amount has been made absolute. La Plata Conservancy District filed an application for reasonable diligence for these water rights in 2019 (19CW3043); the December 2019 resume for that application confirms that water has been delivered from Long Hollow Reservoir to New Mexico under the Compact.

c. In Case No. 00CW49, Water Division 7, the La Plata Water Conservancy District filed an application seeking an additional water storage right for Long Hollow Reservoir, and a conditional storage right in Johnny Pond Reservoir, for various uses of water, including "for delivery of Colorado's compact obligations to New Mexico under the La Plata River Compact." The Water Court entered a decree approving these conditional water rights on December 8, 2004. Diligence has been maintained on the Long Hollow Reservoir rights; the conditional right for Johnny Pond Reservoir was cancelled in the most recent diligence decree in 10CW98 (November 29, 2018).

d. In Case No. 16CW3005, Water Division 7, the La Plata Water Conservancy District filed an application for an augmentation plan and exchange, using the water rights decreed to Long Hollow Reservoir as a source of augmentation to replace depletions resulting from the La Plata River Mitigation Site that would otherwise be curtailed to meet Colorado's obligations under the La Plata River Compact. The Water Court entered a decree approving the augmentation plan and exchange on July 24, 2019.

Conclusion: Water Divisions 1, 2, 3 and 7, along with the Colorado Ground Water Commission, have recognized, or assumed, that Compact compliance is a beneficial use of water. In each case, the recognition or assumption of beneficial use did not necessarily lead to a uniform method of implementation.

- For instance, LAWMA's augmentation plan decree in Case No. 02CW181 recognizes that compliance with the Arkansas River Compact, by replacing depletions to useable Stateline flows, is a beneficial use of water. In a subsequent matter involving compliance with the Arkansas River Compact, the State Engineer's Irrigation Improvement Rules, and the Water Court's approval of those Rules, seem to have assumed compact compliance to be a beneficial use.

- Similarly, one of the decreed beneficial uses of water under the Closed Basin Project's decree in W-3038 to provide supplemental water to meet Colorado's delivery obligations under the Rio Grande Compact. Further, in an agreement between the State Engineer and San Luis Valley Irrigation District, the State Engineer acknowledged that water may be released from Rio Grande Reservoir to fulfill Compact delivery requirements, which further relies on the premise that compact compliance is a beneficial use.

- Moreover, both the Division 1 Water Court and the Ground Water Commission recognized that assisting the State of Colorado in meeting its Republican River Compact obligations is a beneficial use of water.

- Finally, the Division 7 Water Court has similarly decreed a conditional water storage right for La Plata Water Conservancy District, for various beneficial uses including "for delivery of Colorado's compact obligations to New Mexico under the La Plata River Compact." La Plata Water Conservancy District's November 2019 diligence application states that it has stored water in Long Hollow Reservoir and delivered water to New Mexico pursuant to the Compact.

DEFINING COMPACT COMPLIANCE IN THE CONTEXT OF A DEMAND MANAGEMENT PROGRAM 5-4-20

As part of the Upper Colorado River Basin States' drought contingency planning, the Colorado Water Conservation Board (CWCB) has initiated investigation of a demand management program consisting of "voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System *for the specific purpose of helping assure compact compliance*" (*emphasis supplied*).[1]

The CWCB Work Plan for evaluating the feasibility of a demand management program includes establishing workgroups consisting of subject matter experts. The workgroups are tasked to analyze various aspects of demand management and to help CWCB staff identify and evaluate priority issues within Colorado regarding demand management feasibility. This paper is the product of the Law and Policy Workgroup with the purpose of defining "compact compliance" in the context of a demand management program.[2]

The discussion and proposed definitions contained in this memorandum do not represent interpretations of existing law by any member of the Law and Policy Workgroup, the state of Colorado or any of its officials or employees, nor predetermine in any manner the position or interests of the state of Colorado, or any workgroup participants or their respective organizations, with respect to interpretation of any interstate compact or other component of the Law of the River.

Legal Framework:

The 1922 Colorado River Compact (1922 Compact)[3] provides that "The states of the Upper Division[4] will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre feet for any period of ten consecutive years reckoned in continuing progressive series . . ."[5] It further provides that should the United States in the future provide for deliveries of Colorado River water to Mexico, "such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin, and whenever necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d)."[6] In 1944 the United States signed a treaty with

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[1] Colorado Water Conservation Board, *Support and Policy Statements Regarding Colorado River Drought Contingency Plans, Demand Management, and Compact Administration*, November 15, 2018 available at https://dnrweblink.state.co.us/cwcb/0/edoc/209095/SUPPORTANDPOLICYSTATEMENTSFINAL11-15-18.pdf?searchid=a0210e79-2c01-40f7-beec-1f66486946ca (CWCB Policy Statement).

[2] The term "compact compliance" is used multiple times in the CWCB Policy Statement but is not defined there or elsewhere.

[3] Colo. Rev. Stat. § 37-61-101.

[4] Colorado, New Mexico, Utah, Wyoming.

[5] 1922 Compact, Article III(d).

[6] *Id.*, Article III(c).

Mexico that guarantees the delivery of 1.5 million acre-feet of Colorado River water to Mexico each year (subject to certain exceptions).[7]

There are interpretive issues among the signatory states to the 1922 Compact concerning the meaning of these and other provisions in Article III. For example: Does Article III(d) describe a non-depletion obligation, or a delivery obligation? What constitutes "waters that are surplus" and a "deficiency" within the meaning of Article III(c) addressing the obligation to Mexico? There are others. These issues are beyond the scope of this paper, but for the purpose of defining "compact compliance" for a demand management program, Article III(c) and Article III(d) articulate the Upper Division states' compact obligation, however it is ultimately quantified.

Although it is implied in Article III(d) and Article IX, the 1922 Compact contains no provision specifically requiring curtailment. The 1948 Upper Colorado River Basin Compact (1948 Compact), however, provides additional instruction on the determination of meeting or not meeting the compact obligation and the resulting consequences and authorities.[8] Article IV of the 1948 Compact provides that "In the event curtailment of use of water by the States of the Upper Division at any time shall become necessary in order that the flow at Lee Ferry shall not be depleted below that required by Article III of the Colorado River Compact, the extent of curtailment by each state of the consumptive use of water . . . shall be determined by the Commission."[9] The Upper Colorado River Commission (UCRC) established by the 1948 Compact is authorized to "make findings as to the necessity for and the extent of the curtailment of use" required by Article IV.[10] The UCRC is also authorized to determine the "extent of curtailment by each State of the consumptive use of water" allocated to it under the 1948 Compact.[11]

The Demand Management Storage Agreement explains that "The purpose of an Upper Basin Demand Management Program will be to temporarily reduce Consumptive Uses in the Upper Basin or augment supplies with Imported Water, if needed in times of drought, to help assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future."[12] Therefore, in the context of the Demand Management Storage Agreement and the CWCB's Demand Management Policy Statement, "compact compliance" means the Upper Division States meeting their obligations under Article III of the Colorado River Compact.

Scenarios Concerning Compact Compliance:

[7] *Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande*, Treaty Between the United States of America and Mexico, signed February 3, 1944, Article X. (Mexican Treaty). It should be noted that there is an exception to this delivery requirement. Article X of the Mexican Treaty contemplates a reduction in deliveries "in the event of extraordinary drought or serious accident to the irrigation system in the United States" that makes it "difficult for the United States to deliver the guaranteed quantify of 1,500,000 acre-feet a year."

[8] Upper Colorado River Basin Compact, 1948, Colo. Rev. Stat. § 37-62-101 (1948 Compact).

[9] 1948 Compact, Article IV.

[10] 1948 Compact, Article VIII(d)(8).

[11] 1948 Compact, Article IV.

[12] Demand Management Storage Agreement, Section I.A.5 and Section II.B.3.a.

There appear to be potentially three different scenarios in which compact compliance comes into play. Defining the term in the context of an "Upper Basin Demand Management Program" requires examination and evaluation of each scenario.

In the first scenario, the ten-year average flow at Lee Ferry falls below the required amount (a "Compact deficit") and the UCRC makes a valid finding that curtailment of consumptive uses in the Upper Division states is necessary to comply with the 1922 Compact. Under this scenario, the Colorado State Engineer is authorized to adopt regulations enabling the State "to meet its compact commitments" if "the compact is deficient in establishing standards for administration within Colorado,"[13] including "regulations as will be legal and equitable to regulate distribution among the appropriators within Colorado obligated to curtail diversions to meet compact commitments" and must simultaneously adhere "to Colorado constitutional and statutory provisions for priority administration."[14]

In the second scenario, hydrologic forecasts and other data convince the UCRC and the states of the Upper Division that a Compact deficit at Lee Ferry is sufficiently imminent that a preemptive curtailment of consumptive use is necessary to maintain compact compliance. Presumably, with a valid UCRC finding that curtailment is necessary to maintain compliance, the State Engineer can administer curtailment as described above, within the state.

The third scenario is the focus of this demand management feasibility investigation as contemplated by the Upper Basin Demand Management Storage Agreement and the CWCB Demand Management Policy Statement. The CWCB has launched the examination of a demand management program "to avoid or mitigate the risk of involuntary compact curtailment and to enhance certainty and security in the Colorado River water supply."[15] The exploration of the feasibility of developing and implementing such a program is an essential element of the Upper Basin Drought Contingency Plan.[16] The type of program being evaluated is a proactive arrangement under which voluntary, temporary, and compensated reductions in consumptive use would be made, with the resulting water savings shepherded to a storage account(s) in the CRSPA Initial Units under the control of the UCRC. This stored water would be used "to help assure compact compliance and reduce the risk of mandatory curtailment."[17] The UCRC must approve any Upper Basin demand management program, but it is not entirely clear whether such approval would provide sufficient authority for the Colorado State Engineer to administer demand management water in the manner that would be required.

Proposed Definitions:

To insure that the public fully understands the CWCB Policy Statement it is important to distinguish between compact compliance that is accomplished through involuntary curtailment (the

[13] Colo. Rev. Stat. § 37-80-104.
[14] *Simpson v. Bijou Irrigation Co.*, 69 P.3d 50, 69 (Colo. 2003).
[15] CWCB Policy Statement, p. 4.
[16] Agreement regarding Storage at Colorado River Storage Project Act Reservoirs under an Upper Basin Demand Management Program, May 20, 2019.
[17] CWCB Policy Statement, p. 2.

first two scenarios discussed above) and voluntary proactive measures, such as demand management, to "help assure compact compliance." With this background in mind **we suggest following definition:**

> **"Compact compliance" means the Upper Division States meeting their obligations under Article III of the Colorado River Compact.**

Efforts to achieve compact compliance may include the three scenarios described above. With respect to the two mandatory administrative scenarios described above, we recommend the term:

> **Compact administration = Involuntary curtailment pursuant to a valid finding by the UCRC that curtailment is necessary in order that the flow at Lee Ferry not be depleted below that required by Article III of the Colorado River Compact.**

With respect to the voluntary demand management scenario, the third scenario described above that is the focus of this demand management feasibility investigation, we recommend the term:

> **Voluntary compact assurance = Voluntary proactive measures, such as demand management, that help assure that the Upper Division states continue to satisfy their obligations under Article III of the Colorado River Compact and thereby reduce the risk of involuntary curtailment.**

Law and Policy Workgroup

Definition of Conserved Consumptive Use

An informal summary definition of Conserved Consumptive Use for purposes of an Upper Basin Demand Management Storage Program is: Upper Basin water that historically has been depleted under valid rights and would continue to be depleted but for its conservation as part of an Upper Basin Demand Management Program to help assure continued compliance with Article III of the Colorado River Compact.

A more specific definition of Conserved Consumptive Use requires reference to the specific language of the applicable governing document – i.e., the May 20, 2019 "Agreement Regarding Storage at Colorado River Storage Project Act Reservoirs under an Upper Basin Demand Management Program (the "Demand Management Storage Agreement"). The Demand Management Storage Agreement is Attachment A2 to the Agreement Concerning Colorado River Drought Contingency Management and Operations referenced in the Colorado River Drought Contingency Plan Authorization Act, P.L 116-14, adopted April 16, 2019.

The term Conserved Consumptive Use is not expressly defined in the Demand Management Storage Agreement. However, for the workgroup's purposes, the definition can be determined by reference to certain sections of the agreement.

Section III.A.3 of the agreement expressly defines Consumptive Use as:

> *The depletion of water for domestic and agricultural beneficial uses as those terms are defined and referred to in the 1922 Colorado River Compact. For purposes of this definition, Consumptive Use also includes the full amount of water: (i) consumed in association with the production of electrical power other than hydropower; and (ii) diverted from the Upper Colorado River System for which there are no return flows to that system, including, for example, diversions outside the natural Colorado River watershed.*

Section III.B.2.a of the agreement provides that "*Water conserved shall only be recognized as part of any Upper Basin Demand Management Program if:*

> *i. The source of conserved water is Upper Colorado River System water, or Imported Water*[1]*;*
>
> *ii. The water is conserved, stored and released for the specific purpose of helping the Upper Division States assure continued compliance with Article III of the Colorado River Compact;*

[1] "Imported Water" is defined by the Agreement as water introduced to the Upper Colorado River System from outside the Colorado River System for the specific purpose of augmenting the supplies available for, or storing water as part of, an Upper Basin Demand Management Program. Such Imported Water need not have been previously consumptively used in its basin of origin.

iii. For Upper Colorado River System water, the water must have been beneficially and consumptively used under valid water rights prior to being conserved as part of an Upper Basin Demand Management Program;

iv. For Upper Colorado River System water, the water must have been physically available for diversion in the year it was conserved, and would have been beneficially and consumptively used within a state or states of the Upper Division but for the conservation for the benefit of an Upper Basin Demand Management Program; and

v. The conserved or Imported Water has arrived at a CRSPA Initial Unit after accounting for any conveyance and associated losses."

DEFINING "ELIGIBILITY" FOR THE PURPOSES OF PARTICIPATING IN A DEMAND MANAGEMENT PROGRAM

The purpose of this memo is to define which water rights are "eligible" to participate in an Upper Basin Demand Management Program operated within Colorado, should such a program ever be developed and individually approved by the Upper Division States through the Upper Colorado River Commission ("UCRC"). The definition proposed herein is based primarily on the Agreement Regarding Storage at Colorado River Storage Project Act Reservoirs Under An Upper Basin Demand Management Program dated May 20, 2019 ("DM Storage Agreement" or "Agreement") and, to a lesser extent, the Colorado Water Conservation Board's Demand Management Policy Statement dated November 15, 2018 ("CWCB Demand Management Policy").

As a starting point, the DM Storage Agreement provides that in order to be eligible to participate in an Upper Basin Demand Management Program, any contribution of water must:

(1) be conserved within, or imported into, the Upper Colorado River System to help assure the Upper Division States' continued compliance with Article III of the Colorado River Compact;[1]

(2) be capable of verification;[2] and

(3) arrive at a CRSPA Initial Unit after accounting for any conveyance and associated losses.[3]

Imported Water is defined in Section III.A.6. of the Agreement as water that has been "introduced to the Upper Colorado River System from outside the Colorado River System for the specific purpose of augmenting the supplies available for, or storing water as part of, an Upper Basin Demand Management program." Upper Colorado River System water is defined in Section III.A.10 to mean water within "the Colorado River System within the Upper Basin."[4]

The DM Storage Agreement imposes additional requirements on water that is derived from within the Upper Colorado River System. More specifically, the Upper Colorado River System water must also have been: (4) beneficially and consumptively used under valid water rights prior to being conserved as part of an Upper Basin Demand Management Program; and (5) physically available for diversion in the year it was conserved. One must also demonstrate that the Upper Colorado River System water would have been beneficially and consumptively used

[1] DM Storage Agreement, Sections III.A.9 and III.B.2.a.ii.
[2] Verification is defined in Section III.A.11 of Agreement to mean the "confirmation of the actual volume of Consumptive Use that is conserved, or Imported Water that is introduced, conveyed to and stored in a CRSPA Initial Unit under an Upper Basin Demand Management Program." The concept of verification is further discussed in Sections III.B.2.b.vi. and III.B.3.b.
[3] The CRSPA Initial Units consist of "Glen Canyon Dam, Flaming Gorge, Curecanti (the "Aspinall Unit"), and Navajo Reservoir as authorized under the 1956 Colorado River Storage Project Act." Agreement, Section III.A.4.
[4] The Colorado River System is further defined to "have the same meaning as defined in the 1922 Colorado River Compact and the 1948 Upper Colorado River Basin Compact." Agreement, Section III.A.2.

within an Upper Division State but for the conservation for the benefit of an Upper Basin Demand Management Program.

In order to be eligible to participate in an Upper Basin Demand Management Program that is operated within Colorado, water right holders must also satisfy the applicable standards set forth in the CWCB's Demand Management Policy. The standards contained in that policy apply across the board - regardless of whether the contributed water is derived from conserved Colorado River System water or Imported Water. For example, the contribution of water must not cause material injury to other water rights holders within Colorado.[5]

It should be noted that the eligibility requirements listed above are based solely on the DM Storage Agreement and the CWCB's Demand Management Policy. It is reasonable to assume that the Upper Division States through UCRC, or the State of Colorado, may establish additional requirements for Colorado water users' participation in the event this process moves forward, such as establishing the duration of time conserved Colorado River System water must have been used prior to enrollment in the demand management program or the length of time a particular water right may be enrolled in the program. The other Upper Division States may also elect to impose additional restrictions on their water users' ability to participate in a program.

[5] CWCB's Demand Management Policy Statement at ¶ 7. More specifically, the policy provides it will be the CWCB Board's strategy to "[c]omply with applicable state law, including, but not limited to, the requirement that no action related to demand management cause material injury to other water right holders."

DEMAND MANAGEMENT PROGRAM – LAW AND POLICY ADVISORY GROUP
POLICY DISCUSSION OF THE MEANING OF TEMPORARY FOR
DEMAND MANAGEMENT PROGRAM PROJECTS
JUNE 9, 2020

I. Introduction

This memorandum addresses four approaches to defining the meaning of "temporary" for the purposes of a demand management program involving the conservation of consumptive use by water users in the State of Colorado for storage in the initial units of the Colorado River Storage Project Act ("CRSPA") reservoirs. This memorandum is not intended to suggest there are no other approaches to defining the meaning of temporary. The discussion and proposed definitions contained in this paper do not represent interpretations of existing law by any member of the Law and Policy Workgroup, the state of Colorado, or any of its officials or employees, nor predetermine in any manner the position or interests of the state of Colorado, the Colorado Water Conservation Board, or any demand management workgroup participants or their respective organizations, with respect to interpretation of any interstate compact or other component of the Law of the River.

II. Background

A. The Demand Management Agreement is prefaced upon the temporary reduction in consumptive use.

The Demand Management Storage Agreement authorizes upper division states access to the unfilled storage capacity in the initial units of the CRSPA reservoirs up to a maximum combined storage of 500,000 acre-feet. The storage space made available in the initial units of the CRPSA reservoirs is to be filled, in part, through the temporary reduction of consumptive uses in the upper basin. Access to the storage space is conditioned upon the investigation of the feasibility of the development and implementation of an upper basin demand management program, actual development of the program, and Upper Colorado River Commission ("UCRC") approval of the program.

Section I.A.4. of the Demand Management Agreement provides that "[t]he purpose of an Upper Basin Demand Management Program will be to ***temporarily*** reduce Consumptive Uses in the Upper Basin . . . if needed in times of drought, to help assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future."

The term "temporarily" is not defined in the Demand Management Agreement. However, other terms in the Agreement help to define the meaning of temporary. Specifically, section III.B.2.a.iv. of the Demand Management Agreement provides that conserved water would have been used but for the conservation activity:

> iv. For Upper Colorado River System water, the water must have been physically available for diversion in the year it was conserved, and ***would have been beneficially and consumptively used*** within a state or states of the Upper Division ***but for the conservation for the benefit of an Upper Basin Demand Management Program***.

Paragraph III.B.2.a.iv. tracks with the requirement that the conservation of water be on a temporary basis. By requiring that water would have been beneficially and consumptively used, paragraph

III.B.2.a.iv. prohibits the conservation of water on a permanent basis. This requirement can be used as a rule of thumb in a demand management program to determine whether projects are temporary. If a water user no longer maintains the intent to beneficially and consumptively use water, the conservation project is probably less likely to be temporary.

B. Colorado water law may help to inform the contours the meaning of temporary for the purposes of a demand management program.

Colorado has adopted several statutes that define frequencies of time that apply to delineate between permanent and temporary uses of water. These statutes also contain provisions that apply to the use of water in water conservation programs, including programs to conserve water to ensure compact compliance.

Statute	Description of Statute
Abandonment of Water Rights C.R.S. §§ 37-92-103(2), 402(11)	Abandonment is defined as "the termination of a water right in whole or in part as a result of the intent of the owner thereof to discontinue *permanently* the use of all or part of the water available thereunder." Abandonment occurs when there is a failure for a *period of ten years* or more to apply to a beneficial use the water available under a water right when needed. It is subject to a *rebuttable presumption* evidenced by the owner's intent not to abandon the right or such acts as loaning or leasing the water to others or good faith...." *Archuleta v. Gomez*, 200 P.3d 333, 344 (Colo. 2009). Even though a water user has not used water for more than ten years, a water user may successfully rebut any presumption of abandonment by showing a continuing intent to put water to beneficial use in the future. Observations: The ten-year period may be tolled under C.R.S. § 37-92-103(2) if the period of nonuse is attributable to participation in certain water conservation or water banking programs. This would apply to a Colorado River demand management program. In addition, a water user may refrain from using water for more than ten consecutive years so long as the water user maintains a continuing intent to apply the water right to beneficial use in the future.
Exemptions for historic consumptive use quantifications C.R.S. § 37-92-305(3)(c)	Water rights participating in certain types of water conservation programs are entitled to statutory protections under C.R.S. § 37-92-305(3)(c) to prevent a decrease when quantifying the historic consumptive use for the water right. "In determining the amount of historical consumptive use for a water right in division 1, 2, 3, 4, 5, or 6, the water judge shall not consider any decrease in use resulting from" participation in: (1) a water conservation program under a federal land conservation program; or (2) where the nonuse or decrease in use of the water from the water right by its owner "for a maximum of *five years in any consecutive ten-year period*" as a result of participation in certain types of water conservation programs, land fallowing programs to conserve water for compact compliance, or a water banking program.

	Observations: Section 37-92-305(3)(c) does not preclude water rights from qualifying for the safe harbor over back-to-back ten-year periods. Section 37-92-305(3)(c) also does not preclude water rights from participating in water conservation programs for more than five out of ten years, although the water right would not receive statutory protection for any additional years during a single ten-year period.
Loaned Water for Instream Flows to Improve Environment C.R.S. § 37-83-105(2)(a)(IV), HB20-1157	Under C.R.S. § 37-83-105(1), agricultural water rights may be loaned to the Colorado Water Conservation Board (CWCB) for instream flow purposes. § Section 37-83-105(2)(a)(IV) provides that a loan "shall not be exercised for more than *three years in a ten-year period*, for which only a single approval by the state engineer is required." Enacted and signed by Governor Polis in March 2020, HB20-1157 expands the number of years within a ten-year period that a renewable loan may be exercised from three years to five years, but for no more than three consecutive years, and allows a loan to be renewed for up to two additional ten-year periods. Observations: Water rights loaned under HB20-1157 are not precluded "from concurrent or *subsequent* inclusion in a water conservation, demand management, compact compliance, or water banking program or plan, as is or may be subsequently defined or described in statute." § 37-83-105(2)(a)(III.5).
Substitute Water Supply Plans (SWSP) C.R.S. §§ 37-92-308(4)(b), (5)(a)	If an application has been filed in water court, a substitute water supply plan (SWSP) is limited to an initial *one year period* with the ability to extend for *up to three years*, with any further extension requiring a showing to the state engineer that the delay in obtaining a water decree is justifiable. If no application has been filed for an augmentation plan or change of water right, and the water use plan or change proposed and the depletions associated with such water use plan or change will be for a limited duration, the plan is limited to a duration *not to exceed five years*. Observations: The applicability of the SWSP statute to demand management projects may depend on whether demand management projects constitute a temporary change of water right. An argument can be made that demand management projects involve the conservation of water that would have been used for but for the conservation of water, and are therefore a conservation activity and not a change of water right.
Interruptible Water supply Agreements C.R.S. § 37-92-309(3)(c)	By statute, an interruptible water supply agreement cannot be exercised for *more than three years in a ten-year period*, for which only a single approval is required. The ten-year period begins with the granting of the approval. Observations: The interruptible water supply agreement is designed to protect water users from injury from temporary transfers of consumptive use water to other water users for undecreed purposes.

C. The 2007 Interim Guidelines May Provide a Roadmap for Defining the Meaning of Temporary in a Demand Management Program.

The 2007 Interim Guidelines' treatment of intentionally created surplus (ICS) water may help to inform how Colorado's demand management program should define temporary water conservation activities. ICS is defined under the 2007 Interim Guidelines to mean "surplus Colorado River System water available for use under the terms and conditions of a Delivery Agreement, a Forbearance Agreement, and these Guidelines."[1]

The 2007 Interim Guidelines creates several categories of intentionally created surplus water, including: extraordinary conservation ICS, tributary conservation ICS, system efficiency ICS, and imported ICS.[2] Of these types of ICS, only System Efficiency ICS "projects are intended to provide temporary water supplies."[3] While not specifically defined in the 2007 Interim Guidelines, the Lower Basin Forbearance Agreement describes system efficiency projects as those involving "contributions of capital to the Secretary for use in Secretarial projects designed to realize efficiencies that save water that would otherwise be lost from the Mainstem [of the Colorado River] in the United States."[4] Although a contractor for ICS water is required to identify the term of the activity, only system efficiency projects are intended to be temporary in nature.[5] Typically, system efficiency ICS credits are based on capital contributions. The credits comprise a portion of the water saved through the efficiency project, and would not be stored, but would rather be provided to the user that developed the credit on a predetermined schedule for some period of years. The Lower Basin Drop 2 Reservoir System Efficiency Project is an example of a temporary System Efficiency ICS project. The Lower Basin Drop 2 Reservoir System Efficiency Project involves the construction of a reservoir to augment supplies and reduce inefficiencies in Lower Basin water orders and deliveries. Although temporary, it extends from 2008-2036.[6]

III. Discussion of Alternatives

The following section explores alternative approaches to defining the meaning of temporary in a demand management program and the pros and cons of each alternative.

A. Alternative 1: Do not adopt a definition of temporary.

Description: Colorado could decide to not adopt a definition of temporary and individually assess whether a demand management project is temporary on a case-by-case basis similar to the approach taken in the lower basin with regard to system efficiency ICS water.

Benefits to this approach:

- Consistent with the 2007 Interim Guidelines.

[1] 2007 Interim Guidelines, pdf p. 32, available at: https://www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf
[2] 2007 Interim Guidelines, supra n. 1, pdf p. 41.
[3] 2007 Interim Guidelines, supra n. 1 pdf p. 41.
[4] Forbearance Agreements, pdf p. 6, available at: https://www.usbr.gov/lc/region/programs/strategies/agreements/Forbearance.PDF
[5] 2007 Interim Guidelines, supra n. 1 pdf p. 42.
[6] Forbearance Agreements, supra n. 4, pdf p. 25.

    - The 2007 Interim Guidelines do not include a definition of "temporary" for system efficiency water used to create intentionally created surplus (ICS) water.
- Allows Colorado and the Upper Basin to maintain flexibility.
    - Keeps options open for demand management projects that cannot be anticipated.
- Avoids a restrictive definition that may limit water availability for a Colorado demand management pool.

Drawback to this approach:

- May make it more difficult to maintain consistency and uniformity between demand management projects.
- May require more administrative oversight and analysis in approving projects for a demand management program.
- Could result in an evolving definition of temporary.

B. Alternative 2: Adopt a single definition of temporary that applies regardless of type of demand management project or water rights involved.

Description: Colorado could adopt a single definition of temporary that would apply to all demand management projects regardless of type of project or water right involved. For example, Colorado could limit water rights to participation in a demand management program to no more than five years of any ten-year period of time. This would align with the safe harbor for historic consumptive use quantifications under C.R.S. § 37-92-305(3)(c)

Benefits to this approach:

- Creates consistency and uniformity between demand management projects.
- Simplifies administrative oversight and analysis required to review and approach demand management projects.
- Ensures that demand management conservation efforts remain temporary and do not gradually become permanent.

Drawbacks to this approach:

- Could eliminate flexibility of a demand management program.
- If the definition of temporary is too restrictive, it may limit water user participation and make it difficult to fill a demand management pool.
- Depending on how temporary is defined, it may discourage system efficiency projects which have the potential to generate conserved water over longer periods of time.

C. Alternative 3: Adopt a max term for system efficiency projects and cap all other types of projects based upon a time period of no more than five years in any consecutive ten-year period.

Description: Colorado could adopt a 20-30 year max term for system efficiency projects, while non-system efficiency projects would be subject to a time period of no more than five years in any consecutive ten-year period of time.

Benefits to this approach:

- Recognizes that system efficiency projects have the ability to conserve water over longer periods of time.
- Provides a greater degree of flexibility than would be available under a single definition that applies to all types of use.

Drawback to this approach:

- May limit flexibility.
- If restrictions on frequency of participation are too restrictive, they may limit ability for water users to participate and make it difficult to fill demand management pool.

D. Alternative 4: Adopt a definition of temporary for projects involving irrigation water rights, but leave the definition of temporary open ended for all other types of demand management water rights.

Description: Consistent with HB20-1157, Colorado could adopt a definition of temporary for irrigation water rights so that such water rights may not participate more than five years in any consecutive ten-year period, but for no more than three consecutive years, and for only two additional ten-year periods, and leave the definition of temporary open-ended for all other types of projects/water rights.

Benefits to this approach:

- Aligns with the 2007 Interim Guidelines treatment of system efficiency projects used for ICS.
- Allows Colorado and the Upper Basin to maintain some level of flexibility.
- Provides additional protections for ag/irrigation water rights.

Drawback to this approach:

- Because this approach limits participation of irrigation water rights, it may place a disproportionate burden on other types of water rights to fill a demand management pool.
- For water rights/ demand management projects that are not subject to a fixed definition of temporary, it:
    - may make it more difficult to maintain consistency and uniformity between demand management projects.
    - may require more administrative oversight and analysis in approving projects for a demand management program.
    - could result in an evolving definition of temporary.

IV. Conclusion

There are at least four different approaches to defining the meaning of temporary for a demand management program, although other approaches may be used. Of the four approaches discussed above, these approaches may provide varying degrees of flexibility for Colorado, and may affect the availability of water for a demand management pool.

DEMAND MANAGEMENT PROGRAM – LAW AND POLICY ADVISORY GROUP
POLICY DISCUSSION OF REVIEW PROCESS FOR DEMAND MANAGEMENT PROGRAM PROJECTS
JUNE 9, 2020

I. Introduction

This memorandum discusses several potential processes for review and approval of projects for a Colorado River demand management program ("DMP") operated within the state of Colorado.

This paper does not represent interpretations of existing law by any member of the Law and Policy Workgroup, the state of Colorado, or any of its officials or employees, nor predetermine in any manner the position or interests of the state of Colorado, the Colorado Water Conservation Board, or any demand management workgroup participants or their respective organizations, with respect to interpretation of any interstate compact or other component of the Law of the River.

On May 20, 2019, the Upper Division States and the Secretary of the Interior entered into an Agreement Regarding Storage at Colorado River Storage Project Act Reservoirs Under an Upper Basin Demand Management Program between the Upper Division States and the Secretary of the Interior ("Demand Management Agreement"). The Demand Management Agreement authorized the Secretary of the Interior to make unfilled storage capacity at the initial units of the Colorado River Storage Project Act Reservoirs ("CRSPA") available for use by the Upper Division States, through the Upper Colorado River Commission, at no charge and in accordance with the terms of the Demand Management Agreement. To access the unfilled storage capacity in CRSPA Reservoirs, the Upper Division States must "investigate the feasibility of developing and implementing an Upper Basin Demand Management Program, and reach consensus" on several items identified in the Demand Management Agreement.

Colorado has initiated a process to investigate feasibility of a DMP within the state, on a parallel track to efforts at the interstate level. On November 15, 2018, the Colorado Water Conservation Board ("CWCB") adopted Support and Policy Statements Regarding Colorado River Drought Contingency Plans, Demand Management and Compact Administration ("Policy Statement"). The Policy Statement expresses the CWCB's strategy to investigate a DMP that:

- Allows for voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System for the specific purpose of helping assure compact compliance.
- Complies with applicable state law, including, but not limited to, the requirement that no action related to demand management cause material injury to other water rights holders.
- Meets the other strategies and policy goals set forth in the Demand Management Agreement and the CWCB's Policy Statement.

CWCB Policy and Support Statement, p. 4 ¶¶(4), (7).

In exploring a framework for a DMP, inquires have been made about available processes for the review and approval of demand management projects and whether projects must undergo water court review. This memorandum explores five potentially available alternatives under Colorado law through which projects can be reviewed and approved for participation in a DMP under existing law. The five alternatives include the use of: (1) water court adjudications to review and approve the change of water rights for use in a DMP; (2) the temporary substitute water supply plan statute, C.R.S. § 37-92-308(5), to

temporarily approve the change of water rights for use in a DMP; (3) the interruptible water supply plan statute, C.R.S. § 37-92-309, to temporarily transfer the consumptive use of a water right for use in a DMP; (4) the water bank statute, C.R.S. § 37-80.5-104.5, to approve the deposit of conserved consumptive use credits in a water bank to be withdrawn for DMP purposes; and (5) the exercise of the State Engineer's authority to promulgate rules and regulations with respect to deliveries of water to enable the state of Colorado to meet its compact commitments under C.R.S. § 37-80-104.

This memorandum reviews the five identified processes, and concludes with a review of the pros and cons associated with each process. Although new legislation may be necessary or useful to facilitate these processes, it is beyond the scope of this memorandum to make such recommendations. This memorandum is not intended to suggest there are no other existing lawful processes to accomplish the goals of DMP. Likewise, this memorandum does not address the authority of the State Engineer concerning the discharge of the obligations of the state of Colorado imposed under the Colorado River and Upper Colorado River Basin Compacts.

II. Processes Available for Review and Approval of Demand Management Projects

1. Use of Water Courts to Review Demand Management Projects

Water users participating in a DMP could be required to go to water court to have their projects adjudicated for demand management uses. The Water Right Determination and Administration Act of 1969, §§ 37-92-101 to -602 ("1969 Act") defines the types of special statutory procedures available for the filing of applications in water court. These include applications for determinations with respect to a change of water right. C.R.S. § 37-92-302(1)(a).

Without assessing the merits, an argument can be made that demand management projects constitute a change of water right as defined in C.R.S. § 37-92-103(5),[1] to the extent consumptive use is being stored in Lake Powell rather than used for decreed purposes and places of use.[2] Arguments can be made that demand management is not a change of water right contemplated by the 1969 Act. However, counter arguments could be made that the quantification and transfer of conserved consumptive use for demand management purposes is a change of water right. Thus, one means of quantifying, reviewing and approving demand management projects would be to require water users to obtain decrees through an adjudicated change of water right.

[1] C.R.S. § 37-92-103(5)(a) defines a change of water right as "a change in the type, place, or time of use, a change in the point of diversion except as specified in section 37-86-111(2), a change from a fixed point of diversion to alternate or supplemental points of diversion, a change from alternate or supplemental points of diversion to a fixed point of diversion, a change in the means of diversion, a change in the place of storage except as specified in section 37-87-101(3), a change from direct application to storage and subsequent application, a change from storage and subsequent application to direct application, a change from a fixed place of storage to alternate places of storage, a change from alternate places of storage to a fixed place of storage, or any combination of such changes….

[2] In contrast to demand management projects, pilot projects involved in the system conservation pilot program did not involve a change of water right because system conservation pilot projects only involved the reduction or forbearance of diversions, and no effort was made to quantify the conserved consumptive use to claim credit for water storage in Lake Powell.

2. Administrative Agency Review of Demand Management Projects

As an alternative to water court adjudication of demand management projects, several statutes provide authority for the administrative approval of temporary transfers of water rights for undecreed purposes.

"Starting with Colorado's first adjudication acts . . . the General Assembly has consistently chosen to assign the water right determination function to the courts and the water distribution function to the water officials," *Santa Fe Trail Ranches Prop. Owners Ass'n v. Simpson*, 990 P.2d 46, 58 (Colo. 1999). However, "nothing in the Colorado Constitution—and particularly nothing in art. XVI, § 6 . . . prevents the legislature from placing such jurisdiction in a different agency." *Larrick v. N. Kiowa Bijou Mgmt. Dist*., 510 P.2d 323, 328 (Colo. 1973) (addressing the constitutionality of the Colorado Groundwater Management Act). Such legislation also does not violate the doctrine of separation of powers, nor does it constitute an unlawful delegation of judicial powers under Colo. Const. art. III and art. VI, s 1. *See Larrick*, 510 P.2d at 328.

In fact, the General Assembly has made exceptions in certain contexts, granting state water officials a wider latitude to approve temporary changes of water rights and plans for augmentation, C.R.S. §§ 37-92-308(4)-(5), to approve interruptible water supply agreements involving a temporary transfer of water rights, C.R.S. § 37-92-309; designated ground water basins, C.R.S. § 37-90-101 *et seq.*, and water banking programs, C.R.S. §§ 37-80.5-102, 37-80.5-104.5.

Such existing authority may enable the State Engineer to quantify review and approve demand management projects. The following table summarizes available statutory mechanisms that may allow existing water rights to be used in a DMP and explains potential shortcomings with each mechanism.[3]

TEMPORARY TRANSFER MECHANISM	APPROVAL ENTITY	PURPOSE	ISSUES WITH TRANSFER MECHANISM
Substitute Water Supply Plan C.R.S. § 37-92-308(5)	State Engineer	For temporary changes of water rights for no more than 5 years.	A five-year limit may be too restrictive.
Interruptible Water Supply Agreement C.R.S. § 37-92-309	State Engineer	Temporary transfer of HCU for another type or place of use.	Requires that the borrowing entity be a water right owner.
Water Banking Statute C.R.S. § 37-80.5-104.5	State Engineer & possibly Water Court	Allows for the lease, exchange, or loan of stored water within a water division.	Could be interpreted as only allowing water banks to operate within the water division for use within the division. Control over credits would need to be immediately transferred to entity administering a DMP to prevent a withdrawal.
State Engineer Authority C.R.S. § 37-80-104	State Engineer	Authorizes regulations for deliveries of water to enable Colorado to meet its compact commitments.	Among other things, a DMP would need to be for the purpose of ensuring compliance with Compact obligations.

[3] For an in depth discussion of these temporary mechanisms as well as other mechanisms authorized by the General Assembly, see Peter D. Nichols, Anne J. Castle, Zach Smith, P. Andrew Jones, Aaron Derwingson, *Standardizing Temporary Water Transfer Procedures in Colorado*, 22 U. Denv. Water L. Rev. 497 (Spring 2019).

a. Substitute Water Supply Plans

Under C.R.S. § 37-92-308(5)(a), if the statutory conditions are met, the State Engineer may approve a temporary substitute water supply plan ("SWSP") "for new water use plans involving … a change of water right, if no application for approval of a plan for augmentation or a change of water right has been filed with a water court and …. change proposed and the depletions associated with such … change will be for a limited duration not to exceed five years…."

To satisfy the statutory conditions of § 308(5)(a):

- The applicant must request approval of the SWSP with the state engineer and demonstrate its proposal will not cause injury to other water rights; and
- Provide a written notice of the request for approval of the SWSP by first-class mail or electronic mail to all parties who have subscribed to the SWSP notification list for the water division in which the proposed plan is located and proof of such notice is filed with the state engineer.

Potentially affected water users are given thirty-five days to submit comments to the state engineer, including "any claim of injury or any terms and conditions that should be imposed upon the plan to prevent injury to a party's water rights or decreed conditional water rights and any other information the opposer wishes the state engineer to consider in reviewing the substitute water supply plan request." C.R.S. § 37-92-308(5)(a)(III).

The state engineer must then make a determination whether "the operation and administration of SWSP will replace all out-of-priority depletions in time, location, and amount and will otherwise prevent injury to other water rights and decreed conditional water rights, including water quality and continuity to meet the requirements of use to which the senior appropriation has normally been put, pursuant to section 37-80-120(3), and will not impair compliance with any interstate compacts." C.R.S. § 37-92-308(5)(a)(IV)(A).

Under § 37-92-308(5)(a)(IV)(C), the state engineer is not required to hold any formal hearings or conduct any other formal proceedings, but may conduct a hearing or formal proceeding if the state engineer finds it necessary to address the issues.

Section 37-92-308(5)(c) also provides that the approval or denial of an SWSP does not "create any presumptions, shift the burden of proof, or serve as a defense in any legal action that may be initiated concerning the [SWSP]." If an applicant or opposer appeals a SWSP, the appeal is made "to the water judge in the applicable water division within thirty days, who shall hear such appeal on an expedited basis." *Id.*

b. Interruptible Water Supply Agreements

The Interruptible Water Supply Agreement ("IWSA") statute, C.R.S. § 37-92-309, is "intended to enable water users to transfer the historical consumptive use of an absolute water right for application to another type or place of use on a temporary basis without permanently changing the water right." C.R.S. § 37-92-309(1). In enacting the IWSA statute, the General Assembly recognized there are "certain circumstances under which administrative approval of the use of [IWSAs] … can maximize the beneficial use of Colorado water resources without the need for an adjudication and without injury to vested water rights or decreed conditional water rights." *Id.*

Under § 309(2), an IWSA is specifically defined as:

> …an option agreement between two or more *water right owners* whereby:
>
> (I) The owner of the loaned water right agrees that, during the term of the agreement, it will stop its use of the loaned water right for a specified length of time if the option is exercised by the borrowing water right owner in accordance with the agreement; and
>
> (II) The borrowing water right owner may *divert* the loaned water right for such owner's purposes, subject to the priority system and subject to temporary approval by the state engineer in accordance with this section.

C.R.S. § 37-92-309(2)(a) (emphasis added).

The State Engineer is authorized to approve and administer IWSAs "that permit a temporary change in the point of diversion, location of use, and type of use of an absolute water right without the need for an adjudication…." C.R.S. § 37-92-309(3). IWSA approved by the State Engineer must include:

- A quantification of the historical consumptive use of the water right.
- An accurate description of the land where the water is decreed for use.
- If the loaned water right is being used for irrigation, a plan to prevent erosion and blowing soils and a description of compliance with local county noxious weed regulations and other land use provisions.
- Any terms and conditions determined by the State Engineer to be necessary to ensure that these standards are met.

C.R.S. § 37-92-309(3)(a).

The state engineer is not required to hold any formal hearing or conduct any other formal proceedings, but may conduct a hearing or formal proceeding if the state engineer finds it necessary to address the issues. § 37-92-309(3)(b), C.R.S.

Similar to the SWSP statute, "[n]either the approval nor the denial of the agreement by the state engineer creates any presumptions, shifts the burden of proof, or serves as a defense in any legal action that may be initiated concerning the [IWSA]…." C.R.S. § 37-92-309(4)(a). Appeals of IWSA decisions must be "expedited, limited to the issue of injury, and made within thirty-five days after mailing of the decision to the water judge in the applicable water division." § 37-92-309(4)(a).

An ISWA "cannot be exercised for more than three years in a ten-year period, for which only a single approval is required. The ten-year period begins with the granting of the approval." § 37-92-309(4)(c). Although the IWSA statute is ambiguous, it can be read as allowing IWSAs to be approved for two additional ten-year periods, under C.R.S. §§ 37-92-309(4)(c) and (6), under a process that requires additional notice through the water court resume process. C.R.S. § 37-92-309(6)(c).

3. Water Bank Program

The Water Bank Program could present another framework for administering, reviewing and approving demand management projects. Under C.R.S. § 37-80.5-104.5(1)(a), upon a request by a water conservancy or conservation district "the state engineer shall promulgate program rules necessary or convenient for the operation of a water bank within the division in which such district is located."

Section 37-80.5-104.5(1)(a) specifies several requirements that the rules must meet. C.R.S. §§ 37-80.5-104.5(1)(a)(I)-(V), (b). Among these requirements, the rules must:

- "[A]uthorize, facilitate, and permit the lease, exchange, or loan of stored water within a water division" without impairing any of Colorado's interstate compacts. C.R.S. § 37-80.5-104.5(1)(a)(I).
- "[A]ccount and address, as appropriate, any necessary or desirable limitations upon the time, place, or type of use of waters made available through the water banks, and the appropriate length of agreements implementing banking transactions." C.R.S. § 37-80.5-104.5(1)(a)(IV).
- "[E]nsure that operation of the banks shall not cause any material injury to the owner of or persons entitled to use water under a vested water right or a decreed conditional water right." C.R.S. § 37-80.5-104.5(1)(b).

In addition, the State Engineer must adopt criteria for the approval and administration of deposits and credits to and from the water bank. C.R.S. § 37-80.5-104.5(c).

There are a number of challenges to adapting the water banking statue to a DMP, including:

- A potential hurdle to utilizing the water banking statute for a DMP is that under C.R.S. § 37-80.5-104.5(2), deposited "credits may be removed by the owner at any time prior to an actual transaction in which control of a credit is transferred, subject to the terms and conditions of the deposit agreement executed with the operator of the bank." Thus, for credits deposited for storage in Lake Powell, ownership of credits would need to be transferred to the entity administering the DMP to prevent a withdrawal, or deposit agreements would need to prohibit withdrawal.
- The water banking statute could be construed as authorizing water banks for lease, exchange or loan of water within the water division and not across state lines or in Lake Powell.
- The water bank statute allows for the assessment of transaction fees, which could help fund the administration of a DMP, but also add additional cost for water users. *See* C.R.S. § 37-80.5-104(1)(d).

4. State Engineer Promulgation of Rules Providing for Review of Demand Management Projects.

It may also be possible to review and approve demand management projects through the State Engineer's statutory authority to promulgate rules and regulations to administer deliveries of water to enable Colorado to meet its compact obligations.

Under C.R.S. § 37-80-104, the State Engineer:

> *shall make and enforce such regulations with respect to deliveries of water as will enable the state of Colorado to meet its compact commitments*. In those cases where the compact is deficient in establishing standards for administration within Colorado to provide for meeting its terms, the state engineer shall make such regulations as will be legal and equitable to regulate distribution among the appropriators within Colorado obligated to curtail diversions to meet compact commitments, so as to restore lawful use conditions as they were before the effective date of the compact insofar as possible.

(Emphasis added).

The Demand Management Agreement authorizes the storage of water in the initial units of the CRSPA reservoirs "to help assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future." Because water conserved under a DMP is to help assure compact compliance, the State may have the authority to promulgate rules and regulations for the review and approval of demand management projects under C.R.S. § 37-80-104.[4]

Such rules would likely be "constrained by all of the statutory restrictions imposed the State Engineer's water rule power, including the provisions set forth in … [C.R.S. §] 37–92–308 [and 37-92-501]" *See Simpson v. Bijou Irrigation Co*., 69 P.3d 50, 71 (Colo. 2003), as modified on denial of reh'g (May 27, 2003).

III. Discussion of Alternatives:

Alternative 1, Water Court Review and Approval: The Water Court can be used to adjudicate changes of water rights for the purpose of quantifying historic consumptive use ("HCU") and any associated return flow obligations for a DMP.

- Pros:
  - Allows for quantification of HCU.
  - Provides an existing mechanism to adjudicate changes in water rights for use in a DMP.
  - Provides certainty to water users.
  - Allows for a determination of injury.

- Cons:
  - Potentially high transaction costs.
  - Inefficient and time consuming. May take years to resolve cases if contested.
  - Relatively permanent result for projects that are intended to be temporary.
  - Likely to discourage participation by water users due to risks posed by water court litigation.
  - The above drawbacks could make a DMP infeasible.

Alternative 2, Substitute Water Supply Approval Process: The State Engineer may use the SWSP process, under C.R.S. § 37-92-305(8), to approve temporary changes of water rights for use in a DMP.

- Pros:
  - Relatively low transaction costs compared to water court.
  - Timely process for review and approval of projects.
  - Consistent with temporary nature of demand management projects.
  - Provides efficient process for review of injury in water court.
- Cons:
  - The five-year limit for approvals with no renewal could be too limited in duration for a DMP.
  - Limited notice and review time.

[4] Arguments also exist that the State Engineer's compact rule power does not extend to a demand management program.

- No protections for underlying water right from abandonment or reduction to HCU unless it is enrolled in an approved program.[5]

Alternative 3, Interruptible Water Supply Agreement Approval Process: The State Engineer may approve IWSAs to authorize the transfer of HCU for use in a DMP.

- Pros:
  - IWSA statute appears aptly suited for the temporary quantification of consumptive use.
  - Provides speedy process for review of consumptive use quantification and determination of injury in water court, if necessary.
  - Low transaction costs as compared to water court.
  - Consistent with the temporary nature of a demand management project.
  - May allow for higher participation in a DMP because there is a low risk of adverse binding precedent when quantifying a water right's consumptive use.
  - Protections for underlying water right from abandonment or reduction to HCU.[6]
- Cons:
  - The IWSA statute is potentially ambiguous as to subsequent renewals.
  - The IWSA renewal process is slightly more cumbersome and complicated than the initial approval process.
  - Limited notice and review time.
  - Three in ten-year limit for approvals may be too limited in duration for a DMP.

Alternative 4, Water Bank Statute: Use of the Water Bank Statute to create rules for the deposit and administration of credits for a DMP.

- Pros:
  - The water bank statute provides a process for developing rules for the deposit and approval of credits that could be useful for administration of a DMP.
  - The assessment of transaction fees may provide a means for funding the administration of a DMP.
  - Relatively low transaction costs compared to water court.
  - Timely process for review and approval of projects.
  - Consistent with temporary nature of demand management projects.
  - Provides efficient process for review of injury in water court.
- Cons:
  - The water bank statute allows for the assessment of transaction fees, which could add to water users' costs when participating in a DMP.
  - Water bank statute could be construed as authorizing water banks for the lease, exchange or loan of water within the water division, and not for use outside of the division.
  - Ownership or control of credits would need to be transferred to the entity responsible for administration of a DMP to prevent a withdrawal under C.R.S. § 37-80.5-104.5(2) or a deposit agreement would need to prohibit withdrawal.

[5] These programs are described in C.R.S. § 37-92-103(2) (protection from abandonment) and C.R.S. § 37-92-305(3)(c) (protection from reduction in HCU).
[6] *ISG LLC v. Arkansas Valley Ditch Association*, 120 P.3d 724, 734 (Colo. 2005).

- Limited notice and review time.

Alternative 5, State Engineer Promulgation of Rules for Review and Approval of Demand Management Projects: The State Engineer may be able to promulgate rules under C.R.S. § 37-80-104 for the delivery of water conserved under a DMP for delivery to the initial units of the CRSPA Reservoirs.

- Pros:
  - Depending on rules, may provide a legally defensible process for developing enforceable rules for a DMP.
  - Allows rules to be tailored to the needs of a DMP in the Colorado River Basin.
  - Allows for the development of rules that have low transaction costs, provide for speedy review of demand management projects and protects other water users from injury, and recognize the temporary nature of demand management projects.
- Cons:
  - Questions exist regarding the applicability of this statute to a demand management program.
  - State Engineer must develop new rules, which may be time consuming.
  - The rules are subject to protest in the Water Court under C.R.S. § 37-92-501(3)(a).
  - May require a determination that a DMP is needed to meet compact commitments.

IV. Conclusion

Arguments exist that at least five processes are currently available for review and approval of demand management projects. These processes may result in varying levels of authority, flexibility and participation in a DMP. A program requiring water court adjudication of projects is likely to result in the higher transaction costs and lower levels of participation in a DMP. In contrast, an administrative review and approval process is likely to have lower transaction costs and less risk, and may therefore create the conditions for higher levels of participation in a DMP. Other processes may be available for the review and approval of demand management projects, including a combination of the above approaches.

The alternatives discussed above assume that demand management would constitute a recognized beneficial use of water. Compact compliance has been deemed a beneficial use in certain situations in Colorado.[7] A voluntary demand management program could be used as a mechanism to help assure compact compliance [8] However, whether demand management meets the definition of a beneficial use of water could be subject to challenge. Other questions exist regarding the viability of the discussed alternatives for demand management purposes under existing law. The Law and Policy Workgroup therefore does not assert that any of the discussed alternatives are definitively available for implementation of a DMP.

[7] See CWCB DM Law and Policy Workgroup, Does Colorado law recognize compliance with an interstate compact as a beneficial use of water? (April 2020).
[8] CWCB DM Law and Policy Workgroup, Defining Compact Compliance in the Context of a Demand Management Program (May 2020), p. 4.

Work Group Meeting Report Out

Work Group: Law and Policy Meeting #1 **Date:** December 19, 2019

Meeting Topics:

Agenda topics included: Workgroup Role/Process; Scope of Discussions (working within framework of Demand Management Storage Agreement); Identification of Threshold Law and Policy Issues; Prioritization of Threshold Issues; Resource/Technology Needs Going Forward.

Key Take Aways:

- Laundry list of legal and policy issues exist within a number of important topics. Important to group issues according to topic to better focus where work group can provide most value.
- Definition of specific terms related to Demand Management critical first step to informing how to consistent evaluate key issues.
- Important to capture evaluation in useful manner i.e., report, charts, etc. to frame paths forward or challenges for the Project Management Team's recommendations to the Board.

Key Discussion Points:

The group identified threshold law and policy questions related to Demand Management that Colorado will need to consider. It grouped these questions into specific topics, and then identified needs to help inform the evaluation process. It then assigned responsibilities to address the initial needs for evaluating the law and policy issues and discussed approaches for developing an end product. These discussions will be refined in future meetings, but included:

Threshold topics (Note: specific issues identified within each topic)
• Legal definitions of critical terms • Purpose and Goal • Water Management and Administration • Governance • Funding • Equity/Neutrality • Hybrid Considerations • Tribal Considerations

Additional technical, informational other needs:

- Literature review of existing law and policy materials related to Demand Management
- Summary of key principals of existing Legal Framework under the Demand Management Storage Agreement.
- ? for Work Groups - Water Accounting/Administration Group – what are topics looking into? What are implications of using storage for DM, how does that work with 1 fill rule,

etc.? Funding Group – What are topics looking into? Tribal Discussion – What are key topics looking into?

Other: The group's next meeting will be held February 5th in Summit County. Place and time to be determined.

Work Group Meeting Report Out

Work Group: Law and Policy Meeting #2 **Date:** February 5, 2020

Meeting Topics:

Agenda topics included: Prior Meeting Summary/Recap/ Steps for Literature Review/Other Compacts/ Review of key principles in Demand Management Storage Agreement and CWCB Summary and Policy Statement/ Review and Discussion of Proposed Definitions for Key Terms/Consideration of Application of Export Statute/Preparation of IBCC/Workgroup Meeting/ Resource-Tech Needs

Key Take Aways:

- Per the Demand Management Storage Agreement, the purpose of any Upper Basin Demand Management Program would be to help assure continued compact compliance. What constitutes "compact compliance," and how it should be defined, therefore, is important to the structure of the entire program.
- How demand management actions will be considered a beneficial use of water will be important to define and clarify.
- Per the Demand Management Storage Agreement, the UCRC will need to identify when Demand Management Program is "turned on" and states/water users can voluntary participate to help assure continued compact compliance. Such finding should be different and separate from a UCRC finding that an Upper Division State MUST take action to produce a certain amount of water to either get back into compact compliance or to maintain compact compliance.
- Per the Demand Management Storage Agreement, the water that fits within a demand management program must be imported into the basin or be classified as conserved consumptive use. The definition of conserved consumptive use, at this point, must include water that has been historically depleted under valid decreed rights and would continue to be depleted but for the program. Raises questions to consider regarding tribal water and augmentation water.
- How to define "temporary" under a Demand Management Program that is voluntary, temporary and compensated is highly dependent on the type of use.
- The export statute is not likely applicable so long as the water created in Colorado under a Demand Management Program is for the benefit of Colorado and its water users.

Key Discussion Points:

1) In defining "compact compliance," it is important to avoid suggesting that any program will be used to exercise the State Engineer's authority to implement anticipatory curtailment to maintain compliance with the compact. It will also be important to make sure that the definition of "compact compliance" incorporates (or does not interfere with) the concept that actions taken for compact compliance constitute a beneficial use (as already contemplated in other basins and water rights).

Work Group Meeting Report Out

Work Group: Law and Policy Meeting #3 **Date:** March 24, 2020

Meeting Topics:

Agenda topics included: Key Takeaways Summaries/ Report out from IBCC Meeting - Purpose of L&P Workgroup * Uncertainties * Questions from Other Workgroups * Approach for Developing Work Product / Definition of Key Terms (Continued discussion) / Next Steps.

Key Take Aways:

- Communications "tool" that CWCB introduced at IBCC meeting may be helpful to evaluate some uncertainties identified by the Workgroup. Will consider more and see if there are key uncertainties that the group wants to map out.
- Purpose of the Law and Policy Workgroup – To focus on framework to help inform three different matters:
    - Identifying the threshold legal and policy questions that the CWCB should be aware of when investigating and potentially determining the feasibility of Demand Management for Colorado. NOTE: Not decision but noting the pros and cons associated with each.
    - Assess key terms to provide a baseline understanding that can help the CWCB, workgroups and other stakeholders speak the same language as considering options.
    - Help inform answers to law and policy questions posed by other workgroups.
- Key uncertainties at this time include:
    - Is there a need to pursue Demand Management? Do we need an insurance program? What is the obligation Colorado is trying to fulfill? CWCB Communications tool may help with this – still thinking on it.
    - If so, "is the juice work the squeeze?" Does it provide sufficient risk mitigation for the effort it will require?
    - What will other states do? How do we agree?
- Approach for Work Product – Develop a basic legal and policy framework:
    - Based on a streamlining of elements from the Demand Management Storage Agreement and CWCB Support and Policy Statement to focus on essential elements for any Demand Management Program in Colorado
    - Identify the legal and policy issues associated with the key elements within the framework, noting the benefits and challenges associated with the alternative ways to assess the matters.
    - Hope is to provide some definition to key elements.
- Key definitions that Workgroup is mapping

- What constitutes "compact compliance," and how it should be defined, therefore, is important to the structure of the entire program.
- Whether demand management actions will be considered a beneficial use of water will be important to define and clarify.
- What constitutes conserved consumptive use and what water rights would fit within a demand management program.
- How to define "temporary" under a Demand Management Program that is voluntary, temporary and compensated.

Key Discussion Points:

1) There are different ways to look at what constitutes compact compliance. The focus of this process should be on helping to assure compact compliance is the basis for conducting demand management activities. In developing this definition, it will remain important to be consistent with wording in the Demand Management Storage Agreement and CWCB Support and Policy Statement. It will also be important to make sure that the definition of "compact compliance" does not interfere with the concept that actions taken for demand management could constitute a beneficial use. .
2) To work within the existing water rights system, there is a need to identify whether water conserved under a demand management program could be considered a beneficial use. In other basins, compact compliance activities have been considered a valid beneficial use – see Rio Grande Closed Basin Project, Republican River Compact Compliance Pipeline and augmentation wells, Long Hollow Reservoir – water court decree, Arkansas River Irrigation Improvement Rules, groundwater commission decisions. While compact compliance activities may be considered a beneficial use in various basins, the activities that are deemed fall within what constitutes compact compliance still need to be defined.
3) What constitutes a "temporary" activity under a demand management program will depend heavily on the type of use – may be different for irrigation vs. municipality. May be different water rights represented by shares in ditch companies. Presenting the pros and cons of different alternatives to consider.
4) Water that is eligible for a Demand Management Program must meet the minimum requirements of the Demand Management Storage Agreement and CWCB support and policy statement.

Additional technical, informational other needs:

1) Working through go to meetings to conduct meetings during COVID-19 concerns. Everyone seems to be managing. Will report out complications as develop.

2) There are three types of compact compliance, and demand management only fits within one. First, there are compact compliance actions to cure a compact violation – triggered by UCRC Finding or Supreme Court order. Second, there are compact compliance actions that are necessary to maintain compliance in the face of a likely/imminent violation. Third there are compact compliance actions to help assure ongoing compliance. Demand management should fit within this third concept and be considered a voluntary activity.

3) To work within the existing water rights system, there is a need to identify how water conserved under a demand management program could be considered a beneficial use. In other basins, compact compliance activities have been considered a valid beneficial use – see Rio Grande Closed Basin Project, Republican River Compact Compliance Pipeline, Long Hollow Reservoir – water court decree, Arkansas River Irrigation Improvement Rules. Also consider the understanding that every post-compact water right is taken subject to the compact – see *Hinderlider.*

4) What constitutes a temporary activity under a demand management program will depend heavily on the type of use – may be different for irrigation vs. municipality. May be different for ditch companies.

5) Water that is eligible for a Demand Management Program must meet the minimum requirements of the Demand Management Storage Agreement.

Additional technical, informational other needs:

- Will look into lease/fallow guidelines and pilot projects for further investigation of what is considered reasonable for temporary.

- Would like to coordinate with the Water Rights Accounting and Administration Workgroup to better understand how Division of Water Resources would administer water in program.

Other: The group's next meeting will be held March 24th in Summit County. Place and time to be determined.

Law and Policy Work Group Meeting Report Out

Meeting Date: April 22, 2020

Meeting Topics:

Agenda topics included: summary of public comment; review of workgroup members' work on various Demand Management topics; discussion of strawman/framework document relating to Demand Management Storage Agreement and CWCB Policy statement; identification of legal and policy alternatives within framework; public comment

Key Take Aways:

- The group identified and discussed the key elements of the Demand Management Policy statement and identified issues that require ongoing discussion and additional clarification.
- There are various points in the Storage Agreement and Policy Statement that require definitions. The group has developed draft definitions of key terms and continues to work on refining and identifying areas of agreement and outstanding issues.

Key Discussion Points:

Discussion about how to frame key issues relating to Demand Management and areas requiring clarification in the Storage Agreement. The group recognized it does not need to reach consensus or decisions on these issues, but rather is working to frame and prepare a work product for the Board identifying the issues and identify various approaches and interpretations.

Workgroup members will continue to work to finalize work products.

Next Steps: Note that one final, brief call was held among the workgroup members on June 5, 2020, for the purpose of discussing logistics for finalizing the group's reports.

Attachment I

Monitoring and Verification Workgroup Documents:

1. Fallowing/Deficit-Irrigation Projects
2. Agricultural Hypothetical Examples
3. Trans-Mountain CU Reduction Projects
4. TMD Hypothetical Examples
5. Reports

FINAL

Ideas for Monitoring and Verification of Agricultural Fallowing/Deficit-Irrigation Projects
Demand Management - Monitoring and Verification Workgroup
June 2020

Notes:

1. **"Generally Accepted" practices draw from existing programs and practices, administration, and water court case law while other practices that have been identified were noted as "Potential". Generally Accepted practices sometimes vary between divisions/locations based on need, applicability, and practicability.**
2. **In this document, "Consumptive Use (CU) credits" or "credits" are defined as the amount of water to be quantified in the stream as available for use in the Demand Management Program (DMP) and are derived by reducing the estimated amount of conserved CU by safety factors to conservatively reflect uncertainties and levels of accuracy.**

Guiding Principles:

1. Measurement and verification must be honest, accurate, and defensible.
2. It must be protective of other water users.
3. It must be as simple, easy, and flexible as possible while still meeting the first two principles.

Temporary Nature:

Demand Management Program: The M&V ideas presented here are meant to address waters temporarily made available to the Demand Management program (program).

Field level: For consumptive use (CU) water produced by reductions in crop consumption due to reduced irrigation, the measure of "temporary" shall be determined at the field level. For ease of implementation and administration, entire ditch system or structures may choose to participate simultaneously, however, the measure of temporary shall still be based at the field level. The fallowing or reduction of irrigation of any particular field is presumed to be limited to a certain number of years within a longer period. Specific terms will be considered on a case-by-case basis, and the standard of scrutiny may be based on the type and duration of the project.

Level of Accuracy:

Typically, the generally accepted practices listed below offer a higher level of certainty in estimation of parameters needed for monitoring and verification of potential demand management projects. This is either due to a higher level of detail or a greater amount of experience of use within Colorado changed water rights history and case law. Often, the higher precision and confidence results in higher cost for monitoring and verification due to required infrastructure, data, or time for an engineer or scientist to perform analysis. The higher precision and level of confidence should also allow for maximization of

transferred CU resulting from a project. The potential practices listed below are typically more untested in Colorado changed water right history and case law. In some cases, they may be simpler or require less analysis and/or infrastructure. The tradeoff in simplicity is that the results will be more uncertain and require safety factors to avoid potential injury to other water users.

Specific Issues:

Measurement of water returned to stream – Quantifying the amount of water that was physically and administratively available and returned to the stream is a cornerstone of monitoring and verification. Headgate diversion and measurement of water returned to the stream is required unless the Division Engineer confirms that an acceptable alternate method of quantification of the amount of water generated is available. The standard applied shall be that credit will only be given for water that is both physically and administratively available, and that can be honestly, easily, and accurately quantified using defensible methods. In general, direct measurement is preferred and will produce the most confidence in measurement. Alternative methods that do not use direct measurement of flows involve assumptions and introduce uncertainty.

Generally Accepted Practices:

Diversion and Measurement

For typical irrigation systems, water must be diverted through the ditch headgate to ensure that it was physically and administratively available and the amount returned to stream measured. Typically a Parshall, Cutthroat, or other type of flume with a stage/discharge recorder is used for measurement; data telemetry is not required but is encouraged. The Division Engineer has a right to verify measurement accuracy. The amount of water diverted and measured back to the stream includes the amount of conserved CU, and an amount representing losses and return flows (see section below).

Bypass of Water

In some cases, water can be bypassed past the ditch headgate if the Division Engineer confirms that the amount of water that is both physically and administratively available can be easily and accurately quantified. The amount of water bypassed shall be determined by headgate diversions measurements and records as a demonstrable physical reduction in allowable diversions.

Potential Practices:

Other Indirect Estimation Methods

In some cases, direct measurement of water available to a field or reductions in diversions may not be possible or feasible. Such cases may include high altitude grass irrigation, high groundwater sub-irrigation situations, or deficit irrigation situations. In such cases, alternative assumptions of conserved CU and return flows may be allowed through conservative engineering estimation methods and accounting methodologies.

Consumptive Use Analysis – A consumptive use (CU) analysis is required to estimate the historical or potential consumptive use of irrigation water and CU factors and volumetric limits that are required for administration. CU factors relate the amount of water that was returned to or left in the stream to the portion that was historically consumed. The factors may need to incorporate ditch losses based on the location of measurement, and are inversely proportional to return flow (RF) factors which may be further subdivided into immediate and delayed portions. Volumetric limits are needed to limit monthly and annual CU/depletion amount totals to historically used amounts, and for a temporary project could be based on maximum rather than average historical amounts.

Additional factors and limits based on the certainty and accuracy of the measurement methodology and CU estimation methodology can be quantified and applied to CU to result in appropriately conservative stream credits and return flow obligations.

Generally Accepted Practices:

Historical Consumptive Use (HCU) Supply-Limited Analysis

A supply-limited HCU analysis limits potential crop demands by historical ditch diversions and soil moisture storage given ditch and irrigation application efficiencies to estimate consumptive use of irrigation water and factors and volumetric limits based on historical use over a representative study period of at least 30 years. Tools such as StateCU, the Lease Fallow Tool (LFT), and IDSCU can be used for an HCU analysis. Required data includes acres, crops, ditch diversion records, shares/ownership, potential evapo-transpiration (PET), precipitation, soil capacity, ditch losses and application efficiency. A site specific engineering analysis is the preferred method and may result in the highest CU credit. However, the use of standardized tools such as the Lease Fallow Tool with conservative assumptions is also acceptable, but will result in lower amounts of CU credit.

Potential Practices:

Potential Consumptive Use (PCU) Analysis

A PCU analysis could be used within a demand management program when ditch diversion records or other data are not available or when conservative measures are also applied. CU factors are estimated with application and ditch efficiencies and volumetric limits based on historical and/or real-time potential crop irrigation water requirement. This analysis does not identify historically water long periods (which lowers CU factors below maximum efficiencies) or water short periods (which reduce volumetric limits). Required data includes crop type, potential evapotranspiration (PET), precipitation, and application efficiency.

Remote Sensing Historical Analysis

Satellite imagery can be processed with methods such as METRIC to estimate historical CU. The analysis can identify historically water short periods, although volumetric limits for a temporary project may be based on maximum usage. CU factors could be estimated separately with application and ditch efficiencies but water long periods which lower these factors would not be identified. Because this methodology incorporates less direct measurement and more uncertainty, its application should be

limited to locations and situations that cannot feasibly use other methodologies or for project types that require the flexibility offered through this method. Relatively cloud-free satellite imagery as well as reference evapotranspiration (ET) and precipitation data are needed.

Estimation of Residual Field Consumptive Use – Many temporary fallowing practices may still consume water, and continued consumption to the extent that it reduces return flows in comparison to the normally irrigated state should either be subtracted from stream credits and/or volumetric limits or replaced as additional return flow requirements. Practices and associated methods to estimate residual consumptive use include:

Generally Accepted Practices:

Full Dry-up: No Residual CU

The residual field CU is typically considered zero if nothing is replanted, deep rooted crops (alfalfa/grass) are removed, and management practices to ensure that inadvertent irrigation does not occur are implemented such as tilled separations from irrigated fields and ditches and periodic field inspections to ensure that the field remains fallow.

Sub-Irrigation: Measurement of Groundwater Levels

Groundwater monitoring wells can be installed and used to estimate the amount of groundwater consumed by crops. Accepted tables of depth to water versus crop consumption are available for alfalfa and grass. The residual consumptive use as indicated by the tables would be subtracted from credits and/or volumetric limits. Some of the potential practices listed below may also accurately account for residual field consumptive use, but have less history in Colorado for that purpose.

Potential Practices:

Non-irrigated Cover or Dryland Crops: Potential Estimation of Soil Moisture Impacts

Non-irrigated and shallow rooted cover crops and dryland crops have been planted on temporary fallowed fields to reduce noxious weeds and maintain soils and productivity using the management practices above to avoid inadvertent irrigation. However, these crops can reduce soil moisture in the year the field is re-irrigated, and modeling or measurement of soil moisture impacts may be required.

Deficit Irrigation: Measurement of Irrigation Water Applied

Any irrigation water applied to a field can be measured with a flume or other device. Under water short conditions efficiencies can be very high; therefore a method to estimate efficiency as a function of the ratio of water applied to PCU should be developed to be used as an accepted assumption. For example, if irrigation application is less than 50% of PCU, then it may be assumed that applied water is 100% consumed, and if 75%, then efficiency can be assumed to be 80%, and so on. It may prove beneficial to define a maximum application efficiency rate that could potentially be approved. The applied water that is estimated to be consumed would be subtracted from PCU to result in an estimate of conserved CU, subject to volumetric limits and further reductions for uncertainty.

Deficit or Sub-Irrigation: Remote Sensing of Actual Consumptive Use

Satellite imagery can be processed with methods such as METRIC to potentially estimate the water consumed by the deficit or sub-irrigated crop. The amount of effective precipitation is estimated and subtracted from this amount to estimate the amount of irrigation or groundwater that was consumed, and this amount would be subtracted from PCU to result in an estimate of conserved CU, subject to volumetric limits and further reductions for uncertainty. Relatively cloud-free satellite imagery as well as reference ET and precipitation data are needed.

Lower Consumption Crops: PET Evaluation

Consumptive use can potentially be reduced by changing from higher consumption crops (such as alfalfa or grass) to lower consumption crops (such as grains). The practice could potentially be used in demand management if the change would occur for multiple years and not part of a typical crop rotation practice. The consumptive use analysis of the higher consumption crop is based on the historical crop distribution on the field for the last 30 years or more, and conserved water is measured back to the stream. The credit and/or volumetric limits based on the historical crop distribution would be reduced by the irrigation requirement of the new crop based on the real-time or maximum PET.

Deficit/Sub-Irrigation: Yield reduction estimates

Studies have related water supply reduction to yield reduction for various crops. Yield reductions could be measured, and credit amounts could be limited by corresponding estimated reduction in water supply. This would require accurate measurement and verification of harvest yields in the project field and potentially in a normally irrigated field. This measurement is several steps removed from actual flow measurement and involves a large number of assumptions. Many factors besides conserved CU may affect crop yield, introducing a large amount of uncertainty.

Return Flow Maintenance – In order to apply irrigation water to new uses while ensuring downstream rights are not injured, the water that would have returned to the stream system as a result of the use of the water right for irrigation needs to be maintained in amount, location, and time such that there is no injury to other water rights holders. Replacement of return flows may also have streamflow benefits, and this workgroup awaits the results of the Demand Management Environmental workgroup to evaluate those benefits. Irrigation water not consumptively used by crops can return to the stream system as surface water (tailwater) runoff or as deep percolation through groundwater systems. Return flows are sometimes referred to as “immediate” (those returning to the stream essentially at the same time as the diversion) and “delayed”. Return flow factors as a function of farm or river headgate deliveries are determined with the CU analysis. Methods to measure and replace return flow requirements include:

Generally Accepted Practices:

Immediate return flows:

Measurement Station – Immediate return flows can be returned through the measurement station along with the CU credit as long as the return flow location is appropriate. In some areas where flows

historically returned to the stream primarily as surface water or at a very fast rate (i.e. less than a month), the entire return flow requirement may be able to be replaced through the measurement station, so long as no downstream users are significantly impacted. These areas can include locations with fields close to the river, where return flows were predominantly surface water, or where underlying materials between the field and river are very permeable. Alternatively, with the approval of the Division Engineer, the downstream call regime may make the lagging or delay of return flow replacement less critical.

Bypass of Water - In some cases, The Division Engineer may confirm that the amount of immediate return flow that is required can be accurately quantified if the water is bypassed past the ditch headgate. This is only allowable in cases where the amount of immediate return flow is only a component of the amount bypassed, with the full amount representing the conserved CU portion and the return flow portion being both physically and administratively available. The amount of water bypassed shall be determined by headgate diversions measurements and records as a demonstrable physical reduction in allowable diversions.

> *Delayed Return Flows -* Unit Response Functions (URFs) will be used to define the timing pattern of delayed return flows. These are often estimated using The Glover-Balmer analytical solution (Glover equation), distances from the field centroid and aquifer boundary (if applicable) to the river, and estimates of groundwater transmissivity and specific yield. Assurances may need to be secured to ensure that water sources will be available into the future:

Recharge Pond – Recharge or infiltration ponds are often used to replace delayed return flows. If the pond is located close to the fallowed field, deep percolation return flows should return to the stream system similarly to how they would have if the field was irrigated. However, evaporation from the pond must also be quantified and this amount replaced by reduction of the credit and/or replacement of this additional water amount into the pond. Evaporation can be estimated from climate data and the days that water is in the pond. Delayed return flows measured back to the stream or bypassed in the same manner as described above can be rediverted (directly or by exchange) into such recharge ponds for delayed release.

Replacement from Reservoir or Other Sources – Delayed return flow requirements can potentially be replaced using reservoir or other water sources. After passing through the measurement station, return flows portions can potentially be exchanged into a reservoir for storage and scheduled release. Some portion of the CU credit may have to be dedicated to reservoir evaporation. Another option is to contract with existing reservoir owners and or augmentation providers to purchase water for scheduled release to replace delayed return flows. The use of such purchased sources would be subject to legal considerations, availability for such use, and would need to consider location to prevent unacceptable impact to other users.

FINAL
Agricultural Hypothetical Demand Management Examples
Monitoring & Verification Demand Management Workgroup
June 2020

INTRODUCTION

The following scenarios are intended to highlight various issues that might arise with Monitoring and Verification (M&V) of conserved consumptive use associated with west slope agricultural participation in a Demand Management program. As such, the intention is that these scenarios be limited to addressing Monitoring & Verification issues and concerns at the field level and back to the headgate plus surface and groundwater return flow issues.

Under all these scenarios there are potentially multiple Administration and Accounting (A&A) issues including shepherding, transit loss, injury, reservoir administration, and certainly more. Some of these issues are noted below in the "Considerations / Questions" section for each scenario. While raised here, the intent is that these issues are highlighted primarily for the Administration and Accounting Workgroup to address separately or in collaboration with the M&V Workgroup.

One issue with significant overlap between the M&V Workgroup and the A&A Workgroup is the potential change in return flow patterns and the need to prevent injury to other water rights.

Graphics for Scenarios 1 – 4, taken from various locations and basins across the west slope, are attached to help portray those scenarios. They are not intended to be specific to any location or parcel but rather highlight, in general, situations that may occur.

SCENARIOS

Scenario 1: Full-season fallow of 40 acres of sprinkler irrigated grass-hay pasture on bench adjacent to stream.

1. Water Supply:
    a. Direct diversion to pumping forebay immediately upstream from subject parcel. There is a full water supply in all years.

2. Considerations / Questions:
    a. How is "saved" direct flow water quantified and bypassed at the headgate?
    b. Are there surface and groundwater return flows concerns that must be investigated?

Scenario 2: (variation of scenario 1). Full-season fallow of 40 acres of sprinkler irrigated grass-hay pasture on bench adjacent to stream.

1. Water Supply:
    a. Direct diversion to pumping forebay immediately upstream from subject parcel. The stream is water short in average and drier than average years and the physical supply is often limited in the late season (essentially this pumping forebay "sweeps" the stream).

2. Considerations / Questions:
    a. How is "saved" direct flow water quantified and bypassed at the headgate?
    b. Are there surface and groundwater return flow concerns that must be investigated?
    c. How can / should transit losses be quantified through the dry-up stream reach and beyond?

Scenario 3: Full-season fallow of 200 acres of flood irrigated grass-hay pasture served with a combination of direct flow and supplemental storage sources of supply. The parcel is located adjacent to a major reservoir and surface and groundwater return flows accrue to the reservoir.

1. Water Supply:
    a. Direct flow early season supply supplemented by local reservoir storage. Both the ditch and storage are the source of supply for other pastures both upstream and downstream from the subject parcel.

2. Considerations/ Questions:
    a. How is "saved" direct flow water bypassed at the headgate(s) to ensure that it is not consumed by the upstream or downstream pasture located on the same ditch?
    b. How is "saved" storage water delivered to the stream system without being consumed on upstream and downstream pastures?
    c. If "saved" storage water is retimed and delivered to the stream later than it normally would delivered for irrigation, how is increased evaporation loss assessed to the "saved" storage water?
    d. How does the change in groundwater return flows impact physical and legal water supply into the downstream major reservoir? Assume that, under normal operations, some of the early return flow accrues to the reservoir when it is in priority (storable inflow) and some lagged return flow would be bypassed later in the season when the reservoir is out of priority.

Scenario 4: Split-season fallow of 50 acres of grass-hay pasture on an upland bench. Lower level irrigated pastures are located between the toe of the upland bench and the stream.

1. Water Supply:
    a. Subject pasture is served by a ditch that also serves several down-ditch and up-ditch users.

   b. Groundwater return flows: 1) may accrue to the ditch serving the parcel located between the below the toe of the bench and the stream, 2) supplement sub-irrigation of the lower parcel, and 3) accrue to the stream.

2. Considerations / Questions:
   a. How is "saved" direct flow water bypassed at the headgate to ensure that it is not consumed by the upstream or downstream pastures located on the same ditch?
   b. How much carriage water (push water) must be left in the ditch to ensure the other users receive the supply they would have received but for the DM program?
   c. How is the down-gradient water user (at the toe of the bench) impacted by the loss of return flow? (non-legal injury)

Scenario 5: (Variation on Administration and Accounting hypothetical #1) Large water user association with 60-mile-long canal system primarily served by direct flow right with supplemental late season storage. 3,000 acres, a small fraction of the total acreage served by the association, is proposed for inclusion in a DM program. The 3,000 acres is split between full season and split-season fallow. The acreage proposed for the DM program includes multiple varieties of row crops.

1. Water Supply:

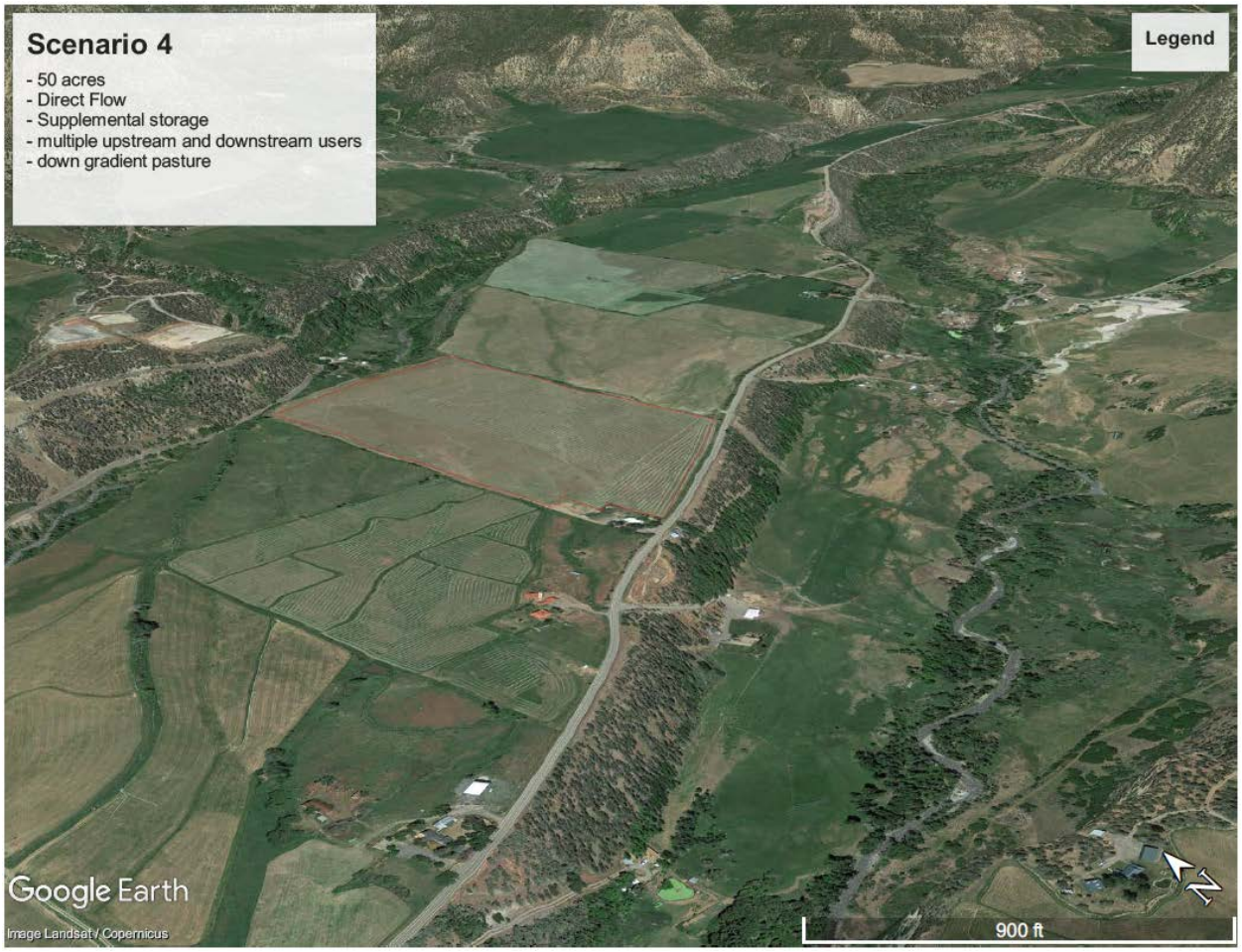
   a. The system is assumed to have a full water supply such that 100% of the ET_p is satisfied for all shareholders by the combination of the direct flow right and supplemental storage (water long system).

   b. There are assumed to be no return flow issues. Tailwater and groundwater return flows accrue to surface drains or subsurface drains which then daylight in the surface drains.

2. Considerations / Questions:
   a. How is "saved" direct flow water measured back to, bypassed and quantified at the headgate?
   b. Given that the system is typically water long, does the "saved" direct flow water need to be measured back to, and bypassed, at the headgate?


Legend
Scenarios 1 & 2
- 40 acres
- Upstream surface diversion pumped to parcel
- Scenario 1: Year around stream
- Scenario 2: Diversion can "sweep" the stream
Google Earth
N
500 ft


Scenario 3
- 200 acres
- Direct Flow
- Supplemental storage
Legend
Ditch
Scenario 3 parcel
Google Earth
4000 ft
N


Scenario 4
- 50 acres
- Direct Flow
- Supplemental storage
- multiple upstream and downstream users
- down gradient pasture
Legend
Google Earth
Image Landsat / Copernicus
900 ft
N

FINAL

Monitoring and Verification of Trans-Mountain CU Reduction Projects
Demand Management - Monitoring and Verification Workgroup
June 2020

INTRODUCTION

The purpose of this document is to provide a conceptual framework to guide trans-mountain (TM) project participation in a Demand Management (DM) program pursuant to the 2019 Drought Contingency Plan Demand Management Storage Agreement. More detailed hypothetical examples are attached that highlight some of the nuanced details and questions that may need to be addressed to adequately quantify and verify reduced Colorado River basin consumptive use by participating TM projects.

Every TM project is unique. As such, there is not a "one size fits all" solution for the quantification and verification of conserved Colorado River basin consumptive use (CU) within the context of a DM program. Therefore, all proposals for participation in a DM program will need to individually and carefully evaluated.

GUIDING PRINCIPLES

The following, over-arching principles shall guide participation by a trans-mountain project in a DM program.

1. Quantification and Verification must be honest, accurate, and defensible.
2. Participation must be protective of other water users.
3. Participation must result in added water to the system and cannot result in re-timing of Colorado River Basin depletions.
4. Participation must be as simple, easy, and flexible as possible while still meeting the first three principles.

TRANS-MOUNTAIN PROJECT DEFINITION

A trans-mountain (TM) project fundamentally is defined by the existence of delivery infrastructure that conveys water from the Colorado River Basin to a receiving river basin, or basins, not tributary to the Colorado River Basin.

MEASUREMENT OF REDUCED COLORADO RIVER CONSUMPTIVE USE

Quantifying the amount of water that is physically and administratively available and returned to the stream is a cornerstone of monitoring and verification. Quantification of reduced Colorado River CU by TM projects shall be measured as reductions in TM deliveries as compared to deliveries that would have occurred absent participation in a DM program. The volume of reduction in TM deliveries must be equal to the volume of water added to the Colorado River Basin system (DMP water). Credit shall only be given for DMP water that is both physically and administratively available, and can be honestly and accurately quantified using defensible methods. For TM diversions, physical measurement of water returned to the stream through an acceptable weir, gauge, or flow meter is required unless the Division of Water Resources confirms an acceptable alternate method of quantification is available.

Considerations for Direct Flow TM Diversions – Certain TM diversions are of a direct flow nature, i.e. the water is not stored in west slope storage prior to delivery to the receiving basin. In such cases, the participant must quantify the amount of water physically and administratively available, then immediately add the DMP water back to the Colorado River Basin through an appropriate measurement device. The diversion and addition of DMP water to the system is essentially simultaneous, therefore, DMP water can only be added to the system while the TM project is in priority and the foregone diversion could have been beneficially used or stored in the receiving basin

The year in which DMP water is added to the Colorado River Basin by Direct flow TM diversions may result in an equivalent reduction in storage volume and / or CU in the receiving basin. However, the reduced storage volume or CU deficit in the receiving basin cannot result in Direct Flow TM diversions in any year subsequent to DMP participation greater than the diversion that would have been made absent the Direct Flow TM's participation in the DMP (i.e. retiming).

Considerations for Diversions into West Slope Storage prior to TM delivery – Certain systems store water in west slope storage prior to TM delivery to the receiving basin. In such cases, the participant must store the water in priority; however, the DMP water may be added to the Colorado River Basin immediately or held in west slope storage for release at a later date. The timing of the diversion, addition of DMP water to the Colorado River Basin system, and TM deliveries do not necessarily coincide. This will have implications for accounting and verification, as well as the calculation of applicable transit losses and shepherding of the water. However, this can also provide opportunities to coordinate the timing and rate in which DMP water is added to the system to provide additional flow related benefits below the storage and on the Colorado River.

Also, in many systems with west slope storage, there is also a direct flow right on the TM delivery infrastructure. In such cases, there may be complex operations where some TM deliveries to the receiving basin are concurrent with diversion under a direct flow right (with the considerations described in the section above), and some operations in the same system entail diversions into storage with subsequent DMP releases and TM deliveries (with the considerations described in this section). In these complex systems, clear monitoring and verification will be important.

Within the hydrologic year of DMP participation, reduced TM deliveries to the receiving basin by TM systems with West Slope storage must be equal to the volume of DMP water added to the Colorado

River Basin. A reduction in TM deliveries may result in an equivalent reduction in storage volume and / or CU in the receiving basin in the year in which DMP water is added to the Colorado River Basin. Such reduced storage volume or CU deficit in the receiving basin cannot result in TM diversions in any year subsequent to DMP participation greater than the diversion that would have been made absent the TM systems participation in the DMP (i.e. retiming).

VERIFICATION OF REDUCED COLORADO RIVER CONSUMPTIVE USE

To maintain honest, accurate, and defensible measurement and verification of reduced Colorado River CU, each TM participant must provide evidence that the amount of DMP water added to the Colorado River system would have been delivered to the receiving basin "but for" participation in the Demand Management Program. Because of the complex and far reaching water supply, storage, and delivery systems of the TM projects, there is no uniform and clearly defined approach to providing this evidence. Therefore, each participating project must formulate its own approach and present reasonable evidence supporting its "but for" claim for credit. Evidence may consist of quantitative analyses, accounting, narrative descriptions, and other information deemed necessary for honest, accurate, and defensible measurement and verification.

Recommended Information for Verification – There is some basic information that participants should take into consideration when formulating their approach and developing evidence to be presented, including but not limited to:

1. The type of TM diversion (i.e. direct flow, storage and delivery, or complex operations)
2. A description of representative TM project operations, such as:
    a. Timing and amount of diversions
    b. Reservoir levels (if applicable)
    c. Timing and amount of TM deliveries (through tunnel, pipeline, or ditch)
3. The amount, rate, and timing of DMP water
4. The timing and amount of TM deliveries for the project period (absent DMP water), the volume of DMP water, and net TM deliveries
5. The amount and timing of demand or storage capacity in the receiving basin to accommodate the import of the water
6. Identification of the gauges or measurement points to be used for monitoring and verification
7. Any volumetric or other limitations that may apply to the diversion of TM water
8. Any relevant agreements or arrangements that affect delivery of TM waters
9. Identification of reduced east slope consumptive use or replacement of west slope supply with alternative east slope supply, if appropriate
10. Other relevant factors

GENERAL PRINCIPLES APPLICABLE TO ALL TM PARTICIPANTS IN A DMP

1. *Coordination of Benefits* – To the degree practicable, TM DMP water may provide additional non-consumptive and flow related benefits. If applicable, the participant may, but is not

required to, operate the project such that the timing and rate in which DMP water is added to the Colorado River system accommodates other uses and benefits.

2. *Volumetric Limits* – For systems with applicable volumetric limits on TM diversions, all DMP water shall count as diverted and delivered TM water for the sake of calculating and measuring these volumetric limits.
3. *Prevention of injury and Impact* – Participants will coordinate with other water users, interested parties and the Division of Water Resources to assure the timing and rate in which DMP water is added to the Colorado River system does not cause injury or undue impact to users or the natural environment.
4. *No Effect on Water Right* – Participation in this program, and specifically any DMP water and reductions in TM deliveries, shall not have any detrimental effect on the validity or future exercise of any water right used in the DMP program.

ATTACHMENTS - TMD Hypotheticals document

FINAL
TMD Hypothetical Demand Management Examples
Monitoring & Verification Demand Management Workgroup
June 2020

1. **Scenario**: Direct TM diversion (ditch, tunnel, or pipeline) to east slope uses without West Slope (WS) storage
   Project: water legally and physically available at the diversion is returned to the Colorado River system instead of being diverted to the East Slope (ES)
   ES use impacts: less water is available for direct use (i.e. irrigation), storage, or marketing to other users. Shortage results in less ES direct use, replacement with another ES source, or lower reservoir levels (either through drawdown to replace use, or less increase in storage due to less water available).
   Primary Challenge: need to demonstrate forgone diversion is added water to the system
   Considerations:
   - Do you need to demonstrate that previous project operations diverted all water that is legally and physically available each year?
   - Do you need to demonstrate that east slope demand is being reduced or met by other ES sources?
   - Do you need to demonstrate the following year that project operations do not deviate from what would have been done if this project were not in place?
     - Yes, but may be simpler if east slope use is direct use (non-storage)
   - Show east slope storage could have stored the water (if applicable)
   - Volumetric limits need to be paper filled

2. **Scenario**: WS reservoir fills and then empties by deliveries to ES each year
   Project: water stored in the reservoir is released to the Colorado River system instead of the ES. Reservoir empties with some water going to ES and some to WS
   ES use impacts: Tunnel delivers to storage prior to use. Shortage results in less ES use, replacement with another ES source, or lower reservoir levels
   Primary Challenge: need to demonstrate forgone diversion is added water to the system
   Considerations:
   - Do you need to demonstrate that previous project operations diverted all water that is legally and physically available each year?
   - Do you need to demonstrate demand is being reduced, being met by other ES sources, or met by storage releases?
   - Do you need to demonstrate the following year that tunnel operations do not deviate from what would have been done if this project were not in place?
   - What are appropriate considerations to refill the WS reservoir?
   - Other TMDs in system do not divert more water

3. **Scenario**: WS reservoir fills but does not empty each year
   Project: water stored in the reservoir is released to the Colorado River system instead of the ES. The WS reservoir is drawn down to a specific level but some water goes to the ES and some to the WS instead of all water going to the ES
   ES use impacts: Tunnel delivers to storage prior to use. Shortage results in less ES use, replacement with another ES source, or lower reservoir levels.
   Primary Challenge: need to demonstrate forgone diversion is added water to the system
   Considerations:
   - Do you need to demonstrate how much previous project operations would typically divert under similar conditions absent a DM program?
   - Do you need to demonstrate what the WS reservoir storage level would have been absent the DM program?
   - Do you need to demonstrate demand is being reduced, being met by other ES sources, or met by storage releases?
   - Do you need to demonstrate that reduced TM deliveries do not create additional opportunity to divert TM water than would have existed absent the DM Project?
   - Do you need to demonstrate the following year that tunnel operations do not deviate from what would have been done if this project were not in place?
   - What are appropriate considerations to refill the WS reservoir?

4. **Scenario**: Water is delivered from a West Slope reservoir through a transmountain tunnel that also has a direct flow right. The storage and direct flow rights have the same priority date.
   Project: hold reservoir down X acre-feet by bypassing storable or divertible water, or releasing X acre feet of previously stored water
   ES use impacts: Tunnel delivers directly to use, or to storage prior to use. Shortage results in less ES use, replacement with another ES source, or lower reservoir levels.
   Primary Challenge: need to demonstrate forgone reservoir diversion is added water to the system
   Considerations:
   - How do you determine when the reservoir can be re-filled if there is no paper fill?
   - Do you have to paper fill the storage account?
   - Do you need to demonstrate additional water was not diverted under the direct flow right (i.e., did not take more through the tunnel than you would have if it were not for the Demand Management project)? If so, what are ways to prove “standard” operations?
   - What happens if reservoir spills or does not historically fill?

5. **Scenario**: Water is delivered from West Slope reservoir reservoir through a transmountain tunnel that also has a direct flow right. The storage and direct flow rights have the same priority date.
   Project: forego diversion under the direct flow right at the tunnel.
   ES use impacts: Tunnel delivers directly to use, or to storage prior to use. Shortage results in less ES use, replacement with another ES source, or lower reservoir levels.
   Primary Challenge: need to demonstrate forgone diversion is added water to the system
   Considerations:
   - Do you need to prove the foregone tunnel diversion could have been beneficially used or stored?
   - If the foregone diversion is not tied to a reduced demand, do you need to demonstrate how the demand was met?
   - Alternatively, could you tie the foregone diversion to a reduced demand to prove it is added water to the system?

6. **Scenario**: East Slope reservoir does not empty every year.
   Project: water stored in the reservoir is used to meet demand that would have been met with imported CO River water.
   Primary Challenge: need to demonstrate forgone diversion is added water to the system
   Considerations:
   - Do you need to demonstrate demand is being met by storage releases and, therefore, less water is brought through the tunnel?
   - Do you need to demonstrate the following year that tunnel operations do not deviate from what would have been done if this project were not in place?
   - Identify conditions in which water could be released from the East Slope reservoir.
   - What are appropriate considerations to refill the reservoir?

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #1 **Date:** September 10, 2019

Meeting Topics:

Agenda topics included: background on demand management and drought contingency planning; process and expectations of the work groups; initial issue identification; and public comment.

The group spent the majority of the meeting listening to presentations on System Conservation Pilot Program (SCPP) projects, monitoring and verification of the SCPP projects, and methods to estimate agricultural consumptive use.

Key Take Aways:

The SCPP projects offer baseline guidance of how monitoring and verification can be performed for temporary fallowing projects. Very little municipal participation in the program resulted in little guidance on non-agricultural monitoring and verification.

The group discussed the challenge of monitoring and verification for trans-basin diversions (TBDs), noting that the foregone West Slope diversion, consideration of storage, reduction in consumptive use, tracking of supply, and already planned conservation all are considerations for monitoring and verification of potential Front Range municipal participants.

The group expressed an interest in simplifying agricultural participation with streamlined methods of determining historic consumptive use (HCU) and operating the projects.

Questions/Concerns to Raise:

The group identified some threshold questions and issues to consider going forward, including:

- How flexible will the program be with complex projects? i.e. fallowing, split-season irrigation, alternative crop-typing, etc.
- How will maintenance of historical return flow patterns be handled? In which areas of the Colorado River basin is this an important consideration?

Additional technical, informational other needs:

The group discussed utilization of a contractor to perform a literature review. The group also discussed a desire for more detailed discussion of possible trans-basin/municipal considerations and participation in a demand management program.

Other:

No public comments were heard during the first meeting. The group will meet next on October 31 from 10am-2pm in Summit County.

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #2 **Date:** October 31, 2019

Meeting Topics:

Agenda topics included: report from other workgroups, including "parking lot" issues; discussion of scenario planning and its applicability to the monitoring and verification workgroup; a small group exercise to identify types of projects, mechanics, and monitoring and verification issues associated with both agricultural and municipal and industrial (M&I) projects; and a discussion of guidance for a consultant to be hired for this workgroup.

The group spent the majority of the meeting in the two small workgroups alternating between discussion of agricultural and M&I projects.

Key Take Aways:

Agricultural projects will need to be considered differently depending on project type (full fallowing, split-season/deficit irrigation, crop changing, etc.) but there are many templates of projects with monitoring and verification for estimating conserved CU. Kelley Thompson will develop a draft rubric that guides monitoring and verification based on project type, quantifies conserved consumptive use to the satisfaction of other Colorado River Basin states, and protects other intra-state water rights from injury.

Trans-basin M&I projects may come in many forms, but ultimately the measure of conserved consumptive use will need to occur at the trans-basin diversions. This will need to involve considering the entire system operations of the project participant (reservoir storage, other supplies, volumetric limits, etc.).

Augmentation stations may be critical for measurement of physical supply for agricultural projects. They are currently uncommon on the West Slope and may prove to be a financial barrier.

The application process should offer guidance, but not mandates for monitoring and verification. Templates for possible application/approval processes include the SWSP process and the HB-1248 process.

Questions/Concerns to Raise:

The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- Are crop switching projects feasible?
- Who will evaluate project proposals? SEO? CWCB? Committee?
- What are the economic impacts of requiring augmentation stations for agricultural projects?
- Do East Slope projects need to prove and monitor consumptive use reduction or just reduction at tunnel?

Additional technical, informational other needs:

Kelley Thompson will forward the SWIIM newsletter and Brian Macpherson will try to obtain an OpenET powerpoint presentation for review at the next meeting.

Other:

No public comments were heard during the second meeting. The group will meet next on February 10 from 10am-2pm in Salida.

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #3 **Date:** February 10, 2020

Meeting Topics: Agenda topics included: report from other workgroups and the regional workshop, including "parking lot" issues; discussion about the upcoming RFP selection and desires from the group for the contractor; planning for the upcoming joint IBCC meeting and joint workgroup meeting. Brian Macpherson gave an OpenET presentation with slides provided by the OpenET team. Kelley Thompson gave a presentation on draft considerations for irrigation demand management project monitoring and verification.

Key Take Aways: Additional outreach to the agricultural community is needed relating to demand management. The Colorado Ag Water Alliance (CAWA) may be a good forum to reach producers.

OpenET, and more generally remote sensing based ET measurement, is perhaps best applied for deficit irrigation projects or end of season validation, and not for a historic consumptive use analysis or for real-time monitoring of conserved consumptive use.

There will be a balance and tradeoffs between accuracy and transaction cost for monitoring and verification of demand management projects. Conservative safety factors may be employed to reduce cost and risk of injury to other water users.

The requirement of an augmentation station for measurement of conserved consumptive use is site-specific. In areas of abundant flow, it may not be necessary.

For the length of the HCU analysis, there was uncertainty if a long period of record similar to change case should be used, or if a short period of record better captures the foregone CU.

Lagged return flow obligations (RFOs) may be repaid with on-farm recharge ponds (which are expensive to construct and operate) or with reservoir storage filled via exchange or lease of reservoir water.

The group would like the consultant to perform a literature review on change cases, organized by region and attribute (crop type, whole ditch vs. partial ditch, elevation band, etc.)

Questions/Concerns to Raise: The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- Is there opportunity for regional opportunities for reservoir releases to pay RFOs?
- Who will approve M&V project plans? Advisory Group? DWR? Who will be responsible for performing M&V? The State? The Applicant?

Additional technical, informational other needs: Workgroup members agreed to do additional research on monitoring and verification considerations.

Other: No public comments were heard during the third meeting. The group will meet next on March 30 from 10am-2pm in Silverthorne.

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #4 **Date:** March 5, 2020

Meeting Topics: Agenda topics included: summary from joint Demand Management - IBCC meeting the previous day; large group scenario planning exercise; Monitoring & Verification individual meeting to identify top priorities and uncertainties; joint meeting with Agricultural Impacts workgroup; joint meeting with Administration and Accounting workgroup.

Key Take Aways: There were many overlapping issues between the two workgroups the M&V group met with. Agreed upon issues with the agricultural impacts workgroup included: the need for sideboards and differentiation of M&V needs depending on project type (high elevation pasture, full and partial fallow, crop switching, M&I, TMDs, etc.); the balance between accuracy and administrative cost of M&V; the responsibilities of the contractor and contractee regarding M&V, infrastructure, and quantification/payment of water volume; the balance of defensible, honest, and accurate M&V with simplicity; the desire to measure "wet water" and not "paper water"; the importance of maintaining return flow patterns where there is injury potential and the need to simplify and pool resources (regional reservoir releases, etc.); the desire for a "straw man" project to work through.

Agreed upon issues with the administration and accounting workgroup included: the need for a simple process that avoids water court; the balance between accuracy of M&V and simplicity, possibly using conservative safety factors; the possibility of using the Lease Fallow Pilot Project approval model (CWCB authority by statute, conservativeness through the criterion guidelines, SEO approval); the importance of maintaining RFOs in key geographic areas and the desire to pool resources; the need to group geographic and sector areas for streamlining of study and guidance; the need for transparency and understanding that there will be uncertainty in the process.

Uncertainties raised in both the individual meeting and the joint meetings included: Who evaluates project proposals? Is Compact Water a legal use? Does it need adjudication by Water Court? Is there a minimum project size for efficiency of administration? Does application from one producer require a ditch-wide analysis? Does Colorado need to scrutinize other Upper Basin state programs? Is a "lowest common denominator" approach required in the Upper Basin in terms of data availability?

Questions/Concerns to Raise: The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- Can the Lit Review identify West Slope reservoirs with decreed augmentation supply (for possible lease/pooling of RFO replacement)?

Additional technical, informational other needs: Workgroup members agreed to do additional research on monitoring and verification considerations.

Other: No public comments were heard during the fourth meeting. The group will meet next on March 30 from 10am-2pm in Silverthorne (re-scheduled as web meeting).

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #6 **Date:** April 24, 2020

Meeting Topics: Agenda topics included: introductions and updates from other workgroups and contractor; additional discussion about monitoring and verification of transmountain diversion projects; special considerations for municipal and industrial monitoring and verification; special considerations for well use participation; initial discussion about creation of hypothetical scenarios; and discussion of next steps.

Key Take Aways: There is uncertainty in the group whether transmountain diversion projects need an identified water reduction project or specified replacement source or if accounting at the tunnel is adequate for monitoring and verification; well user participation will need to consider lagged depletions, but should otherwise be treated like a surface diverter in terms of monitoring and verification; there is uncertainty whether moving up the schedule of a municipal conservation project (e.g. turf replacement) constitutes "temporary" and how long credit should be given for; there is uncertainty whether municipalities issuing watering restrictions to create demand management water would be "voluntary" for municipal customers; West Slope municipal participation in the program will be straightforward, but monitoring and verification will likely be costly because water reduction will have to be on a small scale (e.g. turf replacement); any hypotheticals considered should consider input from one or more large municipalities, System Conservation Pilot Program (SCPP) projects, and Irrigators of the Lands in the Vicinity of Kremmling (ILVK) projects.

Questions/Concerns to Raise: The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- Would transmountain project applicants be required to identify a specific conservation project or replacement source of non-Colorado River water? Either at the time of application or at the time of credit?
- Would a municipality imposing drought restrictions in order to conserve consumptive use violate the voluntary condition of demand management for water customers?
- How long would credit be given for a municipality fast-tracking a conservation, reuse, or other project where water savings are applied to DM for the approved period?

Additional technical, informational, or other needs: Workgroup members agreed to do additional reporting on monitoring and verification considerations, including for transmountain diversion projects, hypothetical projects, and for existing streamlined tools.

Other: One public comment was heard during the sixth meeting. The group will meet next on May 15 from 9am-12:30pm via web meeting.

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #7 **Date:** May 15, 2020

Meeting Topics: Agenda topics included: introductions and updates from other workgroups and contractor SGM; reminders about final deliverables and need for framing uncertainties; additional discussion about monitoring and verification of transmountain diversion (TMD) projects; hypothetical scenarios of TMD projects; and discussion of next steps.

Key Take Aways: The workgroup does not need to reach consensus on all topics and instead need to frame the issues for the Board; identifying uncertainties is a key task; the Project Management Team will likely develop a summary document with several workgroup work products as attachments. The contractor was introduced to the group and discussed the tasks identified for them to accomplish. A discussion was held regarding the TMD document and several issues were identified such as how to identify "representative" operations, how to prevent re-timing of TMDs through double book accounting, and the importance of considering each TMD system separately. A document of TMD hypothetical scenarios was discussed which included the scenario, project, east slope use impacts, primary challenges, and monitoring and verification (M&V) considerations.

Questions/Concerns to Raise: The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- When comparing demand management operations to "representative" or "typical" operations, how do you quantify those operations?
- For TMD projects, if "double books" are kept with accounting using demand management operations and hypothetical accounting using non-demand management operations (to prove non-retiming), how long and to what level of detail would this accounting be kept?
- Is there a way to prove non-retiming for a TMD projects besides 1) Proving reduction in consumptive use on the East Slope, 2) Providing an East Slope replacement supply, or 3) paper filling volumetric limits that do result in curtailment of physical and legal supply (i.e. volumetric limits are typically hit)?

Additional technical, informational, or other needs: Workgroup members agreed to do additional reporting on monitoring and verification considerations, including for agricultural hypothetical scenarios, use of streamlined state tools for agricultural hypothetical scenarios, and for creation of the workgroup summary document.

Other: Two public comments were heard during the seventh meeting. The group will meet next on June 1 from 9am-12:30pm via web meeting.

Work Group Meeting Report Out

Work Group: Monitoring and Verification Meeting #8 **Date:** June 1, 2020

Meeting Topics: Agenda topics included: introductions and updates from other workgroups and contractor SGM; additional discussion about transmountain diversion (TMD) project document; Lease Fallow Tool and ET datasets demonstration and presentation; discussion about agricultural hypotheticals document; group wrap up and discussion of final deliverables and Board presentation.

Key Take Aways: The uniqueness of Colorado's TMD projects was reiterated, making rules of thumb for monitoring and verification (M&V) difficult. The M&V document was re-written to convey more general principles that project participants would need to prove in their project proposals. A presentation was made on one of the State's tools (the Lease Fallow Tool) to assess historic consumptive use (HCU) for irrigated parcels. A presentation was also made on the State's future climate and ET dataset using the Penman Monteith equation. Agricultural hypotheticals were considered and discussed. For verification and maintenance of return flows, the importance of augmentation stations (or alternative measurement) and on-farm recharge to replicate return flow timing was discussed. Non-use of these two pieces of infrastructure is possible but would require project participants to describe how injury will be avoided. The use of remote sensing and/or monitoring wells was also discussed to quantify levels of sub-irrigation to be subtracted from conserved consumptive use. The importance of maintaining river flow for environmental purposes, whenever possible, was discussed, as well as other ways to provide multiple benefits to various stakeholders.

Questions/Concerns to Raise: The group identified some "parking lot" questions and issues for other groups to consider, including but not limited to:

- How will injury be evaluated with respect to return flows?
- Is the concept of "foregone consumptive use" an acceptable alternative to "historic consumptive use"?

Additional technical, informational, or other needs: Workgroup members will review all deliverable documents and make suggestions for final deliverables and Board presentation.

Other: Three public comments were heard during the eighth meeting. This was the final workgroup meeting.

Attachment J

Water Rights Administration and Accounting Workgroup Documents:

1. Summary
2. Reports

Demand Management Issues – Administration and Accounting Work Group 2019*

Tasks:

- **Generate list of key issues identified related to administration and accounting of a potential demand management program that you believe require additional analysis and why.**

- **Identify mechanisms to perform this additional analysis (Eg literature review, pilot, studies, modeling) and a brief summary of each**.

1. What is the appropriate process for changing the use of a water right from its current use to demand management?

There have been many important administrative and accounting issues identified though our meetings over the past few months. Additionally, we have analyzed the existing administrative statutory programs that could effectuate, even in part, the goals of the demand management program.

- Can these issues be resolved through a single statutory program that can entirely allow the implementation of the demand management program?
- Is one of the biggest issues and hurdles the lack of a specific and clearly defined statutory program to implement the demand management program?
- Is it detrimental to try to rely on piecemealing of existing statutory programs and could this lead to conflicts and unnecessary delays?
- If so, is there is need for legislative action to specifically implement a pilot demand management program that could ultimately evolve into a permanent program if the pilot program proves successful?
- Would the appropriate process need to include the following features?
    - Administrative, rather than judicial, review and approval of the proposed change of use of to demand management;
    - A requirement that the change of use not result in injury to other water rights;
    - An opportunity for other water rights holders to participate to in the review process to assure they are protected against injury;
    - The requirement that the Division of Water Resources be allowed to shepherd water changed to demand management use past upstream or downstream diversions, provided that no injury results;
    - Protection of the water right to be used for demand management against abandonment or loss of consumptive use credit.
- Could a process for changing the use of a water right to demand management might be modeled after one or more of Colorado's existing ATM mechanisms but still be established by new legislation?

* This summary reflects only the thoughts and opinions of various Work Group members and is not an endorsement by the State of Colorado.

2. Is "demand management" a beneficial use of water?

When necessary to increase water deliveries in order to accomplish a compact compliance purpose, CRS 37-80-104 allows a Colorado State Engineer to curtail existing uses pursuant to rules and regulations.

- Could this be extended to a Demand Management Agreement, through voluntary and temporary relinquishment of existing water rights to accomplish the same objective?
- Are these actions relinquishments and therefore at risk of appropriation by other in-state water users unless such rights are changed to include "demand management" as a type of use? See also CRS 37-81-101 to 104.
- Unless recognized by intervening downstream States, will such flows be intercepted by their water users prior to reaching the intended destination?
- Can resolution of this question be achieved through passage of legislation that establishes that "demand management" is a beneficial use with certain limitations?
- Should there be other limitations on demand management as a beneficial use including but not limited to a volumetric limitation on the amount of water that can be used for demand management, in order to assure that Colorado does not over-participate in a demand management program?
- Similarly, could proportionality concepts also be worked into the limitations of demand management as a beneficial use, so that different water use sectors and regions of the state share proportionally in demand management?
- Is an appropriate means of providing the necessary protections for such voluntarily relinquished water rights in Colorado to have the legislature recognize "demand management" as a beneficial use and to provide procedures to allow existing water rights to be changed to include this type of use, similar to Water Rights Protection water rights concept as was established through HB16-1228?
- Will water rights changed to include demand management need to include rights to be stored and stored by exchange?
- Does CRS 37-81-101(2) preclude the possibility of utilizing a temporary change of water right of the type authorized by CRS 37-92-308 (4) and (5), et.al., in order to effect a change which would result in the use of an existing water right in another state? Could the legislature further expand the authority of the state to provide an exception to the change procedure specified in this statute?
- What other options are available to protect water previously decreed for another use and not be diverted and allow it to be "shepherded" to another point of diversion?
- What mechanism needs to be in place to move this water past other likely senior water rights (diversions)? Additional conversations with the Law and Policy Group are warranted.

The Colorado Water Conservation Board's Support and Policy Statements dated November 15, 2018 states: "Demand management activities that could be promoted in Colorado … would likely involve intentionally reducing consumptive uses from the Colorado River System and storing the conserved water at the Initial Units to help assure the Upper Basin's continued compact compliance."

- Does this encompass not only the beneficial consumptive use that typically defines the measure of a water right but also water salvaged from non-beneficial uses,

waters authorized for transmountain diversion from the Colorado River Basin but intentionally not diverted in order to accomplish non-consumptive purposes and potentially, water released from storage for purposes other than that for which it was originally appropriated, in order to meet some temporally specific compact purpose?
- Is there interest in researching any of these alternative types of water which might be applied to demand management purposes in connection with the Demand Management Agreement?
- Depending on how the Conservation Board answers the previous question in the affirmative, then does the statutory definition of changes of water right to include demand management purposes should recognize that applicants may be permitted to claim reduced historical non-beneficial uses as well as foregone beneficial uses in the quantification of the changed rights.

3. Who has the authority to secure this water for a beneficial use?

Typically, water is administered at the direction of a water right owner pursuant to a decree or in response to the terms of a various types of administratively approved plans originated and proposed by an applicant.

- In the case of a Demand Management operation which ostensibly will accomplish a public demand management objective, it is unclear who or what entity is authorized to contract with the owner of a water right that has been changed to demand management uses and to initiate a Demand Management operation in concert with a legitimately devised compact compliance strategy.
- Also, if such operations will likely involve the exchange of water into one of the Initial Units or other reservoirs, which entity should establish appropriative rights of exchange and storage to facilitate these operations?
- Should Colorado's representative to the Upper Colorado River Compact Commission in consultation with the Colorado Water Conservation Board have authority to devise any alternative compact compliance strategy involving a demand management operation and to initiate it through the auspices of the Colorado State Engineer?
- Is the Colorado Water Conservation Board the appropriate entity to receive legislative authorization to hold exclusive rights to appropriative rights of exchange and storage in connection with a demand management operation in order to protect the public purpose of demand management?
- Because compact compliance is a state obligation, should the beneficial use of water for demand management should be limited to the CWCB, in the same way that the use of water for instream flow is limited to the CWCB?
- Does the CWCB need to work in cooperation with DWR and what are the consequences of allowing private ownership? In looking at how this has been addressed in the Rio Grande, they have determined that having private water rights held in storage out of the state is not something that was found to work there.
- Once a water right is changed to include "demand management" as a type of use, should the Colorado Water Conservation Board accept the responsibility of ensuring that a mechanism exists and is accepted by each state so that the amount of water so diverted or appropriated and transported through or into such other state or

states is credited as a delivery to such other state or states by Colorado, of water to which such other state or states may be or claim to be entitled from such interstate source under an existing interstate compact? (See CRS 37-81-103.)

- Regardless of the entity or venue which may be authorized to approve any change of water right to include demand management as a type of use, should the legislature recognize terms and conditions as legitimate, which require the owner of such a changed right to forego their constitutional right to appropriate unappropriated waters of the state which may be available in order to accomplish the same purposes as those historically met by the changed right, so that the Compact compliance objective of the changed right is not frustrated?

4. How would storage and administration and accounting for such storage in the Aspinall Unit pursuant to the DMSA be accomplished?

- Would storage of demand management water in the Aspinall Unit result in significant changes in operations of the unit?
- How would this be accounted for?
- Would this require NEPA or consultation under the ESA?
- Will resolution of these questions require legal analysis and reservoir modeling?
- Would a pilot project inform these issues?
- In river basins other than the Gunnison, where we do not have CRSPA storage facilities, how will demand management be accomplished?
- Is storage a requirement for demand management to function, or can demand management be operated on a direct flow basis?
- If storage is a requirement, are there reservoirs that could be used for this purpose, both legally and physically (their decrees allow it and capacity is available)?
- If storage is to be permitted in reservoirs other than the Aspinall Unit, how can accounting for this water be achieved?
- Does the Rio Grande basin offer guidance as to the complexities of this exercise? For example, as to curtailing diversion upstream to deliver a quantity of water downstream?
- Does this raise other issues, including trust in the administration and challenges to their daily decisions?
- Do the water users in the Rio Grande have valuable experience that could offer some insight to the other challenges as well?
- How will ensuring historical return flows be achieved? Will this depend upon existing analysis and available data?
- How will transit losses be assessed on waters routed within the State's waterways for demand management purposes?
- Does this necessitate promulgation of rules by the State Engineer under existing Compact Rule making authority to establish reasonable transit losses or procedures to be used to establish such losses to be applied to the yield of demand management water right released from Initial Unit, within Colorado?
- To the extent possible, should such rules follow procedures to be used by other Upper Division States which describe how transit losses will be determined and applied to the yield of demand management water rights released from Initial Units?

- Should rules be subject to the approval of the Upper Colorado River Commission under the Demand Management Storage Agreement or an amendment thereto?

5. Mechanisms for Further Analysis

- Can the work of the various workgroups could be relied upon to inform the development of a robust program that should be led by DWR and CWCB with legal guidance from the AGO? These agencies have a proven track record to develop effective programs that are centered on scientific and legal investigation and historical administrative experience.
- Could the CWCB direct CWCB staff to work with the SEO and AGO staffs to initiate a dialog with the Legislative Water Resources Review Committee this summer and fall to hopefully gain support of proposed legislation that could implement a pilot demand management program that could realistically start in 2021?
- Is this a priority because it seems time is of essence?
- Does this proposed process allow time for input from other agencies like the AGO on legal issues that have been raised (e.g., whether "demand management" is a beneficial use) and federal agencies like BOR on potential use and operation of federal reservoirs for storing demand management water?
- Could several of the administrative and legal issues raised (and others that are identified in the other workgroups) be addressed in legislation?
- Could a specific pilot program be effective in gathering important data and statistics regarding important issues like environmental, agricultural and economic impacts and creates a potential funding mechanism to implement the pilot program and to provide for continued education and outreach.
- Could the need for any specific rulemaking to implement the program can also be addressed in legislation?
- Would a successful pilot program employ a defined engagement of our sister Upper Basin states to address interstate issues of implementing each state's specific demand management program in meeting the collective goals of the DCP?

Administration and Accounting Work Group Meeting Summary

Work Group: Administration and Accounting Work Group Meeting #1 **Date:** November 18, 2019

Meeting Topics:

Agenda topics included: a presentation from Cleave Simpson from the Rio Grand Water Conservation District regarding compact compliance and demand management activities currently occurring in the San Luis Valley; a group discussion of issues and challenges RGWCD faces with those efforts; a discussion of lessons learned and some key takeaways from the SCPP; issue identification related to the administration and accounting of conserved water created as a result of a potential demand management program in Colorado; and a discussion of whether or not there are administration and accounting parallels between the statutes and processes governing ATMs in Colorado and a potential demand management program.

Key Take Aways:

That there have been challenges with sufficient levels of participation in the Rio Grande Water Conservation District's conservation/fallowing program. Also, a program that is voluntary and compensated has not resulted in sufficient levels of water user engagement. Demand Management as provided for in the DCP may not be the same as the approach taken in the compact compliance approach. Is demand management administered and accounted for by reducing consumption or increasing flows?

That the process applied when considering how to account for and administer water rights that are participating in a potential demand management program will need to be examined. Water users are accustomed to a water court model that authorizes administration of the water right. Would this be utilized? If not, what processes would be implemented to facilitate the accounting and administration of the water rights? Would that process need to be the same or similar to those processes applied in the other Upper Basin States, by the UCRC, by the Lower Basin?

Compact compliance is a state obligation. What type of beneficial use would the participating water rights be administered for? What process would be applied for the measurement of the conserved consumptive use? What would the timeframe be? A representative period? Some time frame similar to that used in the Lower Basin for their ICS? Limited to the year in which the conservation occurs? Other? Would this need to be the same timeframe for all the Upper Basin States?

The Group discussed the ATM program and whether there would be parallels or lessons that could be learned and/applied from a deeper examination of the ATM program, the related statutes, polices, regulations and implementation issues.

Additional technical, informational other needs:

For the next meeting, the group may further consider parallels with the ATM program and further identify issues related to the need for statutory fixes as to potential new beneficial uses and consideration of processes related to administration and accounting of water rights in relation to the Aspinall Unit.

Other: No public comments were heard during the first meeting.

Administration and Accounting Work Group Meeting Summary

Work Group: Administration and Accounting Work Group Meeting #2 **Date:** February 10, 2020

Meeting Topics:

Agenda topics included: a presentation by Alex Funk from the CWCB regarding Alternative Transfer Methods ("ATMs"); a discussion of benefits, issues and challenges associated with the use of ATMs; a discussion of how the structure and implementation of ATMs might be applied to the administration and accounting of conserved water created as a result of a potential demand management program in Colorado; and what questions this Group would like to pose to other Work Groups.

Key Take Aways:

A brief summary was provided of the State Engineer's presentation on Compact Administration in the Colorado River Basin and the Second Regional Demand Management Workshop that occurred at the January meeting of the Colorado Water Congress.

That there are numerous methods that have been authorized by state statute to create flexibility in moving water between agricultural and urban uses with a mix of water court and DWR involvement and pilots for each to analyze impacts. The State Water Plan directed further investigation and development of ATMs and recognized that the practice of permanent transfers from agriculture to municipalities aka "buy and dry" could not continue. While ATMs are not defined by the Water Plan, guidelines are provided.

One example occurs in the Rio Grande basin and involves split-season fallowing. In one instance, an irrigator agreed to fallow in the first part of the season and irrigate during the latter part of the season. The program required mimicking return flows and keeping the ditch whole for other users. The price per acre foot was almost doubled to induce the irrigator to participate.

That despite the variety of options, ATMs are little used. CWCB has plans to examine the reasons for this in 2020 and determine next steps. That the lack of participation could stem from the fact that because of their temporary nature, they are perceived as creating uncertainty and not worth the time, expense and effort for the irrigator. That municipalities are willing to participate but that they require certainty as to their water supplies. That ATMs that include a water court component create greater security.

That elements of existing statutes authorizing ATMs could potentially be applied to a demand management program but issues and challenges exist with each. Questions arose in the context of the water conservation and agricultural protections statutes and whether there is a need for participants to obtain a change of water right for compact compliance and whether these processes afford opportunities for increasing operational efficiencies for participants. Additional questions identified related to how such a beneficial use would be administered in relation to free river conditions and how the administration of conserved water would occur to the state line. The Group expressed a desire to reach out to the Law and Policy and Monitoring and Verification Work Groups on intersecting elements of these issues.

Additional technical, informational other needs:

For the next meeting, the Group may further consider parallels with the work of the Law and Policy and Monitoring and Verification Work Groups and further identify issues and challenges related to administration and accounting issues based on the type and location of participating water users, the amount of water to be conserved and mechanisms to administer and account for conserved water in relation to the Initial Units and accepted accounting practices within Colorado and throughout the Upper and Lower basins.

O**ther:** No public comments were heard during this meeting.

Administration and Accounting Work Group Meeting Summary

Work Group: Administration and Accounting Work Group Meeting #3 **Date:** April 16, 2020

Meeting Topics:
Agenda topics included: a review of the topics discussed, and issues identified at the IBCC/CWCB meeting held March 5, 2020. The Work Group had an opportunity to benefit from the cross-over meetings with the Law and Policy and Monitoring and Verification Work Groups. The Work Group then analyzed several hypotheticals related to administration and accounting resulting from various water rights that would participate in a potential Demand Management Program.

Key Take Aways:
A brief summary from the IBCC/CWCB Meeting held on March 4-5, 2020 was provided. The Work Group felt some topics applied and other did not. Of those that applied, the Group modified. Discussion included but was not limited to (a) Upper Division States in relation to Colorado's pool and what the target amount would need to be; (b) amount of DM participants modified to the number of structures and volume of water required; (c) acute or chronic: storage of small amounts of water over a longer period of time and/or develop a program that could acquire large amounts of water over short period of time; (d) reservoir storage options limited to storage in the initial units (Aspinall) or consideration of other reservoirs. Other factors considered: (i) hydrology (ii) being able to exchange water to Navajo or Flaming Gorge (UCRC purview); and (iii) compact compliance as a beneficial use.

The remainder of the meeting was spent discussing various hypotheticals related to administration and accounting matters as to demand management. The hypotheticals were not intended to advance any particular position but to think through elements of various on-the-ground scenarios. The Work Group was tasked with analyzing several water administration scenarios that included different combinations of factors including but not limited to the type of water right owner, the type of use, and priority date of the water right, in order to identify issues associated with each scenario and of those issues, those that the Work Group believed were in need of further analysis to include in the Report to the CWCB Board.

Additional technical, informational other needs:
For the next meeting, the Group will further consider the administration and accounting issues and challenges presented in the hypotheticals based on the type and location of participating water users, the amount of water to be conserved and mechanisms to administer and account for conserved water in relation to the Initial Units and accepted accounting practices within Colorado and throughout the Upper and Lower basins.

O**ther:** Public comments were heard during this meeting including concern at the complexity of the issues related to the administration and accounting for a potential demand management program. The group is scheduled to meet via video conference for the final meeting on May 18, 2020.

Administration and Accounting Work Group Meeting Summary

Work Group: Administration and Accounting Work Group Meeting #4 **Date:** May 18, 2020

Meeting Topics:
Agenda topics included: a review of the hypotheticals discussed at the April 16, 2020 Work Group Meeting and issues identified. The Work Group then reviewed Members' lists of identified issues, priorities and proposed methods for additional analysis of those issues as the next step in the feasibility investigation as to a potential Demand management Program.

Key Take Aways:
Discussion included but was not limited to (a) whether or not there is a need for "compact compliance" as a recognized beneficial use; (b) Which entities could or should utilize water for this purpose and who manages such a program; (c) accounting challenges associated with tracking water to be used for this purpose and how it is colored; (d) how to administer these water rights in relation to the available Initial Unit and questions related to NEPA; (e) how to avoid injury to water rights; (f) elements associated with administrative and judicial mechanisms and how to allow for due process; (g) how to calculate conserved consumptive use and safeguard against abandonment or loss of consumptive use credit; and (h) how to balance efficiency of deliveries with the need for equity.

Next Steps:
A brief overview was provided as to various logistics for compiling the report summarizing this first phase of the demand management feasibility investigation and timelines to provide a draft to the CWCB Board in time for the July CWCB Board Meeting and a Demand Management Workshop with the CWCB Board to be scheduled in August. Additionally, the benefits of some type of pilot project was discussed.

O**ther:** Public comments were heard during this meeting including mention of other proposed plans for fallowing lands served by the Colorado River, the federalization of the Upper Basin and concern as to risks to water rights placed to beneficial use at the time the 1922 Compact was ratified.

Attachment K

Summary of IBCC Discussions regarding Equity

Summary of IBCC Discussions Surrounding Equity in Demand Management

Background:

As defined in the CWCB Board-approved 2019 Work Plan for Demand Management Feasibility Investigations (Work Plan), eight Demand Management (DM) Workgroups were established to explore key DM-related topics for Fiscal Year 2019/2020 including: 1) Agricultural Impacts 2) Economic Impacts and Local Government, 3)Education and Outreach, 4) Environmental Considerations, 5) Funding, 6) Law & Policy, , 7) Monitoring and Verification, 8)Water Rights Administration and Accounting. The work plan further directed that the concept of equity be considered throughout the feasibility investigation.

Although it had been discussed in almost all of the workgroups, the concept of equity, defined here as "sense of fairness," was not specifically being addressed by any one workgroup, though it has been a topic of discussion for many of the workgroups. In 2019, CWCB coordinated with the Interbasin Compact Committee (IBCC) to explore the concept of equity – effectively having IBCC act as an additional, de facto DM workgroup, looking at the equity issue specifically. The DM workgroup and IBCC discussions were still being formulated (formally starting in August 2019) by the July 2019 CWCB board meeting - a joint meeting with IBCC. In order to match the DM workgroup timeline and to have input included in the forthcoming July 2020 CWCB board meeting memo packet, IBCC's October (2019), March and June (2020) meetings included time to discuss DM equity. There is also one IBCC member on all but one of the eight DM workgroups.

CWCB Board Process, Policy & Stakeholder Input:

The work done pursuant to the FY 2019/2020 Work Plan, including IBCC input on equity, will be delivered to the CWCB board consistent with the CWCB Board's *Demand Management Policy Statement* which was adopted by the CWCB Board in November 2018. Three key elements of the CWCB policy statement should be noted as they relate to IBCC's DM equity discussion. They include the board's stated policy to:

- "Develop the state's position and approach on whether and how to develop any Upper Basin Demand Management Program that could potentially be implemented within Colorado consistent with state law to avoid or mitigate the risk of involuntary compact curtailment and to enhance certainty and security in the Colorado River water supply."

- "Prioritize avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders. The Board will work with water rights holders and stakeholders to assess the feasibility of and promote mechanisms for obtaining roughly proportionate contributions of water consumptively used from the Colorado River System to a Demand Management program over a given timeframe from participants on each side of the Continental Divide."

- "Investigate voluntary, temporary, and compensated reductions in consumptive use of waters that otherwise would deplete the flow of the Upper Colorado River System for the specific purpose of helping assure compact compliance. Consistent with the Upper Basin Demand Management Storage agreement, the Board may also join the UCRC and other Upper Basin States in any evaluation of importing of waters from outside the natural Colorado River watershed to augment the Upper Colorado River System for compact compliance purposes."

Lastly, it should be noted that while IBCC and the workgroups are providing their input to the board, neither the workgroups nor the IBCC are making recommendations to the CWCB Board. Rather, these inputs and considerations help broaden and frame the public discussion around issues the CWCB Board should be aware of.

IBCC Discussion Summary Overview & CWCB Board Request

The following represents a summary of IBCC's last three meetings where DM equity was discussed and this document is only meant to capture the main discussion points from those meetings. Broadly, the IBCC has acknowledged that a DM program that shares the burden across Colorado may create greater opportunities for equity than curtailment. Unlike curtailment, the concept of a DM program could be used to develop more equitable solutions for mitigating risks by providing Colorado with choices and flexibility that serve to mitigate risks.

At the same time, risk tolerance may be different across the state. This is the central challenge, and this summary does not presume to have solved it nor should it be taken to mean or otherwise imply that IBCC has reached consensus on the topic of DM equity. It has not. This is because some IBCC members did not feel they had the time to fully explore hypotheticals or scenarios that may have allowed them to reach consensus, noting that at this initial stage in the feasibility investigation, it was difficult to speak in concrete terms about what equity may mean. To that end, the IBCC would like the CWCB Board to consider how to continue engaging IBCC in a meaningful way on the important issue of equity.

IBCC Discussion Summary to Date

The IBCC talked about DM equity issues at the October 23, 2019 IBCC meeting, the March 4, 2020 IBCC meeting, the combined and March 5, 2020 IBCC & DM Workgroup Meeting, and the June 17, 2020 IBCC meetings. The latter will be posted to the CWCB's website when the minutes are available. For reference, the DM Workgroup March 2020 Joint IBCC & Demand Management Report is also linked here. The IBCC summary is meant to capture the major pieces of those discussions while recognizing that IBCC has not reached a consensus direction (as noted in the section above).

In tackling the issues of DM equity, conversations have centered largely on two things:
1. How to define "equity" and,
2. Whether it is possible to create an equitable DM program.

Broadly defined as a sense of fairness, IBCC has been keen to point out that equity is in the eye of the beholder or "what is fair to *me.*" In other words, if a DM program were to be established it would need to consider equity issues in and across each basin so as not to create disproportionate impacts to any one geographic area, sector, economy, etc. At the same time, because one's sense of fairness is often heavily influenced by their level of trust, building trust is inherent in building equity.

Regarding whether or not a program could actually be equitably created, IBCC is uncertain – member polling was split. In fact, IBCC explored several hypothetical DM approaches during a March 4, 2020 IBCC meeting exercise (slides for March 4 and March 5 can be found on the CWCB website). The exercise helped highlight how ostensibly equitable approaches to DM might still be perceived as inequitable. At the same time, this exercise and other IBCC discussions also illustrate how stakeholders, if consulted, will work to identify challenges, mitigate issues and develop *more equitable* outcomes.

The collective input of IBCC suggests that the structure of any potential DM program would have to be flexible enough to address both existing and potentially emerging basin-specific concerns across any number of issues. However, flexibility itself may not be sufficient to address equity concerns. Additionally, because building trust is fundamental to establishing equity, any process to develop a DM program or any resultant program would need to be open, transparent and responsive.

To provide context, specific comments taken directly from the IBCC minutes are listed on the following pages. These bullets capture the main points of IBCC discussions related either directly or indirectly to equity. The full minutes from each meeting (linked above) can be referenced for additional detail.

IBCC MINUTES THAT DIRECTLY RELATE TO EQUITY

- *One of the largest issues is how to build trust in a demand management program.*

- *One of the benefits of the demand management process is that the conversation can focus on equity. While curtailment is a top-down and reactive management process, demand management is a proactive process that creates the opportunity to engage with communities.*

- *Fairness is an important concept in the equity discussion. Whenever a decision is made, people will evaluate whether they were treated fairly. Despite the complexity of the problem, the program must be managed fairly.*

- *Some expressed the view that equity should not serve as a barrier to implementing a demand management program, and it should not be used as a way to prevent water from getting to Lake Powell.*

- *Building trust is an important factor in the process of developing a demand management program. Water is a serious topic, which makes it easy for people to be afraid or suspicious. IBCC members should continue to have conversations with their communities to gather community perspectives to assist in developing a demand management program that works for the communities across the state.*

- *All groups across Colorado working together may be able to develop solutions for the water issues in Colorado; it is important to continue to think about tackling water issues in cooperation with one another.*

- *The term equity makes some people uncomfortable. Other terms, like shared responsibility, were also discussed, with some emphasizing that concept of shared responsibility changes the conversation to how citizens can help protect the state most effectively by providing water to Lake Powell. [Note: any potential Demand Management program would be strictly voluntary, with nobody being forced to participate if they do not choose to do so. Therefore, while the concept of "shared responsibility" may be open to interpretation, it does not refer to or imply any potential Demand Management program design that would involve mandatory participation**

- *One common theme is that each group discussed concerns with disproportionally affecting different geographic areas within and among the basins. Fairness is related to proportionality, and proportionality by basin and geography is important. Fairness is also related to proportional impacts across the state.*

- *Various issues associated with management of the program should be explored further, including how market forces impact participation in a potential program, the concept of credits associated with the pool, and other issues.**

- *There is also a question as to if DM might be enabling speculation and creating a market for agricultural water rights.**

- *There are two different types of equity: equity of impact and equity of opportunity. Equity of impact is making sure that not one basin takes on the burden of demand management. Equity of opportunity is making sure that the benefits of a demand management program are distributed more evenly and that not only a couple of water rights users benefit from the program.*

- *It is not possible to talk about fairness until there is recognition that there is a lack of trust in developing a demand management program. Some of the mistrust is historic, but there is a willingness to trust as the IBCC comes together to listen to each other in open and candid conversation to determine what each person needs to make a demand management program fair.*

- *Market mechanisms and finance could drive a demand management program with caps by geographic locations. Different sectors could then decide how much to contribute to a program.*

IBCC MINUTES THAT INDIRECTLY RELATE TO EQUITY AND/OR WERE CONSISTENLY DISCUSSED

- *One way to frame the demand management conversation is through the perspective of risk. Water users want to know the likelihood that the state will be in a curtailment scenario and to what degree it will impact water usage in the state.*

- *One reason that it is important to know the State Engineer's Office's plan for a potential curtailment scenario is that it allows water users to understand their risk and act accordingly. For example, if the State Engineer's Office plans to administer a curtailment program based on prior appropriation, low and high priority water users should understand the risk to their water usage that is associated with that plan.*

- *Demand management has been an elusive idea, and the IBCC and the basin roundtables have exercised patience as they have worked to define and understand the problem. When problems are not solved quickly, some people assume the worst.*

- *There are similarities to be made between the Colorado River, the Rio Grande, and other rivers, like the Republican River. It is important to learn how different river basins are managing their water resources, and there are many lessons to take from the Rio Grande River Basin. The producers and water users of the Rio Grande have long worked with the State Engineer's Office to develop a system of self-government. It is likely that the federal government in some form will need to provide funding to the state and basin roundtables, so understanding how the federal government participates and funds the program in the Rio Grande is essential.*

- *A common theme among the groups was a discussion of a free market versus guided market versus government program for implementing demand management.**

- *Another common theme was that no two water rights are alike. There are remaining questions about how to analyze the value of water rights and the socioeconomic impacts of a demand management program. There may be a need for a ditch wide analysis of socioeconomic impacts.*

- *The value of water can be difficult to quantify because the value of water goes beyond its transactional value. The value of water also comes from the economic activities and recreation tourism it generates as well as from its social and aesthetic values.**

- *There is not one solution that will solve everything; there will likely need to be a combination of factors and sideboards that go into a program. There should be a list of all the factors that need to go into an assessment of a program.*

- *Having some type of criteria was a common discussion topic, including determining who develops the criteria and who evaluates programs and projects using the criteria. Some participants said that local grassroot organizations or basin roundtables could develop criteria and evaluate projects. Other tables discussed that sectors could develop criteria and decide how to allocate resources, but there is still an important task of identifying who speaks for a certain sector.*

- *The industry sector is missing from the discussion. The Economic Considerations and Local Government workgroup have discussed incentivizing power plants downstream that use hydrological power to participate in a demand management program. The Economic Considerations and Local Government workgroup also has discussed the water rights of some of these retiring power plants and whether they could be used to address water deficits under the Colorado River Compact. It is important to involve industry in the discussion because in some counties, they may represent a significant portion of water use.*

- *There are remaining questions about how to decide who participates, who defines the terminology, who decides how to measure socioeconomic impact, and whether a voluntary program is actually voluntary if there are pressures from the community.*

*Bullets marked with an asterisk have been adjusted from the original minutes to better reflect IBCC feedback on the final draft going to the CWCB board.

Exhibit D:

CWCB Demand Management Step II Work Plan

November 2020

Demand Management Feasibility Investigation Step II Work Plan
November 18, 2020

1) Purpose and Need for this Work Plan

The Colorado Water Conservation Board's (CWCB) mission is to conserve, develop, protect, and manage Colorado's water for present and future generations. In carrying out this mission, the CWCB is considering whether a Demand Management program as contemplated in the Demand Management Storage Agreement may provide additional protection to Colorado water users and the state as a whole.

In Fiscal Year 2019-2020, the CWCB conducted the initial stage of the Demand Management Feasibility Investigation as directed by the CWCB Board of Directors' November 2018 Support and Policy Statement and the 2019 Work Plan. The CWCB has completed the work of the 2019 Work Plan, and hereby adopts this Step II Work Plan, designed to guide the next steps in Colorado's investigation.

The CWCB will continue to implement the strategies and policies as initially adopted in the November 2018 Support and Policy Statement, attached here and fully incorporated herein.

While the 2019 Work Plan was designed to identify and analyze key threshold issues associated with a potential Demand Management program in Colorado, this Step II Work Plan will analyze key outstanding questions and priority issues. This effort will rely and build on work completed under the 2019 Work Plan, including but not limited to information contained in the July 2020 Update to the Board.

The CWCB Board and staff recognize that Demand Management is one potential element of the broader Colorado River state strategy. It is yet to be determined whether Demand Management will be a feasible tool to help maintain compliance with compact obligations. The Demand Management investigation continues in parallel with many other projects, programs, and discussions regarding the Colorado River Compact. This Work Plan, however, is limited to the Demand Management Feasibility Investigation within Colorado.

2) Background:

Under the terms of the Colorado River Compact, the Upper Division States (Colorado, Wyoming, New Mexico, Utah) are required to not deplete the Colorado River below 75 million acre-feet over 10 years at Lee Ferry, Arizona. If the Upper Division States fail to meet this obligation, it could be asserted that the Upper Division States are in violation of the Compact. Compact administration could result in mandatory water usage cutbacks throughout the Upper Division States, including Colorado.

Looking for solutions to help avoid or mitigate impacts from a Compact administration scenario and add additional security to the system, in 2019 the Upper Division States adopted a Drought Contingency Plan for the Colorado River Basin which includes the authorization of a potential 500,000-acre-foot water storage account in Lake Powell. As part of the

agreement, the Upper Division States agreed to explore the feasibility of a potential Demand Management program for the purpose of creating a storage pool of water that may be used to ensure ongoing Compact compliance or mitigate the risks associated with Compact administration.

While it is yet to be determined whether a Demand Management program will be developed in Colorado, the CWCB is the steward of the state's water policy and therefore the agency with the authority to consider the feasibility of and potentially implementation of a Demand Management program within Colorado. As part of its core mission of protecting Colorado's water, the CWCB is dedicated to protecting the very people that rely on Colorado's water (water users) for their livelihoods and wellbeing. The Board has directed that staff consider the feasibility of a potential Demand Management program that would be voluntary, temporary, compensated, and equitable. Exploring the opportunities of such a program, however, requires a great deal of water-user input, data gathering, legal expertise, and ultimately approval from all of the Upper Division States, the Upper Colorado River Commission, and the U.S. Secretary of Interior if a program is to be established in the Upper Basin.

3) Step II Work Plan Overarching Goals

a) The goals below are all intended to support the ultimate goal of determining whether Demand Management is feasible from Colorado's perspective. The feasibility determination is specifically contemplated and defined in the Demand Management Storage Agreement (DSMA)[1] and implicates several related questions for the state, including: whether Demand Management is achievable, whether it is worthwhile from Colorado's perspective, and whether it is advisable to make a feasibility determination. Each of these inquiries is meant to inform the ultimate feasibility determination.

i) Achievable: Determine whether Demand Management would be achievable from Colorado's perspective.

(1) This goal is focused on the question of whether it would be achievable for Colorado to implement a Demand Management program pursuant to the terms of the Demand Management Storage Agreement, and in compliance with state and federal law. Such a determination implicates issues of funding, beneficial use, administration and accounting of the water, verifying conserved consumptive use, and similar questions that relate to the on-the-ground operation of a program and potential projects.

(2) The first stage of the feasibility investigation, largely focused on identifying and considering threshold issues, provided a large body of useful information in considering whether it may be achievable to establish a Demand Management program. This work will provide the baseline and foundational information for the further achievability analysis, and will assist in analyzing the question identified in (ii), of whether a Demand Management program is worthwhile for Colorado. Additionally, the System Conservation Pilot Program and other efforts and studies

[1] The DMSA is available at https://www.usbr.gov/dcp/docs/final/Attachment-A2-Drought-Managment-Storage-Agreement-Final.pdf

have helped to inform some questions associated with the achievability issue. This and other related work will be incorporated in this analysis.

ii) Worthwhile for Colorado: Determine whether a Demand Management program is worthwhile for Colorado.
   (1) This goal is focused on whether - assuming it is possible to establish a Demand Management Program that complies with and satisfies the elements of the Demand Management Storage Agreement and applicable law- it can be done in a way that is palatable and beneficial to the state from a Colorado perspective. For example, this raises questions of how secondary impacts and benefits may be identified, tracked, and mitigated, and whether a program can be set up in an equitable and proportional way.
   (2) Goals (i) (Achievability) and (ii) (Worthwhile for Colorado) may inform each other. For example, although it may be determined in considering the Achievability goal that it is *possible* to verify conserved consumptive use and track the water to the state line, this will raise the question of whether the procedures and mechanisms necessary to accomplish this are too costly or too onerous so as to not make it worthwhile for Colorado when balanced against the amount of security provided to the state by a potential program. This analysis will be considered in contrast to the option of taking no action and reacting to circumstances as they arise, which could risk potential Compact administration and the additional costs, uncertainty, litigation, and potential intrastate controversies associated with it.

iii) Advisable: Determine whether it would be advisable to make a feasibility determination relating to Demand Management.
   (1) This question contemplates whether Demand Management may be the most appropriate tool for Colorado to utilize to create additional security and provide protection to water users. As there may be several ongoing discussions and issues that may change over time, this question must be addressed at the time a feasibility determination is under consideration by the CWCB. Therefore, the first two questions of whether a program may be achievable and whether it would be worthwhile for Colorado should be answered before the advisability question is addressed.

Below is a visual representation of these steps.

4) Engagement and Process Considerations

a) The CWCB leads the Demand Management feasibility investigation on behalf of the state. The tasks outlined in the remainder of this Work Plan are designed to help the Board consider outstanding issues and open questions to be analyzed in the Demand Management feasibility investigation. This section addresses process issues to ensure the Board continues to lead this investigation and is fully informed on the full range of Demand Management issues and efforts across the state.

b) Board engagement
   i) Stakeholder briefings: Throughout the course of this Work Plan, the Board will invite key stakeholder groups, conservancy districts, conservation districts, Tribal Nations, non-governmental organizations, and others to present to and dialogue with the Board at its regularly-scheduled meetings. These briefings will provide the Board with varying perspectives across the state on Demand Management issues. The Project Management Team will assist and advise the Board in coordinating these discussions.
   ii) Workshops: The Board will hold workshops periodically throughout the course of this Work Plan as warranted to provide opportunities for more in-depth discussion and review of specific issues raised in and associated with the feasibility investigation.

c) Progress reports
   i) Throughout the course of this Work Plan, the Project Management Team will provide regular progress reports to the Board, seeking input, clarification, and guidance as appropriate. These updates may inform the Board's determinations to hold workshops, make policy findings, or complete additional tasks.
   ii) In addition to these reports, the Project Management Team will also update the Board on progress made on specific tasks referred to in this document.

d) Public outreach and engagement
   i) Public outreach and engagement continue to be an important element of the Demand Management Feasibility Investigation.

ii) As part of this Work Plan, the Project Management Team, with assistance from the consultant team, will develop a communications tool kit designed to assist in general Demand Management messaging for feasibility and potential pilot program phases of the investigation. Regular updates will be provided to the Board on these efforts.

iii) Additionally, the Project Management Team will work with the consultant team, key stakeholders, and others across the state to better understand communications networks and how varying types of media outlets are used across the state. This work is intended to provide additional information regarding how various water users, stakeholders, and others with interest in a potential Demand Management Program, receive information and provide input. The Project Management Team will use the information gathered in this analysis to adjust the communications strategies as needed and consider implementing additional communications tools and methods.

iv) In the meantime, CWCB staff will utilize existing communications mechanisms to provide regular public updates on the Demand Management Feasibility Investigation, potentially including but not limited to:

(1) Public workshops (held virtually as needed).

(2) Utilization of social media and CWCB website to provide regular updates and seek feedback throughout the course of the Work Plan.

(3) Regular updates will be provided proactively and as requested to key stakeholders, water users, and others across the state, including but not limited to the Basin Roundtables, Interbasin Compact Committee, and the Public Education Participation and Outreach Workgroup.

e) Ongoing discussions with Tribal Nations

i) The Project Management Team will continue to engage with the Ute Mountain Ute and Southern Ute Tribes on a government-to-government basis.

ii) As the above tasks are completed, the Project Management Team will consult with the Tribal Nations on framework development and potential demonstration projects.

f) Interbasin Compact Committee engagement

i) Project Management Team will request feedback from the Interbasin Compact Committee on the following issues:

(1) Substantive equity and proportionality issues and potential solutions to create more equity and proportionality relating to a draft framework.

(2) Process-related mechanisms for ensuring equity and proportionality within the draft framework.

(3) Potential equity and proportionality issues relating to specific projects, programs, or efforts relating to Demand Management.

5) Tasks

a) Develop a draft strawman framework of a Demand Management program.

i) The Project Management Team will work with the consultant team and staff to develop a draft framework, which is intended to provide an analysis of potential Demand Management program structure and design.

ii) This framework will be based on and incorporate work completed by the workgroups, consultant team, and others throughout the course of the 2019 Demand Management

Work Plan adopted by this Board. The progress made to date will form the basis and serve as the starting point of the framework.

iii) The Project Management Team will provide regular updates and incorporate feedback from the Board on this effort.

iv) After developing an initial draft framework, the Project Management Team will seek feedback from workgroup members, IBCC members, Tribal Nation representatives, stakeholders, and others as appropriate, on elements of the framework.

v) In developing this draft framework, the elements below may be considered, including but not limited to:

(1) Program and process design and timeframe for contribution to a potential Demand Management pool.

(2) Equity in program design and processes.

(3) Analysis of potential costs of a program and feasible funding sources.

(4) Project-specific and local impacts and benefits, as well as resources available to assist in identifying those impacts and benefits.

(5) Potential procedures and guidelines for monitoring and verification of program participation.

(6) Environmental, recreational, and other potential benefits and impacts of a program.

b) Analyze and learn from existing, ongoing, and/or new programs and projects.

i) The Project Management Team will work with CWCB staff and others to identify outstanding questions, issues, and research needs that may be assessed through existing efforts and projects, including but not limited to Alternative Transfer Method arrangements that may inform the Demand Management Feasibility Investigation and report on information gathered. The Project Management Team will also identify issues associated with existing efforts that may benefit from additional analysis and research and will prioritize and conduct or direct this analysis to be completed through use of existing funding sources.

ii) The information gained in this process and throughout development of the framework will help inform potential implementation of projects aimed at addressing key data gaps and outstanding questions.

iii) The identification of remaining questions and issues warranting further analysis will be based on work done to date by the workgroups and others throughout the course of the 2019 Demand Management Work Plan, and the specific questions identified by the workgroup members as outlined in the July 2020 Demand Management Feasibility Investigation Update and attachments thereto. These issues may include but are not limited to:

(1) Understanding the various impacts, benefits, and issues associated with a diversity of demand management activity in varying locations and under varying conditions

(2) Best management practices relating to potential conservation activity to mitigate potential on-farm impacts and increase benefits; and

(3) Identification and measurement of potential impacts and benefits associated with various types of conservation activities.

c) Ongoing assessment of potential larger-scale pilot program

i) Based on work completed in the above tasks, on an ongoing basis, consider whether it may be appropriate to develop a programmatic-scale Demand Management pilot

program, potentially in collaboration with the other Upper Division States, should they wish to participate.

d) In addition to regular progress reports, the Project Management Team will issue a report to the Board summarizing the key findings of this step in the feasibility investigation upon its completion.

6) Summary of Step II Work Plan

i) Consistent with its mission to conserve, develop, protect, and manage Colorado's water for present and future generations, the CWCB enters the second step of analyzing the feasibility of a Demand Management program. With the approval of Step II, CWCB moves steadily forward with determining the feasibility of a Demand Management program, with particular focus on the questions of whether it would be achievable, worthwhile for Colorado, and advisable.

Exhibit E:

CWCB Demand Management Framework

March 2021

COLORADO WATER CONSERVATION BOARD

Protecting Colorado Water

DEMAND MANAGEMENT FRAMEWORK

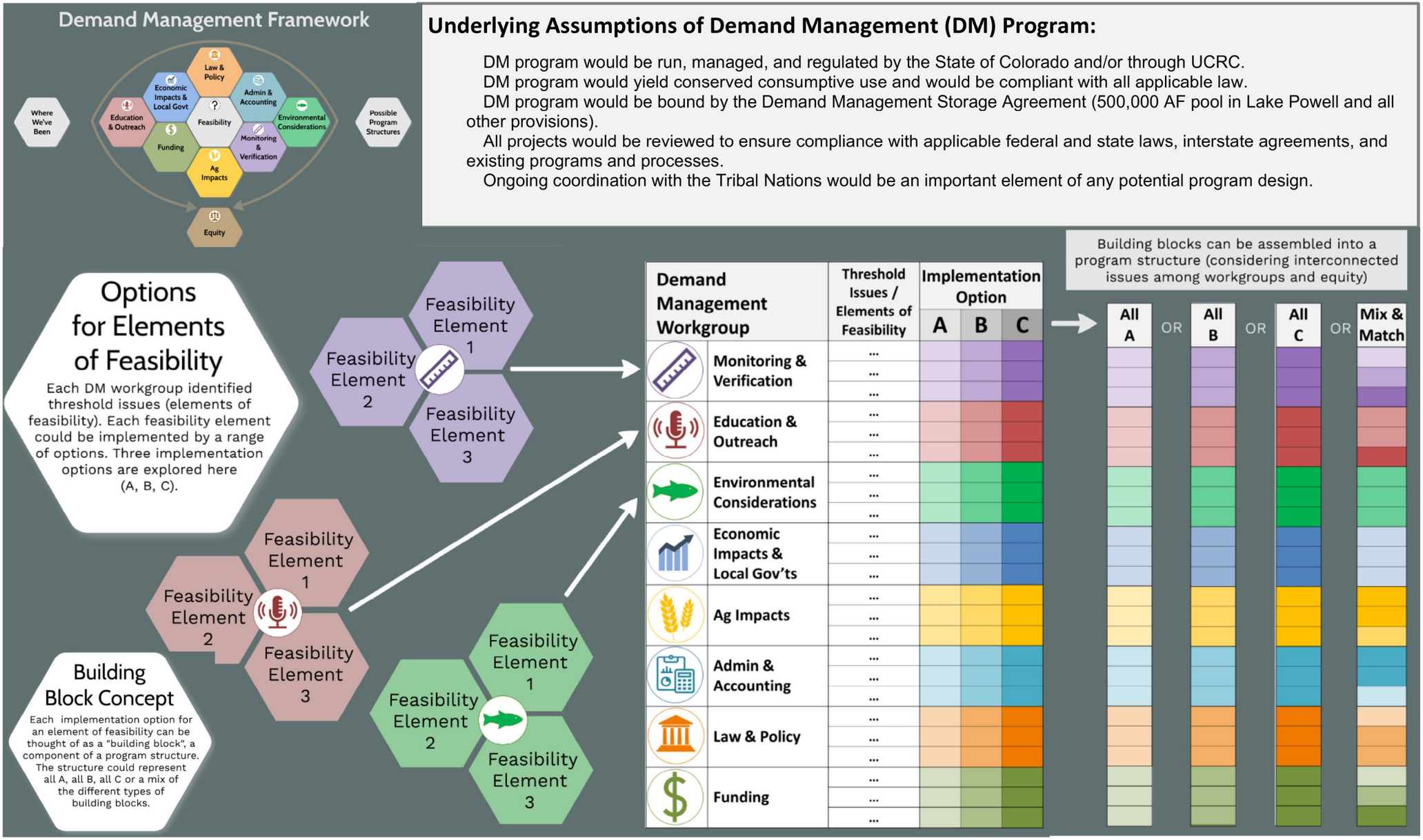
As part of Colorado's Demand Management Feasibility Investigation (see Work Plan) led by the Colorado Water Conservation Board (CWCB), this document includes a Demand Management Framework focusing on various issues associated with a potential Demand Management program.

While reviewing, note that the following Demand Management Framework draft is:

- For a potential Demand Management program that would involve temporary, voluntary, and compensated reductions in consumptive water use pursuant to the Demand Management Storage Agreement.
- Not a Demand Management program, but rather a tool for discussion regarding a potential program, which is not a foregone conclusion.
- Designed to be iterative, and there will likely be multiple updated versions released as the discussion progresses.
- Designed to show a broad range of implementation options, without showing preference for any given option.
- Set up using a range from A to C, designed to roughly correlate with level of complexity for the various implementation options. These designations do not correlate with any value judgments about which option may be best.
- Not intended to represent any commitments or guarantees regarding viability of a program design. For example, some options presented may have budgetary or other constraints.
- Intended to be used as a tool for discussion across Colorado about what may work and what may not work in a potential Demand Management program from varying perspectives, and any information gathered throughout this process is intended to assist CWCB in determining whether Demand Management may be achievable, worthwhile, and advisable from Colorado's perspective.
- Not intended to represent any position of the CWCB or the State of Colorado regarding the feasibility of Demand Management.

To provide feedback on this Framework document, please email demandmanagement@state.co.us or visit engagecwcb.org.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources



*Note that Law & Policy and Administration & Accounting elements are not included in this analysis.

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DM Program Structure Matrix of Building Blocks

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DM Workgroup • Guiding Principles	Threshold Issues / Elements of Feasibility	Implementation Options A	 B	 C	Interconnected Issues, Tradeoffs, and Equity Considerations
Timeframe and scale of DM Program		All potential options may impact or be impacted by the timeframe and scale of a DM Program.			
Monitoring & Verification (Agricultural DM Project) • Honest, accurate, transparent, and defensible • Protective of other water users • As simple, easy, and flexible as possible • Participation adds water to the Colorado River Basin – not solely a retiming of depletions	**Measure water returned to stream**	Bypass of diversions (streamflow and/or reservoir releases, if applicable) if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use through moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.	Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch at a flume with a stage/discharge recorder, after which would be returned to the stream.	Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch with multiple real-time recording devices and a telemetry system to remotely monitor diversions and the measured returns of the irrigation supply to the stream.	Simplifying the measurement and verification requirements may underestimate the amount of water generated for a DM project based on the need to use conservative assumptions and/or estimates. Increasing the measurement and verification requirements may result in increased instrumentation requirements, longer review and/or enrollment periods, and may increase program costs, but could result in greater amounts of credits/water generated for individual DM projects. Equity considerations include participation across diverse geographic areas, wide-spread locations within a stream system, wide-ranging ditch system complexities, and agricultural sectors/markets.
	Conduct a consumptive use analysis	Use the Division of Water Resources' Lease Fallow Tool to estimate historical consumptive use (conservatively underestimating to protect downstream users).	Complete a general site-specific potential consumptive use analysis, similar to a Substitute Water Supply Plan (SWSP), to estimate consumptive use, while considering the available diversion data and/or historical remote sensing data and/or aerial photographs.	Complete a detailed site-specific engineering analysis, similar to a water court change case, with parcel specific representative data to determine historical consumptive use and return flows.	
	Estimate the residual field consumptive use	Complete fallowing, removal of deep-rooted crops, and management practices to prevent inadvertent irrigation with visual inspections.	Full or split fallowing with ongoing measurement of groundwater levels and/or visual soil moisture inspections.	Split fallowing, irrigation of lower consumptive crops, or deficit irrigation with ongoing measurement of applied irrigation supplies, soil moisture, and remote sensing.	
	Maintain return flows	Bypass of diversions or the immediate delivery of both the consumptive use and return flow portions of the irrigation supply back to the stream after measurement.	Develop unit response functions (URFs) to determine the timing of delayed return flows to the stream and replace in time from legally available contracted supplies (reservoir releases or augmentation credits).	Determine the historical return flow patterns through a site-specific study and then construct and equip a recharge or infiltration pond with measurement devices near the fallowed field to maintain historical return flows in time, location, and amount.	Simplifying the monitoring and verification requirements for return flow maintenance may increase participation in a DM program, but could decrease streamflow absent a supply to replace lagged irrigation return flows. Increasing the monitoring and verification requirements for return flow maintenance may reduce participation in a DM program, but could be more protective of streamflow by identifying a supply to replace lagged irrigation return flows.
Monitoring & Verification (Transmountain DM Project)	**Measure water returned to stream**	Bypass of diversions if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use using moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.	Diversion of the transmountain supply for measurement in a flume with a stage/discharge recorder, after which would be returned to the stream OR measurement of reservoir release.	Diversion of the transmountain supply with real-time recording devices and a telemetry system to remotely monitor measured returns/releases of the transmountain supply to the stream.	Simplifying the measurement and verification requirements may underestimate the amount of credits/water generated attributable for a DM project based on the need to use conservative assumptions and/or estimates. Increasing the measurement and verification requirements may result in increased instrumentation requirements, longer review and/or enrollment periods, and may increase program costs, but

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.

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DM Program Structure Matrix of Building Blocks

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• Honest, accurate, transparent, and defensible • Protective of other water users • As simple, easy, and flexible as possible • Participation adds water to the Colorado River Basin – not a retiming of depletions	**Verify conserved consumptive use occurs on the East Slope**	Water user provides accounting demonstrating the reduction of West Slope deliveries for a DM activity did not result in additional West Slope diversions from another of its transmountain systems or contractual supply.	Water user provides accounting demonstrating the reduction of West Slope deliveries for a DM activity was offset by another East Slope supply or through a reduction in the overall demand of its customers.	Water user maintains double accounting records for several years to confirm that a DM activity in one year wasn't offset by retiming of future Colorado River depletions in subsequent years. This includes all reservoir accounting records and the reconciliation of carryover storage of West Slope supplies in East Slope reservoirs.	could result in greater amounts of credits/water generated for individual DM projects. Equity considerations include participation across diverse East Slope geographic areas, wide-spread locations of individual TMD projects, wide-ranging TMD system complexities, and ability to share conserved consumptive use impacts across all users within a DM participant's system.
Monitoring & Verification (Process considerations for all projects)	**Coordinate environmental and other benefits**	Qualitatively demonstrate an increase in streamflow after bypassing a transmountain diversion and/or divert, measure, and return flows to the stream. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream.	Qualitatively demonstrate that temporary storage in a West Slope reservoir for a planned release bolsters non-consumptive, environmental and flow related benefits. Impacts and benefits evaluated qualitatively only. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream and reservoir operations.	Quantitatively demonstrate that temporary storage in a West Slope reservoir for multi-benefit planned releases bolsters non-consumptive, environmental, and flow related benefits. Impacts and benefits evaluated quantitatively. Measurement needs could include flumes for measuring bypass of diversions and/or return flows; additional stream gages; measurements of water quality, etc. Accounting required to monitor a project's net effect (e.g. lagged return flow accretion timing, etc.).	Foregone agricultural and TMD diversions could provide additional benefits for non-consumptive uses and environmental flow needs both immediately after release and/or after temporary storage. Incorporating West Slope storage to manage releases of foregone agricultural and TMD diversions could maximize flexibility and bolster non-consumptive and environmental flow needs, but would result in additional evaporative losses and would reduce water generated by an individual DM project. Incorporating West Slope storage could also increase the requirements for measuring, verifying, and quantifying environmental benefits and/or impacts.

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DM Program Structure Matrix of Building Blocks

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Education & Outreach • Transparent and inclusive stakeholder engagement to shape the program • Address communication gaps with message consistency, partner networks, and virtual engagement • Water education at the state, regional, and local levels • Include an equity lens in all engagement and communication	**Water education (to engage broad audiences)**	State creates detailed website resources, issues press releases, conducts interviews, and delegates many education tasks to PEPO, WEco, and other partners.	State partners with groups such as WEco, PEPO, educators, cooperative extension or similar entity, and universities to implement a series of education activities; implements a targeted communications plan; offers webinars to partner organizations; some new audience engagement.	State brings on new staff or funds education to travel statewide for strategic teaching efforts rooted in drought and water shortage knowledge; partners extensively; communicates broad scale (i.e. radio, billboards, TV) to new water audiences.	"Change management" is an ongoing and resource-intensive effort to evolve both the program design and the state's attitudes towards water use.
	Stakeholder engagement (to inform the program)	State builds upon successes of preexisting programs. Utilizing Board and IBCC input, and updated website comment functionality, the state develops a DM program with assistance from consultants or others as needed and appropriate.	Leveraging the Board, Roundtables, IBCC, CWC, conservation districts, and public meetings, the State leads a public input process to inform a DM program and geography. As the program is developed, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies.	The state engages a broad and diverse range of stakeholders over an extended period. As the program is developed and implemented, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies. Based on this input, elements of the DM program are appropriately tailored to local needs across the state. An iterative process with evolving program options.	More localized programs may mean that some programs cost the state more, and other programs cost the State less. Stakeholders would need to determine whether it is fair for taxpayer dollars to be distributed inequitably for the sake of equity. While an evolving program structure may be desirable as a mechanism to proactively avoid or mitigate potential negative impacts, it may make it more difficult to ensure a clear, predictable process is in place. If a DM program is established, CWCB will coordinate with other state agencies relating to conflict resolution processes available.
	Program marketing (to ensure participation)	State remains active in water forums like CWC; implements marketing plan as needed to target audiences; maximizes pre-existing participants. No active solicitation. Assumes participants would approach state.	State partners with local actors to assist with program marketing; implements proactive marketing plan to target audiences using annual allocated funds.	State opens local offices to be liaisons between the state and program participants; extensive marketing; maximizes new program participants. State has a role in co-developing applications with new applicants.	The "bang for the buck" considerations would need to be weighed by decision makers and stakeholders regarding the extent to which additional efforts yield increased program participation. Lower levels of marketing would limit the State's ability to educate / market for increased participation in certain geographies / sectors. Smaller operations, non-English speakers, and nontraditional participants such as mining or food industry would benefit from higher levels of implementation. Proportionality of program adoption would require active marketing and education efforts in areas with lower levels of implementation.
Environmental Considerations • Achieve a net environmental benefit over time, and across hydrologic conditions and geographies	**How potential environmental benefits and impacts are considered**	Environmental benefits and impacts (flow needs, affected habitat, and/or species, alignment with other plans or efforts, etc.) considered through existing review processes and frameworks.	Identify potential environmental benefits and impacts and associated risks for potential projects. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies to identify and track potential benefits and impacts, including CPW and others as appropriate.	Consider each item in a comprehensive list of potential benefits and impacts. Public stakeholder engagement could be required for large projects. This may include consultation with local entities or with a committee of experts to assess local needs and impacts. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies and local entities to identify and track potential benefits and impacts, including CPW and others as appropriate.	

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DM Program Structure Matrix of Building Blocks

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• Provide opportunities for projects with net environmental benefits • Not harm the environment • Evaluate project environmental benefits/impacts without creating an unnecessarily burdensome process for applicants • Identify project impacts/benefits to environmental resources, including flow, water quality, affected habitats, etc.	**Assessing net benefit or impact**	Environmental benefit or impact of a given project is assessed through existing review processes and frameworks.	List of environmental considerations evaluated qualitatively for benefits or impacts. Net benefit or impact of a project is evaluated qualitatively based on evaluation of considerations.	List of environmental considerations evaluated quantitatively for benefits or impacts. Net benefit or impact of a project is evaluated quantitatively and qualitatively based on the evaluation of considerations. Evaluate risks and tradeoffs.	More comprehensive environmental assessments could be burdensome to potential applicants as well as the State. However, greater risk of adverse impacts or lost opportunities if these assessments are not conducted.
	Strategies to incentivize benefits	No incentives provided for projects with potential environmental benefits.	Preference and/or additional monetary or program incentive given to projects with net environmental benefits.	Preference and/or additional monetary or program incentive given to projects with greater net environmental benefits. Potential partnerships with NGOs and/or local organizations to support the assessment of potential benefits.	Coordinate efforts on incentivizing benefits with local governments to streamline approval. Opportunities for collaboration on a county/local level.
	Strategies to avoid, offset, or mitigate any negative impacts	No additional strategies implemented to avoid, offset, or mitigate any potential negative impacts.	Evaluate the program as a whole for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: potential storage and retiming of return flows in an upstream reservoir to increase benefits and/or mitigation measures.	Evaluate specific projects for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: Potential partnerships with NGOs and/or local organizations to help in realizing benefits and mitigating potential impacts and provide additional funding, programs, or opportunities. Potential projects could include watershed restoration work, diversion structure improvements, etc.	These are very similar to the options for monitoring and verification. Additional mitigation measures would require additional funding. Measurement and quantification of potential environmental benefits and/or impacts would have monitoring and verification components or requirements (see Monitoring & Verification).
Economic Impacts & Local Governments • Any program participation must be voluntary • Initial goal of program should be to do no harm • Program should seek to create net benefits for water users • Program operations should be transparent & collaborative	**Support for municipal participants**	Existing programs and funding sources are used to support municipal participants.	State consults with and provides support for municipal participants in developing projects.	State identifies other programs that may be coordinated to support municipal participation and assists in facilitating more significant conservation programs. State consults with local governmental entities to identify appropriate mitigation opportunities.	A water efficiency program is not temporary. However, it is likely to be the least disruptive option. Municipal participant may eliminate or minimize impacts on municipal water customers. However, mechanism of municipal participation and/or reliance on other water sources may impact water availability for other users.
	Municipal sector mitigation	Existing programs and funding sources are used relating to municipal sector mitigation. Municipalities may take steps to avoid secondary impacts to their customers.	State more actively works to identify and track potential secondary impacts to municipalities resulting from participation in the program. A portion of project compensation spent on mitigation efforts. Mitigation payments are made to municipalities or communities.	State sets specific protocol and mechanisms for identifying and tracking potential secondary impacts resulting from municipal participation. A larger portion of compensation spent on mitigation with a defined list of required mitigation actions dependent upon type of project activity. State partners with local governmental entities to identify appropriate mitigation opportunities.	Potential impacts to system reliability depending upon type of municipal participation. Mitigation measures taken by municipalities may have impacts outside their municipal boundaries. Municipalities with fewer resources may be less able to mitigate potential impacts on their own, resulting in areas of low socioeconomic status potentially having lower access to green spaces or other resources.

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DM Program Structure Matrix of Building Blocks

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	Consultation with local governments to track impacts and develop mitigation measures	General education and outreach to inform local governmental entities, water boards of DM program. State does not consult with municipal participants or local governments to identify, track, or mitigate potential impacts and identify potential benefits to local economies resulting from a DM Program.	State consults with program participant and/or local governmental agencies to identify potential impacts and mitigation strategies, for all types of project activity, and to identify potential benefits to local economies and communities relating to a DM Program, as well as strategies to increase benefits.	Inter-governmental Agreement (IGA) or similar framework developed to facilitate robust and iterative consultation process with local governments and other entities to address local concerns and mitigate local impacts, with specific strategy and focus on mitigating or avoiding potential adverse impacts and increasing potential benefits, for all types of project activity.	Less consultation with local governments may result in increased adverse impacts that are not adequately tracked and mitigated. There is a varying level of resources and capacity available for local governments to facilitate coordination and mitigation efforts. This variation may affect the extent to which impacts are tracked and mitigation measures implemented across the state. Consultation with the Colorado Municipal League and Regional Councils of Governments may be helpful in determining appropriate parties and mechanisms for engagement.
Ag Impacts • Equitable & proportional across state • Minimize & mitigate off-farm impacts • Program should be a structured & guided market • Program operations need to align with growing season schedules	**Agricultural sector mitigation**	Existing programs and funding sources are used to promote agricultural viability.	Fund is established to provide compensation to local entity for community economic development fund. Grant program established to assist with local agricultural and economic viability.	State and partners make efforts to identify potential secondary impacts. Fund established that potentially provides compensation for mitigation, some of which is distributed to water management entity servicing property, while a portion is distributed to local/rural economic development or other appropriate organization. Additional staff time targeted at mitigating agricultural sector impacts to non-participants. Dependent on funding availability and identification of appropriate funding source.	Limiting the community development fund to verifiable DM impacts would present additional complexity, but would perhaps lower costs or avoid reimbursement of economic impacts beyond the State's control; alternatively a community fund that supports projects regardless of verifiable impact would be easier to manage and generate positive community outcomes. State verification of potential impacts could be costly and difficult to accomplish. Assess impacts to tenant farmers and land rental prices through community outreach efforts, noting it may be challenging to distinguish DM-related impacts. Community impacts in sovereign Tribal Nations may require alternative structure. Determinations may need to be made regarding which sectors or workers receive preference in assistance.
	Agricultural participant field requirements	No field requirements	State works with cooperative extension, other local agencies to establish guidelines for cover crops (for annual crops) and weed and pest control measures (for perennial crops). State partners/contracts with cooperative extension or similar entity for technical assistance and limited monitoring of compliance.	State works with cooperative extension, other local agencies to establish guidelines for cover crops (for annual crops) and weed and pest control measures (for annual and perennial crops). State provides staffing for technical assistance and monitoring of compliance.	Cover cropping could add complexity to monitoring and verification of consumptive use; soil health practices such as conservation tillage could reduce Monitoring & Verification complexity; development of any mitigation guidelines would likely require input from the United States Department of Agriculture, Colorado Department of Agriculture, and cooperative extension. Cover cropping could provide additional environmental benefits; select cover crops could help offset impacts to livestock feed disruptions and provide additional revenue for the participant. Producers may lack knowledge of cover cropping techniques. Though cover crops may create additional costs, state may work with USDA NRCS to offset participant cost of any on-farm mitigation requirements. There may be federal crop insurance implications.

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DM Program Structure Matrix of Building Blocks

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	Agricultural participant assistance	Existing programs and resources in place are utilized to facilitate agricultural participant assistance to help fully realize potential benefits of participation or mitigate potential impacts.	State creates a grant or cooperative contracting program with the university cooperative extension service, conservation districts, or similar technical service providers, to offer technical assistance and help fully realize potential benefits of participation or mitigate agronomic impacts from the DM program to the participants.	State creates additional staff capacity responsible for assisting in fully realizing benefits of participation or mitigation of impacts from the DM program to the participants. Position manages a budget for technical assistance and mitigating impacts.	Participants would likely need technical assistance in both navigating any potential DM in-take process and in selecting/implementing mitigation measures (e.g. cover cropping); providing the ability to grant or contract with third parties would likely reduce programs costs and address state capacity concerns. Producer participants familiar with working with agricultural service providers may be more willing to work with a trusted contact versus state staff. In addition to direct technical assistance, online information regarding any DM sign-up process or agronomic impacts and best management practices would be helpful and more accessible
Process Considerations	**Soliciting projects**	No state solicitation	Annual grant funding for entities to identify & develop project applications	State staff support & grant funding for identifying & developing project applications	
	Application requirements	Participants are not required to submit information regarding mitigation, monitoring, or other elements with their application. No certification program due to open enrollment process.	Select mitigation & monitoring elements must have been completed or substantially planned for application.	Select mitigation & monitoring elements must have been completed or substantially planned for application. A certification process ensures that project applications meet minimum requirements.	
	Project selection process	Open enrollment (first come, first serve) for projects of any duration. No certification processes. Review is done on a project-specific basis.	Annual RFP process without any certification process. Coordination with local governments, entities, others to facilitate a "guided market" approach aimed at ensuring a program aligns with specific goals and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).	Annual RFP process with certification required. Clear protocol developed, incorporating coordination with local governments, entities, others, to establish a "guided market" approach designed to ensure the program aligns with specific goals and values and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).	Care should be taken to ensure that the timing of the application, review, and approval process align with when agricultural participants make operational decisions
	Localization and program evolution	No additional protocol put in place to localize and/or evolve a program to local needs.	Review of DM program put in place at specific milestone to consider successes, lessons learned, and stakeholder feedback. The review directly informs future program management across the state.	Regular review of the DM program to consider successes, lessons learned, and stakeholder feedback. The review directly informs program management at local level. The review is public, transparent, and available for comment.	Depending on the level and scale at which programs evolve, there may be program differences (perceived as inequity) over time at the Basin levels. Local agencies / entities have different statutes, capacity, jurisdictions, resources, knowledge, and mobilization. Different basins can engage at different levels.

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DM Program Structure Matrix of Building Blocks

DRAFT

Funding • Portfolio of funding sources should be considered • Costs would be influenced by many factors including program design, scale, and participation	**Range of annual costs**	$3M - $16M Example Cost Breakdown: 10% Program Costs 90% Compensation Cost	$5M - $20M Example Cost Breakdown: 30% Program Costs 70% Compensation Cost	$12M - $30M Example Cost Breakdown: 65% Program Costs 35% Compensation Cost	Payment offered may impact who is interested and able to participate, which may affect proportionality in terms of sector and region. Compensation range reflects that some may be willing to participate at lower cost than others, and in some cases additional compensation may be available outside of state fund.
	Funding Sources	Compensation paid by State through budget reallocation	Compensation paid by State through fees	Compensation paid by State through blend of multiple sources.	

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.

Exhibit F:

Input Received on Demand Management Framework

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Stakeholder Input

CWCB Demand Management Feasibility Investigation

Spring - Summer 2021

Contents:

Meeting summaries prepared for CWCB by Emily Zmak, CDR Associates. This document is intended to summarize stakeholder input and does not necessarily represent the views or opinions of CWCB staff or Board.

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Demand Management Workgroup Workshop Meeting Summaries

DEMAND MANAGEMENT FRAMEWORK MEETINGS

Spring 2021

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Colorado Water Conservation Board
Department of Natural Resources

Economics and Local Government Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

April 20, 2021 | 12:00 - 1:30p

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Mark Smith, Colorado College, the Economics and Local Government Workgroup ("workgroup") had a facilitated discussion on the content within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- It is difficult to present both details and an uncomplicated overview in the same framework.
- The right-hand column could be clarified with a title along the lines of "considerations" or "interconnected issues." Issues should be captured in a consistent and accurate way.
- The A-B-C columns should better illustrate the escalation in complexity.
- "Do no harm" is a guiding principle that should be captured as fundamental to all topics / sections.
- Additional clarity around municipal participation would be helpful.
- Impacts to local government are closely connected to agriculture. The consultation category should capture that agriculture is a key component in addressing community impacts.
- Water efficiency programs may be more disruptive than currently captured in the framework.
- Green spaces are an important consideration to capture.
- Mitigation funds should be directly linked to the sector impacted.
- Iterative mitigation would allow communities to incorporate lessons-learned and/or unexpected impacts into mitigation measures.

Open Questions

- Does surplus water count as consumptive use?
- What criteria should be used to judge whether or not demand management is a good idea?
- What does proportionality mean?
- How much would other agencies be involved in a demand management program?

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Funding Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

April 21, 2021 | 10:30 - 12:00

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Brett Bovee, Westwater Research, the Funding Workgroup ("workgroup") had a facilitated discussion on the content captured within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- Consider clarifying the budgets' inclusion of one-time costs and early investments.
- Both fees and taxes should be considered as funding sources.
- Federal investments could be captured in the commentary as a potential funding source.
- The current presentation of costs begs the question, "Why would you pay more for the same amount of water?" The framework could articulate that the B- and C-columns fund worthwhile secondary benefits, such as consistency and mitigation. Attractive program components may have additional costs.
- There should be an expansive consideration of financing and funding, such as looking towards supply chains to broaden the pool of fee-payers.
- Costs should be considered on a perpetual basis, not solely an annual or near-term basis.
- Municipal participants would need to consider revenues and possible rate pressures, which would have impacts on low income communities and raise issues like bill affordability and customer assistance.
- Cost equity could be captured. There are different impacts and benefits to different geographies, water consumers, and economies.
- The framework could capture opportunity costs. Understanding opportunity costs could help clarify whether an entity should participate or not.

Open Questions

- How expansive are the references to "water users"? Direct users, secondary users?
- What is the optimum program? Defining that would be helpful in considering financing.
- Can the demand management model be built in a way that it is transferable to other Basins?
- What is the benefit for the cost and effort of the program?

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Agricultural Impacts Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

April 22, 2021 | 10:00 - 11:30a

MEETING PURPOSE: To ensure that the framework responds to workgroup members' initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Brett Bovee, Westwater Research, the Agricultural Impacts Workgroup ("workgroup") had a facilitated discussion on the content captured within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- Communicate the range of options' pros and cons, as well as financial and opportunity costs
- Consider addressing holistic sustainability and resiliency to future impacts within the framework
- A demand management program should treat producers fairly
- Consider intra-system impacts to ensure that nonparticipants are unaffected
- Pre-existing procedures, operations, and governance requirements for irrigation providers are constraints that a program would work within; for example, not all systems have individual water rights
- System compensation is an important consideration, although is only represented in Column C
- Soil health is a potential secondary benefit. The state could provide optional techniques or technical services to producers for improving soil health during fallowing. This could be a participation incentive.
- While the framework recognizes legal damages, it does not mention inconveniences. Someone will always be inconvenienced; early engagement could mitigate non-damaging impacts.
- Local benefit will stem from farmer compensation. Development funds could build and support agricultural economies, although the majority of the money should go to the program participants.
- Not all potential participants will be appropriate participants.

Open Questions

- Will there be a mandatory crop type to prevent further landscape damage?
- How much will be paid to producers?
- Who pays for technical assistance offered to program participants?

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Environmental Considerations Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

April 26, 2021 | 2:00 - 3:30p

MEETING PURPOSE: To ensure that the framework responds to workgroup members' initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Jordan Dimick and Bailey Leppek, SGM Engineering, the Environmental Considerations Workgroup ("workgroup") had a facilitated discussion on the content captured within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- □ The framework is a useful tool for evaluating trade-offs
- □ A successful program would provide resilience for the environment and recognize holistic environmental benefits
- □ Proportionality and fairness should be linked to discussions about water and costs
- □ Assessing net benefit should work within existing local environmental rules and guidance
- □ A long-term program will evaluate environmental benefit / impact through a different lens than a short-term program; for example, the timing of flows matters more in a long-term program
- □ Review language for implications or assumptions of adverse risk caused by some participants
- □ The value of water will factor into the proportionality discussion, and the more complicated the program, the more financially difficult it will be to launch the program

Open Questions

- □ What long-term programmatic options exist outside of the drought contingency plan timeframe?
- □ How can a demand management program be linked to other state programs to achieve win-win outcomes for environmental benefit?

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Monitoring & Verification Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

April 30, 2021 | 12:00 - 1:30p

MEETING PURPOSE: To ensure that the framework responds to workgroup members' initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Jordan Dimick, SGM Engineering, the Monitoring and Verification Workgroup ("workgroup") had a facilitated discussion on the content captured within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- Interconnected issues include potential environmental benefits, transmountain diversion projects, and agricultural techniques like deficit irrigation.
- The purpose of monitoring and verification is to accurately quantify what wet water has been added to the system, so functionality, accuracy, and efficacy are key themes.
- The references to time are not as accurate when referring to historical diversion rates. Consider taking out the "or" in the cell discussing bypass diversions, because of the potential disconnect between CCU on the west slope and historical diversion rates.
- Terms benefit from careful definitions. For example, conserved consumptive use may mean different things when discussing CCU in the Colorado River system or on the East Slope.
- Monitoring and verification in multiple systems is complex, and considerations include historic canal losses, potential telemetry, and field return flows.
- There are a variety of tools and resources available to potential DM participants.
- Grounding the A-B-C columns in hypotheticals would help to build more detail and illustrate a program.
- Equity considerations are less applicable to monitoring and verification than other workgroup topics.
- Consider building options for future participation from other sectors, like industry or environmental.
- Column A approaches to monitoring and verification may be too simplistic for many DM programs.

Open Questions

- How will pilot programs inform the framework?

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Education & Outreach Workgroup

DEMAND MANAGEMENT FRAMEWORK MEETING

May 3, 2021 | 1:30 - 3:00p

MEETING PURPOSE: To ensure that the framework responds to workgroup members' initial feedback, and to solicit additional input on framework elements.

Version 1 of the draft demand management framework is available for review here.

Discussion Highlights

Following presentations on the demand management framework ("framework") by Amy Ostdiek, CWCB, and Emily Zmak, CDR Associates, the Education and Outreach Workgroup ("workgroup") had a facilitated discussion on the content captured within the workgroup's focus area.

The overall discussion focused on:

- The framework and the elements, trade-offs, and considerations captured within it; and
- Informing the CWCB Board's decision-making process.

Framework Feedback

- □ Clarify messaging around purpose, motivation, and objectives.
- □ Outreach should give a clearer sense of the options to illustrate what implementation would look like.
- □ With a statewide program, messaging outside of Column C would be difficult because of the scale.
- □ Consider adding additional detail to capture the increasing complexities for message development. The range could capture the basic process for message development; and at a higher level, message specificity for certain geographies or target demographics.
- □ Education and outreach should identify target audiences for different messages. This process could include co-developing messages with the target audiences.
- □ A feedback loop will build trust and develop a better program.
- □ While the general public could benefit from general water education about curtailment and drought, targeted audiences should be DM program participants and other impacted stakeholders.
- □ Simplifying the framework's presentation would assist with engagement and interpretability.
- □ The framework does not capture the "why" (advisability) nor climate change.
- □ Frame issues around shared values, such as individual agency and the program's facilitation of choice.

Open Questions

- □ How are impacts being communicated? To what level of detail?
- □ How do messages change by audience and geography?

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Public Workshop Meeting Summaries

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION

June 2021

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Demand Management Public Workshop #1

PUBLIC WORKSHOP MEETING #1

June 1, 2021 | 1:00 - 2:30p

Discussion Highlights

Following presentations on the Demand Management Framework ("Framework") by Amy Ostdiek, CWCB; the Monitoring & Verification section by Jordan Dimick, SGM; and the Environmental Considerations category by Bailey Leppek, SMG; the Public Workshop #1 had a facilitated discussion on the Framework categories Monitoring & Verification ("M&V") and Environmental Considerations.

Framework Feedback

- Participants' priority considerations included: creating a truly voluntary program; ensuring effectiveness; balancing accuracy and implementability; and maximizing benefits to environment
- Concern that M&V is complicated enough without combining it with the issue of proportionality
- Consider clarifying the language regarding municipalities on the West and East Slopes
- Broad concern for understanding how this framework is going to inform the CWCB decision-making and implementation processes
- Shift to hypotheticals to illustrate what requirements might be for each category
- Broaden the lens to include West Slope municipalities and industrial water users
- Concern about the significant costs of issues-management
- Define what shepherding water from remote and/or rural locations to the state line looks like
- Consider other options for incentivizing environmental benefits
- The state could consider a minimum and more robust requirement for environment
- Considering equity and proportionality in M&V adds an additional, complicated layer
- Gaps in the framework include the state's process for shepherding water; clarity on state measurement rules or mechanisms; and pilots to address transmountain projects and environmental impacts
- Incorporate relative time, accuracy, and costs into the Framework's A-B-C options
- Concern that incentives are shifting away from compact compliance and toward environmental benefit

Open Questions

- How to connect the Framework to decision-making and implementation at the CWCB?
- How does the Demand Management program work in different locations and elevations?
- How will the Board make decisions about the A, B, and C columns? And how does the Framework inform feasibility?
- How could a program incentivize a C-column approach to the environment without or beyond money?
- What does the cost look like? Where does the funding come from?
- What is the process for shepherding water to the state line?

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Demand Management Public Workshop #2

PUBLIC WORKSHOP MEETING #2

June 14, 2021 | 11:30 - 1:00p

Discussion Highlights

Following presentations on the Demand Management Framework ("Framework") by Amy Ostdiek, CWCB; the Economic Impacts & Local Governments section by Brett Bovee, WestWater Research; and the Agricultural Impacts section by Angie Fowler, SGM; the Public Workshop #2 had a facilitated discussion on the Framework categories Economic Impacts & Local Governments and Agricultural Impacts.

Framework Feedback

- Provide technical details about what Demand Management would encompass and look like in application, specifically for farmers and ranchers in the Colorado River Basin
- Interest in exploring the legal details of Demand Management in the Framework
- Concern about how to address claims of injury and how to prevent injury
- Consider defining alternative or innovative incentives for Demand Management participants beyond money, especially for municipalities
- Define the long-term implications for rural communities and the impacts to the agricultural sector
- Consider storing water in reservoirs within the state, rather directly in Lake Powell, to provide more internal control
- Develop clear direction for next steps and approach
- If participants are going to give up water for a few years, they need assurance that the program will provide insurance from curtailment
- Desire for a program to align with growing season schedules and ranch operations
- Impacts will likely be very localized and specific, so the Framework should include a process to evaluate and resolve local impacts in a responsive manner
- Consider secondary impacts of a program, such as health care

Open Questions

- How to ensure that one sector or region doesn't bear all the burden?
- How best to prepare water users for the new normal of water scarcity?
- What are the considerations and agreements that must be reached with the other Upper Basin states that are not encompassed by the Framework?
- Would the Demand Management program work with other state agencies?
- How is Demand Management different from existing programs like the ATM program?
- How is CWCB considering abandonment or speculation issues of water rights?
- Can other people object to an applicant's Demand Management application?
- How will the pricing of water work?
- What does "temporary" entail (years, months)?

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Demand Management Public Workshop #3

PUBLIC WORKSHOP MEETING #3

June 14, 2021 | 1:30 - 3:00p

Discussion Highlights

Following presentations on the Demand Management Framework ("Framework") by Amy Ostdiek, CWCB; and the Education & Outreach and Process Consideration sections by Emily Zmak, CDR Associates, the Public Workshop #3 had a facilitated discussion on the Framework categories Education & Outreach and Process Considerations.

Framework Feedback

- Foster broader understanding for water providers and users about Demand Management's purpose and goals
- Turn the Framework into action through clearly-defined next steps and process clarity, and push up the contingent decision
- Define and articulate the problem of compact curtailment as the alternative to Demand Management
- Engage actual water users to better understand problems and obstacles for potential participants, which may require making the process more clearly defined
- Be intentional in special engagement with the Ute Tribe
- Create Spanish-language newsletters and informational documents about Demand Management, and partner with Latino organizations to assist with translation and messaging
- Add specificity about the audiences that should be targeted for outreach to better define the goals
- Stakeholder education needs to be informed by a real process, data, and programmatic information
- Group consensus that Column C in Process Considerations is needed to mitigate user concerns and ensure program success
- Incorporate process transparency with the public, especially around lessons-learned and successes
- Include a technical state role or service to help water users apply and develop applications

Open Questions

- Where are the other Upper Basin States in their processes?
- What is the worst-case scenario without Demand Management?
- Who are the key audiences, and what are the messages those audiences need to hear?
- How to engage water users to inform the planning process?
- How to reach stakeholders who have not shown up to CWCB's engagement opportunities?
- How do we communicate water and water challenges with diverse and historically underserved populations?

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Public Listening Session Meeting Summary

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION

June 29, 2021

Discussion Preface

Following brief presentations on the Demand Management process by Greg Johnson, CWCB, and Emily Zmak, CDR Associates, meeting participants provided comment about the Demand Management framework; the work done to date; organizational positions pertaining to the proposed Demand Management program; and/or personal thoughts and reactions to the concept of Demand Management. Comments were limited to five minutes per participant, and were otherwise unrestricted.

Participants were encouraged to submit written comment in addition to the statements summarized below.

Comment Summaries

Aaron Citron, The Nature Conservancy

- Recognizing the ongoing bad hydrology and need for cohesive Colorado River policy, he encourages CWCB to pursue Demand Management as a critical piece in a suite of tools to address Colorado River issues
- Encourages CWCB to capture trade-offs in the framework document and to include sideboards to benefit rivers, protect communities, and ensure proportionality
- Advocates for advancing policies that would build a Demand Management program, which could include pilots and demonstrations to illustrate how a program could function

Mark Harris, Grand Valley Water Users

- He believes that the process to-date and the Demand Management framework have adequately captured the concept of Demand Management
- Now that the initial work is done, it is time to answer questions like, “So what?” and “What now?” Encourages CWCB to try a compensated, voluntary, and temporary program.
- Believes that many farmers, ranchers, and their organizations are willing to find solutions
- Supports CWCB’s identification of practical solutions, and believes that trying something new is the best way to answer the important questions
- Urges CWCB to articulate the next steps in the Demand Management process and develop a timeline

Tom Gray, Yampa/White/Green Basin Roundtable

- Are there hard parameters or sideboards about what Demand Management would look like and, if not, when will the hard parameters begin to be established? Encourages the development of hard statements for people to grapple with and respond to.
- Will staff make a recommendation to the Board about next steps?

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Don West, Colorado Water Exchange

- Regarding the Monitoring and Verification section of the Framework, he advocates for a combination of the A and B Columns
- Is comfortable with the state's Lease Fallow tool, probably in Column B
- Encourages transparency around crop coefficients; in particular, taking a statement like, "For this program, the state will use X crop coefficient with Y elevation adjustments."
- What is the role of municipalities in conserved consumptive use? The framework focuses on the agricultural aspect.

Alden Vanden Brink, White River

- He believes that Demand Management adds to the crisis, and that it adds a target on agriculture
- The White River has depended on flood irrigation and artificial recharge for more than 100 years
- Encourages developing more reservoir space to alleviate compounding pressures on the White
- Would like a no-injury clause to protect White River users

Jeff Meyers, Yampa/White/Green Basin Roundtable

- He believes that motivation to deal with the drought is strong
- The framework document is valuable; however, the detail, complexity, and presentation means it is not the most accessible document
- Encourages CWCB to include language in the framework that defines equity as a means of ensuring all Colorado basins participate on an equitable basis
- A key issue is return flow, namely the ecosystem benefits of flood irrigation
- Feels that there is not a lot of knowledge about what Demand Management might mean or how seriously the hydrology is, so sees education and outreach as critical in this process
- Would be helpful to know from the State Engineer what curtailment might look like

Abby Burk, Audubon

- Both birds and people dependent on the Colorado River have been impacted by water supplies
- Demand Management is an alternative to curtailment and provides flexibility for Colorado
- Audubon is supportive of a Demand Management program to protect Colorado and other water users, and to yield environmental benefits; encourages CWCB to move forward and avoid delays
- Believes the framework is a good start: the next step is to evaluate the trade offs and develop a program that can be one tool in the toolbox

Austin Vincent, Colorado Farm Bureau

- Agriculture is one of the state's largest economies, especially on the West Slope and in rural areas
- Wants to help find the solution to western water supplies and to avoid risk of curtailment
- Colorado Farm Bureau supports temporary, voluntary, and compensated programs that share the load with municipal, in-stream, environmental, and recreational flows
- Wants to have attainable goals that supports producers and creates a practical program
- Encourages CWCB to use existing programs and state agencies in a Demand Management program
- Encourages CWCB to expand education and outreach with farmers / producers on the West Slope

Orla Bannan, Western Resource Advocates

- Has submitted written comments to CWCB
- Sees the need for urgent action because of the bad hydrology
- Encourages CWCB to look for next steps and find win-win environmental benefits

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Chris Treese, ret. Colorado River District, consulting with Southwest Colorado River District

- Has submitted written comments to CWCB from the Southwest Colorado River District Board
- Characterizes the Southwest guidelines as skeptical-but-constructive, and articulates a commitment by their Board to remain engaged in Demand Management discussions
- Principally concerned with protecting agriculture and ensuring that a Demand Management program not target agriculture, nor encourage speculation in Western Colorado's agricultural waters
- Remains mindful of the consequences of both a Demand Management program and compact administration, which is not equitable, compensated, nor voluntary

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EngageCWCB Survey Responses

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION

Engage CWCB Survey Responses

Questions					
What river basins are you interested in?	Southwest River Basin	Southwest River Basin	Yampa-White-Green River Basin	Colorado River Basin	Arkansas River Basin Colorado River Basin Gunnison-Uncompahgre River Basin North Platte River Basin Rio Grande River Basin South Platte River Basin Southwest River Basin Yampa-White-Green River Basin
From your perspective, Demand Management (select all that apply):					
Would benefit agricultural water users overall.	X	X		X	
Would hurt agricultural water users overall.			X		
Would benefit urban water users overall.	X	X			
Would hurt urban water users overall.			X		
Is an opportunity for the entire state to collaborate for the benefit of the Colorado River.		X	X	X	X
Is an opportunity for Colorado to insure itself against mandatory curtailment in the Colorado River Basin.	X			X	X
Is an opportunity to build resilience in rural communities.			X		X
Is a program that individual producers should be able to choose to participate in.	X	X	X	X	X
Is a program that communities should be able to provide feedback on.	X	X	X		X
Is a program that municipalities should be able to choose to participate in.	X	X	X	X	X
How might a Demand Management program potentially benefit or impact you individually?	To avoid the potentially devastating economic impacts of a Colorado River water curtailment on the west slope.	Probably not much effect	Increased likelihood of low stream flows in the summer, fall, and winter months reducing ability for irrigation (rising food cost), recreation (angling, canoeing, waterfowl), community water restrictions, degrades drinking water quality (water aesthetics, increased water treatment cost passed to the consumer), increase of nuisance aquatic vegetative species, increased tax burden risk due to seasonal low impacts on threatened and endanger species that live in our rivers (successes and dollars expended, invested, from protecting these species), increase concentration of wildlife to lands for available food, forage, water, winter range security, private land owner wildlife impacts and conflicts, loss of productive ag lands, create great dependence upon purchasing outside livestock feed source to maintain herd, livestock herd reductions due to loss of feed, secondary economic impacts from loss of agriculture, recreation, community water conservation losses to personal income (car washes, lawn care, plumbers), increased utility rates, increased to NPDES water quality standards and community waste water treatment processes	Rationalizing the approach to dealing with threats to the Colorado Basin, including agriculture, from climate change, hydrologic volatility, and related pressures. Waiting for the train wreck, slow or fast is a poor choice.	1. I live in rural Colorado and open space is a very important component of my quality of life. Programs that open the door for development of agricultural lands and/or abandonment without weed control would affect my community. Impacts (positive or negative) to the community MUST be taken into account in selecting participation. 2. I'm an avid outdoors person and work hard personally and professionally to help protect rivers and watersheds. A program that results in negative impacts to rivers and watersheds would impact me directly. 3. Wildfires have devastating effects on people, communities, rivers, watersheds and the wildlife they support. The potential for participating fields to increase wildfire risk needs to be evaluated before projects are accepted.
How might a Demand Management program potentially benefit or impact your community?	Avoiding the economic impacts of a curtailment.	Perhaps excess water could be dinted from city supplies for compensation. Protection from a call.	[Ditto]	See #6	See response above.

Survey Responses

What topics or concerns would you like addressed in the next phase of the feasibility investigation?	Piloting the use of auctions to determine who gets paid and how much.	Value of water under this scenario	How to maintain the Colorado River system when water reserves are depleted due to continued drought and or aridification. Impacts to alluvial storage and agriculture return flows. Impacts to basins and water users dependent upon alluvial storage and return flows from agriculture. Quantify the injury to water users when storage is depleted. Quantify how basins without storage are impacted. Why does Colorado not want to use the states full Colorado Compact allocation? Why is Colorado anti-water storage for compact protection purposes? What risk are there and growing while Colorado continues to vet DCP and DM? Is there valuable time being lost to get critical projects done to offset or lessen drought and aridification impacts while the water political world vets DCP and DM? What will happen to an area, community, region should water not be available? What is the States plan for areas that lack adequate drought resiliency? What legal risk is the state opening if a DM program is developed and people run out of water due to a Colorado Approved or Sponsor DM program? Does "no-jury" come into the DCP/DM equation?	We know how to create CCU, programmatic pilots investigating the administration of such CCU should be among the choices	How will flows be shepherded to Lake Powell (or any other storage bucket)? Is storage in Lake Powell the best alternative (in light of tremendous evaporation loss); should storage in Colorado reservoir be explored as a first alternative, with delivery to Powell on an as needed bases? These matters are not included in the Framework.

Do you have any additional thoughts or feedback on the Demand Management Framework and the way the potential program is being considered?	I have previously commented to the CWCB that it needs to pilot the use of auctions. Auctions are a fair and equitable means to determine who gets paid and by how much. It is also fair to who pays the bill. The attached concept paper outlines the use of auctions. Attached is a water auction design document recently co-authored by Dr. Bonnie Colby from the University of Arizona and the Colorado River Research Group. https://climas.arizona.edu/publication/report/water-auctions-design-implementation-and-evaluation Additionally, below are a couple of opinion pieces that I co-authored regarding the use of auctions to reduce Colorado River Water use. Fresh Water News, August 19, 2020 Opinion: Use auctions to set prices for Colorado River drought pool https://www.watereducationcolorado.org/fresh-water-news/opinion-use-auctions-to-set-prices-for-colorado-river-drought-pool/ The Colorado Sun, September 14, 2020 Opinion: Colorado needs a water market to reduce Colorado River water use https://coloradosun.com/2020/09/13/colorado-river-compact-denver-water-opinion/?utm_source=ActiveCampaign&utm_medium=email&utm_content=A+fragile+foundation+for+vaccines+%2F+Lauren+Boebert+s+rise+%2F+State+sues+USPS+over+voting+misinfo+%2F+After+Suncor+settlement&utm_campaign=Sunriser+-+9%2F14%2F2020&vgo_ee=NoyTwJ1V3BKXqMdyi2gTAw%3D%3D I will be happy to help the CWCB think through how to design water auctions and the market structures required to implement any Demand Management Program.	I think the market should determine price. Mostly excess storage will be the best source.	Very dangerous program that opens up unintended secondary impacts to other water users. Each basin is different and should be treated as such. "No-injury" should be implemented. Yampa/White/Green Basin Roundtable Recommended Draft Demand Management Statement Executive Summary Context In the face of persistent drought and anticipated long-term growth in demand for water, Colorado and the other 6 Colorado River Basin states have prepared a Drought Contingency Plan (DCP). One element of that plan is to investigate the feasibility of Demand Management (DM). If implemented, DM will become a future program which, on a voluntary, temporary, and compensated basis, will reduce water use by individual, public, and commercial water rights holders, to avoid administration of the Colorado River Compact on the Colorado River. Statement of Principles Given the context for DM in Colorado, the Yampa/White/Green River Basin Roundtable considers the following concepts to be important in the development of a DM program: 1. Preservation of Quality of Life in the Y/W/G River Basin: Any DM program must preserve and enhance agriculture, local communities, and economies in our basin, while protecting municipal delivery, addressing environmental needs as well as recreational water use, and offering locally accepted methods to reduce consumptive use without injury. 2. Equity of Responsibility and Opportunity: A DM program must be structured to ensure that no river basin nor single water user group (i.e, Ag, M&I) bears a disproportionate share of DM responsibility, and to provide DM opportunities to all water right holders on a reasonably equitable basis. To ensure equity, some form of inter-basin apportionment is required. 3. Guided Market: The State of Colorado should establish a marketplace for DM water transactions that is structured to ensure/mandate fairness and transparency. 4. Recreation and Environment: Any DM program must consider/analyze its impacts on environmental and recreational needs, including those resulting from changes in water supply and/or timing of flows, and must not adversely impact these water uses and their contributions to local economies. 5. Rural Communities: Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, or social impacts. 6. Compensation for Value of Water Conserved: Any DM program must fairly compensate a participant who foregoes use of a water right. Compensation must be based on all economic impacts to the participant and not solely on the loss of income from the crop or product not produced. 7. Trans-Mountain Diversions (TMDs): Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the CRS, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit trans	We need to consider lower case demand management, that being water conservation, learning what we can, as we wrestle with upper case DM as a part of DCP; dm is coming ready or not.	The Framework does a good job summarizing the threshold issues and alternatives discussed in each DM workgroup, but it is still too abstract and vague. I think it is time to put one or more strawmen out there so people can react. And by strawman, I mean an outline of a potential program with specific components.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Stakeholder Letters Submitted to CWCB

DEMAND MANAGEMENT FEASIBILITY INVESTIGATION

Grand Valley Water Users Association

Comments to CWCB DM Framework Listening Session June 29, 2021

I am Mark Harris General Manager of GVWUA in the Grand Valley

Thanks to all of you inside and outside the CWCB that have worked diligently to get us to this DM Framework to this point.

I am not going to make specific comments on the contents of the Framework or discuss the process by which it has been developed, but we do believe the process and the resulting document provides an adequate exploration of the appropriate issues and provides a place from which to continue the search for real time and real world solutions to the use of DM as a part of DCP and perhaps on what we call lower case dm….productive approaches to water conservation that are a part of all our futures.

What I do want to share briefly is what I am being asked by the Board I serve and the farmers and other water users we deal with every day.

What folks want to know is the "so what" and "what now"….

We hear a pretty clear concern with the state of the River, compounded by weather concerns, and by extension the fate of the GVWUA and the Grand Valley in the face of these challenges. People are asking us what we managers, the CWCB, organizations like the River District, and other organizations are doing to effectively deal with the outcomes of worsening trends and increased volatility, not just for this year and the very near term, but for the longer term as well.

They wonder how these DM explorations address the very real problems they see coming?

Our organization knows that many farmers and ranchers know how to create CCU, and even perhaps how to deal with it within their own organization or on their ditch. But the larger question I am asked is SO HOW move on and WHERE is the vehicle by which we do something productive with that water potentially made available in a voluntary, temporary, and compensated basis in several geographies by various methods.

Who is working on that that they ask? And when? What's next after all this talk they ask? Can't we try something?

Well the GVWUA submits that the time to work on answering those challenges is upon us. We recognize, acknowledge, and respect the very real differences in opinion that many of our peers and partners have regarding these difficult issues. But we also believe that many farmers, ranchers, and the organizations that serve them remain willing to find a productive way forward for agriculture and the State of Colorado, if for no other reason than it is in our best interest to do so. ***Agriculture will be as heavily impacted by the solutions to the water problems we face as we are from the problems themselves.***

Finally, we support CWCB's identification and funding of appropriate, practical, PROGRAMMATIC PILOT PROJECTS that help understand how to administer the CCU that many people already know how to create.

I know I am not telling you anything new when I say that the only way to really raise the important questions and to identify the positive and negative consequences of our actions is to try something.

You have heard me use his analogy before, but here it is one more time.

You can sit in the coffee shop all winter and talk about, cuss and discuss, and second a new crop for next spring. **But sometime you just gotta take the planter to the field…..**and you may get a few blanks, and you may abandon the plan in favor of another one next year, but you know you have to be trying something every year. Embracing the past too tightly does not help us deal with the future.

There is no other way to advance the agenda without taking some well-considered risk. And all those involved in creating the FRAMEWORK have done that. We urge the CWCB to take aggressive action toward putting this time and effort to continued good use, clearly articulating the next steps in the DM process, and creating a projected schedule by which it can be accomplished.

It doesn't look like the water and the weather are not going to wait for us.

Thanks for time this afternoon and good luck**.**

RIO BLANCO WATER CONSERVANCY DISTRICT

July 6, 2021

Colorado Water Conservation Board of Directors
1313 Sherman Street, Room 718
Denver, Colorado 80203

RE: Colorado Drought Contingency Plan - Demand Management

Dear Honored Member of the Colorado Water Conservation Board of Directors

The Rio Blanco Water Conservancy District (RBWCD) would like to say it is a pleasure to provide comment on Demand Management however recognizing our present state of drought and continued aridification this is proving to push a level of conversation not many are fully prepared for nor comfortable with. There is more gratifying task we all would rather be doing in our water world but here we are today in our drought-stricken region formulating a plan for a better tomorrow. Evidently all of us were chosen in one fashion or another to be part of this crucial topic in preparation for our future generation's water security. Changing times for sure.

The winds of change are upon us, and we recognize the need for adaption to our changing environment. Being such, the RBWCD believes it is imperative for the CWCB to understand the function of the White River Basin with respect to Drought Contingency Planning (DCP) - Demand Management (DM). We believe no other Colorado water basin in our great state functions as we do nor has done so for such an extend period.

Our White River community is cultivated around areas of alluvial gravel deposits that have been washed out from the Flat Tops and high desert plains over the millennium recharged by snow, rains, and flood irrigation. The combination of these is what keeps the water available for our community needs. With the reduction in snowpack and seasonal rains not to forget increased temperatures, this has impacted our ability to put water to full beneficial use due to the lack of directly available supply from the stream or retiming of water while also reducing the alluvium storage.

RIO BLANCO WATER CONSERVANCY DISTRICT

Under normal years with average precipitation, flood irrigation plays an immense role "topping-off" our White River alluvial aquifers but with the loss of direct flows and seasonal precipitation less water is available to be applied shorting the alluvial aquifer storage not to forget the natural recharge occurrence which our White River basin is dependent upon. Once the alluvium is full water eventually migrates back to the stream as return flows for other later in the season beneficial water reuse. Typical return flow season is from late summer to late winter months.

For DM discussion purposes, the White River basin has: 2 municipalities, Meeker (ground water supply) and Rangely (direct diversion surface water supply) supporting a population of about 6,400 citizens; limited industry that continues to be sequestered; recreation; and agriculture. A DM program imposed upon the municipalities will have limited conserved consumptive use with the small population, industrial water use is an incredibly small quantity, recreation is non-consumptive, so that leaves agriculture to take care of the lion's share of water for a White River DM program. As the DM program is rolling out with uncertain side boards, we must presume any Conserved Consumptive Use will be primarily sacrificed by agriculture which is the life blood of our basin hydrology. Take away or restrict flood irrigation and we eat away at the primary drought insurance policy of our community and stream ecology shorting alluvial recharge and return flows, which has been encountered during previous drought-stricken years.

Unlike other Colorado basin's, the White River is void of any real storage for drought or contingency protections hence part of the purpose and need for RBWCD along Yellow Jacket Water Conservancy District, Town of Rangely, and Rio Blanco County to aggressively push for Wolf Creek Reservoir. Our community is progressing with our Drought Contingency Plan that includes physical storage because we understand the vulnerability to our present system and how storage provides water user flexibility. White River constituents currently face an imminent municipal, agricultural, environmental, and economic catastrophe without a resilient water supply then add DM on top of our already tasked and limited water resources? The picture is grim for our community to say the very least. What happens to our towns if there is over conservation as part of a DM program and our water supply is eliminated or injuriously reduced due to the dry up of agriculture or another DM alternative? Where do we turn to then to carry us through these water short times? Critical storage is not here yet and as DM is evolving there will become more need and reliance upon storage. We ask, what are the states

RIO BLANCO WATER CONSERVANCY DISTRICT

plans to carry our district water needs through when water is already past the state line as part of a state Drought Contingency Plan and basins lack critical components for drought resiliency?

By keeping water in the stream and out of our alluvium by reducing flood irrigation what affect will this have upon stream ecology or the threatened and endangers fishes that reside here later in the season with reduced alluvium storage and return flows? What happens to the considerable investments made for the protection and recovery of our threatened and endangered species or recreational fishery species? Modeling completed for the White River demonstrates low to no stream flow risk to be very real.

Proponents for a DM program express climate change as a purpose and need for such a program yet are they taking into consideration the impacts to drying areas up removing green belts from playing a roll in carbon sequestration and the associated atmospheric cooling these areas provide? Perhaps in place of drying areas up we should be wetting areas using the plants and soils for what they have to offer. How does a browned pasture or field aid or play into a warming climate? Are we treating a symptom as opposed to implementing part of a cure by not wetting and activating these carbon bioreactors?

Part of the DM discussion includes conserved water to be stored downstream in Lake Powell. The district finds this approach unique since once the water has exited Colorado the multiple beneficial uses of our precious resource are no longer possible to Colorado water users. Has the state completed a Cost/Benefit analysis quantifying the benefits to our state by keeping the conserved consumptive use within our boarders? Our analysis has shown the financial benefits keeping water within our basin with the short list detailing; increased economic diversity, healthier municipalities, greater agriculture security, more recreation, stronger healthier stream ecology, and increased carbon sequestration. The White River, while not having formal representation to the DM framework development, is unaware of any attempt by the state to quantify such an analysis. Seeing this, the RWBCD recommends the state quantify these benefits as part of the DM process in a truly representative, open, and transparent means without prejudice including entities or individuals having a truly vested stake in any DM program. This includes entities statutorily created for water conservation such as water conservancy and conservation districts who have additional concepts for DM yet not part of the conversation.

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"The Colorado Water Conservation Board's mission is to conserve, develop, protect, and manage Colorado's water for present and future generations." We understand and agree with this complex mission also realizing the state has a legal obligation to meet the Colorado River Compact. Not a simple task. In the instance of DCP and DM is the state truly looking for the wellbeing of our White River community? We see DM evolving around continued or expanded trans-mountain diversions, restrict less-developed basins/regions, and benefit the lower Colorado River basin states all of which is elated to in the DM Framework.

Through a public process created by HOUSE BILL 05-1177 "COLORADO WATER FOR THE 21ST CENTURY ACT" the Yampa-White-Green Basin Round Table unanimously created seven (7) Principles specific to Demands Management. The RBWCD believes these principles are important and MUST be an essential part of any DM program. The principles are: https://drive.google.com/file/d/1YpIQhFCnzzK5FgZ5mQO0Eo8Y19kmDak6/view

1. *Preservation of Quality of Life in the Y/W/G River Basin: Any DM program must preserve and enhance all aspects of quality of life in our basin, including agriculture, local communities, and local economies, while protecting municipal delivery, addressing environmental needs as well as recreational water use, and offering locally-accepted methods to reduce consumptive use without injury.*
2. *Equity of Responsibility and Opportunity: A DM program must be structured to ensure that no river basin nor single water user group (i.e, Ag, M&I) bears a disproportionate share of DM responsibility, and to provide opportunities for all water right holders to participate on a reasonably-equitable basis. To ensure equity, some form of inter-basin apportionment is required.*
3. *Guided Market: The State of Colorado should establish a marketplace for DM water transactions that is equitable and transparent.*
4. *Rural Communities: Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, or social impacts.*
5. *Recreation and Environment: Any DM program must consider/analyze its impacts on environmental and recreational needs, including those resulting from changes in water supply and/or timing of flows. Any DM program should strive to benefit, and must not adversely impact, environmental and recreational water uses and their contributions to local economies.*
6. *Compensation for Value of Water Conserved: Any DM program must fairly compensate participants. Compensation should be based on all economic impacts to the participant and not solely on the loss of income from the crop or product not produced.*

RIO BLANCO WATER CONSERVANCY DISTRICT

7. *Trans-Mountain Diversions (TMDs): Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the CRS, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit trans-mountain diverters from purchasing Western Slope water to meet a DM responsibility.*

The Rio Blanco Water Conservancy District unequivocally believes in water conservation and the overlaying rationale for DM but we question the looming injury such a program will have to our basin water users. We continue progressing our locally driven drought planning efforts that includes considerable water conservation imploring upon the CWCB and other state water agencies part of the DM development framework to keep the intricacies and lack of drought resiliency of our White River community in mind as the states DCP evolves. We must reiterate, significant desire to participate in a DM type program is evident in our White River basin however, we lack critical tools necessary for drought and over conservation resiliency. Basin storage is a vital component of our drought planning and must be part of any successful DM program.

Thank you for the opportunity to provide comment.

Wade Cox
Board President
Rio Blanco Water Conservancy District

Wade K Cox

2252 East Main Street – Rangely, Colorado 81648 Phone (970) 675-5055 Fax (970) 675-5531

June 30, 2021

Ms. Amy Ostdiek
Colorado Water Conservation Board
1313 Sherman Street, Suite 718
Denver, Colorado 80203

Delivered via electronic mail to amy.ostdiek@state.co.us

Re: Comments on Demand Management Feasibility Investigation

Dear Ms. Ostdiek,

On behalf of Trout Unlimited ("TU"), I am pleased to offer these comments on the Demand Management Feasibility Investigation (the "Investigation") and the Demand Management Framework (the "Framework"). TU appreciates the hard work of the Colorado Water Conservation Board ("CWCB") and its staff in leading the Investigation and in developing the Framework, and we appreciate the opportunity to provide input on these important issues.

As you will recall, in August of 2020, TU sent you a letter commenting on a number of issues related to demand management and the CWCB's Demand Management Feasibility Investigation. A copy of TU's 2020 letter is attached for your reference. Many of the issues we discussed in our 2020 letter remain outstanding or unresolved. While we recognize that demand management is complex and while we appreciate that development of the Framework has been time-consuming for CWCB staff, as an overriding matter we would have liked to have seen more progress towards resolution of demand management issues over the past year. Going forward, as we discuss in more detail below, it is important that the CWCB increase the pace of the Investigation.

Declining Climatic Conditions Require Swift Action

As you know well, climatic conditions across the Colorado River basin are in decline. Another year of hot and dry conditions has dramatically reduced runoff into an already-low Lake Powell, which is now approaching the lowest level since its filling in the early 1960s. The U.S. Bureau of Reclamation ("Reclamation") recently declared a Stage 1 shortage on the Colorado River, and Reclamation is projecting a further decline in water availability by 2022, which would trigger harsh curtailment measures under the 1922 Colorado River Compact. The need for action is urgent, and the CWCB must act now to advance the development of a demand management program, even if there is not 100% consensus across the state regarding the parameters of a demand management program.

Trout Unlimited: America's Leading Coldwater Fisheries Conservation Organization
Post Office Box 770450, Steamboat Springs, Colorado 80477
(303) 204-3057 • drew.peternell@tu.org • www.tu.org

Failure to Act Could Have Devastating Consequences

Failure to take action to address the declining hydrological conditions in the Colorado River basin could lead to severe economic disruption, litigation, or federal intervention. In other words, delays make it more likely that Colorado will suffer negative consequences or lose local control over shaping how to respond to the worsening climatic conditions in the Colorado River basin. Such a loss of control is not in the state's best interest. While there may be some hard choices in structuring a voluntary demand management program, the consequences of not acting could be significantly more disruptive to Colorado.

Demand Management is Critical

Reducing Colorado's risks under the 1922 Colorado River Compact will require a multitude of responses, with demand management likely being the most important. The upper Colorado River basin states' plan to release water from several upper basin reservoirs to bolster Lake Powell levels is an important tool, but it is a temporary fix that will not on its own prevent declines in Lake Powell elevations. Other solutions, including expanded water conservation and reuse, land use planning, infrastructure improvements, and investments in healthy watersheds will also be required. Demand management may be the most powerful risk-reduction response available.

A Pilot Program Would Help Advance the Investigation

The 2019 Drought Contingency Plan ("DCP"), which provided the upper basin states a seven-year opportunity to test demand management and store the conserved water in Lake Powell, expires in 2026. If the upper basin states are going to learn how a demand management program can work, it is imperative to launch a pilot program as soon as possible. Otherwise, we would be missing the opportunity to learn as much as we can during the DCP window. The CWCB should commit to initiating a new, multi-year pilot program with projects across different water use sectors and geographies as soon as possible. Given our past involvement in the System Conservation Pilot Program and other on-the-ground demonstration projects in the years since then, TU looks forward to working actively with our partners in the agricultural community to develop projects under a pilot program.

Conclusion

Trout Unlimited urges the State of Colorado to act quickly and decisively towards the development of a demand management program, and we look forward to continuing to work with the Colorado Water Conservation Board towards this goal. Thank you for the opportunity to provide these comments.

Sincerely,

Drew Peternell

June 28, 2021

Colorado Water Conservation Board
1313 Sherman St., 7th Floor
Denver, CO 80203
Via: demandmanagement@state.co.us

RE: Response to Request for Input on Demand Management Feasibility Decision

Dear Members,

The Theodore Roosevelt Conservation Partnership is a coalition of 60 hunter, angler, science and outdoor recreation groups working to ensure all Americans have quality places to hunt and fish. The TRCP has worked for most of its 20 years primarily with federal agencies but also with state governments on water issues of importance, including trying to correct the water demand-supply imbalance in the Colorado River Basin because of the importance of the Basin's habitat for fish and wildlife. We have been following the Colorado Water Conservation Board's efforts to determine the feasibility of a Demand Management program closely, including by serving on the Environmental Values Work Group in 2020.

Because TRCP staff will not be able to attend the Demand Management Framework Public Listening Session June 29th from 5-7 pm, we ask the Board to consider our comments below as it determines Colorado's next steps.

Context:

As the Board is well aware, this year's extreme drought conditions come on top of a 20 year mega-drought. The hydrology for the Basin's rivers and reservoirs is simply dire. If the Bureau of Reclamation's most recent 24-month study projections are true, Lake Powell may decline to elevation 3525 during the 2022 water year, triggering reductions in hydropower production at Glen Canyon Dam and putting Upper Basin cities, ranches and recreational water users at real risk for compact curtailment.

As a result, time is of the essence for the Board to identify and implement tools to help Colorado's water users collectively, including those who value our rivers for recreational benefit. Absent state solutions, individual water users will take individual action that may not help the State, its fish and wildlife, or even downstream water users. And, while the TRCP is aware of the Upper Colorado River Commission is also evaluating the feasibility of demand

management, its process cannot answer state-specific questions, so Colorado must find answers to its own issues rather than waiting for that investigation to conclude.

Delay will make it more likely that Colorado loses control to shape the responses best for its community of water users. Without action, Colorado's water users are at ever greater risk of severe economic disruption and potentially even litigation or federal intervention. Compared to those risks, which only grow with each dry year, it is worth the Board taking a leadership role to structure a demand management program, along with other tools (like the one-time reservoir releases current under discussion) to address the Basin's water challenges.

Further delay of pilots and a full demand management program in Colorado will also add to the existing burdens for Latino communities in Colorado and the Colorado River Basin. One third of U.S. Latinos live within Colorado River Basin states, including ours. As a group, Latinos are more likely to face health impacts from climate change than others. And, one cannot imagine a demographic more supportive of building resilient water systems that serve people, fish and wildlife. An astonishing 96% of Latinos in the West support funding to modernize water infrastructure and restore natural areas in ways that improve drought resilience, while 93% agree that, notwithstanding state budget shortfalls, it is imperative to fund protection of states lands, water and wildlife. Without adequate responses to drought and climate change – which is primarily expressed in terms of drought and fire in the West, including Colorado – Latinos will continue to feel the disproportionate adverse health impacts and other effects of climate change and drought. It is therefore incumbent on the CWCB to act expeditiously to stand up programs like demand management and others, that can build climate and drought resiliency without delay.

The Board, with its staff of policy, technical and legal experts, and having conducted several years of public outreach regarding demand management and other tools, is best positioned to act in a way that will best serve Colorado's people and water resources, including the fish and wildlife that resource supports. The Board must lead on demand management but also work with other agencies, water users and communities of interest to expand water conservation and reuse, promote land use plans that fosters efficient water use, fund upgrades to aging less efficient water infrastructure and invest in healthy forests and watersheds.

Framework Comments and Next Steps

The draft framework does a good job of laying out the many factors, and thus decisions that the Board would have to make to set up and implement an equitable, voluntary and effective demand management program. But the framework does not provide a way to evaluate the tradeoffs – costs and benefits – amongst those decisions. For example, with knowing the financial cost of choosing a simple, more complex or robust alternative for any one factor, the CWCB cannot know how that choice may constrain what other choices would be available based solely on their cost. While a more sophisticated decision support tool, along with more complete data, e.g., on the cost of various choices, would help the Board, given the need for quick action, there is not the time available to optimize a program at inception.

If the Board is going to set up a demand management program, not only the hydrology, but the seven-year timeline of the 2019 Drought Contingency Plan, demands action within the year. The States, Reclamation, and others have begun renegotiating the 2007 Interim Shortage Guidelines, which must also be completed in 2026. If the Upper Basin states are going to learn anything from a demand management program, they must launch that program and implement associated projects as soon as possible. A demand management program cannot help in a practical matter, or provide lessons useful for the renegotiation unless it is in place before the crisis, not after the horse is out of the barn.

We encourage the CWCB to be practical and focus on moving quickly beyond the Framework to seek solutions and implement a pilot program that incorporates a diverse range of pilot projects. There are too many additional complex questions that will also take time to answer. We encourage the CWCB staff to focus on identifying and answering key questions and supporting additional pilot projects, including hypothetical exercises in certain circumstances, as a good approach. A range of pilots is needed, incorporating diverse geographies and project types, including not only agricultural projects, but also transmountain diversion, industrial, and other projects. The conceptual proposal for a programmatic pilot from the Agricultural Impacts Demand Management Workgroup can be a starting point.

Because of the State's interests in, and in some respects, responsibilities for maintaining fish and wildlife habitat, as well as the economic benefits of recreational water use, the Board's next steps should include an analysis of potential environmental co-benefits in pilot project design or a full demand management program. Such co-benefits only become more critical in the face of changing hydrology and increasing aridification, which affect native and important non-native game species alike. Pilots as well as a full program both have the potential to impact recreational and environmental flows, either positively or negatively. We urge the state to incorporate an analysis of environmental and recreation needs and potential benefits and impacts, as well as quantitative monitoring and verification of those, in pilots and any DM program.

Thank you in advance for your consideration,

Melinda Kassen, Sr. Counsel
Jared Romero, Director of Strategic Partnerships

Feedback on the CWCB Demand Management Framework

By the Y/W/G Basin Roundtable Big River Committee
June, 2021

The Framework and Review Process

The CWCB DM Framework document contains a great deal of detailed information about DM issues and solutions, primarily gleaned from and organized around the DM Work Group discussions. The conceptual framework, based on 3 levels of solutions to address issues, is a well-thought-out approach to presenting the issues that have surface and some proposed solutions for them.

Members of the Y/W/G BRC have reviewed the Framework document in detail, and summarized their comments, suggestions, and questions in the brief that follows. The BRC chose to review the Framework document by comparing it to the Y/W/G Executive Summary of DM Principles ("Principles") published in March of this year. For each Framework topic and subtopic, members of the BRC reviewed solutions to determine whether or not those solutions aligned with or were counter to the Principles. Note that several subtopics in the Framework document are not addressed, as they do not appear to intersect with the Principles.

Comments and questions are generally divided into 2 parts; an initial section that highlights high-level comments and suggestions, and a more detailed discussion of several important topics and sub-topics contained in the Framework.

High-Level Issue Discussion

Following is a summary of high-level comments and suggestions:

1. Purpose and Goal of DM. The DM Framework should state clearly that the overarching purpose of any DM program is to reduce consumptive water usage in order to avoid a Compact call (Y/W/G Context). Although the idea of yielding conserved consumptive use and the goal of placing 500KAF in a pool in Lake Powell are discussed in the Underlying Assumptions of the doc, these were both missed by several reviewers, and it would be helpful if they were more clearly stated at the outset.

2. Shared Responsibility/Opportunity and Apportionment. The DM Framework should also state clearly that all CRS basins and water rights holders will share in responsibility and opportunity of the DM program (Y/W/G Principles 2, 7.) Specifically, no discussion of projects from Industrial water users is provided, while Municipal subtopics emphasize 'support'; several reviewers commented that the document is focused on Ag. While TMD projects are discussed, nowhere does the Framework indicate the requirement that TMD diverters participate in DM. Finally, no discussion of inter-basin apportionment, or some other means of ensuring shared responsibility/opportunity between and among basins, is offered.

Detailed Issue Discussion

Each of the topics and subtopics that intersect with the Y/W/G DM Principles was discussed to determine whether and to what degree each was aligned. Following is a summary of that review:

Major Topic 1: Monitoring and Verification (Agricultural DM Project)

Subtopic: Maintain Return Flows

Option A – (Y/W/G Principles 1, 4, 5): Does not align. Failure to maintain return flows will be detrimental to ag, urban/suburban water users, and recreation in our basin during the late summer/fall season.

Option B – (Y/W/G Principles 1, 4, 5): Could align, provided that adequate storage was available.

Option C – (Y/W/G Principles 1, 4, 5): Would align by providing locally-sourced return flow. However, the solution seems impossibly complex and costly.

Major Topic 1: Monitoring and Verification (Transmountain DM Project)

Subtopic: Measure Water Returned to Stream

Option A – (Y/W/G Principle 7): Does not align. Absent some form of accounting validation (as provided for in the next subtopic), a simple estimate provided by the TMD operator would leave room for a range of harmful outcomes. For example, the TMD operator could simply overestimate the amount of water to be diverted at that diversion point, and take credit for a greater DM impact than was actually earned.

Option B – (Y/W/G Principle 7): Does align. This approach, to which an auditable provision should be added, would help to ensure that the conserved consumptive use claimed is not simply replaced by other Western Slope waters in a 'shell game'.

Option C – (Y/W/G Principle 7): Does align. This approach is the most thorough, but probably is impractical to implement.

Subtopic: Verify Conserved Consumptive Use Occurs on the East Slope

Option A – (Y/W/G Principle 7): Does align. An auditable provision should be added to this statement, but this approach would prevent the 'shell game' tactic that allows a TMD operator to simply switch one West Slope source for another while claiming a DM contribution.

Option B – (Y/W/G Principle 7): Does align, slightly better than Option A but an auditable provision should be added.

Option C – (Y/W/G Principle 7): Does align, but seems overly complicated and expensive.

** Note: This subtopic title could be considered misleading; perhaps a better name would be: 'Verify Accuracy of Accounting for Foregoing TM Diversion and that Conserved Consumptive Use Occurs on the East Slope'.

Subtopic: Coordinate Environment and Other Benefits

Option A – (Y/W/G Principles 1, 4, 5, 7): Does align. Option A does not provide any additional benefit, but it does not involve negative impact.

Option B – (Y/W/G Principles 1, 4, 5, 7): Does align. The provision for temporary storage in a Western Slope reservoir helps to mitigate environmental and other impacts.

Option C – (Y/W/G Principles 1, 4, 5, 7): Does align (see comments for Option B) but is too complex and costly for actual implementation.

Major Topic 3: Environmental Considerations

Subtopic: Assessing Net Benefit or Impact

Option A – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Option B – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Option C – (Y/W/G Principles 1, 2, 4, 5): Does align, provided that benefits to Y/W/G basin and communities are part of the consideration.

Subtopic: Strategies to Incentivize Benefits

Option A – (Y/W/G Principles 2, 4): Does align. Ensures that all DM contributors have equal opportunity to participate.

Option B – (Y/W/G Principles 2, 3, 4): Does not align. Given hydrology, this option prioritizes participation by main stem users over tributary users.

Option C – (Y/W/G Principles 2, 3, 4): Does not align. Given hydrology, this option prioritizes participation by main stem users over tributary users.

Subtopic: Strategies to Avoid, Offset or Mitigate any Potential Negative Impacts

Option A – (Y/W/G Principles 2, 4): Does not align. Provides no benefit to Y/W/G basin users or communities.

Option B – (Y/W/G Principles 2, 4): Does align. Solutions provided would help to mitigate return flow issues and community impacts.

Option C – (Y/W/G Principles 2, 4): Does align, but seems too complex and costly.

** Note: This subtopic is very broad; some reviewers needed more context.

Major Topic 4: Economic Impact and Local Government (All DM Projects)

Subtopic: Support for Municipal Participants

Option A – (Y/W/G Principle 2, 7): May align, depending on implementation. Accounting verification required; as many municipals have conservation plans, it will be necessary to distinguish between permanent programs and CCU for DM.

Option B – (Y/W/G Principle 2, 3, 7): Does not align. Comments under Option A apply. But beyond those accounting factors, support for municipal project development provided in addition to DM compensation would constitute a large advantage for municipal projects, resulting in inequitable solutions.

Option C – (Y/W/G Principle 2, 3, 7): Does not align. Comments under Options A and B apply. And in addition to those considerations, this Option would potentially require the state of CO to make subjective decisions regarding the applicability secondary and tertiary impacts to DM, then to fund those which are deemed applicable. Ultimately, this Option is unsustainable.

Subtopic: Municipal Sector Mitigation

Option A – (Y/W/G Principle 1, 2, 4, 7): May align, depending on implementation. While this Option does not provide DM-based funding mitigation, it does allow for locally-accepted methods and decision-making.

Option B – (Y/W/G Principle 1, 2, 3, 4, 7): Does align, but involves complexities and subjective, bureaucratic judgements that would render it non-operational.

Option C – (Y/W/G Principle 1, 2, 3, 4, 7): Does align. This Option improves on the previous one by asserting non-subjective protocols. However, it would be complex and costly to implement, and very likely would not be sustainable.

Major Topic 5: Agricultural Impacts

Subtopic: Agricultural Mitigation

Option A – (Y/W/G Principle 1, 6): Does align, provided that compensation for participation is equitable. The goals for Ag Impacts (equitability, mitigating non-farm impacts, guided market, alignment with growing seasons) can and should met through appropriate funding for participants.

Option B – (Y/W/G Principle 1, 3, 6): Does align, but involves complexities and bureaucracy that would be difficult to sustain, and are unnecessary if compensation for participants is equitable.

Option C – (Y/W/G Principle 1, 3, 6): Does align, but involves complexities and bureaucracy that would be difficult to sustain, and are unnecessary if compensation for participants is equitable. Would likely be too costly to implement.

Subtopic: Agricultural Participant Field Requirements

Option A – (Y/W/G Principle 6): Does align. The operating principle asserted here is that the individual landowner holds a property right about which he/she is entitled to make decisions.

He/she has incentive to protect the value of that property through appropriate weed and pest control.

Option B – (Y/W/G Principle 3, 6): May align, depending on implementation. Providing assistance or support at the request of the individual landowner is appropriate. Enforced regulations for private property should not be implemented.

Option C – (Y/W/G Principle 3, 6): May align, depending on implementation. Providing assistance or support at the request of the individual landowner is appropriate. Enforced regulations for private property should not be implemented. Additional staffing may add cost that is unsustainable.

Yampa/White/Green Basin Roundtable
Demand Management Statement

Executive Summary

Context

In the face of persistent drought and anticipated long-term growth in demand for water, Colorado and the other six Colorado River Basin states have prepared a Drought Contingency Plan (DCP). One element of that plan is to investigate the feasibility of Demand Management (DM). If implemented, DM will become a future program which, on a voluntary, temporary, and compensated basis, will reduce water use by individual, public, and commercial water rights holders, to avoid administration of the Colorado River Compact on the Colorado River.

Statement of Principles

Given the context for DM in Colorado, the Yampa/White/Green River Basin Roundtable considers the following concepts to be important in the development of a DM program:

1. Preservation of Quality of Life in the Y/W/G River Basin: Any DM program must preserve and enhance all aspects of quality of life in our basin, including agriculture, local communities, and local economies, while protecting municipal delivery, addressing environmental needs as well as recreational water use, and offering locally-accepted methods to reduce consumptive use without injury.
2. Equity of Responsibility and Opportunity: A DM program must be structured to ensure that no river basin nor single water user group (i.e, Ag, M&I) bears a disproportionate share of DM responsibility, and to provide opportunities for all water right holders to participate on a reasonably-equitable basis. To ensure equity, some form of inter-basin apportionment is required.
3. Guided Market: The State of Colorado should establish a marketplace for DM water transactions that is equitable and transparent.
4. Rural Communities: Any DM program must evaluate and address all impacts that could result to rural communities, including negative economic, cultural, or social impacts.
5. Recreation and Environment: Any DM program must consider/analyze its impacts on environmental and recreational needs, including those resulting from changes in water supply and/or timing of flows. Any DM program should strive to benefit, and must not adversely impact, environmental and recreational water uses and their contributions to local economies.
6. Compensation for Value of Water Conserved: Any DM program must fairly compensate participants. Compensation should be based on all economic impacts to the participant and not solely on the loss of income from the crop or product not produced.
7. Trans-Mountain Diversions (TMDs): Basins which benefit from water diverted from the Upper Colorado River must be considered as part of the CRS, with applicable DM responsibilities and opportunities, and subject to equitable apportionment for DM purposes. Any DM program must prohibit trans-mountain diverters from purchasing Western Slope water to meet a DM responsibility.

The Nature Conservancy Colorado

The Nature Conservancy in Colorado
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Boulder, CO 80302

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nature.org/colorado

June 28, 2021

Submitted by email

RE: Demand Management Framework Comments

Dear Colorado Water Conservation Board members and staff:

The Nature Conservancy (TNC) appreciates the Colorado Water Conservation Board (CWCB) request for feedback on the Demand Management (DM) framework. We opted to send a letter rather than fill out the survey due the complexity of the issue and desire to provide more information than the survey could provide.

TNC is a global environmental nonprofit working in Colorado for over 55 years to create a world where people and nature can thrive. Our mission is to conserve the lands and waters on which all life depends. TNC has over one million members and works in all 50 states and impacts conservation in 72 countries and territories across the world.

Reservoirs in the Colorado River Basin, filled to the brim at the end of the 20th century, are at historic lows. By 2060, demand for water from the Colorado River may exceed supply by more than 3.2 million acre-feet. Coming up short could put at risk the drinking water supplies of almost 40 million people in the Southwest, agricultural production, endangered species, the health of our rivers, and future economic growth, as well as the Colorado River's $26 billion outdoor recreation economy with its quarter-million jobs. With so much at stake, we have been following CWCB efforts to determine the feasibility of a Demand Management program closely, and four TNC staff members served on the CWCB's demand management work groups.

Now, another year of hot and dry conditions have dramatically reduced run-off into an already low Lake Powell, which is now approaching the lowest level since its filling in the early 1960s. The U.S. Bureau of Reclamation recently projected that by early 2022, Lake Powell is likely to decline to elevation 3,525 feet—a level that would result in reduced hydropower production at Glen Canyon Dam and would put the Upper Basin at risk of triggering harsh curtailment measures under the 1922 Colorado River Compact. These unprecedented conditions require that Colorado decision-makers act swiftly and decisively to develop and implement a plan and tools to protect and manage Colorado's water and rivers for present and future generations.

Existing conditions require a multitude of responses, and demand management is a vital tool to address the Upper Basin's water challenges. The Upper Basin states' plan to release water from

several Upper Basin reservoirs to bolster Lake Powell levels is one important tool, but it is a temporary fix that won't prevent risky declines in Lake Powell on its own. Other solutions, including expanded water conservation and reuse, land use planning, infrastructure improvements, and investments to improve the health of forests and watersheds will also be required. Demand management, based on the bedrock principles of "temporary, voluntary, and compensated," and with sideboards to avoid disproportionate impacts and ensure environmental protection, may be one of the most useful risk-reduction responses available.

With hydrology rapidly degrading, the longer we wait to develop effective tools to collectively mitigate risk the more likely we are to lose local control in shaping how Colorado will respond and what tools will be available to us.

The CWCB draft framework is a good start in laying out the many decisions needed to set up and implement an equitable, voluntary, and effective demand management program. The Framework is a good summary of the State of Colorado's demand management feasibility evaluation, but it does not provide a way to evaluate tradeoffs and benefits to aid in decision-making. The framework is very detailed, which can be useful in understanding the State's process to date; however, its complexity may also be confusing to many stakeholders. As is, it provides a concise high-level summary of key workgroup concepts and issues. However, it cannot be used as a decision-making tool because it lacks a way to evaluate or consider tradeoffs and benefits between the various components of one category and the implications of that component choice on other categories.

We believe that CWCB decision-makers must evaluate trade-offs, make the hard calls, and develop a demand management program that can be in place as one tool if the situation continues to decline. The state should not let the desire for the perfect be the enemy of the workable—the current and projected hydrology doesn't allow Colorado to wait for 100 % consensus. **Now is the time for the CWCB to move forward so it has a plan and a program in place *before* a crisis.**

Inaction or undue delay could lead to severe economic disruption, litigation, and even federal intervention. While there may be some hard choices in structuring a voluntary demand management program and no one wants to reduce their water use, the consequences of not having a plan to address the crisis will be severe and costly. The decision to proceed or delay needs to be made in the full context of what can happen if dry years continue. There won't be any do-overs and curtailment without any siderails seems like a risky path for Colorado. The CWCB, with its staff and legal experts and the benefit of extensive public outreach, is positioned to make good decisions that best serve Colorado's people and water resources.

Many states in the Upper Basin are deferring to the UCRC feasibility process. That process is important but will not answer state-specific questions. Colorado must find answers to its own issues and concerns rather than waiting for the UCRC investigation to conclude.

The 2019 Drought Contingency Plan, which provided the Upper Basin States with a seven-year opportunity to test demand management and store the water conserved in Lake Powell, expires in 2026. The States, Reclamation, and others have begun renegotiating the 2007 Interim Shortage

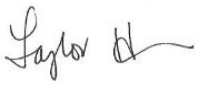
Guidelines, which must also be completed by 2026. If the Upper Basin states are going to learn how a demand management program can work, it seems that we are missing the opportunity to learn as much as we can during the DCP window to experiment with different approaches and pilot programs.

We encourage the CWCB to focus on moving quickly beyond the Framework to seek solutions and implement a program that incorporates a diverse range of pilot projects. We hope that the State will not linger on the process of finalizing or improving the Framework. We encourage the CWCB staff to focus on identifying and answering key questions and supporting additional pilot projects, including hypothetical exercises in certain circumstances, as a good approach. A range of pilots is needed, incorporating diverse geographies and project types, including not only agricultural projects, but also transmountain diversion, industrial, and other projects. The Agricultural Impacts Demand Management Workgroup shared a conceptual proposal for a programmatic pilot that offers opportunities for systematic exploration of the multiple objectives identified by the State and other interested parties.

The State has interests in and responsibilities for maintaining environmental, fish and wildlife, and recreational water uses and values. These only become more critical in the face of changing hydrology and increasing climate change driven drought. A demand management program has the potential to positively or negatively impact recreational and environmental flows, including target flows for endangered species. **We urge the state to create a demand management program that benefits rivers and that incorporates in program and project development and implementation an analysis of environmental and recreation needs and potential benefits and impacts, as well as quantitative monitoring and verification of project benefits and impacts**.

We thank the CWCB staff for their work in developing the framework and commend them on their efforts to ensure a robust and open conversation about demand management in Colorado.

Sincerely,



Carlos E. Fernandez
Colorado State Director

Taylor Hawes
Colorado River Program Director

CC:
Becky Mitchell
Lauren Ris
Dan Gibbs
Jonathan Asher
Kelly Romero-Heaney

DEMAND MANAGEMENT: Preliminary Guiding Principles

Adopted June 10, 2021

The principles outlined below are intended to guide Southwestern Water Conservation District (SWCD) in its evaluation of and input to any Demand Management (DM) program the state of Colorado, in cooperation with the other three Upper Basin states, may advance.

SWCD has not adopted a position of support, opposition or neutrality on the feasibility or development, let alone implementation, of a DM program within the Upper Basin. There are simply too many unknowns at this point. DM is an evolving concept; accordingly, this is a living policy document that will be reviewed periodically to reflect changing program elements, evaluations, and goals of DM in Colorado and the Upper Basin.

SWCD was created by the General Assembly in 1941 to lead in the conservation, use and development of the water resources of the San Juan and Dolores river basins, both of which are tributary to the Colorado River. SWCD's organic act also includes the charge "to safeguard for Colorado, all waters to which the state of Colorado is equitably entitled." Demand management is a novel concept that, if implemented, has the potential to alter water use and administration within the Upper Basin and, on a more local level, within SWCD's boundaries. Accordingly, SWCD will remain involved in the evaluation and potential formation and implementation of any DM program Colorado may pursue.

Colorado River Basin Drought Contingency Plans:
At least since the turn of this century, the security and sustainability of Colorado River water supply has been in question. The basin is currently experiencing one of the worst hydrologic cycles in recorded history. Continuing drought, resulting in worsening water supply and storage conditions, increases the risk of curtailment in the Upper Basin.

To reduce the risk of Lake Powell and Lake Mead declining to critically low levels, the United States Department of the Interior (Interior) and the seven Colorado River basin states agreed to develop and implement plans to overlay the 2007 Interim Guidelines addressing forecasted low reservoir elevations if the drought continued. The resulting Colorado River Drought Contingency Plans (DCP) were submitted to Congress on March 19, 2019. On April 16, 2019, then President Trump signed the Colorado River Drought Contingency Plan Authorization Act into law. This bill requires Interior to execute the Colorado River Drought Contingency Plans without delay and to operate applicable Colorado River System reservoirs accordingly.

For its part, the Upper Division states of Colorado, New Mexico, Utah and Wyoming committed to three primary strategies to address the impacts of continued drought in the basin. The first strategy, weather modification, was already being implemented across the basin and needed no federal legislation so was not included as part of the legislation passed in the Upper Basin's Drought Contingency Plan (DCP). The other two strategies focus directly on the goal to minimize the risk of water levels at Lake Powell falling below target elevations: an immediate response and a multi-year plan. The second strategy, articulated in the Drought Response Operations Agreement of the Upper Basin's DCP, is an immediate response measure designed to utilize operational adjustments or releases from the Colorado River Storage Project Act (CRSPA) Initial Units to bolster storage levels at Lake Powell when Lake Powell approaches a critical low elevation of 3,525' MSL. The Drought Response Operations Agreement also provides mechanisms for recovering storage at those same CRSPA Initial Units in subsequent years.

The Upper Basin's longer-term strategy is to explore the feasibility of developing and implementing a new demand management program that could generate water savings by either temporarily reducing existing water use within the Upper Basin or augmenting supplies with imported water. Under the Upper Basin's DCP, up to 500,000 acre-feet of DM water savings can be stored in the CRSPA Initial Units to help assure continued compliance with the Colorado River Compact under certain circumstances.

Most of the investigations and discussions pertaining to DM to date, have been focused on generating DM "water savings" through the voluntary, compensated and temporary reduction of historically consumptively used (HCU) water within the Upper Basin in order to assist with Colorado River Compact compliance. As a result, the guiding principles set forth below are based on the assumption that DM water will be generated in this manner.

Guiding Principles:

The foundational elements of any DM program must be voluntary, temporary, and compensated reductions in use of water that was being beneficially used under existing rights that otherwise would have depleted Colorado River basin flows within the Upper Basin.

SWCD believes DM is not a panacea. Additional options and alternatives (e.g., forest management, groundwater storage, weather modification, non-native phreatophyte removal, importing water from outside of the Colorado River basin) should be equally and fully explored as we work towards the goal of supply security and sustainability in the Colorado River basin.

Exploration of DM must be just one part of the comprehensive, basin-wide strategy for addressing short- and long-term water supply and demand imbalance that may be included in the next set of Interim Guidelines currently in negotiations regarding the operations of Lake Mead and Lake Powell for future Colorado Compact compliance.

SWCD pledges to evaluate DM as one of many possible strategies to provide flexibility and reduce the risk of curtailment in the Upper Basin.

SWCD will participate in the exploration and potential formation of any Colorado DM program to ensure any proposed program is capable of achieving its stated objectives and that adverse consequences are avoided, minimized, or fully mitigated.

Any DM program must operate within Colorado's Prior Appropriation Doctrine. The creation, storage, delivery and use of DM water must not injure any existing water right within Colorado.

Before deciding whether it would be feasible to adopt, let alone implement, a DM program within Colorado, the State must commit to developing the technical platform necessary to demonstrate that a program can be accomplished without injury to other users within Colorado, at a sufficient scale, and that any conserved water can be conserved, protected, and ultimately delivered for Compact compliance.

Any DM program must ensure equitable and proportional participation from all basins consuming Colorado River water as well as all regions and sectors of Colorado's economy. SWCD acknowledges that "equity" and "proportionality" are critical but undefined terms within the context of demand management. Both are currently the subject of statewide focus.

Transmountain diverters of Colorado River water must participate in DM using water that was historically diverted and beneficially used under decreed transmountain water rights. Transmountain diverters must not be allowed to purchase or otherwise rely upon other water supplies that originate in the Colorado River Basin in order to accomplish their proportional participation in DM.

A successful DM program can help ensure the safety and economic health of all Coloradans. Accordingly, the considerable funding required for DM must not target water right holders, water users, or other specific groups.

Colorado's DM program, if any, must be designed and implemented to support and aid sustaining Colorado's predominantly family- and locally-owned agriculture.

Storage of DM "savings" should be in CRSPA Initial Units that are located as high in the system as practicable.

Releases of DM water from storage should only be made by the Upper Colorado River Commission for the purpose of helping the Upper Division States assure continued compliance with Article III of the Colorado River Compact without impairing the right to exercise existing Upper Basin water rights in the future. Such releases should be timed, to the extent practicable, to provide the greatest economic, environmental, and recreational benefits.

Any DM program must not encourage or reward speculation in Colorado water resources.

Any DM program must recognize there will be impacts resulting from implementation of DM, and that impacts, both positive and negative, will be neither equally nor equitably distributed. Therefore, any DM program must include adequate mitigation for those individuals, water districts and ditch and reservoir companies, and communities impacted by implementation of a DM program. Additionally, DM mitigation should be designed to provide a net benefit to participating individuals, water projects, and their communities.

The evaluation of DM's feasibility, appropriateness, and whether DM is a timely and worthwhile pursuit must be approached without prejudice. In other words, a determination of infeasibility, inappropriateness or unworthiness must be honestly evaluated.

In order to 'test' DM and to allow for incremental implementation and accrual of meaningful DM savings, SWCD recognizes that initial implementation of DM may be required at a pilot or demonstration scale. However, any pilot or demonstration DM program must be conducted in conformance with Colorado water law, without injury to other water users and without prejudice regarding its conclusions or consequences.

As it continues to evaluate the appropriateness of DM, SWCD will remain mindful of the severe consequences of Compact Administration, which could force involuntary, and uncompensated water curtailments that could, in turn, result in disproportionate impacts to certain water users, economic sectors and geographic regions.

SWCD appreciates the CWCB's outreach and inclusivity in its evaluation process to date. SWCD pledges its continued, constructive participation with the state in its DM investigations.

Future Process:
SWCD will continue to explore demand management, including by proactively identifying and communicating its concerns regarding disproportionate and negative impacts potentially resulting from implementation of DM.

SWCD will continue to reach out to water districts, Tribes, and other interested parties in its on-going evaluation and assessment of DM.

SWCD will continue to evaluate water supply, water rights, and water uses and their respective relationships to Compact compliance.

SWCD will collaborate closely with the Colorado River District in order to maintain, to the greatest extent possible, harmony on DM between the two districts.

SWCD will continue to engage in all appropriate Colorado River Compact discussions.

COLORADO WATER CONSERVATION BOARD

Protecting Colorado Water

DEMAND MANAGEMENT FRAMEWORK

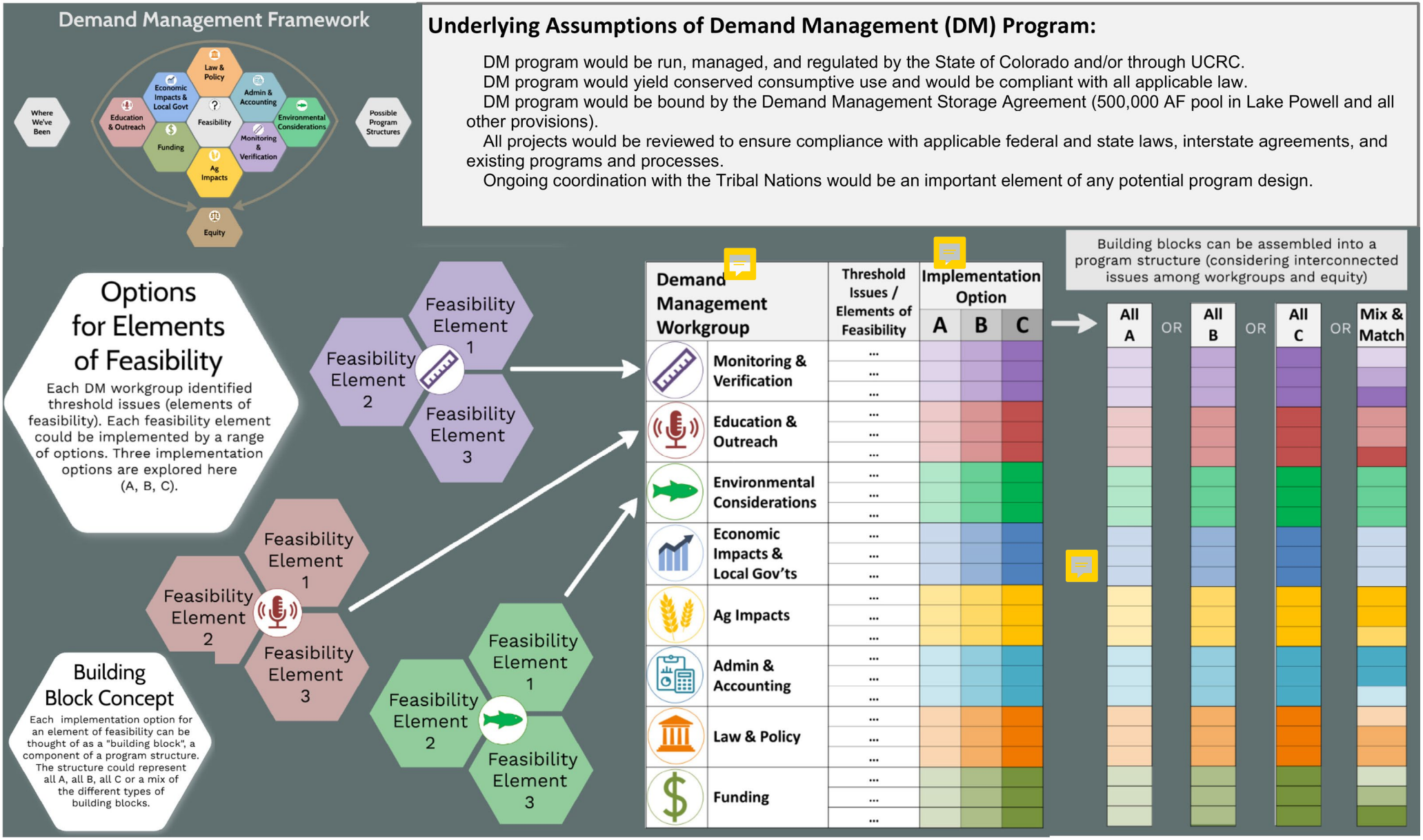
As part of Colorado's Demand Management Feasibility Investigation (see Work Plan) led by the Colorado Water Conservation Board (CWCB), this document includes a Demand Management Framework focusing on various issues associated with a potential Demand Management program.

While reviewing, note that the following Demand Management Framework draft is:

- For a potential Demand Management program that would involve temporary, voluntary, and compensated reductions in consumptive water use pursuant to the Demand Management Storage Agreement.
- Not a Demand Management program, but rather a tool for discussion regarding a potential program, which is not a foregone conclusion.
- Designed to be iterative, and there will likely be multiple updated versions released as the discussion progresses.
- Designed to show a broad range of implementation options, without showing preference for any given option.
- Set up using a range from A to C, designed to roughly correlate with level of complexity for the various implementation options. These designations do not correlate with any value judgments about which option may be best.
- Not intended to represent any commitments or guarantees regarding viability of a program design. For example, some options presented may have budgetary or other constraints.
- Intended to be used as a tool for discussion across Colorado about what may work and what may not work in a potential Demand Management program from varying perspectives, and any information gathered throughout this process is intended to assist CWCB in determining whether Demand Management may be achievable, worthwhile, and advisable from Colorado's perspective.
- Not intended to represent any position of the CWCB or the State of Colorado regarding the feasibility of Demand Management.

To provide feedback on this Framework document, please email demandmanagement@state.co.us or visit engagecwcb.org.

COLORADO
Colorado Water Conservation Board
Department of Natural Resources



*Note that Law & Policy and Administration & Accounting elements are not included in this analysis.

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DM Program Structure Matrix of Building Blocks

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DM Workgroup • Guiding Principles	Threshold Issues / Elements of Feasibility	Implementation Options A	 B	 C	Interconnected Issues, Tradeoffs, and Equity Considerations
Timeframe and scale of DM Program		All potential options may impact or be impacted by the timeframe and scale of a DM Program.			
Monitoring & Verification (Agricultural DM Project) • Honest, accurate, transparent, and defensible • Protective of other water users • As simple, easy, and flexible as possible • Participation adds water to the Colorado River Basin – not solely a retiming of depletions	**Measure water returned to stream**	Bypass of diversions (streamflow and/or reservoir releases, if applicable) if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use through moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.	Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch at a flume with a stage/discharge recorder, after which would be returned to the stream.	Diversion of the irrigation supply (streamflow and/or reservoir releases, if applicable) into a ditch with multiple real-time recording devices and a telemetry system to remotely monitor diversions and the measured returns of the irrigation supply to the stream.	Simplifying the measurement and verification requirements may underestimate the amount of credits generated for a DM project based on the need to use conservative assumptions and/or estimates. Increasing the measurement and verification requirements may result in increased instrumentation requirements, longer review and/or enrollment periods, and may increase program costs, but could result in greater amounts of credits/water generated for individual DM projects. Equity considerations include participation across diverse geographic areas, wide-spread locations within a stream system, wide-ranging ditch system complexities, and agricultural sectors/markets.
	Conduct a consumptive use analysis	Use the Division of Water Resources' Lease Fallow Tool to estimate historical consumptive use (conservatively underestimating to protect downstream users).	Complete a general site-specific potential consumptive use analysis, similar to a Substitute Water Supply Plan (SWSP), to estimate consumptive use, while considering the available diversion data and/or historical remote sensing data and/or aerial photographs.	Complete a detailed site-specific engineering analysis, similar to a water court change case, with parcel specific representative data to determine historical consumptive use and return flows.	
	Estimate the residual field consumptive use	Complete fallowing, removal of deep-rooted crops, and management practices to prevent inadvertent irrigation with visual inspections.	Full or split fallowing with ongoing measurement of groundwater levels and/or visual soil moisture inspections.	Split fallowing, irrigation of lower consumptive crops, or deficit irrigation with ongoing measurement of applied irrigation supplies, soil moisture, and remote sensing.	
	Maintain return flows	Bypass of diversions for the immediate delivery of both the consumptive use and return flow portions of the irrigation supply back to the stream after measurement.	Develop unit response functions (URFs) to determine the timing of delayed return flows to the stream and replace in time from legally available contracted supplies (reservoir releases or augmentation credits).	Determine the historical return flow patterns through a site-specific study and then construct and equip a recharge or infiltration pond with measurement devices near the fallowed field to maintain historical return flows in time, location, and amount.	Simplifying the monitoring and verification requirements for return flow maintenance may increase participation in a DM program, but could decrease streamflow absent a supply to replace lagged irrigation return flows. Increasing the monitoring and verification requirements for return flow maintenance may reduce participation in a DM program, but could be more protective of streamflow by identifying a supply to replace lagged irrigation return flows.
Monitoring & Verification (Transmountain DM Project)	**Measure water returned to stream**	Bypass of diversions if the physical and legal availability can be easily determined; or estimate the amount of conserved consumptive use using moderate engineering estimates (such as reducing historical diversion rates) to protect downstream users.	Diversion of the transmountain supply for measurement in a flume with a stage/discharge recorder, after which would be returned to the stream OR measurement of reservoir release.	Diversion of the transmountain supply with real-time recording devices and a telemetry system to remotely monitor measured returns/releases of the transmountain supply to the stream.	Simplifying the measurement and verification requirements may underestimate the amount of credits/water generated attributable for a DM project based on the need to use conservative assumptions and/or estimates. Increasing the measurement and verification requirements may result in increased instrumentation requirements, longer review and/or enrollment periods, and may increase program costs, but

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.

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DM Program Structure Matrix of Building Blocks

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• Honest, accurate, transparent, and defensible • Protective of other water users • As simple, easy, and flexible as possible • Participation adds water to the Colorado River Basin – not a retiming of depletions	**Verify conserved consumptive use occurs on the East Slope**	Water user provides accounting demonstrating the reduction of West Slope deliveries for a DM activity did not result in additional West Slope diversions from another of its transmountain systems or contractual supply.	Water user provides accounting demonstrating the reduction of West Slope deliveries for a DM activity was offset by another East Slope supply or through a reduction in the overall demand of its customers.	Water user maintains double accounting records for several years to confirm that a DM activity in one year wasn't offset by retiming of future Colorado River depletions in subsequent years. This includes all reservoir accounting records and the reconciliation of carryover storage of West Slope supplies in East Slope reservoirs.	could result in greater amounts of credits/water generated for individual DM projects. Equity considerations include participation across diverse East Slope geographic areas, wide-spread locations of individual TMD projects, wide-ranging TMD system complexities, and ability to share conserved consumptive use impacts across all users within a DM participant's system.
Monitoring & Verification (Process considerations for all projects)	**Coordinate environmental and other benefits**	Qualitatively demonstrate an increase in streamflow after bypassing a transmountain diversion and/or divert, measure, and return flows to the stream. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream.	Qualitatively demonstrate that temporary storage in a West Slope reservoir for a planned release bolsters non-consumptive, environmental and flow related benefits. Impacts and benefits evaluated qualitatively only. No additional measurement structures are required above what is deemed necessary to verify measurement of water returned to the stream and reservoir operations.	Quantitatively demonstrate that temporary storage in a West Slope reservoir for multi-benefit planned releases bolsters non-consumptive, environmental, and flow related benefits. Impacts and benefits evaluated quantitatively. Measurement needs could include flumes for measuring bypass of diversions and/or return flows; additional stream gages; measurements of water quality, etc. Accounting required to monitor a project's net effect (e.g. lagged return flow accretion timing, etc.).	Foregone agricultural and TMD diversions could provide additional benefits for non-consumptive uses and environmental flow needs both immediately after release and/or after temporary storage. Incorporating West Slope storage to manage releases of foregone agricultural and TMD diversions could maximize flexibility and bolster non-consumptive and environmental flow needs, but would result in additional evaporative losses and would reduce water generated by an individual DM project. Incorporating West Slope storage could also increase the requirements for measuring, verifying, and quantifying environmental benefits and/or impacts.

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.

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DM Program Structure Matrix of Building Blocks

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Education & Outreach • Transparent and inclusive stakeholder engagement to shape the program • Address communication gaps with message consistency, partner networks, and virtual engagement • Water education at the state, regional, and local levels • Include an equity lens in all engagement and communication	**Water education (to engage broad audiences)**	State creates detailed website resources, issues press releases, conducts interviews, and delegates many education tasks to PEPO, WEco, and other partners.	State partners with groups such as WEco, PEPO, educators, cooperative extension or similar entity, and universities to implement a series of education activities; implements a targeted communications plan; offers webinars to partner organizations; some new audience engagement.	State brings on [illegible] staff or funds education to travel statewide for strategic teaching efforts rooted in drought and water shortage knowledge; partners extensively; communicates broad-scale (i.e. radio, billboards, TV) to new water audiences.	"Change management" is an ongoing and resource-intensive effort to evolve both the program design and the state's attitudes towards water use.
	Stakeholder engagement (to inform the program)	State builds upon successes of preexisting programs. Utilizing Board and IBCC input, and updated website comment functionality, the state develops a DM program with assistance from consultants or others as needed and appropriate.	Leveraging the Board, Roundtables, IBCC, CWC, conservation districts, and public meetings, the State leads a public input process to inform a DM program and geography. As the program is developed, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies.	The state engages a broad and diverse range of stakeholders over an extended period. As the program is developed and implemented, stakeholders are invited to address the CWCB Board to proactively identify and discuss how the program is working from varying perspectives and geographies. Based on this input, elements of the DM program are appropriately tailored to local needs across the state. An iterative process with evolving program options.	More localized programs may mean that some programs cost the state more, and other programs cost the State less. Stakeholders would need to determine whether it is fair for taxpayer dollars to be distributed inequitably for the sake of equity. While an evolving program structure may be desirable as a mechanism to proactively avoid or mitigate potential negative impacts, it may make it more difficult to ensure a clear, predictable process is in place. If a DM program is established, CWCB will coordinate with other state agencies relating to conflict resolution processes available.
	Program marketing (to ensure participation)	State remains active in water forums like CWC; implements marketing plan as needed to target audiences; maximizes pre-existing participants. No active solicitation. Assumes participants would approach state.	State partners with local actors to assist with program marketing; implements proactive marketing plan to target audiences using annual allocated funds.	State opens local offices to be liaisons between the state and program participants; extensive marketing; maximizes new program participants. State has a role in co-developing applications with new applicants.	The "bang for the buck" considerations would need to be weighed by decision makers and stakeholders regarding the extent to which additional efforts yield increased program participation. Lower levels of marketing would limit the State's ability to educate / market for increased participation in certain geographies / sectors. Smaller operations, non-English speakers, and nontraditional participants such as mining or food industry would benefit from higher levels of implementation. Proportionality of program adoption would require active marketing and education efforts in areas with lower levels of implementation.
Environmental Considerations • Achieve a net environmental benefit over time, and across hydrologic conditions and geographies	**How potential environmental benefits and impacts are considered**	Environmental benefits and impacts (flow needs, affected habitat, and/or species, alignment with other plans or efforts, etc.) considered through existing review processes and frameworks.	Identify potential environmental benefits and impacts and associated risks for potential projects. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies to identify and track potential benefits and impacts, including CPW and others as appropriate.	Consider each item in a comprehensive list of potential benefits and impacts. Public stakeholder engagement could be required for large projects. This may include consultation with local entities or with a committee of experts to assess local needs and impacts. Evaluate possibility of realizing potential benefits and mitigating potential impacts. Coordinate with other agencies and local entities to identify and track potential benefits and impacts, including CPW and others as appropriate.	

*Note that implementation options A through C do not reflect the relative value or preference of any particular approach. They roughly align with varying levels of complexity, and are designed to encourage discussion about various tradeoffs relating to potential program designs.

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DM Program Structure Matrix of Building Blocks

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• Provide opportunities for projects with net environmental benefits • Not harm the environment • Evaluate project environmental benefits/impacts without creating an unnecessarily burdensome process for applicants • Identify project impacts/benefits to environmental resources, including flow, water quality, affected habitats, etc.	**Assessing net benefit or impact**	Environmental benefit or impact of a given project is assessed through existing review processes and frameworks.	List of environmental considerations evaluated qualitatively for benefits or impacts. Net benefit or impact of a project is evaluated qualitatively based on evaluation of considerations.	List of environmental considerations evaluated quantitatively for benefits or impacts. Net benefit or impact of a project is evaluated quantitatively and qualitatively based on the evaluation of considerations. Evaluate risks and tradeoffs.	More comprehensive environmental assessments could be burdensome to potential applicants as well as the State. However, greater risk of adverse impacts or lost opportunities if these assessments are not conducted.
	Strategies to incentivize benefits	No incentives provided for projects with potential environmental benefits.	Preference and/or additional monetary or program incentive given to projects with net environmental benefits.	Preference and/or additional monetary or program incentive given to projects with greater net environmental benefits. Potential partnerships with NGOs and/or local organizations to support the assessment of potential benefits.	Coordinate efforts on incentivizing benefits with local governments to streamline approval. Opportunities for collaboration on a county/local level.
	Strategies to avoid, offset, or mitigate any negative impacts	No additional strategies implemented to avoid, offset, or mitigate any potential negative impacts.	Evaluate the program as a whole for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: potential storage and retiming of return flows in an upstream reservoir to increase benefits and/or mitigation measures.	Evaluate specific projects for opportunities for partnership(s) to add environmental value (enhance benefits or avoid, offset, and or mitigate negative impacts). Examples: Potential partnerships with NGOs and/or local organizations to help in realizing benefits and mitigating potential impacts and provide additional funding, programs, or opportunities. Potential projects could include watershed restoration work, diversion structure improvements, etc.	These are very similar to the options for monitoring and verification. Additional mitigation measures would require additional funding. Measurement and quantification of potential environmental benefits and/or impacts would have monitoring and verification components or requirements (see Monitoring & Verification).
Economic Impacts & Local Governments • Any program participation must be voluntary • Initial goal of program should be to do no harm • Program should seek to create net benefits for water users • Program operations should be transparent & collaborative	**Support for municipal participants**	Existing programs and funding sources are used to support municipal participants.	State consults with and provides support for municipal participants in developing projects.	State identifies other programs that may be coordinated to support municipal participation and assists in facilitating more significant conservation programs. State consults with local governmental entities to identify appropriate mitigation opportunities.	A water efficiency program is not temporary. However, it is likely to be the least disruptive option. Municipal participant may eliminate or minimize impact municipal water customers. However, mechanism of municipal participation and/or reliance on other water sources may impact water availability for other users.
	Municipal sector mitigation	Existing programs and funding sources are used relating to municipal sector mitigation. Municipalities may take steps to avoid secondary impacts to their customers.	State more actively works to identify and track potential secondary impacts to municipalities resulting from participation in the program. A portion of project compensation spent on mitigation efforts. Mitigation payments are made to municipalities or communities.	State sets specific protocol and mechanisms for identifying and tracking potential secondary impacts resulting from municipal participation. A larger portion of compensation spent on mitigation with a defined list of required mitigation actions dependent upon type of project activity. State partners with local governmental entities to identify appropriate mitigation opportunities.	Potential impacts to system reliability depending upon type of municipal participation. Mitigation measures taken by municipalities may have impacts outside their municipal boundaries. Municipalities with fewer resources may be less able to mitigate potential impacts on their own, resulting in areas of low socioeconomic status potentially having lower access to green spaces or other resources.

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DM Program Structure Matrix of Building Blocks

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	Consultation with local governments to track impacts and develop mitigation measures	General education and outreach to inform local governmental entities, water boards of DM program. State does not consult with municipal participants or local governments to identify, track, or mitigate potential impacts and identify potential benefits to local economies resulting from a DM Program.	State consults with program participant and/or local governmental agencies to identify potential impacts and mitigation strategies, for all types of project activity, and to identify potential benefits to local economies and communities relating to a DM Program, as well as strategies to increase benefits.	Inter-governmental Agreement (IGA) or similar framework developed to facilitate robust and iterative consultation process with local governments and other entities to address local concerns and mitigate local impacts, with specific strategy and focus on mitigating or avoiding potential adverse impacts and increasing potential benefits, for all types of project activity.	Less consultation with local governments may result in increased adverse impacts that are not adequately tracked and mitigated. There is a varying level of resources and capacity available for local governments to facilitate coordination and mitigation efforts. This variation may affect the extent to which impacts are tracked and mitigation measures implemented across the state. Consultation with the Colorado Municipal League and Regional Councils of Governments may be helpful in determining appropriate parties and mechanisms for engagement.
Ag Impacts • Equitable & proportional across state • Minimize & mitigate off-farm impacts • Program should be a structured & guided market • Program operations need to align with growing season schedules	**Agricultural sector mitigation**	Existing programs and funding sources are used to promote agricultural viability.	Fund is established to provide compensation to local entity for community economic development fund. Grant program established to assist with local agricultural and economic viability.	State and partners make efforts to identify potential secondary impacts. Fund established that potentially provides compensation for mitigation, some of which is distributed to water management entity servicing property, while a portion is distributed to local/rural economic development or other appropriate organization. Additional staff time targeted at mitigating agricultural sector impacts to non-participants. Dependent on funding availability and identification of appropriate funding source.	Limiting the community development fund to verifiable DM impacts would present additional complexity, but would perhaps lower costs or avoid reimbursement of economic impacts beyond the State's control; alternatively a community fund that supports projects regardless of verifiable impact would be easier to manage and generate positive community outcomes. State verification of potential impacts could be costly and difficult to accomplish. Assess impacts to tenant farmers and land rental prices through community outreach efforts, noting it may be challenging to distinguish DM-related impacts. Community impacts in sovereign Tribal Nations may require alternative structure. Determinations may need to be made regarding which sectors or workers receive preference in assistance.
	Agricultural participant field requirements	No field requirements	State works with cooperative extension, other local agencies to establish guidelines for cover crops (for annual crops) and weed and pest control measures (for perennial crops). State partners/contracts with cooperative extension or similar entity for technical assistance and limited monitoring of compliance.	State works with cooperative extension, other local agencies to establish guidelines for cover crops (for annual crops) and weed and pest control measures (for annual and perennial crops). State provides staffing for technical assistance and monitoring of compliance.	Cover cropping could add complexity to monitoring and verification of consumptive use; soil health practices such as conservation tillage could reduce Monitoring & Verification complexity; development of any mitigation guidelines would likely require input from the United States Department of Agriculture, Colorado Department of Agriculture, and cooperative extension. Cover cropping could provide additional environmental benefits; select cover crops could help offset impacts to livestock feed disruptions and provide additional revenue for the participant. Producers may lack knowledge of cover cropping techniques. Though cover crops may create additional costs, state may work with USDA NRCS to offset participant cost of any on-farm mitigation requirements. There may be federal crop insurance implications.

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	Agricultural participant assistance	Existing programs and resources in place are utilized to facilitate agricultural participant assistance to help fully realize potential benefits of participation or mitigate potential impacts.	State creates a grant or cooperative contracting program with the university cooperative extension service, conservation districts, or similar technical service providers, to offer technical assistance and help fully realize potential benefits of participation or mitigate agronomic impacts from the DM program to the participants.	State creates additional staff capacity responsible for assisting in fully realizing benefits of participation or mitigation of impacts from the DM program to the participants. Position manages a budget for technical assistance and mitigating impacts.	Participants would likely need technical assistance in both navigating any potential DM in-take process and in selecting/implementing mitigation measures (e.g. cover cropping); providing the ability to grant or contract with third parties would likely reduce programs costs and address state capacity concerns. Producer participants familiar with working with agricultural service providers may be more willing to work with a trusted [illegible]t versus state staff. In addition to direct technical assistance, online information regarding any DM sign-up process or agronomic impacts and best management practices would be helpful and more accessible
Process Considerations	**Soliciting projects**	No state solicitation	Annual grant funding for entities to identify & develop project applications	State staff support & grant funding for identifying & developing project applications	
	Application requirements	Participants are not required to submit information regarding mitigation, monitoring, or other elements with their application. No certification program due to open enrollment process.	Select mitigation & monitoring elements must have been completed or substantially planned for application.	Select mitigation & monitoring elements must have been completed or substantially planned for application. A certification process ensures that project applications meet minimum requirements.	
	Project selection process	Open enrollment (first come, first serve) for projects of any duration. No certification processes. Review is done on a project-specific basis.	Annual RFP process without any certification process. Coordination with local governments, entities, others to facilitate a "guided market" approach aimed at ensuring a program aligns with specific goals and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).	Annual RFP process with certification required. Clear protocol developed, incorporating coordination with local governments, entities, others, to establish a "guided market" approach designed to ensure the program aligns with specific goals and values and does not create unacceptable adverse impacts (see Economic Impacts and Local Governments and Agricultural Impacts sections).	Care should be taken to ensure that the timing of the application, review, and approval process align with when agricultural participants make operational decisions
	Localization and program evolution	No additional protocol put in place to localize and/or evolve a program to local needs.	Review of DM program put in place at specific milestone to consider successes, lessons learned, and stakeholder feedback. The review directly informs future program management across the state.	Regular review of the DM program to consider successes, lessons learned, and stakeholder feedback. The review directly informs program management at local level. The review is public, transparent, and available for comment.	Depending on the level and scale at which programs evolve, there may be program differences (perceived as inequity) over time at the Basin levels. Local agencies / entities have different statutes, capacity, jurisdictions, resources, knowledge, and mobilization. Different basins can engage at different levels.

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DM Program Structure Matrix of Building Blocks

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Funding • Portfolio of funding sources should be considered • Costs would be influenced by many factors including program design, scale, and participation	**Range of annual costs**	$3M - $16M Example Cost Breakdown: 10% Program Costs 90% Compensation Cost	$5M - $20M Example Cost Breakdown: 30% Program Costs 70% Compensation Cost	$12M - $30M Example Cost Breakdown: 65% Program Costs 35% Compensation Cost	Payment offered may impact who is interested and able to participate, which may affect proportionality in terms of sector and region. Compensation range reflects that some may be willing to participate at lower cost than others, and in some cases additional compensation may be available outside of state fund.
	Funding Sources	Compensation paid by State through budget reallocation	Compensation paid by State through fees	Compensation paid by State through blend of multiple sources.	

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Exhibit G:

Demand Management Literature Review

July 2021

EXHIBIT G

Demand Management Feasibility Investigation Literature Review

July 2021

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Consultant Team

CDR Associates

SGM

WestWater Research / Colorado College

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Introduction

In 2019, the consultant team was retained to conduct a literature review relating to topics that correlate with the workgroups convened pursuant to the 2019 Work Plan adopted by the Colorado Water Conservation Board. The consultant team was directed to conduct a literature review and to identify key data gaps in the literature to help inform Colorado's Demand Management Feasibility Investigation.

The consultant team conducted the literature review, as well as additional research and interviews in some cases to inform their findings. This report summarizes the consultant team's findings in the following topic areas:

- Agricultural Impacts
- Economic Impacts and Local Governments
- Education and Outreach
- Environmental Considerations
- Funding
- Monitoring and Verification

Each section of this report captures:

- A summary of the literature review
- A summary of work completed in addition to the literature review
- Key takeaways
- Data gaps

The Administration and Accounting and Law and Policy workgroups were not associated with the Consultant Team's scopes and therefore not included in this report.

SECTION 1 – FEASIBILITY INVESTIGATION BACKGROUND

Colorado is currently investigating the feasibility of a potential Demand Management (DM) program. Demand Management is the concept of temporary, voluntary, and compensated reductions in the consumptive use of water in the Upper Colorado River Basin. Each of the Upper Colorado River Basin States (also referred to as the Upper Division States) are conducting their own investigations to determine whether a potential program would be feasible from their states' perspectives.

It is beyond the scope of this document to provide an overview of the minimum requirements to establish a Demand Management Program. However, more information relating to the Drought Contingency Plan (DCP) and associated agreements can be found at the following website: https://www.usbr.gov/dcp/index.html.

Investigation Background

The DM Feasibility Investigation (Investigation) follows direction of the CWCB Board in the Support and Policy Statements adopted in November 2018, the 2019 Work Plan (Step I), and the most recent Step II Work Plan approved in November 2020.

2019 Work Plan

The 2019 Work Plan (Step I) had three primary components:

1. Establish **workgroups** comprised of subject-matter experts and key Colorado River stakeholders, which were directed to meet publicly at least four times in Fiscal Year 2019-20, and to identify key threshold issues for board consideration
2. **Regional workshops** designed to facilitate the public discussion around DM and provide opportunities for CWCB staff updates on the Investigation; and
3. Continued **education and outreach**.

In addition, the CWCB Board directed staff to facilitate a literature review, completed by the Consultant Team.

The July 2020 Board meeting included a presentation of the summary of workgroup discussions and other work found at the following website:

https://dnrweblink.state.co.us/cwcb/0/edoc/212695/8_Demand%20Management%20Update.pdf?searchid=a1d2b86a-6aab-4b53-b5dc-e3dd570b71fb

Step II Work Plan

Following the 2019 Work Plan, the Board adopted the Step II Work Plan, which contemplates exploration of potential program design options through development of a Framework. Figure 1 shows how information gained in the 2019 Work Plan has helped to inform the Framework, which shows a range of implementation options and program design options.

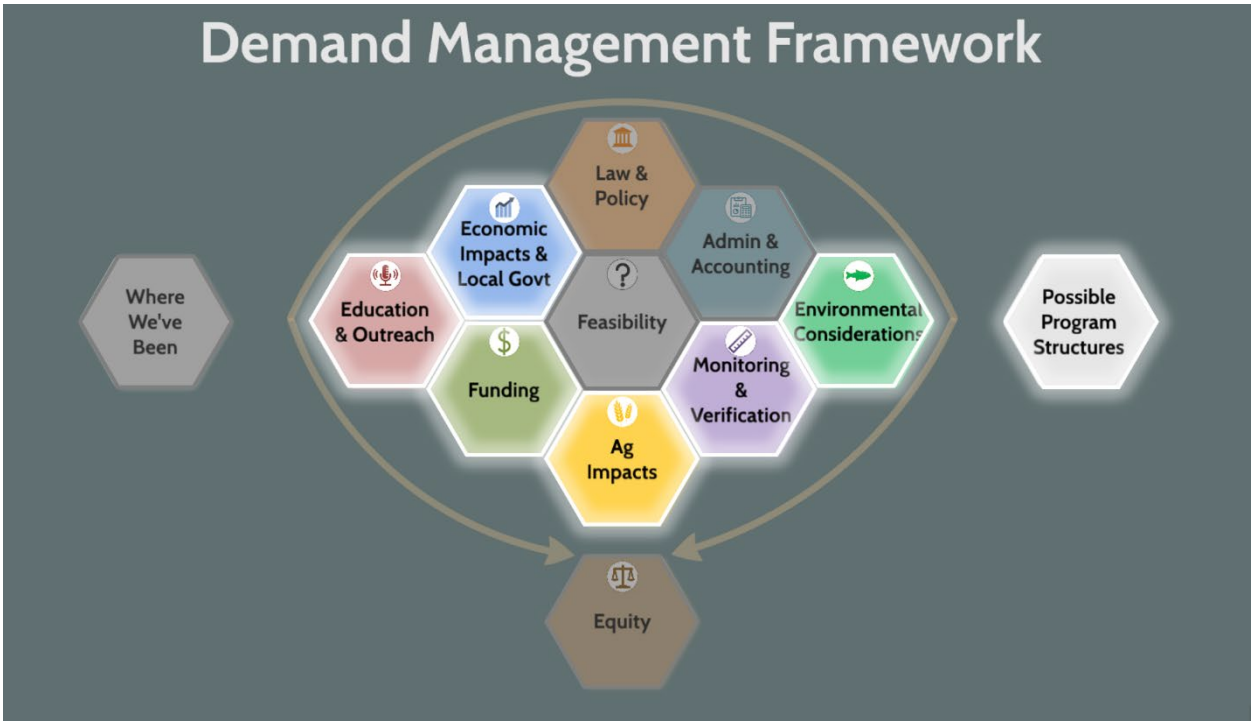


Figure 1. Demand Management Framework. The white highlighted tiles depict the Consultant Team's focus workgroups.

Consultant Team

The DM Consultant Team is comprised of three consultant firms that were responsible for different tasks. Each team member reviewed information from the workgroups, conducted a comprehensive literature review, and some conducted additional analyses and interviews. A list of each team member and their specific focus-area(s) are:

- CDR
  - Education and Outreach (E&O)
- WestWater Research & Colorado College
  - Agricultural impacts
  - Economics and Local Governments
  - Funding
- SGM
  - Monitoring and Verification
  - Environmental Considerations

SECTION 2 – LITERATURE REVIEW OVERVIEW

A comprehensive list of the documents reviewed by the Consultant Team is included in **Exhibit A**. The following sections summarize the literature reviews and analyses of the Consultant Team. While compiling the individual components of the literature review, the Consultant Team identified interconnected issues that were relevant across specific workgroup topics. Pertinent areas of overlap were included in each applicable section.

SECTION 3 – AGRICULTURAL IMPACTS - LITERATURE REVIEW & ANALYSES

WestWater Research led the Agricultural Impacts literature review. The tasks associated with their work specifically included:

- Participation in the final meeting of the Agricultural Impacts workgroup as a listener.
- Compilation and review of past studies and research regarding the agricultural impacts of water conservation and reduced irrigation projects in the Western U.S.
- Analysis of design elements of a DM program as they relate to agricultural impacts.
- Identification of knowledge or data gaps in the ability to understand and evaluate agricultural impacts of a DM program and individual DM project activities in the agricultural sector.

This report section provides a summary of the literature review research findings.

Literature Review

There is an extensive body of knowledge and library of past research studies on the impacts of reduced irrigation activities. This section summarizes some high-level summary points from the literature review.

What we know

Demand management is the reduction of consumptive water use. The types of activities that can be undertaken in the agricultural sector to reduce consumptive water use are focused on reduced irrigation, which can take on a variety of forms such as: full-season fallowing, split-season fallowing, rotational fallowing, deficit irrigation, and crop switching. Each demand management activity will have different economic effects which depend upon the existing water use and crop and livestock production on a farm or ranch property. It is also important to distinguish demand management activities as those resulting in water conservation or conserved consumptive use, and not activities that result in greater water use efficiency which do not generally result in a reduction in consumptive use. The following two sections (below) expand upon the on-farm and off-farm impacts of agricultural demand management activities.

On-Farm Impacts

All demand management activities that may be implemented in the agricultural sector will reduce the irrigation water supply to the crop. Various types of irrigation reduction are possible for a given operation, but the primary (expected) methods are listed in the above paragraph. On-farm impacts of demand management activities are described in the points below.

- **Crop Yield**. In the Colorado agricultural sector, a reduction in consumptive water use is expected to result in a reduction of crop yield. This is the most direct impact of reduced irrigation and will result in

reduced income for the producer. The extent of yield reduction depends on the crop type, extent of water stress, and timing of water stress.

- **Crop Quality**. The quality of the harvested crop or grazed pasture is often influenced by reduced irrigation, with both positive and negative quality changes documented. Particularly for alfalfa and grass hay cut for sale, quality influences price and therefore has an impact on producer income.
- **Management Impacts**. A variety of management impacts exist for reduced irrigation activities. For hay and pasture fields, there are expected to be significant and multi-year management impacts from large-scale reduced irrigation. Hay fields and pastures can take several years to establish and reduced stand density and quality changes from reduced irrigation can result in disruptions to operations. For cattle ranchers, reduced pasture production can impact herd sizes, health, and genetics, particularly if supplemental feed is not easily acquired. These impacts are expected to scale down with reduced demand management activity and forage crops are unique in their ability to scale with various irrigation inputs. For annual crops, full-season fallowing and crop switching are the most likely activities to be implemented and disruptions to operations are expected to be less than multi-year forage crops. Also, specialty annual crops are likely to see greater operational and management impacts compared to commodity crops. One aspect that is universal is the negative impact to business relationships that comes with not producing (or producing less of) a crop or agricultural product, which forces customers (buyers) to look elsewhere. The temporary reduction in agricultural production could impact the long-term business plans for producers.

Off-Farm Impacts

The off-farm impacts of reduced irrigation and agricultural production that come with demand management can touch upon multiple economic sectors in a community. Additional information on off-farm impacts is provided in the Economics & Local Government section of this report. For this report section, off-farm impacts will focus only on the agricultural sector. Off-farm impacts are organized into the following three categories: (1) hydrologic, (2) economic, and (3) agronomic.

Hydrologic Impacts

Irrigation activities change the natural hydrologic flow patterns in a watershed. These changes are often documented in the engineering studies that accompany water right change of use applications in water court. Cessation or reduction of irrigation results in a similar but reversed change to flow patterns. For many areas in Colorado, irrigation has been occurring for well over a century, such that both natural and human reliance on the irrigation flow patterns has occurred. Reduced irrigation due to demand management may result in the following hydrologic impacts:

- Increased annual streamflow volumes due to reduced crop consumptive use and reduced losses in the conveyance and application systems. Annual volume increases are the underlying reason for conducting demand management activities.
- A shift in the timing of streamflow with increases during the spring snowmelt period and reductions during the late summer and fall seasons. This shift results from not holding back spring runoff flows through irrigation diversion and land application.
- Reduction in canal flows serving multiple producers, such as irrigation districts and mutual ditch companies, which can negatively impact canal operations. Less carriage or “push” water can create hydraulic problems on ditch systems, particularly affecting neighboring producers needing elevation head in the canals and those located at the tail-end of ditches.
- A shift in the timing and volume of streamflow may result from changes in groundwater pumping for irrigation. Aquifer water levels may also increase with reduced pumping across a large area.

Economic Impacts

The off-farm economic impacts are tied to the flows of money into agricultural production and out of agricultural sales. In other words, off-farm economic impacts relate to an agricultural producer's typical spending habits and his/her modified spending habits under demand management. For production inputs, it is common to look at crop enterprise budgets developed by university extension offices to understand input types and values. The dollar value of operating costs (per acre) in the crop budget tables provide an indication of the relative economic impact resulting from reduced purchases by the producer because of demand management. For example, the 2018 budgets indicate that alfalfa hay has operating costs totaling $334 per acre or $86 per ton of hay production. Most of these operating costs will scale down with reduced production (yield) under demand management. Fixed costs identified in the crop budgets are not expected to change significantly under demand management activities.

The economic impact of modifications to spending that typically results from agricultural net income is more difficult to quantify and predict. Demand management activities will be compensated, and compensation amounts will need to be greater than the expected loss in agricultural net income to incentivize participation from agricultural producers. The off-farm economic impact from spending depends upon the source of compensation funds and whether the compensation income is spent locally or not. Limited data from two surveys indicate that approximately half to nearly all of the compensation payments will be spent locally.

The two money flows described above (inputs to and spending from agricultural production) are based on an owner-operator farm system. Many farms and ranches in Western Colorado have absentee landowners and are farmed by long-term lease tenants. An additional economic impact results to tenant farms if the landowner decides to participate in demand management activities without collaborating with the lease tenant. Demand management can disrupt the owner-tenant relationship because compensation payments to the owner may not be shared with the tenant, who will experience lost production and income. Landowners are incentivized to work with their lease tenants before participating in demand management activities to maintain a beneficial relationship with the tenant and to maintain market lease rates for the property.

Agronomic Impacts

The off-farm agronomic impacts relate to weeds, pests, and dust. A field that is participating in demand management can be a nuisance to neighboring fields due to these issues and therefore weed, pest, and dust management are often required as part of short-term and permanent fallowing plans. The extent of impact if such management actions are not taken is site dependent, based on field location, soil types, and localized infestation issues. Many of these agronomic impacts can be mitigated through cover crop establishment on fallowed fields and weed & pest controls on perennial forages.

The following illustration in **Figure 3** provides a conceptual model for thinking about the agricultural impacts of demand management and captures many of the themes identified in the literature review.

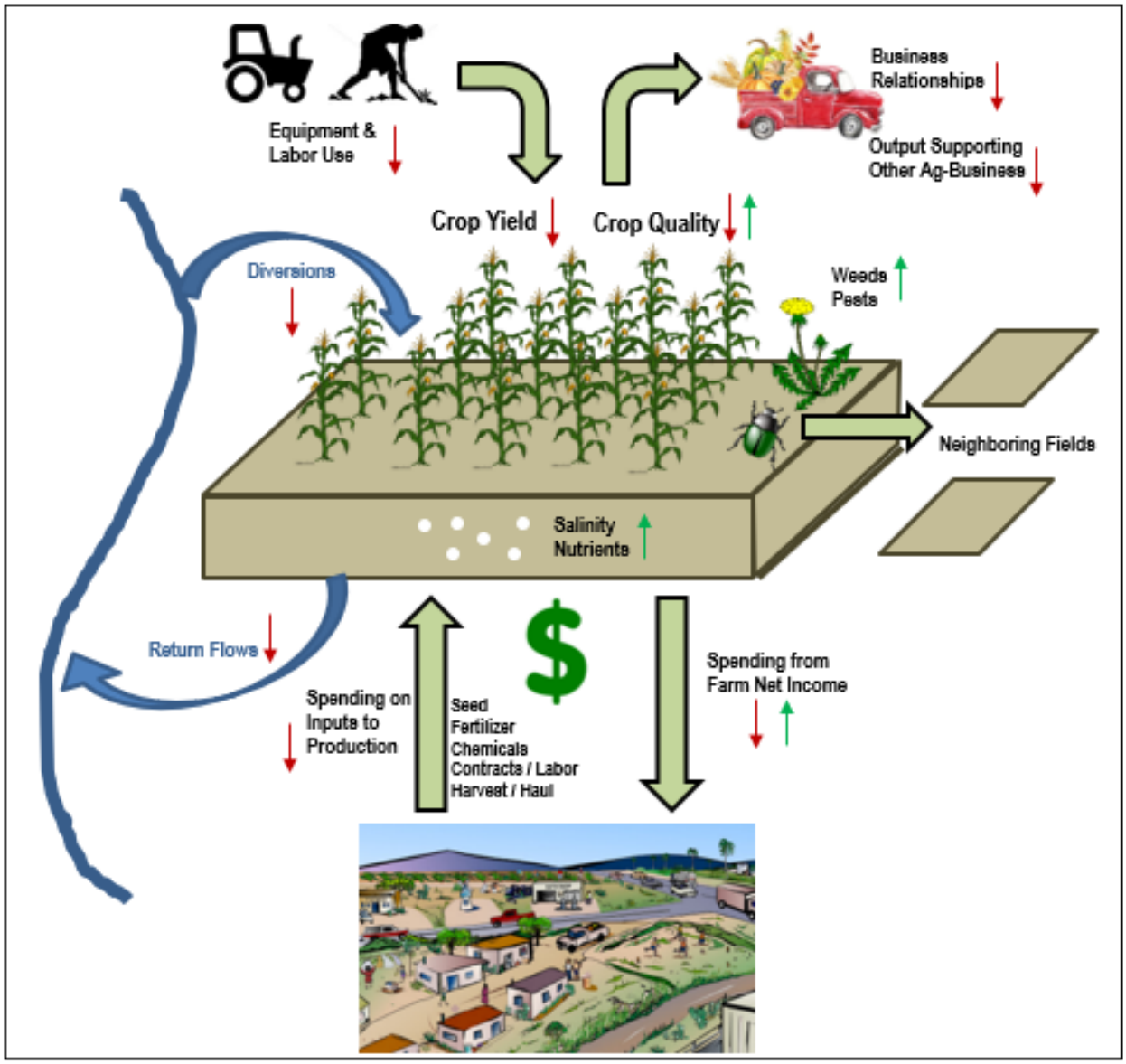


Figure 2. Conceptual Model of Agricultural Impacts from Demand Management Activities.

Key Takeaways

- **Develop Educational Resources for Producers**. The CWCB may work with the Colorado Department of Agriculture, Colorado State University Extension, Natural Resource Conservation Service, and other land management groups to develop a guide for agricultural producers on how to apply for and conduct demand management activities while minimizing on-farm and off-farm impacts. The guide may be organized by crop type and demand management activity and may present best management practices (BMPs) for reduced irrigation. In addition, technical staff support may be funded and supported to assist producers in designing their demand management programs.
- **Ensure Contracting Aligns with Seasonal Cycles**. The CWCB may ensure that the application, review, and approval process is timed to align with when producers make decisions and investments each growing season. For example, project contracts by October 1 of the preceding year would be best, by January 1 of the activity year would be good, and by approximately March 1 of the activity year is

necessary. If a rolling application process is used, then a demand management program may build in sufficient time to allow the producer to adjust investments and business commitments prior to activity implementation.

- **Limit Demand Management Activity Duration**. The available research suggests that partial-season reduction in irrigation on perennial forage crops, particularly alfalfa, can be achieved without significant and lasting damage to the forage stand. Full-season fallowing can be conducted on perennial forages but is best suited to the latter years of a stand when re-establishment is planned. For annual crops, multiple continuous years of demand management will require diligent management of weeds and pests. In general, agricultural impacts are less if specific fields do not participate in complete full-season fallow activities for multiple consecutive years.
- **Develop a Guide for Compensation Calculations.** This review identifies multiple on-farm and off-farm elements that compensation payments may consider. The CWCB may develop a simple guidance worksheet that helps producers understand the various costs that are likely to be incurred in demand management activities. Compensation payments are expected to be customized by each producer and operation, but general guidelines may be helpful to ensure that producers do not experience unforeseen costs as part of the program.
- **Limit Concentration of Activities**. An important tool in program design to minimize significant off-farm impacts of demand management activities is to limit the geographic concentration of projects. Demand management will be structured as a voluntary program and therefore the program may place maximum limits on the number of irrigated acres approved for participation in demand management by river basin or county.
- **Mitigate Off-Farm Impacts**. This review identifies hydrologic, economic, and agronomic impacts from demand management activities that the program may be designed to minimize and/or mitigate, and the following mitigation elements may be considered by CWCB. It is difficult to quantify the off-farm impacts for each specific project such that a program may look to implement standardized policies and payments that will apply to all projects.
- **Hydrologic Impacts**: Hydrologic impacts to off-site water users can be evaluated using standard engineering techniques such as those applied in Substitute Water Supply Plan (SWSP) applications. In addition, the CWCB may consider including mitigation payments to the managing ditch company, irrigation district, or other water user association as part of project costs (as applicable) to mitigate impacts to canal operations on larger systems.
- **Economic Impacts**: The on-farm economic impacts are expected to be fully addressed through compensation payments determined by the producer. Program design may be more concerned with off-farm economic impacts, which can partly be minimized through project selection. Mitigation payments to local governments may be a consideration of a demand management program, and these payments can be used for grant or loan programs for qualifying businesses or other economic development initiatives. The need for mitigation payments to local governments has not been definitively determined based on our research. It will be difficult to customize economic impact mitigation for each project due to uncertainty and privacy concerns with producer finances, such that a program may look to develop mitigation approaches applied uniformly to certain categories of demand management projects.
- **Agronomic Impacts**: Both on-farm and off-farm agronomic impacts can be minimized with a requirement that all farms and ranches participating in demand management conduct weed and pest control measures as part of the proposed projects. For perennial forages, this is likely to consist of various integrated approaches to maintaining a healthy forage stand. For annual crops, this is likely to require the establishment of a cover crop. A program may consider a requirement for field management techniques, such as cover cropping and weed & pest controls. CWCB may consider the compilation and

development of information resources to assist producers in determining the best cover crop and weed & pest control measures for their operation.

Data Gaps

There are two types of data gaps associated with the assessment of agricultural impacts: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when evaluating the impacts of specific demand management projects.

Data Gaps in Evaluating the Feasibility of Demand Management

No major data gaps concerning agricultural impacts are identified that would significantly benefit an evaluation of demand management feasibility. Significant resources have been applied in studying demand management concepts for the past 8 years. Additional studies that are presently underway or near completion will also add to our understanding of agricultural impacts. Most of the data gaps identified during our analysis were focused on other subject areas, such as quantification of consumptive use savings and facilitation of program activities. The following data gaps related to agricultural impacts were identified:

- The costs, benefits, and impacts of crop switching and deficit irrigating as demand management activities. Most of the research we reviewed focused on partial and full-season cessation of irrigation on perennial forage stands. There are several outstanding questions about how (and if) crop-switching and deficit irrigation would work as demand management activities.
- The impact of demand management activities on the availability of hay for livestock operations. Demand management activities at a small scale will result in reduced hay production locally may require local purchase of supplemental hay. At a large scale, there are uncertainties about how the hay market would respond and how hay availability would be impacted. It is possible that demand management impacts would mirror past drought periods with a similar reduction in hay production.
- Additional information on specific best management practices for managing a field that is experiencing reduced irrigation, particularly a full-season fallowing. It is well-established that cover crop establishment for annual crops and various weed and pest control measures for perennial forage crops are critical to mitigating impacts, but specific information on practices relevant to different Western Slope agricultural zones would be beneficial. This information could form the basis for guides assisting producers in project implementation.

Further research and information on the above topics would be beneficial but is not likely to significantly change the existing knowledge base on agricultural impacts of demand management activities. Agricultural impacts will often be site-specific. The CWCB may consider additional pilot projects to expand the diversity of project examples. The pilots are not expected to provide definitive findings but rather improved perspective on likely impacts.

Data Gaps in Quantifying Impacts of Specific Demand Management Projects

The agricultural impacts associated with specific demand management projects will need to be addressed as part of compensation payments and program design. On-farm impacts will be site specific and standardized impact metrics are unlikely to be useful across operations. Each producer may evaluate the expected impacts, with available information resources and technical assistance, and incorporate impacts into proposed compensation terms. Off-farm impacts are a greater concern for program design, and program design is anticipated to mitigate off-farm impacts more than information gaps addressed during the application and review process.

SECTION 4 – ECONOMICS & LOCAL GOVERNMENTS – LITERATURE REVIEW & ANALYSES

WestWater Research worked with Dr. Mark Smith from the Colorado College Economics Department to lead the Economics & Local Governments processes for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final meeting of the Economic Impacts & Local Governments workgroup as a listener.
- Compilation and review of past studies and research regarding the economic impacts of water conservation projects in the agricultural and municipal water use sectors.
- Analysis of design elements of a DM program as they relate to economic impacts.
- Identification of knowledge or data gaps in the ability to understand and evaluate economic impacts of a DM program and individual DM project activities in the agricultural and municipal sectors.
- Implementation of a survey of 19 municipal water providers in Colorado to better understand the municipal perspective on a DM program and anticipated DM activities.

Literature Review

There is an extensive body of knowledge and library of past research studies on the impacts of reduced irrigation activities, or demand management types of projects in the agricultural sector. There is also an extensive knowledge base on municipal water conservation; however, there is a general lack of information on voluntary, compensated, and temporary reduction of water use in the municipal sector. This section summarizes key points from the literature review on economic impacts.

What we know

To evaluate the economic impacts of demand management, it is necessary to consider both the direct impacts of reducing water use through demand management activities, and the indirect effects of reduced water use. These are often referred to as the primary and secondary impacts of an action or decision. An expanded discussion on the primary and secondary impacts of agricultural and municipal demand management is provided in subsequent sections. In brief they are:

- **Agricultural Demand Management**. Irrigation water is one of many inputs to crop production. Reduced water use results in less production as the primary impact of demand management. Secondary impacts reflect the other economic sectors that are affected by both reduced water use and reduced production. Backward-linked impacts result from the producer spending less on production inputs, such as seed, fertilizer, labor, and other items. Forward-linked impacts result from less harvested crop feeding into agri-businesses and other industries.
- **Municipal Demand Management**. Municipal water providers provide a service which allows their customers to live and work, enjoy a good quality of life (health, safety, and happiness), and allows businesses to function. Direct water uses in a municipal system are varied and diverse. Reduced water use results in less service, which can be reflected in various ways in a community as the primary impact depending on how both the water utility and individual customers choose to implement demand reduction. Secondary impacts reflect the nature of conservation activities and can include impacts to urban vegetation, property values, and wildlife habitat, among others. It is important to acknowledge

that there remains significant uncertainty on how demand management will be achieved in the municipal sector and if demand management activities will impact municipal water use customers.

Economic Impacts of Reduced Agricultural Water Use

The economic impact of reducing water use in the agricultural sector has been studied in many locations and was previously reviewed for the Colorado Water Bank Working Group and for the Colorado River District. In addition, there are active studies occurring on the West Slope that will aid in the understanding of secondary economic impacts. The secondary or regional economic impacts of demand management activities primarily depends on the type of agricultural operation (crop type, farm size, location) and the type of activity to reduce water use. This section provides a high-level summary of economic impacts from reduced agricultural water use. Additional information on agricultural impacts is provided in a separate review for the Agricultural Impacts in the preceding section of this report.

Actions to Reduce Agricultural Water Use

Demand management is the reduction of consumptive water use. The types of activities that can be undertaken to reduce consumptive water use are focused on reduced irrigation, which can take on a variety of forms such as: full-season fallowing, split-season fallowing, rotational fallowing, deficit irrigation, and crop switching. Each demand management activity will have different economic effects which depend upon the existing water use and crop and livestock production on a farm or ranch property. It is also important to distinguish demand management activities as those resulting in water conservation or conserved consumptive use, and not activities that result in greater water use efficiency which do not generally result in a reduction in consumptive use.

Direct On-Farm Impacts

All demand management activities that may be implemented in the agricultural sector will reduce the irrigation water supply to the crop and will be compensated. The net income to the producer under demand management is expected to be positive to motivate participation, with compensation payments exceeding the on-farm costs associated with demand management activities. Compensation payments need to consider the following on-farm impacts of demand management activities:

- **Reduced Crop Yield**. In the Colorado agricultural sector, a reduction in consumptive water use is expected to result in a reduction of crop yield. This is the most direct impact of reduced irrigation and will result in reduced income for the producer. The extent of yield reduction depends on the crop type, extent of water stress, and timing of water stress.
- **Modified Crop Quality**. The quality of the harvested crop or grazed pasture is often influenced by reduced irrigation, with both positive and negative quality changes documented. Particularly for alfalfa and grass hay cut for sale, quality influences price and therefore has an impact on producer income. For annual crops, reduced irrigation may result in an unmarketable product.
- **Negative Farm Management Impacts**. A variety of management impacts result from reduced irrigation and reduced production. One universal impact is the negative impact to business relationships that comes with not producing (or producing less of) a crop or agricultural product, which forces customers (buyers) to look elsewhere. The temporary reduction in agricultural production could impact the long-term business plans for producers. For hay and pasture fields, there are expected to be significant and multi-year management impacts. For cattle ranchers, reduced pasture production can impact herd sizes, health, and genetics. The on-farm impacts on cattle ranches are a function of location and scale of reduced production. In remote areas where access to supplemental hay is limited and associated replacement costs are high, the on-farm impact of reduced forage is expected to be relatively high. For areas that have access to hay for maintaining herds, a smaller on-farm impact is expected and can be estimated as the cost of acquiring supplemental hay for feed. For annual crops, full-season

fallowing and crop switching are the most likely activities to be implemented and disruptions to operations are expected to be less than multi-year forage crops.

- **Costs of Mitigation Activities**. In addition to changes in irrigation practices, the producer will likely need to invest in certain on-farm projects to reduce the off-farm impact of the demand management activities. These mitigation activities and projects are anticipated to include: (1) cover crop establishment on fallowed fields, (2) new weed and pest control measures on perennial forage stands, and (3) replacement water sources to prevent injury to downstream water users.

The positive net income to the producer results in positive on-farm economic impacts of demand management. An important point is that positive on-farm impacts will only result if the compensation paid for demand management activities exceeds the combined cost of the on-farm impacts listed above. A premium above these on-farm costs is expected to motivate participation and to address risk and uncertainty to agricultural operations.

Off-Farm Impacts

The off-farm impacts of reduced irrigation and agricultural production that come with demand management can touch upon multiple economic sectors in a community. Off-farm impacts can also be positive and negative depending on the economic sector and location. For this review, off-farm impacts are divided into two broad categories below.

Costs / Negative Impacts

Secondary economic effects of reduced irrigation involve all sectors of the regional economy that directly or indirectly transact with irrigated agriculture. Some of the secondary impacts considered likely to occur include:

- Loss in the value of output, personal income, and employment resulting from reduced spending in industries that provide inputs and support services to agriculture (referred to as backward-linked industries),
- Loss of output, personal income, and employment in sectors that use agricultural outputs as inputs to production (referred to as forward-linked industries),
- Effects caused by changes in net income spending in the region, and
- Changes in local tax revenues.

When agricultural production declines in a region, the reduced crop production results in a lower expenditure on agricultural inputs (first round effect). As a result, workers, stores, and support services directly related to agriculture reduce spending within the economy (second round effect) and the businesses that they buy from reduce their spending (third round effect), and so on. In addition, reduced agricultural production can lead to reduced activity for agri-businesses that rely on harvested crop inputs, resulting in further economic loss. These impacts are sometimes referred to as the multiplier effect.

The results of the recent 2020 economic study of demand management in Western Colorado indicate an indirect effect multiplier of approximately 0.34 and an induced effect multiplier of approximately 0.40, resulting in a total backward-linked economic impact equal to approximately 0.74, equal to 74% of reduced agricultural on-farm production. Additional forward-linked effects on the livestock industry were estimated to have a multiplier of 0.3, or 30% of direct agricultural output. In total, the secondary economic impacts of demand management were estimated to have a multiplier of 1.04 relative to the lost agricultural production value. This study indicates that secondary economic impacts of demand management are roughly equal to the primary on-farm economic impacts of lost production value.

The impact on businesses and economic sectors that utilize farm output (forward-linked industries) depends largely on the crop type and presence of food products and food processing industries in the region. For

most of the Western Slope, irrigation is practiced producing forage crops in support of the livestock industry. Hay trucking and slaughter facilities are two forward-linked industries that may be impacted by reduced forage production. The 2020 economic analysis of demand management indicated potential forward-linked impacts equal to approximately 30% of lost agricultural output.

The economic impact of modifications to spending that typically results from agricultural net income is more difficult to quantify and predict. Demand management activities will be compensated, and compensation amounts will need to be greater than the expected loss in agricultural net income to incentivize participation from agricultural producers. The off-farm economic impact from spending depends upon the source of compensation funds and whether the compensation income is spent locally or not. The 2020 economic analysis of demand management in Western Colorado indicated that compensation payments may or may not offset secondary economic impacts, depending on the extent to which payments are spent locally within the region.

The two money flows described above (inputs to and spending from agricultural production) are based on an owner-operator farm system. Many farms and ranches in Western Colorado have absentee landowners and are farmed by long-term lease tenants. An additional negative impact results to tenant farms if the landowner decides to participate in demand management activities without collaborating with the lease tenant. Demand management can disrupt the owner-tenant relationship because compensation payments to the owner may not be shared with the tenant, who will experience lost production and income. Landowners are incentivized to work with their lease tenants before participating in demand management activities to maintain a beneficial relationship with the tenant and to maintain market lease rates for the property.

In addition to the negative effects associated with changes to agricultural production, there are several environmental and recreational impacts to consider that result from a change in the timing of water flows. Irrigation, and specifically flood irrigation from surface water sources, slows the movement of water across the landscape through soil infiltration and return flows back to the stream channel. The result is that snowmelt runoff peak flows are reduced through irrigation diversion and late-summer low-flows are increased from return flows. The long-term presence of irrigated agriculture across much of the Western Slope has resulted in an environment and recreational economies that are built on this altered hydrology. Modifying the timing and magnitude of streamflow may cause additional negative economic impacts. In particular, the following are noted:

- **Wetland and Wet Meadow Habitat**. Many irrigation ditch and canal systems have wetlands and wet meadow habitat that have been formed by irrigation practices. In addition, the canals may also provide important riparian habitat. The inefficiency of surface conveyance and flood irrigation often results in habitat development down-gradient from irrigated parcels and ditch systems. A reduction in irrigation could result in negative impacts to these habitats and environmental resources. Wetland mitigation bank credits on the Western Slope have varied values depending on location and type of wetland credit.
- **Decreased Late-Season Flows for Recreational Activities**. Water-based recreation activities, and particularly fishing and boating, could be negatively impacted by a reduction in late-season streamflow. Negative effects are only anticipated to be noticeable on smaller tributary creek and river systems. The effects are also dependent on the relative scale of reduced irrigation and streamflow impact. The methods and concepts presented in previous research for recreational benefits of improved streamflow could be modified to consider the recreational costs of reduced late-season flows.

Benefits / Positive Impacts

The possible economic benefits of demand management activities are derived from two sources: (1) higher net income to the producer resulting in greater spending, and (2) modified hydrology resulting in greater streamflow annual volume and changes to streamflow timing. In addition, previous research on off-farm benefits identified possible salinity control benefits resulting from not leaching salts in the soil profile.

The benefit of higher net income to agricultural producers has an uncertain benefit to the surrounding economy that is largely dependent on how the additional income is spent. As stated previously, limited survey data indicate that past water conservation projects have seen half to nearly all of the compensation payments spent locally. The off-farm benefits of compensation spending may be significantly reduced if projects have absentee landowners located out of the local region. The temporary nature of demand management activities helps to ensure that project participants will maintain their properties and agricultural operations, which helps to ensure local benefit of the compensation payments.

The off-farm benefits of modified hydrology are specific to a location and project, as modified hydrology may also result in off-farm costs (see above). Downstream of the project site, annual streamflow volume will be greater based on the demand management activities. The timing and magnitude of increased streamflow is critical to understanding whether a benefit results from water conservation activities. Previous research on two System Conservation Pilot Program (SCPP) projects in Colorado and Wyoming found that these two water conservation projects resulted in nominal off-farm benefits besides salinity control. The research does indicate that off-farm benefits are expected to increase with larger volumes of water conservation activity. The following points summarize benefit concepts by various end uses:

- **Recreation**. The recreational benefit of modified hydrology is most likely to impact fishing and boating activity. The benefit can be estimated as a combination of: (1) the increase in number of visitor days, and/or (2) the increased value (enjoyment) of each visitor day. For both boating and fishing, the timing of additional streamflow needs to indicate a significant improvement to result in a measurable benefit.
- **Environmen**t. The environmental benefit is typically evaluated based on the presence of threatened or endangered species. The benefit may represent reduced recovery program costs or societal benefits of improved species habitat. Similar to recreation, environmental benefits are expected to be most significant if the modified hydrology represents a significant improvement in streamflow and the timing of flow increase is critical to realizing an environmental benefit.
- **Hydropower**. Run of river hydropower facilities are likely to see a direct benefit of larger streamflow volume as long as diversion capacity is not a limiting factor. Dam hydropower facilities are less likely to see a hydropower benefit unless the modified hydrology results in significant flow volume increases or the timing of flow increase occurs outside of the snowmelt period.
- **Salinity**. Reduced irrigation results in less deep percolation below the crop root zone and less leaching of salts in the soil profile into subsurface flows. In areas of the Colorado River Basin where active salinity reduction projects are in place, the benefit of reduced leaching can be significant.
- **Municipal**. Municipalities may enjoy benefits of reduced risk of Compact administration, since the goal of a potential Demand Management program would be to ensure ongoing compliance by the Upper Division States with the Colorado River Compact. This benefit is significant and is a primary driver of current efforts.

Mitigation of Negative Economic Impacts

Mitigation of negative economic impacts associated with water supply development projects and large water transfers is most often accomplished through federal and state environmental permits and is usually motivated by legal requirements to provide mitigation. For small and localized water transfers from agriculture to other uses, mitigation is not typically a legal requirement besides ensuring non-injury to other water right holders. Water right transfers often have negative economic impacts that are not mitigated. For a demand management program, mitigation may be evaluated and categorized based on on-farm and off-farm impacts. On-farm economic impacts are expected to be fully mitigated through compensation payments defined by the producer. Program design may be more concerned with off-farm impacts. Potential off-farm economic mitigation measures include:

- **Mitigation Payments to the Affected Community**. Mitigation payments, in addition to producer compensation, could be a component of a demand management program. The payments would be utilized for local community investments, which might take the form of grant and loan programs administered by county or other local governments, capital investment in specific economic development projects or infrastructure needs, and/or direct payments to local governments. Previous research identified three water transfer programs that provided explicit mitigation payments to local communities, ranging from 4% to 30% of producer compensation. These mitigation payments were provided primarily as a lump sum payment at the start of a multi-year water transfer program which probably would not be applicable under a demand management program. Two challenges with mitigation payments have been identified: (1) distributional challenges caused by mitigation efforts not targeting the most impacted sectors of the local economy, and (2) geographic challenges associated with dispersed project sites and impacts across the West Slope. These challenges may be addressed through a combination of mitigation payment investment rules and local oversight of mitigation payment spending.
- **Alternative Cropping & Land Uses on Participating Properties**. Creating an economic use of the participating lands during the period of demand management activities is a possible mitigation tool. Alternative cropping with a low water use requirement is a possibility but will reduce the conserved consumptive use benefits of demand management activities. Dryland grazing is a widely applicable alternative land use that may provide some limited economic activity. The types of alternative land uses are likely to be site-specific but investments could be made on properties to generate alternative economic activity, particularly if the property is intending to conduct demand management activities over multiple years.
- **Compensation Payments as Mitigation**. Most of the water transfer programs previously reviewed did not include any additional mitigation payments or policies to offset negative secondary (off-farm) impacts. Many programs may consider the compensation payments to the producer to be sufficient mitigation of local economic impacts. As stated previously, the suitability of compensation payments as mitigation for off-farm impacts is directly tied to the spending habits of producers in demand management years.

The economic effects of modified hydrology due to demand management activities are previously noted as potentially: (1) environmental impact of lost wetland and riparian habitat, and (2) recreational impact of modified streamflow for boating and fishing activities.

Economic Impacts of Reduced Municipal Water Use

This section first provides examples of reduced water use in the municipal sector, followed by a discussion of direct and indirect economic impacts of municipal conservation activities. There remains uncertainty as to how municipal demand management will be quantified, particularly for trans-basin diversions diverting from the Colorado River Basin to the Front Range. It is possible that a municipal utility could accomplish verifiable demand management through operations and management without requiring a modification in water use at the customer level. For this analysis, municipal demand management is evaluated assuming that water use reductions occur. The economic impacts described in this section provide context but may or may not be applicable to demand management in the municipal sector depending on how a potential program gets vetted and what demand management activities are implemented.

Context of Municipal Water Conservation in Colorado

Over the past 30 years both the Federal government and State of Colorado have enacted laws that have impacted both water conservation and water use efficiency for municipal water providers. These laws now guide municipal water use in three critical areas: (1) plumbing fixtures, (2) landscaping and outdoor water use, and (3) motivating municipal planning for efficient water use and effective drought response.

Context is critical in understanding the operating space for future efficiency and conservation efforts in the municipal sector. Past municipal water efficiency efforts have significantly reduced per capita water consumption. Colorado statewide municipal water use rate (per person) has declined from about 240 gallons, per-capita, per-day (gpcd) in 2000 to about 160 gpcd in 2015. In the future, these municipal water conservation savings and efficiency benefits have become "hardened" into baseline consumption, such that they will likely not be available to provide for future demand management. The greatest potential for additional conservation and demand reduction is expected to be in the following five areas: (1) further limiting water use in residential and commercial landscaping, (2) extending low-flow plumbing fixture requirements into older homes and commercial properties, (3) extending efficiency requirements to smaller water providers, (4) adopting smart metering to reduce losses and inefficiencies in the distribution system and in-home, and (5) modifying water use habits and practices**.**

Actions to Reduce Municipal Water Use

Actions to reduce municipal water use have often been divided into two categories: (1) water conservation and (2) water use efficiency. Water conservation temporarily reduces water use in response to drought or supply disruption and may be scaled back once the supply disruption ends. Water use efficiency, on the other hand, aims at maximizing the water end use benefit while minimizing waste, and efficiency practices often continue indefinitely and may be expanded. Both water conservation and water use efficiency can be achieved by policies and programs designed by municipal water providers.

Cities such as Denver, Fort Collins, and Colorado Springs, where water conservation and efficiency programs have existed for over 20 years, have seen a significant reduction in per capita water use through implementing many practices. These actions have also resulted in demand hardening. The implications for hardened water demand and past conservation efforts might be considered when establishing a baseline municipal water use for demand management. In evaluating and selecting conservation and efficiency activities, municipalities have a range of criteria that could be applied.

Municipalities also have the option to make conservation activities mandatory through policy changes. Research shows that mandatory strategies yield more water savings than those that are voluntary. However, if well implemented and tied to attractive rebates, voluntary options can be effective as well.

Direct Economic Impacts

Water conservation programs directly impact water providers in three ways:

- **Revenue loss from selling less water**. Water supply has high fixed costs. Dams, reservoirs, tunnels, pipelines, treatment plants and distribution systems are all major capital investments. Once these investments have been made, the variable cost of moving an added cubic foot through the system is low. Given these high capital costs, it is more cost-efficient to have one provider serving a broad geographic area to distribute these costs over a larger customer base. Therefore, water utilities are either municipally owned or regulated by a water district. Municipal water providers have several ways of recovering their fixed cost including tap fees for new construction, monthly service charges on existing customers, and the unit charge on the volume used (water rate). Where fixed costs are covered by tap fees and the monthly service charge, water conservation activities will have less impact on utility revenues. If these costs are allocated to the water rate, conservation may result in reduced operating revenue. Rates are often adjusted periodically to offset the impact of water conservation, and to respond to inflation and other cost increases associated with capital projects and operations.
- **Costs of running conservation programs**. Program costs will vary significantly with the size of the provider and the ambition of the conservation program. Water conservation programs range from public awareness and education to subsidies for turf removal and replacing landscape irrigation. Cost efficiency requires that suppliers begin with the lowest unit cost activities. Equity implies that water conservation

opportunities are not denied to low-income households that may lack the resources to adopt more efficient water use practices.

- **Impacts on wastewater treatment**. Wastewater treatment is affected when the influent flow to the treatment plant becomes more concentrated and thus more difficult to treat to the desired effluent standard. The problem is particularly acute when effluent is reused in either potable or non-potable systems.

These direct economic impacts may be a component of the compensation or benefit sought by an individual municipal water utility seeking to conduct demand management (water use reduction) activities. Like the agricultural sector, the balance of compensation (or direct benefit) versus direct economic impact will determine the overall net impact to municipal water utilities.

Indirect Economic Impacts

Indirect impacts on urban areas are largely livability and quality of life effects. The business effects are likely to be somewhat isolated as relatively few commercial activities depend upon water. It is possible that landscaping businesses will see a decline, and heavy water use industries may struggle if pricing is used to encourage conservation. The livability impacts may be considerable and widespread, especially if conservation actions result in the die off of established trees and the desolation of parks and other urban green spaces. Unlike the indirect impacts in agriculture, these municipal impacts are not anticipated to result in reduced commercial activity and reduced profits. Nevertheless, Colorado attracts and retains both people and industry because it is a desirable place to live, both for its abundant natural beauty as well as its pleasant towns and cities with a high quality of life. These attributes that attract and retain economic activity are put at risk if significant municipal water conservation activities were to occur. A municipal water utility may incorporate some indirect impacts into its proposed compensation for conducting demand management activities, particularly those impacts that are within municipal control.

Mitigating Negative Economic Impacts

Demand management in the municipal sector may require new levels of both conservation and efficiency, and these activities may result in economic impacts as described above. Direct economic impacts to the municipal utility are expected to be evaluated by the utility and incorporated into any requested compensation to conduct demand management. Indirect impacts may or may not be included as part of the requested compensation and are a greater concern for demand management program administration and design. The following mitigation activities are targeted at both direct and indirect impacts of municipal demand management activities.

- **Colorado's Water Plan**. The state's 2015 water plan, "...sets forth the measurable objectives, goals, and actions by which Colorado will address its projected future water needs and measure its progress - all built on our shared values." The plan was developed to address supply gaps resulting from a possible doubling of the state's population by 2050. Section 6.3 identifies many actions under (1) municipal water conservation, (2) water reuse, (3) land use, (4) agricultural conservation, efficiency, and reuse, (5) self-supplied industrial conservation and reuse, and (6) state agency conservation. The conservation and efficiency measures identified in the Plan provide a foundation for future demand management efforts.
- **Regionalization**. Front Range municipalities could examine the potential benefits of regionalizing supplies to improve reliability by taking advantage of a more diversified portfolio of water supplies. It is possible that future droughts will differentially impact streamflow conditions across the state. In addition, some metro Denver suppliers are primarily dependent upon Denver Basin groundwater. By jointly managing both surface and groundwater supplies, cooperating utilities may be able to firm up supplies under demand management.

- **Water conservation extension programs**. Current CWCB water conservation guidelines apply only to utilities that serve over 6,000 accounts. The state's largest suppliers have already instituted a range of programs to conserve water. The state could fund extension programs that enable large utilities to provide the same programs to smaller utilities which could take advantage of conservation options that are both proven and lowest cost. For example, smart meters could be installed by small utilities who then contract for data support from a utility that has already set up a system. An extension program represents a knowledge transfer to smaller water utilities to help ensure that demand management activities are effective and cost-efficient.
- **Conservation pricing**. Raising prices and/or implementing an increasing block rate structure on customers are both used to reduce water demand. In contrast to mandatory water restrictions, the effectiveness of using higher prices to reduce demand is less certain. Conservation pricing is also utilized to respond to successful water conservation to cover fixed costs with less water sales. Raising prices has a disproportional impact on low-income households. When using conservation pricing, utilities may establish low-income assistance programs and consider rebates for additional revenue to avoid these negative impacts. Approximately 85 percent of Front Range and eastern slope water providers, and 77 percent of western slope water providers, have such tiered rate structures.
- **Xeriscape assistance programs**. Municipal demand management is expected to fall heavily on outdoor water uses by residences, businesses, and institutions. Large-scale water use reduction may involve turf removal and many indirect impacts results from the loss of tress and green spaces. Some of these indirect impacts can be mitigated by replacing turf with xeriscape plants and landscaping. Several Colorado communities provide education and financial assistance for water users to modify their landscaping to a xeriscape design.
- **Urban Forestry**. Many indirect impacts from water conservation result from loss of trees and urban green spaces that provide many community benefits that enhance the livability of towns and cities. Demand management may provide options for cities to maintain existing trees and even expand urban forests into low-income neighborhoods that often have fewer trees. Tree canopy mapping often reflects income inequality and Colorado is no exception. The tree canopy in Colorado Springs neighborhoods, for instance, ranges from less than 5% in low-income to more than 50% in high-income neighborhoods. Planting trees in low-income neighborhoods would both reduce inequality and increase air and water quality benefits for all. Targeted investments for tree health, such as direct irrigation and fertilization, is a way to reduce stress on the urban trees.
- **Turf Conversion in Parks**. Demand management may involve redesign of urban parks to reduce water use. Vast green spaces may give way to more selective green spaces, artificial turf on playing fields, and more extensive use of xeriscape. In addition, continued irrigation of trees in parks when turf is removed is an important consideration. In general, municipalities may consider maintaining parks and outdoor green spaces even if residential and commercial irrigation is reduced because of the community benefits.
- **Project vs. Programmatic Demand Management**. A demand management program may anticipate supporting both project (i.e., single entity) as well as programmatic (e.g. universal smart metering) as strategies for creating conserved consumptive use. Establishing a baseline, monitoring, and verifying savings generated over many users will be critical for any programmatic approach.
- **Water - Energy Nexus**. Colorado has 25 operating thermal power plants that all require water for cooling. Retiring these plants and replacing them with wind and solar farms will reduce both consumptive water uses and greenhouse gas emissions – a double-dividend.

Additional Work Completed

WestWater performed interviews with municipalities across the State to investigate demand management related to municipal operations. A memorandum summarizing municipal interviews is available upon request.

Key Takeaways

These key considerations are based on the literature review summarized in previous sections. The following activities and policy elements are key considerations related to the specific purpose of reducing and/or mitigating economic impacts of demand management activities.

- **Mitigation Payments in Program Design**. The feasibility investigation may consider a program that includes mitigation payments to offset indirect economic impacts, particularly for agricultural demand management projects. Mitigation funding requirements might be established as part of program design and should likely be standardized across all projects. Standard mitigation payments would avoid the process of evaluating economic impacts of each proposed project and will provide certainty to the program participants and funders. The mitigation funding might be given to local governments to make local decisions on spending the money.
- **Ensure that the Program is Voluntary**. From an economic perspective, it is important that demand management remain a voluntary program without any requirement or mandate to participate and reduce water use. In both the agricultural and municipal sectors, there is a large amount of diversity in risk, ability to pay, direct and indirect impacts, and required compensation related to demand management. A voluntary program ensures that significant direct economic impacts do not occur to specific water users and communities.
- **Include Environmental and Recreational Benefits and Impacts in Project Review**. The process of soliciting and evaluating demand management projects is not yet determined. The CWCB might consider some form of analysis and reporting on the environmental and recreational benefits of proposed demand management projects as part of the review process. It is important to distinguish that this type of analysis is not part of informing mitigation requirements but instead for supporting projects that may provide a specific benefit.
- **Leverage Other Funding Sources**. Reduced water use may result in other benefits and there may be other programs established to provide funding resources for reducing water use and/or realizing these indirect benefits. A demand management program could look to develop and publish (online) a reference list of complementary funding programs and sources for consideration by project participants. Example and possible funding sources include the Environmental Protection Agency (EPA), U.S. Bureau of Reclamation (USBR), Natural Resources Conservation Service (NRCS), and U.S. Fish and Wildlife Service (USFWS).
- **Indirect Impacts of Reduced Municipal Water Use**. Our literature review did not provide definitive findings on the scope or scale of indirect impacts related to reduced municipal water use, particularly for: (1) environmental impacts of reduced outdoor water use, (2) social and community impacts of reduced outdoor water use, and (3) equity implications of reduced water use. The CWCB may consider developing a work plan to better understand these impacts. Consider potential benefits and impacts for east slope agriculture (supplemental sources of water).

Data Gaps

This section provides a discussion of two types of data gaps: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when evaluating the impacts of specific demand management projects.

Data Gaps in Evaluating the Economic Feasibility of Demand Management

The economic feasibility of demand management can be better evaluated when demand management activities are better defined, particularly for the municipal sector. Most of the data gaps identified during our analysis were focused on other subject areas, such as definition of qualifying activities and program administration. The following data gaps related to economic impacts were identified:

Agricultural Sector

- Further research may consider the definition of standard economic multipliers specific to West Slope agriculture for informing mitigation payments. Further work could be done to generate one or more standard multipliers which would be used to define mitigation payments for agricultural demand management projects. These multipliers may be used to determine the full costs of each project and make equivalent comparisons between projects. The 2020 economic analysis for Western Colorado provides an information basis to define these multipliers.
- Additional data gaps are identified in the Agricultural Impacts section of this report that should be incorporated into this economic review.

Municipal Sector

- Further research may be done to better define municipal demand management activities. The impacts of municipal demand management activities stem from a better definition of those activities, and impacts are difficult to evaluate without this definition. The municipal sector may not have to or be willing to reduce end uses of water to achieve demand management.
- Additional research could evaluate the ability to reduce municipal water use. It is expected that the municipal utilities will propose to conduct demand management activities based on system-specific analysis. In terms of understanding feasibility of demand management, the state might consider an analysis looking at the broad feasibility of additional water use reductions in the municipal sector. The following elements might be included in such an analysis:
    - Evaluating the existing water efficiency practices across the state to identify the potential water savings from: (a) retrofitting pre-compliance homes and commercial buildings with low flow fixtures; (b) extending proven water efficiency programs into smaller water providers; (c) reducing non-revenue water lost through systems leakage. Such efforts can generate consistent, long-term water savings.
    - Evaluating the effectiveness and experience of Colorado water providers with water pricing strategies. Water providers have used a range of conservation pricing strategies to reduce water use. These include tiered rates, seasonal pricing, conservation surcharges, and tap fees. These strategies could be assessed for effectiveness, revenue impact and fairness. Water managers may find the experience of other utilities, within Colorado and with which they are likely to have some familiarity, more compelling than experience from other states and countries.
    - Evaluating the impacts of reduced outdoor watering. The major savings in municipal water uses will likely come from reductions in outdoor water use. Practices to reduce outdoor water use have been widely applied, but we have limited understanding of the impacts on urban livability and options to mitigate these impacts.

- Further evaluate the indirect impacts of reduced municipal water use. This literature review provides information on past research related to the indirect impacts of reduced water use in the municipal sector. Our review indicates that more information is needed on the impacts of water efficiency and conservation efforts on inequality and on environmental resources beyond urban landscaping. Academic papers and utility reports note the importance of these indirect impacts; however, studies that attempt to measure or quantify such impacts have not been identified.

Data Gaps in Evaluating Economic Impacts of Specific Demand Management Project

The economic impacts associated with specific demand management projects will need to be addressed as part of compensation payments and program design. Direct impacts will be site specific for farm operations and municipal water systems. Each demand management applicant or participant is likely to evaluate the expected direct impacts, with available information resources and technical assistance, and incorporate impacts into proposed compensation terms. Indirect impacts are a greater concern for program design, and program design is anticipated to mitigate indirect impacts more than information gaps that are addressed during the application and review process. Project-specific economic analyses will be difficult to conduct due to cost and timing.

SECTION 5 – EDUCATION AND OUTREACH – LITERATURE REVIEW & ANALYSES

CDR Associates led the Education and Outreach (E&O) and Statewide Engagement processes for the Investigation. The tasks associated with these efforts specifically included:

- Participating in the Education and Outreach workgroup meetings.
- Conducting a literature review that analyzed and summarized the existing knowledge of education and outreach strategies, lessons learned, and data gaps.
- Conducting program manager interviews that collected first-hand data on education and outreach for existing water conservation and efficiency programs.
- Supporting CWCB with Statewide Engagement planning and facilitation.
- Developing a summary of the key considerations and practical education and outreach strategies relating to a potential DM program that integrates the findings from the literature review and feedback from the Education and Outreach workgroup and other key stakeholders.

The education and outreach findings detailed in this report align with the CWCB's additional policy goal statements to work with water rights holders and stakeholders in determining the feasibility of DM in Colorado:

> (6) Prioritize avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders. The Board **will work with water rights holders and stakeholders** to assess the feasibility of and promote mechanisms for obtaining roughly proportionate contributions of water consumptively used from the Colorado River System to a Demand Management program over a given timeframe from participants on each side of the Continental Divide.
>
> (8) **Consider and be fully informed by the input and considerations of water rights holders and stakeholders** potentially impacted by application of demand management strategies within Colorado, and institute a public review process for any such proposed demand management program.

Literature Review

CDR's literature review aimed to:

- Identify education and outreach lessons learned from similar policy efforts.
- Develop key considerations and/or engagement toolkit (strategies and tactics) for consideration in next steps of the Investigation.
- Identify decision milestones and tradeoffs for future consideration.

The key findings informed the E&O goals and parameters for a potential DM program, as well as considerations linked to messaging, trust building, and program localization / evolution.

The literature review evaluation examined the literature through the following thematic questions:

- What would motivate people to participate in the Demand Management program?
- What components of a DM program excite potential participants? How do you build support for change? How do you build interest in a program like this?

- What disincentivizes people?
- How do you build trust in a low-trust environment? How do you build regional cooperation in a context of competition?
- Who was the target audience of the program? How familiar were people / do people need to be before adopting the program? How was the program messaged or marketed? How do you tailor messages (benefits, impacts) to different audiences?

Overall, the literature was vague in specific detail around E&O efforts, although general themes have proved to be informative for the exploration of the feasibility of a hypothetical DM framework. The literature reviewed for education and outreach themes included:

- Summary of "Lessons Learned" from UCRC's "Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin", by UCRC & Wilson Water Group, 2018
- Lessons Learned from the System Conservation Partnership Program, by The Nature Conservancy, February 2016
- GVWUA Final Report on the Conserved Consumptive Use Pilot Projects, by GVWUA and J-U-B Engineers, 2019
- TNC Briefing Paper: Upper Basin Demand Management and Water Banking, by The Nature Conservancy, 2019
- Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado by MacIlroy, Colorado State University, 2019
- Towards Regional Sustainability Assessment Utilizing Community Based Participatory Research, Sustainability Indicators, and Future Scenario Modeling, by Dubinsky, CU Denver, 2019
- Urban Water Conservation in the Sacramento, California Region during the 2014-2016 Drought, by Talbot, UC Davis, 2019
- The Poudre Water Sharing Working Group: A Report to the CWCB, by The Poudre Water Sharing Working Group, 2015
- Appendix C: 2018 System Conservation Pilot Program Update, by the Upper Colorado River Commission, 2018

What we know

Education, outreach, and engagement is critical to the success of a program. The most perfectly designed program, without willing participants, will not accomplish the goals of a demand management program.

There is no one-size-fits-all solution: we know that each of Colorado's distinct sub-basins will need a contextualized approach, and an approach that keeps Colorado's residents at the heart of the solution.

Based upon the literature review and program manager interviews, the overarching E&O principles for designing and implementing a demand management program are:

- Engagement to develop and tailor the program to community needs: outreach prior to and during the exploration into the feasibility of a program to ensure it represents the potential participants.
- Motivate participation in a demand management program: following the establishment of a demand management program, marketing and outreach to program participants may align with local values, motivations to apply, and messages that resonate with community identities.

- Water education on broad policy impacts and benefits of the program: to inform and educate the broader public on the risks of inaction and the statewide benefits that justify the State's investment in a demand management program.

Additional Work Completed

Program Manager Interviews

Program manager interviews were conducted by CDR Associates following the literature review to fill in data gaps around education and outreach. In particular, the goal was to supplement the Investigation with information about how water conservation programs undertake education, outreach, communication, and marketing efforts.

Program Managers Interviewed

Program managers were selected because of their experience designing, managing, and/or evolving water efficiency programs for agricultural or municipal audiences. Program managers were from organizations including:

- Palo Verde Irrigation District
- San Luis Valley Subdistrict 1
- Colorado River Water Conservation District
- Central Platte Natural Resource District (NRD)
- North Platte NRD
- Tri-Basin NRD
- Twin Platte NRD
- Idaho Snake River
- NRCS CREP Programs
- Metropolitan Fallowing Program
- Denver Water
- City of Westminster
- Republic River Conservation District
- Resource Central

Methodology / Interview Approach

The goal of the interviews was to better understand successes, lessons learned, and techniques linked to education and outreach on water conservation programs. Interviewees were promised that quotes and comments would not be directly attributed to them. Meetings were not recorded to encourage candidness. The interviews ran approximately 45 to 60 minutes via Zoom or telephone.

The following questions guided the interview discussions:

1. Please describe your conservation / efficiency program.
2. Was extensive outreach conducted before the program was established?
3. If the program was voluntary, what motivated participation in the demand management program?
4. What were the general outreach strategies and specific tactics implemented?
5. What would you have done differently if you had a chance?
6. Who else would you recommend we speak with for more information?

Interview Key Themes

The following description of seven key themes represent topics and sentiments heard in two or more interviews. The intent is to identify and describe themes for further discussion with stakeholders, and not to prescribe solutions or remedies. The rural designation includes agriculture and small municipal perspectives. The urban perspective captures dense areas.

Rural Themes

1. Localization and evolution of the program
2. Proactive and hardcopy outreach
3. Trust-building with stakeholders
4. Inclusion in process

Localization and evolution of the program

A program that remains reflective of community needs results in higher participation. Several of the interviewees reported that by engaging with farmers about their needs, the co-developed program led to participation that exceeded expectations. One interviewee from the San Luis Valley takes a farm-by-farm approach to ask, "What do you need? What isn't good about the current program? What works for you?" By applying a variety of soft skills, the interviewee links input to programs.

This approach is evident in the San Luis Valley's half-usage pilot program. The program started with discussions with farmers, grew with Board input, and then our interviewee aligned the concept with timelines and budgets. The pilot was originally budgeted at $120,000; it surpassed that in the first week of enrollment, and in total a pool of $1,000,000 funded pilot participation.

Proactive and hardcopy outreach

Whereas some communities are familiar and comfortable with digital outreach and marketing, many of the agricultural-oriented interviewees emphasized that their outreach prioritizes tried-and-true methods. In part, this approach works because of the average age of producers (in some communities, interviewees estimated the average age was 50 years old). The interviewee from Nebraska's Central Platte NRD used outreach like mailed quarterly newsletters; newspaper articles; radio advertisements in the spring and fall to target farmers on tractors listening to market updates and farm news; annual information meetings; and the development of an NRD radio jingle.

Trust-building with stakeholders

Interviewees with agricultural audiences emphasized that implementing a program in ag communities takes time. "If you're going to do something like this, you've got to be in it for the long term," said one of the NRD interviewees, "There's no better PR than a satisfied customer." Producers are risk averse. In the interviewee's case, his conservation program's first year had poor participation; the following years benefited from local talk, trust, and evidence of the program's benefit.

Similarly, the San Luis Valley interviewee credited programmatic success to personal relationships. When communication can go both ways, particularly in getting questions answered, then individuals feel more confident in making a well-informed decision.

Inclusion in process

A theme echoed throughout the agricultural interviews was the importance of process inclusion for producers, farmers, ranchers, and rural water users. Ideally, decisions are made at a local level by local program managers or, even better, by potential program participants.

Urban Themes

5. Defining motivation for participation
6. Ease of application and program management
7. Engaging water managers and local government leaders

Defining motivation for participation

For urban residents and water providers, interviewees linked successful programs to marketing aligned with participants' motivations. For household users, participants in water efficiency and conservation programs typically identified water savings as the primary motivator. As a Front Range interviewee said, "The target audience is people who want to do the right thing. They understand that Colorado is semi-arid and that

they're putting too much water into their landscape." And, in a City of Westminster survey, customers identified the top two reasons for promoting water efficiency as: "It ensures long-term water supply security" and "Water is a limited resource."

For municipalities and water providers, motivators are efficiency, impact, and adaptation to the local context. One interviewee highlighted that "blanket solutions" for reducing consumptive use are difficult, as water providers have a strong sense of identity for their customers and organization. Additionally, most municipalities and water providers run lean organizations: few have dedicated staff to developing and implementing water efficiency programs. Programs need to be efficiently managed to align with capacity and need to have tangible impact to make the resources worthwhile.

Ease of application and program management

The ease of application to a program was a motivator at both the household- and water provider-levels, and the ease of program management was a motivator for water providers. Interviewees felt that complex processes would not be successful due to reasons including household attention spans, the level of effort to maintain a program, and the staff needed to run complex programs.

Engaging water managers and local government leaders

Two interviewees found success in implementing programs via water managers and local government leaders. Buy-in from local government leaders increases the likelihood of program implementation, because it provides visibility about a program and, often, elevates the prioritization and timeline of a program's implementation.

Outreach Strategies and Tactics

Interviewees pointed to a spectrum of strategies and tactics to increase participation, raise awareness, and market a program. The tactics have been divided into two categories (municipalities / urban water users and agricultural / rural water users), because approaches varied widely depending on the local context of the interviewee.

Municipalities / Urban Water Users

Messaging

- Simplify and tailor messaging: for example, consider urban programs Cash for Grass or Slow the Flow

Internal Communication Methods

- Reduce barriers to marketing and program management for staff unfamiliar with outreach, such as premade marketing toolkits:
- Flyer templates
- Sample social media posts separated out by month, with corresponding photos
- Editable text that can be used in micro-, medium-, or long-form media
- Ads for local newspapers
- Customer-service trainings for staff

External Communication Methods

- Create opportunities for in-person engagement and relationship-building
- For example, offer free audits to get a water expert into someone's home, educate that customer, build relationships, and trust, and connect them to pre-existing programs
- Outreach in consistent and audience-appropriate places.

- Strategies include:
- Utility bill inserts
- Direct mail
- Targeted social media promotion
- NextDoor posts and ads
- Posts in small local papers
- Joint press releases, often with a customer testimony
- E-news lists
- A customer survey asked: "What's the best way to reach you about water efficiency programs?"
- 42% flyers and inserts in my bill
- 40% messages on my bill
- 10% social media
- 15% website
- Advertise incentives to target audiences like developers, HOAs, and hot development areas

Leveraging Values

- Use data-based decision-making to inform and urban programs
- Define goals around scale and geography to help program managers have an equitable, balanced, and efficient approach to simplify applications for target participants

Agricultural / Rural Water Users

Messaging

- Codefined messaging: ask potential users what they need, and what would or wouldn't work. Then shape a message based on their input.
- Relationships are more important than words. Messaging may follow rapport and trust with the community.
- One-size won't fit all. Farmers have diversity in operations; different crop types have different needs.

Internal Communication Methods

- Training program employees
- Calls with the State on possible program changes

External Communication Methods

- Consider timing of outreach, such as radio ads during harvest season and newsletters in off-seasons
- Having a participant-centric approach is important for long-term participation in the program
- Outreach in consistent and audience-appropriate places. These include:
- Radio
- Radio ads in spring and fall to correlate with the timeframe that farmers are listening to market updates on their tractors

- Customized radio jingle
- Radio interviews
- Town halls, producer meetings, symposiums, and webinars
- Have included features like guest speakers and presentations about new innovations
- Provide updates on programs, aquifer levels, hydrology changes
- Newspaper updates, articles, and newsletter postings
- Newsletters and information bulletins
- Fact sheets and flyers
- Website content
- Blog to provide narrative about key issues
- Guest writers
- Press releases
- Social media, although not as successful because of age of producers
- Board member marketing, word-of-mouth marketing
- School water education on a variety of issues; best interaction with 4th, 5th, 6th graders
- Text (SMS) communication between program managers and participants for quick updates
- Local office locations allow people to come learn about conservation programs for their area

Leveraging Values

- Trust and relationships between a program manager and local communities, which could look like:
- Co-learning: host opportunities for producer / farmer roundtables to inform programmatic decisions
- Upfront time commitments: state how long a pilot or program will be around, and then be consistent.
- Long-term strategy: "There's no better PR than a satisfied customer."

Key Takeaways

The following statements capture overarching takeaways from the Education and Outreach literature review and interviews conducted, and represent common considerations for establishing buy-in for a future potential DM program.

- **Motivations to participate.** Motivation to participate is connected to information, clarity, and education about the program objectives and larger economic / social / environmental issues. Addressing these motivations includes: ensuring the protection of water rights and confirming that participation in compact security is a beneficial use under Colorado Water Law; defining short- and long-term financial benefits for participants, especially to reduce risk and increase profitability; and educating potential participants on the process, goals, and program details, to provide the context needed to relate a program to personal situations.
- **Build Support for a Demand Management Program.** Develop local communication strategies and partner with local, established networks to communicate messages. Involve communities as early as possible in program design. Inclusion of trusted local and state representatives will result in a program with higher agricultural water user participation. Additionally, align a program with producer values

like free-market economies and flexibility in operation and production schedules. Institutionalize into the program benefits for sustainable agriculture and rural communities. Create general policy parameters and rules to facilitate flexibility for the program to fit local stakeholder needs, maximize community benefits, and respond to local concerns.

- **Disincentives.** Primary reasons for nonparticipation include misconceptions about program purpose, local attitudes towards water conservation / fallowing, and concern about impacts to the economy and community. Potential participants are hesitant about overly public information about specific projects. Perceptions about whether a demand management program is necessary or unnecessary is closely linked to how an individual perceives Colorado River Basin water issues.
- **Build Trust and Regional Cooperation.** Local outreach builds trust, relationships, and community buy-in, especially when outreach results in impact and influence. Prioritize face-to-face meetings, ranging from town halls to door-to-door messaging within sub-basins. Develop clear, well-defined scenarios to help communities understand potential benefits or impacts of policy choices. Facilitate opportunities for communities to participate and/or access in research methods, datasets, reporting, and models. Enlist local key stakeholders and non-governmental organizations (NGOs) to participate in program outreach. Communicate with stakeholders, landowners, ditch and reservoir companies, and general irrigators before, during, and after projects. Define decisions that can be made at the local level, instead of the state or federal levels.
- **Defining and Communicating with Target Audiences.** Audiences with preexisting relationships with CWCB and/or partner organizations are more likely to participate in conservation programs. Use communication channels that are appropriate to the target audience. Consider the timing of messages, so the target audience has the bandwidth to engage on potentially applying to a program. Be clear and consistent in messaging so that potential participants receive one message. Develop a multi-pronged approach so that messaging to rural and urban audiences happens at state, regional, and local levels. Build upon existing water messaging platforms, such as Water Efficiency Plans and communications related to drought.

In addition to the literature review, CDR has helped facilitate the stakeholder engagement process relating to the Demand Management Framework and Demand Management more generally. Therefore, in lieu of an analysis of data gaps relating to Education & Outreach, the following section provides key observations relating to Colorado-specific issues and values. Further engagement can continue to inform what elements of a potential Demand Management program are acceptable to different sectors and communities, what elements or areas need further exploration or discussion, and what elements have buy-in or support.

Coloradan Values: A Commentary

Following the Statewide Engagement effort to engage diverse perspectives, CDR Associates provided the following anecdotal commentary to articulate Colorado-specific values. The following commentary is in no way comprehensive nor universal. However, an understanding of Colorado-specific values can help inform the advisability of a program.

Individual Choice

Coloradans appreciate individual choice and discourage government oversight. This value was articulated in rural and urban contexts; for example, producers participate in fallowing programs when it suits their financial objectives or personal lifestyles, and homeowners participate in municipal conservation programs to beautify yards or protect the environment.

Any potential demand management program may align with the value to participate when and where Coloradans choose to. Similarly, messaging and motivation for a demand management program might

recognize that individual choice applies to demand management but does not apply to Compact administration, which would not be voluntary or compensated.

Local Control

Colorado's government is designed to support and empower local control, and this is a value shared by many in the state. Many Coloradans support decision-making made at the lowest level of government possible, including town councils and county commissions. This value seems especially true on the West Slope.

Any potential demand management program may incorporate the role of local government and local decision-making into its decision-making. Inclusion from the start, such as in shaping the program framework and in designing mechanisms to protect against unintended impacts, would likely build local trust and buy-in.

Agricultural Participation in Decision Making

Agricultural communities--including many who would be eligible participants for a potential demand management program--value participation in decision-making. Agricultural stakeholders want to shape the decisions that would impact their ways of life, income, community well-being, and local economies.

Any potential demand management program may proactively include agricultural communities in the process. This includes program development, program implementation, and any changes to the program after its launch. Agricultural participants would be critical to the success of a demand management program in achieving conserved consumptive use.

SECTION 6 – ENVIRONMENTAL CONSIDERATIONS – LITERATURE REVIEW

SGM led the Environmental Considerations processes for the Investigation. The tasks associated with these efforts specifically included:

- Review and develop environmental criteria for assessing impacts of potential demand management activities.
- Identify data gaps, tradeoffs, and interrelated topics relevant to the Environmental Considerations workgroup and assist in determining methods to address data gaps as directed, as identified in the literature review.
- Summarize instream flow, environmental and recreational issues relating to past water conservation programs.

Literature Review

SGM reviewed various types of water savings, water banking, pilot projects and/or water conservation reports (listed in **Exhibit A**) and information to understand how environmental considerations, impacts and net benefits, were considered or how they influenced projects to balance these needs. Like the Monitoring and Verification literature review, SGM reviewed this information to understand how future projects could inform the integration of environmental considerations for a potential DM program, including:

- Current methodologies, data, and information to measure environmental attributes both in the agricultural and municipal contexts.

- Details associated with consumptive use and conservation estimation and monitoring, verification methods, and related issues.
- Data gaps and methods for being able to consider and measure environmental attributes within the DM monitoring and verification process.

SGM took the direction of the Environmental Considerations workgroup and summarized key topics, criteria, and considerations relating to previous conservation projects (**Exhibit B)**. Summary information included:

- Primarily purpose/goal of the project.
- Key takeaways.
- Project location.
- Program name, administration, structure, nature and duration of project practice.
- Tools uses to assess environmental impacts.
- Impacts to streamflow including magnitude, frequency, duration, timing, rate of change in hydrologic conditions, and return flow impacts.
- Impacts to species including critical stream reaches, critical land or riparian habitat, and list of species impacted.
- Impacts to water quality including salinity, temperature, and other constituents.
- Environmental considerations tradeoffs predicted outcome from activities, and proportionality.
- Ability to offset losses to environmental services and opportunities to incentivize environmental components for CCU projects.
- Evaluation of impacts (positive or negative) to instream flows, stream or watershed management plans, critical habitat, state species of concern, basin roundtable environmental values, conservation strategies, and other community goals and/or projects.

What we Know

Overall, the literature review concluded that most projects and studies did not consider nor measure how conserved consumptive use impacts or benefits environmental attributes. However, there was recognition in some studies that the environment benefits with increased streamflows due to lower diversions. In general, these streamflow impacts were correlated to better fish habitat due to higher instream flow and lower temperatures.

There was recognition that the following key elements might influence environmental impacts or benefits, and in some instances, offered suggestions for integrating potential mechanisms for measuring these benefits and impacts.

Streamflow Impacts

Generally, the literature found increased streamflow could benefit the environment. “Environmental Water Transactions in the Colorado River Basin: A Closer Look” (Stanford Woods Institute for the Environment, 2018, Exhibit A) reviewed instream flow projects including the SCPP projects. Notably, the report found that “although the total amount of water restored by these transactions is very small compared to the overall water budget of the basin, in certain watersheds, transactions have provided significant benefits for local streamflow.” Specifically, these were the Price River watershed in Utah and the Green River watershed in Wyoming.

Another report, "Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture" (Aillery et al, 1999, Exhibit A) focused on the impact of diverted water and the impact of decreased streamflow on salmon species. Specifically, it found "flow alterations have significantly increased travel time for juvenile fish migrating to the ocean, a primary factor in reduced survival rates." The report investigates different methods to increase streamflow in the Columbia River basin. As this relates to a DM program, increased streamflow to move water to Lake Powell could have positive impacts on fish species.

Modeling

The literature identified the importance of modeling to be able to fully predict changes in streamflow during a demand management program. Currently, the models do not handle extra pools of water in the reservoirs and would need to be updated to help appropriately drive reservoir operation. In "Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows," (Hydros Consulting, 2011, Exhibit A), StateMod could be most easily reconfigured to simulate environmental flow targets (through Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.

Species

Throughout the literature, different fish species are discussed with a focus on trout and salmon populations in the Western United States. One of the secondary benefits of the SCPP projects included increased streamflow in the Middle Piney Creek. As streamflow decreases, water temperature tends to rise, "often beyond ideal thresholds and also reduces available habitat." The GV CUPP (J-U-B Engineers Inc., 2017, Exhibit A) found "increased water in the river resulted in $23,000 of estimated savings not spent on endangered fish programs." More broadly in the United States, adding minimum flow requirements for the Snake River at Lower Granite Dam, and for the Columbia River at McNary Dam has improved salmon and steelhead populations (Aillery et al, 1999, Exhibit A).

Water Quality

Salinity impacts were discussed in four of the reports reviewed, mostly reviewing projects in the Grand River Valley. During the SCPP, it was estimated that the "2017 Grand Valley water conservation project is estimated to have reduced salt loading to the Colorado River by 4,960 tons." (UCRC, 2018, Exhibit A). In the Colorado River District's "Colorado River Water Bank Feasibility Study: Phase 2," (MWH, 2013, Exhibit A) water quality impacts are discussed with focus on salinity and selenium. "Salinity and selenium issues may make fallowing or deficit irrigation more attractive to Project farmers, as impacted lands might be taken out of production with less impact on overall yields. In addition, reduced irrigation of these lands may have benefits in improved quality of return flows." In this study, salinity effects (not affected or marginally affected) were a screening criterion used to select candidate systems representing a broad range of characteristics. In the "Infographic: Grand Valley Pilot Project Secondary Benefits," (TNC, 2019, Exhibit A) reduced irrigation "on salty soils improved water quality and resulted in an estimated savings of $282,720 from money not spent on other measures to reduce salinity." However, another review, "Research Synthesis: Agronomic Impacts of Reduction Irrigation," (Culp and Kelly, 2019, Exhibit A) raises the concern that "salt will move to the surface of the soil during periods of fallowing." If this occurs, "a pre-planting leaching irrigation" may be required which could "reduce the water savings from fallowing."

Additional Considerations

A summary of additional project considerations from the literature suggested the following to promote the inclusion of environmental attributes. These considerations are also discussed in the M&V section.

- Using streamflow station data helps understand the impacts to streamflow from foregone diversions.

- Increasing water in the river could result in savings due to less spending on endangered fish programs in studies.
- Reducing irrigation on salt soils could improve water quality and save money on salinity reduction programs.
- Maintaining historical return flows may be a challenge and may require storage and timed releases or construction of recharge basins but could offer net environmental benefits.
- Reducing irrigation on salty soils may improve water quality and reduce costs for salinity reduction programs. However, salty soils should be monitored as extra irrigation may be needed in subsequent years to perform leaching irrigation – reducing the long-term water savings.
- Increasing streamflows keeps temperatures low, improving fish habitats.

Key Takeaways

The key takeaways relating to a potential DM Program that support Environmental Considerations aligns with the need to ensure ongoing Compact compliance, however, there is a strong need to fill in the data gaps to be able to measure the potential impacts or benefits associated with the streamflow impacts.

List of key things that would support measuring impacts or benefits include:

- **Local Support and Participation**. Enlist local key stakeholders and non-governmental organizations (NGOs) to partner and realize opportunities to provide a net environmental benefit.
- **Alternatives Analysis**. Initiate a high-level assessment of environmental impacts of all recommended and alternate water management strategies considered.
- **Expand Project Purpose to Consider Additional Objectives**. The literature review revealed that many of the demand management programs did not have an environmental focus.

Data Gaps

The following data gaps were identified in the Environmental Considerations literature review:

- **Data**. Measured data on the impacts on fallowing and deficit irrigation on downstream streamflow and environmental resources due to changes in return flows.
- **Modeling**. The actual timing and reduction in depletions will require return flow modeling
- **Instrumentation and Monitoring Equipment**. There will be a need for cost effective flow monitoring to gage the environmental benefits in specific locations

The Environmental Considerations workgroup identified specific issues of interest to be considered in the literature review. SGM looked for mentions of these items and the following issues were not addressed in the 54 documents reviewed:

- Stream Management Plan/Watershed Management Plan objectives.
- Basin Round Tables environmental values lists/mapping.
- Colorado River Cutthroat Trout conservation strategy.
- Other known community/entity project.
- Environmental specific tradeoffs.
- Other known community/entity projects.

SECTION 7 – FUNDING – LITERATURE REVIEW & ANALYSES

WestWater Research led the Funding processes for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final meeting of the Funding Workgroup as a listener.
- Compilation and review of past studies and research regarding the costs and funding structures for other water conservation programs in the Western U.S. like a DM program.
- Analysis of design elements of a DM program as they relate to costs and beneficiaries.
- Identification of knowledge or data gaps in the ability to understand and evaluate the costs and funding options for a DM program.

Literature Review

There was found to be a lack of literature and past research on the costs and funding structures for demand management types of water conservation programs. WestWater compiled data and conducted original research on other water conservation programs in the Western U.S. to support the funding analysis.

What we know

Cost Components of Example Demand Management Programs

This section provides an inventory and analysis of other "demand management" programs in the Western U.S. In identifying comparable programs, the following selection criteria and loose definition were applied: (1) voluntary, (2) compensated, (3) consumptive water use reduction that is (4) temporary for any piece of land and is distinguished from two-party transactions because it is (5) operated by a single entity as a program over multiple years, often with a (6) regulatory or policy driver. Pilot projects were included. The costs of demand management vary by the type of water use (demand) being managed and reduced. Costs are significantly different between the agricultural and municipal sectors.

Agricultural Demand Management

Most of the demand management programs identified in the Western U.S. have been programs to reduce agricultural water use in order to utilize the savings for an alternative water use, such as municipal or environmental. A total of 17 example agricultural demand management programs were identified in more than 6 different states. A range of entities have developed and administered the agricultural demand management programs, including municipal water agencies, state government agencies, local / regional water districts, and others. The following cost components were identified in reviewing the example agricultural demand management programs:

- **Water Costs**. As defined above, all example demand management programs were compensated and therefore all had a water cost associated with agricultural conservation activities. The water costs reflect various factors: (1) the foregone agricultural value, or lost net revenue, (2) the program compensation structure and term, and (3) the type of demand management activity. A more expansive discussion of agricultural economic impacts from conducting demand management activities is provided in a previous section of this report. The water costs for agricultural participants in a Colorado demand management program are likely to reflect the predominance of perennial forage crops on the Colorado West Slope.
- **Administration Costs**. All of the example demand management programs had administrative costs, with an average annual cost $40 per acre-foot. Administration costs include regulatory approvals to

initiate projects and annual monitoring and verification activities. In one example, these costs were paid by the participating landowners and were covered as part of the compensation (water cost). With the exception of the Catlin Canal Pilot Project on the Lower Arkansas River, administration costs ranged from $4 to $48 per annual acre-foot (AF) of demand reduction. The Catlin Canal Pilot Project had estimated administration costs of $167 per AF, per year which reflects the attributes of this project and relatively stringent administrative requirements found in Colorado and particularly along the Front Range.

- **Mitigation Costs**. Only 5 of the 17 example demand management programs included mitigation payments to offset economic and related secondary (indirect) impacts from reduced agricultural water use. For the 5 programs that include mitigation as part of the program, the mitigation payments ranged from $2 to $86 per annual AF of water use reduction, with an average annual payment of approximately $50 per AF.

Municipal Demand Management

The activities to achieve demand management in the municipal sector remain uncertain, and it is likely that municipal water providers will take different approaches to implement demand management within their systems. This funding analysis considers municipal demand management through water conservation as one potential method, but it is recognized that it may not be broadly applicable. Water conservation was selected because most Colorado municipal water providers have a water conservation program or plan of activities that can be evaluated for example costs of demand management. Unlike the agricultural examples described in the previous section, municipal programs are typically not intended to produce a transferable water supply to another use. Municipal demand management programs are typically targeted at one of the following objectives:

1. Permanently reducing individual customer water use through a variety of indoor and outdoor water conservation and efficiency activities, including public outreach, rebate programs, tiered or water budget rate structures, home water audits, and others.
2. Temporarily reducing both individual customer and municipal-scale water use in response to a potential water supply shortage due to drought, infrastructure damage, or other emergencies. Regulatory measures are often applied to achieve demand management, such as every other day outdoor watering, bans or limitations on certain water uses, and temporary increases to water billing rates.

Any potential Demand Management program in Colorado would be voluntary, temporary, and compensated. Municipal demand management examples do not necessarily align with all three characteristics. Water conservation program activities in the first category above have associated direct costs (compensation) and are voluntary actions but are often intended to result in permanent water use reduction. The second category of regulatory actions are intended to be temporary but are often not voluntary or compensated. For this analysis, the cost of municipal demand management references observed costs of permanent municipal water conservation programs, but it may be recognized that temporary demand management can be achieved in the municipal sector and historically has been more likely to occur through regulatory (policy) actions at little to no direct cost. In addition, many municipal water providers may look to implement demand management activities with no water service impact to their customers and therefore with no water conservation actions by their customers.

The costs of municipal demand management were evaluated using two approaches and datasets:

- **Municipal Conservation Activities**. Municipal demand management is achieved through a combination of activities, such as those listed above. These activities each have an estimated water demand reduction and cost. Previous research indicates that indoor residential conservation activities have costs that are roughly 50% of the outdoor conservation activities. The costs also increase with greater degrees of water demand reduction. In total, past research indicates municipal conservation

activities having total direct costs of $500 per AF or more. This cost is likely to represent a permanent water use reduction, and the annual equivalent cost is estimated at approximately $20 per AF based on a 4% discount rate over an indefinite period.

- **Municipal Conservation Programs**. Many municipal water providers have annual water conservation programs with associated budgets to achieve demand reduction. Instead of looking at the cost of individual activities, it is helpful to look at the overall costs of municipal water conservation programs to understand the administrative costs, the inefficiencies in program spending, the effects of program activities that do not have associated costs, and the impact of growth in the number of service customers. A historical analysis of municipal demand management over the period 2000-2020 was completed for 9 example municipal water providers who utilize Colorado River Basin supplies. The average unit cost was found to be approximately $1,500 per AF of demand reduction, which is considered to better reflect the total cost of achieving overall volume reductions in municipal demand, as opposed to reductions in per-person water use rates.

Municipal demand management costs in Colorado may consider two important factors:

- **Trans-Basin Diversions**. Most municipal water use in the Colorado River Basin in Colorado is sourced from trans-basin diversions to the Front Range. These trans-basin diversions have historically not had any return flows to the Colorado River system from municipal effluent, and therefore any municipal diversion demand reduction from these trans-basin diversions is effectively a reduction in consumptive use from the Colorado River Basin. This contrasts with municipal water users located in the Colorado River Basin, who would mostly realize consumptive use savings only from a reduction in outdoor watering uses.
- **Water Supply Portfolio**. Most Front Range municipal water providers, particularly the largest volume users, have a water supply portfolio that sources water from a variety of river systems and projects. The composition of municipal water supplies that are sourced from the Colorado River system as a portion of the overall supply portfolio influences how total municipal demand management activities relate to water diversion reductions in the Colorado River Basin. Available data indicates that municipal water utilities in Colorado that are reliant on the Colorado River Basin for a portion of their water supply have 50% to 60% of their water supply sourced from other water systems. Therefore, municipal water providers would need to specifically reduce Colorado River Basin sources commensurate with demand management activities, otherwise the unit costs per volume of Colorado River water use reduction would potentially double.

Cost Factors for Demand Management Program

Cost estimates of a DM program are inherently uncertain because the costs can vary significantly depending on the following factors (among others):

- **Funding**. The funding structure of a demand management program is expected to influence costs, and particularly the amount of state government funding required. Decisions about who pays for demand management influences who bears the costs but also impacts the cost itself.
- **Scale / Volume**. Costs are directly a function of scale, or the annual volume of demand management being implemented. At the present time and for the near term, the scale of demand management in Colorado will be limited by volume of the conservation pool in Lake Powell created by the DCP. The annual volume of demand management will depend on how much space within the conservation pool is available to Colorado and how fast that space is intended to be filled.
- **Timing**. Costs escalate under emergency action, which has long motivated planning efforts in various subject areas. Demand management activities in the agricultural and municipal sectors may be more difficult and more costly to achieve during a drought, or if activities are required due to pending water

shortages or Compact administration. A multi-year consistent demand management program is expected to carry lower costs than a program that is reacting to stressful conditions.

- **Project Selection Process & Equity Policies**. The process for selecting demand management projects may influence program costs, depending on what type of process is established, how applicants are identified and evaluated, and how projects are compared. Several of the Workgroups have had discussions supporting equity in a demand management program, including water use sector equity between agricultural and municipal water users and spatial equity to limit the concentration (and associated impacts) of demand management activities. Implementing regulatory limits to provide for equity is expected to increase costs, due to a reduction in the pool of potential projects and deviation from a lowest-cost system of project selection.
- **Administrative Process**. The process established to conduct an upfront review of each project application, and the process established for monitoring and verification of project activities are both significant factors in overall project costs. It will be important to establish a review and monitoring process for the demand management program that is not cost prohibitive. Another aspect of approval is any environmental review and mitigation that is required as part of the program.
- **Participant Requirements**. Compensation payments are expected to reflect any lost economic opportunity associated with reduced water use, and any costs associated with meeting program requirements. As described in a separate section of this report, participant requirements may include cover crops, weed and pest controls, and other elements to reduce off-farm impacts.
- **Mitigation**. In addition to compensation paid to participants, there may be mitigation payments paid to offset economic and environment impacts resulting from the projects. Example mitigation includes: (1) payments to the larger ditch company or irrigation district for operational impacts, (2) payments to the county to offset economic impacts, (3) payments to an environmental organization to offset wetland or riparian impacts.
- **Economic Factors**. The multi-year and potentially multi-decade timeline of a demand management program results in various economic factors influencing costs. Some examples include: (1) agricultural commodity market prices influencing compensation payments, (2) interest rates influencing the cost of capital outlays, (3) inflation influencing all prices & costs, (4) population and economic growth influencing water supply & demand imbalances and water transaction values. There are other factors to consider, but the underlying point is that a variety of factors outside of the program's design and control will influence program costs.

Key Takeaways

The takeaways provided in this section are crafted to advance the demand management discussion and feasibility analysis in Colorado.

- **Activity & Scale**. Proactive programs that aim for annual demand management activities over a longer period of time are a more cost-effective method, as opposed to a surge of activity during a drought or other stressor. Therefore, funding sources may be structured to be reliable and consistent. Costs of demand management activities are a primary consideration if the program is publicly funded.
- **Certification Process**. Several of the time-intensive and costly aspects of project review and approval can be completed upfront and remain valid for many years. Therefore, other successful demand management programs have been designed with a certification process for projects that can allow each project to be thoroughly reviewed but also allow annual flexibility in participation.
- **Minimize Seller Costs**. To encourage participation in the demand management program, program design might avoid a significant cost burden for participants, or entities conducting demand

management activities. Monitoring and verification activities (and proving non-injury) may require the installation of equipment and annual data collection efforts. In addition, there may be mitigation costs associated with the ditch organization, local community, and environment. Upfront capital costs and mitigation costs could be incorporated into annual compensation payments. The program design may also consider state agency staff to conduct the initial reviews of applications and to assist in project administration. With these program design elements, the participant costs may be limited to developing application materials.

- **Incorporate Monitoring & Verification Costs into Project Selection**. The process of comparing and selecting project proposals requires that the full cost of the project be quantified. The compensation aspects of each proposal are expected to be defined by the participant. Monitoring and verification components of each project will be more difficult for the applicant to define. The costs of monitoring, verification, and administrative approval (to ensure non-injury) are expected to vary significantly across projects. Monitoring and verification costs could be evaluated with DNR assistance as part of a certification process and costs may be considered as a required element of each project application. An accurate evaluation of project proposals requires an "apples to apples" comparison of full project costs.

Data Gaps

This section provides a discussion of two types of data gaps: (1) those currently present in evaluating the feasibility of a demand management program, and (2) those that are likely to be present when structuring specific demand management funding options.

Data Gaps in Evaluating the Feasibility of Demand Management

The costs of demand management remain uncertain because of multiple variables and decision-points affecting the program. The preliminary estimates on cost feasibility may continue to be revisited by CWCB staff as the program design is explored. As continued analysis occurs, the following data gaps related to funding are identified:

- **Process Considerations**. Preliminary ideas on a program process are identified in the form of a single conceptual framework. The costs of a demand management program are inherently tied to the application and selection process, requirements for monitoring and verification, and project evaluation. It is expected that many of the data gaps involving process will be filled if, and as decisions are made regarding program structure.
- **Program Requirements**. Costs are also a function of program requirements, such as mitigation for local economic impacts and augmentation of stream depletions. Program costs can rise significantly depending on how program and participant requirements are defined.

Data Gaps in Structuring Specific Funding Options

The data gaps listed above for evaluating feasibility also apply to structuring specific funding options for demand management. Specific funding options can be developed once these data gaps are addressed.

SECTION 8 – MONITORING & VERIFICATION – LITERATURE REVIEW

SGM led the Monitoring and Verification literature review for the Investigation. The tasks associated with these efforts specifically included:

- Participation in the final two meetings of the Monitoring and Verification workgroup as a listener.
- Compilation and review of past studies and research regarding M&V considerations and practices detailed in previous CCU and ATM pilot projects, as well as western states water banking programs.
- Analysis of design elements for a potential DM program as they relate to M&V activities.
- Identification of knowledge or data gaps for consideration of the implementation of M&V requirements in a potential DM program, along with individual DM M&V project requirements.

Literature Review

SGM reviewed various types of water savings, water banking, pilot projects and/or water conservation reports and information that had similar goals and could inform the feasibility of a DM program, including:

- Current methodologies, data, and information to measure DM and water conservation both in the agricultural and municipal contexts.
- Details associated with consumptive use and conservation estimation and monitoring, verification methods, and related issues.
- Data gaps and methods for being able to continue advancing the DM monitoring and verification process.

Overall, the reports captured a summary of pilot project, such as the System Conservation Pilot Program (SCPP), and water conservation activities in Colorado and other areas across the Rocky Mountain West. The literature review considered a wide array of documents including research papers, demand-side vs supply-side municipal studies, state-mandated water conservation programs in California, crop rotations, energy-water benefits, and ATM research. The reports (shown in **Exhibit A**) generally analyzed off-farm benefits, conserved consumptive use, lessons learned and environmental impacts.

To better record the breadth and depth of information available in the literature, SGM summarized key topics, criteria, and takeaways relating to previously completed projects within a table. Summary information included:

- Primarily purpose/goal of the project.
- Key takeaways.
- Project location.
- Program name, administration, structure, nature and duration of project practice.
- Source and amount of water conserved.
- Monitoring and verification requirements, equipment, and processes:
    - Measurement of water returned to the stream.
    - Consumptive use analyses.
    - Estimate of residual field consumptive use.

  - Return flow maintenance.
  - Verification of conserved consumptive use.
  - Coordination of benefits.
  - Municipal considerations.
- Implications for storage, hydropower, recreation, and environmental considerations.
- Program lessons learned, successes and/or challenges, tradeoffs, proportionality, and alignment with M&V workgroup guiding principles.
- Project data gaps, keys to success, identified challenges, and overall findings and lessons learned.

See **Exhibit B** for the comprehensive tables documenting the overall M&V literature review findings.

What we know

Overall, few of the reports focused on the specific methods, instruments, or techniques used for monitoring and verification activities. Almost all the literature identified that projects need to be evaluated at the individual field level, as no two projects are alike. Generally speaking, the measurement devices commonly used by irrigators and municipalities are adequate to monitor and verify demand management project activities. The challenge often identified in the literature wasn't inadequate devices, but a lack of measurement devices physically installed near the project area. At the project level, a combination of existing measurement devices and field visits were used to verify conservation projects were operating as planned. However, the literature often cited that detailed measurement and verification of the achieved conservation amount wasn't completed, rather that the conservation practices were implemented. As an example, the Grand Valley Water Users Association Conserved Consumptive Use Pilot Project (GV CCUPP) relied on an independent contractor to perform site visits throughout the project to verify fallowed fields, give advice for weed control, as needed, and document compliance. The reports and lessons learned from the project emphasized the importance of utilizing an independent contractor to the success of the project. Ultimately, this increased trust between the participants and the program administration. The literature also identified that widespread and readily available remote sensing may help with monitoring and verification practices in the future, as well as to understand the historical irrigation practices and potential conservation benefits at a proposed site.

Consumptive Use Analysis

There are multiple computer programs available that can reasonably estimate the amount of historical consumptive use of agricultural operations. Each program is slightly different and requires a certain amount of input data. The ability to estimate the historical consumptive use is predicated on the availability of adequate climate data, water diversion records, cropping information, and soil characteristics. For instance, the CU analyses of SCPP projects focused on the specific amounts and associated cost of conserved water. Overall, the SCPP resulted in an estimated consumptive use reduction from all 45 projects in 2015 through 2017 of 22,116 acre-feet (AF). Additionally, projects complete in 2018 increased the reduction of consumptive use by 25,097 AF for a total of 47,213 AF over the entire SCPP timeframe.

The System Conservation Pilot Program also considered the difference between estimated consumptive use reduction on the applications and the reduction calculated during the subsequent analysis. Overall, the application estimates underestimated the reduction by 2,728 AF (approximately 7%). The SCPP identified that in order to accurately calculate the actual CU conserved in a project, thorough on the ground measurements are needed. In addition, the GV CCUPP pilot program analyzed the conserved consumptive use compared to the number of acres enrolled in the project. They found in 2017 with 1,069 acres enrolled in the pilot project resulted in 2,715 AF of water conserved. Similarly, in 2018, 1,252 acres were enrolled

which conserved 3,178 AF with both years yielding approximately 2.5 AF of conserved water per acre enrolled in the GV CCUPP pilot program.

It is important to note that the purpose of the System Conservation Pilot Program was not to create quantifiable water savings in Lake Powell, but rather to test the concept of a program incorporating temporary, voluntary, compensated reductions in conserved consumptive use.

Lessons Learned

Three primary lessons learned from the SCPP include:

- Outreach & communication is essential.
- Operational & legal issues must be addressed at ditch company/irrigation district level.
- Simplifying the process allows for greater efficiency.

Multiple participants voiced concerns about "broader economic impacts and social issues for" their communities – emphasizing the necessity of outreach and communication. For monitoring and verification purposes, the SCPP literature emphasized the importance of supporting efforts to estimated conserved consumptive use and the independence of verification work from the local administrators (such as ditch company/irrigation district staff). Additionally, The GV CCUUP found there was an increased interest in participation after the first year of the program and similarly indicated the importance of independent monitoring and verification-built trust within the pilot program.

Secondary Impacts

The SCPP literature described the benefits of a DM-type program increased environmental flows, decreased cost of alternative habitat flow restoration projects, improved societal benefits from habitat flows for endangered species, reduced salinity loading in the Colorado River, and increased municipal and hydropower benefits. Other pilot projects in Colorado observed that increased flows contributed minimal improvement to the overall recreational flow needs. Some documents did consider temporary water transfers and the associated impact to instream flows (ISF). These transfers without legally changing the water rights resulted in irrigators conserving water through a variety of means and leaving some portion of that water instream, which generally bolstered flows during the irrigation season, but may have reduced non-irrigation season return flows within a stream segment. The SCPP was documented to have the added effect of enhancing streamflow, and it was further determined that the availability of consistent funding would be crucial to success of long-term demand management efforts, whether for streamflow, water security or (most likely) multiple objectives.

SCPP Overview and General Findings

- Focused on the general administration and process of running a demand management system rather than the specifics of monitoring and verification.
- Attempted to streamline the process for participants (irrigators) and keep the barriers to entering a program/project minimal.
- Concluded that the size of the ditch and its governance/bylaws greatly influenced how conserved water projects could be operationally achieved and accounted (for).
- Realized that the size of the ditch company changed how water was managed.

    For example, large ditch companies diverted supplies and ran through their system; medium ditch companies diverted supplies and ran through their system or reduced their river headgate diversions; and small ditches reduced their river headgate diversions or closed it.

- Systems with multiple shareholders will likely require management participation (i.e., water users association or ditch company board) for success.
- The SCPP return flow maintenance practices were considered, but generally not adequately.
- Modelling considerations will need to be updated to handle water storage for potential demand management project operations.
- Flexibility to allow for locally driven solutions can drive higher engagement.

ATM Pilot Project Overview and Findings

- Avoided the need to go through a water court application process. However, complex monitoring and verification requirements may require a legal process that complicate the implementation of projects (historical consumptive use, change of use cases, etc.).
- Existing legal platforms to avoid water court are limited to instream flows leases, Substitute Water Supply Plan, and Interruptible Water Supply Agreement.
- These existing options have limitations and may not apply to every case or be useful in all projects so other options may need to be developed to avoid water court.
- Protection of vested water rights along with a flexible delivery schedules for M&I stakeholders are key for agricultural producers so they can keep growing crops/livestock.
- Guaranteed supplies are paramount for M&I water providers.
- An overall pilot project goal may be to reduce costs for M&I stakeholders such that ATMs are more affordable or more beneficial than buy-and-dry.
- The cost of installing new and/or highly accurate monitoring and verification equipment may be a participation barrier, depending upon the accounting and administration requirements.

Additional Findings

- Integrating local issues/sentiment was critical to the successful launch of conserved consumptive use pilot projects.
- Independent verification of project compliance helped maintain a level of trust and eliminated many interpersonal issues between irrigators, districts, and ditch companies.
- Sources of funding could cause contention if irrigators perceived a Front Range entity was paying for an area to be fallowed.
- Models worked well for estimating conserved consumptive use, though without on-farm analyses, the calculation of actual water savings was difficult to determine.
- Calculated estimate consumptive use and verification of conserved consumptive use in agriculture is improved with nearby climate stations.

Themes

The following statements capture overarching themes from the Monitoring and Verification literature review and represent common considerations for establishing buy-in for a future potential DM program.

Local data and input

Local focus was identified as one of the most crucial components for obtaining buy-in, finding project participants, and addressing misconceptions or apprehensions, etc. This theme cannot be emphasized

enough, as nearly every report highlighted this as contributing factor to the success of projects. Additional information surrounding the need for local data and input included:

- Generally, standard measurement equipment available and used by many irrigators and municipalities is adequate to monitor and verify conserved consumptive use projects. Locally, challenges may occur due to a lack of measurement devices, or with antiquated devices in poor condition.
- The availability of local data and equipment will inform the monitoring and verification needs and/or requirements for conserved consumptive use projects.
- A local presence is helpful to address any technical monitoring and verification needs. As a result, costs associated with local technical services for monitoring and verification could be significant.
- Regarding proportionality, M&I participants could more likely afford the engineering and legal costs than agricultural participants.
- Regarding proportionality, costs to support local technical services could prevent agricultural participation.
- Drought messaging can significantly influence a customer's response to whether or not they will conserve.

    For instance, the Drought Monitor could indicate conditions that are too regional and general and not reflect site-specific conditions. This develops a lack of trust in the regional information and represents an opportunity to change practices.

Flexible program

- Each conserved consumptive use project is different. Therefore, a flexible program structure could be more attractive to prospective applicants, especially by considering local and regional needs.
- However, a flexible program structure could require more administrative coordination and effort and could take longer to develop.

Infrastructure

- Potential participants in future pilot projects may need significant investment in infrastructure to accurately monitory and verify the conserved water and to ensure that return flows are maintained to avoid injury to downstream users.

Key Takeaways

The key takeaways relating to a potential DM Program that support M&V activities were largely based on the observed themes and may be used to fill the identified data gaps. In summary they include:

- **Utilize Local Resources.** The literature indicated obtaining local data and input to drive a monitoring and verification implementation was key to building public trust in the program, as discussed in the Education and Outreach section. Local resources were instrumental to support efforts to estimate conserved consumptive use, address any technical monitoring and verification needs for participants, as well as to provide independence for verification work from the local administrators (such as ditch company/irrigation district staff).
- **Develop a Flexible Program.** Projects in different geographic regions will require different implementation methods, project operations and local support. A project in one area will have different soil conditions, crops, ditch operations, community relations, etc. than another project. Allowing program flexibility for different implementation options increased participation in the literature reviewed.

- **Provide Funding to Support Investment in Measurement Infrastructure.** The literature highlighted it is not uncommon to have good potential projects in areas which lack the infrastructure to be able to monitor and verify the project. The initial capital costs and ongoing operations and maintenance costs required to install the measurement structures needed for accurate monitoring and verification of conservation projects needs to be addressed to promote participation in those projects.
- **Communicate with stakeholders, landowners, ditch, and reservoir companies before, during, and after projects.** The literature highlighted the importance of working directly with the program participants and those whose operations were directly impacted by participant participation (i.e. ditch companies, reservoir companies, etc.) throughout the process to future participation and trust in the monitoring and verification process.
- **Numerous takeaways from the E&O section, would support an effective M&V program implementation.** The SCPP literature highlighted the importance of a local project champion to reach out to potential project stakeholders and then work through implementation challenges, including building trust in the monitoring and verification processes.

Data Gaps

- More data would need to be collected to fully monitor and verify project yields and the resulting system increases, impacts to downstream water users, and ultimate benefit to Lake Powell.
- While standard irrigation and municipal measurement devices will likely be adequate, there is not detailed information regarding equipment or measurement instrumentation recommendations and/or data processing methods.
- There is a need for significant investments in infrastructure to accurately account for any conserved water and to ensure that return flows are maintained to avoid injury to downstream users.
- Fallowing projects are easier for monitoring and verification purposes, as general techniques include site visits to document that a field isn't being irrigated, as well as to observe the growth of any vegetation along with a review of careful accounting practices.
- Verification requirements will likely be more challenging and detailed for non-fallowing projects, as producers will seek to reduce the consumptive use of plants, while still obtaining a harvest.
- Accurately assessing the CCU from deficit irrigation or alternative crops will be harder to quantify/verify, requires more monitoring and data collection, and ultimately relying on more rigorous technical analyses.
- There may be a need for improved coverage of climate stations in regions of Colorado to support M&V activities for some future pilot projects.
- ET estimation methods vary regarding the necessary data, processing techniques, and resultant accuracy. Generally, the more plentiful the data and rigorous the analyses, the greater the cost and accuracy. Future pilot projects may explore various technical options and the resultant CCU.

ACRONYMS

AF	Acre-Feet
AFY	Acre-Feet/Year
ATM	Alternative Transfer Methods
Basin	Colorado River Basin in Colorado
BMP	Best Management Practice
CCU	Conserved Consumptive Use
CCUPP	Conserved Consumptive Use Pilot Program
CRWCD	Colorado River Water Conservation District
CFS	Cubic Feet per Second
CRCA	Colorado River Cooperative Agreement
CU	Consumptive Use
CWA	Clean Water Act
CWCB	Colorado Water Conservation Board
CWP	Colorado Water Plan
DCP	Drought Contingency Plan
DM	Demand Management
DMSA	Demand Management Storage Agreement
DNR	Department of Natural Resources
DWR	Division of Water Resources
E&O	Education and Outreach
EPA	U.S. Environmental Protection Agency
GPCD	Gallons Per-Capita per-Day
IBCC	Interbasin Compact Committee
Investigation	Demand Management Feasibility Investigation
ISF	Instream Flow
MAF	Million Acre-Feet
M&I	Municipal and Industrial
M&V	Monitoring and Verification
NGO	Non-governmental organization
NRCS	Natural Resources Conservation Service
PMT	Project Management Team

SB	Senate Bill
SEO	State Engineer's Office
SWSP	Substitute Water Supply Plan
TMD	Transmountain Diversion
UCRC	Upper Colorado River Commission
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service

Demand Management Literature Review

EXHIBIT A

Exhibit A. Summary of Literature Review Reports and Documents.

Title	Year Published	Publisher/Authors
System Conservation Pilot Program Secondary Benefits: Final Report with Case Studies	2019	WestWater Research for TNC
Infographic: Grand Valley Pilot Project Secondary Benefits	2019	TNC
Research Synthesis: Agronomic Impacts of Reduction Irrigation	2019	Culp and Kelly for TNC
Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin	2018	Upper Colorado River Commission
Final Report: Appendix C: 2018 System Conservation Pilot Program Update	2018	Upper Colorado River Commission
Pilot Program Funding Agreement	2014	Bureau of Reclamation
Colorado River Water Bank Feasibility Study: Phase 1	2012	Colorado River Water Conservation District
Colorado River Water Bank Feasibility Study: Phase 2	2013	For Colorado River District. By MWH.
Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)	2012	Natural Resources Consulting Engineers, Inc
Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado	2019	MacIlroy, Colorado State University
Briefing Paper: Upper Basin Demand Management and Water Banking. Addressing Risk and Creating Certainty: Exploring Options for an Upper Basin Demand Management Program	2019	TNC
Colorado River Water Bank Work Group: An Overview of Previous Studies & Reports	2018	Colorado River Water Bank Working Group
GVWUA Final Report on the Conserved Consumptive Use Pilot Projects	2019	GVWUA and J-U-B Engineers
Lessons Learned from the System Conservation Partnership Program	2016	The Nature Conservancy

Exhibit A. Summary of Literature Review Reports and Documents.

Title	Year Published	Publisher/Authors
Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows	2011	Hydro Consulting for TNC
Environmental Water Transactions in the Colorado River Basin: A Closer Look	2018	Stanford Woods Institute for the Environment
Lower Colorado River Basin Pilot Program	NA	Bureau of Reclamation
System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin	2017	Wyoming SEO Callaway, AWRA Impacts magazine
SNWA Water Resource Portfolio	2019	Southern Nevada Water Authority
Colorado River Basin Water Bank: Framework & Financial Analysis	2017	WestWater Research for TNC
Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture	1999	Aillery et al, Marine Resource Economics
Feasibility of water efficiency and reuse technologies as demand-side strategies for urban water management	2017	Berhanu et al, Journal of Industrial Ecology
Response to water crisis: How do Iranian farmers think about and intent in relation to switching from rice to less water-dependent crops?	2019	Boazar et al, Journal of Hydrology
Temporary water transfers for urban water supply during drought	1992	Clark, CSU
Flexible water allocations and rotational delivery combined adapt irrigation systems to drought	2018	Cody, K.C., Ecology and Society
Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity	2017	Colby (Ch. 3.1.4), Book eds Ziolkowska & Petersen
Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling	2016	Dubinsky, CU Denver
Economic viability of deficit irrigation in the Western US	2018	Manning et al, Agricultural Water Management.
The role of groundwater trading in spatial water management	2014	Palazzo and Brozovic, Agricultural Water Management

Exhibit A. Summary of Literature Review Reports and Documents.

Title	Year Published	Publisher/Authors
Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain	2019	Ren et al, Stochastic Environmental Research & Risk Assessment
Opportunities for saving and reallocating agricultural water to alleviate water scarcity	2017	Richter et al., Water Policy
Urban water conservation in the Sacramento, California region during the 2014-2016 drought	2019	Talbot, UC Davis
Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado	2016	Vashisht, Colorado State University,
Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains	2018	Yonts et al, J. of Agricultural Water Management
Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming	2017	Rosado, U of Wyoming
Standardizing Temporary Water Transfer Procedures in Colorado	2020	Nicols, Peter D, et al, University of Denver Water Law Review
Use of Alternative Transfer Methods to Increase Water Supplies for Conejos Basin Agriculture, Municipal, and Environmental Purposes	2017	DiNatale Water Consultants
Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley	2011	Trout, Raley, Montano, Witwer & Freeman, P.C.
Little Thompson Farm ATM Grant Completion Report	2018	Larimer County Natural Resources
HB13-1248 Catlin Canal Company Rotational Land Fallowing-Municipal Leasing Pilot Project	2018	The Lower Arkansas Valley Water Conservancy District, Ber Hill Greenleaf Ruscitti, LLP, & Martin and Wood Water Consultants, Inc.
Yampa Basin ATM Study	2014	TNC, Trout Unlimited & CDM Smith
Grand Valley Water Users Assn Conserved Consumptive Use Pilot Project Development: Process, Procedure, and Lessons Learned: Water Banking-Next Steps Part II	Mar-17	J-U-B Engineers, Inc.

Exhibit A. Summary of Literature Review Reports and Documents.

Title	Year Published	Publisher/Authors
Grand Valley Water Users Assn 2017 CCUPP In-Season Verification	2017	J-U-B Engineers, Inc.
Power Canal Capacity Report, Grand Valley Water Users Assn	Dec-2015	Olsson Associates
Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture	May-2011	Brown and Caldwell
Final Project Report: Implementation of Deficit Irrigation Regimes: Demonstration & Outreach	May-2016	Chavez, CSU
The Poudre Water Sharing Working Group: A Report to the CWCB	May-2015	The Poudre Water Sharing Working Group
FLEX Water Market: Education and Implementation Phase	Dec-2015	Brown and Caldwell, Ducks Unlimited, Aurora Water and LJCG
Alternatives to Permanent Dry Up of Formerly Irrigated Lands	Jun-2013	DiNatale Water Consultants & CSU
Water Partnerships: an evaluation of alternative agricultural water transfer methods in the South Platte basin.	Mar-2012	DiNatale Water Consultants, Inc.
Project Report: Lake Canal alternative agricultural practices and in-stream flow demonstration project	Jun-2013	Colorado Water Innovation Cluster
Final Report of the Lower South Platte Irrigation Research and Demonstration Project	Jun-2014	Hansen, Chavez, Garcia & Lytle

Demand Management Literature Review

EXHIBIT B

Exhibit B

This Exhibit includes 12 different tables that summarize the findings from the SGM Literature Review. There were 3 sets of documents [SCPP, Lit (General Literature), and ATM] considered across 4 different evaluation criteria (ATM, Environmental, General, and Monitoring & Verification). The following table provides a map of these exhibits.

Exhibit	**Document Category**	**Criteria**
B-1	SCPP	ATM
B-2	Lit (General Literature)	ATM
B-3	ATM	ATM
B-4	SCPP	Environmental Criteria
B-5	Lit (General Literature)	Environmental Criteria
B-6	ATM	Environmental Criteria
B-7	SCPP	General
B-8	Lit (General Literature)	General
B-9	ATM	General
B-10	SCPP	Monitoring & Verification
B-11	Lit (General Literature)	Monitoring & Verification
B-12	ATM	Monitoring & Verification

This table lists the various areas considered for each criterion.

Criteria Category	**Specific Areas to Identify**
ATM	Identified Local Impacts
	Identified Regional Impacts
	Operational Type of Project
	Types of Crops
	Agronomic Impacts • Yield • Quality • Recovery • Water Quality Effects • Soil Health Effects
Environmental Criteria	Streamflow Impacts • Magnitude • Frequency • Duration • Timing • Rate of change of hydrologic conditions • Return Flow Impacts
	Species Impacts • Return Flow Impacts • Critical Stream Reaches Impacted • Critical Land or Riparian Habitat Impacted • Species Impacted
	Water Quality Impacts • Salinity • Temperature • Other
	Data Gaps, Questions for Future Projects • Tradeoffs – Resource Impacts • Predicted outcome for applying “avoid, mitigate, offset” hierarchy
	Program Level Goals • No net loss to environmental services, recognizing tradeoffs • Build incentives for projects with net environmental benefits
	For Proposed Future Transactions, Need to Evaluate Impacts (Positive or Negative) to: • ISFs (or other flow targets) • Stream Management Plan (SMP) or Watershed Management Plan (WMP) objectives • Critical Habitat & Flow Recommendations • State Species of Concern • Basin Roundtable (BRT) Environmental Values Lists/Mapping • CRCT Conservation Strategy • Other Known Community/Entity Projects

General	Document Title Publisher/Author(s) Document Description General Notes Story Map (hyperlink) Primary Purpose/Goal of Report or Study Key Takeaways
	Project Location Information • Project Location Description • Latitude • Longitude • Elevation
	Demand Management Program Basics • DM Program/Activity Name • DM Program Structure • Nature of DM Practices • Duration of DM Practices Implementation (Duration and Frequency)
	Source and Amount of Conserved Water • Source of Water Conserved • Amount of Water Conserved – Conserved Consumptive Use
	High Level Program Information • DM Program Administration • DM Program Monitoring and Verification Considerations • DM Program Education and Outreach Efforts • Tools Used to Measure General Outcomes • DM Program Funding Considerations • DM Economic Considerations • DM Agricultural Impacts Considerations • Recreation
	Program Effectiveness • Lessons Learned • Program Successes and/or Challenges • Pros/Cons
Monitoring and Verification	Methodologies and/or Processes • Measurement of Water Returned to the Stream • Consumptive Use Analysis • Estimated Residual Field Consumptive Use • Return Flow Maintenance • Verify Conserved Consumptive Use • Coordination of Benefits
	Necessary Data and Equipment for Agricultural Participants • Representative Crop ET Data • Verification of Conserved Consumptive Use

	• Sub-irrigation • Reservoir Operations • River Diversions & Foregone or Bypassed Diversions • Lateral Delivery and Ditch Loss • Irrigation and Non-irrigation Season Return Flows • Resulting Streamflow
	Necessary Data and Equipment for Municipal Participants • Reservoir Operations • River Diversions • Foregone or Bypassed Diversions • Ditch or Pipeline Delivery • Overall Collection Systems • Monitor System-wide Operations to Verify Conserved Consumptive Use • Detailed System-wide Accounting Records
	Program Level Considerations • Tradeoffs – Value and/or Cost Implications for More Precise Data • Proportionality
	M&V Workgroup Guiding Principles • Honest, Accurate, and Defensible • Protective of Other Water Users • Simple, Easy, and Flexible • Resulted in Added Water, rather than a Retiming of Depletions
	Lessons Learned
	Key Takeaways • Data Gaps • Keys to Success • Identified Challenges • Overall Findings and Recommendations

Exhibit B-1
SCPP Documents with ATM Criteria

								Additional ATM Specific Components				
								Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)				
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
SCPP-01 System Conservation Pilot Program Secondary Benefits: Final Report with Case Studies	2019	WestWater Research for TNC	This case study report looked at whether the reduction in consumptive use in SCPP projects also generated off-farm benefits by applying select methods to quantify off-farm benefits to two case studies in Colorado and Wyoming. Note from TNC: An executive summary is also available, along with a more detailed report that outlines the framework for assessing secondary impacts/benefits and the associated methodology for quantifying or evaluating each impact/benefit.	Benefits assessed include increased environmental flows, decreased cost of alternative habitat flow restoration projects, societal benefits from habitat flows for endangered species, estimates of dramatic savings in salinity control, and municipal and hydropower benefits. Increased flows for the evaluated Colorado projects contributed minimal improvement to recreational flow needs. Cost savings were estimated by the cost of existing augmentation plans used to meet environmental and salinity management needs.	Not discussed.	Not discussed.	Annual projects.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-02 Infographic: Grand Valley Pilot Project Secondary Benefits	2019	TNC	This infographic summarizes the results of secondary benefits analysis as applied to the Grand Valley Pilot Project Case Study.	Grand Valley Pilot Project paid farmers to voluntarily reduce their irrigation water use in order to keep more water in the river to help increase water security within the Colorado River Basin in the face of ongoing drought. While focus was on water security several off-farm benefits occurs because of the project.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03 Research Synthesis: Agronomic Impacts of Reduction Irrigation	2019	Culp and Kelly for TNC	This memo reviews research on fallowing and limited irrigation to highlight key findings related to agronomic impacts of limited irrigation or other methods to reduce consumptive use of irrigation water in the Upper Colorado River Basin. The concluding section also identifies remaining research questions and suggests potential implications and possible next steps for a demand management program. The appendix summarizes the parameters of several of the studies reviewed. All of the referenced reports and publications are available on request.	Reviews methods and findings of existing research on agronomic impacts of limited irrigation in the following categories: yield, quality, water use efficiency, recovery, soil health, weeds/diseases/pests, and ag operations. Next steps and identified research needs include understanding impacts over a variety of geographies and crops, as well as long-term recovery. Management and operations needs include understanding the benefits of rotational fallowing, deficit irrigation, and crop switching. Finally, there are many needs in the verification of conserved consumptive use.	-Reduced crop yields. -Potentially prolonged recovery periods. -Possibility for both positive and negative soil health changes. -Increased chance of weeds, pests, erosion, and loss of topsoil. -Operational challenges and limitations. -Potential for herd size reductions with reduced grass/alfalfa/hay yields.	Not discussed.	Various irrigation water management studies including deficit irrigation, full fallow, partial season irrigation, crop switching, dryland farming, rotational fallowing, irrigation efficiency and water conservation.	Alfalfa, grass/hay, corn, barley, wheat, sunflowers, beans, and tuber/root crops.	-Alfalfa: deficit irrigation can reduce yield by approximately 1-ton per acre in high elevations and 5-tons per acre in low elevations, with a similar reduction in yield for grass/hay. Limited irrigation can affect stand density of alfalfa, especially in sandy soil in hotter climates. -Corn: decrease in water of 50% will only reduce yield by 25%. It's better to restrict water during early stages. -Barley: each day of severe stress during heading equal to one-bushel per acre reduction in yield. Water stress prior to or just after flowering most impacts barley. -Wheat: stress during maturing resulted in 10% yield reduction, while stress during aerial vegetative stage had almost no effect on yield. -Sunflower: decrease in water by 20% during early vegetative period reduced yield by 5%, while same reduction during flowering stage resulted in a 50% yield reduction. -Beans: water stress during reproductive stages (flower and pod fill) has the greatest impact on yield. Moisture stress can reduce yield by 27%. -Tuber & root crops: indeterminate crops can endure 4-5 days of moisture stress throughout the growing season with limited reduction in yield or quality. For potatoes any depletion past 80 percent leads to decreases in quality and/or yield.	- Quality of alfalfa can increase with moderate water stress. - Other crops can have similar qualities to fully irrigated crops. See yield comments (left).	- Alfalfa and grass/hay generally shows full recovery when irrigation is returned following limited irrigation. - Recovery is more difficult in arid climates with sandy soil. - Recovery is more difficult after multiple years of consecutive DM activities.	Not discussed.	- Salt will move to the surface of the soil during periods of fallowing. Some fields may need a pre-planting leaching irrigation, reducing the water savings. - Recovery from limited irrigation may be affected by micronutrient availability. - Deep rooted crops (alfalfa and corn) will use moisture deeper in the soil; potentially reducing the groundwater level. - No-till increased the amount of water stored in the soil dure to reduced evaporation, improved infiltration, reduced runoff, and increased snow catching. - Fallowing is often an overall benefit to soil health.
SCPP-04 Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin	2018	Upper Colorado River Commission	Full SCPP report from UCRC; project list; Lessons learned: administration & implementation, operational, cost/benefit/risk, legal constraints, outreach & education.	List of future questions to be answered p4	Not discussed.	Not discussed.	- Fallow, split season deficit irrigation, alternative cropping and deficit irrigation - Combination of fallow and split season deficit irrigation - Municipal foregone diversions and irrigation conservation project	Grass pasture, corn, winter wheat, alfalfa, beans, clover, triticale, small grains,	Not discussed.	Not discussed.	Not discussed.	Not discussed.	- There can be benefits to agriculture through soil resting.
SCPP-05 Final Report: Appendix C: 2018 System Conservation Pilot Program Update	2018	Upper Colorado River Commission	2018 update to UCRC full report, including Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Document includes Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Not discussed.	Not discussed.	-fallow, split season deficit irrigation, and combination of fallow and split season deficit irrigation	-Grass pasture, alfalfa, corn, and a variety	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-06 Pilot Program Funding Agreement	2014	Bureau of Reclamation	2014 SCPP funding agreement between CRB entities	Reviews history of compacts, storage allowances, demand management efforts by signatories. Defines goals and parameters of SCPP. Identifies NRCS programs that might support on-farm conservation improvements: EQIP and SWEP & ensures that projects will coordinate with respective NRCS State Conservationists.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.	Not applicable for the pilot program agreement.
SCPP-07 Colorado River Water Bank Feasibility Study: Phase 1	2012	Colorado River Water Conservation District	Water bank planning phase; conservative estimate of potential WB supplies, and demand for those supplies.	Includes potential WB uses, supply, magnitude & frequency of need, supply-use scenarios. App. A: categories of W/E slope water uses, App. B: CRC WB Feasibility Study Water Supply Technical Memo, App. C: Eval of CRC WB Hydrologic Scenarios w/UCRB model, App. D: Basic supply & use comparison scenarios for CRC WB technical memo	High percentages of fallow or deficit irrigation practices will impact local and regional economies to a greater degree.	High percentages of fallow or deficit irrigation practices will impact local and regional economies to a greater degree.	- Deficit irrigation of alfalfa and pasture grass. - Fallowing of small grains, corn, and dry beans	Alfalfa, pasture grass, small grains, corn, and dry beans	- Deficit irrigation on orchards and vineyards impacts yields and often has negative impacts on the subsequent year's production. - Fallowing is feasible for small grains and grain corn. - Deficit irrigation is possible for all crops, but best suited for perennial forage crops of alfalfa and pasture. - Pasture can be deficit irrigated every year without significant long-term impacts, including minimized stand reduction. - Alfalfa and pasture enter a stressed or dormant condition without significant loss of plant population or long-term crop damage. - In some instances pastures and alfalfa are grown successfully for many years without irrigation. - In most areas, alfalfa and pasture will produce harvestable yields with limited or no irrigation. - Deficit irrigation or no irrigation results in a significant decrease in yields.	The most critical time to provide an adequate water supply to grasses for maintaining a healthy crop is in the early spring through the first harvest.	It is important that pasture not be over-grazed during stress periods to protect the crowns of grasses which are important for plant recovery.	Not discussed.	Not discussed.
SCPP-08 Colorado River Water Bank Feasibility Study: Phase 2	2013	For Colorado River District. By MWH.	Water bank planning phase; test cases assessing on-farm impacts for representative irrigation systems	Includes candidate systems, screening criteria & selection, site visits for system evaluation, financial impacts on ag ops, operational scenarios & comparison to ATM work. App. A: Candidate system identification & evaluation; App. B Test Case site reports	- Other local impacts could include diminished aesthetics, reduced groundwater recharge for residential use, reduced baseflows to streams for fisheries and wildlife, and impacts to wetlands. - The need to reduce local cattle herds. - Depress the local economy.	- Impact and weaken the regional economy. - Potential long-lasting effects on regional cattle herds. - Impacts to regional streamflows, water and wildlife, aquifer recharge. - Increase regional prices for feed crops if a large number of producers participate. - Weaken the regioanl agricultural infrastructure.	Considered rotational fallowing, split-season irrigation, split-field irrigation, longer-term rotational fallowing, permanent fallowing, changes to crop type, and water efficienty projects.	Pasture grass, alfalfa, and row crops.	This was identified as a long-term study need, especially for high elevation pasture systems.	Not discussed.	Not discussed.	In areas underlain by the Mancos Shale, fallowing land will help the water quality of return flows to the receiving stream.	Not discussed.
SCPP-09 Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)	2012	Natural Resources Consulting Engineers, Inc	Technical analysis for water bank feasibility study, included in 2012 WB planning phase 1 report .pdf	Data section includes analysis, irrigated areas, water rights categories, and climate stations. Examined CU requirements (w/StateCU & Blaney-Criddle), ET verification (Penman-Monteith w/4 CoAgMet stations), and HCU (StateCU values for elevation bands in each division multiplied by irrigated acres). Water bank supply and cost: "fallowing suitable for small grains, grain corn, & dry beans." Deficit Irr available for all crops but best suited to alfalfa & pasture. "These crops combined account for over 98% of the acreage, irr CU, and supply-limited CU." Discusses split-season irrigation.	High percentages of fallow or deficit irrigation practices will impact local and regional economies to a greater degree.	High percentages of fallow or deficit irrigation practices will impact local and regional economies to a greater degree.	-Deficit irrigation of alfalfa and pasture grass. -Fallowing of small grains, corn, and dry beans	Alfalfa, pasture grass, small grains, corn, and dry beans	-Deficit irrigation on orchards and vineyards impacts yields and often has negative impacts on the subsequent year's production. -Fallowing is feasible for small grains and grain corn. -Deficit irrigation is possible for all crops, but best suited for perennial forage crops of alfalfa and pasture. -Pasture can be deficit irrigated every year without significant long-term impacts, including minimized stand reduction. -Alfalfa and pasture enter a stressed or dormant condition without significant loss of plan population or long-term crop damage. -In some instances pastures and alfalfa are grown successfully for many years without irrigation.	The most critical time to provide an adequate water supply to grasses for maintaining a healthy crop is in the early spring through the first harvest.	It is important that pasture not be over-grazed during stress periods to protect the crowns of grasses which are important for plant recovery.	Not discussed.	Not discussed.
SCPP-10 Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado	2019	MacIlroy, Colorado State University	This report was designed to assist in identifying and better understanding the socio-cultural components of a potential demand management program. The research, completed in Spring 2019, explored perceptions of demand management among stakeholders on the Western Slope through individual interviews and focus groups. The findings shed light on the barriers and opportunities for a demand management program, including ideas and feedback on what a successful program would look like, and why water users may or may not want to participate.**An executive summary is also available.**	This is an interview-based report that covers perceptions of DM, definitions of voluntary, compensated, temporary, and equity (their words are proportional/parity)--and finds that these definitions are not straight-forward and must be carefully communicated. Explores relationships with water and landscape, as well as "sacred values of the Western Slope." Addresses perceptions of DM in context of 2007 Interim Guidelines and broader basin-to-basin politics. Many interviewees doubt the viability of a voluntary compensated program, and even suggest that a mandatory uncompensated call would work better, avoid equity issues, and cost less overall. Compensation was a very challenging topic, with differing views of DM as a burden vs opportunity. Highlights clash of free-market values with the perspective of water as a commodity--discussion of different role water plays for irrigators vs Front Range residents. Who bears responsibility to pay--who is responsible for the shortage problems (many don't see the Upper Basin at fault). Temporary program vs temporary participation--fraught discussion. Discussion of Western Slope Sacred Values, how water and farming is part of identity. Numerous people suggested every water user curtail use and respect water and that we should make water conservation part of being a Coloradan.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.

									Additional ATM Specific Components			
									Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)			
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
SCPP-11 Briefing Paper: Upper Basin Demand Management and Water Banking. Addressing Risk and Creating Certainty: Exploring Options for an Upper Basin Demand Management Program	2019	TNC	This briefing paper provides a general background on the DCP and demand management. It frames the key issues to address in evaluating a demand management program and is offered in the spirit of promoting discussion and decision-making on how to structure, govern, finance, and implement such a program.	Briefly evaluates Upper Basin risk based on drought hydrology, and discusses how to reduce that risk. Asks many questions about Dm, program governance and structure, cost and funding, policy, measurement and verification. Identifies many of the key issues being addressed by CWCB DM workgroups. Key successes from SCPP are locally-driven solutions, minimizing impacts & maximizing benefits, e.g. through local coordination of projects. Tabulates past options considered for avoiding compact curtailment.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-12 Colorado River Water Bank Work Group: An Overview of Previous Studies & Reports	2018	Colorado River Water Bank Working Group	This overview documents summarizes the studies completed by the Colorado River Water Bank Work Group in their effort to provide information about what types of solutions may be available to preserve communities, agriculture, power production and the river itself.	This work includes a two-phase feasibility study, an assessment of how reduced irrigation for compact purposes would work with different irrigation systems on Colorado's West Slope, economic work on pricing and payments, and scientific research on the agronomic impacts of reduced irrigation.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.
SCPP-13 GVWUA Final Report on the Conserved Consumptive Use Pilot Projects	2019	GVWUA and J-U-B Engineers	This report provides a summary of the 2018 and 2019 Conserved Consumptive Use Pilot Projects completed by the Grand Valley Water Users Association (GVWUA). The initial part of the report provides a good summary of both the 2017 and 2018 pilots. Appendix H provides the details of the survey GVWUA completed of all participating producers, gathering their input on their experience and perspectives on the pilot project. Appendix I summarizes GVWUA's thinking more broadly on the pilot and demand management.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-14 Lessons Learned from the System Conservation Partnership Program	2016	The Nature Conservancy	TNC's lessons learned in their SCPP involvement, including lessons from Trout Unlimited and Colorado Water Trust	Top 3 lessons: outreach & communication is essential, operational & legal issues must be addressed at ditch company/irrigation district level simplify the process for efficiency.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-15 Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows	2011	Hydro Consulting for TNC	Evaluation of computer models of the Gunnison River to assess their ability to simulate a potential water bank in the basin using the Aspinall Unit reservoirs and the effect on reservoir operations, including environmental flows	StateMod, Aspinall PBO/EIS Model, and CRSS are evaluated for their capabilities to simulate Aspinall Unit operations, environmental flows, and potential water-banking. Specifically, this modeled the Black Canyon wate right, new ESI/PBO requirements at the Whitewater gage, and a water-banking option at Aspinall. Modifications to the Gunnison StateMod are necessary to simulate environmental flows and enhance reservoir accounting options.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-16 Environmental Water Transactions in the Colorado River Basin: A Closer Look	2018	Stanford Woods Institute for the Environment	Reviews CRB environmental transfers to track extent of activity. Examines SCPP projects by this lens, given the ISF benefits of SCPP. Found that SCPP-funded projects had the effect of enhancing streamflow.	Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.
SCPP-17 Lower Colorado River Basin Pilot Program	NA	Bureau of Reclamation	Webpage with tables of projects from each pilot phase	"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
SCPP-18 System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin	2017	Wyoming SEO Callaway, AWRA Impacts magazine	Description of Wyoming SCPP, how it works, participation, and future efforts.	Neither extensive nor technical, but includes some description of process & participation.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-19 SNWA Water Resource Portfolio	2019	Southern Nevada Water Authority	Chapter from SNWA's water plan	Addresses temporary supplies including different aspects of Intentionally Created Surplus, recharge and banking, DCP, and conservation tools.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	2017	WestWater Research for TNC	This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different approaches to developing a water bank. The information is intended to provide concepts and preliminary numbers for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.	Evaluates 4 frameworks of a Colorado Basin water bank sufficient to address 250,000 AF of CCU: annual water bank leases, option leases in critical years, non-option critical year leases, and response to a 1922 compact call. WestWater Research developed a cost-estimation spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Exhibit B-2
Lit (Gen. Literature) Documents with ATM Criteria

					Additional ATM Specific Components							
									Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)			
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
Lit-01 Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture	1999	Aillery et al, Marine Resource Economics	Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River	Investigates ag impacts of fish recovery measures "such as modified timing for dam releases, reservoir drawdown, and flow augmentation in the Columbia River basin, on the regional agricultural sector are evaluated. [....] Results suggest that drawdown and/or minor reductions in irrigation water diversions would reduce producers' profits by less than 1% of baseline levels. However, the most extreme scenario--a long drawdown period combined with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-02 Feasibility of water efficiency and reuse technologies as demand-side strategies for urban water management	2017	Berhanu et al, Journal of Industrial Ecology	Economic model of water cost provided by above-code water efficiency and reuse technologies, including variations & uncertainty analysis.	Estimates that efficiency and reuse can meet 85% of 50yr projected needs to the Lower Colorado River Authority service area (central TX)	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-03 Response to water crisis: How do Iranian farmers think about and intent in relation to switching from rice to less water-dependent crops?	2019	Boazar et al, Journal of Hydrology	Study of farmer response to gov't demand management, switching crops.	"Structural equation modeling showed that farmers' intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-04 Temporary water transfers for urban water supply during drought	1992	Clark, CSU	PhD dissertation modeling options for temporary water transfers	"This research develops a water right option agreement (WROA) model, methods of analysis, and legal implementation strategy under Colorado law." Interviewed professionals, estimates costs, identified that WROA "can be superior in terms of cost, reliability, and operational flexibility to both water-right purchases and construction of additional reservoir storage.	Promote a water saving status among farming community. Perhaps this is where getting information to support the No Action across the 5 Planning Horizons comes into play.	- The paper recognized the need to quantify local drought conditions (as opposed to making the decision to have a temporary transfer on a statewide decision). - The need for the transfer and benefits are locally driven	Emphasized discussing storage, which could be considered in the regional impacts category.	There is ,mention of Federal Water systems on page 24.	Not discussed.	Not discussed	Not discussed	Included a discussion on the Senate Bill 89-181 and the rulemaking by the SEO to implement water quality standards in review of water transfers Mentioned the use of the mass balance method or the mixing zone method to estimate the influence of flow on water quality standards	Not discussed
Lit-05 Flexible water allocations and rotational delivery combined adapt irrigation systems to drought	2018	Cody, K.C., Ecology and Society	Water allocation experiment in San Luis Valley, Colorado for self-governing irrigation systems.	Examines relationships between rules and physical context of water supplies; specifically the outcomes of water allocations between members and how they rotate water delivery.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-06 Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity	2017	Colby (Ch. 3.1.4), Book eds Ziolkowska & Petersen	Chapter from book "Competition for Water Resources: Experiences and Management Approaches in the US and Europe" collecting global examples/discussion of approaches and solutions to water supply scarcity, including western US	Ch 2.1.1: Challenges for US irrigated ag in the face of emerging demands and climate change, Ch 3.1.4: Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity (reviews online trading systems to reduce transaction costs, methods for cost-effective verification of CCU, and other breakthroughs facilitating temporary & intermittent trading more feasible. Examples from AZ and CA (IID), NE, Australia, CO-Big Thompson.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-07 Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling	2016	Dubinsky, CU Denver	PhD dissertation that identified San Luis Valley sustainability indicators and modeled future scenarios, developing a CU indicator for 1980-2010. Conducted scenario modeling to guide decision-makers towards desired outcomes from policy decisions. Coupled sustainability indicators with future scenario modeling to inform the SLV stakeholders about a variety of social and environmental issues. Results indicated that through specific shifting of cropping rotations and minimal land fallowing, SLV could reduce water use and Greenhouse Gas Emissions while increasing soil carbon and improving soil health. In addition, the solar energy development pathways investigated by this study showed that the potential exists to offset most or all of the region's GHG emissions.	Utilized Community Based Participatory Research to engage stakeholders & keep research relevant. Highlighted groundwater-dependence of SLV, suggests irrigation water use could be decreased 10% with shifts in crop regime and minimal fallowing.	Not discussed.	Not discussed.	Fallowing, Crop shifting	Potato, alfalfa, small grain	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Used a green manure cover crop to promote soil health
Lit-08 Economic viability of deficit irrigation in the Western US	2018	Manning et al, Agricultural Water Management.	Research on agro-economics of deficit irrigation.	Deficit irrigation (DI) can be optimal during late growth and maturation stages given elevated water prices (depending o output price and production costs).	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-09 The role of groundwater trading in spatia water management	2014	Palazzo and Brozovic, Agricultural Water Management	Republican River Basin assessment of coupling surface-groundwater management.	Geospatial dataset of RRB irrigation wells modeling crop choice, land, and water use decisions by well. "Our analysis highlights the importance of the initial distribution of permits and the institutional context in which trading occurs." Cost savings from trading groundwater pumping are distributed unevenly between wells, counties, and groundwater management institutions.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-10 Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain	2019	Ren et al, Stochastic Environmental Research & Risk Assessment	Evaluation of different cropping patterns (including fallowing) & water supply scenarios.	Framework for using a crop model & regression to predict effects of cropping adjustments on groundwater sustainability & crop production	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-11 Opportunities for saving and reallocating agricultural water to alleviate water scarcity	2017	Richter et al., Water Policy	- Review of literature & internet to identify water-saving strategies in irrigated agriculture. - Review of case studies in which water savings have been successfully transferred to other uses.	- Catalogs water savings opportunities, claims of irrigation-efficiency savings potential, logistics of reallocating due to other ag diverting savings. Findings suggest considerable potential to reduce irrigation CU and that savings can be reallocated when proper consideration is given to water budget accounting.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-12 Urban water conservation in the Sacramento, California region during the 2014-2016 drought	2019	Talbot, UC Davis	UC Davis Master's Thesis cataloging/analyzing supply & demand management actions under CA's drought policies.	Evaluates outdoor watering, public outreach, media role, water-related energy savings. Makes recommendations for urban water suppliers on revenue recovery, reducing use of rebates as demand management, and scaling drought response tasks for different levels of gov't. Summarizes & analyzes CA legislation establishing approval for long-term budget-based efficiency targets.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

							Additional ATM Specific Components					
									Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)			
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
Lit-13 Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado	2016	Vashisht, Colorado State University, Colorado	CSU Master's Thesis evaluating remote sensing for estimating monthly consumptive use (CU) and conserved CU (CCU) on the West Slope	Used evapotranspiration (ET) observations at experimental plots of traditional irrigation and water-banking irrigation practices to evaluate methods of verifying CCU. Reviews methods for measuring and monitoring CU, discusses limitation and potential for ReSET remote sensing CU model.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-14 Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains	2018	Yonts et al, J. of Agricultural Water Management	2010-2015 study in Nebraska of efforts to decrease ag groundwater pumping; impacts of water use efficiency and crop yield	"Reducing irrigation water by 25% caused no significant yield reduction and improved irrigation water use efficiency by 26%." Applying 50% Etc. resulted in 30% yield reductions, and planting directly in crop residue did not improve bean yield under deficit irrigation. Ample early season rainfall is a boon to pre-flowering deficit irrigation yields, but under normal-to-dry conditions post-flowering deficit yields more.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-15 Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming	2017	Rosado, U of Wyoming	Master's thesis on irrigation system efficiency in Little Wind Unit	Uses ag water balance & geophysical techniques to quantify & locate water losses. "Large errors and data gaps associated with the inflows, outflows, diversions, and precipitation data, [...which] identified specific needs for better data."	Paper not found								
Lit-16 Standardizing Temporary Water Transfer Procedures in Colorado	2020	Nicols, Peter D, et al, University of Denver Water Law Review	Review of strengths and challenges of existing legal mechanisms for ATMs and recommendations for consolidation and standardization.	This article will describe the barriers in existing law to temporary transfers and the various approval mechanisms available under existing Colorado law. It will provide an assessment of the strengths and limitations of the existing transfer methods and make a recommendation for consolidation and standardization.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed

Exhibit B-3
ATM Documents with ATM Criteria

									Additional ATM Specific Components			
									Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)			
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
ATM-01 Use of Alternative Transfer Methods to Increase Water Supplies for Conejos Basin Agriculture, Municipal, and Environmental Purposes	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205333&dbid=0	Trujillo Meadows Reservoir ATM Study (TMR Study): "The primary objective of the TMR Study is to investigate the feasibility of a unique ATM that involves enlarging Trujillo Meadows to provide intra-year regulation of water supplies including direct flow storage and storage of other agricultural and augmentation water rights for agricultural users diverting from the San Antonio.	ATM w/ recreational and environmental benefits for municipal augmentation w/enlargement of Trujillo Meadows Reservoir. Stakeholder meetings for federal & state agencies, ag, and town aug needs. Model of ATM, details of benefits, recommended path fwd. Appendix A estimates of monthly inflows to reservoir. Water rights include USFS Reserved Rights decreed as ISF, interstate shepherding for flow through NM.	Improved Ag Deliveries, flood minimization, mid-summer streamflow, recretalonal benefit,	Compact and river administration benefits	Storage expansion	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-02 Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley	2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195733&dbid=0	The goal of this report is to "report on the development from 2002 through mid-2011 of rotational land fallowing-water leasing (fallowing-leasing) in the Lower Arkansas Valley of Colorado (Lower Valley) by the Lower Arkansas Valley Water Conservancy District (Lower Ark District) and the Lower Arkansas Valley Super Ditch Company, Inc. (Super Ditch)."	Return flow needs may require additional recharge ponds & stations; Return flows unnecessary at times due to trans-basin supply; considers monthly return flow "factors"; analysis by Leonard Rice Engineers found that replacement water will be required in the non-irrigation season in most cases.	More water supply benefit to northern Munis, less water supply benefit to Lower Ark communities but $$ benefit to Lower Ark communities	Benefits farmers by giving them an option to not sell water/land and move out	Lease-Fallow, associated storage expansion	Not discussed	Potential benefit to reduced upstream irrigation	Not discussed	Not discussed	Improved due to reduced overall irrigation and improved irr. efficiency	Potential improvements to selenium, TDS, salinity, and hardness from reduced irrigation
ATM-03 Little Thompson Farm ATM Grant Completion Report	2018	https://www.larimer.org/sites/default/files/uploads/2018/larimer_county_atm_final_report.pdf	Study funded through CWCB 2015 ATM Grant. The Little Thompson Farm receives supply from Handy Ditch and Reservoir Company shares and 240 C-BT units. The consultant team found that "it was feasible for Larimer County to afford, from a water supply perspective, to sell some C-BT units (115) and share some other units (80) in some years, while still having sufficient water on the farm for corn and sugar beets, as well as crops that require less water." The study looks at aspects of feasibility, including: Economics; Farm Financial Viability under wet, dry, and very dry year scenarios; dry year water value. The report also investigates potential partnerships, and outlines the final water sharing agreement. "Larimer County sold 115 C-BT units to Broomfield and retained a first right of refusal to lease back these units for assessment cost plus 10%, when available." The report also discusses Lessons Learned and Future Considerations: Legal Hurdles/Barriers to Replication (Northern Rulemaking, Direct Flow Rights, Delivery Efficiency Impacts from Water Transfers); Public Perception & Political Will (Educating and Obtaining Support of Leadership, Public Support, Out of County Partners, Continued Education); Negotiating an ATM: Successful Tips, Tricks, and Tools (Establish and Pursue Goals with an Open Mind About Implementation, Minimize the Cooks and Trust Your Team).	Cover crop & leaving crop residue prevents wind erosion, maintains soil fertility, controls weeds; non-irrigated cover crops: dryland milo, sorghum/Sudan grass for soil health, reduce weeds, potential revenue; w/no cover crop, control weeds w/herbicide or tillage (tillage can reduce erosion by forming large soil clods & enhancing infiltration); Class II and III soils, slopes 0-5%, not high enough for severe erosional problems; no/low-till also recommended to reduce direct evap, improve soil health, reduce fuel & costs; irrigation efficiency via contour farming, drip irrigation, SM & ET monitoring, drought tolerant crops, GPS irrigation guidance; no return-flow requirements due to CBT water, so no effort to quantify despite opponents	Reduced return flow from C-BT water to Little Thompson Creek; Overall, keeps farm viable; Helps shore up water security for Broomfield	In general, keeps farms operating and water in ditches, which was positive to regional communities	Interruptable Water Supply Agreement	Corn, sugar beets	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-04 HB13-1248 Catlin Canal Company Rotational Land Fallowing-Municipal Leasing Pilot Project	2018	https://dnrweblink.state.co.us/cwcb/0/edoc/210320/19%2001%2015%202018%20Annual%20Report%20-%20Catlin%20Pilot%20Project%20FINAL.pdf?searchid=3856cf32-c475-4163-840c-5361fa65041f	The Catlin Pilot Project was the first rotational land fallowing-municipal leasing pilot project under HB 13-1248: Irrigation Water Leasing Municipal Pilot Projects. This project aims to makes available up to 500 acre-feet of water for lease to three municipal water providers – the Town of Fowler, the City of Fountain, and the Security Water District (Municipal Participants) - from rotational fallowing of lands located on six farms irrigated under the Catlin Canal in the Arkansas River Basin.	Huge emphasis on return flows; using Lease Fallow Tool from DWR to calc available water & owed returns; "Pay As You Go" target deliveries for return flow; use of recharge structures supported well-timed return flows; augmentation station used for faster return flows and consumptive use water delivered to municipal participants; erosion & weed control included herbicide, disk tilling, cover crops (winter wheat, hay)	Not discussed	Not discussed	Lease-Fallow	Not discussed	Possibly no change but inconclusive due to 2018 being low water year and all-around reduced crop yield	Not discussed	No major issues found	Not discussed	No erosion, no noxious weeds
ATM-05 Yampa Basin ATM Study	2014	https://dnrweblink.state.co.us/cwcb/0/edoc/199193/Yampa%20-%20NC%20Use%20of%20ATM%20to%20Met%20Non%20%20Consumpt%20Needs_FINALReport%203-28-14_with%20apps.pdf	Study conducted by Trout Unlimited (TU) and funded by CWCB's Alternative Agricultural Water Transfers Grant Program. The purpose of the study was to identify locations in the Yampa Basin where potential ATM transactions could help to meet multiple uses (nonconsumptive needs and agricultural shortages), and identify types of ATM transactions most suitable for meeting multiple purposes. Ideal candidate reaches, as specified by project proponent TNC and its partners, would involve the following scenario: - Upstream agricultural water user with full or surplus irrigation supplies and transferable CU water - Downstream agricultural water user with an irrigation CU shortage (consumptive need) - A need for water in the reach between to improve flows for trout (including Colorado cutthroat trout) or warmwater fish (nonconsumptive need)	Used StateMod delay table to estimate historic return flows; more efficient irrigation improves water quality by lowering return flow contaminant transport, fewer excess nutrients due to fertigation in drip systems; TNC/TU partnership to support instream flows for habitat w/ATM loans used when downstream ISF right is not satisfied & to provide flow in a reach without ISF right	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-06 Grand Valley Water Users Assn Conserved Consumptive Use Pilot Project Development: Process, Procedure, and Lessons Learned: Water Banking-Next Steps Part II	42795	http://www.grandvalleywaterusers.com/uploads/8/2/6/0/82606774/03-01-17_ccupp_projectdevelopment_final.pdf	The Conserved Consumptive Use Pilot Project (CCUPP) is a pilot demand management project intended to test the mechanisms necessary for a Western Slope irrigation water provider to intentionally reduce consumptive use in a voluntary and compensated manner. This report summarizes the process of developing the CCUPP, the procedure used, and lessons learned.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-07 Grand Valley Water Users Assn 2017 CCUPP In-Season Verification	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205144&dbid=0	Field compliance and payment summary for the 2017 CCUPP, including verification forms for each program participant for 2017.	Includes 2017 verification documentation including photographs, recommendations, comments/notes	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-08 Power Canal Capacity Report, Grand Valley Water Users Assn	12/1/2015	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=201813&dbid=0	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank:" to convey CCU via unused capacity within the Orchard Mesa Power Canal (power canal) to deliver water to the Grand Valley Power Plant (GVPP). The report investigated the potential unused capacity within the Power Canal, including the potential for additional water to generate hydroelectric power.	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank." Compensated, temporary, voluntary. Lists current operations, water rights, data. Incomplete file in link, merged with 2017 Next Steps Part II	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-09 Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture	5/1/2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195709&dbid=0	An extensive evaluation to: 1) To identify barriers to implementation of alternative transfers and to describe potential strategies for overcoming barriers. 2) To develop tools for agricultural producers to evaluate the viability of potential alternative transfers. 3) To further actual alternative transfers by evaluating three demonstration projects that include owners of agricultural water rights and potential end users of the temporarily transferred water.	Extensive final report on ATM investigation & pilot on NE South Platte covering barriers (cost, risk/uncertainty, lack of supply, reluctance, power dynamic), needs and means to address barriers, Lease Evaluation Tool (AgLET) ag economics evaluator, exchange capacity analysis, flex market pilot project w/Aurora.	Not much discussion of local impacts outside of irrigation practices and M&I use	Overall tone that keeping ag is good and that buy-and-dry by M&I should be avoided	Flex Market w/ rotational fallowing, IWSA	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed

									Additional ATM Specific Components				
									Agronomic Impacts (How long does it take for a crop to fully return to pre-fallowing productivity?)				
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Identified Local Impacts**	**Identified Regional Impacts**	**Operational Type of Project**	**Types of Crops**	**Yield**	**Quality**	**Recovery**	**Water Quality Effects**	**Soil Health Effects**
ATM-10 Final Project Report: Implementation of Deficit Irrigation Regimes: Demonstration & Outreach	May-16	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199317&dbid=0	Evaluation of different methods of monitoring crop water stress and consumptive use (CU) under deficit irrigation. Demonstrations, workshops, educational outreach on crop stress monitoring.	Demo project to evaluate different methods of monitoring crop water stress and CU under deficit irrigation & demo educational outreach on crop stress monitoring.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-11 The Poudre Water Sharing Working Group: A Report to the CWCB	May-15	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=198097&dbid=0	Final report of Poudre Water Sharing Working Group - a prototype ATM water sharing group between agricultural users (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and municipal users (Fort Collins, Greeley, and Tri-Districts) on the Poudre River, facilitated by the Colorado Water Institute at Colorado State University. The report focuses on the formation of the working group, relationship building, lessons learned, survey of ag users, development of prototype agreements, and regional cooperation strategies.	Final report of prototype ATM water sharing group between ag (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and muni (Fort Collins, Greeley, and Tri-Districts) on the Poudre River. Identified CCU calculation methods as a large barrier.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-12 FLEX Water Market: Education and Implementation Phase	December-15	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=197916&dbid=0	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders. The goal of this project was to successfully implement the FLEX Water Market concept through education, facilitation, and consultation, with specific focus on developing FLEX markets in Water Division 1 with municipal, industrial, agricultural, and environmental/ conservation partners. The team consulted with multiple potential partners, but in the end this project did not result in a water sharing agreement.	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-13 Alternatives to Permanent Dry Up of Formerly Irrigated Lands	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199208&dbid=0	Review of benefits and issues of two alternatives to buy and dry that maintain some continued level of agricultural production: 1) dry land farming, and 2) limited irrigation.	Review of benefits and issues of buy and dry and alternatives. Potential for conversion of ag land to dry land or deficit-irrigation, economic & maintenance issues w/dry land & deficit.	Limited irrigation may or may not be economically feasible depending on climate, precip, water supply issues; localized approach to evaluate benefits / Reveg can reduce tax values of adjacent properties / Dry-land farming is likely to result in economic loss	Same as previous column <----------	Feasibility study: comparison of full irrigation to limited irrigation, and revegetation	Wheat corn, sorghum, alfalfa, pasture grass/hay, native grass, millet	Limited irrigation for Front Range (South Platte) parcels wouldn't typically have high enough yields to justify cost of farming due to lack of precipitation / Dry land farming results in very low yields but is cheaper than revegetation	Not discussed	Not discussed	Potential nutrient loading if high residual N in soils from previous crop-type and fertilization	Improper planning ahead of dry-up can lead to high residual N, high compaction, poor drainage, low organic matter, noxious weeds
ATM-14 Water Partnerships: an evaluation of alternative agricultural water transfer methods in the South Platte basin.	March-12	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199215&dbid=0	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte, focused on FRICO shareholders.	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte	From lab experiment results, shared water bank concept doesn't necessarily increase the efficiency of water usage in ag, but impacts are lessened by comparison to typical buy-and-dry	M&I still gets water but ag gets to use more than it would during buy-and-dry	Feasibility study, survey, and some experiments to vet ATM concept called Shared Water Bank	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-15 Project Report: Lake Canal alternative agricultural practices and in-stream flow demonstration project	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=203045&dbid=0	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	Potential for enhanced flows in the river for environmental benefits	Potential for added water throughout season to a long reach of Cache La Poudre River (Lake Canal Diversion to Greeley No. 3 Diversion)	IWSA for deficit irrigation, with some fallowing	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-16 Final Report of the Lower South Platte Irrigation Research and Demonstration Project	Jun-14	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199218&dbid=0	Technical research paper with three tasks. Task 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. Task 2. Simplify the administrative burden of maintaining return flows. Task 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	Goals were 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. 2. Simplify the administrative burden of maintaining return flows, and 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	Not really, this report primarily focused on the science, data, and accuracy of ET modeling	Not discussed	Deficit Irrigation	Corn	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-17 RGWCD Net Annual Replacement Plans	Reports exist for each year. Reviewed report for April 13, 2020	https://rgwcd.org/sd-1-annual-replacement-plan	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc. Reviewed the 2020 Annual Replacement Plan (ARP), to meet requirements for the Plan Year under the provisions of the PWM for Subdistrict No. 1 decreed by the Division No. 3 Water Court in Case Nos. 2006CV64 and 2007CW52. This report describes a plan to remedy injurious stream depletions caused by the withdrawal of groundwater from Subdistrict Wells. This ARP includes a series of tables created by Subdistrict No. 1 staff and the RGDSS modeling team tabulating stream replacement quantities and locations resulting from Subdistrict No. 1 well groundwater withdrawals and a water portfolio to be used to replace such stream depletions.	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc.	Agriculture is still holding on to water rights and maintaining irrigation practices at limited capacity / More water in the stream and marginal improvement in aquifer	Agriculture is still holding on to water rights and maintaining irrigation practices at limited capacity / More water in the stream and marginal improvement in aquifer	Fallowing, forbearance	Alfalfa, grain, and potatoes primarily; also oats, sudan grass hay, grass; other various crops	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-18 Alternative Water Transfers in Colorado: A Review of Alternative Transfer Mechanisms for Front Range Municipalities	2016	https://www.edf.org/sites/default/files/alternative-water-transfers-colorado.pdf	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed

Exhibit B-4
SCPP Documents with Environ. Criteria

					Environmental Resources that May be Affected											Next Steps										
					Streamflow (Hydrology) Impacts					Species Impacts			Water Quality Impacts			Data Gaps, Questions for Future Projects										
																			Program level goals		For proposed future transactions, need to evaluate impacts (positive or negative) to:						
Title	Date	Publisher/Authors	Description	Notes	Magnitude	Frequency	Duration	Timing	Rate of change of hydrologic conditions	Return Flow Impacts	Critical Stream Reaches Impacted(where)	Critical Land or Riparian Habitat Impacted	Species Impacted	Salinity	Temperature	Other	Tradeoffs - Resource Impacts	Predicted outcome from applying "avoid, mitigate, offset" hierarchy	Proportional	No net loss to envr. services, recognizing tradeoffs	Build incentives for projects with net envr. benefits.	ISFs (or other flow targets)	SMP or WMP objectives / proposed projects	Critical habitat & flow recommendations	State species of concern	BRT environmental values lists/ mapping	CRCT conservation strategy	Other known community / entity projects
SCPP-01 System Conservation Pilot Program Secondary Benefits: Final Report with Case Studies	2019	WestWater Research for TNC	This case study report looked at whether the reduction in consumptive use in SCPP projects also generated off-farm benefits by applying select methods to quantify off-farm benefits to two case studies in Colorado and Wyoming. Noted from TNC: An executive summary is also available, along with a more detailed report that outlines the framework for assessing secondary impacts/benefits and the associated methodology for quantifying or evaluating each impact/benefit.	Benefits assessed include increased environmental flows, decreased cost of alternative habitat flow restoration projects, societal benefits from habitat flows for endangered species, estimates of dramatic savings in salinity control, and municipal and hydropower benefits. Increased flows for the evaluated Colorado projects contributed minimal improvement to recreational flow needs. Cost savings were estimated by the cost of existing augmentation plans used to meet environmental and salinity management needs.	CO: See Table 4 for Monthly Flow Comparison: CCU, River Flows at top of 15-mile reach, BiOp Flow Recommendation for 15-mile Reach. "the flow contributions to the Colorado River were estimated as only the CU associated with the participating fields. Conveyance and on-farm efficiency losses associated with the reduced irrigation demands were not factored into flows redirverted to the Grand Valley Power Plant.... only the conserved CU volumes were estimated as streamflow benefits at the upper end of the 15-Mile Reach." WY: See Table 7 for Monthly Flow Comparison: CCU and Middle Piney Creek Estimated Flow. "the streamflow benefit of the project is the estimated CU savings."	Assessed monthly for 1 year (CO) and 2 years (WY)	CO: See Table 4 for Monthly Flow Comparison: CCU, River Flows at top of 15-mile reach, BiOp Flow Recommendation for 15-mile Reach. WY: See Table 7 for Monthly Flow Comparison: CCU and Middle Piney Creek Estimated Flow.	CO: See Table 4 for Monthly Flow Comparison: CCU, River Flows at top of 15-mile reach, BiOp Flow Recommendation for 15-mile Reach. WY: See Tables 7 for Monthly Flow Comparison: CCU and Middle Piney Creek Estimated Flow. "The data in Table 7 indicate that the 2016 conservation projects are estimated to have had a significant impact on August and September streamflow."	Not discussed.	Return flows identified as a data gap, but this project only quantified CCU. " Future water conservation projects may consider potential benefits of redirverting additional water to the Power Canal to account for on-farm and conveyance system return flows. For this analysis, only the conserved CU volumes were estimated as streamflow benefits at the upper end of the 15-Mile Reach."		Not discussed.			Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-02 Infographic: Grand Valley Pilot Project Secondary Benefits	2019	TNC	This infographic summarizes the results of secondary benefits analysis as applied to the Grand Valley Pilot Project Case Study.	Grand Valley Pilot Project paid farmers to voluntarily reduce their irrigation water use in order to keep more water in the river to help increase water security within the Colorado River Basin in the face of ongoing drought. While focus was on water security several off-farm benefits occurs because of the project.	"Increased water in the river resulted in $23,000 of estimated savings not spent on endangered fish programs."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	"Increased water in the river resulted in $23,000 of estimated savings not spent on endangered fish programs."	Not discussed.	"Increased water in the river resulted in $23,000 of estimated savings not spent on endangered fish programs."	Reduced irrigation on salty soils improved water quality and resulted in an estimated savings of $282,720 from money not spent on other measures to reduce salinity."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03 Research Synthesis: Agronomic Impacts of Reduction Irrigation	2019	Culp and Kelly for TNC	This memo reviews research on fallowing and limited irrigation to highlight key findings related to agronomic impacts of limited irrigation or other methods to reduce consumptive use of irrigation water in the Upper Colorado River Basin. The concluding section also identifies remaining research questions and suggests potential implications and possible next steps for a demand management program. The appendix summarizes the parameters of several of the studies reviewed. All of the referenced reports and publications are available on request.	Reviews methods and findings of existing research on agronomic impacts of limited irrigation in the following categories: yield, quality, water use efficiency, recovery, soil health, weeds/diseases/pests, and ag operations. Next steps and identified research needs include understanding impacts over a variety of geographies and crops, as well as long-term recovery. Management and operations needs include understanding the benefits of rotational fallowing, deficit irrigation, and crop switching. Finally, there are many needs in the verification of conserved consumptive use.	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	"Salt will move to the surface of the soil during periods of fallowing. When returning from fallowing, some fields may need a pre-planting leaching irrigation, which could reduce the water savings from fallowing."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-04 Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin	2018	Upper Colorado River Commission	Full SCPP report from UCRC; project list; Lessons learned: administration & implementation, operational, cost/benefit/risk, legal constraints, outreach & education.	List of future questions to be answered p4	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-05 Final Report: Appendix C: 2018 System Conservation Pilot Program Update	2018	Upper Colorado River Commission	2018 update to UCRC full report, including Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Document includes Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Report addresses return flows as a data gap / legal constraint / issue: "Addressing the impacts of reduced return flows. Changes in irrigation and diversion practices reduce the availability of late season return flows—which in Upper Basin water-short systems may be critical to preventing injury to downstream users. While the SCPP discussed the impacts of reduced late season return flows during the project selection process, there was no mechanism to account for and/or address these impacts. In a larger-scale program, these impacts will need to be considered to prevent injury to other water right holders and non-program participants."	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-06 Pilot Program Funding Agreement	2014	Bureau of Reclamation	2014 SCPP funding agreement between CRB entities	Reviews history of compacts, storage allowances, demand management efforts by signatories. Defines goals and parameters of SCPP. Identifies NRCS programs that might support on-farm conservation improvements. EQIP and SWIP A ensures that projects will coordinate with respective NRCS State Conservationists.	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-07 Colorado River Water Bank Feasibility Study: Phase 1	2012	Colorado River Water Conservation District	Water bank planning phase; conservative estimate of potential WB supplies, and demand for those supplies.	Includes potential WB uses, supply, magnitude & frequency of need, supply-use scenarios. App. A: categories of W/E slope water uses. App. B: CRC WB Feasibility Study Water Supply Technical Memo; App. C: Eval of CRC WB Hydrologic Scenarios w/ICRMI model. App. D: Basic supply & use comparison scenarios for CRC WB technical memo	The report describes "evaluation of the magnitude and frequency of Water Bank need based on demand shortages" but does not discuss flow magnitude and frequency.	Not discussed	Not discussed	The report acknowledges "the actual timing and reduction in depletions would likely require some kind of return flow modeling."	Not discussed.	Return flow timing is recognized as a data gap. "The actual timing and reduction in depletions would likely require some kind of return flow modeling."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-08 Colorado River Water Bank Feasibility Study: Phase 2	2013	For Colorado River District. By MWH.	Water bank planning phase; test cases assessing on-farm impacts for representative irrigation systems	Includes candidate systems, screening criteria & selection, site visits for system evaluation, financial impacts on ag ops, operational scenarios & comparison to ATM work. App. A: Candidate system identification & evaluation; App. B Test Case site reports	Return flow locations and patterns addressed as a criteria: Implementation of fallowing or deficit irrigation practices could affect return flows that are a source of inflow to downstream river segments and water supply to downstream water users. Locations of return flows from test case irrigation systems were based on the link-node system definition in the StateMod model. Monthly return flow patterns were also adopted from the data in the StateMod model.	Not discussed.	Not discussed.	Next steps Sec 6.2 pg. 41 identifies this as a question/next step: "Estimate the potential impacts of fallowing or deficit irrigation on downstream streamflow and environmental resources due to changes in return flows." Return Flow Locations and Patterns addressed as a criteria: Implementation of fallowing or deficit irrigation practices could affect return flows that are a source of inflow to downstream river segments and water supply to downstream water users. Locations of return flows from test case irrigation systems were based on the link-node system definition in the StateMod model. Monthly return flow patterns were also adopted from the data in the StateMod model.	Not discussed.	Noted in general that return flows are a concern / data gap / next step, and that measurement of return flow impacts will be important. . "All of the site visits revealed difficulties in water banking administration. First, none of the systems had adequate measurement of diversions and return flows to directly calculate foregone CU through a mass balance." The Direct Measurement method of accounting for reduced depletions is the most accurate and defensible, but it would be very difficult to measure diversions and surface/subsurface return flows at all participating fields." . Next Steps: "Estimate the potential impacts of fallowing or deficit irrigation on downstream streamflow and environmental resources due to changes in return flows. Return Flow Locations and Patterns addressed as a criteria: Implementation of fallowing or deficit irrigation practices could affect return flows that are a source of inflow to downstream river segments and water supply to downstream water users. Locations of return flows from test case irrigation systems were based on the link-node system definition in the StateMod model. Monthly return flow patterns were also adopted from the data in the StateMod model.	Not discussed.	Not discussed.	Not discussed.	"Salinity and selenium issues may make fallowing or deficit irrigation more attractive to Project farmers, as impacted lands might be taken out of production with less impact on overall yields. In addition, reduced irrigation of these lands may have benefits in improved quality of return flows." Salinity effects (not affected or marginally affected) was a screening criteria used to select candidate systems representing a broad range of characteristics. "Soil and groundwater salinity were used as a surrogate for estimating whether a candidate irrigation system could have potential productivity issues during drought periods that would make it a better candidate for temporarily taking lands out of production. Whether a candidate system has potential salinity related issues was determined based on GIS coverage that has salt loading rates (tons/acre) in return flows from irrigated areas. The GIS coverage was developed by the U.S. Geological Survey (USGS) Utah Water Science Center for the Upper Colorado River Basin USGS SPARROW model."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-09 Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)	2012	Natural Resources Consulting Engineers, Inc	Technical analysis for water bank feasibility study included in 2012 WB planning phase 1 report .pdf	Data section includes analysis, irrigated areas, water rights categories, and climate stations. Examined CU requirements (w/StateCU & Blaney-Criddle), ET verification (Penman-Monteith w/4 CoAgMet stations), and HCU (StateCU values for elevation bands in each division multiplied by irrigated acres). Water bank supply and cost: "fallowing suitable for small grains, grain corn, & dry beans." Deficit Irr available for all crops but best suited to alfalfa & pasture. "These crops combined account for over 98% of the acreage, in CU, and supply-limited CU." Discusses split-season irrigation.	"- The reduction in diversions would include the irrigation efficiencies. The actual timing and reduction in depletions would likely require some kind of return flow modeling."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Recognized as a data gap / next step: - "The actual timing and reduction in depletions would likely require some kind of return flow modeling."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-10 Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado	2019	MacIlroy, Colorado State University	This report was designed to assist in identifying and better understanding the socio-cultural components of a potential demand management program. The research, completed in Spring 2019, explored perceptions of demand management among stakeholders on the Western Slope through individual interviews and focus groups. The findings shed light on the barriers and opportunities for a demand management program, including ideas and feedback on what a successful program would look like, and why water users may or may not want to participate.**An executive summary is also available.**	This is an interview-based report that covers perceptions of DM, definitions of voluntary, compensated, temporary, and equity. (their words are proportional/parity)--and finds that these definitions are not straight-forward and must be carefully communicated. Explores relationships with water and landscape as well as "sacred values of the Western Slope." Addresses perceptions of DM in context of 2007 Interim Guidelines and broader basin-to-basin politics. Many interviewees doubt the viability of a voluntary compensated program, and even suggest that a mandatory uncompensated cab would work better, avoid equity issues, and cost less overall. Compensation was a very challenging topic, with differing views on if it is even an opportunity. Highlights clash of free-market values with the perspective of water as a commodity--discussion of different role water plays for irrigators vs Front Range residents. Who bears responsibility to pay--who is responsible for the shortage problems (many don't see the Upper Basin at fault). Temporary program vs temporary participation--fraught discussion. Discussion of Western Slope Sacred Values, how water and farming is part of identity. Numerous people suggested every water user curtail use and respect water and that we should make water conservation part of being a Coloradan.	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-11 Briefing Paper: Upper Basin Demand Management and Water Banking. Addressing Risk and Creating Certainty. Exploring Options for an Upper Basin Demand Management Program	2019	TNC	This briefing paper provides a general background on the DCP and demand management. It frames the key issues to address in evaluating a demand management program and is offered in the spirit of promoting discussion and decision-making on how to structure, govern, finance, and implement such a program.	Briefly evaluates Upper Basin risk based on drought hydrology, and discusses how to reduce that risk. Asks many questions about Dm, program governance and structure, cost and funding, policy, measurement and verification. Identifies many of the key issues being addressed by CWCB DM workgroups. Key successes from SCPP are locally-driven solutions, minimizing impacts & maximizing benefits, e.g. through local coordination of projects. Tabulates past options considered for avoiding compact curtailment.	Section 8 (Key Lessons, identifies flow as an issue to be addressed: "Address local river flow needs for fish and wildlife - Coordinate with NGOs, local water users, and water managers on water administration methods that direct water savings in stream at strategic locations and/or strategic times."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flows identified as a data gap / next step: from a legal and engineering standpoint for a program to protect water rights holders. " Water users, state and federal agencies, and other stakeholders will need accurate data on consumptive water use that includes, among other things, agreed upon methods for calculating water savings and maintaining return flows. While some of these are engineering questions, policy may be needed to help translate these concepts into the rules and regulations of a long-term program." Recommends developing a standardized approach to estimating and addressing return flow impacts.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-12 Colorado River Water Bank Work Group: An Overview of Previous Studies & Reports	2018	Colorado River Water Bank Working Group	This overview documents summarizes the studies completed by the Colorado River Water Bank Work Group in their effort to provide information about what types of solutions may be available to preserve communities, agriculture, power production and the river itself.	This work includes a two-phase feasibility study, an assessment of how reduced irrigation for compact purposes would work with different irrigation systems on Colorado's West Slope, economic work on pricing and payments, and scientific research on the agronomic impacts of reduced irrigation.	Impacts to flow not discussed. "secondary impacts ... will need to be answered prior to deciding whether implementation of a demand management program is feasible and desirable for water users in Colorado."	Not discussed.	Not discussed.	Colorado River Water Bank Feasibility Study: Phase 2: "None of the systems had adequate measurement of diversions and return flows to directly calculate foregone CU through a mass balance." "Other benefits of irrigation could be impacted (late-season return flows, wildlife habitat, scenic open space)" Next Steps:" 2. Estimate the potential impacts of fallowing or deficit irrigation on downstream stream flows and environmental resources due to changes in return flows."	Not discussed.	Ideal candidate systems have relatively few downstream users, therefore lower return flow impacts. Site visits qualitatively assessed potential impacts of deficit irrigation or fallowing on return flows and downstream users. Mostly addressed as a data gap / next step: . "Colorado River Water Bank Feasibility Study: Phase 2: "None of the systems had adequate measurement of diversions and return flows to directly calculate foregone CU through a mass balance." . "Other benefits of irrigation could be impacted (late-season return flows, wildlife habitat, scenic open space)" . Next Steps:" 2. Estimate the potential impacts of fallowing or deficit irrigation on downstream stream flows and environmental resources due to changes in return flows."	Not discussed.	"Other benefits of irrigation could be impacted (late-season return flows, wildlife habitat, scenic open space)"	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-13 GVWUA Final Report on the Conserved Consumptive Use Pilot Projects	2019	GVWUA and J-U-B Engineers	This report provides a summary of the 2018 and 2019 Conserved Consumptive Use Pilot Projects completed by the Grand Valley Water Users Association (GVWUA). The initial part of the report provides a good summary of both the 2018 and 2019 pilots. Appendix H provides the details of the survey GVWUA completed of all participating producers, gathering their input on their experience and perspectives on the pilot project. Appendix I summarizes GVWUA's thinking more broadly on the pilot and demand management.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt, and explicitly prohibits any active plant growth on fallowed land	Impacts to flow not discussed. More focused on CCU and impact to farmers.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed. More focused on CCU and impact to farmers.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-14 Lessons Learned from the System Conservation Partnership Program	2016	The Nature Conservancy	TNC's lessons learned in their SCPP involvement including lessons from Trout Unlimited and Colorado Water Trust	Top 3 lessons: outreach & communication is essential, operational & legal issues must be addressed at ditch company/irrigation district level simplify the process for efficiency.	Impacts to flow not discussed.	Not discussed.	Not discussed.	"When you focus on consumptive use reductions, what about return flow issues? How do you prevent injury and keep other water right holders and non-participants whole?"	Not discussed.	Identified as a data gap / next step related to water rights. "The current program does not provide any instream protection for conserved water. A successful program must be able to administer and account for conserved water in order to create value for both buyers and sellers. In order to get participants and address community issues, the program must provide assurances that water rights will not be negatively impacted and that non-participants will not be injured...When you focus on consumptive use reductions, what about return flow issues? How do you prevent injury and keep other water right holders and non-participants whole?"	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Title	Date	Publisher/Authors	Description	Notes
SCPP-15 Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows	2011	Hydro Consulting for TNC	Evaluation of computer models of the Gunnison River to assess their ability to simulate a potential water bank in the basin using the Aspinall Unit reservoirs and the effect on reservoir operations, including environmental flows	StateMod, Aspinall PBO/EIS Model, and CRSS are evaluated for their capabilities to simulate Aspinall Unit operations, environmental flows, and potential water-banking. Specifically, this modeled the Black Canyon water right, new ESI/PBO requirements at the Whitewater gage, and a water-banking option at Aspinall. Modifications to the Gunnison StateMod are necessary to simulate environmental flows and enhance reservoir accounting options.
SCPP-16 Environmental Water Transactions in the Colorado River Basin: A Closer Look	2018	Stanford Woods Institute for the Environment	Reviews CRB environmental transfers to track extent of activity. Examines SCPP projects by this lens, given the ISF benefits of SCPP. Found that SCPP-funded projects had the effect of enhancing streamflow.	Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.
SCPP-17 Lower Colorado River Basin Pilot Program	NA	Bureau of Reclamation	Webpage with tables of projects from each pilot phase	"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."
SCPP-18 System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin	2017	Wyoming SEO Callaway, AWRA Impacts magazine	Description of Wyoming SCPP, how it works, participation, and future efforts.	Neither extensive nor technical, but includes some description of process & participation.
SCPP-19 SNWA Water Resource Portfolio	2019	Southern Nevada Water Authority	Chapter from SNWA's water plan	Addresses temporary supplies including different aspects of Intentionally Created Surplus, recharge and banking, DCP, and conservation tools.
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	2017	WestWater Research for TNC	This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different approaches to developing a water bank. The information is intended to provide concepts and preliminary numbers for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.	Evaluates 4 frameworks of a Colorado Basin water bank sufficient to address 250,000 AF of CCU: annual water bank leases, option leases in critical years, non-option critical year leases, and response to a 1922 compact call. WestWater Research developed a cost-estimation spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.

Environmental Resources that May be Affected — Streamflow (Hydrology) Impacts

Title	Magnitude	Frequency	Duration	Timing	Rate of change of hydrologic conditions	Return Flow Impacts
SCPP-15	Discusses how StateMod configuration could be changed to simulate environmental flow targets (through the Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.	Discusses how StateMod configuration could be changed to simulate environmental flow targets (through the Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.	Discusses how StateMod configuration could be changed to simulate environmental flow targets (through the Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis so there are no results to share on how the water banking project would impact flows.	Discusses how StateMod configuration could be changed to simulate environmental flow targets (through the Black Canyon and at Whitewater), including base flow and peak flow targets. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact flows.	Not discussed.	Discusses how StateMod configuration is set up to model return flows. However, modeling was not done in this analysis, so there are no results to share on how the water banking project would impact return flows.
SCPP-16	"Although the total amount of water restored by these transactions is very small compared to the overall water budget of the basin, in certain watersheds, transactions have provided significant benefits for local streamflow. This is particularly true in the Price River watershed in Utah and the Green River watershed in Wyoming." "TU efforts on the Price River with the Carbon Canal Company are worth specific mention. SCPP deals with irrigators that receive water from the Carbon Canal Company have both been able to focus benefits for flows in the Price River, and increase the chances that conserved water will make it downstream to Lake Powell." "From 2014 through 2018, the SCPP has funded forty six informal transactions in the state of Wyoming (Figure 13). The two most active years in the state for these deals have been 2016 and 2018, both with respect to the number of deals negotiated and the acre-feet of irrigation water involved. Although these deals all had the primary purpose of conserving water and improving water security, they have all been facilitated by Trout Unlimited in the Green River Basin and have as an additional benefit potential improvements." Specific analysis of flows was not done. Less quantitative, and more qualitative. No justification or documentation provided on how, where, when, flows were benefited.	"Most of the transactions have multiple benefits, including improving water security, piloting water conservation tools, supplementing farm and ranch revenue and improving streamflow and aquatic ecosystems. There is obvious synergy between the goals of promoting water conservation, enhancing water security and restoring streamflow. Projects that have one of these goals as a primary purpose will usually also fulfill the others. Programs focused on one of these goals can benefit from support for the other goals."	Not discussed	Not discussed	Not discussed.	Return flow impacts not discussed.
SCPP-17	Impacts to flow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Return flow impacts not discussed.
SCPP-18	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.
SCPP-19	Impacts to flow not discussed, other than in a very general senses that the Drought Contingency Plan "keeps more water in the river for the benefit of all water users and the environment."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts from temporary supplies not discussed. Does generally mention that SNWA heavily relies upon return flow credits (such as from wastewater treatment plants). Direct water reuse will reduce the amount of return-flow credits (which are reused indirectly).
SCPP-20	Impacts to flow not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.

Environmental Resources that May be Affected — Species Impacts / Water Quality Impacts

Title	Species Impacts: Critical Stream Reaches Impacted (where)	Species Impacts: Critical Land or Riparian Habitat Impacted	Species Impacts: Species Impacted	Water Quality Impacts: Salinity	Water Quality Impacts: Temperature	Water Quality Impacts: Other
SCPP-15	3 environmental flow targets below Aspinall Unit considered: - Black Canyon of the Gunnison National Park Service In-Stream Flow (01CW05) with a measuring point immediately below the Gunnison Tunnel, a few miles downstream of Crystal Reservoir, - the EIS/PBO targets at the Whitewater gage below the inflows from the North Fork and Uncompahgre rivers (The environmental flow targets at Whitewater resulted from several years of work through the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin outside the San Juan River sub-basin (Recovery Program)), - and the targets for fish screening, passage and migration at the Redlands dam about 6 miles below the Whitewater gage	Not discussed.	Endangered Fish Species in the Upper Colorado River Basin, in the Gunnison River	Not discussed.	Not discussed.	Not discussed.
SCPP-16	In Arizona, "TNC has been working with the Diamond ditch water users on a gradually reducing diversions. Beginning in 2013 with 5 cubic feet per second (CFS) reduction and topping out in 2016, with a 9.5 CFS reduction, these projects have added significant flows to a critical reach of the river."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-17	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-18	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-19	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-20	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Next Steps — Data Gaps, Questions for Future Projects

Title	Tradeoffs - Resource Impacts	Predicted outcome from applying "avoid, mitigate, offset" hierarchy	Proportional	Program level goals: No net loss to env. services, recognizing tradeoffs	Program level goals: Build incentives for projects with net env. benefits.	For proposed future transactions, need to evaluate impacts (positive or negative) to: ISFs (or other flow targets)	SMP or WMP objectives / proposed projects	Critical habitat & flow recommendations	State species of concern	BRT environmental values lists/ mapping	CRCT conservation strategy	Other known community / entity projects
SCPP-15	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-16	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-17	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-18	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-19	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-20	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Exhibit B-5
Lit (Gen. Literature) Documents with Environmental Criteria

EXHIBIT G

					Environmental Resources that May be Affected												Next Steps											
																	Data Gaps, Questions for Future Projects											
					Streamflow (Hydrology) Impacts						Species Impacts			Water Quality Impacts						Program level goals		For proposed future transactions, need to evaluate impacts (positive or negative) to:						
Title	Date	Publisher/Authors	Description	Notes	Magnitude	Frequency	Duration	Timing	Rate of change of hydrologic conditions	Return Flow Impacts	Critical Stream Reaches Impacted (where)	Critical Land or Riparian Habitat Impacted	Species Impacted (what)	Salinity	Temperature	Other	Tradeoffs - Resource Impacts	Predicted outcome from applying "avoid, mitigate, offset" hierarchy	Proportional	No net loss to env. services, recognizing tradeoffs	Build incentives for projects with net env. benefits.	ISFs (or other flow targets)	SMP or WMP objectives / proposed projects	Critical habitat & flow recommendations	State species of concern	BRT environmental values lists/ mapping	CRCT conservation strategy	Other known community / entity projects
Lit-01 Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture	1999	Aillery et al, Marine Resource Economics	Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River	Investigates ag impacts of fish recovery measures "such as: modified timing for dam releases, reservoir drawdown, and flow augmentation in the Columbia River basin, on the regional agricultural sector are evaluated. [....] Results suggest that drawdown and/or minor reductions in irrigation water diversions would reduce producers' profits by less than 1% of baseline levels. However, the most extreme scenario--a long drawdown period combined with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."	"Policy scenarios focus on alternative strategies to increase flow velocities in the Columbia-Snake system" "Flow alterations have significantly increased travel time for juvenile fish migrating to the ocean, a primary factor in reduced survival rates."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.	Minimum flow objectives for Snake River at Lower Granite Dam, and for the Columbia River at McNary Dam	Not discussed.	Endangered species act: "Formal ESA listings for Columbia-Snake River salmon and steelhead populations triggered formation of a recovery program." Minimum flow objectives for Snake River at Lower Granite Dam, and for the Columbia River at McNary Dam."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-02 Feasibility of water efficiency and reuse technologies as demand-side strategies for urban water management	2017	Berhanu et al, Journal of Industrial Ecology	Economic model of water cost provided by above-code water efficiency and reuse technologies, including variations & uncertainty analysis.	Estimates that efficiency and reuse can meet 85% of 50yr projected needs to the Lower Colorado River Authority service area (central TX)	Impacts to flow not discussed. Focuses more on costs-benefits of various municipal efficiency practices.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.	No assessment for environmental impacts associated with this specific study for the 2012 State Water Plan for Texas includes a high-level assessment of environmental impacts of all recommended and alternate water management strategies for Texas	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-03 Response to water crisis: How do Iranian farmers think about and intent in relation to switching from rice to less water-dependent crops?	2019	Boazar et al, Journal of Hydrology	Study of farmer response to gov't demand management, switching crops.	"Structural equation modeling showed that farmers' intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations."	Impacts to flow not discussed. Report focuses instead on farmers' attitudes and believes around crop switching.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-04 Temporary water transfers for urban water supply during drought	1992	Clark, CSU	PhD dissertation modeling options for temporary water transfers	"This research develops a water right option agreement (WROA) model, methods of analysis, and legal implementation strategy under Colorado law." Interviewed professionals, estimates costs, identified that WROA "can be superior in terms of cost, reliability, and operational flexibility to both water-right purchases and construction of additional reservoir storage.	Impacts to flow are not discussed. Focus is more on technical, legal, operational framework and costs of temporary transfers.	Not discussed	Not discussed	Not discussed	Not discussed	Notes that for any agreement, historical consumptive use and return flows must be quantified. "Due to existing claims on the return flow portion of the water by downstream interests such as junior water-rights holders and instream flow consider-ations, only a portion of the irrigation water can be made available to the city by the final transfer process." Discusses considerations for determining location and calculating timing and amount of return flows, both surface and groundwater. "Location of the existing use relative to the proposed temporary use determines the return flow requirements and impacts of the transfer on other parties...Referring to Table 6.2.1, columns (1) and (2), if the transfer has significant depletion effects, deductions from the lessee's available credits may be negotiated for mitigation of instream impacts and other effects."	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Included a discussion on the Senate Bill 89-181 and the rulemaking by the SEO to implement water quality standards in review of water transfers Mentioned the use of the mass balance method or the mixing zone method to estimate the influence of flow on water quality standards	If the temporary transfer has significant depletion effects, deductions from the lessee's available credits may be negotiated for mitigation of instream impacts or other effects A plan of augmentation and an exchange agreement may yield much more water for the user	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-05 Flexible water allocations and rotational delivery combined adapt irrigation systems to drought	2018	Cody, K.C., Ecology and Society	Water allocation experiment in San Luis Valley, Colorado for self-governing irrigation systems.	Examines relationships between rules and physical context of water supplies; specifically the outcomes of water allocations between members and how they rotate water delivery.	Impacts to streamflow from DM practices were not discussed. Appendix I discusses Long-term climate change in the SLV. Appendix I also acknowledges the prior appropriation system already impacts environmental considerations: "Unique return flow dynamics can lead to externalities when transfers occur in water markets (Howe et al., 1982). In addition, PA has no inherent place for environmental uses of water, posing challenges for ecosystem integrity under a water constrained future; only in the past 40 to 20 years have in stream flows and non-consumptive recreational uses been incorporated into Colorado water law." Prior Appropriation may therefore be working against risk mitigation and may exacerbate inequalities and vulnerabilities in the overall agricultural sector.	Not discussed.	Not discussed.	Impacts to streamflow from DM practices not discussed. Appendix I discusses long-term climate change in the SLV, including timing of runoff.	Not discussed.	"The four institutional configurations that are possible by combining the shortage sharing and delivery rules have different implications for return flows…": Table 4 suggests that shortage sharing agreements may alter return flows. [Shortage sharing is defined as the alteration water allocations between users of the same irrigation system in times of drought, regardless of the original criteria used to allocate water (land owned, private rights held, historical use, etc.)] In extreme shortage, tail-enders should be the most stressed due to seepage losses, depressed hydraulic head, and decreased return flows.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-06 Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity	2017	Colby (Ch. 3.1.4), Book eds Ziolkowska & Petersen	Chapter from book "Competition for Water Resources: Experiences and Management Approaches in the US and Europe" collecting global examples/discussion of approaches and solutions to water supply scarcity, including western US	Ch 2.1.1: Challenges for US irrigated ag in the face of emerging demands and climate change, Ch 3.1.4: Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity (reviews online trading systems to reduce transaction costs, methods for cost-effective verification of CCU, and other breakthroughs facilitating temporary & intermittent trading more feasible. Examples from AZ and CA (IID), NE, Australia, CO-Big Thompson.	Emphasizes the need for cost effective flow monitoring to gage environmental benefits in specific locations: "Cost-effective verification of stream flow changes linked to trading and low transaction cost procedures to negotiate and implement trades have made temporary and intermittent arrangements to reduce CU feasible in many areas. This is particularly helpful to assuring flows for environmental needs and for recreation, uses in which water's value varies significantly with specific locations and seasons." Addresses importance of measuring CCU rather than diversion or acreage reductions: "A program that accounts solely for changes in diversions or changes in acres irrigated (and that pays farmers on the basis of reductions in diversions or acreage) will encounter problems such as detrimental effects on surface flows and downstream water rights, as well as on groundwater in storage. A farmer paid to cut back on the basis of reducing irrigated acres may change crop mix, irrigation technology, and water management on remaining acreage..."	Not discussed	Not discussed	Acknowledges in a general sense that CU trading programs have a goal of "real-time reductions in agricultural consumption to produce a desired improvement in surface flows at specific locations and seasons." "In regions where trading programs must achieve streamflow and lake-level mandates, changes in water use on farms must result in measurable increases in water availability at specific locations and seasons." Acknowledges the need to incorporate ditch loss, return flow lagging etc. : "Various programs have devised strategies, such as designated trading zones with different trading ratios and multiyear trading, to address variations in hydrologic connectivity and time lags between reduced water consumption on a farm and improved surface flows at the desired location. Differences in conveyance losses and aquifer characteristics can be incorporated into trading rules to ensure that decreased water use on a specific farm will improve surface flows at a target location and time period. "	Not discussed	Addresses return flow impacts primarily as a data gap / next step. 'Generally discusses the difficulties of data availability for determining return flows and historical consumptive use. Lower Colorado River Accounting System (LCRAS): In the Lower Colorado River Basin (LCRB), water use within irrigation districts receiving water under contracts with Reclamation is tracked through one of the most sophisticated water accounting systems in the world, the Lower Colorado River Accounting System (LCRAS). This system requires detailed records of diversions, return flows, CU, etc. and provides a baseline from which to quantify change in CU. However, such comprehensive water use measurement, monitoring, and accounting systems are lacking in most basins of the western United States and elsewhere in the world. Acknowledges the need to incorporate ditch loss, return flow lagging etc. : "Various programs have devised strategies, such as designated trading zones with different trading ratios and multiyear trading, to address variations in hydrologic connectivity and time lags between reduced water consumption on a farm and improved surface flows at the desired location. Differences in conveyance losses and aquifer characteristics can be incorporated into trading rules to ensure that decreased water use on a specific farm will improve surface flows at a target location and time period. "	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Examples in Nebraska: 1) CPNRD: "The Central Platte Natural Resources District (CPNRD) in 2007 approved a Water Banking Policy to reduce the need to regulate irrigators while returning Platte River flows in its area to mandated levels. CPNRD acquires water rights from landowners through the bank. For every acre-foot river flow improvement from banked water, there is that much less regulation the CPNRD has to impose." ...."CPNRD has been acquiring permanent easements from willing sellers to retire irrigated acres (and other uses) and convert to uses that have lesser impacts on river flows. The program incentivizes retirement of lands that have a larger impact on river flows, since the fee structure is based upon a payment for each acre-foot of impact on the river." "In a 2012 effort to compete against private individuals looking to buy water rights, the CPNRD directors doubled the rate that they will pay for water rights to $8000 per acre-foot of depletion of the river; up from $3750. At the end of 2013, CPNRD had a balance of 2464 acre-feet of water rights available for offset in the over-appropriated area." 2) TPNRD: "In 2013-2014, Nebraska's Twin Platte Natural Resources District (TPNRD) created and implemented a mechanism "to help agricultural producers put groundwater to its best use by facilitating the transfer of certified irrigated acres." An online mechanism operated by a neutral market manager, Mammoth Trading, matches buyers and sellers anonymously and confidentially, simultaneously comparing bids and offers. The trading system ensures that transfers comply with TPNRD rules (such as flow lines, stream depletion factors, slope), manages the approval process with TPNRD, undertakes title searches, and works with farmers on finalizing paperwork and transferring funds." 3) Collaborations: "In 2012, four NRDs in western Nebraska bought nearly 20,000 acres of farmland in southern Lincoln County, the beginning of the N-CORPE Project (Nebraska Cooperative Republican Platte Enhancement Project, Nebraska Educational Telecommunications, 2014). Crops on over 16,000 acres of purchased lands are idled, the land is seeded to grass, and the irrigation water is sent to the South Platte and Republican rivers to help the NRDs and Nebraska meet legal obligations. The participating NRDs plan to pipe water from the farm's irrigation wells to the Platte and Republican Rivers. The project enhances stream flow with water that otherwise would have irrigated acres owned by N-CORPE in Lincoln County and is the largest grassland restoration project in Nebraska."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-07 Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling	2016	Dubinsky, CU Denver	PhD dissertation that identified San Luis Valley sustainability indicators and modeled future scenarios, developing a CU indicator for 1980-2010. Conducted scenario modeling to guide decision-makers towards desired outcomes from policy decisions. Coupled sustainability indicators with future scenario modeling to inform the SLV stakeholders about a variety of social and environmental issues. Results indicated that through specific shifting of cropping rotations and minimal land fallowing, SLV could reduce water use and Greenhouse Gas Emissions while increasing soil carbon and improving soil health. In addition, the solar energy development pathways investigated by this study showed that the potential exists to offset most or all of the region's GHG emissions.	Utilized Community Based Participatory Research to engage stakeholders & keep research relevant. Highlighted groundwater-dependence of SLV, suggests irrigation water use could be decreased 10% with shifts in crop regime and minimal fallowing.	Discusses declining SLV aquifer levels due to diversions compared to runoff. Pg. 66.	Not discussed.	Not discussed.	Acknowledges climate change impacts on runoff (shift from June to May) pg. 66.	Not discussed.	Return flow impacts not discussed.	Not discussed.	Discusses the importance of flood irrigation in river valleys, regarding wetland habitats and also impacts to compact compliance. "This is a complex system and solely increasing efficiency may not be the answer. Along the riparian corridors, diverted water used for growing meadows and pasture sustains a variety of wetland types that are invaluable for waterfowl, wildlife, recreation, and other ecosystem services." "While flooding land during the growing season may not appear to be an efficient use of water, it provides an important service, as these lands provide habitat for native species, as well as grazing land for livestock." "If river corridor zones were permanently dried by change of use, it would cause a substantial challenge to the State's ability to meet compact requirements."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	"On the other hand, through this analysis, we see that native vegetation consumes significant amounts of water, which affects the region's ability to maintain a sustainable aquifer. It will be important for future regional water use analyses to allocate water towards ecosystem services and environmental flow requirements. Much work has been done in the area of quantifying ecosystem services and these methodologies could be applied to river basins such as SLV (Costanza et al. 1998, 2014, 2011; Costanza 2014)."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-08 Economic viability of deficit irrigation in the Western US	2018	Manning et al, Agricultural Water Management.	Research on agro-economics of deficit irrigation.	Deficit irrigation (DI) can be optimal during late growth and maturation stages given elevated water prices (depending on output price and production costs).	Impacts to flow not discussed. Focuses more on costs.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Return flow impacts not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-09 The role of groundwater trading in spatial water management	2014	Palazzo and Brozovic, Agricultural Water Management	Republican River Basin assessment of coupling surface-groundwater management.	Geospatial dataset of RRB irrigation wells modeling crop choice, land, and water use decisions by well. "Our analysis highlights the importance of the initial distribution of permits and the institutional context in which trading occurs." Cost savings from trading groundwater pumping are distributed unevenly between wells, counties and groundwater management institutions.	Acknowledges that groundwater pumping impacts surface water flows, and how that impacts Republican River Basin interstate compacts (NE obligation to KS). "The effect of pumping a well on instream flows is a function of the distance of that well to the nearest stream." "Although we do not model the spatial, dynamic impact of trading on instream flows, our results show that on average, pumped water moves away from streams after trading relative to the base-line regulation. This suggests that a simple trading scheme with a single permit price may simultaneously reduce both abatement costs to farmers and damages to instream flows. Our results imply that where there is very little unused allocation and water moves away from streams after trading – such as in the Upper Republican Natural Resources District – a restricted trading scheme canthus generate both economic and stream flow benefits. Because the groundwater pumping externality on stream flow is spatial, dynamic, and lagged, a dynamic model with detailed hydrology is needed to analyze the exact impact of trading on stream flow, as well as to estimate the optimal trading ratio between wells closer to streams and further from streams."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	The study found that in general, trading tends to result in applied water moving farther away from streams (a result of the specific well distribution in the study area in Nebraska). This also impacts return flows. "Moving the location of pumping further from the river will decrease stream depletion, but it will also decrease the contribution of return flows to shallow subsurface flow and thus to stream baseflow. If irrigation is relatively efficient overall, the net impact of moving the average location of pumping water away from the river should reduce stream depletion in the long run." "... in the study area, reducing stream depletion rather than reducing aquifer depletion is the primary goal of regulation. This implies that water is being transferred from relatively more efficient wells to relatively less efficient wells. As a result, for a random distribution of efficiency, water trading results in a decrease in consumptive water use and an increase in returnflows. … All else equal, wells with a higher (lower) technical efficiency will have a lower (higher) unconstrained water use, a lower (higher) marginal abatement cost at their current allocation, and will thus be more likely to sell (buy) water permits."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-10 Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain	2019	Ren et al, Stochastic Environmental Research & Risk Assessment	Evaluation of different cropping patterns (including fallowing) & water supply scenarios.	Framework for using a crop model & regression to predict effects of cropping adjustments on groundwater sustainability & crop production	Impacts to flow not discussed. Focuses more on nexus between food and water.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-11 Opportunities for saving and reallocating agricultural water to alleviate water scarcity	2017	Richter et al., Water Policy	- Review of literature & internet to identify water-saving strategies in irrigated agriculture. - Review of case studies in which water savings have been successfully transferred to other uses.	- Catalogs water savings opportunities, claims of irrigation-efficiency savings potential, logistics of reallocating due to other ag diverting savings. Findings suggest considerable potential to reduce irrigation CU and that savings can be reallocated when proper consideration is given to water budget accounting.	"This paper focuses on the potential water savings that might be realized in irrigated agriculture without loss of crop production, as well as opportunities to redirect saved water toward environmental restoration or to other uses." "Accurate determination of potential water savings in irrigation requires estimation of the volume of water associated with each of the water flow pathways illustrated in Figure 2 so that the net change in 'water available for subsequent use' (including environmental uses) can be properly evaluated."	Not discussed.	Not discussed.	"Unfortunately, until recently most water conservation efforts on farms, and claims of water-saving potential, have focused solely on changes in the volume of water withdrawn or applied to farm fields (large arrows in Figure 2), neglecting the volume and fate of return flow back into the original water source, creating misleading impressions of water benefits within the overall irrigation network within which water practices have been modified. This insufficient accounting can lead to counter-intuitive outcomes, or a 'water efficiency paradox' (Scott et al., 2014), in which seemingly more efficient irrigation application can result in greater net consumptive use, ultimately lessening the volume available for subsequent use."	Not discussed.	Acknowledged as a data gap that most reports and papers fail "to properly account for key elements of water budgets such as return flows." "most water conservation efforts on farms, and claims of water-saving potential, have focused solely on changes in the volume of water withdrawn or applied to farm fields (large arrows in Figure 2), neglecting the volume and fate of return flow back into the original water source, creating misleading impressions of water benefits within the overall irrigation network within which water practices have been modified." Report describes the importance of return flows to downstream users, and the fact that some increased efficiency practices can even increase crop consumptive use and therefore increase water scarcity.	Recognizes a need to show flow benefits are being provided to reaches purportedly receiving benefits.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Paper recognizes enabling increases in agricultural production through the use of water-saving programs could allow consumptive water use to grow and river flows or groundwater levels will be further depleted, often to the point of complete drying, with attendant loss of biodiversity and social and economic benefits such as riverine fisheries.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-12 Urban water conservation in the Sacramento, California region during the 2014-2016 drought	2019	Talbot, UC Davis	UC Davis Master's Thesis cataloging/analyzing supply & demand management actions under CA's drought policies.	Evaluates outdoor watering, public outreach, media role, water-related energy savings. Makes recommendations for urban water suppliers on revenue recovery, reducing use of rebates as demand management, and scaling drought response tasks for different levels of gov't. Summarizes & analyzes CA legislation establishing approval for long-term budget-based efficiency targets.	Impacts to flow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Noted when municipal efficiency practices were enacted, wastewater treatment plant effluent discharge was also reduced. Other than that brief mention, return flow impacts or implications are not discussed.	Not discussed	Not discussed	Discusses importance of keeping water in storage for environmental flows to keep salt water from moving up river from the ocean, (pg. 22) and to "minimize the impacts of reduced flows from Folsom Lake on fish and wildlife." (pg. 74).	Discusses importance of keeping water in storage for environmental flows to keep salt water from moving up river from the ocean (fresh water releases to push back seawater), (pg. 22) and to "minimize the impacts of reduced flows from Folsom Lake on fish and wildlife." (pg. 74).	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Energy savings were realized through the water conservation efforts (GHG emission reductions and reduced kWh of electricity)	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-13 Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado	2016	Vashisht, Colorado State University, Colorado	CSU Master's Thesis evaluating remote sensing for estimating monthly consumptive use (CU) and conserved CU (CCU) on the West Slope	Used evapotranspiration (ET) observations at experimental plots of traditional irrigation and water-banking irrigation practices to evaluate methods of verifying CCU. Reviews methods for measuring and monitoring CU, discusses limitation and potential for ReSET remote sensing CU model.	Impacts to flow not discussed. More about the technology used to verify any DM practice.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Briefly mentioned as a data gap, in that many methods for quantifying CU do not allow measurement of return flows.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-14 Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains	2018	Yonts et al, J. of Agricultural Water Management	2010-2015 study in Nebraska of efforts to decrease ag groundwater pumping; impacts of water use efficiency and crop yield	"Reducing irrigation water by 25% caused no significant yield reduction and improved irrigation water use efficiency by 26%." Applying 50% Etc. resulted in 30% yield reductions, and planting directly in crop residue did not improve bean yield under deficit irrigation. Ample early season rainfall is a boon to pre-flowering deficit irrigation yields, but under normal-to-dry conditions post-flowering deficit yields more.	Impacts to flow not discussed. More focused on impacts to crop yield.	Not discussed	Not discussed	Not discussed	Not discussed	Return flow impacts not discussed.	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-15 Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming	2017	Rosado, U of Wyoming	Master's thesis on irrigation system efficiency in Little Wind Unit	Uses ag water balance & geophysical techniques to quantify & locate water losses. "Large errors and data gaps associated with the inflows, outflows, diversions, and precipitation data, [...which] identified specific needs for better data."	Paper not found																							
Lit-16 Standardizing Temporary Water Transfer Procedures in Colorado	2020	Nicols, Peter D, et al, University of Denver Water Law Review	Review of strengths and challenges of existing legal mechanisms for ATMs and recommendations for consolidation and standardization.	This article will describe the barriers in existing law to temporary transfers and the various approval mechanisms available under existing Colorado law. It will provide an assessment of the strengths and limitations of the existing transfer methods and make a recommendation for consolidation and standardization.	Not addressed, other than addressing the need to find a streamlined approach to calculating and maintaining return flows.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	The difficulty of calculating and challenge of maintaining historical return flows is recognized as part of the "No Injury Rule" barrier and "Calculation of HCU" barrier to implementation. The Lease Fallow Tool is recognized as a potential solution to simplify and streamline the evaluation process, described as a "transparent, simple, and streamlined approach." Also recommends the state engineer rulemaking address a streamlined approach to determine HCU and return flows.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Exhibit B-6
ATM Documents with Environmental Criteria

EXHIBIT G

																	Next Steps											
					Environmental Resources that May be Affected												Data Gaps, Questions for Future Projects											
					Streamflow (Hydrology) Impacts						Species Impacts			Water Quality Impacts						Program level goals		For proposed future transactions, need to evaluate impacts (positive or negative) to:						
Title	Date	Publisher/Authors	Description	Notes	Magnitude	Frequency	Duration	Timing	Rate of change of hydrologic conditions	Return Flow Impacts	Critical Stream Reaches Impacted (where)	Critical Land or Riparian Habitat Impacted	Species Impacted (what)	Salinity	Temperature	Other	Tradeoffs - Resource Impacts	Predicted outcome from applying "avoid, mitigate, offset" hierarchy	Proportional	No net loss to env. services, recognizing tradeoffs	Build incentives for projects with net env. benefits.	ISFs (or other flow targets)	SMP or WMP objectives / proposed projects	Critical habitat & flow recommendations	State species of concern	BRT environmental values lists/ mapping	CRCT conservation strategy	Other known community / entity projects
ATM-01 Use of Alternative Transfer Methods to Increase Water Supplies for Conejos Basin Agriculture, Municipal, and Environmental Purposes	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205333&dbid=0	Trujillo Meadows Reservoir ATM Study (TMR Study): "The primary objective of the TMR Study is to investigate the feasibility of a unique ATM that involves enlarging Trujillo Meadows to provide intra-year regulation of water supplies including direct flow storage and storage of other agricultural and augmentation water rights for agricultural users diverting from the San Antonio.	ATM w/ recreational and environmental benefits for municipal augmentation w/enlargement of Trujillo Meadows Reservoir. Stakeholder meetings for federal & state agencies, ag, and town aug needs. Model of ATM, details of benefits, recommended path fwd. Appendix A estimates of monthly inflows to reservoir. Water rights include USFS Reserved Rights decreed as ISF, interstate shepherding for flow through NM.	Potential benefits from proposed project discussed in a general sense, due to ability to time releases from additional stored water. Benefits not analyzed. "Enhance streamflow for a longer period during the runoff season." "Coordinated operations of Rio Grande, Beaver, Platoro, and Trujillo Meadows Reservoirs could provide for streamflow enhancements while replacing well-pumping depletions." Next steps identified for further analysis: "The Rio Grande Basin Plan RiverWare model should ….. also be used to evaluate streamflow, leading to analysis of riparian, environmental, recreational, and economic benefits."	Potential benefits from proposed reservoir expansion include: "Enhance streamflow for a longer period during the runoff season"	Potential benefits from proposed reservoir expansion include: "Enhance streamflow for a longer period during the runoff season"	Projects that involve storage have the benefit of operational flexibility for timing of releases for environmental benefit, primarily mid-summer releases (pg.. 69) "Releases of direct flow or other legally available water stored in Trujillo Meadows could be timed to enhance streamflow while releasing water for additional supplies to irrigators." Problem this addresses: "The early runoff and inability to regulate flows on the Los Pinos and San Antonio Rivers has resulted in challenges in meeting irrigation water demands, managing delivery of Compact water, flood control, fish habitat, and riparian health." "Platoro water augmentation deliveries can be retimed to provide streamflow enhancements."	Not discussed.	Assumes that ATMs will have to maintain historical return flow patterns to protect other water rights. Return flows are incorporated into the RGDSS model: "Return flows are calculated as ditch diversion minus CU, minus a loss calibration factor, and are lagged back to the river."	"Additional releases of water in mid-summer will enhance stream and riparian values through a prolonged release of additional flow after the peak runoff. This will improve aquatic habitat quality and species diversity downstream due to prolonged stream volume, lower temperatures, and higher levels of dissolved oxygen." "Improved quality of aquatic habitat and species diversity downstream due to prolonged stream volume after peak runoff could result in lower temperatures and improved dissolved oxygen."	"An enlargement of Trujillo Meadows would also result in increased surface acres and shoreline miles that would provide benefits for wildlife use and wildlife-related recreation (fishing, hunting, wildlife watching) and boating."	Primarily discusses impact of construction activities to species, not effects of operating the project once completed. Analysis of sensitive species with potential to occur in the reservoir expansion project area given in Table 7. Forest Service Management Indicator species in Table 8.	Not discussed.	"Additional releases of water in mid-summer will enhance stream and riparian values through a prolonged release of additional flow after the peak runoff. This will improve aquatic habitat quality and species diversity downstream due to prolonged stream volume, lower temperatures, and higher levels of dissolved oxygen."	Increased dissolved oxygen as a result of higher flows and lower temperatures from summer releases.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-02 Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley	2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195733&dbid=0	The goal of this report is to "report on the development from 2002 through mid-2011 of rotational land fallowing-water leasing (fallowing-leasing) in the Lower Arkansas Valley of Colorado (Lower Valley) by the Lower Arkansas Valley Water Conservancy District (Lower Ark District) and the Lower Arkansas Valley Super Ditch Company, Inc. (Super Ditch)."	Return flow needs may require additional recharge ponds & stations; Return flows unnecessary at times due to trans-basin supply; considers monthly return flow "factors"; analysis by Leonard Rice Engineers found that replacement water will be required in the non-irrigation season in most cases.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Assumes that ATMs will have to maintain historical return flow patterns to protect other water rights, and discusses measurement structures may be required to verify this. "Most ditches, however, will require additional return flow stations and recharge ponds to facilitate replacement of return flow obligations to water rights holders in the vicinity of the affected reach of the Arkansas River to avoid injury to other water rights." Table 12 shows costs for return flow stations. Also discusses considerations for locating these return flow stations or recharge ponds. In addition to calculating CU, the locations and timing of the required return flows were estimated with the Ground Water Accounting Model (GWAM). Also identifies that streamlining the approach to maintaining return flows is a next step: the Lower Ark district is working with the Arkansas Basin Roundtable Task Force to "simplify and reduce the cost of fallowing-leasing. This includes development of an administrative tool to address historic consumptive use and return flows from fallowingleasing to simplify implementation of water leases, a pilot program, and possible statutory or administrative changes or action to facilitate fallowing-leasing."	Not discussed.	Not discussed.	Not discussed.	"In 1998, the USGS performed a water quality evaluation in the Arkansas Valley for an approximate 11-mile reach of the Arkansas River that begins near La Junta and continues below the Fort Lyon Canal headgate. A key finding from the study suggests that with general irrigation reductions, "downstream irrigators could realize some benefit from lower salinity irrigation water [including] crop yields, and the ability to grow crops that are less salt tolerant and have higher cash value.""	Not discussed.	Water quality issues for irrigators discussed chapter 7.4, pg.. 114. Primarily TDS. "Pat Edelmann, Southeast Colorado Chief, USGS Colorado Water Service Center, acknowledges that it is reasonable to anticipate some improved water quality along the Arkansas River from reduced irrigation return flows if some of the results from the simulations made with the model occur on a broad scale in the lower basin. The USGS, in cooperation with the Regional Resource Planning Group, seeks to better define the water-quality conditions, the dominant source areas, and the processes that affect water quality in the Arkansas River basin."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-03 Little Thompson Farm ATM Grant Completion Report	2018	https://www.larimer.org/sites/default/files/uploads/2018/larimer_county_atm_final_report.pdf	Study funded through CWCB 2015 ATM Grant. The Little Thompson Farm receives supply from Handy Ditch and Reservoir Company shares and 240 C-BT units. The consultant team found that "it was feasible for Larimer County to afford, from a water supply perspective, to sell some C-BT units (115) and share some other units (80) in some years, while still having sufficient water on the farm for corn and sugar beets, as well as crops that require less water." The study looks at aspects of feasibility, including: Economics; Farm Financial Viability under wet, dry, and very dry year scenarios; dry year water value. The report also investigates potential partnerships, and outlines the final water sharing agreement. "Larimer County sold 115 C-BT units to Broomfield and retained a first right of refusal to lease back these units for assessment cost plus 10%, when available. " The report also discusses Lessons Learned and Future Considerations: Legal Hurdles/Barriers to Replication (Northern Rulemaking, Direct Flow Rights, Delivery Efficiency Impacts from Water Transfers); Public Perception & Political Will (Educating and Obtaining Support of Leadership, Public Support, Out of County Partners, Continued Education); Negotiating an ATM: Successful Tips, Tricks, and Tools (Establish and Pursue Goals with an Open Mind About Implementation, Minimize the Cooks and Trust Your Team).	Cover crop & leaving crop residue prevents wind erosion, maintains soil fertility, controls weeds; non-irrigated cover crops: dryland milo, sorghum/Sudan grass for soil health, reduce weeds, potential revenue; w/no cover crop, control weeds w/herbicide or tillage (tillage can reduce erosion by forming large soil clods & enhancing infiltration); Class II and III soils, slopes 0-5%, not high enough for severe erosional problems; no/low-till also recommended to reduce direct evap, improve soil health, reduce fuel & costs; irrigation efficiency via contour farming, drip irrigation, SM & ET monitoring, drought tolerant crops, GPS irrigation guidance; no return-flow requirements due to CBT water, so no effort to quantify despite opponents	"In ensuring a viable irrigated farm in perpetuity, the County retained a sufficient water supply, after the sale and even when the ATM is exercised, to allow irrigation to continue similarly to how it has been done historically on the farm, and in most years, there will be no perceptible impact to the Little Thompson River. However, the County does not deny that this deal will, at times, result in a reduction in water flowing off the farm into the Little Thompson River, to some extent."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	This report raised the unique issue of return flow impacts from transbasin supplies (CBT in this case). This issue is unique, because unlike with in-basin supplies, there is no legal obligation to maintain return flows from trans-mountain diversions. The project received opposition from farmers downstream of the proposed project that rely on return flows from C-BT. The County responded that in most years irrigation will continue and there will be no perceptible impact, but that at times, the project will result in a reduction in return flows. "Alternative transfers are an alternative to buy and dry that prevent the permanent dry up and land conversion of productive farmland. However, ATMs are still transfers, and while they can spread and absorb some of the impacts of municipal participation in agricultural water, they do not eliminate it entirely." "In discussions with the stakeholders and potential water partners, the team interacted with several local ditch companies and came to realize that although C-BT does not have return flow obligations, removing C-BT units from these ditch systems can impact their operational viability."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Acknowledges that while maintaining land under agricultural production in perpetuity has advantages compared to buy and dry, the lease agreement will have some impacts to flow compared with historical agricultural operations.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-04 HB13-1248 Catlin Canal Company Rotational Land Fallowing-Municipal Leasing Pilot Project	2018	https://dnrweblink.state.co.us/cwcb/0/edoc/210320/19%2001%2015%202018%20Annual%20Report%20-%20Catlin%20Pilot%20Project%20FINAL.pdf?searchid=3856cf32-c475-4163-840c-5361fa65041f	The Catlin Pilot Project was the first rotational land fallowing-municipal leasing pilot project under HB 13-1248: Irrigation Water Leasing Municipal Pilot Projects. This project aims to makes available up to 500 acre-feet of water for lease to three municipal water providers – the Town of Fowler, the City of Fountain, and the Security Water District (Municipal Participants) - from rotational fallowing of lands located on six farms irrigated under the Catlin Canal in the Arkansas River Basin.	Huge emphasis on return flows; using Lease Fallow Tool from DWR to calc available water & owed returns; "Pay As You Go" target deliveries for return flow; use of recharge structures supported well-timed return flows; augmentation station used for faster return flows and consumptive use water delivered to municipal participants; erosion & weed control included herbicide, disk tilling, cover crops (winter wheat, hay)	Return flow obligations were determined. Deliveries were measured and accounted for. "These deliveries exceeded the amounts necessary to meet return flow obligations in some months."	Not discussed.	Not discussed.	Timing of return flow obligations was considered and accounted for. "Catlin Pilot Project shall endeavor to replace the calculated amount of tailwater return flow on a daily basis." "these return flow obligations were consistently met on a daily basis, and for the year slightly exceeded return flow obligations." Timing of deep percolation return flow obligations to the stream system was managed and accounted for using deliveries via recharge ponds. "Deep percolation return flow deliveries were necessary because neither recharge pond was capable of providing recharge to the Arkansas River as quickly as the historical deep percolation from the Diamond A West Farm returned to the river."	Not discussed.	"Deliveries were assigned to one of three categories: (1) consumptive use water available to the Municipal Participants; (2) tailwater return flow obligations; and (3) deep percolation return flow obligations" pg. 9. Chapter V. Return Flow Obligations (pg. 19). Tailwater returned via augmentation station. Deep percolation return flows replaced through recharge ponds and augmentation station deliveries. "Deep percolation return flow deliveries were necessary because neither recharge pond was capable of providing recharge to the Arkansas River as quickly as the historical deep percolation from the Diamond A West Farm returned to the river." "Catlin Pilot Project ... utilized the "Pay As You Go" approach for replacing deep percolation return flow obligations, which involves making contemporaneous deliveries of water to meet those obligations to properly located recharge facilities."	Not discussed.	Not discussed.	Considers concerns of invasive species (noxious weeds) from fallowing. Study found that in 2018, "the fallowing of historically irrigated fields did not result in any problems from erosion or noxious weeds."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-05 Yampa Basin ATM Study	2014	https://dnrweblink.state.co.us/cwcb/0/edoc/199193/Yampa%20-%20NC%20Use%20of%20ATM%20to%20Meet%20Non%20%20Consumpt%20Needs_FINALReport%203-28-14_with%20apps.pdf	Study conducted by Trout Unlimited (TU) and funded by CWCB's Alternative Agricultural Water Transfers Grant Program. The purpose of the study was to identify locations in the Yampa Basin where potential ATM transactions could help to meet multiple uses (nonconsumptive needs and agricultural shortages), and identify types of ATM transactions most suitable for meeting multiple purposes. Ideal candidate reaches, as specified by project proponent TNC and its partners, would involve the following scenario: - Upstream agricultural water user with full or surplus irrigation supplies and transferable CU water - Downstream agricultural water user with an irrigation CU shortage (consumptive need) - A need for water in the reach between to improve flows for trout (including Colorado cutthroat trout) or warmwater fish (nonconsumptive need)	Used StateMod delay table to estimate historic return flows; more efficient irrigation improves water quality by lowering return flow contaminant transport, fewer excess nutrients due to fertigation in drip systems; TNC/TU partnership to support instream flows for habitat w/ATM loans used when downstream ISF right is not satisfied & to provide flow in a reach without ISF right	Study looks for the ideal participant to maximize environmental benefit. "The ideal scenario to accomplish the goal of relieving irrigation shortages while meeting environmental needs would consist of a lease of water from a willing upstream irrigator, delivery of that water through a stream reach that has an identified environmental need for higher flows, and then delivery of that water to a downstream irrigator whose agricultural water right is short."	Not discussed	Not discussed	Study notes that the difficulty in matching up the timing with when CCU is available, when water is needed by downstream user, and when the environmental flows would be most beneficial. "Many variables influence whether such leases can provide benefits to the environment, with the primary variable being whether the leased water is available at times when needed by the natural environment, such as in late summer to increase flows and decrease water temperature."	Not discussed	The StateMod analysis considered return flow obligations to understand how the magnitude and timing of return flows would be impacted by temporary leasing, and what flow obligation would have to be met. Return flow maintenance recognized as part of Technical and Administrative Factors for Further Consideration in Next Steps. "Water associated with the return flows can be protected down to the historical point of return so as to avoid causing injury to water users that relied on the return flows." "The obligation is dependent upon the expected lag between time of diversion and time of return. A detailed analysis will be required to determine (a) lag time and (b) historical point of return. If lag time is short (e.g., 1-2 days), there may be no need to lag return flows and the water can be bypassed at the headgate for delivery to the river at the appropriate location of historical return flows. If lag time is long (e.g., 1 month), the lessor will be responsible for preventing injury to downstream users by maintaining the timing of return flows."	"The ideal scenario to accomplish the goal of relieving irrigation shortages while meeting environmental needs would consist of a lease of water from a willing upstream irrigator, delivery of that water through a stream reach that has an identified environmental need for higher flows, and then delivery of that water to a downstream irrigator whose agricultural water right is short." "Environmental needs considered were (a) CWCB-held ISF water rights that have historically not been satisfied, (b) moderate and high risk locations identified in the Watershed Flow Evaluation Tool study (CDM Smith. 2012), and (c) other stream reach locations identified by local biologists as being at times acutely short of flows needed to sustain fish." "A less complicated scenario may exist where a CWCB ISF water right is the recipient of leased water.... [but] it does not meet the ideal of serving both irrigation shortages and environmental needs."	Not discussed	The study focused on environmental benefit - where ATMs can provide the MOST benefit to certain species. In screening for optimal locations for ATMs, the study mapped habitats of warm water fish (native bluehead sucker and flannel mouth) and trout (Cutthroat, Brook, Brown, and Rainbow). Trout Flow-Ecology Relationship is based on summer flows (average for August to September) and is expressed as a percent of natural mean annual flow. The lower the percentage of average August and September flows, the higher the risk of a particular location. "The effectiveness of ATMs on the trout flow-ecology relationship locations was assessed in terms of the potential to increase August and September flows, and, especially, to move from a 0, 1, or 2 rating to a 3 or 4 rating." Warmwater Fish Flow-Ecology Relationship is based on the "30-day minimum flow" - a running mean calculated over the summer-autumn flow period (July 1 to November 30) for each year, then averaged over the study period. "The effectiveness of ATMs on the warmwater fish was assessed in terms of increases in late growing season and winter month flows and by the potential for a lease of water to lower the percent reduction in potential biomass."	Report qualitatively mentions connection between flow and water quality: "Water quality improvements. Traditional furrow irrigation has high return flows that may be high in salinity and other pollutants. Through the use of these highly efficient irrigation systems the return flows are reduced along with the accompanying contaminants."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Study looks at locations where ATMs can provide the most benefit. This study could provide helpful criteria in screening a potential DM project for net environmental benefit.	"Based on the investigation of legal mechanisms, it was found that water could be temporarily leased to the CWCB for the benefit of decreed ISF water right reaches." In selecting optimal reaches, the study looked at magnitude of shortages for intervening ISF water rights.	Not discussed.	In identifying optimal locations, the study considered the Colorado River cutthroat trout reaches in the Yampa River Basin.	In identifying optimal locations, the study considered: - the Colorado River cutthroat trout reaches in the Yampa River Basin - trout and warmwater fish flow-ecology risk	Not discussed.	Not discussed.	Not discussed.
ATM-06 Grand Valley Water Users Assn Conserved Consumptive Use Pilot Project Development: Process, Procedure, and Lessons Learned: Water Banking-Next Steps Part II	42795	http://www.grandvalleywaterusers.com/uploads/8/2/6/0/82606774/03-01-17_ccupp_projectdevelopment_final.pdf	The Conserved Consumptive Use Pilot Project (CCUPP) is a pilot demand management project intended to test the mechanisms necessary for a Western Slope irrigation water provider to intentionally reduce consumptive use in a voluntary and compensated manner. This report summarizes the process of developing the CCUPP, the procedure used, and lessons learned.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land.	Impacts to flow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-07 Grand Valley Water Users Assn 2017 CCUPP In-Season Verification	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205144&dbid=0	Field compliance and payment summary for the 2017 CCUPP including verification forms for each program participant for 2017.	Includes 2017 verification documentation including photographs, recommendations, comments/notes	Impacts to flow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-08 Power Canal Capacity Report, Grand Valley Water Users Assn	12/1/2015	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=201813&dbid=0	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank:" to convey CCU via unused capacity within the Orchard Mesa Power Canal (power canal) to deliver water to the Grand Valley Power Plant (GVPP). The report investigated the potential unused capacity within the Power Canal, including the potential for additional water to generate hydroelectric power.	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank." Compensated, temporary, voluntary. Lists current operations, water rights, data. Incomplete file in link, merged with 2017 Next Steps Part II	Impacts to flow in the river not discussed in this report, but it is important to note that if CCU water were diverted and delivered by means of excess capacity in the Power Canal, that water would not be available in stream for biological needs. However, as it would be delivered at the power plant, that water would be available in the 15-mile reach.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Although not discussed in the report, using CCU for hydropower generation presents a tradeoff with keeping water in the river for biological needs.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-09 Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture	5/1/2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195709&dbid=0	An extensive evaluation to: 1) To identify barriers to implementation of alternative transfers and to describe potential strategies for overcoming barriers. 2) To develop tools for agricultural producers to evaluate the viability of potential alternative transfers. 3) To further actual alternative transfers by evaluating three demonstration projects that include owners of agricultural water rights and potential end users of the temporarily transferred water.	Extensive final report on ATM investigation & pilot on NE South Platte covering barriers (cost, risk/uncertainty, lack of supply, reluctance, power dynamic), needs and means to address barriers, Lease Evaluation Tool (AgLET) ag economics evaluator, exchange capacity analysis, flex market pilot project w/Aurora.	In the demonstration projects assessed, there will be no impact to magnitude of streamflow as historical return flows have been quantified and will be maintained through recharge facilities.	In the demonstration projects assessed, there will be no impact to streamflow as historical return flows have been quantified and will be maintained through recharge facilities.	In the demonstration projects assessed, there will be no impact to streamflow as historical return flows have been quantified and will be maintained through recharge facilities.	In the demonstration projects assessed, there will be no impact to timing of streamflow as historical return flows have been quantified (including a lagging analysis) and will be maintained through recharge facilities.	Not discussed	1) Platte Valley Irrigation Company (PVIC) Augmentation Group/Aurora Water (the Flex Water Market): Historical return flows for Base CU and Flex CU are maintained by diversion into the recharge facilities located on or very near the farms where irrigation is permanently or temporarily suspended. Return flow deliveries will infiltrate into the alluvial aquifer and will eventually accrue to the river in the correct amount, time, and location as they have historically. 3) DT Ranch/Town of Wiggins (Interruptible Water Supply Agreement): Return flows were quantified as part of the HCU analysis. Deep percolation lagging calculated with IDS AWAS. DT Ranch has multiple location options for recharge facilities. Each year the agreement is executed, DT Ranch will quantify the historical amount, location, and timing of return flows resulting from both on-farm runoff and deep percolation. Likely return flows will be delivered to a recharge facility near or on the fields that are fallowed in years when the IWSA is executed.	Not discussed	Potential benefits of using recharge wetlands as a component of alternative transfers are discussed in Section 4.3. Wetlands provide habitat benefits to birds, fish, and other wildlife.	Using wetlands as a recharge method for ATMs provides habitat for migratory waterfowl and other species.	Not discussed.	Not discussed.	Potential benefits of using recharge wetlands as a component of alternative transfers are discussed in Section 4.3. Water quality benefits include: nitrogen removal, phosphorus removal, carbon sequestration, sulfur reduction from sulfate to sulfide, suspended solids filtration, metals removal.	Note the tradeoff between creating wetlands with an environmental benefit and reducing the CCU generated.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-10 Final Project Report: Implementation of Deficit Irrigation Regimes: Demonstration & Outreach	May-16	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199317&dbid=0	Evaluation of different methods of monitoring crop water stress and consumptive use (CU) under deficit irrigation. Demonstrations, workshops, educational outreach on crop stress monitoring.	Demo project to evaluate different methods of monitoring crop water stress and CU under deficit irrigation & demo educational outreach on crop stress monitoring.	Impacts to flow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-11 The Poudre Water Sharing Working Group: A Report to the CWCB	May-15	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=198097&dbid=0	Final report of Poudre Water Sharing Working Group - a prototype ATM water sharing group between agricultural users (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and municipal users (Fort Collins, Greeley, and Tri-Districts) on the Poudre River, facilitated by the Colorado Water Institute at Colorado State University. The report focuses on the formation of the working group, relationship building, lessons learned, survey of ag users, development of prototype agreements, and regional cooperation strategies.	Final report of prototype ATM water sharing group between ag (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and muni (Fort Collins, Greeley, and Tri-Districts) on the Poudre River. Identified CCU calculation methods as a large barrier.	Impacts to flow not discussed, other than a few general mentions of needing to replace return flow obligations.	Not discussed	Not discussed	Not discussed	Not discussed	The report touches on the need to maintain historical return flows, and describes this as a challenge. This may require storage and timed releases or construction of recharge basins. For interruptible supply agreements, the domestic provider wishing to utilize agricultural water under CRS 37-92-309 would be responsible for meeting the State's application and approval requirements. The costs for constructing the recharge or infiltration basins needed to satisfy return flows however, could be shared by both parties or needed infrastructure could be constructed by one party with adjustments made to the lease price that would compensate the party who develops this infrastructure. Note that there are no return flow requirements for trans-basin water.	Not discussed	Appendix A to the report (values / benefits provided by irrigated agriculture) touches on the benefit agriculture provides to wildlife habitat (esp. migrating waterfowl and songbirds). The report does not however talk about impacts expected to habitat from ATM activities.	Migrating waterfowl and songbirds, resident wildlife	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-12 FLEX Water Market: Education and Implementation Phase	December-15	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=197916&dbid=0	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders. The goal of this project was to successfully implement the FLEX Water Market concept through education, facilitation, and consultation, with specific focus on developing FLEX markets in Water Division 1 with municipal, industrial, agricultural, and environmental/ conservation partners. The team consulted with multiple potential partners, but in the end this project did not result in a water sharing agreement.	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders.	Impacts to flow not discussed, other than a few general mentions of needing to replace return flow obligations.	Not discussed	Not discussed	Not discussed	Not discussed	The FLEX Water Market is characterized by a focus on the use of recharge sites and other environmentally beneficial delivery methods and water management. In evaluating potential partners to implement a FLEX Water Market, BC also considered what effects the change of use would have upon other water rights, such as the timing of return flows. The candidate in the North Poudre Irrigation Company (NPIC) would have been able to provide temporary recharge facilities for delivery of subsurface return flow obligations. Also discussed methods for maintaining return flows for a large-scale FLEX Water Market on the Front Range, includign the possibility of using multiple storage facilities of moderate size at various locations along the river.	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Externalities discussed that may affect index based pricing: "The WRPIx may offer a baseline to which potential sellers (or lessors) could reference, but the index is based on historical transactions in the market for water. Historically, the market for water has suffered from several defects that violate basic economic notions of competitiveness – relatively few buyers and sellers, high transaction costs, lack of information, uneven bargaining power, and potential externalities (return flow, etc.), meaning that the market prices captured by the index may be skewed (either positive or negative)."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

																	Next Steps											
					Environmental Resources that May be Affected												Data Gaps, Questions for Future Projects											
					Streamflow (Hydrology) Impacts						Species Impacts			Water Quality Impacts						Program level goals		For proposed future transactions, need to evaluate impacts (positive or negative) to:						
Title	**Date**	**Publisher/Authors**	**Description**	**Notes**	**Magnitude**	**Frequency**	**Duration**	**Timing**	**Rate of change of hydrologic conditions**	**Return Flow Impacts**	**Critical Stream Reaches Impacted** (where)	**Critical Land or Riparian Habitat Impacted**	**Species Impacted** (what)	**Salinity**	**Temperature**	**Other**	**Tradeoffs - Resource Impacts**	**Predicted outcome from applying "avoid, mitigate, offset" hierarchy**	**Proportional**	**No net loss to env. services, recognizing tradeoffs**	**Build incentives for projects with net env. benefits.**	**ISFs (or other flow targets)**	**SMP or WMP objectives / proposed projects**	**Critical habitat & flow recommendations**	**State species of concern**	**BRT environmental values lists/ mapping**	**CRCT conservation strategy**	**Other known community / entity projects**
ATM-13 Alternatives to Permanent Dry Up of Formerly Irrigated Lands	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199208&dbid=0	Review of benefits and issues of two alternatives to buy and dry that maintain some continued level of agricultural production: 1) Dry land farming, and 2) limited irrigation.	Review of benefits and issues of buy and dry and alternatives. Potential for conversion of ag land to dry land or deficit-irrigation, economic & maintenance issues w/dry land & deficit.	Impacts to streamflow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Report notes need to replace historical return flows in location, timing, quantity and rate of flow to prevent injury to other water rights. Return flows noted as a challenge with limited irrigation, recommended to fund the evaluation of return flow patterns from limited-irrigation farming. Claims for return flows from the limited-irrigation use would likely be contested by objectors in the water court transfer due to the deficit irrigation approach with a far less than full water supply. Methods of maintaining return flows not discussed.	Not discussed	Environmental benefits: Report briefly discusses environmental benefits of revegetating lands with plant species that will improve environmental health and quality. Selection of revegetation species can be used to create environmental benefit. Dried and revegetated lands can also be returned to habitat, and the farmer may be eligible for subsidies under the Conservation Reserve Program (CRP): "Once the irrigation water has been sold and the irrigated lands dried up, the landowner may be eligible for federal farm subsidies under the Conservation Reserve Program (CRP)... Enrollment in CRP is a competitive process and favors lands in environmentally sensitive areas, such as farms very close to streams or wetlands. CRP payments are not available to farmers who choose to continue farming formerly irrigated lands under dry land or limited irrigation farming practices." Environmental Impacts: Report briefly discusses possible negative impacts associated with dry-up associated with noxious weeds (invasive species) preferentially taking over in dried areas.	Not discussed.	Previously irrigated fields tend to have buildup of salinity in the soils, which affects revegetation species options. Impacts to water quality from salinity not discussed.	Not discussed.	Nitrogen (N) and Phosphorus (P) levels in the soil affect revegetation viability. High N promotes weed growth over native or introduced species. Cover crops can reduce soil N through plant uptake. Soil can also be amended with high Carbon (C) to N amendments, mulches, or compost. Another option is to allow N to be naturally attenuated through weed uptake or leaching; this can have negative impacts to water quality.	Noted disadvantage of limited irrigation: "The water court transfer of a portion of the historical consumptive use, with the remainder left for limited irrigation, is difficult to decree and administer because of the maintenance of historical return flows and allocation of consumptive use to the water left for limited irrigation."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-14 Water Partnerships: an evaluation of alternative agricultural water transfer methods in the South Platte basin.	March-12	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199215&dbid=0	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte, focused on FRICO shareholders.	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte	Impacts to streamflow not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Return flows for FRICO shares had already been quantified. The 403 Decree [Case No. 02CW403] and the resulting ditch-wide change identifies consumptive use, storage decrees and capacities, recharge capabilities, and the timing of return flows, providing technical and water transfer information that is not typically available on irrigation delivery systems in Colorado.	In the survey of FRICO shareholders, one question asked if respondents are willing to sign a lease in which the water is used to maintain instream flows for river system recreation: 24.1% are willing, 48.3% are not willing. One question asked if respondents are willing to sign a lease in which the water is used to maintain wildlife habitat: 29.3% are willing, 37.9 % are not willing.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	The report notes the costs of storge for delayed return flows may deter municipalities from leases (they would favor permanent agreements due to the high overhead costs).	Not discussed.	Not discussed.	Not discussed.	Not discussed.	In the survey of FRICO shareholders, one question asked if respondents are willing to sign a lease in which the water is used to maintain instream flows for river system recreation: 24.1% are willing, 48.3% are not willing.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-15 Project Report: Lake Canal alternative agricultural practices and in-stream flow demonstration project	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=203045&dbid=0	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	Benefit: A goal of the project was to negotiate an interruptible water supply agreement that would yield consumptive use that would be used for stream flow enhancement in the Cache la Poudre River between the Lake Canal Co.'s river diversion (north of Fort Collins) and the Greeley No. 3's river diversion (west of Greeley). An agreement was not reached. Impact: it was understood that return flows would be replaced in time, amount, and location, thereby causing no negative impact to streamflow.	Impact: it was understood that return flows would be replaced in time, amount, and location, thereby causing no negative impact to streamflow.	Impact: it was understood that return flows would be replaced in time, amount, and location, thereby causing no negative impact to streamflow.	Once the amount of saved consumptive use water is documented, the Water Borrowers will influence the timing of the delivery to the Poudre River.	Not discussed	Return flows were quantified as part of the consumptive use analysis. For an average consumptive use in 2012 of 162.1 AF, the return flows (surface and sub surface) were estimated to be 108 AF. Surface return flow obligations were to be provided and measured during the course of the transfer. Temporary recharge pits were envisioned to be installed on each farm to meet subsurface return flow obligations in an easily defined manner. real-time measurement of return flows and transferrable consumptive use was proposed rather than relying exclusively on the results of a historical use analysis to determine transferrable consumptive use and return flow obligations.	A goal of the project was to negotiate an interruptible water supply agreement that would yield consumptive use that would be used for stream flow enhancement in the Cache la Poudre River between the Lake Canal Co.'s river diversion (north of Fort Collins) and the Greeley No. 3's river diversion (west of Greeley). The transferred consumptive use and surface return flow obligation would be left in the Cache la Poudre River. Water Borrowers desired for the transferrable consumptive use water to pass through Fort Collins. An agreement was not reached.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Participants need to outline all their needs/requirements at the onset of the negotiation process otherwise it could have unintended consequences. For example, late in the negotiation process, it was discovered that some river management elements (timing, volume, ecological benefits) had value added for some participants. These elements were never considered in the initial discussions. These elements added another layer of complexity to the water transfer and management.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Comments on the IWSA application to the SEO on behalf of the CWCB: ISF Section stated that it supported the efforts outlined in the IWSA proposal but had three comments related to C.R.S. §37-92-309: 1. Use of the term "in-stream flows" potentially creates confusion with their Instream Flow programs and protections. 2. The proposed exchanges could potentially extend to reaches of the Poudre River where CWCB holds instream flow rights. 3. Although CWCB does not hold instream flow rights in this vicinity, if it did it would be requesting more detail about the method of consumptive use	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-16 Final Report of the Lower South Platte Irrigation Research and Demonstration Project	Jun-14	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199218&dbid=0	Technical research paper with three tasks. Task 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. Task 2. Simplify the administrative burden of maintaining return flows. Task 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	Goals were 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. 2. Simplify the administrative burden of maintaining return flows, and 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	Potential benefit of Water Allocation Approach: The return flow assumptions are conservative and additional return flows may provide benefits to rivers and downstream users.	Not discussed	Not discussed	Not discussed	Not discussed	The goal of the allocation approach is to simplify and reduce the costs to administer a change use case and protect historic return flows even while maintaining some level of irrigation on the farm. In this approach, 100% of the historic return flows would be met with a secondary method (ie: constructed wetlands or recharge ponds) and the allowable diversion would be capped at the fraction of historic consumptive use kept for irrigation. The cap in diversion allocation guarantees the target CU savings and historic return flow, and the irrigator is allowed to fully consume the diverted water. From the perspective of return flow maintenance, the allocation approach is conservative because water diverted for irrigation that becomes return flow is additional flow above the requirement. This provides a net benefit to the stream if additional return flows are generated.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-17 RGWCD Net Annual Replacement Plans	Reports exist for each year. Reviewed report for April 13, 2020	https://rgwcd.org/sd-1-annual-replacement-plan	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc. Reviewed the 2020 Annual Replacement Plan (ARP), to meet requirements for the Plan Year under the provisions of the PWM for Subdistrict No. 1 decreed by the Division No. 3 Water Court in Case Nos. 2006CV64 and 2007CW52. This report describes a plan to remedy injurious stream depletions caused by the withdrawal of groundwater from Subdistrict Wells. This ARP includes a series of tables created by Subdistrict No. 1 staff and the RGDSS modeling team tabulating stream replacement quantities and locations resulting from Subdistrict No. 1 well groundwater withdrawals and a water portfolio to be used to replace such stream depletions.	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc.	Not discussed in report.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
ATM-18 Alternative Water Transfers in Colorado: A Review of Alternative Transfer Mechanisms for Front Range Municipalities	2016	https://www.edf.org/sites/default/files/alternative-water-transfers-colorado.pdf	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	The report identifies that a goal of ATMs in general is "to maintain or improve streamflow which support environmental and recreational activities" and that environmental interests can be involved in water transfers. "The instream flow benefits from diversion reductions are two-fold: (1) an increase in streamflow equal to the full diversion reduction between the canal point of diversion and the location of the return flows, and (2) an increase in streamflow equal to the consumptive use fraction between the location of return flows and all downstream reaches." Instream flow benefits of diversion reductions are only realized for the stream reach between the point of diversion and the location of return flows. Specific benefits and impacts are not discussed in this report.	Not discussed	Not discussed	Not discussed	Not discussed	The report mentions that in general, the water right holder is responsible to maintain historic return flow patterns and complete any other activities to ensure that all other (surrounding) water right holders are not impacted by the transfer or change.	The report identifies that a goal of ATMs in general is "to maintain or improve streamflow which support environmental and recreational activities" and that environmental interests can be involved in water transfers. Specific benefits and impacts are not discussed in this report.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	In the discussion of different transfer methods, the report mentions that "water rights may be temporarily leased to the Colorado Water Conservation Board to provide for instream flows. Such instream flow leases can occur for up to 120 days in a calendar year. The CWCB is required to adopt criteria and keep records of instream flow leases, and obtain a decree quantifying HCU for the water right." It also discusses briefly the possibility to use an interruptible water supply agreement for environmental instream flow uses.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

Exhibit B-7
SCPP Documents with General Criteria

EXHIBIT G

Title	Date	Publisher/Authors	Description	Notes
SCPP-01 System Conservation Pilot Program Secondary Benefits: Final Report with Case Studies	2019	WestWater Research for TNC	This case study report looked at whether the reduction in consumptive use in SCPP projects also generated off-farm benefits by applying select methods to quantify off-farm benefits to two case studies in Colorado and Wyoming. Note from TNC: An executive summary is also available, along with a more detailed report that outlines the framework for assessing secondary impacts/benefits and the associated methodology for quantifying or evaluating each impact/benefit.	Benefits assessed include increased environmental flows, decreased cost of alternative habitat flow restoration projects, societal benefits from habitat flows for endangered species, estimates of dramatic savings in salinity control, and municipal and hydropower benefits. Increased flows for the evaluated Colorado projects contributed minimal improvement to recreational flow needs. Cost savings were estimated by the cost of existing augmentation plans used to meet environmental and salinity management needs.
SCPP-02 Infographic: Grand Valley Pilot Project Secondary Benefits	2019	TNC	This infographic summarizes the results of secondary benefits analysis as applied to the Grand Valley Pilot Project Case Study.	Grand Valley Pilot Project paid farmers to voluntarily reduce their irrigation water use in order to keep more water in the river to help increase water security within the Colorado River Basin in the face of ongoing drought. While focus was on water security several off-farm benefits occurs because of the project.
SCPP-03 Research Synthesis: Agronomic Impacts of Reduction Irrigation	2019	Culp and Kelly for TNC	This memo reviews research on fallowing and limited irrigation to highlight key findings related to agronomic impacts of limited irrigation or other methods to reduce consumptive use of irrigation water in the Upper Colorado River Basin. The concluding section also identifies remaining research questions and suggests potential implications and possible next steps for a demand management program. The appendix summarizes the parameters of several of the studies reviewed. All of the referenced reports and publications are available on request.	Reviews methods and findings of existing research on agronomic impacts of limited irrigation in the following categories: yield, quality, water use efficiency, recovery, soil health, weeds/diseases/pests, and ag operations. Next steps and identified research needs include understanding impacts over a variety of geographies and crops, as well as long-term recovery. Management and operations needs include understanding the benefits of rotational fallowing, deficit irrigation, and crop switching. Finally, there are many needs in the verification of conserved consumptive use.
SCPP-04 Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin	2018	Upper Colorado River Commission	Full SCPP report from UCRC; project list; Lessons learned: administration & implementation, operational, cost/benefit/risk, legal constraints, outreach & education.	List of future questions to be answered p4
SCPP-05 Final Report: Appendix C: 2018 System Conservation Pilot Program Update	2018	Upper Colorado River Commission	2018 update to UCRC full report, including Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Document includes Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)
SCPP-06 Pilot Program Funding Agreement	2014	Bureau of Reclamation	2014 SCPP funding agreement between CRB entities	Reviews history of compacts, storage allowances, demand management efforts by signatories. Defines goals and parameters of SCPP. Identifies NRCS programs that might support on-farm conservation improvements: EQIP and SWEP & ensures that projects will coordinate with respective NRCS State Conservationists.
SCPP-07 Colorado River Water Bank Feasibility Study: Phase 1	2012	Colorado River Water Conservation District	Water bank planning phase; conservative estimate of potential WB supplies, and demand for those supplies.	Includes potential WB uses, supply, magnitude & frequency of need, supply-use scenarios. App. A: categories of W/E slope water uses, App. B: CRC WB Feasibility Study Water Supply Technical Memo, App. C: Eval of CRC WB Hydrologic Scenarios w/UCRB model, App. D: Basic supply & use comparison scenarios for CRC WB technical memo
SCPP-08 Colorado River Water Bank Feasibility Study: Phase 2	2013	For Colorado River District. By MWH.	Water bank planning phase; test cases assessing on-farm impacts for representative irrigation systems	Includes candidate systems, screening criteria & selection, site visits for system evaluation, financial impacts on ag ops, operational scenarios & comparison to ATM work. App. A: Candidate system identification & evaluation; App. B Test Case site reports
SCPP-09 Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)	2012	Natural Resources Consulting Engineers, Inc	Technical analysis for water bank feasibility study, included in 2012 WB planning phase 1 report .pdf	Data section includes analysis, irrigated areas, water rights categories, and climate stations. Examined CU requirements (w/StateCU & Blaney-Criddle), ET verification (Penman-Monteith w/4 CoAgMet stations), and HCU (StateCU values for elevation bands in each division multiplied by irrigated acres). Water bank supply and cost: "fallowing suitable for small grains, grain corn, & dry beans." Deficit Irr available for all crops but best suited to alfalfa & pasture. "These crops combined account for over 98% of the acreage, irr CU, and supply-limited CU." Discusses split-season irrigation.
SCPP-10 Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado	2019	MacIlroy, Colorado State University	This report was designed to assist in identifying and better understanding the socio-cultural components of a potential demand management program. The research, completed in Spring 2019, explored perceptions of demand management among stakeholders on the Western Slope through individual interviews and focus groups. The findings shed light on the barriers and opportunities for a demand management program, including ideas and feedback on what a successful program would look like, and why water users may or may not want to participate. **An executive summary is also available.**	This is an interview-based report that covers perceptions of DM, definitions of voluntary, compensated, temporary, and equity (their words are proportional/parity)--and finds that these definitions are not straight-forward and must be carefully communicated. Explores relationships with water and landscape, as well as "sacred values of the Western Slope." Addresses perceptions of DM in context of 2007 Interim Guidelines and broader basin-to-basin politics. Many interviewees doubt the viability of a voluntary compensated program, and even suggest that a mandatory uncompensated call would work better, avoid equity issues, and cost less overall. Compensation was a very challenging topic, with differing views of DM as a burden vs opportunity. Highlights clash of free-market values with the perspective of water as a commodity--discussion of different role water plays for irrigators vs Front Range residents. Who bears responsibility to pay--who is responsible for the shortage problems (many don't see the Upper Basin at fault). Temporary program vs temporary participation--fraught discussion. Discussion of Western Slope Sacred Values, how water and farming is part of identity. Numerous people suggested every water user curtail use and respect water and that we should make water conservation part of being a [illegible]
SCPP-11 Briefing Paper: Upper Basin Demand Management and Water Banking. Addressing Risk and Creating Certainty: Exploring Options for an Upper Basin Demand Management Program	2019	TNC	This briefing paper provides a general background on the DCP and demand management. It frames the key issues to address in evaluating a demand management program and is offered in the spirit of promoting discussion and decision-making on how to structure, govern, finance, and implement such a program.	Briefly evaluates Upper Basin risk based on drought hydrology, and discusses how to reduce that risk. Asks many questions about Dm, program governance and structure, cost and funding, policy, measurement and verification. Identifies many of the key issues being addressed by CWCB DM workgroups. Key successes from SCPP are locally-driven solutions, minimizing impacts & maximizing benefits, e.g. through local coordination of projects. Tabulates past options considered for avoiding compact curtailment.
SCPP-12 Colorado River Water Bank Work Group: An Overview of Previous Studies & Reports	2018	Colorado River Water Bank Working Group	This overview documents summarizes the studies completed by the Colorado River Water Bank Work Group in their effort to provide information about what types of solutions may be available to preserve communities, agriculture, power production and the river itself.	This work includes a two-phase feasibility study, an assessment of how reduced irrigation for compact purposes would work with different irrigation systems on Colorado's West Slope, economic work on pricing and payments, and scientific research on the agronomic impacts of reduced irrigation.
SCPP-13 GVWUA Final Report on the Conserved Consumptive Use Pilot Projects	2019	GVWUA and J-U-B Engineers	This report provides a summary of the 2018 and 2019 Conserved Consumptive Use Pilot Projects completed by the Grand Valley Water Users Association (GVWUA). The initial part of the report provides a good summary of both the 2017 and 2018 pilots. Appendix H provides the details of the survey GVWUA completed of all participating producers, gathering their input on their experience and perspectives on the pilot project. Appendix I summarizes GVWUA's thinking more broadly on the pilot and demand management.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land
SCPP-14 Lessons Learned from the System Conservation Partnership Program	2016	The Nature Conservancy	TNC's lessons learned in their SCPP involvement, including lessons from Trout Unlimited and Colorado Water Trust	Top 3 lessons: outreach & communication is essential, operational & legal issues must be addressed at ditch company/irrigation district level simplify the process for efficiency.
SCPP-15 Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows	2011	Hydro Consulting for TNC	Evaluation of computer models of the Gunnison River to assess their ability to simulate a potential water bank in the basin using the Aspinall Unit reservoirs and the effect on reservoir operations, including environmental flows	StateMod, Aspinall PBO/EIS Model, and CRSS are evaluated for their capabilities to simulate Aspinall Unit operations, environmental flows, and potential water-banking. Specifically, this modeled the Black Canyon water right, new ESI/PBO requirements at the Whitewater gage, and a water-banking option at Aspinall. Modifications to the Gunnison StateMod are necessary to simulate environmental flows and enhance reservoir accounting options.
SCPP-16 Environmental Water Transactions in the Colorado River Basin: A Closer Look	2018	Stanford Woods Institute for the Environment	Reviews CRB environmental transfers to track extent of activity. Examines SCPP projects by this lens, given the ISF benefits of SCPP. Found that SCPP-funded projects had the effect of enhancing streamflow.	Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.
SCPP-17 Lower Colorado River Basin Pilot Program	NA	Bureau of Reclamation	Webpage with tables of projects from each pilot phase	"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."
SCPP-18 System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin	2017	Wyoming SEO Callaway, AWRA Impacts magazine	Description of Wyoming SCPP, how it works, participation, and future efforts.	Neither extensive nor technical, but includes some description of process & participation.

Title	Primary Purpose / Goal of Report / Study	Key Takeaways (Related to Objective / Goal)	Project Location Information: Project Location(s) Description	Latitude	Longitude	Elevation (feet)	DM Program Basics: DM Program/Activity Name	DM Program Structure	Nature of DM Practices	Duration of DM Practices Implementation (Program Duration and Frequency)	Source and Amount of Conserved Water: Source of Water Conserved	Amount of Water Conserved-Conserved Consumptive Use (CCU)
SCPP-01	"This project explores whether the reduction in CU provided by the SCPP also generates off-farm benefits in addition to the 'system' water." Also seeks to quantify the economic benefits of two SCPP project case-studies. The benefit sectors evaluated in this memorandum for the two case-studies include the following: 1. Environmental 2. Recreation 3. Hydropower 4. Salinity 5. Municipal	Grand Valley Project - Hydropower benefits of close to $10,000 resulted from the dedicated diversion of CU savings to the Grand Valley Power Plant. - Environmental benefits of about $23,000 were estimated because of the management efforts and obligations defined under a recovery program for T&E fish species in the 15-mile reach directly below the project diversion point. - Salinity benefits of over $280,000 were the most surprising benefits evaluated in this study and should be further verified. - In total, off-farm benefits of the Grand Valley project were estimated to total $315,710, which is equivalent to approximately $99 per acre-foot of conserved water and approximately 30% of total project costs. Middle Piney Creek Projects - Hydropower benefits were estimated to be insignificant because of the operation plans for the two downstream reservoirs. - Environmental benefits for T&E species are focused on the Green River below Flaming Gorge Reservoir, and reservoir outflows would be unchanged. Local environmental benefits in Wyoming were evaluated but not quantified. - Salinity benefits were estimated to be negligible because the project is not located in a defined salinity management area under the Salinity Control Program. - Recreational benefits were estimated to be approximately $600, dependent upon the level of recreational access below the project location. This $600 benefit represents $0.44 per acre-foot of conserved water and 0.2% of project costs.	-Grand Valley (CO) -Middle Piney Creek (WY)	CO: 39.189107 WY: 42.514320	CO: -108.280763 WY: -110.234874	CO: 4793 WY: 7097	System Conservation Pilot Project in the Upper Colorado River Basin	SCPP is an effort initiated by the USBR with several large municipal water providers to conduct water lease agreements with water users within the Colorado River Basin to generate water to benefit reservoir elevations in Lake Powell and Lake Mead. GVWUA held a voluntary lottery for producers to participate in 1 of 4 program activities. A total of 10 participates were selected based on overall funding for the Grand Valley CCUPP.	FF - Full Season Fallow WW - Irrigation after 10/1 SS - Irrigation after 9/1 AA - Irrigation after 8/1	Colorado River: 2017 Middle Piney Creek: 2015 - 2016	Colorado River (CO), Piney Creek (WY)	Grand Valley Project: 3,226 AF CCU Total, see Table 2. Middle Piney Creek: 133 CCU Total in 2015, 1,347 AF CCU Total in 2016, see Table 6.
SCPP-02	Infographic to put monetary benefits [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Title	High Level Program Structure: DM Program Administration	DM Program Monitoring & Verification Considerations	DM Program Education and Outreach Efforts	Tools Used to Measure General Outcomes	DM Program Funding Considerations	DM Program Economic Considerations	DM Program Agricultural Impacts Considerations	Recreation	Program Effectiveness: Program Lessons Learned	Identified Program Successes and/or Challenges	Program Pros/Cons
SCPP-01	Not discussed.	Not discussed.	Not discussed.	Streamflow data (USGS gages) GVWUA diversions were measured at the Roller Dam and Power Canal to measure participants supply used at the Grand Valley Power Plant and returned at the top of the 15 Mile Reach.	Funding for the Grand Valley Project came from SCPP and other funding sources. Funding for the 2 ranches DM activities near Middle Piney Creek came from SCPP.	In total, off-farm benefits of the Grand Valley project were estimated to total $315,710, approximately $99/AF of CCU, approximately 30% of total project costs. In total, off-farm benefits of the Middle Piney Creek projects were estimated to total $600, approximately $0.44/AF of CCU, approximately 0.2% of project costs	Not discussed.	CO: Rafting, kayaking. WY: Fishing. "This analysis of recreational benefits resulting from the Grand Valley conservation project focuses on recreational river boating along the Colorado River downstream from the Grand Valley Power Plant discharge into the Colorado River near Palisade, CO." "The focus of [the Middle Piney Creek] analysis is on fishing because rafting and kayaking on Middle Piney Creek and the Green River downstream are not considered as popular recreational activities." "Average year recreational benefits of the Middle Piney Creek project are estimated to be $605, while dry year benefits double to $1,122." "Increase in the number of fishing trips: A search of the literature indicated that a 1980 study on the effect of Middle Piney Creek. The 1980 study showed that angler days would be expected to increase with increases in streamflow up to a maximum angler use at about 65% of bank full. If streamflow increased beyond that point, the study estimated angler use tapered off slowly with angler use being about two-thirds of maximum at bank full streamflow. This quadratic relationship was also found for wading anglers on the Fryingpan River in western Colorado."	- Off-farm benefits range from municipal, hydropower, environmental, salinity, and recreation. - For boating and fishing, the value of water is not only related to the amount of water, but the timing of water. - The size of the two projects (generally) did not provide a measurable benefit in many of the sectors analyzed. - Scaling up of the projects would have generally resulted in more measurable benefits in many of the sectors analyzed. - Surprisingly the biggest benefit achieved came from the reduction in salt load associated with the Grand Valley Project. - The size of the two projects would have had a more measurable benefit had the activities taken place in a dry year like 2002. - Hydropower benefits were assumed to be zero if the inflows into power generation stations if the baseline plus project water exceeded the power generation stations' maximum capacity.	Successes: The GV CCUPP had several off-farm benefits: - Hydropower benefits of $9,950. - Environmental benefits of $23,040. - Societal benefits of $88,600. - Salinity benefits of $287,720. Challenges: - The Middle Piney Creek Project had minimal off-farm benefits. Shepherding and/or administering of CCU to Lake Powell was not possible. - Projects had little to no increase in the levels in Lake Powell.	Pros: - Off-farm benefits were measurable and achieved for the Grand Valley Project. - Recreational and environmental benefits can be achieved by increasing late-season flows. - Off-farm benefits showed the ability to offset program costs. Cons: - Off-farm benefits were negligible for the Middle Piney Creek projects. - Upscaling of the projects would be necessary to significantly impact Lake Powell lake levels. - Water could not be shepherded and/or administered down to Lake Powell.
SCPP-02	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

EXHIBIT G

Title	Date	Publisher/Authors	Description	Notes	Primary Purpose / Goal of Report / Study	Key Takeaways (Related to Objective / Goal)
SCPP-19 SNWA Water Resource Portfolio	2019	Southern Nevada Water Authority	Chapter from SNWA's water plan	Addresses temporary supplies including different aspects of Intentionally Created Surplus, recharge and banking, DCP, and conservation tools.	The paper describes Southern Nevada Water Authority (SNWA)'s water resources portfolio, including: Permanent Resources, Temporary Resources, and Future Resources.	Permanent Resources include: Colorado River supplies (including return-flow credits); Tributary Conservation Intentionally Created Surplus (ICS); permitted groundwater rights in the Las Vegas Valley; and reclaimed water. Temporary Resources (defined as banked water) include banked water locally and through banking agreements with other states: Southern Nevada Water Bank, California Water Bank, Arizona Water Bank, Intentionally Created Surplus. Future Resources ("defined as those resources expected to be available to SNWA at some point during the planning horizon") include: Desalination, In-State Groundwater, Virgin River/Colorado River Augmentation, Transfers/Exchanges. Water Conservation is also discussed.
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	2017	WestWater Research for TNC	This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different approaches to developing a water bank. The information is intended to provide concepts and preliminary numbers for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.	Evaluates 4 frameworks of a Colorado Basin water bank sufficient to address 250,000 AF of CCU: annual water bank leases, option leases in critical years, non-option critical year leases, and response to a 1922 compact call. WestWater Research developed a cost-estimation spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.	Estimate costs of a water bank under four frameworks which model how a Colorado Basin water bank would operate at a scale sufficient to address 250,000 AF of demand management (or consumptive use reduction) in the State of Colorado from Western Slope agriculture : 1. Avoidance #1 - Annual Water Bank Leases. 2. Avoidance #2 – Option Leases in Critical Years. 3. Avoidance #3 – Critical Year Leases. 4. Response to Compact Call.	-"The total cost of water leasing is significant, with the important assumption that 250,000 AF would need to be leased from the Colorado Western Slope over a 25-year period." -"If the M&I water rights were to attempt to conduct water leases in response to a Compact call, this analysis shows that such an effort could be more expensive than a proactive approach." "The total costs can be divided as process costs and water costs." "some contract mechanism is likely required to keep lease rates low during a drought period, when water supplies will be stressed."

Title	Project Location Information: Project Location(s) Description	Latitude	Longitude	Elevation (feet)	DM Program Basics: DM Program/Activity Name	DM Program Structure	Nature of DM Practices	Duration of DM Practices Implementation (Program Duration and Frequency)	Source and Amount of Conserved Water: Source of Water Conserved	Amount of Water Conserved-Conserved Consumptive Use (CCU)
SCPP-19 SNWA Water Resource Portfolio	Southern Nevada with references to a California and Arizona Water Bank	N/A	N/A	N/A	This is not a specific DM program but rather a review of SNWA's portfolio and the steps SNWA has taken to improve water demand and the availability of water in future years.	Not discussed.	Generally reviews water banks set up by SNWA. "The Lower Basin States will begin making DCP contributions when the elevation of Lake Mead is projected to be at or below 1,090 feet. Contribution amounts vary by state and are based on Lake Mead water levels. Nevada's DCP contribution ranges from 8,000 to 10,000 AFY. This volume of water is in addition to any mandatory reductions associated with a federally declared shortage. Mandatory shortage reductions cannot be recovered." "DCP ICS credits are not available in years when the elevation of Lake Mead is projected to be at or below 1,025 feet."	Varies. Review includes all of SNWA's water resources portfolio, which includes water banked under different conditions.	Varies.	"As of 2018, SNWA has more than 335,000 acre-feet of water stored in the Southern Nevada Water Bank for future use through an agreement with LVVWD. SNWA may recover water banked under this agreement in any water supply condition. This plan assumes a maximum recovery rate of 20,000 AFY" "As of 2018, Nevada has banked more than 330,000 acre-feet of water in California. This plan assumes a maximum recovery up to 30,000 AFY during normal and shortage conditions, subject to agreement terms." "The SNWA stored approximately 614,000 acre-feet of Colorado River water underground in Arizona's aquifers for SNWA's future use as of 2018. Additional water can be banked on a pay-as-you-go basis up to 1.25 million acre-feet. SNWA can recover up to 40,000 AFY during any water supply condition and may recover up to 60,000 AFY during a declared shortage."
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	Western Slope, CO	N/A	N/A	Varies	Not a DM program - Water Bank Framework Analysis	This was not a DM program. This analyzed 4 frameworks for leasing water - specifically the financial costs of water banking	Costing assumes "the annual leasing would be structured as a rotational fallowing program." with different structures under the four frameworks.	Not discussed - not a project but a study.	Agriculture	Not discussed - not a project but a study.

Title	High Level Program Structure: DM Program Administration	DM Program Monitoring & Verification Considerations	DM Program Education and Outreach Efforts	Tools Used to Measure General Outcomes	DM Program Funding Considerations	DM Program Economic Considerations	DM Program Agricultural Impacts Considerations	Recreation	Program Effectiveness: Program Lessons Learned	Identified Program Successes and/or Challenges	Program Pros/Cons
SCPP-19 SNWA Water Resource Portfolio	Not discussed.	Not discussed.	SNWA has performed extensive outreach and education opportunities to incentivize residents to remove unused turf to decrease the demand for municipal outdoor watering which cannot be recaptured and reused.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	SNWA has focused for years on water used outdoors and for cooling as that these uses cause the water to be lost to the system rather than be recaptured and possibly reused. SNWA has seen success by focusing on the following areas: - Remove unused turf - Change irrigation clocks to follow mandatory time-of-day and day-of-week watering restrictions.	Success: Outreach and education across all sectors in the community helped to improve efficiency and decrease truly consumptive water uses	Not discussed.
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	Not discussed - analysis of 4 water leasing frameworks. Includes administration costs of 4 full time employees and associated overhead	Not discussed - analysis of 4 water leasing frameworks. Includes costs for monitoring but not verification of the amount of CU water saved.	Not discussed.	Cost analysis of each framework.	Not discussed - does not describe funding sources. relative costs are determined for the different frameworks	Not discussed - concludes a framework to prevent spiking of costs of leased water during times of drought	Not discussed.	Not discussed.	This analysis displays the importance of a framework to keep water leasing costs stable during times of drought. Frameworks where leased water costs are not secured prior to drought show higher framework costs as 10%-15% of the modeled frameworks are direct water costs.	Success: The costs are lower in the annual water leasing framework (farms in the program would fallow once every 5 years) and the framework using options to lease water in critical storage years (years Lake Powell is low)	Not discussed.

Exhibit B-8
Lit (Gen. Literature) Documents with General Criteria

EXHIBIT G

							Project Location Information				DM Program Basics				Source and Amount of Conserved Water		High Level Program Structure										
																									Program Effectiveness		
Title	Date	Publisher/Authors	Description	Notes	Primary Purpose / Goal of Report / Study	Key Takeaways (Related to Objective / Goal)	Project Location(s) Description	Latitude	Longitude	Elevation (feet)	DM Program/Activity Name	DM Program Structure	Nature of DM Practices	Duration of DM Practices Implementation (Program Duration and Frequency)	Source of Water Conserved	Amount of Water Conserved- Conserved Consumptive Use (CCU)	DM Program Administration	DM Program Monitoring & Verification Considerations	DM Program Education and Outreach Efforts	Tools Used to Measure General Outcomes	DM Program Funding Considerations	DM Program Economic Considerations	DM Program Agricultural Impacts Considerations	Recreation	Program Lessons Learned	Identified Program Successes and/or Challenges	Program Pros/Cons
Lit-01 Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture	1999	Aillery et al, Marine Resource Economics	Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River	Investigates ag impacts of fish recovery measures "such as: modified timing for dam releases, reservoir drawdown, and flow augmentation in the Columbia River basin, on the regional agricultural sector are evaluated. [....] Results suggest that drawdown and/or minor reductions in irrigation water diversions would reduce producers' profits by less than 1% of baseline levels. However, the most extreme scenario--a long drawdown period combined with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."	Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River. "This paper presents an analysis of changes in profit from agricultural production under alternative salmon recovery measures. (Rather opposite of other DM literature, which analyzes impacts to Ag as primary and ecological impacts as secondary.)	Investigates ag impacts of fish recovery measures "such as: modified timing for dam releases, reservoir drawdown, and flow augmentation in the Columbia River basin, on the regional agricultural sector are evaluated. [....] Results suggest that drawdown and/or minor reductions in irrigation water diversions would reduce producers' profits by less than 1% of baseline levels. However, the most extreme scenario--a long drawdown period combined with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."	Columbia-Snake River Basin, ID, OR & WA	N/A	N/A	N/A	Augmentation of flows in the Snake-Columbia River Basin	Not discussed - looks at possible implications for ag by moving water from irrigation to instream flows to increase time/distance travelled by young salmon to the ocean.	Unlike other reports, this report describes the primary motivation for flow alterations as environmental (salmon recovery). Ag impacts are addressed as a consequence.	Seven scenarios of recovery measures presented in Table 2, page 28.	Idaho Water Bank and permeant water purchased by USBR	"Reclamation has been purchasing water in the upper Snake River basin since 1993. More than 57,500 acre-feet in permanent water rights and an average of 267,000 acre-feet of in annual leases from the Idaho Water Bank have been procured through voluntary transactions. Combined, these purchases total roughly 75% of the interim goal for flow augmentation of 0.427 maf. "	Analysis of economic impacts to ag for possible scenarios to improve salmon and steelhead populations in the Snake-Columbia River Basin.	Not discussed - analysis of economic impacts to ag for possible scenarios to improve salmon and steelhead populations in the Snake-Columbia River Basin.	Not discussed - analysis of economic impacts to ag for possible scenarios to improve salmon and steelhead populations in the Snake-Columbia River Basin.	Not discussed - analysis of economic impacts to ag for possible scenarios to improve salmon and steelhead populations in the Snake-Columbia River Basin.	As the USBR has stated reductions in agricultural deliveries would need to be voluntary and would thus need to be compensated by the federal government at a level high enough to cover profit losses	Figure 2 summarizes the percent change in profit for each of the 7 scenarios of reservoir drawdowns and/or flow augmentations. Decreases in producer profits for the region are as follows: Scenario 1 (Core management measures which were already set for implementation in 2000) - 0.15% Scenario 2 (Flow augmentation (low flow))- 0.27% Scenario 3 (Flow augmentation (high flow)) - 2.38% Scenario 4 (Reservoir draw down (2 month)) - 0.33% Scenario 5 (Reservoir draw down (4.5 month)) - 0.67% Scenario 6 (Flow augmentation (low flow) and Reservoir draw down (2 month)) - 0.46% Scenario 7 (Flow augmentation (high flow) and Reservoir draw down (4.5 month)) - 2.77%	The analysis considers which crops would be most heavily impacted (specifically higher-valued specialty crops which have a lower profit margin), which areas would be most impacted (the Idaho portion of the Snake River Basin), and the specific impact to profits. Other than impacts to lost profits from crop sales, the analysis also considered increased power costs due to lower hydroelectric outputs and increased shipping costs due to impacted barge transportation were included in the profit impacts.	Not discussed.	Not discussed.	Not discussed - an analysis of possible scenarios to improve salmon and steelhead populations.	Not discussed - an analysis of possible scenarios to improve salmon and steelhead populations.
Lit-02 Feasibility of water efficiency and reuse technologies as demand-side strategies for urban water management	2017	Berhanu et al, Journal of Industrial Ecology	Economic model of water cost provided by above-code water efficiency and reuse technologies, including variations & uncertainty analysis.	Estimates that efficiency and reuse can meet 85% of 50yr projected needs to the Lower Colorado River Authority service area (central TX)	- "Estimate the technically feasible levelized cost of water provided by seven above-code water efficiency (i.e., beyond that required by building code) and reuse technologies." - Model uncertainty and variation in technology adoption cost and performance ..... differentiate between new construction and retrofits. - Developed a conservation supply curve to compare the levelized cost of efficiency and reuse technologies with conventional supply-side water management strategies.	"- We estimate that efficiency and reuse in the residential sector can meet 85% of 50-year projected needs (the difference between projected demand and estimated supplies) for the LCRA service area. - We also estimate lower levelized costs for immediate retrofits of most technologies, promoting incentives for early technology adoption. - The fraction of demands met by demand-side strategies range from around 60% to 100%. Occupancy drives much of the variability because it significantly affects demand. - Water-efficient showerheads and bathroom faucet aerators perform well over a variety of assumptions, indicating that these technologies should be a priority for	Lower Colorado River Authority service area (central TX)	30.294	-97.782	550	Demand-side management for urban water management	Not discussed.	Municipal demand-side management strategies: - 5 "above-code" (water use efficiency beyond that required by building code) efficiency - 2 reuse technologies (household rainwater harvesting and integrated toilet-sink devices)	Not discussed.	Municipal demand management activities	Not discussed.	Not implemented; studied by the Lower Colorado River Authority (LCRA)	Not discussed.	Not discussed.	No assessment for environmental impacts associated with this specific study for the 2012 State Water Plan for Texas includes a high-level assessment of environmental impacts of all recommended and alternate water management strategies for Texas	Studied the levelized costs for technologies in a "replace-immediately" scheme versus a "replace-as-retire" scheme	Studied the levelized costs for technologies in a "replace-immediately" scheme versus a "replace-as-retire" scheme	Not discussed.	Not discussed.	This study highlighted demand-management options to traditional water supply provisions and developed a supply curve to guide economically efficient incentive programs that achieve optimal water savings. Also recognized was the need to understand the potential indirect effects on efficiency and reuse technologies with environmental considerations (e.g., increase demand for technologies could increase greenhouse gas emissions through production, avoided importation, desalination, and recycling supply-side projects can drive more advanced water treatment, which typically have higher energy usage).	Not discussed.	Studied the levelized costs for technologies in a "replace-immediately" scheme versus a "replace-as-retire" scheme Recognized further studies will be needed and the need to understand environmental impacts
Lit-03 Response to water crisis: How do Iranian farmers think about and intent in relation to switching from rice to less water-dependent crops?	2019	Boazar et al, Journal of Hydrology	Study of farmer response to gov't demand management, switching crops.	"Structural equation modeling showed that farmers' intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations."	Estimate costs of a water bank under four frameworks which model how a Colorado Basin water bank would operate at a scale sufficient to address 250,000 AF of demand management (or consumptive use reduction) in the State of Colorado from Western Slope agriculture : 1. Avoidance #1 - Annual Water Bank Leases. 2. Avoidance #2 – Option Leases in Critical Years. 3. Avoidance #3 – Critical Year Leases. 4. Response to Compact Call.	"To achieve our goal, we used a social psychological theory known as the Theory of Interpersonal Behavior. A sample of 250 rice growers in southwest Iran was selected. Structural equation modeling showed that farmers' intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations.	Iran	N/A	N/A	N/A	Demand-side management	Voluntary	Switching to less water intensive crops (banning rice growing, as a water intensive crop).	Not discussed.	Agriculture	Not discussed.	Iranian Minister of Energy (goal); "head of the environmental organization"	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Water is cheap in Iran but the value of rice is high (and a big water demanding crop)	Not discussed.	Not discussed.	Farmers in Iran feel an obligation to conserve water by switching from rice to less water-dependent crops; The more a farmer perceives his activities as a moral obligation to save water, the greater his intention will be to engage in a high level of water conservation behavior	Farmers in Iran feel an obligation to conserve water by switching from rice to less water-dependent crops; The more a farmer perceives his activities as a moral obligation to save water, the greater his intention will be to engage in a high level of water conservation behavior	The report implies that being a "water saver" in the Iranian culture is something that will influence behavior and is a strong moral component for considering changing crops. Report provides a suggestion to consider a positive, self-rewarding feeling to motivate
Lit-04 Temporary water transfers for urban water supply during drought	1992	Clark, CSU	PhD dissertation modeling options for temporary water transfers	"This research develops a water right option agreement (WROA) model, methods of analysis, and legal implementation strategy under Colorado law." Interviewed professionals, estimates costs, identified that WROA "can be superior in terms of cost, reliability, and operational flexibility to both water-right purchases and construction of additional reservoir storage.	"The objectives of the research are to: I) identify the variables which determine the feasibility of the WROA [water rights option agreement] for urban water supply, 2) locate any existing WROA applications, 3) formulate a WROA model by examining technical, legal, and operational factors, and 4) perform a case study to evaluate the WROA model and analysis methodology. The perspective of the investigation has been from the viewpoint of the municipal water utility.	"Results of the analysis of alternative dry-year supply scenarios suggest that the WROA can be superior in terms of cost, reliability, and operational flexibility to both water-right purchases and construction of additional reservoir storage." Findings: "1) During the 1976-1978 Colorado drought short-term water transfers were the most widely used method for obtaining additional water during shortage. 2) Seasonal temporary water transfers are routinely done in several areas of the state. 3) The use of long-term agreements for temporary water transfers is not widespread. 4) There is risk in entering WROA because of potential challenge by objectors. 5) Criteria govern the decision-making process for dry-year water supply. These criteria are water supply reliability and control of the source, customer satisfaction, cost of water supply, and operational limitations of water supply alternatives. 6) Recent research of water supply reliability and water consumer preferences indicates that risk of system failure may be viewed differently by utility management	General study of Colorado. Case study: Greeley CO, Boyd Lake System				Not discussed.	Referenced a drought water supply plan as a proposed framework for implementing a water right option agreement (WROA). The drought water supply plan would be submitted to the State Engineer's Office (SEO) for review and approval under existing Colorado statutes.	Temporary transfers from Agriculture using a Water Right Option Agreement (WROA).	Temporary; drought-driven	Agriculture	Not discussed.	Explores possibilities for Colorado: - Ad hoc agreement fashioned by engineers, lawyers, and the parties water court decree - Drought water supply plan (implemented under Colorado statues (37-92-101 to 37-92-602) and (37-80-120 C.R.S.)	Not dicussed - focuses on economics and funding.	Conducted water manager interviews and conducted consumer surveys and customer satisfactions surveys	- Included a discussion on the Senate Bill 89-181 and the rulemaking by the SEO to implement water quality standards in review of water transfers - Mentioned the use of the mass balance method or the mixing zone method to estimate the influence of flow on water quality standards	The report focuses on funding factors and has a wealth of information	The report focuses on economic factors and has a wealth of information	Not discussed.	Not discussed.	Use of short-term leases as a RESPONSE to drought is not recommended (could cut the cost of a drought but only if water is available at a price the city can afford) The use of the WROA requires more consideration of forecasting methods. The purchase of surplus water rights can be characterized as inefficient due to the necessity to manage the extra water in most years.	Not discussed.	Not discussed.
Lit-05 Flexible water allocations and rotational delivery combined adapt irrigation systems to drought	2018	Cody, K.C., Ecology and Society	Water allocation experiment in San Luis Valley, Colorado for self-governing irrigation systems.	Examines relationships between rules and physical context of water supplies; specifically the outcomes of water allocations between members and how they rotate water delivery.	Focuses mostly on the equity implications of different rules on delivery to head-of-ditch vs. end-of-ditch users. "...during water shortage self-governing irrigation systems often change water allocations between members and rotate water delivery. However, it is unclear how these rules interact with each other as configurations and with contextual factors, such as the degree of water scarcity. It is also unclear how these rules influence outcomes between irrigators closer to the water source and those farther from it. How might different configurations of rules interact with water availability to produce outcomes along an irrigation system's canal network? This study addresses this question by exploiting a natural experiment in water distribution and allocation rules during shortage among a stratified sample of 60 snowmelt dependent irrigation systems in the San Luis Valley of	A key finding was the combination of rotational delivery and flexible water allocations produces the most equal crop growth between irrigators at the head and tail of the irrigation system at all levels of water availability. The marginal productivity of water at the head and tail end of irrigation systems at all levels of water availability is also equalized under this configuration. These results suggest a greater likelihood of ongoing collective action, important for climate change adaptation. However, rotation with flexible allocations is outperformed by other configurations depending on context.	San Luis Valley (SLV), Rio Grande Basin, Colorado. 700 active self-governing irrigation systems.	37.434331 W	-105.866664 N	7000	Common Pool Resource (CPR) governance and influence of irrigation performance of shortage sharing and delivery methods during drought.	Not discussed.	"Two common drought responses of irrigation systems, (1) water delivery via rotation and (2) shortage sharing, in four configurations: rotation with shortage sharing, rotation without shortage sharing, simultaneous delivery with shortage sharing, and simultaneous delivery without shortage sharing." - Irrigation performance as a result of these irrigation system approaches were determined by applying a regression analysis across numerous variables (Table 1 and Figure 2) to determine if field-level outcomes such as irrigated, fallowed, percent irrigated, or the NDVI could be used to inform irrigation systems governance.	Four-year drought period from 2011-2014	Agriculture	Not discussed.	Local self-governance (water allocation and water distribution rules).	Few gates and gages are in use along the San Luis Valley irrigation systems (by "eye").	- Surveyed 60 irrigation system leaders in 2013 to assess rules in use and other irrigation system features (stratified sample). - Annual meetings inform the collective choice rules of the irrigation systems, operational rules of allocation and delivery. Selected through majority vote, consensus, inherited tradition, hegemonic behavior of powerful irrigators.	- Compiled data from various public sources (Colorado Department of Natural Resources' Rio Grande Decision Support System), United States Geologic Survey, and Google Earth Engine [Normalized Difference Vegetation Index (NDVI) and elevation raster]. - Variables listed in Table 1 and Figure 2 were used in a regression analysis to inform field-level outcomes including irrigation performance (irrigated or fallowed; percent irrigated or NDVI).	Not discussed.	The study recognized a lack of available direct data on the wealth available to irrigation systems or individual farmers.	Not discussed.	Not discussed.	- The lack of farm-level data limited the ability to understand the farm-level effects (of the irrigation system practices). - A lack of wealth data to the irrigation systems or individual farmers limited the ability to understand the farm-level effects (for instance the money to support maintenance and operation of the irrigation system). - Shortage sharing can result in worse performance of the systems, overall, and for tail-end users in particular, if rotation is not employed. - Shortage sharing, however, produces benefits overall, when coupled with rotational delivery and improves equality between head-end and tail-end users.	- The study advances the literature by considering the combined effects on irrigation performance of shortage sharing and delivery method. - The study determined that rotational delivery with shortage sharing was the most robust institutional configuration (of those examined). This provided the most equality between head-enders and tail-enders overall and had positive marginal productivity up and down the canal at all levels of water availability. - The rotational delivery with shortage sharing also appeared to be well-suited for systems large and small, growing a wide array of crops, with different social and cultural norms, and various technological and infrastructural mixes.	- Governance rules need to consider hydrologic context, equity, and social norms when experimenting with the implementation of irrigation system rules (and adoption of them).
Lit-06 Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity	2017	Colby (Ch. 3.1.4), Book eds Ziolkowska & Petersen	Chapter from book "Competition for Water Resources: Experiences and Management Approaches in the US and Europe" collecting global examples/discussion of approaches and solutions to water supply scarcity, including western US	Ch 2.1.1: Challenges for US irrigated ag in the face of emerging demands and climate change, Ch 3.1.4: Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity (reviews online trading systems to reduce transaction costs, methods for cost-effective verification of CCU, and other breakthroughs facilitating temporary & intermittent trading more feasible. Examples from AZ and CA (IID), NE, Australia, CO-Big Thompson.	"This chapter describes initiatives focused upon reducing agricultural CU to achieve specific surface flow changes, emphasizing electronic water trading initiatives and the role of baselines in measuring and monitoring changes in CU."	"Water trading programs continue to evolve where economic motivation for trading is strong. - Legal mandates to protect species and habitat and to comply with surface water sharing compacts and treaties have spurred an emphasis on finer measurement and monitoring of reduced CU on irrigated land to produce temporally and spatially specific changes in stream flows. - Online water trading is quickly becoming the norm in newer trading programs. - Seasonal and temporary transfers of water are particularly vulnerable to being rendered infeasible because of high transaction costs. - Cost-effective verification of stream flow changes linked to trading and low transaction cost procedures to negotiate and implement trades have made temporary and intermittent arrangements to reduce CU feasible in many areas. This is particularly helpful to assuring flows for environmental needs and for recreation, uses in which water's value varies significantly with specific locations	United States and Australia. Specific programs discussed in CA, AZ, NE, and Murray-Darling Basin of Australia	Several project locations across several states discussed in this paper.	Several project locations across several states discussed in this paper.	Several project locations across several states discussed in this paper.	An analysis of water trading markets	Not discussed.	Suspending irrigation for an entire year on a field that has a documented history of regular irrigation, "regulated deficit irrigation", Seasonal (rather than year-round) suspension of irrigation	Varies. Some trading is permanent, some is temporary.	Agriculture	Not discussed.	Not discussed - considers trading markets	M&V in trading markets is driven by compliance with legal mandates for environmental protection and surface water sharing compacts. Remote sensing appears to provide a good fit to aid in M&V.	Not discussed.	Not discussed.	Not discussed	The advent of internet based trading systems and have improved the ease of trading. Auctions have also allowed sellers and buyers to set "reserve" prices and keep costs from dipping low from competition. Internet trading platforms have generally been private but with the push from public entities, this could change.	Not discussed.	Not discussed.	- Where "economic motivation for trading is strong," trading programs continually improve. - "Seasonal and temporary transfers of water are particularly vulnerable to being rendered infeasible because of high transactions costs."	Success: - "Legal mandates to protect species and habitat and to comply with surgace water sharing compacts and treaties have spurred an emphasis on finer measurement and monitoring of reduced CU on irrigated land to produce temporally and spatiallly specific changes in stream flows. Challenge: - Cost-effective verification will be needed to lower transaction costs	Not discussed.
Lit-07 Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling	2016	Dubinsky, CU Denver	PhD dissertation that identified San Luis Valley sustainability indicators and modeled future scenarios, developing a CU indicator for 1980-2010. Conducted scenario modeling to guide decision-makers towards desired outcomes from policy decisions. Coupled sustainability indicators with future scenario modeling to inform the SLV stakeholders about a variety of social and environmental issues. Results indicated that through specific shifting of cropping rotations and minimal land fallowing, SLV could reduce water use and Greenhouse Gas Emissions while increasing soil carbon and improving soil health. In addition, the solar energy development pathways investigated by this study showed that the potential exists to offset most or all of the region's GHG emissions.	Utilized Community Based Participatory Research to engage stakeholders & keep research relevant. Highlighted groundwater-dependence of SLV, suggests irrigation water use could be decreased 10% with shifts in crop regime and minimal fallowing.	Chapter III: Consumptive Water Use Analysis of Upper Rio Grande Basin in Southern Colorado: "Region-specific data and models were utilized to analyze the consumptive water use of SLV."	"San Luis Valley "is much more reliant on irrigation in comparison to other regions." "- On average, SLV experiences three months of water shortage per year due to the unsustainable extraction of groundwater (GW). - Results show that agriculture accounts for 77% of overall water consumption and it relies heavily on an aquifer (about 50% of agricultural consumption) that is being depleted over time. - It was found that, even though potato cultivation provides the most efficient conversion of groundwater resources into economic value (m3 GW/$) in this region, it relies predominantly (81%) on the aquifer for its water supply. - However, cattle, another important agricultural commodity produced in the region, provide good economic value, but rely significantly less on the aquifer (30%) for water needs."	San Luis Valley, Rio Grande Basin, Colorado.	37.58 W	-106.15 N	7600	Not discussed - document analyzes current practices rather than demand management practices.	Not discussed - document analyzes current practices rather than demand management practices.	Document analyzes current practices rather than demand management practices. It also discusses what are the consumptive uses of water in the San Luis Valley.	Not discussed.	Agriculture	Figure on page 60 and 62 shows total consumptive water content of all crops by type.	Not discussed.	Not discussed.	Not discussed.	Used Ecological Footprint Analysis (EFA) to measure environmental burden; Energy Analysis to track the quantity of embodied solar energy in various items and economic activities/services Green Net Regional Product captures the externalities associated with natural resource depletion through alternative-valuation methods (GNRP is an environmental economic metric) Fisher Information measures the order or predictability of data.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Drought and overuse has threatened the regions overlying the aquifer in the SLV, which is relied on for the majority of the irrigation water for crops. Carbon and water are also linked together for: 1) increased drought and water shortages have been linked to climate change; 2) pumping water (including irrigation water) requires energy which in turn results in more GHG emissions from electricity production; and 3) improving soil health leads to greater water holding capacity of the soil (which reduces irrigation requirements and increasing soil carbon which is a marker of soil health, can reduce atmospheric GHG. Financial water saving incentive program. BIP documents ways to improve soil health and increase soil water holding capacity, improve stream flow forecasting, irrigation improvements, head gate and ditch restoration projects and documents the importance of maintaining a healthy stream corridor to achieve efficient compact deliveries at the state line. Farmers use "recharge pits" at the corners of their fields so water can infiltrate into the aquifer Considered environmental flow requirements (EFR) Looking to allocate water towards ecosystem services and environmental flow requirements in the future. Soil health management practices (organic matter, water-holding capacity, soil	Successes: - Developed a formal community engagement process and a Community Advisory Board (CAB). - Consumptive water use accounting and indicator model supported decision making. (inspired by the Water Footprint methodology) - Water Footprint Methodology - framework to quantify fresh water usage along the entire supply chain. Used to assess both direct CU and indirect embodied water content of individual products (milk and clothes) as well as for populations of nations and planet. - Regional-specific baseline informed decision making. Specifically, RGDSS calibrated for the region allows for robust region-specific accounting. - Cattle provide good economic value but rely less (30%) on the aquifer for water needs	Not discussed.
Lit-08 Economic viability of deficit irrigation in the Western US	2018	Manning et al, Agricultural Water Management.	Research on agro-economics of deficit irrigation.	Deficit irrigation (DI) can be optimal during late growth and maturation stages given elevated water prices (depending on output price and production costs).	Assess economic viability of deficit irrigation. - "...Develop an agro-economic model that connects plant growth-stage-specific evapotranspiration (ET) targets with farm profitability." - "...Use the model to determine the economic conditions under which ET targets of less than 100% are optimal for profit-maximizing maize farmers in Colorado."	"With 2015 input costs, as maize grain prices increase beyond $0.19 kg −1, DI can become optimal during the late vegetative growth stage but requires a water cost greater than U.S. $0.21 m −3. Under some output price and water cost combinations, DI in the maturation stage also becomes optimal. These results suggest that producers could respond to increasing water scarcity with deficit irrigation, but only in a range of water costs that depends on output price and production costs."	Northern Colorado	40.433 degrees N	104.633 degrees W	4,685	Deficit irrigation viability for maize producers in Colorado.	Used an agro-economic model connecting plant growth-stage specific evapotranspiration (ET) targets to farm profitability.	Deficit irrigation. "One potential alternative to drying land includes deficit irrigation (DI), defined as applying less water than needed to satisfy full plant evapotranspiration (ET) requirements, resulting in drought stress and yield losses."	Not discussed.	Agriculture	Not discussed.	Not discussed.	- Crop-ET production functions that capture the physical relationships between producer irrigation decisions, realized ET, crop growth, and water demands. - Also considered weather and area planted. - Measured water use to crop yields	Not discussed.	The paper documents the modeling results of an agro-economic model developed to connect a decision about growth-stage-specific crop ET to stochastic profit earned by a profit-maximizing producer. This requires connecting plant-growth-stage specific ET targets to water use and crop yields.	Not discussed.	The paper documents the modeling results of an agro-economic model developed to connect a decision about growth-stage-specific crop ET to stochastic profit earned by a profit-maximizing producer. This requires connecting plant-growth-stage specific ET targets to water use and crop yields.	Not discussed.	Not discussed.	- Water costs could increase as irrigation districts impose fees to cover increased costs to acquire and deliver water or as energy costs increase to pump water. - The market value of water would also likely continue to increase as population growth in water-scarce regions raises municipal and industrial willingness to pay for water. - There may also be an increase in environmental values of water. As this occurs a producer may realize an increased opportunity cost of water used on the farm.	Not discussed.	Not discussed.
Lit-09 The role of groundwater trading in spatial water management	2014	Palazzo and Brozovic, Agricultural Water Management	Republican River Basin assessment of coupling surface-groundwater management.	Geospatial dataset of RRB irrigation wells modeling crop choice, land, and water use decisions by well. "Our analysis highlights the importance of the initial distribution of permits and the institutional context in which trading occurs." Cost savings from trading groundwater pumping are distributed unevenly between wells, counties, and groundwater management institutions.	The purpose is to understand "the spatial heterogeneity of the costs of water use restrictions to farmers" to evaluate "the effectiveness of current and alternative water management policies." "- use a geospatial population dataset of irrigation wells in the Republican River Basin of Nebraska and model the simultaneous crop choice, land and water use decisions at a well level. - estimate the magnitude and distribution of costs of current groundwater restrictions as well as cost savings from alternative market-based policies that allow trading of permits between farmers."	"Our analysis highlights the importance of the initial distribution of permits and the institutional context in which trading occurs. Both allocated but unused permits and land estimated to move from irrigated to dryland crops provide important trading volume into the water rights market. The results show that the cost savings from allowing trading of groundwater pumping rights are distributed unevenly between wells, counties, and groundwater management institutions."	Republican River Basin (RRB) of Nebraska	39 degrees N	96 degrees W	~1,000	Models and analyzes costs of alternate spatial water management policies on individual groundwater users across a large ag watershed (groundwater trading).	Models and analyzes costs of alternate spatial water management policies on individual groundwater users across a large ag watershed (groundwater trading).	Trading of groundwater rights (e.g. pumping groundwater back to the stream).	Not discussed. Model developed to represent a farmer's optimal choice of irrigated and dry land crops, land use, and water application.	Agriculture (groundwater)	Not discussed.	Not discussed.	Not discussed.	Not discussed.	- Used an Excel-based decision support tool, Water Optimizer. Inputs (not outcomes): - For a given set of well-specific, economic, and agronomic parameters and water allocation, Water Optimizer determines optimal crop choice, land use, water application, and expected profits. - Used well-specific hydrologic conditions; State Soils Geographic (STATSGO) database for Nebraska; county-specific agronomic data.	Not discussed.	- The paper documents the potential cost savings from water markets and the potential reduction in costs if initial allocations of rights lead to market power. - Model considered corn, wheat, soybeans, and sorghum. Crop prices were taken from the USDA National Agricultural Statistics Service for the period 2005-2009. - The paper also recognizes the tradeoffs associated with no formal market (search costs may be high; brokerage costs as well as regulators' costs of monitoring and enforcing the transfer of the right to use the water may be very large).	Producers may be less likely to trade if they fear non-use or leasing of their water rights might lead to their loss.	Not discussed.	Analysis demonstrated that the effectiveness of market-based schemes to reduce costs of regulation to agricultural water users while maintaining instream flows is likely to vary within and between watersheds based on local institutions and geophysical conditions.	Not discussed.	Not discussed.
Lit-10 Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain	2019	Ren et al, Stochastic Environmental Research & Risk Assessment	Evaluation of different cropping patterns (including fallowing) & water supply scenarios.	Framework for using a crop model & regression to predict effects of cropping adjustments on groundwater sustainability & crop production	- The purpose of the research was to predict the effects of cropping adjustments on groundwater sustainability and food production (primarily wheat) in the piedmont region of the North China Plain. - Different cropping patterns (including fallowing) and water supply scenarios were set up, using the DSSAT crop model and a regression model.	- The results indicate that: (1) irrigation water requirement needs to be limited to a maximum level of 187 mm/a to sustain groundwater at the present level. Above this level, every 100 mm of irrigation pumping leads to a decline of 0.49 m in the groundwater level; (2) under the current water supply conditions, and taking groundwater sustainability, food supply, water use efficiency and soil fertility recovery into consideration, leaving 34% of the cropland fallow or leaving it fallow every 3 years seems to be the best option; (3) If an extra amount of water of 0.2 or 0.5 billion m^3 is supplied as a result of the SNWT Project, the percentage of cropland which should be left fallow can decrease to 25% or 11% respectively.	North China Plain	36 to 40 degrees N	114 to 119 degrees E	160	Not discussed - no formal program.	Not discussed - no formal program.	Simulated how different cropping patterns (including fallowing) could be adjusted to minimize the decline in groundwater levels while maintaining productive wheat crops.	Not discussed.	Agriculture	-The results of the simulations indicate that: (1) Irrigation water requirement needs to be limited to a maximum level of 187 mm/a to sustain groundwater at the present level. Above this level, every 100 mm of irrigation pumping leads to a decline of 0.49 m in the groundwater level; (2) Under the current water supply conditions, and taking groundwater sustainability, food supply, water use efficiency and soil fertility recovery into consideration, leaving 34% of the cropland fallow or leaving it fallow every 3 years seems to be the best option; (3) If an extra amount of water of 0.2 or 0.5 billion m^3 is supplied as a result of the SNWT Project, the percentage of cropland which should be left fallow	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	- Although not a DM Program, this study did mention the influence on various cropping patterns and maize and wheat production.	- Although not a DM Program, this study did recognize when considering cropping pattern adjustment, sacrificing some of the maize production can to some degree offset the detrimental effect such adjustments have on wheat production. Therefore the reduction in both wheat and maize production should be considered when alternative cropping patterns are proposed.		Not discussed.	Not discussed.	Not discussed.
Lit-11 Opportunities for saving and reallocating agricultural water to alleviate water scarcity	2017	Richter et al., Water Policy	- Review of literature & internet to identify water-saving strategies in irrigated agriculture. - Review of case studies in which water savings have been successfully transferred to other uses.	- Catalogs water savings opportunities, claims of irrigation-efficiency savings potential, logistics of reallocating due to other ag diverting savings. Findings suggest considerable potential to reduce irrigation CU and that savings can be reallocated when proper consideration is given to water budget accounting.	"A comprehensive literature and internet survey was undertaken to identify well-documented studies of water-saving strategies in irrigated agriculture, as well as a review of case studies in which water savings have been successfully transferred to other uses." "Literature review of potential water savings in irrigated agriculture: 1. Were the flow pathways illustrated in Figure 2 adequately and explicitly accounted for? 2. If all flow pathways were not explicitly accounted for, each of the following questions must be answered in the affirmative: (i) If the study documented a reduction in non-beneficial or beneficial consumptive use, could it reasonably be assumed that the water-saving measure applied could result in making an equal volume of water available for subsequent use in many settings? (ii) Did the study document, or could it reasonably be assumed, that crop yields would not be decreased (i.e. within 5% of original yield)?"	"Our findings suggest that there is in fact considerable potential to reduce consumptive water use in irrigation systems when proper consideration is given to water budget accounting, and those savings can be beneficially reallocated to other purposes."	See Table 1 pdf pg.. 9, for table of water saving measures, primary flow pathway estimated, saved volume, % savings, and location.	Several project locations across several states discussed in this paper.	Several project locations across several states discussed in this paper.	Several project locations across several states discussed in this paper.	Not discussed.	Not discussed.	Lit review of many practices. See Table 1 pdf pg.. 9, for table of water saving measures, primary flow pathway estimated, saved volume, % savings, and location.	Not discussed.	Agriculture	See Table 1 on pdf pg. 9, for a table of water saving measures, primary flow pathway estimated, saved volume, % savings, and location. "In most real-world applications, any water left in water sources due to lessened water applications per hectare by farmers is consumptively used by other farmers sharing the same water source, either through increases in crop production on the same land area, by switching to a more valuable but consumptive crop (e.g. bananas), or by allowing the irrigated land area to expand."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.		Not discussed.	Not discussed.	Not discussed.
Lit-12 Urban water conservation in the Sacramento, California region during the 2014-2016 drought	2019	Talbot, UC Davis	UC Davis Master's Thesis cataloging/analyzing supply & demand management actions under CA's drought policies.	Evaluates outdoor watering, public outreach, media role, water-related energy savings. Makes recommendations for urban water suppliers on revenue recovery, reducing use of rebates as demand management, and scaling drought response tasks for different levels of gov't. Summarizes & analyzes CA legislation establishing approval for long-term budget-based efficiency targets.	"This thesis catalogs and analyzes supply and demand management actions implemented in the region in the context of the state's developing drought policies. Primary activities such as reducing outdoor watering and increasing public outreach are explored along with the related roles of media and water related energy saving during drought. Looking forward, the thesis explores recommendations for urban water suppliers and the State to prepare for the next drought, including available revenue recovery mechanisms for urban water suppliers, reduced roles of rebate programs as a drought response, and appropriately scaled drought response tasks for state, regional, and local entities. The thesis also summaries and analyzes recent drought and conservation related legislation...approved in 2018 to establish long term budget-based efficiency targets for urban water suppliers, setting the stage for the next phase of drought management and water efficiency in the state."	Recommendations are made to increase water efficiency in California (starting on page 165).	California, Sacramento region	38.669 W	-121.27 N	231	Urban water conservation	Report discusses drought policies, drought planning and drought legislation	Municipal efficiency measures: "During 2014, the Sacramento region focused on coordinating conservation messaging, ramping up local conservation programs such as toilet rebates, hiring or reassigning local supplier staff for water waste enforcement, collaborating with neighboring water suppliers to provide alternative supply options, and meeting with local environmental groups to minimize the impacts of reduced flows from Folsom Lake on fish and wildlife." "Demand management actions including rebate programs, direct installation, audit services, and public outreach also were implemented."	2014-2016	Municipal	"The Sacramento region saved approximately 53,000 million gallons between June 2015 and May 2016, with individual supplier savings ranging from 166 to 11,000 million gallons. The region's water savings equates to providing water to 477,000 average households in the region for a year, assuming 304 gallons per household per day (RWA, 2018). This savings represented 10% of the statewide savings of 524,000 million gallons during the same time period."	Senate Bill 606 and Assembly Bill 1668 (2018) established long term budget-based efficiency targets for urban water suppliers (see Table 38)	Water conservation targets	The program relied heavily on outreach and education efforts	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	- It is important to coordinate water shortage contingency planning and implementation A program should: - Foster water system flexibility and integration - Improve water suppliers' fiscal resilience - Address water shortages in vulnerable communities and ecosystems - Balance long-term water use efficiency and drought resilience Other lessons learned: - Droughts encourage improvements in management - A diversified economy buffered the economic impacts of drought - Diversified supply systems help mitigate drought and climate change - Ecosystems were most impacted by the drought - Small rural systems are especially vulnerable to drought	Successes: - Recognized the value of conjunctive use - water supplier or group of water suppliers effectively align their water supply withdrawals with current water supply conditions (need interconnections) - Beyond drought, conjunctive use can "create" additional supply for beneficial uses like environmental use, water transfers, and groundwater banking	Not discussed.
Lit-13 Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado	2016	Vashisht, Colorado State University, Colorado	CSU Master's Thesis evaluating remote sensing for estimating monthly consumptive use (CU) and conserved CU (CCU) on the West Slope	Used evapotranspiration (ET) observations at experimental plots of traditional irrigation and water-banking irrigation practices to evaluate methods of verifying CCU. Reviews methods for measuring and monitoring CU, discusses limitation and potential for ReSET remote sensing CU model.	- Quantify precise CU by crops for temporary agreements. Remote Sensing is considered as the most feasible method to determine spatial actual crop water use over large areas. This report includes: "- A preliminary performance evaluation of ReSET model for daily consumptive water use estimates under energy limiting and water limiting conditions..." - determine "crop growth stage information for grass and alfalfa pastures of the Western Slope..." - develop an "empirical relation between vegetation index (VI) and crop coefficient (Kc)." "Reflectance based approach for grass and alfalfa pastures was evaluated with ReSET-derived daily estimates of crop consumptive use."	"Evaluation of grass daily ET with ground sensors pointed to an underestimation by about 25%" "Overall, this preliminary evaluation reveals a high potential of ReSET to be utilized in the Uncompahgre for the estimation of daily CU at large spatial scales for alternate water transfer methods like water banks."	Western Slope of Colorado, Uncompahgre Valley	38.509 N	-107.874 W	5,775	Not discussed - although chose to evaluate grass and alfalfa pastures because they occupy a large portion of irrigated agriculture in the study area and are economically fit for a water bank.	Not discussed.	More about the technology used to verify any DM practices than about the practices themselves.	Not discussed.	Agriculture	Estimated using the ReSET model to determine daily consumptive water use under energy-limiting and water limiting conditions.	Not discussed.	Not discussed.	Not discussed.	- Remote Sensing of Evapotranspiration (ReSET) model that explicitly takes into account the spatial variability in the weather data. - COAGMET for weather data. - USDA NASS Cropscape for crop cover classification maps. - Landsat and Sentinel satellites were used to provide crop growth stage information for grass and alfalfa pastures of the Western Slope. - Empirical relationship between vegetation index (VI) and crop coefficient (Kc) was developed to determine reflectance-based crop coefficients.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-14 Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains	2018	Yonts et al, J. of Agricultural Water Management	2010-2015 study in Nebraska of efforts to decrease ag groundwater pumping; impacts of water use efficiency and crop yield	"Reducing irrigation water by 25% caused no significant yield reduction and improved irrigation water use efficiency by 26%." Applying 50% Etc. resulted in 30% yield reductions, and planting directly in crop residue did not improve bean yield under deficit irrigation. Ample early season rainfall is a boon to pre-flowering deficit irrigation yields, but under normal-to-dry conditions post-flowering deficit yields more.	"Among irrigated crops in the region, dry bean (a major cash crop and critical to crop rotation systems) has relatively low water use and is capable to withstand periods of stress. Consequently, two experiments within six consecutive growing seasons (2010–2015) were conducted to determine the impacts of multiple irrigation scenarios (full irrigation, deficit irrigation, and rainfed) and two soil surface conditions (bare soil versus crop residue) on dry bean production, irrigation water use efficiency, and temporal soil water dynamic within the crop root zone."	"The results (2012–2015) indicated that reducing irrigation water by 25% on average increased irrigation water use efficiency (IWUE) by 26% and only caused 6% yield reduction in relative to the full irrigation treatment scenario. However, applying only 50% crop evapotranspiration requirement (ETc) resulted in significant yield reduction (30% reduction on average) in 5 out of 6 years compared to the full irrigation treatment (p < 0.05)."	Western Nebraska high plains (Panhandle District)	41.89 N	103.68 W	3900	Water conservation and deficit irrigation strategies for dry bean production in western Nebraska High Plains.	Not discussed.	Effect of the following in yield, soil water dynamics and irrigation water use efficiency of dry bean: Multiple irrigation scenarios (full irrigation, deficit irrigation, and rainfed) Surface residue conditions (bare versus residue-covered)	2010 - 2015	Agriculture	Reduced irrigation water amounts across 8 treatments Water conservation and deficit irrigation	Nebraska Resource District (NRD) - prescribe pumping limitations for water applications Limits are set in terms of an annual average pumping with no exceedance of a set value over three or five years	Soil type and climate were considerations. Reducing irrigation water by 25% of ETc had no significant impact on yield (2010-2012, normal and above average years). Target key crop growth stages (vegetation versus reproductive)	Not discussed - academic research paper	Not discussed.	Research	Not discussed.	Crop yield	Not discussed.	Not discussed.	Not discussed.	Pros: - Represented arid conditions and crop yield over a six year time period capturing a rangy of precipitation seasons - Measured influence of water conservation and deficit irrigation on yield with different soil cover and timing and volume of irrigation amounts within different critical growth stages of the crop Con: - Crop type (dry bean, common in Colorado?); irrigation application (sub-surface drip)
Lit-15 Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming	2017	Rosado, U of Wyoming	Master's thesis on irrigation system efficiency in Little Wind Unit	Uses ag water balance & geophysical techniques to quantify & locate water losses. "Large errors and data gaps associated with the inflows, outflows, diversions, and precipitation data, [...which] identified specific needs for better data."	Paper not found.																						
Lit-16 Standardizing Temporary Water Transfer Procedures in Colorado	2020	Nicols, Peter D, et al, University of Denver Water Law Review	Review of strengths and challenges of existing legal mechanisms for ATMs and recommendations for consolidation and standardization.	This article will describe the barriers in existing law to temporary transfers and the various approval mechanisms available under existing Colorado law. It will provide an assessment of the strengths and limitations of the existing transfer methods and make a recommendation for consolidation and standardization.	1) Describe the barriers in existing law to temporary transfers 2) Describe the various approval mechanisms available under existing Colorado law 3) Provide an assessment of the strengths and limitations of the existing transfer methods 4) Make a recommendation for consolidation and standardization	1) Describe the barriers in existing law to temporary transfers A. No-Injury Rule discourages requests for a temporary change of use for a water sharing arrangement where the costs may not justify the concessions needed to avoid expensive and risky litigation. B. Anti-Speculation Doctrine discourages sharing where an irrigator may be willing to temporarily share her water with another user for a different type of use at a different place. C. Calculation of Historical Consumptive Use: water rights owners have become very reluctant to expose their rights to a change proceeding if not absolutely necessary because of the substantial risk of loss of some portion of the right as a result of an HCU calculation. If a transfer is intended to be only temporary, the risk of an adverse quantification is magnified. This concern can be mitigated by providing that the effect of a quantification for a temporary transfer expires at the end of the transfer period. D. Time and Cost are particularly a problem for temporary changes as the benefits are not permanent. Thus, small, temporary transfers are effectively priced out of the water court change process. 2) Describe the various approval mechanisms available under existing Colorado law A. Substitute Water Supply Plans (Colo. Rev. Stat. § 37-92-308) B. Interruptible Water Supply Agreements (Colo. Rev. Stat. § 37-92-309) C. Fallowing-Leasing Pilot Program (Colo. Rev. Stat. §37-60-115(8)) D. Temporary Ag-to-Ag Loans (Colo. Rev. Stat. § 37-83-105(1)) E. Temporary Loans for Instream Flow (Colo. Rev. Stat. § 37-83-105(2)(a)) F. Agricultural Water Protection Water Rights (Colo. Rev. Stat. §§ 37-92-305(19) and 37-92-308(12) G. Water Bank (Colo. Rev. Stat. § 37-80.5-101) 3) Provide an assessment of the strengths and limitations of the existing transfer methods: discussed for each method. 4) Recommendations for consolidation and standardization: Proposed program structure summarized in Lessons Learned.	NA, review of legal framework	NA	NA	NA	Not discussed.	Report presents a Proposed Uniform Temporary Transfer Procedure (from assessment of best features of all reviewed temporary transfer types). See lessons learned.	ATM.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Proposed Uniform Temporary Transfer Procedure: - Application filed with the state engineer. - Notice to all subscribers to the SWSP list for the appropriate water division. - A comment period of thirty-five days, except for loans to in-stream flows and Ag-to-Ag loans [suggest keeping existing timeframes for comment by water rights owners (15 days from mailing of notice) and decision by the state engineer (20 days from mailing of notice)]. - A determination by the state engineer that the transfer would not injure other vested water rights or decreed conditional water rights, or impair interstate obligations. - Administrative approval by the state engineer. - Appeal to water court pursuant to the Administrative Procedure Act, not a de novo proceeding. The appeal may be heard on an expedited basis when the appealing party(s) agree to pay a fee to cover the direct costs associated with an expedited appeal. - Availability of an optional, standardized, and streamlined approach to determine HCU and return flow. The state engineer would phase in the approach for water districts where it would be most useful. While the approach would be uniform, it would use local factors for ditch loss, transit losses, and farm irrigation efficiency. The state engineer would develop the local factors through an informal process with input from a technical advisory committee(s) of water professionals. Use of the approach would create a rebuttable presumption that no injury would result, switching the burden of proof to the objectors. It would not, however, create any presumptions in any subsequent legal proceeding. - Authorization of the use of option contracts between water rights owners and new users for temporary transfers that identify the maximum amount of HCU that could be transferred, and the specific type and place of use. - Authorization of approval for any purpose for three-in-ten years or 30 percent of HCU on a rolling ten-year average, with the option to renew for two ten-year terms. Any increase in the amount, or change in the type or place of use after the initial ten-year approval would require an additional approval, which would be subject to appeal. Water rights approved for temporary transfers should be used in accordance with their decrees in any years not temporarily transferred to another use. - All periods of time during which a water right is used for another approved	Recommendations for consolidation and standardization: A. No-Injury rule: The authors assert that inclusive and uniform language is appropriate in stating the non-injury standard for temporary transfers. Such transfers should not result in injury to "other vested water rights or decreed conditional water rights" and should not impair compliance with any interstate obligations. B. Anti-Speculation doctrine: Colorado law should provide a limited exception to the anti-speculation doctrine to implement the ATM policies set forth in Colorado's Water Plan. Specifically, option contracts should be authorized for temporary transfers to meet the anticipated needs of users that identify the specific type and place of their future use. This would complement Agricultural Water Protection Water Rights discussed above by allowing water rights owners who do not have the resources to adjudicate a change to make their water rights available to others to meet future needs. C. Administrative Approval: The authors believe the state engineer is best able to determine injury to other water rights and impairment of interstate compacts for transfers that are limited in duration. And since existing statutes nearly universally task the state engineer with these determinations, there is not any compelling reason to change that responsibility. The state engineer can delegate this responsibility to the division engineer if desired and in appropriate circumstances. D. Appeals of Administrative Approvals: The state engineer now has substantial experience with the various types of temporary transfers and is in the best position to evaluate and guard against injury to other water rights. Owners of water rights, of course, should receive notice and have an opportunity to provide comments concerning injury to their rights. The state engineer would consider comments in crafting the terms of approval, as occurs now. With those safeguards in place, an appeal to the water court based on the standards of the Administrative Procedure Act seems an appropriate mechanism that provides due process while acknowledging the expertise of the state engineer together with the goal of reducing cost and delay. Emergency SWSPs are so short lived—ninety-one days maximum—that an appeal process would be meaningless. E. Notice: The SWSP notification list should be used to provide notice for any temporary transfer requiring notice to interested parties. Short-term transfers for emergency purposes should not require notification. F. Standardized HCU and return flow analysis: Development of tools akin to the LFT by the state engineer and adoption by rulemaking would give interested parties an opportunity to participate in their development and approval by the water court before they could be used. State engineer rulemaking would also ensure due process and fairness in developing a streamlined approach to determine HCU and return flow. The rules should provide for methodologies that incorporate specific local factors, at no higher level than the water districts in Water Divisions 1, 2, and 5 that receive the overwhelming majority of water court applications. The standardized methodologies should be developed in concert with a technical advisory committee. G. Temporal Limits on Transfers: The authors do not believe there are principled legal reasons to differentiate the approval periods between temporary transfers for different purposes. Thus, the authors recommend that Colorado authorize approval of temporary transfers for any purpose for three-in-ten years or 30 percent of the HCU on a rolling ten-year average, with the option to renew for two ten-year terms. Any increase in the amount or change in the type or place of use after the initial ten-year approval would require an additional approval, which would be subject to appeal. Water rights approved for temporary transfers should be used in	Not discussed.

Exhibit B-9
ATM Documents with General Criteria

EXHIBIT G

Exhibit B-10
SCPP Documents with M&V Criteria

EXHIBIT G

Title	Date	Publisher/Authors	Description	Notes
SCPP-01 System Conservation Pilot Program Secondary Benefits: Final Report with Case Studies	2019	WestWater Research for TNC	This case study report looked at whether the reduction in consumptive use in SCPP projects also generated off-farm benefits by applying select methods to quantify off-farm benefits to two case studies in Colorado and Wyoming. Note from TNC: An executive summary is also available, along with a more detailed report that outlines the framework for assessing secondary impacts/benefits and the associated methodology for quantifying or evaluating each impact/benefit.	Benefits assessed include increased environmental flows, decreased cost of alternative habitat flow restoration projects, societal benefits from habitat flows for endangered species, estimates of dramatic savings in salinity control, and municipal and hydropower benefits. Increased flows for the evaluated Colorado projects contributed minimal improvement to recreational flow needs. Cost savings were estimated by the cost of existing augmentation plans used to meet environmental and salinity management needs.
SCPP-02 Infographic: Grand Valley Pilot Project Secondary Benefits	2019	TNC	This infographic summarizes the results of secondary benefits analysis as applied to the Grand Valley Pilot Project Case Study.	Grand Valley Pilot Project paid farmers to voluntarily reduce their irrigation water use in order to keep more water in the river to help increase water security within the Colorado River Basin in the face of ongoing drought. While focus was on water security several off-farm benefits occurs because of the project.
SCPP-03 Research Synthesis: Agronomic Impacts of Reduction Irrigation	2019	Culp and Kelly for TNC	This memo reviews research on fallowing and limited irrigation to highlight key findings related to agronomic impacts of limited irrigation or other methods to reduce consumptive use of irrigation water in the Upper Colorado River Basin. The concluding section also identifies remaining research questions and suggests potential implications and possible next steps for a demand management program. The appendix summarizes the parameters of several of the studies reviewed. All of the referenced reports and publications are available on request.	Reviews methods and findings of existing research on agronomic impacts of limited irrigation in the following categories: yield, quality, water use efficiency, recovery, soil health, weeds/diseases/pests, and ag operations. Next steps and identified research needs include understanding impacts over a variety of geographies and crops, as well as long-term recovery. Management and operations needs include understanding the benefits of rotational fallowing, deficit irrigation, and crop switching. Finally, there are many needs in the verification of conserved consumptive use.
SCPP-04 Final Report: Colorado River System Conservation Pilot Program in the Upper Colorado River Basin	2018	Upper Colorado River Commission	Full SCPP report from UCRC; project list; Lessons learned: administration & implementation, operational, cost/benefit/risk, legal constraints, outreach & education.	List of future questions to be answered p4
SCPP-05 Final Report: Appendix C: 2018 System Conservation Pilot Program Update	2018	Upper Colorado River Commission	2018 update to UCRC full report, including Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)	Document includes Appendices C (2018 update), D (2017 CU analysis), and E (2018 CU analysis)
SCPP-06 Pilot Program Funding Agreement	2014	Bureau of Reclamation	2014 SCPP funding agreement between CRB entities	Reviews history of compacts, storage allowances, demand management efforts by signatories. Defines goals and parameters of SCPP. Identifies NRCS programs that might support on-farm conservation improvements: EQIP and SWEP & ensures that projects will coordinate with respective NRCS State Conservationists.
SCPP-07 Colorado River Water Bank Feasibility Study: Phase 1	2012	Colorado River Water Conservation District	Water bank planning phase; conservative estimate of potential WB supplies, and demand for those supplies.	Includes potential WB uses, supply, magnitude & frequency of need, supply-use scenarios. App. A: categories of W/E slope water uses, App. B: CRC WB Feasibility Study Water Supply Technical Memo, App. C: Eval of CRC WB Hydrologic Scenarios w/UCRB model, App. D: Basic supply & use comparison scenarios for CRC WB technical memo
SCPP-08 Colorado River Water Bank Feasibility Study: Phase 2	2013	For Colorado River District. By MWH.	Water bank planning phase; test cases assessing on-farm impacts for representative irrigation systems	Includes candidate systems, screening criteria & selection, site visits for system evaluation, financial impacts on ag ops, operational scenarios & comparison to ATM work. App. A: Candidate system identification & evaluation; App. B Test Case site reports
SCPP-09 Colorado River Compact Colorado water bank feasibility study: water supply technical memorandum. (Appendix B to Colorado River Water Bank Feasibility Study: Phase 1)	2012	Natural Resources Consulting Engineers, Inc	Technical analysis for water bank feasibility study, included in 2012 WB planning phase 1 report .pdf	Data section includes analysis, irrigated areas, water rights categories, and climate stations. Examined CU requirements (w/StateCU & Blaney-Criddle), ET verification (Penman-Monteith w/4 CoAgMet stations), and HCU (StateCU values for elevation bands in each division multiplied by irrigated acres). Water bank supply and cost: "fallowing suitable for small grains, grain corn, & dry beans." Deficit Irr available for all crops but best suited to alfalfa & pasture. "These crops combined account for over 98% of the acreage, irr CU, and supply-limited CU." Discusses split-season irrigation.
SCPP-10 Exploring Perceptions of a Voluntary Agricultural Water Conservation Program on the Western Slope of Colorado	2019	MacIlroy, Colorado State University	This report was designed to assist in identifying and better understanding the socio-cultural components of a potential demand management program. The research, completed in Spring 2019, explored perceptions of demand management among stakeholders on the Western Slope through individual interviews and focus groups. The findings shed light on the barriers and opportunities for a demand management program, including ideas and feedback on what a successful program would look like, and why water users may or may not want to participate. **An executive summary is also available.**	This is an interview-based report that covers perceptions of DM, definitions of voluntary, compensated, temporary, and equity (their words are proportional/parity)--and finds that these definitions are not straight-forward and must be carefully communicated. Explores relationships with water and landscape, as well as "sacred values of the Western Slope." Addresses perceptions of DM in context of 2007 Interim Guidelines and broader basin-to-basin politics. Many interviewees doubt the viability of a voluntary compensated program, and even suggest that a mandatory uncompensated call would work better, avoid equity issues, and cost less overall. Compensation was a very challenging topic, with differing views of DM as a burden vs opportunity. Highlights clash of free-market values with the perspective of water as a commodity--discussion of different role water plays for irrigators vs Front Range residents. Who bears responsibility to pay--who is responsible for the shortage problems (many don't see the Upper Basin at fault). Temporary program vs temporary participation--fraught discussion. Discussion of Western Slope Sacred Values, how water and farming is part of identity. Numerous people suggested every water user curtail use and respect water and that we should
SCPP-11 Briefing Paper: Upper Basin Demand Management and Water Banking. Addressing Risk and Creating Certainty: Exploring Options for an Upper Basin Demand Management Program	2019	TNC	This briefing paper provides a general background on the DCP and demand management. It frames the key issues to address in evaluating a demand management program and is offered in the spirit of promoting discussion and decision-making on how to structure, govern, finance, and implement such a program.	Briefly evaluates Upper Basin risk based on drought hydrology, and discusses how to reduce that risk. Asks many questions about Dm, program governance and structure, cost and funding, policy, measurement and verification. Identifies many of the key issues being addressed by CWCB DM workgroups. Key successes from SCPP are locally-driven solutions, minimizing impacts & maximizing benefits, e.g. through local coordination of projects. Tabulates past options considered for avoiding compact curtailment.
SCPP-12 Colorado River Water Bank Work Group: An Overview of Previous Studies & Reports	2018	Colorado River Water Bank Working Group	This overview documents summarizes the studies completed by the Colorado River Water Bank Work Group in their effort to provide information about what types of solutions may be available to preserve communities, agriculture, power production and the river itself.	This work includes a two-phase feasibility study, an assessment of how reduced irrigation for compact purposes would work with different irrigation systems on Colorado's West Slope, economic work on pricing and payments, and scientific research on the agronomic impacts of reduced irrigation.
SCPP-13 GVWUA Final Report on the Conserved Consumptive Use Pilot Projects	2019	GVWUA and J-U-B Engineers	This report provides a summary of the 2018 and 2019 Conserved Consumptive Use Pilot Projects completed by the Grand Valley Water Users Association (GVWUA). The initial part of the report provides a good summary of both the 2017 and 2018 pilots. Appendix H provides the details of the survey GVWUA completed of all participating producers, gathering their input on their experience and perspectives on the pilot project. Appendix I summarizes GVWUA's thinking more broadly on the pilot and demand management.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land
SCPP-14 Lessons Learned from the System Conservation Partnership Program	2016	The Nature Conservancy	TNC's lessons learned in their SCPP involvement, including lessons from Trout Unlimited and Colorado Water Trust	Top 3 lessons: outreach & communication is essential, operational & legal issues must be addressed at ditch company/irrigation district level simplify the process for efficiency.
SCPP-15 Considerations for Modeling a Water Bank at the Aspinall Unit with Current Environmental Flows	2011	Hydro Consulting for TNC	Evaluation of computer models of the Gunnison River to assess their ability to simulate a potential water bank in the basin using the Aspinall Unit reservoirs and the effect on reservoir operations, including environmental flows	StateMod, Aspinall PBO/EIS Model, and CRSS are evaluated for their capabilities to simulate Aspinall Unit operations, environmental flows, and potential water-banking. Specifically, this modeled the Black Canyon water right, new ESI/PBO requirements at the Whitewater gage, and a water-banking option at Aspinall. Modifications to the Gunnison StateMod are necessary to simulate environmental flows and enhance reservoir accounting options.
SCPP-16 Environmental Water Transactions in the Colorado River Basin: A Closer Look	2018	Stanford Woods Institute for the Environment	Reviews CRB environmental transfers to track extent of activity. Examines SCPP projects by this lens, given the ISF benefits of SCPP. Found that SCPP-funded projects had the effect of enhancing streamflow.	Analysis used UCRC 2018 Final Report; no new data. 20,000ft view of ISF projects including SCPP projects.
SCPP-17 Lower Colorado River Basin Pilot Program	NA	Bureau of Reclamation	Webpage with tables of projects from each pilot phase	"Although the Pilot Program will be ongoing until 2035, as of 2019, future announcements of funding opportunities and requests for additional project proposals are not being contemplated."
SCPP-18 System Conservation: a collaborative approach to drought contingency planning the Upper Colorado River Basin	2017	Wyoming SEO Callaway, AWRA Impacts magazine	Description of Wyoming SCPP, how it works, participation, and future efforts.	Neither extensive nor technical, but includes some description of process & participation.
SCPP-19 SNWA Water Resource Portfolio	2019	Southern Nevada Water Authority	Chapter from SNWA's water plan	Addresses temporary supplies including different aspects of Intentionally Created Surplus, recharge and banking, DCP, and conservation tools.
SCPP-20 Colorado River Basin Water Bank: Framework & Financial Analysis	2017	WestWater Research for TNC	This memo evaluates different framework concepts to scale up operations of the Water Bank and provides comparative costs and other factors to consider in different approaches to developing a water bank. The information is intended to provide concepts and preliminary numbers for TNC and the Water Bank Working Group to consider and discuss in ongoing Water Bank development efforts.	Evaluates 4 frameworks of a Colorado Basin water bank sufficient to address 250,000 AF of CCU: annual water bank leases, option leases in critical years, non-option critical year leases, and response to a 1922 compact call. WestWater Research developed a cost-estimation spreadsheets based on the volume of water leases, number of associated acres, and number of farms or ranches leasing water.

	Monitoring and Verification							
	Methodologies and/or Processes						Necessary Data and Equipment	
							Agricultural Participants	
Title	Measurement of water returned to the stream	Consumptive use analysis	Estimated residual field consumptive use	Return flow maintenance	Verify conserved consumptive use	Coordination of Benefits	Representative Crop ET Data	Verification of conserved consumptive use
	e.g. analytical processes and whether or not M&V activities were measured, estimated, or not considered						*e.g. field specific data or regional data?*	*e.g. visual verification, regional data, or specific data?*
SCPP-01	-Grand Valley Project relied on existing ditch infrastructure to measure diversion at the Roller Dam and into the Power Canal. No specific methodologies or processes were identified. -Both projects relied on USGS stream gages to measure streamflow.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	The two identified SCPP case studies were complete as originally planned, and the off-farm benefits were analyzed after the projects were completed. There was not a mention of direct coordination of benefits. The report did indicate that in the future a retiming of the release of CCU (if possible) could increase the environmental and recreational benefits by increasing streamflow in the late summer and fall.	Not discussed.	Not discussed.
SCPP-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-04	Not discussed.	In general, the applicants in CO, NM, and UT calculated historical potential consumptive use based on Modified Blaney-Criddle with an elevation adjustment, while the applicants in Wyoming used remote sensed data (Landsat satellite imagery) with the energy balance model METRIC (Mapping Evapotranspiration with High Resolution and Internalized Calibration). -The lack of consistent streamflow and streamflow data made analyses from each state challenging. In CO, StateCU, HydroBase were relied upon and were generally sufficient.	-2015: N/A -2016 and 2017 - two options were available: 1: Assume one day of irrigation provides one-weeks' worth of supply. 2: Assume the entire soil zone was filled during irrigation and would be fully consumed thereafter.	Not discussed.	-Use climate data from nearby climate station defined in each verification plan. -Estimate the potential CU using the daily Penman-Monteith calculation or modified Blaney-Criddle calculation (reduced by effective precipitation) during the project-specific contracted participation period. -Adjust the daily calculations based on water supply limitations (either diversion records, coordination with ditches, or discussions with SEO/DWR staff in each state).	- Two projects (1 in CO and 1 in WY) with supplies in private reservoirs attempted to complete November releases to support low streamflow, but were not allowed to make releases for undecreed uses. - Therefore, no direct coordination of benefits was achieved.	Relied upon nearby climate station selected for each project. Daily climate data for the Penman-Monteith method were required, and include: air temperature, humidity, radiation and wind speed.	- Scheduled site visits during project implementation. - Standard approach for photographs and documentation of site visits. - Finally, the use of readily available climate data to calculate the potential CU (reduced by effective precip) using a Penman-Monteith or modified Blaney-Criddle calculation during the project-specific contracted participation period (adjusted for water supply limitations).
SCPP-05	Not discussed.	In general, the applicants in CO, NM, and UT calculated historical potential consumptive use based on Modified Blaney-Criddle with an elevation adjustment, while the applicants in Wyoming used remote sensed data (Landsat satellite imagery) with the energy balance model METRIC (Mapping Evapotranspiration with High Resolution and Internalized Calibration). -The lack of consistent streamflow and streamflow data made analyses from each state challenging. In CO, StateCU, HydroBase were relied upon and were generally sufficient.	-2018 (two options): 1: Assume one day of irrigation provides one-weeks' worth of supply. 2: Assume the entire soil zone was filled during irrigation and would be fully consumed thereafter.	Not discussed.	-Use climate data from nearby climate station defined in each verification plan. -Estimate the potential CU using the daily Penman-Monteith calculation or modified Blaney-Criddle calculation (reduced by effective precipitation) during the project-specific contracted participation period. -Adjust the daily calculations based on water supply limitations (either diversion records, coordination with ditches, or discussions with SEO/DWR staff in each state).	Not discussed.	-Relied upon nearby climate station selected for each project. Daily climate data required for the Penman-Monteith method were required, and include: air temperature, humidity, radiation and wind speed.	-Scheduled site visits during project implementation. -Standard approach for photographs and documentation of site visits. -Finally, the use of readily available climate data to calculate the potential CU (reduced by effective precip) using a Penman-Monteith or modified Blaney-Criddle calculation during the project-specific contracted participation period (adjusted for water supply limitations).
SCPP-06	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-07	Not discussed.	- StateCU was used to estimate the irrigation water requirement or consumptive irrigation requirement. - Local climate station were used within the StateCU analyses.	ET verification was considered using the Penman-Monteith method with CoAgMet data from Cortez, Delta, Mancos, and Yellow Jacket.	- Not addressed. Identified that return flow considerations and modeling were likely important. - Alfalfa cannot be grown as a cover crop because of its deep root system and impacts to return flows to the river.	Actual water savings through deficit irrigation are difficult to determine without on-farm analyses. The report focused on a conceptual analysis and assumed the CU savings through deficit irrigation would be equal to the average monthly CU in months when irrigation was curtailed.	Not discussed.	- ET verification was considered using the Penman-Monteith method with CoAgMet data from Cortez, Delta, Mancos, and Yellow Jacket.	Not discussed.
SCPP-08	- For high elevation grass pasture, the irrigation diversions and return flows are rarely measured or recorded, making direct accounting of foregone CU difficult. - For private ditch systems, diversions and return flows are not adequately measured to directly calculate foregone consumptive use. - For tribal irrigation systems, insufficient measurements of diversions and return flows make calculation of foregone CU impractical. - For USBR projects, There are higher levels of water measurement, it is still not adequate for determining foregone consumptive use. These projects would also require estimation of reduced CU through remote sensing, meteorological data, or yield estimates. - All of the site visits revealed difficulties in water banking administration. First, none of the systems had adequate measurement of diversions and return flows to directly calculate foregone CU through a mass balance.	- The lack of adequate measurement devices at the 8 project locations indicates the need for CU calculations based on remote sensing, meteorological data, or use of standard water requirements by crop type, elevation and irrigation type. - StateMod and StateCU were considered during the screening activities.	- The lack of adequate measurement devices at the 8 project locations indicates the need for CU calculations based on remote sensing, meteorological data, or use of standard water requirements by crop type, elevation and irrigation type.	- Not directly discussed, but paper recommended fields for fallowing/deficit irrigating should be selected to avoid areas with subirrigation and to avoid negative impacts to other irrigators and benefits of groundwater return flows (wildlife habitat, fisheries, etc). - Surface water and groundwater return flows should be measured. - It is unlikely that any irrigation systems will have measurement capabilities or historical data sufficient to accurately compute actual CU savings for Water Bank contributions based on the difference between diversions and return flows.	- Direct Measurement – Reduced depletions would be computed from direct on-farm measurements of total diversions less total return flows for full CU conditions versus reduced CU conditions from fallowing or deficit irrigation. Surface water and groundwater return flows would be measured. - Crop Yield Differences – CU savings would be inferred based on changes in crop yield, using relationships between acre-feet of water used per ton of crop produced. Actual crop yield with reduced depletions from fallowing or deficit irrigation would be compared against the yield that had been generated historically by a full water supply. - Remote Methods of Estimation – Crop yields and water use would be estimated based on aerial photography or satellite imagery used to estimate irrigated acreage, evapotranspiration (directly or indirectly), crop yields, and other agricultural data. - Meteorological Calculations of Consumptive Use – Water use would be estimated from the nearest Colorado Agricultural Meteorological Network (CoAgMet) station or other meteorological data. Calculations could be constant throughout time or vary daily depending on data available. - Standard Crop Water Requirements – Standard crop water requirements adopted from research data based on crop type, elevation, soil conditions, irrigation practices, and regional factors would be adopted. Standard values could be used for all years, or wet year / average year / dry year values could be adopted.	- Salinity and selenium issues may make fallowing or deficit irrigation more attractive to project farmers, as impacted lands might be taken out of production with less impact on overall yields. In addition, reduced irrigation of these lands may have benefits in improved quality of return flows. - Various pre-harvest and harvest cost savings (fertelizer, fuel, labor, equipment costs, etc.) are a benefit to full fallow activities.	- The availability of CoAgMet stations nearby can help determine representative crop ET data.	As described in "Methodologies to verify conserved consumptive use" column: - Direct Measurement - Crop Yield Differences - Remote Methods of Estimation - Meteorological Calculations of Consumptive Use - Standard Crop Water Requirements
SCPP-09	Not discussed.	-StateCU was used to estimate the irrigation water requirement or consumptive irrigation requirement. -Local climate station were used within the StateCU analyses. -	-ET verification was considered using the Penman-Monteith method with CoAgMet data from Cortez, Delta, Mancos, and Yellow Jacket.	-Not addressed. Identified that return flow considerations and modeling were likely important. -Alfalfa cannot be grown as a cover crop because of its deep root system and impacts to return flows to the river.	Actual water savings through deficit irrigation are difficult to determine without on-farm analyses. The report focused on a conceptual analysis and assumed the CU savings through deficit irrigation would be equal to the average monthly CU in months when irrigation was curtailed.	Not discussed	-ET verification was considered using the Penman-Monteith method with CoAgMet data from Cortez, Delta, Mancos, and Yellow Jacket.	Not discussed.
SCPP-10	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.
SCPP-11	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.
SCPP-12	Not discussed.	- "Energy-Balance methods tend to under-estimate well irrigated conditions but over-estimate dry-conditions on pasture grasses on a monthly basis." - "Combination of IWB, MSR5 and remote-sensing could be workable strategy for continuous evaluation of AET and CCU." - Split season irrigation may cause Alfalfa plants to use more water during the hotter months - Shifting to crops with lower water use or short growing seasons could also lower CU	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Discusses remote sensing technology discussed in a 2016 Webinar. Remote sensing could be used to accurately measure ET, however cloud cover could interfere with data collection.	Not discussed.
SCPP-13	Water returned to the stream was not directly measured.	CU was calculated using StateCU calculations for the period of fallowing.	Fields were required to be fully fallowed and all weeds removed to eliminate residual field CU.	Not discussed.	Verification was done with monthly site visits to visually verify the field was fallowed and weeds were controlled chemically or mechanically.	Not discussed.	Not discussed.	Contracted staff member performed monthly site visits to verify and record fallowing. Any action items from these visits (i.e. remove weeds) were included in the site visit reports.
SCPP-14	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-15	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-16	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-17	Water conserved was measured by foregone diversions/withdrawal.	Not discussed.	Not necessary as the point of the projects was to leave water in Lake Mead and could be measured entirely by foregone diversions/withdrawals.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-18	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Monthly visits to sites to verify fallowing, write up a short report with photos and make any suggested changes as needed.	Not discussed.	Not discussed.	Monthly visits to sites to verify fallowing was carried out.
SCPP-19	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-20	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

	Monitoring and Verification						
	Necessary Data and Equipment						
	Agricultural Participants						
Title	Sub-irrigation	Reservoir operations	River diversions & foregone or bypassed diversions	Lateral delivery and ditch loss	Irrigation and non-irrigation season return flows	Resulting streamflow
	e.g. wells monitored or piezometers	*e.g. staff gauge reading or outlet meter?*	*e.g. flume or pump, regular or continuous readings?*	*e.g. regular or continuous flume readings?*	*e.g. measured and returned via aug station?*	*e.g. available streamflow measurements?*
SCPP-01	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Based on the topography and satellite imagery for the Middle Piney Creek Projects, the conveyance losses and on-farm irrigation losses were estimated to have a relatively quick and proximal return to Middle Piney Creek.	No specific information was provided, but USGS gages were listed as being used to determine streamflow.
SCPP-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	Monitoring and Verification							
	Necessary Data and Equipment							
	Municipal Participants							
Title	River diversions	Foregone or bypassed diversions	Reservoir operations	Ditch or pipeline delivery	Overall collection systems	Monitor system-wide operations to verify conserved consumptive use	Detailed system-wide accounting records
	e.g. flume or pump, regular or continuous	*e.g. estimated from streamflow measurements or*	*e.g. staff gauge reading or outlet meter?*	*e.g. flume or pump, regular or continuous readings?*	*e.g. monitor other diversion from the same basin?*	*e.g. compare overall basin diversions to previous years and*	*e.g. are system-wide accounting records*
SCPP-01	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	Monitoring and Verification						
	Program Level Considerations						
			Monitoring & Verification Workgroup Guiding Principles				
Title	Tradeoffs - Value and/or cost implications for more precise data	Proportionality	Honest, accurate, and defensible	Protective of other water users	Simple, easy, and flexible	Resulted in added water, rather than a retiming of depletions	Lessons learned
	e.g. value between estimating a lower yield vs. obtaining measurements to increase yields?	*e.g. geographic diversity?*	*e.g. accuracy of estimates and/or data collected?*	*e.g. consideration of adjacent and/or downstream water users?*	*e.g. amount of effort required to equip farm and/or implement project?*	*e.g. activity resulted in a net increase in water in the stream?*	*e.g. critical items, or considerations for future projects?*
SCPP-01	Not discussed.	Not discussed.	The report discussed the lack of recent, local boating data on the Colorado and fishing data on the Middle Piney limited the ability to estimate the recreational benefits for both projects.	Not discussed.	Not discussed.	The GV CCUPP redirected the foregone irrigation diversions from the Grand Valley Canal into the Power Canal for hydropower generation and then returned the unconsumed water back to the Colorado River at the top of the designated 15-mile critical reach of the Colorado River for managed for endangered fish. The Middle Piney Creek projects did not divert water, thus the streamflow benefit was the CCU.	-The report identified a framework to evaluate municipal, hydropower, environmental, salinity, and recreational benefits within the context of a Colorado River Basin conservation project. -A scaled-up conservation effort (approximately 10 times greater than the Grand Valley and Middle Piney projects) would be needed to see more significant values of off-farm benefits. -Off-farm benefits are very dependent upon the project location and local constraints and/or opportunities. -In a USBR designated salinity control basin, one of the economically largest benefits would be the reduction in salt load to the Colorado River. -The timing and quantity of the CCU supply is very important for recreational benefits, namely boating and fishing. -The ability to quantify off-farm benefits may result in economic gains, which can offset program/operational costs.
SCPP-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	While water security was the main focus, changes in water management that resulted from the project led to several positive secondary benefits to the larger region.
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	Key Takeaways			
Title	Data gaps	Keys to success	Identified challenges	Overall findings and recommendations
	e.g. data and/or information necessary for future projects?	*e.g. crucial paths and/or processes that should be replicated?*	*e.g. mistakes that should be avoided?*	*e.g. comments on the feasibility of DM activities?*
SCPP-01	Current and more proximal streamflow data would have been resulted in more accurate benefit measurements. There was not a sufficient amount of recreational fish user data, nor estimated daily angler benefit yields ($/day/angler). There was not a sufficient amount of recreational boater data for some stretches of the Colorado River, and none for the Middle Piney River.	Not discussed.	The ability to get recent, local, and representative off-farm data (electrical rates, boater days, economic data, streamflow data, salinity control program rates, and municipal lease costs) is paramount for accurate benefit analyses.	One of the analyzed DM project did result in off-farm benefits in multiple sectors. The anticipated benefit to Lake Powell was likely negligent, given the inability to shepherd water to Lake Powell, and the relatively small amount of water consumed. Future conservation projects should be upscaled to see increased benefits. Local and regional off-farm benefits are very dependent upon the local of the project and nearby opportunities.
SCPP-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.
SCPP-03	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-04	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-05	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-06	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-07	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-08	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-09	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-10	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-11	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-12	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-13	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-14	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-15	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-16	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-17	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-18	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-19	[illegible]	[illegible]	[illegible]	[illegible]
SCPP-20	[illegible]	[illegible]	[illegible]	[illegible]

Exhibit B-11
Lit (Gen. Literature) Documents with M&V Criteria

EXHIBIT G

					Monitoring and Verification					
					Methodologies and/or Processes					
Title	Date	Publisher/Authors	Description	Notes	Measurement of water returned to the stream	Consumptive use analysis	Estimated residual field consumptive use	Return flow maintenance	Verify conserved consumptive use	Coordination of Benefits
					e.g. analytical processes and whether or not M&V activities were measured, estimated, or not considered					
Lit-01 Salmon recovery in the Columbia River basin: analysis of measures affecting agriculture	1999	Aillery et al, Marine Resource Economics	Analysis of ag impacts from salmon-recovery-related flow alterations in Columbia River	Investigates ag impacts of fish recovery measures "such as: modified timing for dam releases, reservoir drawdown, and flow augmentation in the Columbia River basin, on the regional agricultural sector are evaluated. [....] Results suggest that drawdown and/or minor reductions in irrigation water diversions would reduce producers' profits b less than 1% of baseline levels. However, the most extreme scenario--a long drawdown period combined with a large reduction in irrigation diversions--would reduce producers' profits by $35 million (2.5%) annually."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed
Lit-02 Feasibility of water efficiency and reuse technologies as demand-side strategies for urban water management	2017	Berhanu et al, Journal o Industrial Ecology	Economic model of water cost provided by above-code water efficiency and reuse technologies, including variations & uncertainty analysis.	Estimates that efficiency and reuse can meet 85% of 50yr projected needs to the Lower Colorado River Authority service area (central TX)	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed
Lit-03 Response to water crisis: How do Iranian farmers think about and intent in relation to switching from rice to less water-dependent crops?	2019	Boazar et al, Journal of Hydrology	Study of farmer response to gov't demand management, switching crops.	"Structural equation modeling showed that farmers intention to change from rice cultivation to another crop is determined by personal norms, beliefs about their role and emotional considerations."	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed
Lit-04 Temporary water transfers for urban water supply during drought	1992	Clark, CSU	PhD dissertation modeling options for temporary water transfers	"This research develops a water right option agreement (WROA) model, methods of analysis, and legal implementation strategy under Colorado law." Interviewed professionals, estimates costs, identified that WROA "can be superior in terms of cost, reliability, and operational flexibility to both water-right purchases and construction of additional reservoir storage.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-05 Flexible water allocations and rotational delivery combined adapt irrigation systems to drought	2018	Cody, K.C., Ecology and Society	Water allocation experiment in San Luis Valley, Colorado for sel governing irrigation systems.	Examines relationships between rules and physica context of water supplies; specifically the outcome of water allocations between members and how they rotate water delivery.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-06 Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity	2017	Colby (Ch. 3.1.4), Book eds Ziolkowska & Petersen	Chapter from book "Competition for Water Resources: Experiences and Management Approaches in the US and Europe" collecting global examples/discussion of approaches and solutions to water supply scarcity, including western US	Ch 2.1.1: Challenges for US irrigated ag in the fac of emerging demands and climate change, Ch 3.1.4: Water trading innovations: reducing agricultural consumptive use to improve adaptation to scarcity (reviews online trading systems to reduce transaction costs, methods for cost-effective verification of CCU, and other breakthroughs facilitating temporary & intermittent trading more feasible. Examples from AZ and CA (IID), NE, Australia, CO-Big Thompson.	Not discussed.	- "The baseline will consider temperature, precipitation, wind, and other factors that determine CU." - Other factors should "include irrigation management practices, temperature and rainfall patterns, soil characteristics, irrigation practices on neighboring farms, eco-nomic incentives to plant competing crops, and returnflow patterns. These data are not available in many areas." - In CA, "farmers wishing to enroll irrigated land for fallowing must document 5years of farm crop production including estimated ET" of applied water.	"Additionally, deep-rooted crops such as alfalfa may consume groundwater when left unirrigated. Well-defined baselines are necessary to address these problems and identify the actual water "savings" from leaving some fields unirrigated. Also, if farmers are paid to practice intentional deficit irrigation (termed regulated deficit irrigation in Colorado), the program needs to account for the fact that deep-rooted crops such as alfalfa may consume groundwater when left unirrigated by surface water."	Not discussed.	"Contract language needs to be crafted to effectively prohibit increased CU on the portion of a participating farmer's land (that is, a farmer with somefields enrolled in the program) that is not enrolled in an irrigation suspension program."	Not discussed.
Lit-07 Towards regional sustainability assessment utilizing community based participatory research, sustainability indicators, and future scenario modeling	2016	Dubinsky, CU Denver	PhD dissertation that identified San Luis Valley sustainability indicators and modeled future scenarios, developing a CU indicator for 1980-2010. Conducted scenario modeling to guide decision-makers towards desired outcomes from policy decisions. Coupled sustainability indicators with future scenario modeling to inform the SLV stakeholders about a variety of social and environmental issues. Results indicated that through specific shifting of cropping rotations and minimal land fallowing, SLV could reduce water use and Greenhouse Gas Emissions while increasing soil carbon an improving soil health. In addition, the solar energy development pathways investigated by this study showed that the potential exists to offset most or all of the region's GHG emissions.	Utilized Community Based Participatory Research to engage stakeholders & keep research relevant. Highlighted groundwater-dependence of SLV, suggests irrigation water use could be decreased 10% with shifts in crop regime and minimal fallowing.	Compact compliance measurement devices	StateCU for scenario planning	Not discussed.	Not discussed.	Not discussed.	Considered greenhouse gas emission reductions with consumptive use and pumping reductions
Lit-08 Economic viability of deficit irrigation in the Western US	2018	Manning et al, Agricultural Water Management.	Research on agro-economics of deficit irrigation.	Deficit irrigation (DI) can be optimal during late growth and maturation stages given elevated water prices (depending on output price and production costs).	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-09 The role of groundwater trading in spatial water management	2014	Palazzo and Brozovic, Agricultural Water Management	Republican River Basin assessment of coupling surface-groundwater management.	Geospatial dataset of RRB irrigation wells modelin crop choice, land, and water use decisions by well. "Our analysis highlights the importance of the initia distribution of permits and the institutional context which trading occurs." Cost savings from trading groundwater pumping are distributed unevenly between wells, counties, and groundwater management institutions.	Not discussed - all wells are metered and annual reporting of pumped volume is mandatory, monitoring and verification of groundwater use is already in place, with strong enforcement.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-10 Evaluating the potentials of cropping adjustment for groundwater conservation and food production in the piedmont region of the North China Plain	2019	Ren et al, Stochastic Environmental Research & Risk Assessment	Evaluation of different cropping patterns (including fallowing) & water supply scenarios.	Framework for using a crop model & regression to predict effects of cropping adjustments on groundwater sustainability & crop production	- The study simulated the groundwater response across different cropping patterns. - There were 3 groundwater sustainability targets and IWR.	The study used the DSSAT (Decision Support for Agrotechnology Transfer), one-dimensional model to simulate crop growth and agricultural water use based on inputs of weather, soil, crop cultivar and management practices.	Not discussed.	Not discussed.	The DSSAT model was re-simulated for a 31 year period of record (1985-2015) to match available irrigation data with monitored groundwater data and to establish a stable relationship between IWR and groundwater level changes.	Discussed the cropping pattern, groundwater level targets and influence on the production of wheat and maize.
Lit-11 Opportunities for saving and reallocating agricultural water to alleviate water scarcity	2017	Richter et al., Water Policy	- Review of literature & internet to identify water-saving strategie in irrigated agriculture. - Review of case studies in which water savings have been successfully transferred to other uses.	- Catalogs water savings opportunities, claims of irrigation-efficiency savings potential, logistics of reallocating due to other ag diverting savings. Findings suggest considerable potential to reduce irrigation CU and that savings can be reallocated when proper consideration is given to water budget accounting.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-12 Urban water conservation in the Sacramento, California region during the 2014-2016 drought	2019	Talbot, UC Davis	UC Davis Master's Thesis cataloging/analyzing supply & demanc management actions under CA's drought policies.	Evaluates outdoor watering, public outreach, medi role, water-related energy savings. Makes recommendations for urban water suppliers on revenue recovery, reducing use of rebates as demand management, and scaling drought response tasks for different levels of gov't. Summarizes & analyzes CA legislation establishin approval for long-term budget-based efficiency targets.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed
Lit-13 Remote sensing assessments of consumptive use of agricultural water in western slope of Colorado	2016	Vashisht, Colorado State University, Colorado	CSU Master's Thesis evaluating remote sensing for estimating monthly consumptive use (CU) and conserved CU (CCU) on the West Slope	Used evapotranspiration (ET) observations at experimental plots of traditional irrigation and water-banking irrigation practices to evaluate methods of verifying CCU. Reviews methods for measuring and monitoring CU, discusses limitation and potential for ReSET remote sensing CU model.	Not discussed.	- Determined monthly CCU from ReSET. - Determined local crop growth stage lengths for different cutting cycles for grass and alfalfa pastures. - Developed VI-Kc model for grass pastures for use with reflectance based crop coefficient method. - Evaluated reflectance-based models for grass.	Not discussed.	Not discussed.	- Verified the crop cover classification mapping information (USDA NASS Cropscape) with on-the-ground observations for the grass and alfalfa crops. - Used ground instruments (LAS setup) at the limited treatment plot to evaluate stress-condition ET. Noted challenges with the LAS measurements due to low battery and disruption of good quality data collection.	Not discussed.
Lit-14 Deficit irrigation and surface residue cover effects on dry bean yield, in-season soil water content, and irrigation water use efficiency in western Nebraska high plains	2018	Yonts et al, J. of Agricultural Water Management	2010-2015 study in Nebraska of efforts to decrease ag groundwater pumping; impacts of water use efficiency and crop yield	"Reducing irrigation water by 25% caused no significant yield reduction and improved irrigation water use efficiency by 26%." Applying 50% Etc. resulted in 30% yield reductions, and planting directly in crop residue did not improve bean yield under deficit irrigation. Ample early season rainfall is a boon to pre-flowering deficit irrigation yields, b under normal-to-dry conditions post-flowering deficit yields more.	Not discussed.	- Predetermined crop evapotranspiration requirement determined irrigation reductions - Irrigation application was limited to 20 mm every 3 days to avoid runoff and simulate a center pivot sprinkler system (51 ha)	Aimed to have no runoff to reduce residual field CU	Not discussed.	Not discussed.	Attempted to reduce runoff from the field Targeted growth stages of the crop across the 9 irrigation treatments (See Table 2 in study)
Lit-15 Irrigation Efficiency and Water Balance of the Little Wind Unit on the Wind River Indian Reservation in Wyoming	2017	Rosado, U of Wyoming	Master's thesis on irrigation system efficiency in Little Wind Unit	Uses ag water balance & geophysical techniques to quantify & locate water losses. "Large errors and data gaps associated with the inflows, outflows, diversions, and precipitation data, [...which] identified specific needs for better data."	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found
Lit-16 Standardizing Temporary Water Transfer Procedures in Colorado	2020	Nicols, Peter D, et al, University of Denver Water Law Review	Review of strengths and challenges of existing legal mechanism for ATMs and recommendations for consolidation and standardization.	This article will describe the barriers in existing law to temporary transfers and the various approval mechanisms available under existing Colorado law It will provide an assessment of the strengths and limitations of the existing transfer methods and make a recommendation for consolidation and standardization.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed

	Monitoring and Verification														
	Necessary Data and Equipment														
	Agricultural Participants								Municipal Participants						
Title	Representative Crop ET Data	Verification of conserved consumptive use	Sub-irrigation	Reservoir operations	River diversions & foregone or bypassed diversions	Lateral delivery and ditch loss	Irrigation and non-irrigation season return flows	Resulting streamflow	River diversions	Foregone or bypassed diversions	Reservoir operations	Ditch or pipeline delivery	Overall collection systems	Monitor system-wide operations to verify conserved consumptive use	Detailed system wide accounting records
	e.g. field specific data or regional data?	e.g. visual verification, regional data, or specific data?	e.g. wells monitored or piezometers	e.g. staff gauge reading or outlet meter?	e.g. flume or pump, regular or continuous readings?	e.g. regular or continuous flume readings?	e.g. measured and returned via aug station?	e.g. available streamflow measurements?	e.g. flume or pump, regular or	e.g. estimated from streamflow measurements or	e.g. staff gauge reading or outlet meter?	e.g. flume or pump, regular or continuous readings?	e.g. monitor other diversion from the same basin?	e.g. compare overall basin diversions to previous years and	e.g. are system-wide accounting records
Lit-01	Not discussed.	Not discussed.	Not discussed.	To decrease the time to the ocean for juvenile fish, flow through rates would need to be increased by targeted reservoir drawdowns which would also have an impact on hydroelectric operations.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-03	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-04	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-05	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-06	Remote sensing can be used to increase the number of data sets available.	Not discussed	Not discussed.	Not discussed.	The ability to accurately track diversions, especially forgone/bypassed diversions allows for better data and makes the process easier	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-07	Alamosa climate station	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-08	- Used hourly weather data and the Standardized Penman-Monteith equation to calculate reference ET on an hourly basis. Hourly reference ET was then summed by day to create daily estimates of reference ET.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-09	Not discussed - used the Nebraska Department of Natural Resources Well Database, soil type, evapotranspiration requirements, and irrigated and dryland crop yields to inform the analyses.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Pumping locations further from the river will decrease stream depletion, but it will also decrease the contribution of return flows to shallow subsurface flow and thus to the stream baseflow.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-10	- Used meteorological data and soil characteristics measured at the Luancheng Station, an Agriculture-Ecosystem-Experiment Station of the Chinese Academy of Science (LAEES). - Irrigation Water Requirement (IWR) was estimated as the simulated ET minus the amount of precipitation.	Not discussed.	Not discussed.	There is a South-North Water Transfer (SNWT) Project that was assumed to provide extra water supply in meeting two of the sustainable groundwater targets (Targets 2 and 3).	Not discussed.	Not discussed.	Not discussed.	Groundwater levels (3 sustainability targets) were used to gauge the cropping pattern adjustments.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-11	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-12	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-13	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-14	- Yes, data from High Plains Climate Center	Not discussed.	Sub-surface drip irrigation was used	Not discussed.	'9 different deficit irrigation scenarios from 2010-2015	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Water was not pumped	Not discussed.	Not discussed.	The study avoided runoff systems.	Measured by pumping and sub-surface irrigation. Crop yield was the overall focus.	NRDs limit pumping
Lit-15	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found
Lit-16	Not discussed.	Not discussed.	Not discussed.	Not discussed.	See Table 2 in study	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.

	Monitoring and Verification										
	Program Level Considerations							Key Takeaways			
			Monitoring & Verification Workgroup Guiding Principles								
Title	Tradeoffs - Value and/or cost implications for more precise data	Proportionality	Honest, accurate, and defensible	Protective of other water users	Simple, easy, and flexible	Resulted in added water, rather than a retiming of depletions	Lessons learned	Data gaps	Keys to success	Identified challenges	Overall findings and recommendations
	e.g. value between estimating a lower yield vs. obtaining measurements to increase yields?	e.g. geographic diversity?	e.g. accuracy of estimates and/or data collected?	e.g. consideration of adjacent and/or downstream water users?	e.g. amount of effort required to equip farm and/or implement project?	e.g. activity resulted in a net increase in water in the stream?	e.g. critical items, or considerations for future projects?	e.g. data and/or information necessary for future projects?	e.g. crucial paths and/or processes that should be replicated?	e.g. mistakes that should be avoided?	e.g. comments on the feasibility of DM activities?
Lit-01	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-02	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Urban water management demand-side strategies should focus on the immediate adoption of net-benefit technologies, which produce considerable water savings and simultaneously provide monetary savings to the consumer.	Not discussed.	Not discussed.	Not discussed.	The study includes a review of the environmental impacts study associated with this specific study for the 2012 State Water Plan for Texas; includes a high-level assessment of environmental impacts of all recommended and alternate water management strategies for Texas.
Lit-03	Water managers could place too much reliance on customer water restrictions in coping with drought	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-04	- Willingness to pay and willingness to accept discussions (Education and Outreach) - "Risk-adverse" attitude increases cost but may not reduce risk - Customer satisfaction is related directly to reliability but inversely to cost	- Equity positions on farm properties can be complex in the case of ag water rights. - Property description and refusal rights have the function of protecting the equity interests of one party while placing constraints upon the other. - Shortage will precipitate a loss of value to the water customer in proportion to the severity and frequency of the shortage.	Not discussed.	The water rights option agreement (WROA), as part of a drought water supply plan, executes a temporary transfer of water at an unknown time in the future. When and how to exercise the option is an element of concern for both parties, related to the protection of other water users.	Not discussed.	Not discussed.	The Colorado Drought Response Plan uses the SWSI to activate the Water Availability Task Force. The SWSI acts as a triggering mechanism to implement predetermined levels of response. Use threshold values of various hydrologic statistics to support triggering mechanisms (if they don't exist or aren't localized enough). The implementation of a local water supply index and the use of triggering mechanisms will assist decision makers in the implementation of the WROA. Figure 6.1.1 has a Dry-Year Water Supply Planning Process, as a reference.	Locally based water supply forecasting and water monitoring schemes are recommended to support implementation of the temporary water transfer. The following criteria were judged significant to the water resources manager and were used as measures of performance: - Reliability and control of the water source - Costs of both reliability and shortage - Operational constraints and other effects Need to define shortage	- Water planning is a regional issue. - Water shortage is a local problem and there is a need for more local data and information to inform the use of a temporary water transfer. - Consider variability of drought across watersheds to inform decision or need for data - Lack of ground water data and resources - Consider cumulative effects of drought within critical watersheds - Defined levels of action promote public awareness and facilitate decision-making for future investments.	The temporary transfer of a water right is supported by an existing framework (drought water supply plan).	Drought severity should be assessed on a local area basis rather than statewide basis
Lit-05	- Benefits of rotation are that it may generate the necessary hydraulic head to push water the length of the ditch system, minimize seepage losses, ease monitoring of water use, affirmatively require delivery to all users, and ensure that enough water is delivered to saturat the root zone of crops. - The potential drawbacks of rotation are that it can be costly to negotiate, requires more work and infrastructure investment to operate that simultaneous delivery, can deliver unequal amounts of water over equal amounts of time, and may be wasteful if individual farmers receive more water than they can use efficiently during their turn in the rotation.	A lack of wealth data to the irrigation systems or individual farmers limited the ability to understand the farm-level effects (for instance the money to support maintenance and operation of the irrigation system).	- Would be a challenge to verify and defend the operations of irrigation systems without measurement devices. - Few gates and gages are in use along the San Luis Valley irrigation systems (by "eye).	A self-governing irrigation system considers many factors, including head-enders and tail-enders along the system. So, protective of other users within the system while operating within the larger Prior Appropriation and water rights structure.	- Annual meetings inform the collective choice rules of the irrigation systems, operational rules of allocation and delivery. Selected through majority vote, consensus, inherited tradition, hegemonic behavior of powerful irrigators. - Numerous irrigation system governance considerations that may or may not make it eas to replicate, however offers flexibility in the delivery of water.	- The study advances the literature by considering the combined effects on irrigation performance of shortage sharing and delivery method. - The study determined that rotational delivery with shortage sharing was the most robust institutional configuration (of those examined). This provided the most equality between head-enders and tail-enders overall and had positive marginal productivity up and down the canal at all levels of water availability. - The rotational delivery with shortage sharing also appeared to be well-suited for systems large and small, growing a wide array of crops, with different social and cultural norms, and various technological and infrastructural mixes.	- The study advances the literature by considering the combined effects on irrigation performance of shortage sharing and delivery method. - The study determined that rotational delivery with shortage sharing was the most robust institutional configuration (of those examined). This provided the most equality between head-enders and tail-enders overall and had positive marginal productivity up and down the canal at all levels of water availability. - The rotational delivery with shortage sharing also appeared to be well-suited for systems large and small, growing a wide array of crops, with different social and cultural norms, and various technological and infrastructural mixes.	- Need farm-level data to measure delivery and use of water and determine the exact rules that would optimize performance under a diverse set of conditions. - Need farm-level data to determine the ability of all users on the system to operate under a self-governing irrigation system.	Not discussed.	Not discussed.	Future work should include direct measures of welfare, identify farm units, use simulation, and investigate different water rights and climactic regions.
Lit-06	Not discussed.	Not discussed.	M&V has been implemented for trading markets in the Western United States and Australia to comply with legal mandates	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.
Lit-07	- Reduced pumping resulted from modeled crop regime changes. - Reduced irrigation resulted in reduced electricity demand and lowered GHG.	Not discussed.	- Yes, through Compact Compliance obligations - Groundwater sub-districts managing water use and delivery	- Compact compliance obligations. - Groundwater sub-districts.	Not discussed.	Scenario planning assumed: 1) Change in rotational practice among the alfalfa growers from 7 years of alfalfa and 1 year of grain to 5 years of alfalfa and 2 years of grain; 2) Fallowing of 7,500 acres of alfalfa/grain (7 yr../1 yr..) rotation land; 3) Fallowing of 25,000 acres of land in the potato/grain (1 yr../1 yr..) rotation lan area, and 4) Shifting of 35,000 acres of land in the potato/grain (1 yr../1 yr..) rotation to a potato/green manure cover crop rotation (1 yr../1 yr..)	See previous summary.	Not discussed.	- Local data to support scenario planning - Concurrent BIP efforts and projects planned that align with overall need to reduce pumping the aquifer, improve soil health, offset GHG, integrate ecosystem functions - A strong community engagement process - Groundwater management sub-districts responsible for supporting compact compliance; managing water saving incentives	Not discussed	See previous comments.
Lit-08	Not discussed.	Not discussed.	The analysis was conducted through the use of an agro-economic model and therefore the defensibility is a function of the inputs and data to reflect site conditions.	Not discussed.	Not discussed.	Not discussed.	- Water costs could increase as irrigation districts impose fees to cover increased costs to acquire and deliver water or as energy costs increase to pump water. - The market value of water would also likely continue to increase as population grows in water-scarce regions raises municipal and industrial willingness to pay for water. - There may also be an increase in environmental values of water. As this occurs a producer may realize an increased opportunity cost of water used on the farm.	- Further research should analyze DI within a context of other water conservation options, including crop selection and other management strategies such as tillage. - Multiple crops should also be considered as well as the ET target per crop. - Changing planting dates and timing of irrigation could also influence the costs and benefits associated with DI.	Output price of maize must be relatively high (compared to input costs) for DI to be optimal at any water cost.	Efforts to conserve water through DI require water prices that likely exceed historical levels in the US high plains.	- If DI is to be used with maize, it should be done first in the late vegetative stage and only within a range of water costs. - DI in the maturation/grain filling stage requires even higher water costs.
Lit-09	#REF!	Not discussed.	The analysis was conducted through the use of a water optimization model and therefore the defensibility is a function of the inputs and data to reflect site conditions.	Water use limited by water rights and enforced by metering.	Not discussed.	Pumping locations further from the river will decrease stream depletion, but it will also decrease the contribution of return flows to shallow subsurface flow and thus to the stream baseflow.	Effective trading over a large area might require a simultaneous reduction in water rights in at least some parts of the basin, so that the large majority of potential market participants were constrained.	Site specific data to reflect model outputs.	See Lessons Learned.	Pumping locations further from the river will decrease stream depletion, but it will also decrease the contribution of return flows to shallow subsurface flow and thus to the stream baseflow.	For wells constrained by current regulations, the optimal deficit irrigation strategy is to irrigate less than the full certified area, but to apply an amount approaching the optimal depth of water.
Lit-10	Not discussed.	Not discussed.	- The modeling outputs need to be informed by good and representative data and have people knowledgeable about how to use the information for informing decisions.	- There were 3 groundwater sustainability targets used to assess the IWR of the crops under the cropping patterns. Hence, there was a recognition of the need to protect groundwater for other water users.	- The DSSAT model used available data to calibrate the model and run the simulations. - It could be replicated if have the information available needed to run the model. Also need people who understand the inputs and modeling outputs.	Not discussed.	- The study provided insights that resting the cropland in summer allows moisture stored in the soil to be reused by wheat in winter. - Recommended that agricultural practices be improved in order to preserve soil water content for the next growing season. - Weed control is a critical factor and should be suppressed (tradeoff is environmental issues that arise from the use of herbicides).	- Consider cropland management during the fallow period.	See Lessons Learned.	The concept of "household food security" makes farmers who are of a low-income community that being exposed to a market-oriented economy could undermine their purchasing power and diminish their food security. Hence, they prefer to grow their own food despite receiving subsidies from the government (making purchase of food affordable).	See Lessons Learned. -
Lit-11	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	- The paper highlights a lack of sufficient accounting leads most often to counter-intuitive outcomes, or a 'water efficiency paradox,' in which seemingly more efficient irrigation application can result in greater net consumptive use, ultimately lessening the volume available for subsequent use. - There is a need for accurate determination of the volume of water associated with each water flow pathway so that the net change in 'water available for subsequent use' can be properly evaluated.	Need for data that supports proper water budget accounting.	- Formal water rights systems supported the successful transfer of water saved in irrigated agriculture to other uses and environmental restoration (Table 4). - 3 examples of successful transactions included: 1) San Diego County and Imperial Irrigation District, 2) Murray-Darling Basin, Australia; and 3) Chaobai River Basin, China. - Issuance of well-defined rights, supported by proper monitoring and enforcement is essential to the process of transferring water use rights to other uses of the environment, and accounting for the cumulative consumptive use of a water source. - Base the volume of the water right on the allowable consumptive use, rather than on allowable withdrawal volumes, to determine the net impact of the use on the hydrologic system. - The total volume of CU authorized through water rights should be explicitly tied to water availability, with consideration of the water that needs to be left in freshwater ecosystems at any time to support their ecological health. - Cap CU. Tie the cap to allow for an adjustment based upon seasonal or annual variability in water supply. - Monitor CU to verify cap. Enable regulators to limit, monitor, and enforce the allowable flow of water into an are	- Greater revenue and water-saving benefits could be realized from other crop-shifting transitions, particularly when converting to crops with very high water productivity. These crop shifts could entail upfront capital costs in converting the farm fields from one crop to another and likely require expenditures in new farm machinery or irrigation infrastructure to enable more efficient irrigation of the new crop type. - However, such conversions can be expected to yield attractive revenue and water benefits in many cases.	- Strategies for reducing beneficial consumptive use through crop management (i.e., by temporary fallowing or shifting to a new crop type) stand out in terms of reliability in water savings and may be some of the easiest and cheapest strategies to pursue. - Crop prices and trends across many different regions indicate that there are possibilities for farmers to shift to alternate crops, thereby saving substantial volumes of water while enabling them to sustain or even increase agricultural revenues (refer to Tables 2 and 3).
Lit-12	- Demand management relies on customer participation; while reductions can be large and demand actions require considerable staff time, funding and ongoing customer commitment to change behavior. - Fines were part of the water conservation strategy by the state and it could have been cheaper for a water supplier to pay the fine than implement the water conservation strategies to meet the goal. - Lower compliance/water conservation targets resulted in greater compliance.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Yes, a 25% water conservation target resulted in 524,000 million gallons of water saved from June 2015 - May 2016	-Demand management relies on customer participation; while reductions can be large and demand actions require considerable staff time, funding and ongoing customer commitment to change behavior. - Prioritizing reducing outdoor water use achieved significant savings - Executive Order B-29-15 required water suppliers to report monthly information on water use, conservation achieved and any related enforcement actions - State, media, and community members created and maintained widespread attentio on the drought - Drought provided numerous opportunities for water suppliers throughout the State to work together	Exploring a "proof of concept" for water transfers (testing the physical and legal systems) - e.g., pumping and delivering groundwater in lieu of pumping surface water to meet local demands, to make surface water available for transfer	- Water suppliers collaboratively met (within 0.5%) the Governor mandated cumulative 25% water savings from the State's urban areas (compared to 2013 water production) from June 2015-May 2016. This amounts to 524,000 Mgal in water savings. This was achieved because the program: - used an enforcement strategy - was a big coordinated effort on conservation messaging across water suppliers - calculated regional targets was helpful for public outreach and media related inquiries	- Demand management relies on customer participation - while reductions can be large, demand actions require considerable staff time and funding and ongoing customer commitment to change behavior. - Local land use codes still allow for predominate turf grass landscapes, although codes are changing to include text discussing lower water use plantings and sustainable designs (in the context of trying to reduce outdoor water usage) - Proposition 218 requires a water supplier not charge more to a customer than it costs to deliver water to the customer (in the context of trying to reduce cost implications of lower water usages with watering restrictions and conservation) - Multiple level of active communication presents challenges (terminology or communication of misinformation)	- Need to align water conservation targets with actual local water supply conditions. - Need a State supply-based drought policy that requires water suppliers to motivate customers to reduce water even when the local water supply is sufficient (supports State and local water manager credibility). - Consider how larger water suppliers (usually with greater volume of supply) implement water conservation differently than smaller water systems who typically have smaller volumes of storage/rights and are in Need most during droughts.
Lit-13	- Consider the datum selection and sensitivity of the model to the datum value (i.e., locations with higher elevations are at a lower temperature than lower elevations causing the model to potentially detect higher locations as having higher ET values). - ET values could be mis-represented by using data from locations that aren't representative of the project (over/under-estimating CCU).	Not discussed.	- The difference between the daily LAS-estimated and ReSET-derived ET was 24.8% on a daily basis, with a maximum difference of 57.1%. - Overall, it was observed that ReSET-derived ET is lower, and may underestimate both stressed and non-stressed categories. - However, ReSET overestimated ET for the peak growth season of grass for some scenarios evaluated in the study (Path 34 / Row 33).	Not discussed - however there is the potential to over or underestimate ET and CU, potentially leading to miscalculations.	- There are multiple variables that factor into the ET calculations, which in turn can result in over or underestimated values. -Site-specific data would support more accurate representation of ET and CU.	Not discussed.	- Traditional point-based consumptive use estimates do not capture intra- and inter-field variability, and water delivery records may not be reliable enough (even if available for project and site parcels) to differentiate between consumptive and non-consumptive uses. - This study investigated the use of ReSET on the Western Slope to determine CU, specifically evaluating its use for the energy-limiting (non-soil-water limiting) and soil-water limiting conditions.	- Consider the datum selection and sensitivity of the model to the datum value (i.e., locations with higher elevations are at a lower temperature than lower elevations causing the model to potentially detect higher locations as having higher ET values). - An energy balance model that is not based on anchor pixels, like Two-Source model, may perform better and worth evaluating in future work. - Need more than one image per month to estimate CU, especially for pasture crops that will experience different cutting cycles and rapidly changing phenology over a month. - MODIS Aqua/Terra should be used in conjunction with Landsat after using a pixel sharpening technique to run ReSET or using an approach that doesn't require a thermal band (like Sentinel in conjunction with Landsat).	-Site-specific data would support more accurate representation of ET and CU. - The NDVI-Kc approach can be a promising tool for estimating near-real time ET in the future, especially when combined with Landsat 7, Landsat 8, Sentinel 2a MSI and Sentinel 2b MSI satellites. - The monthly CU (and subsequent CCU) estimation using this approach on an enhanced temporal scale has a potential to overcome the limitations of using the energy balance approach which relies on the thermal bands, thus a limited temporal frequency of only Landsat satellites.	- There are multiple variables that factor into the ET calculations, which in turn can result in over or underestimated values. - Site-specific data would support more accurate representation of ET and CU.	- Further evaluation of ReSET under both full and limited irrigation conditions on a monthly time-scale is recommended. - Further validation needs to be done using lysimeter or neutron probe ET estimation.
Lit-14	Invested in soil water monitoring probes (503 D Hydro probe, CPN International) MMAOV macro in SAS 9.4 software program used to analyze data	Not discussed	The measurement of pumping supports the amount of irrigation water applied	Reduced pumping (irrigation) could benefit groundwater levels, but is not discussed	The following equipment is needed: - pumps with meters - probes to measure sub-surface soil conditions	Resulted in retiming of groundwater depletions	Timing of irrigation relative to the growth of the plant could be helpful when timing deficit irrigation In arid western Nebraska, it was noted that ET almost always exceeded precipitation. It could be helpful in understanding timing and application of water	Higher elevation snowpack and timing of deficit irrigation was not applicable as they rely on flood irrigation however, this study could be helpful for a range of elevations where different surface irrigation practices begin	Multiple consecutive years across a variety of hydrologic/precipitation seasons	None but study limited to dry beans	Consider deficit irrigation to support critical growth of crop for higher yield
Lit-15	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found	Paper not found
Lit-16	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed

Exhibit B-12
ATM Documents with M&V Criteria

EXHIBIT G

					Monitoring and Verification																															
					Methodologies and/or Processes						Necessary Data and Equipment															Program Level Considerations							Key Takeaways			
											Agricultural Participants								Municipal Participants									Monitoring & Verification Workgroup Guiding Principles								
Title	Date	Publisher/Authors	Description	Notes	Measurement of water returned to the stream	Consumptive use analysis	Estimated residual field consumptive use	Return flow maintenance	Verify conserved consumptive use	Coordination of Benefits	Representative Crop ET Data	Verification of conserved consumptive use	Sub-irrigation	Reservoir operations	River diversions & foregone or bypassed diversions	Lateral delivery and ditch loss	Irrigation and non-irrigation season return flows	Resulting streamflow	River diversions	Foregone or bypassed diversions	Reservoir operations	Ditch or pipeline delivery	Overall collection systems	Monitor system-wide operations to verify conserved consumptive use	Detailed system-wide accounting records	Tradeoffs - Value and/or cost implications for more precise data	Proportionality	Honest, accurate, and defensible	Protective of other water users	Simple, easy, and flexible	Resulted in added water, rather than a retiming of depletions	Lessons learned	Data gaps	Keys to success	Identified challenges	Overall findings and recommendations
					e.g. analytical processes and whether or not M&V activities were measured, estimated, or not considered						*e.g. field specific data or regional data?*	*e.g. visual verification, regional data, or specific data?*	*e.g. wells monitored or piezometers*	*e.g. staff gauge reading or outlet meter?*	*e.g. flume or pump, regular or continuous readings?*	*e.g. regular or continuous flume readings?*	*e.g. measured and returned via aug station?*	*e.g. available streamflow measurements?*	*e.g. flume or pump, regular or*	*e.g. estimated from streamflow measurements or*	*e.g. staff gauge reading or outlet meter?*	*e.g. flume or pump, regular or continuous readings?*	*e.g. monitor other diversion from the same basin?*	*e.g. compare overall basin diversions to*	*e.g. are system-wide accounting*	*e.g. value between estimating a lower yield vs. obtaining measurements to increase yields?*	*e.g. geographic diversity?*	*e.g. accuracy of estimates and/or data collected?*	*e.g. consideration of adjacent and/or downstream water users?*	*e.g. amount of effort required to equip farm and/or implement project?*	*e.g. activity resulted in a net increase in water in the stream?*	*e.g. critical items, or considerations for future projects?*	*e.g. data and/or information necessary for future projects?*	*e.g. crucial paths and/or processes that should be replicated?*	*e.g. mistakes that should be avoided?*	*e.g. comments on the feasibility of DM activities?*
ATM-01 Use of Alternative Transfer Methods to Increase Water Supplies for Conejos Basin Agriculture, Municipal, and Environmental Purposes	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205333&dbid=0	Trujillo Meadows Reservoir ATM Study (TMR Study): "The primary objective of the TMR Study is to investigate the feasibility of a unique ATM that involves enlarging Trujillo Meadows to provide intra-year regulation of water supplies including direct flow storage and storage of other agricultural and augmentation water rights for agricultural users diverting from the San Antonio.	ATM w/ recreational and environmental benefits for municipal augmentation w/enlargement of Trujillo Meadows Reservoir. Stakeholder meetings for federal & state agencies, ag, and town aug needs. Model of ATM, details of benefits, recommended path fwd. Appendix A estimates of monthly inflows to reservoir. Water rights include USFS Reserved Rights decreed as ISF, interstate shepherding	Like-basin methodology using nearby basin with stream measurement -- Conejos River basin selected	2004 Rio Grande StateCU from 1950-2002 for districts 20-22, 24-27, and 35	Not discussed.	Coordinated releases from Platoro Reservoir and Trujillo Meadows	Not discussed.	Not discussed	RGDSS and StateCU	Dry-up and conserved CU dependent upon proposed enlargement of storage and/or vice-versa	Not discussed.	Inflow, storage, and outflow measurement would be needed to monitor	Not discussed.	Study applied 50% combined ditch loss and irrigation efficiency for demand estimates	Not discussed.	Outflow measurement and/or stream gage downstream	Pumping rates, volumes, reporting to states	Dry-up from irrigators related to amount of storage proposed	Storage and release need to be coordinated through other reservoirs	Recommended conveyance from Conejos River to San Antonio River	Not discussed.	Not discussed.	Pumping records and augmentation requirements	Benefits of meeting augmentation requirements for Towns outweighs cost of expansion of existing reservoir and/or additional reservoir construction	Helps alleviate Rio Grande Compact obligations and distribute curtailments throughout basin	If proper measurement structures installed to determine storage & outflow	Yes, interstate compact obligations are big driver for feasibility study, as well as in-state water right	No, no, and kinda	No this would only result in re-timing of depletions and/or augmentation	Enlargement would be feasible to help Towns/Municipalities with augmentation	Stream flow measurement, storage measurement on Trujillo Meadows	Not discussed	Not discussed	Evaluate enlargement of Trujillo as well as placement of additional reservoir in basin
ATM-02 Development of Land Fallowing-Water Leasing in the Lower Arkansas Valley	2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195733&dbid=0	The goal of this report is to "report on the development from 2002 through mid-2011 of rotational land fallowing-water leasing (fallowing-leasing) in the Lower Arkansas Valley of Colorado (Lower Valley) by the Lower Arkansas Valley Water Conservancy District (Lower Ark District) and the Lower Arkansas Valley Super Ditch Company, Inc. (Super Ditch)."	Return flow needs may require additional recharge ponds & stations; Return flows unnecessary at times due to trans-basin supply; considers monthly return flow "factors"; analysis by Leonard Rice Engineers found that replacement water will be required in the non-irrigation season in most cases.	Return flow stations, ponds, flumes	Hydrologic-Institutional (H-I) Model, Groundwater Accounting Model (GWAM)	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Most storage included at Pueblo Reservoir and conveyed to munis through SDS	Not discussed.	All-or-none approach with Super Ditch Co - lateral users will have to follow Super Ditch. Ditch loss was calculated as 10% conveyance, 65% irrigation efficiency	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Munis were worried about another entity buying up water rights during lease and leaving Muni high-and-dry after lease term expires	Munis want protections, lease-fallow is generally attractive to farmers	Yes	Yes	No, no, and kind of	No this would only result in re-timing of depletions and/or augmentation	Not discussed	Not discussed	Increasing storage for farmers to use as lease water, simple tools and admin process to help farmers balance economic choices	Not discussed	Continue developing and piloting lease-fallow programs
ATM-03 Little Thompson Farm ATM Grant Completion Report	2018	https://www.larimer.org/sites/default/files/uploads/2018/larimer_county_atm_final_report.pdf	Study funded through CWCB 2015 ATM Grant. The Little Thompson Farm receives supply from Handy Ditch and Reservoir Company shares and 240 C-BT units. The consultant team found that "it was feasible for Larimer County to afford, from a water supply perspective, to sell some C-BT units (115) and share some other units (80) in some years, while still having sufficient water on the farm for corn and sugar beets, as well as crops that require less water." The study looks at aspects of feasibility, including: Economics; Farm Financial Viability under wet, dry, and very dry year scenarios; dry year water value. The report also investigates potential partnerships, and outlines the final water sharing agreement. "Larimer County sold 115 C-BT units to Broomfield and retained a first right of refusal to lease back these units for assessment cost plus 10%, when available. " The report also discusses Lessons Learned and Future Considerations: Legal Hurdles/Barriers to Replication (Northern Rulemaking, Direct Flow Rights, Delivery Efficiency Impacts from Water Transfers); Public Perception & Political Will (Educating and Obtaining Support of Leadership, Public Support, Out of County Partners, Continued Education); Negotiating an ATM: Successful Tips, Tricks, and Tools (Establish and Pursue Goals with an Open Mind About Implementation, Minimize the Cooks and Trust Your Team)	Cover crop & leaving crop residue prevents wind erosion, maintains soil fertility, controls weeds; non-irrigated cover crops: dryland milo, sorghum/Sudan grass for soil health, reduce weeds, potential revenue; w/no cover crop, control weeds w/herbicide or tillage (tillage can reduce erosion by forming large soil clods & enhancing infiltration); Class II and III soils, slopes 0-5%, not high enough for severe erosional problems; no/low-till also recommended to reduce direct evap, improve soil health, reduce fuel & costs; irrigation efficiency via contour farming, drip irrigation, SM & ET monitoring, drought tolerant crops, GPS irrigation guidance; no return-flow requirements due to CBT water, so no effort to quantify despite opponents	Parshall flume on farm for normal irrigation, Ditch company rules dictate when/amount of different water types for irrigation (direct, storage, C-BT)	Integrated Decision Support Consumptive Use model (IDSCU)	Not discussed.	Sometimes, when C-BT credits not transferred to Broomfield	Not discussed.	Farm keeps irrigating most years (9 or 10 out of 11) and gets cash for sold credits	Soil moisture and ET monitoring station recommended, not implemented	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Dry Creek Lateral of the Handy Ditch, end-of-ditch users could lose out if too much ATM water transferred out. Ditch loss was calculated as 25-50% conveyance	Reduced return flow to Little Thompson River as a result of ATM	Reduced return flow to Little Thompson River as a result of ATM	Handy Ditch Company closely tracks water in ditch	Not discussed	Ditch company holds shares in reservoirs and delivers them to members through Hany Ditch	Both, existing infrastructure on Farm	Accounting in reservoirs where Ditch Company owns shares	Not discussed.	Presumably in place at Ditch Co.	Not discussed	Not discussed	Yes	Yes	Yes	No	Legal mechanisms to allow change of use to be flexible enough for munis and stable enough for farmers is an issue for this ATM; Working with Ditch company to maintain critical mass of flows in Handy Ditch was important for buy-in; public perception was crucial and political engagement from County was essential; locally-focused, in-person, face-to-face, tailored to muni concerns; develop clear goals but stay willing to compromise; dedicate staff to properly execute on the project goals; have a plan B	Not discussed	Keeping critical mass in ditch for Ditch Company buy-in; work with water conservancy district closely; limited legal mechanisms through water court make it tricky; be conservative in ditch efficiency to keep downstream users whole; identify clear goals with establish an ATM but stay flexible about details	Limited legal mechanisms; identifying and engaging with best fit for municipal partner to sell/lease shares	Through pilot demonstrations, the State can help encourage "innovators" and "early adopters" such as Larimer County and Broofield to consider adopting ATMs to meet their goals
ATM-04 HB13-1248 Catlin Canal Company Rotational Land Fallowing-Municipal Leasing Pilot Project	2018	https://dnrweblink.state.co.us/cwcb/0/edoc/210320/19%2001%2015%202018%20Annual%20Report%20-%20Catlin%20Pilot%20Project%20FINAL.pdf?searchid=3856cf32-c475-4163-840c-5361fa65041f	The Catlin Pilot Project was the first rotational land fallowing-municipal leasing pilot project under HB 13-1248: Irrigation Water Leasing Municipal Pilot Projects. This project aims to makes available up to 500 acre-feet of water for lease to three municipal water providers – the Town of Fowler, the City of Fountain, and the Security Water District (Municipal Participants) - from rotational fallowing of lands located on six farms irrigated under the Catlin Canal in the Arkansas River Basin.	Huge emphasis on return flows; using Lease Fallow Tool from DWR to calc available water & owed returns; "Pay As You Go" target deliveries for return flow; use of recharge structures supported well-timed return flows; augmentation station used for faster return flows and consumptive use water delivered to municipal participants; erosion & weed control included herbicide, disk tilling, cover crops (winter wheat, hay)	Timpas Creek augmentation station	LFT	Not discussed.	LFT and coordinated exchanges/releases at Timpas Creek Augmentation Station and nearby recharge ponds	Accounting for exchanges and water deliveries to munis	Not discussed	Not discussed.	Accounting for exchanges and water deliveries to munis	Not discussed.	Not discussed.	Field visits to track condition of fallowed areas	Not discussed.	Accounting for exchanges and deliveries to Timpas Creek Aug Station	Not discussed.	Existing structures, diversion records	Existing structures, diversion records	LAWCD coordinates releases from Pueblo Reservoir	Existing structures, diversion records	Existing structures, diversion records	Not discussed.	Yes very detailed	CU Water estimates based on LFT and H-I models differ dramatically and may limit water available to munis excessively	Not discussed	Yes	yes	No, yes, and yes	No	Largely successful project: water deliveries were made, return flow obligations met, farmers got paid, munis got water at reduced rate, fallowed areas were able to bounce back with re-irrigation, no issues with erosion or noxious weeds	None identified or stated in report	Cooperation and communication among state(s), districts, munis, SEO; recommend an "owe-the-river" storage account at participating reservoirs to allow for more precise exchange accounting and less excess storage of CU credits	Conservative exchange rates for deliveries meant that munis had reduced CU credits available	Successful operation of pilot project; COMMENT: no discussion of public engagement or perceptions, so more research into public take on pilot project
ATM-05 Yampa Basin ATM Study	2014	https://dnrweblink.state.co.us/cwcb/0/edoc/199193/Yampa%20-%20NC%20Use%20of%20ATM%20to%20Meet%20Non%20%20Consumpt%20Needs_FINALReport%203-28-14_with%20apps.pdf	Study conducted by Trout Unlimited (TU) and funded by CWCB's Alternative Agricultural Water Transfers Grant Program. The purpose of the study was to identify locations in the Yampa Basin where potential ATM transactions could help to meet multiple uses (nonconsumptive needs and agricultural shortages), and identify types of ATM transactions most suitable for meeting multiple purposes. Ideal candidate reaches, as specified by project proponent TNC and its partners, would involve the following scenario: - Upstream agricultural water user with full or surplus irrigation supplies and transferable CU water - Downstream agricultural water user with an irrigation CU shortage (consumptive need) - A need for water in the reach between to improve flows for trout (including Colorado cutthroat trout) or warmwater fish (nonconsumptive need)	Used StateMod delay table to estimate historic return flows; more efficient irrigation improves water quality by lowering return flow contaminant transport, fewer excess nutrients due to fertigation in drip systems; TNC/TU partnership to support instream flows for habitat w/ATM loans used when downstream ISF right is not satisfied & to provide flow in a reach without ISF right	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	CWCB ISF could be a very useful tool for protecting instream flows for downstream users but cannot protect against intervening senior diversions; state data is useful but has limitations, on-ground-data will be essential; shepherding is very challenging; collaboration among all water users will be key	Not explicitly, just that StateMod can only do so much, need to get in situ data	Local participation through ag organizations, roundtables, conservancy districts, etc.	Not discussed	Not discussed
ATM-06 Grand Valley Water Users Assn Conserved Consumptive Use Pilot Project Development: Process, Procedure, and Lessons Learned: Water Banking-Next Steps Part II	42795	http://www.grandvalleywaterusers.com/uploads/8/2/6/0/82606774/03-01-17_ccupp_projectdevelopment_final.pdf	The Conserved Consumptive Use Pilot Project (CCUPP) is a pilot demand management project intended to test the mechanisms necessary for a Western Slope irrigation water provider to intentionally reduce consumptive use in a voluntary and compensated manner. This report summarizes the process of developing the CCUPP, the procedure used, and lessons learned.	Land management contract: manage weeds & plant growth, soil erosion (leave plant residue, tillage for clods, tillage for crust), w/mid-season visit to confirm mgmt. activities are consistent w/contract; interviewees concerned w/DM externalities including local economy & aesthetics; CCU verification procedures (Exhibit B) don't specify methods to verify CU on fallowed land, but does include sites visits to verify land mgmt. and explicitly prohibits any active plant growth on fallowed land	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	GVWUA members are NOT that thrilled about DM projects, need more convincing than Front Range irrigators; planning for at least one year out from any decisions or agreements; localized and personalized outreach is crucial to find participants; directly address negative impacts of decreasing irrigation on the Western Slope (environmental, local economy, etc.); ensure federal compliance; market risks of Non-participation as much as benefits of participation; engage ag producers early and often in program process	Not discussed	Not discussed	Not discussed	Not discussed
ATM-07 Grand Valley Water Users Assn 2017 CCUPP In-Season Verification	2017	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=205144&dbid=0	Field compliance and payment summary for the 2017 CCUPP, including verification forms for each program participant for 2017.	Includes 2017 verification documentation including photographs, recommendations, comments/notes	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-08 Power Canal Capacity Report, Grand Valley Water Users Assn	12/1/2015	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=201813&dbid=0	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank:" to convey CCU via unused capacity within the Orchard Mesa Power Canal (power canal) to deliver water to the Grand Valley Power Plant (GVPP). The report investigated the potential unused capacity within the Power Canal, including the potential for additional water to generate hydroelectric power.	Very brief report on "one potential mechanism through which water associated with CCU could be protected and returned to the Colorado River under a pilot project water bank." Compensated, temporary, voluntary. Lists current operations, water rights, data. Incomplete file in link, merged with 2017 Next Steps Part II	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed
ATM-09 Completion Report: Development of Practical Alternative Agricultural Water Transfer Measures for Preservation of Colorado Irrigated Agriculture	5/1/2011	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=195709&dbid=0	An extensive evaluation to: 1) To identify barriers to implementation of alternative transfers and to describe potential strategies for overcoming barriers. 2) To develop tools for agricultural producers to evaluate the viability of potential alternative transfers. 3) To further actual alternative transfers by evaluating three demonstration projects that include owners of agricultural water rights and potential end users of the temporarily transferred water.	Extensive final report on ATM investigation & pilot on NE South Platte covering barriers (cost, risk/uncertainty, lack of supply, reluctance, power dynamic), needs and means to address barriers, Lease Evaluation Tool (AgLET) ag economics evaluator, exchange capacity analysis, flex market pilot project w/Aurora.	Potentially new flumes in tailwater laterals; measurement devices at recharge stations or wetlands/ponds	Standard methods	Not discussed.	Accounting at recharge stations primarily, or estimated from irrigation efficiencies and diversion records (with ditch losses)	Depends on the ATM program: fallowing vs. deficit irrigation, etc.	Not discussed	Standard methods	For fallowing: SEO verifies by checking field is not irrigated; For deficit irrigation: technology available to quantify aspects of CU but have not been tested in Water Court!	Not discussed.	Not discussed.	CDSS	Not discussed.	Depends on which portions of land are fallowed, may need additional pipelines/ditches or pumping to get water to the historical patterns; may need multiple infrastructure changes to re-establish timing	Not discussed.	Not discussed	These flows are not accounted in the available supply for transfer	Not discussed.	Common crux of issue for potential ATMs -- Muni is upstream of the irrigation point-of-use so actually transferring water, minimizing exchange dry-up, etc. can be challenging and more so the further the irrigated land is from the Muni	Not discussed.	Not discussed.	Not discussed.	Potential injury to senior water rights holders based on historical consumptive use analysis -- some recent Water Court cases (ES.1.3) "risk associated with any process that quantifies a senior right based on historical use, in light of recent decisions curtailing use of senior water rights based on 'lawful' versus 'unlawful' historical use."	Concern of ag users that benefits outweighed by the pain of implementation, reporting, monitoring, application, etc.; Munis are not interested in a program that isn't easier, faster, or cheaper than buy and dry.	Not discussed	Not discussed	Not discussed	Not discussed	Legal mechanism is crucial to get buy-in on both sides: 1) protections for ag users from diminishment of rights or risk of abandonment; 2) Munis know buy-and-dry and any program that is potentially less efficient or doesn't provide long-term security is not worth the trouble IWSA is currently the only option that allows for ATM without water court change case and "simpler" approval process through SEO; low participation in IWSA indicates that the protection to water rights still presents obstacles that are too onerous General recommendation that SEO should have more authority regarding rulemaking for temporary water transfers under the umbrella of ATMs	Most discussion relied on CDSS data that is publicly available and leverage existing irrigation and recharge infrastructure / Limited discussion of equipment and infrastructure needs for 1) delivery of transferred water (usually upstream to &I) and 2) measurement of CU/return flows/etc.	Programs that can address the barriers listed in the next cell --->	Five barriers identified from interviews with M&I and ag users: 1) High transactional cost, equal to or greater than typical buy and dry process; 2) Risk and Uncertainty, for ag users related to HCU analysis potentially diminishing value of right based on unlawful historical practices, for M&I users the untested nature of some ATMs is too risky; 3) Lack of Capabilities for Delivery, lack of infrastructure can be a major barrier; 4) Opposing reluctance between M&I and Ag users need for permanent supplies and desire to remain flexible year-to-year, respectively; 5) Power Imbalance, related to access to technical and legal services to	Not discussed
ATM-10 Final Project Report: Implementation of Deficit Irrigation Regimes: Demonstration & Outreach	May-16	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199317&dbid=0	Evaluation of different methods of monitoring crop water stress and consumptive use (CU) under deficit irrigation. Demonstrations, workshops, educational outreach on crop stress monitoring.	Demo project to evaluate different methods of monitoring crop water stress and CU under deficit irrigation & demo educational outreach on crop stress monitoring.	Standard methodologies	Study focused on comparing measurement techniques to estimate crop coefficients (and therefore ET and therefore CU): Crop coefficient (Kc), soil water balance, infrared thermometers, Crop Water Stress Index, Landsat NDVI, ground based NDVI and ReSET methods	Not discussed.	Not discussed.	Not discussed.	Not discussed	Soil moisture sensors, infrared thermometers (IRTs), landsat images	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Conclusion is that Landsat-NDVI based crop coefficient estimates are just as accurate as expensive and labor intensive ground-based measurements	Not discussed	Yes	Not discussed	Relatively, is all open-source data and indices provided by USGS from Landsat sattelites	Not discussed	IRTs require calibration and research-grade instruments can be several hundred to several thousand dollars; commericial handheld IRTs require extensive calibration and separate instrumentation to properly measure canopy temperatures; CWSI tends to underestimate ET becuase background temperature measurements can contaminate IRT measurements; SWB with soil sensors is intensive, expensive, and typically covers limited areas (could be good for small projects?); reflectance based crop coefficient estimates using remote sensing NDVI are just as accurate as other ground-based NDVIs	NDVI is a useful tool to estimate crop coefficients and ET for large, ditch-scale analysis; SWB could be a good alternative for small applications	Not discussed	Ground-based techniques (CWSI, ReSET) have similar or worse accuracy compared to satellite-based techniques for estimating NDVI. Ground based techniques are labor intensive and require investment in research-grade equipment. Landsat NDVI from USGS is FREEEEEEEEEEEEE.	Ground-based techniques (CWSI, ReSET) have similar or worse accuracy compared to satellite-based techniques for estimating NDVI. Ground based techniques are labor intensive and require investment in research-grade equipment. Landsat NDVI from USGS is FREEEEEEEEEEEEE.
ATM-11 The Poudre Water Sharing Working Group: A Report to the CWCB	May-15	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=198097&dbid=0	Final report of Poudre Water Sharing Working Group - a prototype ATM water sharing group between agricultural users (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and municipal users (Fort Collins, Greeley, and Tri-Districts) on the Poudre River, facilitated by the Colorado Water Institute at Colorado State University. The report focuses on the formation of the working group, relationship building, lessons learned, survey of ag users, development of prototype agreements, and regional cooperation strategies.	Final report of prototype ATM water sharing group between ag (North Poudre Irr Co, Water Supply & Storage Co, New Cache la Poudre Irr Co, and Larimer/Weld Irr Co) and muni (Fort Collins, Greeley, and Tri-Districts) on the Poudre River. Identified CCU calculation methods as a large barrier.	Standard methodologies	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Personalized approach to ag about alternative options	Not discussed	Proposed buy and supply hybrid ATM: "[...] where land and water that a farmer needs/wants to sell is purchased by a conservation entity (typically with multiple partners) that places a conservation easement on the farm and leases or sells back to an agricultural producer. A portion of the water is reserved for lease to domestic water providers for drought firming, recover 3 years in 10, or even for base supply where possible.
ATM-12 FLEX Water Market: Education and Implementation Phase	##########	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=197916&dbid=0	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders. The goal of this project was to successfully implement the FLEX Water Market concept through education, facilitation, and consultation, with specific focus on developing FLEX markets in Water Division 1 with municipal, industrial, agricultural, and	Investigation of FLEX water market implementation: engagements, index based pricing, theorizing on large-scale implementation, meetings between willing shareholders.	Standard methodologies	Standard methodologies	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Market volatility and changing priorities for private industry make it tough to work out deals; customized approach for infrastructure needs on a case-by-case basis to assess needed infrastructure; Pipelines to deliver downstream ag water upstream to M&I could have the unintended consequence that Interstates had -- if you're not able to access the pipeline, then your water will be	Consumptive use quantification could potentially be used to substitute the need for a change-in-use with end-users to be determined -- framework for Water Court case??
ATM-13 Alternatives to Permanent Dry Up of Formerly Irrigated Lands	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199208&dbid=0	Review of benefits and issues of two alternatives to buy and dry that maintain some continued level of agricultural production: 1) Dry land farming, and 2) limited irrigation.	Review of benefits and issues of buy and dry and alternatives. Potential for conversion of ag land to dry land or deficit-irrigation, economic & maintenance issues w/dry land & deficit.	Standard methodologies	Standard methodologies	Not discussed.	Not discussed.	Depends on farming practice...Permanent dry-up is site visits to verify no irrigation and reveg process in underway; Limited Irrigation is more complicated to track amount of water being applied to land (what is partial CU for a crop?)	Some discussion where limited irrigation could benefit both M&I and ag user: when there are surplus water in their supply portfolio that cannot be directly used or stored, so this can be leased back to irrigators, which are accounted for in the form of recharge stations and any surplus credits. The recharge credit framework takes care of lagged return flow timing issues and allows better coordination between M&I and ag	None - standard methodologies applied	Limited irrigation is difficult to quantify using standard methodologies (i.e. court-accepted)	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Difficult to maintain during limited irrigation	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Recharge accounting at any recharge stations would be key to any sort of limited irrigation or lease-back agreement between M&I and ag	Potentially costly to verify CU on limited irrigation of crops	Not discussed	Not discussed	Not discussed	Not discussed	Revegetation of sites could lead to increased water in streams rather than just a retiming but it would depend on the crop type	Historically irrigated field have poor soil health and perennial and/or native vegetation are ill-equipped to handle poor soils (high compaction, poor structure, low organic matter, and possible high nutrient residuals).	Soil physiochemical analysis, organic matter content (also helps indicate infiltration and crusting issues), and soil texture analysis can help determine best path to revegetation strategies	Planning ahead of field fallowing or dry-up can improve outcomes for establishment of native non-irrigated vegetation. Minimize carryover of Nitrogen. Weed control continued for 3-5 after planting/seeding native veg	Each site needs specific species, equipment, tillage practices, and timing to achieve best results. Long-term project timeline of 5+ years to achieve good results. Significant cost to farmer / No crop insurance or assistance available for limited irrigation / typically 0.5ft/acre of water is more valuable than limited irrigation yield (payout from limited irrigation farming unlikely to justify cost of continued farming efforts)	Water court has legal authority to allow limited irrigation in an ATM but it hasn't been established or tested in any case yet /
ATM-14 Water Partnerships: an evaluation of alternative agricultural water transfer methods in the South Platte basin.	March-12	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199215&dbid=0	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte, focused on FRICO shareholders.	Water market experiment, survey of municipal & industrial providers on ATM practices, leases, evaluation of shared water bank scenarios on South Platte	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Report details an economic experiment where volunteers played a game to test out scenarios of a "shared water bank" to see whether M&I or Ag users benefit the most by tracking who gets more water under different market conditions and regulations	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Economic laboratory experiment to test water leasing market results: - Ag users will retain more water rights and more water than in typical buy-and-dry practices and thus add benefit to rural communities over buy-and-dry - Leasing markets do not necessarily lead to efficiency gains in water usage or ag production - Overall, there's a reduced impact to rural communities but at the cost of water rights holders because the value of water rights will decrease with introduction of water leasing market	Not discussed	Yes	Yes - leasing markets allow M&I to buy leases from farmers during dry years without buy-and-dry impacts but there's not much benefit to farmers in wet years	Not discussed	Lots of Ag and M&I survey results about willingness to participate in ATMs/Water Sharing Banks: - Ag users willing to work with M&I but want short-term agreements with flexibility for dry/wet years - M&I users generally do not see ATMs as great solution, they are still planning on buy-and-dry for the future, they see lease-back to ag as best alternative to buy-and-dry but it's not their first choice	None identified or stated in report. The hypothetical scenarios that were modeled all relied on publicly available data from the DWR.	Incentives that assuage concerns of both farmers and M&I, but primarily M&I needs Not putting cost burden entirely onto ag and M&I but perhaps State sharing some cost	Inherently opposing goals of individual irrigators and M&I	Findings: - Irrigators are reluctant of ATMs due to 1) concerns over ability to sell their water rights in the future, 2) reluctance to go through water court for fear of consequences similar to Case No 02CW403 - M&I users plan to acquire ag water rights as part of their long-term supply planning & development - M&I users are reluctant of any ATM method unless they can be assured 1) permanent supply, 2) ownership of water rights used in their supply, 3) certainty & reliability, 4) they can have a permanent supply at the end of an agreement period for an ATM. Recommendations: - Survey M&I across other Divisions to see if they share concerns of S. Platte M&I's - Refine and educate M&I about ATMs - Work with M&I to construct ATMs that address their primary concerns - Conduct additional lab experiments like detailed in the report to vet ATM concepts - Develop financial models that help illustrate impacts of buy-and-dry vs. ATMs - Incentivize preservation of agriculture by ensuring that costs are not borne entirely by irrigators or M&I
ATM-15 Project Report: Lake Canal alternative agricultural practices and in-stream flow demonstration project	June-13	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=203045&dbid=0	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	Proof of concept project planning for ATM/ISF program on Lake Canal. Monitoring/verification based on deliveries, surface returns, inflow to recharge pits, and soil moisture sensors to verify return flows by lack/presence of moisture movement below the root zone. Project was not implemented due to ongoing water scarcity at the time (2012-2013) and inability to agree on a price. Describes extensive legal work to arrive at proof of concept.	This project was not actually implemented - By-pass of diversions from the Lake Canal headgate on the Cache La Poudre River - Storage water conserved would remain in Storage at S. Gray Res or Timnath Res - Project goal was to allow conserved CU to flow past Fort Collins, but that could only be directly accomplished for in-priority diversions from Cache La Poudre into Lake Canal; stored conserved use had to be exchanged upstream with C-BT water based on agreement with WC and Lake Canal Co superintendent	HCU to quantify water right, and another Transferrable CU analysis based on crops used for deficit irrigation This project was not actually implemented	Computed from baseline CU (i.e. HCU) and measured CU by only deficit irrigating a portion of each participating farm This project was not actually implemented	Same This project was not actually implemented	This project was not actually implemented '- Integrated SCADA system to collect and record data from measurement structures at participating farms - Diversion Flows: in-situ real-time measurements at existing Parshall flumes into an integrated SCADA system - Surface Return Flows: in-situ real-time measurements at proposed flumes at all surface runoff outfalls at partipicating farms (number and placement dependent on site topography/hydrology - Soil Moisture: capacitance soil sensor arrays integrated into SCADA to monitor soil moisture in root zone and below, taking difference between two to estimate subsurface return flow - Recharge pits mointored with long-throated flumes - Weekly aerial imagery captured for particpating farms to inlcude RGB, NIR, and heat signature (IR)	Hyptothetically yes, irrigators get paid for conserving water (fallowing or deficit irrigation) and the M&I interest in maintaining environmental flows for longer reach through Fort Collins could've been achieved This project was not actually implemented	ACSE-PM and Blaney-Criddle calibrated for periods where data for ASCE-PM was insufficient This project was not actually implemented	Approx. $20,000/farm investment in instrumentation on existing flumes, installation of new flumes, soil moisture sensor arrays, and integrated SCADA system This project was not actually implemented	Soil moisture sensor vertically-oriented array down to 7-feet below surface This project was not actually implemented	Stage-capacity curve and water level measurements This project was not actually implemented	Wet-well at flume with pressure transducers for in-situ flow data logging This project was not actually implemented	Existing flumes at ditch turnouts maintained and recorded by ditch company need to be outfitted with pressure transducers for continuous measurements This project was not actually implemented	Proposed flumes to be installed strategically at surface runoff outfalls, outfitted with continuous data logging and integration to SCADA This project was not actually implemented	Estimated from data collected in SCADA This project was not actually implemented	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Estimated $20,000 per property for instrumentation and equipment required to set up integrated SCADA This project was not actually implemented	Independent appraisals of water lease rates, agricultural production opportunity cost would help even the playing field for negotiations between irrigator and M&I This project was not actually implemented	Independent appraisals of water lease rates, agricultural production opportunity cost would help even the playing field for negotiations between irrigator and M&I This project was not actually implemented	Yes	Yes, IWSA allowed for direct flow credits to be counted towards conservation goals as well as late season storage releases, though the Borrower's (Nature Conservancy and City of Fort Collins) valued late-season flows more than excess peak flows for environmental goals This project was not actually implemented	Hypothetically, yes. This project was not actually implemented	This project was not actually implemented but some important lessons were identified from the progress that the project made: - An established and agreed upon lease rate structure is crucial at the beginning of a project - Commission an independent appraisal of the value of conserved water at the outset of a project to ensure both parties are negotiating in good faith - Both sides are weary of any agreement that can be seen as precedent on setting prices for water and tying the value of water to an economic index was agreeable - Flexibility in the timing of deliveries is crucial - Needs, values, and preferences need to be established early and communicated clearly from both sides - Trust building to overcome social and political barriers was time consuming and completely necessary - Other industrial sectors can influence perceived price of water and that needs to be considered in appraisals, particularly any demand from oil & gas - Characteristics of the physical river diversions are important to ensure honest tracking of conserved water	This project was not actually implemented but some important questions were posed in the report: - Does there need to be a direct connection between the timing of the conserved consumptive use and the delivery of water to the river? - Does CU need to be "saved" before it can be "spent"? - Could an unintended consequence of this type of ATM be that this is another tool to get water out of the river and into the treatment plant thereby decreasing river flows in the end? - Does it make sense to try and limit the number of agreements or does this kind of IWSA make this too complicated to be a viable option in other projects?	- Water lease rate was the most difficult point of discussion for the project -- opportunity cost to farmers foregoing sales of profitable crops was a hurdle and oil & gas sector was willing to pay more than Munis in the end - DWR was a willing participant in planning the implementation of the project with respect to river management, instrumentation, and how to monitor and report on return flows - Some project participants had negative interactions and the social/professional history was difficult to overcome	See Lessons Learned	Although actual conservation was not implemented, this project was able to demonstrate/accomplish some tasks: - Quantified the potential supply for the Cache La Poudre River for a reach including Fort Collins - Demonstrate use of IWSA for transferring water outside of a ditch service area - Identify some economic factors driving the ATM - Demonstrate that deficit irrigation can be implemented without adverse impacts to downstream rights - Identify factors that contribute or prevent participation from Ag and M&I
ATM-16 Final Report of the Lower South Platte Irrigation Research and Demonstration Project	Jun-14	https://dnrweblink.state.co.us/cwcb/ElectronicFile.aspx?docid=199218&dbid=0	Technical research paper with three tasks. Task 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. Task 2. Simplify the administrative burden of maintaining return flows. Task 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	Goals were 1. Develop calculation & verification of consumptive water use and water savings, such that water court requirements can be satisfied--uses a stress coefficient, the crop water stress index CWSI, and the ReSET model of remote sensing. ReSET showed accuracy of 92-98% for fields under normal growing conditions and successfully detected abnormal growing conditions to accordingly reduce ET estimates. 2. Simplify the administrative burden of maintaining return flows, and 3. Estimate supply delivery potential. Project on Lower South Platte Irrigation Research Farm near Iliff.	- Assumption is that return flow obligations are met through augmentation so reservoir releases of stored water are applied to cover CCU and Return flows (i.e. no surface return flow from deficit irrigated fields)	Root zone water balance (RZWB) to get estimates of stress coefficient (Ks) and ET for corn in well-irrigated vs. deficit-irrigated plots	Limited/Deficit Irrigating ET estimates were compared in actual test plots: - Stress coefficient - Crop Water Stress Index (CWSI) - ReSET mode (satellite based method)	Water allocation approach -- diversions are limited to what is needed for deficit consumptive use and either augmentation flows are used to maintain return flows	- Stress coefficient -- neutron probe readings used to estimate initial soil moisture conditions for input into the FAO-56 model, which could then estimate changes in stress coefficient (thus ET) over time. - Crop Water Stress Index -- research-grade infrared thermometer used to measure crop canopy temperature changes over time and stress index and thus ET are estimated, with lots of complicated corrections of the infrared thermometer data - ReSET Model -- satellite imagery is tracked over irrigation season and the ReSET model is applied to estimate ET	Not discussed	A control field, ideally in the same property or proximal to project site would need to be fully irrigated and measured in the same method used to quantity CCU (stress coefficient, CWSI, or ReSET).	Depends on the ET estimation methodology: - Stress Coefficient -- neutron probe measurements and soils study to estimate water retention parameters - CWSI -- research-grade infrared thermometer and lots of corrections for background temperature readings and local climate data - ReSET -- no equipment but specific technical knowledge and computers to analyze satellite imagery	Not discussed.	Not discussed.	Allocation approach to return flow maintenance uses normal river diversion measurements: - Return flows are met by a court-approved augmentation plan as opposed to project specific measurements of soil moisture -Diversions are limited to the target deficit irrigation amount and the remainder stays in the river, return flows are maintained through augmentation	Not discussed.	Allocation approach to return flow maintenance uses normal river diversion measurements: - Return flows are met by a court-approved augmentation plan as opposed to project specific measurements of soil moisture	Potentially higher, if CCU is underestimated via ET calculations (methods evaluated all tend to underestimate ET)	Not discussed.	Not discussed.	Yes potentially need to install additional recharge for exchanges and/or pipelines and surface storage to smooth out differences between exchange pumping rates and existing pipeline capacities	Yes the report evaluated installation of a new pipeline to bring exchange water upstream	Not discussed.	Not discussed.	Not discussed.	Depends on the ET methodology: - Stress coefficient -- detailed measurements are needed at the beginning of irrigation season (soil study and neutron probe measurements) to establish initial conditions for FAO-56 model - Crop Water Stress Index -- More use of specialized equipment (infrared thermometer) deployed to the project site throughout irrigation season for no significant improvement in ET estimate - ReSET -- Requires specialized analysis but no major investment in project-specific infrastructure	Allocation method for maintaining return flows require the availability of credits through an approved augmentation plan or willingness to establish a court-approved augmentation plan. CCU depends on ET methodology: - Stress coefficient -- one-time measurements needed at project site prior to irrigation season - Crop Water Stress Index -- continual measurements with specialized research-grade equipment required at the project-site and additional labor to QA/QC the data - ReSET -- special technical expertise required to get best results from model, but no significant investment in infrastructure or equipment needed other than local weather data (could be from existing climate stations)	Yes all three ET estimates are peer-reviewed science-based methodologies	Yes, allocation method for return flow maintenance is limited to projects that can utilize augmentation sources or have willingness to invest in establish an augmentation structures	Yes, the stress coefficient method is identified in report as being the recommended approach for property owners involved in deficit irrigation projects	Yes, less water is diverted from the river and consumed by crops	- ET and CU can be estimated by the stress coefficient method (FAO-56) and diversions at the headgate can be reduced in conjunction with deficit-irrigated ET values - A baseline plot in the project area needs to also be evaluated during the project to establish "normal" wet-irrigation conditions and calculate conserved CU by deficit irrigation - Allocation method for return flow maintenance allows for simple conservative estimates of return flows that are achieved through augmentation and if the ET estimates under-predict CCU, there's a net benefit to the streamflow and downstream users - Delivery of deficit-irrigation CCU is site and region-specific, depending on where along the river the CCU credits are being exchanged from and exchanged to, and additional storage, recharge, and/or pipelines might be required to make deliveries from ag-site to munis	None identified in this report -- it was science based and relied heavily on actual climate and project-site data for comparing three different ET estimation methods	- Reducing administrative burden on verifying return flow maintenance by implementing the allocation method, which can be summarized as: 1) divert the minimum required volume at the headgate to meet estimated deficit irrigation target 2) assume that no flow from the project site is returned to the stream 3) measure CCU at the project site to verify ET and adjust diversions accordingly (daily or weekly, etc.) 4) augment required return flows from an approved (presumably existing) augmentation source	ET estimation methods can have accuracy issues and are highly dependent upon the accuracy of the data being input into the models (garbage in = garbage out). The report identifies the stress coefficient method (FAO-56) as the most cost-effective method for estimating ET and CCU in deficit irrigation projects with accuracy similar to more intensive methodologies like Crop Water Stress Index (CWSI) and ReSET model.	ET estimation methods can have accuracy issues and are highly dependent upon the accuracy of the data being input into the models (garbage in = garbage out). The report identifies the stress coefficient method (FAO-56) as the most cost-effective method for estimating ET and CCU in deficit irrigation projects with accuracy similar to more intensive methodologies like Crop Water Stress Index (CWSI) and ReSET model.
ATM-17 RGWCD Net Annual Replacement Plans	Reports exist for each year. Reviewed report for April 13, 2020	https://rgwcd.org/sd-1-annual-replacement-plan	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc. Reviewed the 2020 Annual Replacement Plan (ARP), to meet requirements for the Plan Year under the provisions of the PWM for Subdistrict No. 1 decreed by the Division No. 3 Water Court in Case Nos. 2006CV64 and 2007CW52. This report describes a plan to remedy injurious stream depletions caused by the withdrawal of groundwater from Subdistrict Wells. This ARP includes a series of tables created by Subdistrict No. 1 staff and the RGDSS modeling team tabulating stream replacement quantities and locations resulting from Subdistrict No. 1 well groundwater withdrawals and a water portfolio to be used to replace such stream depletions.	Rio Grande Water Conservancy District plan to meet interstate compacts through forbearance agreements, leases for exchanges to meet streamflow criteria, temporary fallowing agreements, etc.	Well meters and diversion records	Assumed pumped groundwater used for irrigation with an 83% efficiency for sprinklers and 60% for flood.	Fallowing is the only CCU, otherwise it's forbearance on pumping/diverting	Met through "augmentation" and releases from upstream reservoirs (Rio Grande Reservoir)	Other than using meter and diversion records, it's not really addressed in the report	Detailed accounting of groundwater withdrawals to assess the storage level of the aquifer and track it over time	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Detailed groundwater pump meter data analysis	Not discussed.	Not discussed.	NA, presumably typical water meters were used, possibly with SCADA to coordinate measurements	Various farms, ditch companies, etc. are pitching in for the project, so lots of "teamwork"	Yes	Yes, a big reason for the project is to meet interstate compact obligations	Yes	Yes	Significant gains will have to be made in order to reach program goals by 2030	Not discussed	Detailed accounting	Not enough curtailment/forbearance/fallowing to reach program goals, significant gains will be needed to meet 2030 targets	Not discussed
ATM-18 Alternative Water Transfers in Colorado: A Review of Alternative Transfer Mechanisms for Front Range Municipalities	2016	https://www.edf.org/sites/default/files/alternative-water-transfers-colorado.pdf	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	Review of ATMs in Colorado for Front Range Municipalities. The report conducted a screening analysis to identify potential case studies for a more detailed analysis of ATM, found 35 municipal water providers based on water source and demand size criteria. Two case study participants were identified: City of Fountain and Town of Windsor. The report conducted a financial analysis of water supply alternatives for the two case studies; findings include recommendations for best ATM practices to suit those municipalities.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed.	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed	Not discussed

Exhibit H:

Demand Management FAQ Outreach Document

June 2021

EXHIBIT H

COLORADO WATER CONSERVATION BOARD

Protecting Colorado Water

DEMAND MANAGEMENT FEASIBILITY

General FAQS

JUNE 2021

Q. What is Demand Management?

A. Demand Management is a potential program that could be used to protect Colorado's water users by helping to avoid or mitigate the impacts of a mandatory Colorado River Compact administration scenario. If such a program is established, it could provide compensation for water users to voluntarily conserve water on a temporary basis.

Q. What is the Colorado River Compact?

A. The 1922 Colorado River Compact requires the Upper Division States of Colorado, New Mexico, Utah, and Wyoming to not deplete the flow of the river below 75,000,000 acre-feet over ten years to the Lower Division States. The Upper Division States have never violated the compact, and the purpose of any Demand Management program would be to maintain compliance with the compact.

Q. What agency has the authority to consider the feasibility of Demand Management and implement a program within Colorado?

A. The Colorado Water Conservation Board (CWCB) has authority to consider and implement a Demand Management program within Colorado. The CWCB was established for the purpose of aiding in the protection and development of the waters of the state, for the benefit of the present and future inhabitants of the state. There are several agencies that operate as political subdivisions, but the CWCB is an agency of the state and its functions are governmental functions for the welfare and benefit of the state and its inhabitants.

Q. Why is Colorado considering the feasibility of a Demand Management program at this time?

A. In 2019, the seven Colorado River Basin States finalized the Drought Contingency Plan (DCP), a suite of agreements designed to provide more security to the Colorado River System. The Demand Management Storage Agreement was part of the DCP, through which the Upper Division States committed to considering the feasibility of a potential Demand Management program.

Q. Why might Colorado benefit from a Demand Management program?

A. The purpose of such a program would be to protect Colorado water users from mandatory curtailment in the event of a compact administration scenario by conserving and storing water as an insurance policy of sorts, to help ensure continued compact compliance in the future. Additionally, a Demand Management program would offer a tool to share the burden across water use sectors, as opposed to potential disproportionate impacts to one sector or subbasin. A Demand Management Program may provide environmental, recreational, and other benefits as well.

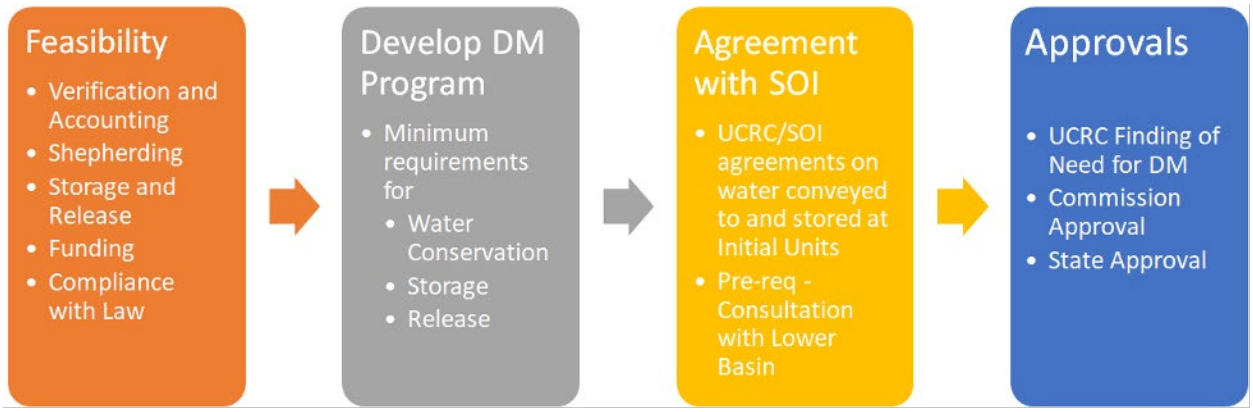
Q. How does Demand Management fit with other Colorado River issues?

A. Demand Management is only one potential tool in the toolkit when it comes to maintaining compact compliance and protecting Colorado's water users. As part of its core mission of protecting Colorado's water, the Colorado Water Conservation Board (CWCB) is dedicated to protecting the very people that rely on Colorado's water (water users) for their livelihoods. It is therefore important to consider all potential mechanisms to increase water security as the CWCB considers the changing climate and uncertainty relating to future hydrologic conditions. Demand Management is one of those options that each of the Upper Basin States (Colorado, New Mexico, Utah, and Wyoming) agreed to investigate and are exploring to help face the future.

Q. Would all Upper Division States need to agree to move forward with a Demand Management program?

A. Yes. To move forward with a Demand Management program as contemplated in the Demand Management Storage Agreement (DMSA) within the Drought Contingency Plan (DCP), key elements of the program would need to be approved by each one of the Upper Division States, the Upper Colorado River Commission (UCRC), and the Secretary of Interior (SOI) prior to its implementation. The Lower Division States would also need to be consulted. Below is a visual representation of the steps that must be taken before a potential program may be established.

Steps to developing a potential Demand Management Program



Q. How would a potential Demand Management program work?

A. Demand Management would be a temporary, voluntary, and compensated program that would allow Colorado River water users to opt-in and temporarily reduce their consumptive use of water in order to assist with water storage for future Colorado River Compact requirements.

Q. Is there currently a Demand Management program set up in Colorado?

A. At this time, there is no Demand Management program in Colorado. Rather, the feasibility investigation into a potential Demand Management program is underway. It is not a foregone conclusion that a Demand Management program will be established. There are many questions that would need to be answered and steps that would need to be taken before one could be set up.

Demand Management Feasibility – General FAQs

Q. Is the purpose of a Demand Management program to protect Colorado water users, or to provide surplus water to the Lower Division States of Arizona, California, and Nevada?

A. The purpose of a potential Demand Management program is to protect water users in Colorado and the other Upper Division States by assisting in maintaining compact compliance for the Upper Division States. It is not to provide surplus water to the Lower Division States. A potential Demand Management program would help the Upper Division States continue to meet their legal obligations and mitigate, prevent, or delay mandatory cutbacks or compact administration in Colorado and the other Upper Division States. It would only be implemented if it is determined to be achievable and worthwhile for Colorado and the Upper Division States.

Q. Would any of the saved water become available for the growing Front Range population?

A. Pursuant to the Drought Contingency Plan and the Demand Management Storage Agreement, all of the water conserved through a Demand Management program could only be used to meet the Upper Division States' obligations of the 1922 Colorado River Compact, rather than providing for any other uses, including Front Range urban uses. Learn more about the Colorado River Compact and "Law of the River."

Q. Is there a target of water conservation that a Demand Management program would be required to meet?

A. The size of a Demand Management program would be determined by the number of water users who voluntarily decide they want to participate, subject to the cap of 500,000 acre-feet of storage among the Upper Division States, pursuant to the Demand Management Storage Agreement.

Q. How can unintended consequences of a Demand Management program be avoided or mitigated?

A. If a program is established, many factors would need to be considered in its design to adequately protect Colorado's water users, communities, and the state as a whole. That is why the Colorado Water Conservation Board is committed to working with stakeholders and others across the state to ensure that if a Demand Management program is established, it takes into account potential adverse consequences and includes mechanisms to mitigate or eliminate them, and is sufficiently adaptable to respond to unintended consequences as they arise.

Q. How would Demand Management avoid adversely impacting the economies of communities in which water users participate?

A. The Colorado Water Conservation Board (CWCB) is analyzing potential economic impacts—both positive and negative—so that any negative impacts may be identified and mitigated or avoided if a program is established. Water users may choose to participate if they determine it is beneficial for them to do so. The CWCB is also dedicated to considering mitigation measures if there are secondary impacts to communities. Throughout the feasibility investigation, community leaders, stakeholders, and others will continue to have opportunities to help the CWCB consider potential program designs that could benefit communities and avoid adverse impacts.

Demand Management Feasibility – General FAQs

Q. Are there any Demand Management pilot programs available?

A. At this time, there are no specific Demand Management pilot programs. There are, however, many conservation-based grant programs available through the Colorado Water Conservation Board, including Water Supply Reserve Funds and Alternative Transfer Methods. These programs are not directly related to Demand Management but could help to inform the Demand Management feasibility investigation.

Q. Should a Demand Management program be established, how could it ensure all sectors reliant on Colorado River water be given equal opportunity to participate?

A. Equity is one of the most important factors in determining the feasibility of such a program. There is broad recognition that equity may be defined in different ways, including not only equitable opportunity to participate but also equity in terms of avoiding adverse impacts to a particular sector or area of the state. That's why the Colorado Water Conservation Board remains dedicated to fully understanding what equity looks like across the state, and also remains committed to ensuring it is a key consideration in the feasibility investigation, and in a potential program.

Q. What is the next step in determining if Colorado should set up a Demand Management program?

A. On November 18, 2020, the Colorado Water Conservation Board (CWCB) adopted the Demand Management Feasibility Investigation Step II Work Plan. The goal throughout this Step will be to build on work completed pursuant to the 2019 Work Plan. Through development of a framework incorporating various potential program designs, issues such as program cost, on-the-ground achievability of potential projects, proportionality of participation across the state, and other key issues will be analyzed.

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Colorado Water Conservation Board's mission is to conserve, develop, protect and manage Colorado's water for present and future generations.

Exhibit I:

CWCB Demand Management Decision-Making Roadmap

October 2021

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Department of Natural Resources

Demand Management Decision-Making Roadmap – October 2021

This document is subject change and is intended to outline an iterative, flexible process

**The appropriate timeline for decision points is not identified within this document, but will rather be considered as the analyses are underway. Dates noted within this document correlate with the time at which the Board is expected to have materials and information needed to conduct each analysis.*

ACHIEVABILITY?		
Monitoring & Verification	**Decision**	**Timeframe for Decision-Making Process**

Is it technically possible to monitor and verify conserved consumptive use within Colorado for a potential Demand Management program?
• Monitoring & Verification elements for all projects
  ○ Measure water returned to stream
  ○ Analyze conserved consumptive use
  ○ Maintain return flows
  ○ Coordinate environmental and other benefits
• Additional potential elements
  ○ Estimate residual field consumptive use
  ○ Identify mechanisms to prevent injury
	YES | NO	Begin* Nov. 2021

Environmental Considerations	**Decision**	**Timeframe**
Is it technically possible to track and monitor potential environmental impacts and benefits? • Consider potential environmental benefits and impacts • Assess net benefit or impact	**YES | NO**	Begin Nov. 2021

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Demand Management Decision-Making Roadmap – October 2021

This document is subject change and is intended to outline an iterative, flexible process

**The appropriate timeline for decision points is not identified within this document, but will rather be considered as the analyses are underway. Dates noted within this document correlate with the time at which the Board is expected to have materials and information needed to conduct each analysis.*

• Incorporate strategies to incentivize benefits, including potential leveraging of other programs • Implement strategies to avoid or mitigate negative impacts		
Education & Outreach	**Decision**	**Timeframe**
Is it possible to develop an outreach plan for a Demand Management program? • Engage broad audiences through a water education program • Inform the program through stakeholder engagement • Ensure participation through program marketing	**YES | NO**	Begin Nov. 2021
Funding	**Decision**	**Timeframe**
Given the above determinations, is it possible to secure a funding source to pay for a potential Demand Management program? • Identify potential federal funding sources, including but not limited to funds available through the federal Bipartisan Infrastructure Bill. • Identify potential state funding sources, including but not limited to funds available through implementation of Proposition DD. • Identify a range of potential costs of a Demand Management program, including payments to participants, potential costs of mitigation of secondary impacts, costs of running a program, and other potential costs.	**YES | NO**	*TBD:* Pending Infrastructure Bill

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Demand Management Decision-Making Roadmap – October 2021

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WORTHWHILE FOR COLORADO?		
Proportionality Considerations	**Board Decision**	**Timeframe**
Can Colorado establish a Demand Management program that prioritizes avoidance of disproportionate negative economic or environmental impacts to any single subbasin or region within Colorado while protecting the legal rights of water rights holders, consistent with the Board's November 2018 Support and Policy Statement?	**YES | NO**	Begin Nov. 2021 (pending IBCC input expected Oct. 2021)
Anti-Speculation Considerations	**Board Decision**	**Timeframe**
Can Colorado establish a Demand Management program that sufficiently addresses or does not further encourage speculation activities?	**YES | NO**	Begin Nov. 2021 (pending analysis of Anti-Speculation Workgroup report)
Analyses and Findings of UCRC and Other States	**Board Decision**	**Timeframe**
Based on information gained from the UCRC feasibility investigation and those ongoing in the other Upper Division States, would a Demand Management program be worthwhile from Colorado's perspective?	**YES | NO**	*TBD: Investigations ongoing*

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ADVISABLE FROM COLORADO'S PERSPECTIVE?	
This analysis will follow completion of the decision-making process above, and contemplates whether it would be advisable to make a feasibility finding given the broader Colorado River strategy.	