Western Resource Advocates

Protecting the Environment & Colorado's Water Supply

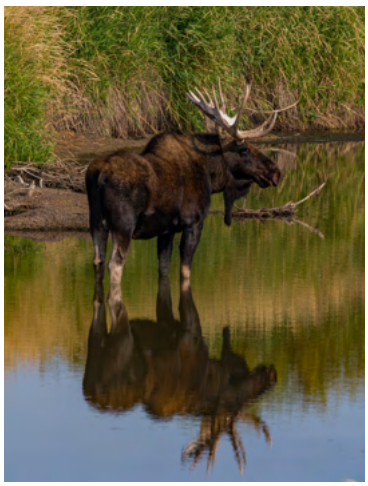
Coloradans depend on healthy rivers

Without healthy rivers, we do not have a reliable water supply for Colorado's farms, ranches, recreation, businesses, fish, and wildlife. Coloradans have faced water shortages nearly every year over the last 23 years and conditions are only expected to worsen as the West becomes hotter and drier.

Healthy streams and wetlands naturally store water and slowly release it downstream when it is most needed. Our stream corridors have been degraded by our water and land use practices, but they can be restored to improve human and environmental health and protect against drought, fire, and floods.

We must protect and restore river health to protect Colorado's water users, recreation, and irreplaceable ecosystems.

Benefits of Healthy Rivers



Creating critical wildlife habitat

Supporting recreation

Meeting the needs of water users

Increasing resilience to drought & wildfire

Existing tools to protect river health have limitations

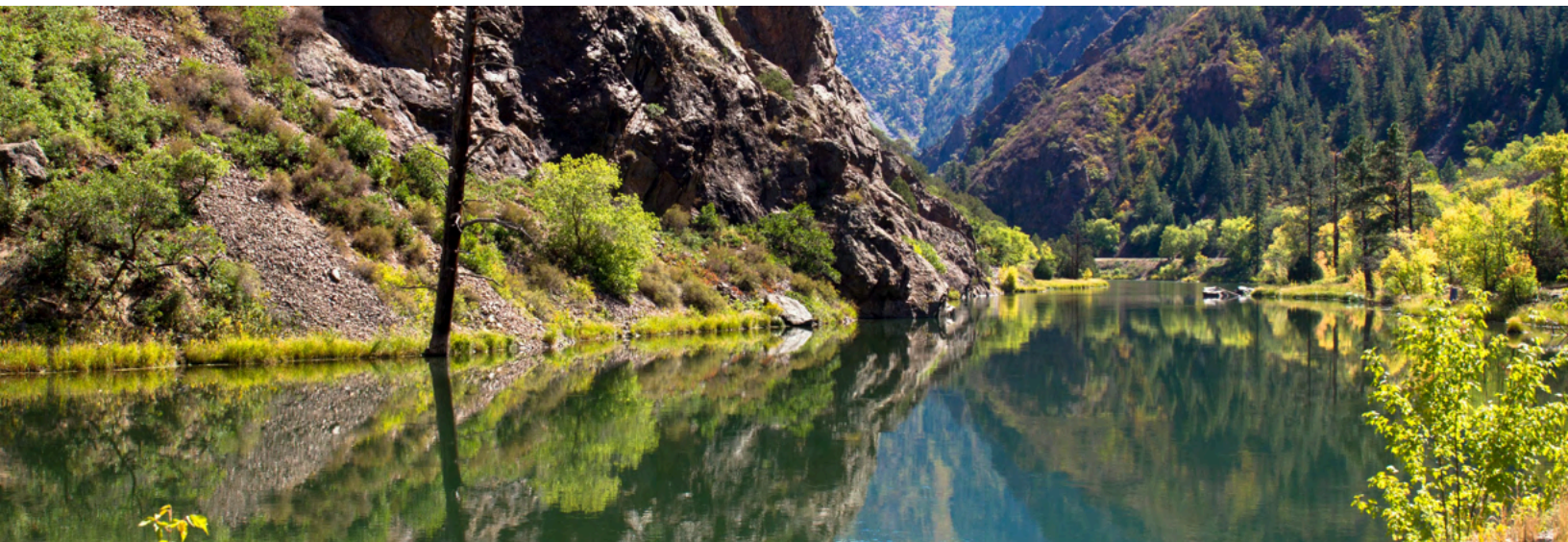
In recent years, Colorado has established numerous programs to benefit river health. Many of these are described in reports and tables produced by the Colorado Water Trust (Attachments 1 and 2, excerpt below).

While these tools exist, Colorado does not have a coordinated program for using them strategically. Great work is being accomplished using these tools, but projects can be isolated, time consuming and require a huge investment of human resource capital. Other tools are limited in their application and could be expanded.

EXCERPT FROM COLORADO WATER TRUST

Available and Potential Tools to Protect and Restore River Flows [DRAFT]

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment?	Used Before?
New ISF Appropriation*	37-92-102(3)	Protect flows as they exist at time of appropriation; purpose is to preserve existing natural environment	CWCB[1] & Water Court	Permanent	New junior water right	Yes	N/A	N/A	YES; *Thousands statewide*
ISF Water Acquisition – Permanent	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Permanent	Direct flow or storage rights; donations, purchases, permanent split-season uses, contractual interests	Yes	N/A; Permanent ISF use	N/A as long as permanent ISF use	YES; *Peabody, McKinley, Valdez, Gabino, Gallegos, Breem*
ISF Water Acquisition – Long Term Leases	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Contractual (but prefer term longer than 10 years)	Leases, Trust Agreements, use of available augmentation water	Yes	Yes, 37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	YES; *Pitkin Co.*
ISF Water Acquisition – Expedited Temporary Instream Flow Loan *(5-in-10 Loan)*	37-83-105(2)	Restore flows with senior water rights; Preserve the natural environment	CWCB[3], DWR	One-year, non-renewable	Must use with existing but water-short ISF	Yes	Yes, 37-83-105(2)(c)	Yes, 37-92-103(2)(b)(V)	No. Used under previous 3-in-10 statute; *Winter Park Ranch W&S District, Stagecoach, Coats Bros.*
ISF Water Acquisition – Renewable Temporary Instream Flow Loan *(5-in-10 Loan)*	37-83-105(2)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2], DWR	5 uses in 10 years, 120 days/year, no more than 3 years consecutive, renewable twice	Must use with existing decreed ISF	Yes	Yes, 37-83-105(2)(c)	Yes, 37-92-103(2)(b)(V)	No. Used under previous 3-in-10 statute; *Winter Park Ranch W&S District, Stagecoach, Coats Bros.*



Strategic timing of water releases can benefit the environment

Flow shortages exist on many Colorado rivers and key environmental needs are facing challenges. By timing water releases strategically, we can keep dwindling streams flowing to benefit fish, wildlife, and the state's outdoor recreation economy.

For example, the Upper Colorado River Endangered Fish Recovery Program works to recover endangered fish in the Upper Colorado River Basin. The program has made significant progress augmenting river flows in 15-mile reach, an important stretch of river for endangered fish, (Attachment 3) but the 15-mile reach frequently falls short during dry years.

During low flows, fish screens and passages associated with diversion structures are unable to operate properly. Low flows also mean that heavy metals and other contaminants are present in the river at higher concentrations – affecting both fish and water users.

It is possible to time water releases in ways that benefit flows by addressing the April hole, spring peak or summer base flows.

Drought and other impacts to river health take many forms, from impacts to riparian vegetation to stress on fish. Western Resource Advocates (WRA) worked with a consultant on instream flow rights to understand specific locations, amounts of water, and times of year in which water releases have the potential to create measurable positive impacts (Attachments 4 and 5, excerpt below).

EXCERPT FROM WRA

Bureau of Reclamation Projects and Downstream River Reaches in Colorado River Tributaries with Instream Flow Rights [DRAFT]

Reclamation Project	Downstream River Reach	ISF Decree	AF Potential Annual Benefit 30-pctl / median / 70 pctl	Season of Maximum Potential Added Benefit
Colorado-Big Thompson	**Colorado River** Blue River to Piney River confluence	5-11CW159	4,021 / 17,971 / 24,820	Winter (Nov-Mar)
Colorado-Big Thompson and other projects below	**Colorado River** GVIC diversion to Gunnison River confluence	5-92CW286	0 / 0 / 2,902	Late Summer (Jul-Sep)
Fryingpan-Arkansas	**Fryingpan River** Rocky Ford to Roaring Fork Confluence	5-73W1945	353 / 615 / 862	Late Summer (Aug-Oct)[1]
Fryingpan-Arkansas	**Roaring Fork River** Fryingpan River to Crystal River confluence	5-85CW639	0 / 0 / 0	N/A
Silt	**Rifle Creek** Rifle Gap Reservoir to Colorado River	5-80CW321	36 / 113 / 175	Winter (Nov-Mar)

[1] A disproportionate share of flow shortfalls to ISF targets during these 'irrigation season months' appear to occur in the latter half of October. Entities such as Colorado Parks and Wildlife prefer to see Fryingpan River flow rates drawn down to 'winter base flow levels' well before the end of October, to avoid adverse impacts to brown trout spawning. Thus, the potential benefits quantified here are arguably an artifact of practices that, in fact, benefit Fryingpan River fisheries.

Attachments

The following documents are referenced in this text and enclosed.

- **Attachment 1:** Colorado Water Trust, 2020. New and Untested Legal Mechanisms for Transferring and Protecting Flows Instream. http://coloradowatertrust.org/wp-content/uploads/2020/09/FINAL-WHITE-PAPER.pdf

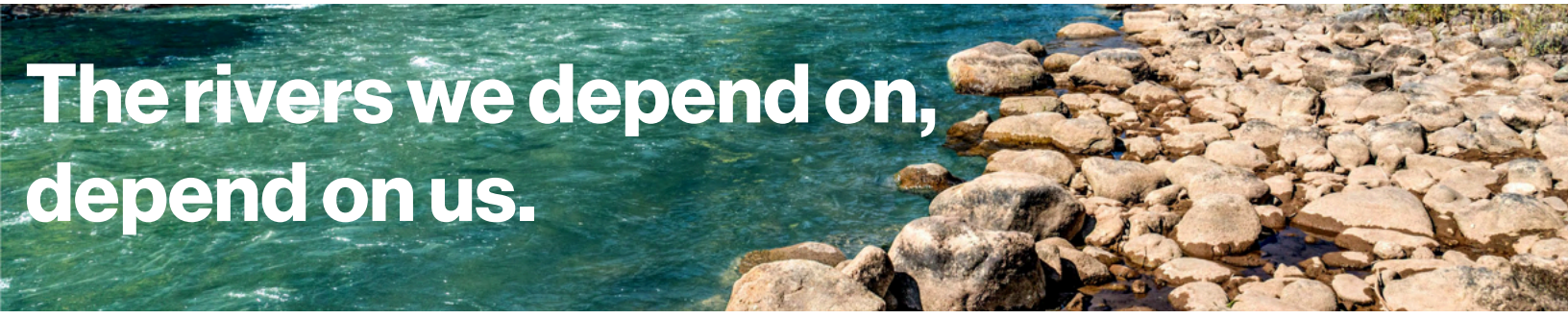
- **Attachment 2:** Colorado Water Trust, 2021. Table of Available and Potential Tools to Protect and Restore Flows.

- **Attachment 3:** United States Fish and Wildlife Service, 2022. A Review of the Upper Colorado River Endangered Fish Recovery Program's Recovery Actions and Endangered Species Response in the Colorado River.

- **Attachment 4:** Draft analysis prepared for Western Resource Advocates, 2023. Summary Table of West-Slope CWCB Instream Flow Rights Downstream from Bureau of Reclamation Water Supply Projects.

- **Attachment 5:** Draft analysis prepared for Western Resource Advocates, 2023. Summary Table of West-Slope Instream Flow Rights Downstream from Non-Bureau of Reclamation Transbasin Export Projects.

Please note that the materials provided here are for informational purposes and some are in summary or draft form. The materials are intended to provide an easily reviewable format. If you have questions about the content please contact the author.



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Attachment 1

New and Untested Legal Mechamisms for Transferring and Protecting Flows Instream

Colorado Water Trust, 2020

COLORADO WATER TRUST

NEW AND UNTESTED LEGAL MECHANISMS FOR TRANSFERRING AND PROTECTING FLOWS INSTREAM

A White Paper Prepared with Support from the Walton Family Foundation
July 2020

NEW AND UNTESTED LEGAL MECHANISMS FOR TRANSFERRING AND PROTECTING FLOWS INSTREAM

July 2020 | Authored by Kate Ryan, Alyson Gould,
Mickey O'Hara, Andy Schultheiss, and Tony LaGreca

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NEW AND UNTESTED LEGAL MECHANISMS FOR TRANSFERRING AND PROTECTING FLOWS INSTREAM

July 2020 | Authored by Kate Ryan, Alyson Gould, Mickey O'Hara, Andy Schultheiss, and Tony LaGreca[1]

INTRODUCTION: THE NEED FOR NEW TOOLS

Colorado's constitutional system of prior appropriation, coupled with historical and continuing agricultural practices, municipal growth, and industrial development, resulted in full appropriation of many of the state's rivers and streams early in the twentieth century. Pressure on Colorado's rivers and streams continues to increase in response to climate change and population growth, which is particularly intense in the Front Range. Over-appropriation now extends even to those basins where appropriative demands seemed like they would remain more manageable as recently as the early 2000s.[2]

The Instream Flow Act of 1973 provided the Colorado Water Conservation Board ("CWCB") with the authority to appropriate and acquire water to preserve the environment to a reasonable degree on streams and lakes.[3] The CWCB has appropriated 1,684 instream flow and minimum lake level water rights in Colorado, covering 9,720 miles of stream.[4] However, the ability of the CWCB to appropriate water for instream flow outside mountain regions has faced challenges, as there are many streams on which flows are simply too low to support an appropriation, or local entities have opposed instream flow appropriations as a matter of local interest. Due to constraints on the CWCB's ability to appropriate new instream flow water rights across the state, legal mechanisms for transferring senior priority water rights and protecting that water as "instream flow"[5] are now more important than ever.

This white paper examines new and untested legal mechanisms for transferring water rights

[1] Many thanks as well for Colorado Water Trust legal externs Josh Boissevain and Casey Weaver for their excellent research, proofreading, and cite checking.

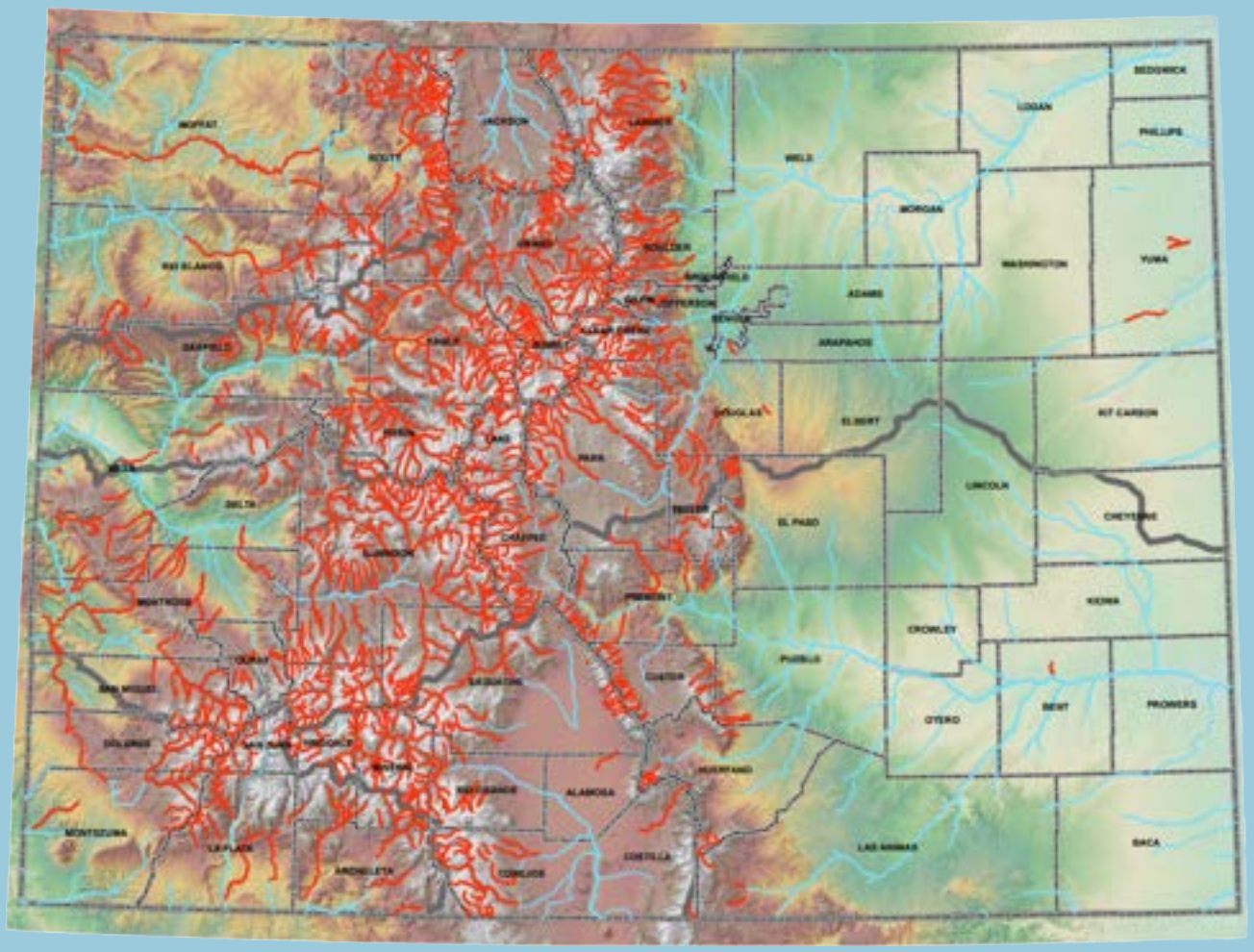
[2] In 2018, the Division Engineer for Water Division 6 administered priority-based calls for water on the Yampa River for the first time ever, requiring water users to install measuring devices or face curtailment, and to dust off plans for augmentation they had probably hoped never to have to use.

[3] S.B. 73-97: An Act Concerning the Appropriation of Water, and Providing for the Appropriation of Water by the State of Colorado to Protect the Natural Environment, ch. 442, sec. 2, 1973 Colo. Sess. Laws 1521, 1521-22 (codified at COLO. REV. STAT. § 37-92-102(3) (2020)). In 2002, the Colorado General Assembly provided that the CWCB could acquire senior water rights not only to preserve the environment, but also to improve the environment to a reasonable degree. S.B. 02-156: An Act Concerning the Authorization of Changes of Absolute Water Rights for Purposes of Instream Use, ch. 149, sec. 1, 2002 Colo. Sess. Laws 445, 445-46 (codified at § 37-92-102(3)).

[4] The Colorado Information Marketplace includes a database of CWCB water rights. Colorado Water Conservation Board, *Minimum Stream Flows – Appropriations*, COLO. INFO. MARKETPLACE, https://data.colorado.gov/Water/Minimum-Stream-Flows-Appropriations/w2ek-aszn (last visited June 25, 2020).

[5] Instream flow is the term that Colorado uses to describe water that flows between two points in order to preserve the environment, and that is protected from diversion, in priority, between those points. Statute prescribes that instream flow is a beneficial use of water, and therefore constitutional, but that beneficial use is exclusive to the CWCB. COLO. REV. STAT. § 37-92-103(4)(c) (2020).

Streams Included in Colorado's Instream Flow Program



Instream flow water rights are more prevalent on small mountain streams than on the rivers of Colorado's eastern plains.

Image from Colorado Water Conservation Board

and protecting them as instream flow in the state of Colorado. The legal mechanisms examined in this white paper are rooted principally in statutory law but include common law[6] mechanisms as well. These tools may also be useful in other western states, at least to the extent that there are commonalities between the prior appropriation principles that guide the states' water law, and to the extent that other state legislatures could replicate Colorado statutes.

Several legal tools are already tested and available to Colorado water users for projects that transfer water rights and protect flows instream.[7] Some tools provide for permanent instream flow transfers, while others are temporary. For permanent solutions, the CWCB can make fee simple acquisitions and long-term leases of water

[6] Common law means the precedent that courts establish through the decisions they make when deciding cases and controversies. There is not often a particular statute or a named water conservation tool to which to refer when invoking common law, but common law nonetheless provides a structure for changes of water rights and therefore tools for transferring and protecting water instream.

[7] *See* Appendix A, *Table of Available and Potential Tools to Protect and Restore Flows.*

rights changed in water court from other uses to instream flow use.[8] Temporary transfer tools include a statutory Water Conservation Program, pursuant to which a water user may reduce or stop diversions for up to 5 in 10 years.[9] Another temporary tool that the Water Trust uses is the statutory Temporary Loan Program, under which the CWCB can gain administrative approval to change a water right to instream flow use on a stream reach with an instream flow water right that would otherwise be short on flow for up to 3 out of 10 years.[10] Finally, the Water Trust uses common law to deliver water rights from storage reservoirs to downstream locations where the water rights will satisfy decreed uses. The Water Trust has also collaborated with the CWCB to acquire senior water rights and strategically relinquish those rights on streams where the water is unlikely to be diverted by junior water users, and will therefore remain in the stream to benefit the stream system. This also provides potential for the CWCB to protect that water from future diversion through an instream flow appropriation.

The tools that the Water Trust and the CWCB currently use for transferring and protecting flows instream have restored a significant amount of water to Colorado streams and rivers. Illustrating the point, since 2001, Water Trust projects have restored over 37,000 acre-feet in 444 miles of streams and rivers.[11] However, Colorado water users continue to explore statutory solutions to facilitate permanent or temporary, and administrative or judicial changes of water rights. The Water Trust aims to explore and test all established tools and new concepts as it strives to restore water to Colorado's rivers in need. Tools that we have yet to implement include certain types of Substitute Water Supply Plans, Interruptible Water Supply Agreements, Agricultural Protection Water Rights, plans for augmentation, and Colorado's struggling but promising water banking program. This paper describes how the Water Trust and the CWCB, like consumptive water users, can use these tools. Water users who desire specifically to protect water instream have also gone to the legislature seeking new legal mechanisms, and this paper describes the tools that those efforts have produced, including an expansion of the Temporary Loan Program and direction for instream flow augmentation plans. Finally, this paper takes an exploratory look at using common law principles to transfer and protect efficiency savings instream and using existing reservoir space.[12]

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[8] COLO. REV. STAT. § 37-92-102(3) (2020).

[9] COLO. REV. STAT. § 37-92-305(3)(c)(A) (2020). Water Conservation Programs facilitate reduced diversions, but water left instream is not protected from diversion. Additionally, Water Conservation Programs are allowed only in Water Divisions 1-6; applicability of the tool would be improved by legislatively expanding the program to Water Division 7, but again, water left instream using the tool would not be protected from diversion so this white paper will not address that possibility in depth.

[10] COLO. REV. STAT. § 37-83-105(2) (2019). The Colorado General Assembly revised the Temporary Loan Program in 2020. H.B. 20-1157 will become effective after a savings clause expires in September 2020, and then the CWCB will be able to use loaned water rights for instream flow for 5 out of 10 years. H.B. 20-1157: An Act Concerning the Colorado Water Conservation Board's Authority to Use Water that a Water Right Owner Voluntarily Loans to the Board for Instream Flow Purposes, ch. 52, sec. 1-2, 2020 Colo. Sess. Laws 179, 179–83 (to be codified at COLO. REV. STAT. § 37-83-105(2) (2020)). This white paper provides more detail on the Temporary Loan Program beginning on page 4.

[11] Visit http://coloradowatertrust.org/ for updated numbers, as the volume of water restored continues to increase while Water Trust projects run.

[12] This white paper focuses only on tools that transfer water from diversion to instream flow, and that also protect such water from diversion by upstream or downstream water users.

THE TEMPORARY LOAN PROGRAM: NEW AND IMPROVED

In 2003, Colorado's General Assembly established a Temporary Loan Program under which water right owners could gain temporary administrative approval for the CWCB to use their water rights to supplement instream flow water rights that would otherwise not be satisfied during drought conditions.[13] To gain State Engineer approval for a change of use under the Temporary Loan Program, a water user works with CWCB staff to prepare an application that evaluates an allocation of historical consumptive use of a water right that can be transferred to instream flow use for up to three years out of ten. The application must be published on multiple notification lists[14] in order to provide other water users with an opportunity to comment on the application and to prevent any injury that the temporary transfer might pose to their own water rights.

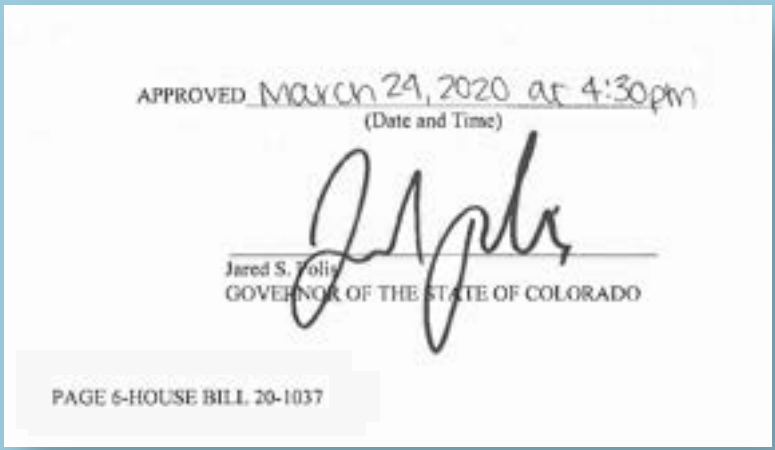
Administrative review of a temporary loan application is expedited, so that water right owners and the CWCB can move quickly to respond to drought situations. After a twenty-day comment period, the State Engineer can approve a Temporary Loan together with terms and conditions to prevent injury. CWCB Board approval is also required for a Temporary Loan, but in order to preserve a nimble and efficient turnaround on applications, that approval can come after the CWCB and water user apply to the State Engineer. State Engineer approval of a temporary loan lasts for a full ten years, although it remains subject to review if another water user is injured by the changed water right use.

The Temporary Loan Program was unused between 2003 and 2011, but when severe drought struck Colorado in 2012, the Water Trust and the CWCB put the program into action on the Yampa

[13] H.B. 03-1320: An Act Concerning the State Engineer's Authority to Administer Temporary Instream Flows Held by the Colorado Water Conservation Board, and, in Connection Therewith, Requiring the State Engineer to Determine Whether Such Temporary Instream Flows Would Likely Injure Existing Rights, and Making an Appropriation, ch. 362, sec. 1, 2003 Colo. Sess. Laws 2396, 2396-98 (though subsequently amended, originally codified at COLO. REV. STAT. § 37-83-105(2) (2003)).

[14] Each of Colorado's seven water divisions has a Substitute Water Supply Plan Notification List, and these lists also provide notice of proposed water right loans to the CWCB for use as instream flow. The Instream Flow Notification List includes notification of proposed loans as well as CWCB appropriations and acquisitions, and any water user or person can join the list by signing up at https://dwr.state.co.us/Portal/Login/Login?ReturnUrl=%2fPortal%2fcwcb%2fNotificationLists.

Through 2019, the Water Trust's Bunte Highline Ditch project used the Temporary Loan Program to restore over 173 acre feet of water to Willow Creek and the Colorado River in Grand County.


APPROVED March 29, 2020 at 4:30pm
(Date and Time)
Jared S. Polis
GOVERNOR OF THE STATE OF COLORADO
PAGE 6-HOUSE BILL 20-1037

House Bill 20-1037 Signed by Governor Jared Polis

River.[15] The Water Trust facilitated a Temporary Loan of water rights stored in Stagecoach Reservoir that made whole a CWCB instream flow water right upstream of the City of Steamboat Springs, benefitting not only the CWCB's instream flow water rights but also fishing and boating on the river. Since then, the Temporary Loan Program has benefitted Colorado streams and rivers over several years and in several locations.[16]

However, until 2020, the Temporary Loan Program was significantly constrained by temporal and geographic limitations. The CWCB could only use a temporary loan for 3 out of 10 years, and the 10-year loan period was nonrenewable unless the loan was never exercised.[17] Geographically, statute limited the CWCB to use of loaned water to preserve the environment on stream reaches where there was a decreed instream flow water right, and to times when that instream flow water right would have otherwise been short on water. In practice, the Temporary Loan Program could only be used to bring streamflows up to a baseflow necessary to preserve the environment to a reasonable degree during drought situations, and only on the limited number of reaches where the CWCB already held instream flow water rights.

In 2019, The Nature Conservancy and Conservation Colorado worked as proponents of legislation to expand the Temporary Loan Program. Lawmakers blocked a 2019 bill, which led to an interim session of communication and collaboration by water users across the state. The Water Trust, the CWCB and multiple consumptive water users provided support for the legislative effort and water user outreach during the interim session.[18] The proponents came back in 2020 and gained bipartisan support for a successful bill. Governor Jared Polis signed House Bill 20-1157 into law on March 20, 2020.

[15] For additional information, visit: *Yampa River – Stagecoach Reservoir,* COLO. WATER TRUST, http://coloradowatertrust.org/project/stagecoach-reservoir-yampa-river (last visited June 27, 2020).
[16] For additional information, visit: *Tomichi Creek – Coats Bros Ditch,* COLO. WATER TRUST, http://coloradowatertrust.org/project/coats-bros-ditch-tomichi-creek (last visited June 27, 2020); *Fraser River – Winter Park Ranch Water & Sanitation District,* COLO. WATER TRUST, http://coloradowatertrust.org/project/winter-park-ranch-ws-fraser-river (last visited June 27, 2020); *Willow Creek – Bunte Highline Ditch,* COLO. WATER TRUST, http://coloradowatertrust.org/project/bunte-highline-ditch-willow-creek (last visited June 27, 2020); *Deep Creek – Yost Ditch,* COLO. WATER TRUST, http://coloradowatertrust.org/project/yost-ditch-deep-creek (last visited June 27, 2020).
[17] COLO. REV. STAT. § 37-83-105(2)(b) (2019).
[18] Among others, Grand Valley Water Users Association, Ute Water Conservancy District, and the Colorado River District were particularly engaged and helpful in representing consumptive water users throughout the legislative process.

The new Temporary Loan Program has several improvements over the original program. It will allow a water user to loan their water right to the CWCB for up to five in ten years, though for no more than three consecutive years.[19] A ten-year approval period will also be renewable for two additional ten-year periods upon reapplication by the CWCB and partner water users. Additionally, a water user will be able to loan water to the CWCB not only to preserve stream flows on an existing instream flow reach, but also to improve stream flows on an existing stream reach.[20] CWCB will approve the flow rates necessary to improve the environment based on recommendations that Colorado Parks and Wildlife provides to the CWCB board.[21] HB 20-1157 directs the CWCB to implement this final improvement through a rulemaking, and the Water Trust anticipates that the rulemaking will also address other outstanding questions about implementation of the expanded Temporary Loan Program.[22]

The Water Trust expects to use this improved tool extensively. Existing project partners have already provided feedback indicating that they will be interested in loaning water rights to the CWCB for up to five in ten years, and project partners have also indicated that they will likely be able to loan water at rates that will improve the environment on stream reaches where the CWCB has an instream flow water right. The Water Trust will need to adjust its use of the Temporary Loan Program to meet some more stringent administrative processes required by House Bill 20-1157, such as providing notice to local water districts when applying for temporary loan approval.[23] Additionally, there is still an expedited approval process for one-year loans of water to respond to drought situations, but for loans that extend beyond a single year the review process is a lengthier 60 days.[24] These administrative steps will protect water users from injury, and will increase local awareness and buy-in for temporary loans that may be exercised for up to fifteen out of thirty years.

Ideally, the Water Trust would like to see the Temporary Loan Program expanded in an additional way. The tool would be particularly useful if loans could be made to preserve and improve the environment not only where there are decreed instream flow water rights, but also on stream reaches where there are no decreed instream flow water rights.[25] For now, Substitute Water Supply Plans (see the following section) fill that role, but a statutory change to include this application in the Temporary Loan Program would add significant additional streamflow restoration capacity to the tool. The ability to utilize this tool on streams that do not have an underlying instream flow water right may be particularly useful on stressed mainstem rivers for which new instream flow appropriations may not be feasible due to lack of water availability or lack of political support.

[19] COLO. REV. STAT. § 37-83-105(2)(b)(IV)(A) (2020).
[20] § 37-83-105(2)(b)(II).
[21] § 37-83-105(3)(a).
[22] The rulemaking will also address how to implement a preference for using stored water in temporary loans to improve the environment to a reasonable degree. *Id.*
[23] § 37-83-105(2)(b)(11)
[24] § 37-83-105(2)(b)(V)(A)-(B).
[25] The 2019 draft legislation proposed allowing the CWCB to use loaned water to preserve or improve the environment on reaches without an existing instream flow water right. However, the General Assembly dropped the proposal from the final legislation in response to strong opposition.

SUBSTITUTE WATER SUPPLY PLANS: ADOPTING AN EXISTING TOOL FOR INSTREAM FLOW

Substitute Water Supply Plans (SWSPs) are tools that water users utilize to obtain administrative[26] approval for temporary changes in use of existing water rights. SWSPs are not specific to changes of use to instream flow—the General Assembly legislated the SWSP process in 2002 in order to afford any water user a streamlined approach to changing water uses during emergency situations and as a temporary augmentation solution.[27] SWSPs are now used for four temporary change of use purposes: (1) to allow the exercise of claims pending water court proceedings[28]; (2) to allow water right changes during emergency situations; (3) to renew a SWSP approved prior to January 1, 2002; and (4) to allow a water right change without water court proceedings if the SWSP will result in no more than five years of depletions.[29] The last purpose—a section 308(5) SWSP—is the tool that this paper describes, as it could be used to facilitate the temporary use of water rights for instream flow by the CWCB.

Permanent changes of a water right are time consuming and expensive due to the water court process, whereas SWSPs and other administratively approved temporary water right changes are more streamlined since they do not involve water court.[30] Water users must go to water court to gain decreed approval for a permanent change of a water right, including a change of use to instream flow. The water court process typically takes at least a year and thousands of dollars in engineering and legal fees to complete. A permanent change of water right also results in a permanent limit on the rate and volume of a water right to its historical consumptive use allocation and establishes permanent return flow obligations.[31]

When a water user applies for a SWSP, on the other hand, water users do not have to go to water court. The State Engineer can approve a temporary change of use. During that temporary change, it is still the case that only the portion of a water right that was historically consumed and permanently removed from a stream can be protected as instream flow. Unlike a permanent

[26] The State and Division Engineers can grant administrative approval for temporary changes of water rights pursuant to specific statutory tool, whereas the water court must approve longer-term and permanent changes of water rights.

[27] H.B. 02-1414 provided for the approval of both *Emergency and Temporary Substitute Supply Plans*. Also in 2002, the State Engineer released Policy 2002-02 for implementing H.B. 1414. Under that policy, the State Engineer limited Emergency Substitute Supply Plans to situations affecting public health and safety, and not instream flow uses. Only Temporary Substitute Supply Plans, therefore, are available to the CWCB. One year later, the State Engineer revoked 2002-02 and replaced it with 2003-02, which states: "9) Only one emergency request pursuant to section 37-92-308(7), C.R.S. (2003) will be allowed per applicant in any twelve-month period, unless the State Engineer specifically allows a subsequent request. Emergency requests are limited to situations affecting the public health and safety and are not intended to be used for situations including, but not limited to, crop relief, piscatorial or recreational purposes." OFFICE OF THE STATE ENG'R, POLICY 2003-2: IMPLEMENTATION OF SECTION 37-92-308, C.R.S. (2003) REGARDING SUBSTITUTE WATER SUPPLY PLANS 2-3 (2003), https://dnrweblink.state.co.us/dwr/0/edoc/3565793/DWR_3565793.pdf?searchid=e594b142-74cf-4045-94c5-b752a905e2f5.

[28] The CWCB used section 37-92-308(4) SWSPs for temporary changes of use to instream flow while it had separate water court applications pending for the Breem Ditch, Gabino Gallegos Ditch, and Valdez Ditch water rights.

[29] Each SWSP type is authorized and described in COLO. REV. STAT. § 37-92-308 (2020).

[30] While the analysis behind a change of water rights for a water court change and an SWSP is similar, meeting judicial standards of proof and opposers' requirements is significantly more expensive in the water court arena.

[31] COLO. REV. STAT. § 37-92-305(3)(d) (2020).

change of water right, however, once the term of the SWSP is over, the owner or user of the water right can return to their pre-SWSP, decreed water use. That water right owner or user will not be constrained to the historical consumptive use allocation applicable during the term of the SWSP and may return to their full decreed pre-SWSP use.[32]

The Water Trust has yet to use a section 308(5) SWSP to gain administrative approval for a temporary transfer of the use of a water right to instream flow use by the CWCB. A section 308(5) SWSP is available for "new water use plans involving out-of-priority diversions or 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 the water court 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 not to exceed five years . . ."[33] In other words, the Water Trust and the CWCB could use a section 308(5) SWSP to change a water right and protect it as instream flow, or augment out-of-priority instream flows, for up to five years. The text in this section focuses on temporary changes of water to direct instream flow use using a section 308(5) SWSP—for more on plans for augmentation, please see pages 12-14.

To gain approval for an SWSP, a water user files a request for approval with the office of the State Engineer. The request for approval must describe the change of use requested—in the case of a section 308(5) SWSP for instream flow, that would be the change from existing decreed uses to instream flow use by the CWCB.[34] The SWSP request for approval is published on a regional notification list so that other water users have an opportunity to review and comment on any

[32] This is true of any administrative, temporary change of use tool, including the Temporary Loan Program and Interruptible Water Supply Agreements. Further, if the owner of the water right does change the water right use in the future, a period of nondecreed use, such as that taking place during the SWSP, must not be included in the study period for evaluating historical consumptive use. § 37-92-305(3)(c) (2020).

[33] § 37-92-308(5)(a).

[34] §§ 37-92-308(5)(a)(I), (IV)(a). An SWSP can permit multiple uses, including the originally decreed use, so long as total use is limited to historical consumptive use and return flow obligations are maintained. An SWSP could be used, therefore, to apply a water right originally decreed for irrigation to split-season irrigation and instream flow use.

The CWCB used an SWSP to restore flows to the Alamosa River downstream of Terrace Reservoir while a change case progressed through water court.

Yampa River

deficiencies or potential injury to their water rights.[35] After thirty-five days, if the State Engineer's office determines that the request can be operated without injury to other water rights, it can approve the section 308(5) SWSP together with terms and conditions to prevent injury.[36] These terms and conditions are similar to those of a water court change of use decree, including a change of water limited in volume and rate to an historical consumptive use allocation, and maintenance of return flow conditions.

The State Engineer can approve a section 308(5) SWSP for a single year, and a water user can reapply for up to five years total for the same temporary change of use under a section 308(5) SWSP.[37] The total number of years allowed for a particular section 308(5) SWSP, however, is further limited by the delayed depletions caused by the temporary change such that no more than five years of delayed depletions are allowed.[38] In practice, this means that if a water right owner uses a water right that causes multiple years of delayed depletions for a temporary change of water use, the five year total will be reduced by the number of years of delayed depletions. For instance, if the Water Trust and the CWCB were to change the use of an irrigation water right that has two years' worth of delayed depletions when diverted for irrigation use, then the Water Trust and the CWCB will have a two-year replacement obligation and will only be able to use the section 308(5) SWSP to authorize a change to instream flow use for up to three years.

The Water Trust could partner with the CWCB to use a section 308(5) SWSP to temporarily change the use of a water right to instream flow use. This would be a particularly valuable tool for the Water Trust and the CWCB because, unlike the Temporary Loan Program tool (see pages 4-6), the CWCB could use a section 305(8) SWSP to preserve and improve flows on a reach of stream where there is no decreed instream flow water right. A section 305(8) SWSP provides water users and the CWCB with a tool to temporarily transfer, and protect, the historical consumptive use allocation of a water right to instream flow, and as such may provide a valuable opportunity for water users considering a permanent transfer who are not yet ready for a full commitment.[39]

SWSPs are available for use in all of Colorado's water divisions,[40] and they can involve a change of water decreed from any type of use to instream flow. Until recently, SWSPs seemed to be a particularly desirable tool since they can be used for up to five years in appropriate circumstances, and because, unlike the 3-in-10 Temporary Loan Program, they could be used to preserve and improve the environment. With House Bill 20-1157's expansion of the Temporary Loan Program, however, temporary loans can be used for up to five in ten years without limitation based on the duration of depletions. Consequently, SWSPs may be more desirable for circumstances where a water user wants to lease or loan water to the CWCB for four or five consecutive years, since the Temporary Loan Program limits changes to three consecutive years. Additionally, SWSPs are particularly desirable because they can be used to restore stream flows where there is no decreed instream flow water right.

[35] § 37-92-308(5).
[36] §§ 37-92-308(5)(a)(IV)(A), (C).
[37] § 37-92-308(5)(a).
[38] Personal communication with Tracy Kosloff, Deputy State Engineer.
[39] The Water Trust has been working on such a pilot project involving a temporary change of water rights using a section 305(8) SWSP.
[40] Water Conservation Programs are one example of a tool for transferring water instream that is not available statewide—these programs are not legislated for use in Water Division 7 in southwest Colorado.

The Water Trust helped the CWCB to change water rights on the Alamosa River. Water released from Terrace Reservoir at the end of the irrigation season helps to keep the river flowing later and farther each year.

INTERRUPTIBLE WATER SUPPLY AGREEMENTS: ADOPTING AN EXISTING TOOL FOR INSTREAM FLOW

Interruptible Water Supply Agreements (IWSAs) are, like SWSPs, administrative tools for facilitating temporary changes of use for a water right.[41] They "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."[42] Under the structure of an IWSA, two or more water right owners enter an option agreement under which one water right owner may loan a water right to a borrowing water right owner for the borrowing water right owner's purposes.[43] Like SWSPs, they could be used to transfer a water right to instream flow use by the CWCB to preserve or improve the environment in stream reaches with or without a decreed instream flow water right. Unlike SWSPs, which

[41] IWSAs are described in COLO. REV. STAT. § 37-92-309(3) (2020), and in rules of the State Engineer, Rules and Regulations for Submittal and Evaluation of Interruptible Water Supply Agreements, 2 COLO. CODE REGS. § 402-15 (2020).
[42] § 37-92-309(3).
[43] § 37-92-309(2).

are a commonly used tool throughout Colorado, the implementation of IWSAs is rare, for a variety of reasons discussed below.

There are certain benefits to an IWSA over an SWSP. The notification and application process is similar, but once the State Engineer approves a ten-year IWSA, the IWSA participants do not need to reapply every year—approval extends for the entire ten-year period. The price tag of a ten-year approval period, however, is high—as of July 2020 the cost rose to $3,397 and that figure increases annually by an amount equal to the Denver Boulder Consumer Price Index.[44] IWSAs do not face the same approval period restrictions as section 308(5) SWSPs with regards to delayed depletions. However, an IWSA may be exercised for only three in ten years, and a ten-year approval is not renewable unless the IWSA was not exercised during the ten-year period.[45]

Overall, however, the structure of an IWSA is not as conducive to instream flow use as an SWSP. For instream flow purposes, the CWCB would enter an option agreement with another water user to use the loaned water right to satisfy an instream flow water right if there were not otherwise enough water in the stream, or to be triggered under other water short circumstances. However, the CWCB generally crafts loan or lease agreements that are contingent on both the CWCB and the water user desiring to exchange rights to use water in any given year, whereas option agreements are typically enforceable by the borrowing party. While there is the potential to build contingencies into an option agreement, they are not designed to be structured in that manner. The Water Trust has not yet encountered a situation in which an IWSA appears to be a superior fit for structuring a project than an SWSP or a Temporary Loan, but the IWSA still holds a place in the toolbox of instream flow acquisition tools should that situation arise.

[44] 2 COLO. CODE REGS. § 402-15.
[45] § 37-92-309(3)(c).

PLANS FOR AUGMENTATION: ESTABLISHING AN INSTREAM FLOW WATER MARKET

A plan for augmentation is a tool approved in water court to increase the supply of water available for beneficial use.[46] Water users that utilize a plan for augmentation are able to make beneficial uses that would otherwise be out-of-priority on Colorado's fully appropriated streams. Traditional plans for augmentation enable water users to pump from wells, maintain the evaporative losses from ponds that intercept groundwater in over-appropriated systems, or make surface diversions at times when such diversions would otherwise be called-out.[47] A plan for augmentation of instream flow, rather than allowing a water user to deplete stream systems out-of-priority, would allow the CWCB to protect water from diversions—also a use that would otherwise be out-of-priority. A CWCB instream flow plan for augmentation would enable the CWCB to acquire water rights decreed for augmentation use to preserve or improve the environment to a reasonable degree on stream reaches where there is insufficient streamflow to appropriate water in-priority for instream flow use.

Since 1986, Colorado statute has provided that the CWCB may "initiate such applications as it determines are necessary or desirable for using water, water rights, or interests in water . . . including augmentation plans."[48] However, this statute does not address whether the CWCB is entitled to file only water court applications for an augmentation plan that increase the available supply of water to replace depletions from out-of-priority diversions, or if the CWCB could increase the available supply of water and protect it instream. Relying on the second, broader interpretation of the instream flow enabling statute, several years ago the Water Trust began a collaboration with Colorado State University's Poudre Runs Through It Study/Action Work Group to investigate using an instream flow plan for augmentation on the Cache la Poudre River.[49]

The Cache la Poudre River is an excellent candidate for an instream flow plan for augmentation. Its headwaters are at the Continental Divide in Rocky Mountain National Park, and from there it flows east through Poudre Canyon to the eastern plains.[50] The 52 miles of river from the mouth of Poudre Canyon through the City of Fort Collins to the City of Greeley and the river's confluence with the South Platte River is a hard-working stretch. Diversions for municipal, irrigation, and industrial uses regularly dry up the river at multiple points, return flows build the river back up below the dry up points, decreed and administrative rights of exchange crisscross numerous locations, and stored, recharged, and changed direct diversion water rights augment out-of-priority depletions of consumptive water users. This hard-working river has not been a candidate for instream flow appropriations by the CWCB due to a lack of water availability and community support. However, water users between Fort Collins and Greeley want to collaborate towards improving the health of the river, and they can do that using augmentation water that they are willing to

[46] COLO. REV. STAT. § 37-92-103(9) (2020).
[47] While statute does not require it, plans for augmentation typically replace depletions attributable to out-of-priority diversions.
[48] S.B. 86-91: An Act Concerning the Acquisition of Water by the Colorado Water Conservation Board for the Purpose of Preserving the Natural Environment to a Reasonable Degree, ch. 235, sec. 1, 1986 Colo. Sess. Laws 1095, 1095 (codified at COLO. REV. STAT. § 37-92-102(3) (2020)).
[49] For more information, see *Improving Flows While Respecting Water Rights*, POUDRE RUNS THROUGH IT STUDY/ACTION WORK GROUP, https://watercenter.colostate.edu/prti-action-initiatives/#1553620695847-1d0f7ddd-ba0c (last visited June 27, 2020).
[50] Upstream of the canyon mouth, the Cache la Poudre River is the only site of a federally designated and protected wild and scenic river in the State of Colorado.

contribute to the CWCB for an instream flow plan for augmentation.

The Water Trust is working with Cache la Poudre River water users, including the Cities of Fort Collins, Greeley and Thornton, water supplier Northern Colorado Water Conservancy District, and irrigation water user consortium Cache la Poudre Water Users Association, as well as the CWCB and CPW, to prepare a water court application for approval of a plan for augmentation of instream flow. In preparing the application it became clear to the State Engineer and project partners that guidance beyond that already provided in statute was necessary, and so the Water Trust and project partners initiated a legislative effort in 2019 that legislators stymied. The Water Trust and project partners came back in 2020 with a bill co-sponsored by Representative Jeni Arndt (D) of Fort Collins and Senator Don Coram (R) of Montrose. With widespread bipartisan support, HB 20-1037 passed and Governor Jared Polis signed the bill into law on March 24, 2020.

House Bill 20-1037 enables the CWCB to file plans for augmentation with the consent of participating augmentation water right owners.[51] The plans for augmentation allowed pursuant to House Bill 20-1037 will use water rights previously changed and quantified in water court to any augmentation use, to preserve and improve the environment to a reasonable degree. Several terms and conditions to prevent injury to other water rights and existing water use operations are mandated by HB 20-1037.[52] There is an obligation by applicants to gain consent from the owners of structures in the river to make modifications required for the plan for augmentation to protect instream flows past these structures and to bear the cost of such modifications and resultant operational changes.[53] An applicant must also prove in water court that the plan for augmentation will not injure other water users' undecreed existing exchanges that were administratively approved before a water court application filing.[54]

[51] § 37-92-102(4.5)(b).
[52] § 37-92-102(4.5).
[53] § 37-92-102(4.5)(b)(VI).
[54] § 37-92-102(4.5)(b)(V).

A plan for augmentation on the Poudre River will provide the opportunity for local water users to reconnect the river in places where it currently dries up completely, not only in winter but also during summer months.

Once the instream flow augmentation plan for the Cache la Poudre is approved, the CWCB will protect augmentation water acquired from Fort Collins, Greeley and Thornton under long-term loan agreements to preserve and improve natural environment to a reasonable degree.[55] CPW will recommend preserve and improve flow rates according to season, and for specific reaches of the Cache la Poudre River, since the river's depth, gradient, and aquatic species' needs vary along the 52 miles of stream subject to instream flow augmentation. Finally, the CWCB will be able to incorporate one of the most significant attributes of a plan for augmentation into this tool: it will be able to add additional, appropriately decreed augmentation water rights to this plan. The plan for augmentation will be able to use not only the seed water provided by project partners to preserve and improve the natural environment of the Cache la Poudre River to a reasonable degree, but also other water users' changed and quantified augmentation water. In this sense, the plan for augmentation will operate somewhat like a bank, or a water market. Water users will be able to loan appropriately decreed water to the CWCB to augment instream flow, but they can withdraw their deposited water for their other needs when they want or need to. By setting up a tool that can incorporate and use many different water rights over time on this hard-working river, the Water Trust aims to create a flexible, effective, and enduring source for protecting water instream on the Cache la Poudre River.

Use of the augmentation plan tool described in House Bill 20-1037 should be a powerful way to improve and protect flows in other areas and on hard-working rivers like the Cache la Poudre River.[56] Setting up an instream flow plan for augmentation will be most productive in basins where there are multiple water users with changed and quantified augmentation water rights who are willing to partner together with one another and with the CWCB. This is also a tool that can be used on rivers where the CWCB has been unable to appropriate an instream flow water right due to a lack of water availability or for other reasons. Under the plan for augmentation structure, the CWCB will acquire water for use through a temporary agreement or in fee simple, and so there does not need to be an underlying instream flow water right. There are other legal structures available for acquiring water for the augmentation of instream flow, such as the appropriation of junior storage water rights decreed for any augmentation use, or specifically decreed for the augmentation of instream flows. It remains to be seen, however, whether claiming a structure for augmentation other than that established in HB 20-1037 would require further legislation.[57] Legislation is a long and resource-intensive effort, but, at least in the case of the project that the Water Trust is leading on the Cache la Poudre River, it looks to have proven worthwhile.

[55] For more information, see *Cache la Poudre River – ISF Augmentation Plan*, COLO. WATER TRUST, http://coloradowatertrust.org/project/isf-augmentation-plan-poudre (last visited June 27, 2020).

[56] Also, unlike Water Conservation Programs, plans to augment instream flow pursuant to section 37-92-102(4.5) will be available statewide.

[57] A savings clause at section 37-92-102(4.5)(c)(II) provides that subsection (4.5) is "not intended to be the exclusive means of authorizing water decreed for augmentation purposes to be used for environmental [purposes]."

Irrigation System in Greeley, Colorado
Photo courtesy of Nicole Geri, www.unsplash.com

AGRICULTURAL WATER PROTECTION WATER RIGHTS: PROVIDING WATER FOR INSTREAM FLOW AND PROTECTING AGRICULTURAL WATER USE

Agricultural Water Protection Water Rights (AWPWRs) are a subset of water rights originally decreed for agriculture or irrigation uses for which historical consumptive use has been quantified in water court, and following which the water rights become available for temporary administrative change via SWSP to other uses. The Colorado General Assembly created statutory guidance[58] to establish AWPWRs in response to the intense pressure mounting on agricultural water users to sell their water to municipalities for permanent changes of use, resulting in widespread "buy and dry." AWPWRs will provide different operational and financial opportunities for the owners of agricultural water rights, and because statute requires that AWPWRs are only available to water right owners who participate in a land or agricultural water conservation program, AWPWRs provide incentive to keep these water rights in agricultural production on a long-term basis.[59]

Following water court quantification proceedings, up to fifty percent of the historical consumptive use of an AWPWR can be used in any given year for other purposes.[60] The water court process to decree AWPWRs includes a calculation of the volume of historical consumptive use available for loan, lease, or trade to other uses in time and amount, and includes return flow obligations and other terms and conditions necessary to facilitate loan, lease, or trades to other water users without

[58] H.B. 16-1228: An Act Concerning an Alternative Transfer Mechanism for Water Rights that Protects the Agricultural Use for Which a Water Right Was Originally Decreed While Permitting Renewable One-Year Transfers of a Portion of the Water Subject to the Water Right, ch. 175, sec. 3-4, 2016 Colo. Sess. Laws 598, 600-04 (codified at COLO. REV. STAT. §§ 37-92-305(19), -308(12) (2020)).
[59] COLO. REV. STAT. §§ 37-92-305(19)(b)(IV)(A)-(B) (2020).
[60] COLO. REV. STAT. § 37-92-305(19)(b)(II) (2020).

injury to other water rights.[61] The application of an AWPWR to other uses requires administrative approval by the State Engineer using an SWSP.[62] The State Engineer has promulgated rules to guide that SWSP approval process that it will apply. Pursuant to these water court-approved rules, AWPWRs can be used on a temporary administrative basis for different uses—including direct or augmentation use for instream flow by the CWCB to preserve or improve the environment.[63]

The Water Trust is optimistic that AWPWRs will be a source of augmentation water for the instream flow augmentation plan on the Cache la Poudre River, and perhaps for other instream flow uses along the eastern plains. The application of AWPWRs to changed uses, including instream flow, is geographically limited. Water Courts can only adjudicate AWPWRs in Water Divisions 1 and 2. There are few CWCB instream flow water rights or Water Trust projects in these areas due to a lack of water availability, and it is possible to envision a scenario where there are sufficient AWPWRs aggregated on a stream that project potential develops. No water users have gone through the AWPWR water court change process to date, and a significant limitation on the program is that the properties served by AWPWRs must be subject to a conservation easement.[64] However, the Colorado Water Trust remains hopeful that agricultural water users will embrace the concept, creating opportunities that generate alternate sources of income and keep water tied to the land, while simultaneously providing a source of protectable instream flows. If AWPWRs prove successful in Divisions 1 and 2, extending this statutory tool statewide could be a promising way to maintain productive agriculture as well as to share water to meet environmental flow needs.

[61] *See* OFFICE OF THE STATE ENG'R, RULES GOVERNING THE REVIEW OF A SUBSTITUTE WATER SUPPLY PLAN FOR THE LEASE, LOAN, OR TRADE OF A DECREED AGRICULTURAL WATER PROTECTION WATER RIGHT (2017), https://www.courts.state.co.us/userfiles/file/Court_Probation/Water_Courts/Water%20Division%202/Rules.pdf.
[62] COLO. REV. STAT. § 37-92-308(12) (2020).
[63] The water courts for Water Divisions 1 and 2 approved the State Engineer's Rules Governing the Review of a Substitute Water Supply Plan for the Lease, Loan, or Trade of a Decreed Agricultural Water Protection Water Right in consolidated Case No. 17CW3152. The Water Trust participated in Case No. 17CW3152 to ensure that AWPWRs and the SWSPs that approve their changed uses may be applied to instream flow use. See *Stipulation Between State Engineer and Colorado Water Trust*, Case No. 92CW3152 at 2-3 (Colo. Water Ct. Div. No. 1, Feb. 13, 2019).
[64] § 37-92-305(19)(b)(IV)(A).

WATER BANKING: AN UNTAPPED TOOL WITH FUTURE PROMISE

In the preceding section describing plans for augmentation of instream flow, this paper compared augmentation plans to water banks or water markets, since water users can temporarily "deposit" appropriately decreed augmentation water rights to bolster instream flows, and because a plan for augmentation aggregates these water rights for instream flow use. However, Colorado already has a statutory water banking tool. Statutory water banks are more like a savings and loan institution in the sense that they are intended to be a depository for water rights available for lease or loan for a variety of uses when demand arises. Water banks provide a clearinghouse in which willing water users may market their water rights to multiple buyers. Despite their potential, and an enabling statute dating to 2003, water banks have yet to be successfully implemented in Colorado.[65]

Colorado statute authorizes the creation of water banks within each of the state's seven water divisions.[66] A water bank program may include practices to simplify and improve[67] administrative approval of water leases, loans, and exchanges of water, which would make water banks significantly more effective. Practices that would simplify administrative approval might include streamlined reviews of historical consumptive use allocation and return flow obligations using equations and factors pre-approved by the State Engineer in order to avoid time consuming and expensive parcel-specific investigations. While such practices would have to conservatively guard against injury to other water rights, they would result in a streamlined evaluation of bank depositors' water rights and facilitate many more deposits than the individual analyses performed for present-day administrative changes, including SWSPs, IWSAs, and the Temporary Loan Program.[68]

Another approach that would benefit water banks would be the inclusion of AWPWRs as water deposited and available for lease, and the extension of the AWPWR tool beyond Water Divisions 1 and 2. At this time, the Colorado water

[65] In Idaho, the Idaho Water Resource Board manages a water bank and local rental pool, the establishment of which dates back to the 1930s. See *Water Supply Bank*, IDAHO DEP'T OF WATER RESOURCES, https://idwr.idaho.gov/water-supply-bank/overview.html (last visited June 28, 2020). In Washington, the state facilitates water banking through a Trust Water Rights Program that operates in several basins. *See Water Banks*, DEP'T OF ECOLOGY, ST. OF WASH., https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-rights/Trust-water-rights/Water-banks (last visited June 28, 2020).

[66] COLO. REV. STAT. § 37-80.5-102 (2020).

[67] *Id.*; A. Castle & L. MacDonnell, *An Enhanced Water Bank for Colorado*, COLO. L. SCHOLARLY COMMONS, GETCHES-WILKINSON CTR. FOR NAT. RESOURCES, ENERGY & THE ENV'T (Mar. 2016).

[68] Furthermore, developing a set of administrative assumptions, equations and factors that could be used for all temporary, administrative changes of water rights would also go far in streamlining those tools.

Reservoir storage provide opportunity to retime streamflow when the aquatic environment needs it most, through water banking or junior storage rights.

bank statute allows only for the banking of stored water.[69] A water bank's potential for success may lie in its ability to aggregate the deposit of numerous water rights with different attributes, so that when end users seek a loan they can find a right that is available to them in the appropriate time, place, and amount. While AWPWRs could be stored or exchanged to storage, many would be more readily available via direct flow. This is true not only of AWPWRs but of other water rights made available for temporary use through a water bank. The present constraint limiting water banking to stored water poses a significant hindrance to the future success of water banks in Colorado.[70]

On Colorado's western slope, water right stakeholders including the Colorado River Water Conservation District, the Southwestern Water Conservation District, the State of Colorado, the Front Range Water Council, and The Nature Conservancy have formed a Water Bank Work Group.[71] The Water Bank Work Group has envisioned a Colorado River basin water bank that would enable agricultural water users to receive compensation for leasing their water rights for municipal, agricultural, and environmental uses, without having to permanently sell water and separate it from the land. If successful, their water bank would strike a balance between agricultural, municipal, and environmental uses without permanent buy-and-dry.[72] The Water Bank Work Group's work is particularly pertinent in response to Colorado's ongoing "demand management" investigations, which seek voluntary, temporary and compensated ways to reduce water use help maintain critical elevations of stored water in Lake Powell and ensure compliance with the Colorado River Compact.

Water banks could be a useful source of instream flow water. If a water bank were large enough, the Water Trust could coordinate to provide water to the CWCB for instream flow use on stream reaches during the times it is needed most. Water banks are not, however, a tool oriented solely or primarily towards streamflow restoration. They are tools that aim to provide water to the entire suite of uses with water supply shortfalls identified in Colorado's Water Plan, including municipal, industrial, and agricultural use. It will be important for the Water Trust or other environmental NGOs to participate in structuring future water banks in Colorado to ensure that environmental uses receive a fair opportunity to participate in a water banking system. Colorado statute provides that water available for acquisition through a water bank may not be prevented from being used for instream flow purposes,[73] but it is possible to foresee a scenario in which consumptive end uses of banked water would be given priority.

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[69] COLO. REV. STAT. § 37-80.5-102 (2020).

[70] Experts have cited this as one reason the Arkansas Basin pilot project water bank failed. Other reasons included unrealistically high asking prices and only two water rights offered for lease in the bank. HAL D. SIMPSON, REPORT TO THE GOVERNOR AND LEGISLATURE ON THE ARKANSAS RIVER WATER BANK PILOT PROGRAM 3 (2005), http://hermes.cde.state.co.us/drupal/islandora/object/co%3A11475.

[71] *See Water Banking Option,* COLO. RIVER DISTRICT, https://www.coloradoriverdistrict.org/water-banking/ (last visited June 28, 2020).

[72] In support of feasibility studies for a Colorado River Basin water bank, the Grand Valley Water Users Association conducted a 1,000-acre lease-fallow project in 2017. The Conserved Consumptive Use Pilot Project (CCUPP) was "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." GRAND VALLEY WATER USERS ASSOCIATION, CONSERVED CONSUMPTIVE USE PILOT PROJECT (CCUPP) DEVELOPMENT: PROCESS, PROCEDURE AND LESSONS LEARNED (2017), http://www.grandvalleywaterusers.com/uploads/8/2/6/0/82606774/03-01-17_ccupp_projectdevelopment_final.pdf.

[73] COLO. REV. STAT. § 37-80.5-102 (2020).

EFFICIENCY TRANSFERS

Colorado is ripe with opportunities for improving the efficiency of application and use of water rights. For instance, ditches can be lined or piped to cut down on seepage and evaporation, irrigation practices can be switched from flood to sprinkler or drip, and farmers can switch to less water intensive crops.[74] Efficiency and conservation is admirable from a production perspective, but the Water Trust has avoided participating in efficiency projects that may result in a net increase of water consumed on a per acre basis, therefore resulting in less water in local streams. For instance, switching from flood to sprinkler or drip irrigation can result in the ability to grow more biomass per acre, increasing the use of diversions and decreasing return flows that recharge local aquifers and support streamflow.[75]

There are efficiency projects, however, that can result in a net decrease in diversions, leaving more water in the stream. Ditch lining is a good example. It reduces delayed return flows, but on the whole and in many circumstances makes it possible to irrigate the same crop while diverting less water. In several western states, including Utah and Idaho, the amount of water saved is transferable to other uses, including instream flow.[76] That is not the case, however, in Colorado. In Colorado, legal rules broadly prohibit waste, and water users are obligated to divert no more than they need for decreed beneficial purposes.[77] In practice, this does not obligate a water user to line their ditch, but it does prevent a water user from transferring water saved by efficiency to other uses without losing the priority associated with the water right. Water saved by efficiency is either consumed by the next water users in line in the priority system, or if there are no water users waiting in the priority line, it becomes part of the natural stream, available for appropriation.

The Water Trust could, in an ideal situation,[78] engage in an efficiency project that leaves non-diverted water in the stream in locations where there are no water users waiting in the priority line to consume that water. Without further action, that water would not be protected in the stream. If the efficiency project were to take

[74] These crops may be less water intensive, but they may also have lower commodity prices. Further, the agricultural producer may not have the experience or desire to grow that type of crop.

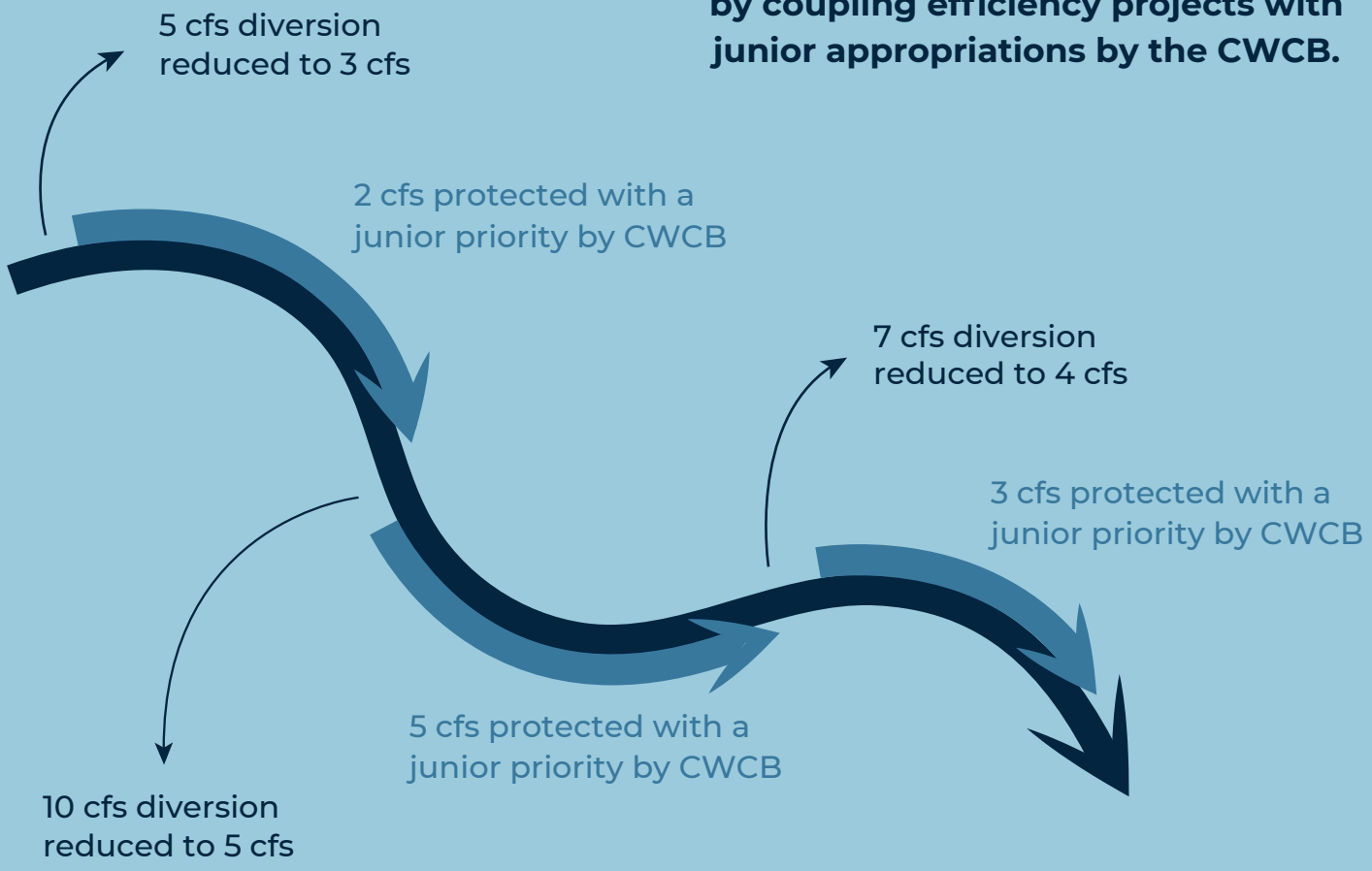
[75] In the Arkansas River Basin, for example, water users who implement irrigation system improvements are required to gain approval from the Division of Water Resources and must take steps to offset increased water consumption. For more information on the Arkansas River Irrigation Improvement Rules, see http://water.state.co.us/SurfaceWater/RulemakingAndAdvising/ArkRiverAC/Pages/ArkSWIrrigImpRules.aspx.

[76] "Developed water" is water that is not naturally part of the river system but is introduced to the system by a developer. "Salvaged water," on the other hand, describes development schemes that attempt to create an independent priority free of the river call for water that is naturally part of the stream system. Courts in most western states treat salvaged water and developed water the same way, entitling users who develop or salvage that water to a superior right to it. *See, e.g.*, Estate of Steed Through Kazan v. New Escalante Irrigation Co., 846 P.2d 1223 (Utah 1992); Basinger v. Taylor, 211 P. 1085 (Idaho. 1922). In Colorado, a number of cases disallow users a superior right to salvaged water. *See, e.g.*, Ready Mixed Concrete Co. v. Farmers Reservoir & Irrigation Co., 115 P.3d 638 (Colo. 2005); Giffen v. Colo., 690 P.2d 1244 (Colo. 1984); R.J.A., Inc. v. Water Users Ass'n of Dist. No. 6, 690 P.2d 823 (Colo. 1984); Se. Colo. Water Conservancy Dist. v. Shelton Farms, Inc., 529 P.2d 1321 (Colo. 1974).

[77] City of Boulder v. Boulder & Left Hand Ditch Co., 557 P.2d 1182, 1185 (Colo. 1976) ("[T]he original appropriators have the right, and in fact it is their duty to prevent, as far as possible, all waste of the water which they have appropriated, in order that the others who are entitled thereto may receive the benefit thereof.").

[78] An "ideal situation" would also take into account the ancillary, non-decreed benefits of irrigation practices that may be less than perfectly efficient. For instance, irrigation may support wetlands, and late season return flows may keep rivers running later in the summer and fall when they might otherwise become dry.

This "Falling Leaf Concept" depicts streamflow restoration accomplished by coupling efficiency projects with junior appropriations by the CWCB.



place on a stream that is not over-appropriated,[79] however, the CWCB could use the water availability created by the efficiency project as the basis for a new appropriation. There could also be situations in which, if there are multiple water rights ripe for efficiency projects on a single stream, an entity like the Water Trust could facilitate the improvement of a series of stream reaches by making water saved by efficiency from each water right available for appropriation by the CWCB. (See diagram depicting a "falling-leaf" pattern of water efficiency savings and appropriation above).

[79] Since the water would be made available for appropriation, not acquisition, the CWCB could file a section 37-92-102(3) application for an amount of water to preserve the environment to a reasonable degree. The CWCB does not have the authority to appropriate water to improve the environment to a reasonable degree.

JUNIOR STORAGE APPROPRIATIONS AND PAPER FILL

Water storage rights can be useful for capitalizing on spring runoff to store water when rivers run high, and then to release it during drier summer and fall months. One way in which existing storage space could be used to benefit instream flows is to use water that would be used for other purposes or for multi-year carryover for instream flow instead. Using the tools currently available to and used by the Water Trust and the CWCB, stored water can be changed for instream flow use permanently in water court, or temporarily using an SWSP, IWSA, or the expanded Temporary Loan Program. There is also potential for partnering with agricultural water users (or other water users with high summer demand) by storing more water during the runoff season, and then delivering that water to agricultural diversions during the summer. That would allow more native water to be left in the stream during summer months to benefit the environment and the released water to be protected as instream flow above diversion points, while still maintaining crop productivity.

Another way to use stored water for instream flow use, either separately from or coupled with agricultural water deliveries, would be by adjudicating a junior storage water right. Reservoirs may hold multiple water rights, and if there is sufficient streamflow available for appropriation, the CWCB, alone or in cooperation with a reservoir owner or operator, could appropriate a new storage right decreed for instream flow (and other water uses, if so desired) adding that instream flow water right to the portfolio of water rights in any given reservoir. A junior water right may displace water stored under senior rights, and if so the State and Division Engineer would "paper fill" the senior water rights that went unfilled.[80] In other words, unfilled senior water rights would be accounted for as if they did fill since they could have taken water in priority but reservoir operators decided to fill junior rights instead. Paper fill and other administrative accounting procedures are usually decreed together with junior storage water rights, setting expectations ahead of time for multiple parties sharing storage space in a single reservoir. Water stored this way could be released at any time needed to optimize instream flow use by the CWCB to preserve and improve the environment.

[80] *See* COLO. DIV. OF WATER RES., GENERAL ADMINISTRATION GUIDELINES FOR RESERVOIRS (2016), https://dnrweblink.state.co.us/dwr/DocView.aspx?dbid=0&id=3579805&page=1&searchid=447392fb-632b-4784-b9ab-d1317ce2e3ed&cr=1.

There are many existing reservoirs where a junior water right could be used to retime flows to benefit the downstream environment.

CONCLUSION

The legal mechanisms described in this paper provide new and untested opportunities for transferring and protecting water in the stream. Since statute only recognized instream flow as a beneficial use in 1973, environmental flows maintain a very junior position in Colorado's priority system. Legal tools are desirable to protect environmental flows under more senior priorities. Several of the tools described in this paper, in particular SWSPs and plans for augmentation, are tried and true methods for facilitating junior consumptive uses that have succeeded in that purpose for decades. Other tools, such as the 3-in-10 Temporary Loan Program that the General Assembly just expanded to be a 5-in-10 Temporary Loan Program, focus exclusively on instream flow transactions.

The tried and true methods that consumptive water users employ have not proven to be a good enough fit to facilitate a significant number of instream flow transactions. The entire suite of legal tools available in Colorado, however, provides opportunity for finding ways to transfer water rights to instream flow using either temporary, administrative or permanent, water court approvals that will suit both environmental needs and the needs of water users who wish to engage in instream flow transactions. All of the tools described in this paper can be utilized under current Colorado law. Future legislative action could be desirable or necessary to facilitate a volume of instream flow transactions that ensures Colorado's streams and rivers flow healthily and support new and existing uses. For now, however, the Water Trust aims to implement projects across our state, and to restore flows to rivers in need, using the tools on which it has relied in the past, and on the legal mechanisms described in this paper.

APPENDIX A: TABLE OF AVAILABLE AND POTENTIAL TOOLS TO PROTECT AND RESTORE FLOWS

Tools described in this paper

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment?	Used Before?
New ISF Appropriation*	37-92-102(3)	Protect flows as they exist at time of appropriation; purpose is to preserve the existing natural environment	CWCB[1] & Water Court	Permanent	New junior water right	Yes	N/A	N/A	YES; *Many statewide*
ISF Water Acquisition – Permanent	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Permanent	Direct flow or storage rights; donations, purchases, permanent split-season uses, contractual interests	Yes	N/A; Permanent ISF use	N/A as long as permanent ISF use	YES; *Moser, McKinley, Vasquez, Gabino Gallegos, Breem*
ISF Water Acquisition – Long Term Leases	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Contractual *(but prefer term longer than 10 years)*	Leases, Trust Agreements, use of available augmentation water	Yes	Yes, 37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	YES; *Pitkin Co.*
ISF Water Acquisition – Temporary Instream Flow Lease (5-in-10 Lease)	37-83-105(2)	Restore flows with senior water rights; Preserve and improve the natural environment on reach with ISF right	CWCB[3], DWR	Up to 5 uses in 10 years, 120 days/year, renewable for two additional ten-year periods	Must use with existing but water-short ISF; amended in 2020 from 3-in-10 to 5-in-10 with two more ten year periods and to preserve and improve	Yes	Yes, 37-83-105(2)(c)	Yes, 37-92-103(2)(b)(V)	YES (under 3 in 10 tool); *Winter Park Ranch W&S District, Stagecoach, Coats Bros.*
Ag to Ag Lease to Downstream User	37-83-105(1)	Potential incidental flow benefits to the intervening stream reach	DWR	180 days/ calendar year	Must involve water rights decreed "solely for agricultural irrigation purposes"	No	N/A	N/A	Not by Water Trust
ISF Water Acquisition — ISF Aug Plan	37-92-102(3) + 37-92-102(4.5)	Restore flows with changed and quantified senior aug water rights; preserve or improve the natural environment	CWCB[2] & Water Court	Permanent and/or contractual term	Not fully tested; legislatively authorized; concept will have process for adding future water to the aug plan built into the water court decree to ensure expedited approvals	Yes	37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	NO; *Poudre Flows plan under development*

APPENDIX A: TABLE OF AVAILABLE AND POTENTIAL TOOLS TO PROTECT AND RESTORE FLOWS

Tools described in this paper

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment?	Used Before?
Water Conservation Programs	37-92-305(3)(c)	Restore flows through voluntary reduced diversions	Enrollment in Water Conservation Program approved by authorized entity	5 years in any consecutive 10 year period; unlimited use if under a specified federal program	Applicable in all water divisions EXCEPT Division 7	No	Yes, 37-92-305(3)(c)	Yes, 37-92-103(2)(b)(I)	YES; *Rio Colorado, SCPP projects*
Forbearance Agreements	N/A	Restore flows through voluntary reduced diversions	Private agreement	Contractual	Impacts historical use of water right (no HCU protection); *Might consider Water Conservation Program instead*	No	No	No	YES; *Wheeler Ditch 2013*
Undecreed Reservoir Release	N/A	Restore flows with storage water release	Private agreement	Contractual	The storage equivalent of a forbearance agreement. Reservoir risks refill next year (can only refill under free river conditions).	No	No	No	*YES; Big Beaver Res. 2002*
Substitute Water Supply Plan *(For pending Water Court Cases)*	37-92-308(4)	Pair with a pending water acquisition to preserve or improve the natural environment	DWR	1 year approval	Expedite ISF use of water rights while water court case for that use is pending	Yes	Same protections as for Permanent or Long Term Water Acquisitions	Yes, 37-92-103(2)(b)(VI)	YES; *Gabino Gallegos, Valdez, Breem*
Substitute Water Supply Plan *(For stream depletions of less than 5 years)*	37-92-308(5)	Restore flows with senior water rights; preserve or improve the natural environment	DWR, CWCB[2] if ISF use	1 year approvals, up to 5 years max renewable	For temporary use of a water right for ISF for 5 years or less; similarities with Temporary Loan but can use on reaches without decreed ISF	Yes	See Note[4]	Yes, 37-92-103(2)(b)(VI)	Not for ISF use
Interruptible Water Supply Agreement	37-92-309	Restore flows with senior water rights; preserve or improve the natural environment	CWCB[2], DWR	3 years in 10, renewable twice	Allows for the temporary loan of one water right for the use under another water right	Yes	See Note[4]	Yes, 37-92-103(2)(b)(VI)	NO

APPENDIX A: TABLE OF AVAILABLE AND POTENTIAL TOOLS TO PROTECT AND RESTORE FLOWS

Tools described in this paper

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment?	Used Before?
Simple Change of Point of Diversion to Downstream Location	37-92-305(3.5)	Restore flows between old and new downstream diversion point	Water court	N/A	Moving the diversion point downstream may increase flows for a section of river; does not require quantification; cannot use with intervening ISF right	No	N/A; Decreed Use	N/A; Decreed Use	Unknown for flow restoration use
Change of Point of Diversion to Downstream Location	37-92-305(3)	Restore flows between old and new downstream point of diversion	Water Court	N/A	If circumstances are not met for a simple change, must then quantify water right	No	N/A; Decreed Use	N/A; Decreed Use	YES; *Breem Ditch*
Strategic Retirement of Water Right	N/A – common law and potential 37-92-102(3)	Restore flows, or protect against future depletions	Private agreement	Permanent	Retire conditional or absolute water right, particularly useful in reaches with existing but junior ISFs.	No	N/A	N/A	YES; *Three Sisters Ditch*
ISF Water Acquisition – Lease Fallowing Pilot Projects	37-60-115(8)	Restore flows with senior water right; preserve or improve the natural environment	CWCB and DWR approval required for both pilot project and also for temporary change	3 years in 10 years	More complicated than equivalent tools	Yes	Yes	Yes	Not for ISF Use
ISF Water Acquisition – Water Bank	37-80.5-101	Restore flows using stored water and temporary approvals; preserve or improve the natural environment	Partner with CWCB & WCD; DWR promulgates rules for each water bank	Not limited by bank, but could be by water rights in bank	Rules would dictate	Yes	See Note[4]	Yes, 37-92-103(2)(b)(VI)	Not by Water Trust
Agricultural Water Protection Water Right	37-92-305(19) & 37-92-308(12)	Restore flows with senior water rights	CWCB[2], Water Court, DWR for SWSP approval	SWSP approval for 3 years, renewable without limitation	Complicated and may be expensive to establish, but water sharing option and good for long term operational planning	Yes	Yes, quantified	Yes, 37-92-103(2)(b)(VI)	NO

APPENDIX A: TABLE OF AVAILABLE AND POTENTIAL TOOLS TO PROTECT AND RESTORE FLOWS

Tools described in this paper

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment?	Used Before?
Storage Water Delivery for Decreed Uses	N/A – common law	Storage releases add water to rivers when delivered for downstream decreed uses such as augmentation, municipal, or other uses	Private agreement	Contractual	Contractual delivery of storage water for decreed use	Depends on decree; possible incidental flow benefits between points	N/A; Decreed Use	N/A; Decreed Use	YES; *Florida River ISF augmentation; Muni-rec contracts; Stagecoach Reservoir*
Storage Release for In-channel Piscatorial Use	Upper Gunnison, 838 P.2d 840 – common law	Restore flows with reservoir release	Water Court	At discretion of owner, pursuant to decree	Exception to CWCB exclusive authority for ISF	Yes, decreed use	N/A; Decreed Use	N/A; Decreed Use	YES, *Taylor Reservoir*
Rotational Crop Management Contracts	37-92-305(4)(a)(IV)	Restore flows with senior water rights	CWCB[2]	Contractual	Useful with a group of irrigators	Yes	Yes, 37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	NO
Storage New Junior Appropriation	N/A – common law	Restore flows to preserve and improve with acquisition and with reservoir release	Water Court	At discretion of owner, pursuant to decree	CWCB exclusive authority for ISF; paper fill senior rights	Yes, decreed use	N/A; Decreed Use	N/A; Decreed Use	NO

* New ISF appropriations are flow maintenance tools, rather than flow restoration tools, but are listed here for comparison purposes. CWCB new appropriation process usually requires 1-2 years to complete.

[2] CWCB water acquisition approval process requires 2 Board meetings; may require a hearing if requested.

[3] CWCB Director can approve temporary ISF leases once SEO determines non-injury; Board will confirm Director's decision at subsequent meeting.

[4] No specific statute, but Case Law may provide protections: *"By enacting these statutes, the General Assembly has authorized short-term changes that do not penalize the appropriator in any subsequent change of water right proceeding. The methodology for calculating historic consumptive use of the water rights over a representative period of time for a permanent change will not count or discount the years of authorized temporary use. The legislature clearly intended to promote flexibility in the administration of water rights, especially in the circumstances of temporarily transferring water from agricultural use to municipal use on a contract basis. It did not intend to penalize owners of decreed appropriations for properly taking advantage of these statutes according to their terms."* ISG, LLC v. Arkansas Valley Ditch Ass'n *120 P.3d 724, 734 (Colo. 2005).*

Attachment 2

Table of Available and Potential Tools to Protect and Restore Flows

Colorado Water Trust, 2021

COLORADO WATER TRUST

Table of Available and Potential Tools to Protect and Restore Flows

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Protected as Instream Use?	Protections for HCU?	Protections from Abandonment ?	Used Before?
New ISF Appropriation*	37-92-102(3)	Protect flows as they exist at time of appropriation; purpose is to preserve the existing natural environment	CWCB[1] & Water Court	Permanent	New junior water right	Yes	N/A	N/A	YES; *Thousands statewide*
ISF Water Acquisition -- Permanent	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Permanent	Direct flow or storage rights; donations, purchases, permanent split-season uses, contractual interests	Yes	N/A; Permanent ISF use	N/A as long as permanent ISF use	YES; *Peabody, McKinley, Valdez, Gabino Gallegos, Breem*
ISF Water Acquisition-- Long Term Leases	37-92-102(3)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2] & Water Court	Contractual *(but prefer term longer than 10 years)*	Leases, Trust Agreements, use of available augmentation water	Yes	Yes, 37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	YES; *Pitkin Co.*
ISF Water Acquisition— Expedited Temporary Instream Flow Loan *(5-in-10 Loan)*	37-83-105(2)	Restore flows with senior water rights; Preserve the natural environment	CWCB[3], DWR	One-year, non-renewable	Must use with existing but water-short ISF	Yes	Yes, 37-83-105(2)(c)	Yes, 37-92-103(2)(b)(V)	No. Used under previous 3-in-10 statute; *Winter Park Ranch W&S District, Stagecoach, Coats Bros.*
ISF Water Acquisition— Renewable Temporary Instream Flow Loan *(5-in-10 Loan)*	37-83-105(2)	Restore flows with senior water rights; Preserve or improve the natural environment	CWCB[2], DWR	5 uses in 10 years, 120 days/year, no more than 3 years consecutive, renewable twice	Must use with existing decreed ISF	Yes	Yes, 37-83-105(2)(c)	Yes, 37-92-103(2)(b)(V)	No. Used under previous 3-in-10 statute; *Winter Park Ranch W&S District, Stagecoach, Coats Bros.*

COLORADO WATER TRUST

Table of Available and Potential Tools to Protect and Restore Flows

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Administrable for Instream Use?	Protections for HCU?	Protections from Abandonment ?	Used Before?
Ag to Ag Lease to Downstream User	37-83-105(1)	Potential incidental flow benefits to the intervening stream reach	DWR	180 days/ calendar year	Must involve water rights decreed "solely for agricultural irrigation purposes"	No	N/A	N/A	Not by Water Trust
ISF Water Acquisition — ISF Aug Plan	37-92-102(3) + 37-92-102(4.5)	Restore flows with portfolio of senior augmentation water rights; preserve or improve the natural environment	CWCB [2] & Water Court	Permanent and/or contractual term	Not fully tested; legislatively authorized; concept will have process for adding future water to the aug plan built into the water court decree to ensure expedited approvals	Yes	37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	NO; *Poudre Flows plan under development*
Water Conservation Programs	37-92-305(3)(c)	Restore flows through voluntary reduced diversions	Enrollment in Water Conservation Program approved by authorized entity	5 years in any consecutive 10 year period; unlimited use if under a specified federal program	Applicable in all water divisions EXCEPT Division 7	No	Yes, 37-92-305(3)(c)	Yes, 37-92-103(2)(b)(I)	YES; *Rio Colorado, SCPP projects*
Forbearance Agreements	N/A	Restore flows through voluntary reduced diversions	Private agreement	Contractual	Impacts historical use of water right (no HCU protection); *Might consider Water Conservation Program instead*	No	No	No	YES; *Wheeler Ditch 2013 + 2014*
Undecreed Reservoir Release	N/A	Restore flows with storage water release	Private agreement	Contractual	The storage equivalent of a forbearance agreement. Reservoir risks refill next year (can only refill under free river conditions).	No	No	No	YES; *Big Beaver Res. 2002*
Substitute Water Supply Plan *(For pending Water Court Cases)*	37-92-308(4)	Pair with a pending water acquisition to preserve or improve the natural environment	DWR	1 year approval	Expedite ISF use of water rights while water court case for that use is pending	Yes	Same protections as for Permanent or Long Term Water Acquisitions	Yes, 37-92-103(2)(b)(VI)	YES; *Gabino Gallegos, Valdez, Breem*

COLORADO WATER TRUST

Table of Available and Potential Tools to Protect and Restore Flows

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Administrable for Instream Use?	Protections for HCU?	Protections from Abandonment ?	Used Before?
Substitute Water Supply Plan *(For stream depletions of less than 5 years)*	37-92-308(5)	Restore flows with senior water rights; preserve or improve the natural environment	DWR, CWCB[2] if ISF use	1 year approvals, up to 5 years max renewable	For temporary use of a water right for ISF for 5 years or less; similarities with Short Term Loan but can use on reaches without decreed ISF	Yes	See Note [4]	Yes, 37-92-103(2)(b)(VI)	Not for ISF use
Interruptible Water Supply Agreement	37-92-309	Restore flows with senior water rights; preserve or improve the natural environment	CWCB[2], DWR	3 years in 10, renewable twice	Allows for the temporary loan of one water right for the use under another water right	Depends	See Note [4] Could pair with a Water Conservation Program	Yes, 37-92-103(2)(b)(VI)	NO
Simple Change of Point of Diversion to Downstream Location	37-92-305(3.5)	Restore flows between old and new downstream diversion point	Water court	N/A	Moving the diversion point downstream may increase flows for a section of river; does not require quantification of water right under certain circumstances	No	N/A; Decreed Use	N/A; Decreed Use	Unknown for flow restoration use
Change of Point of Diversion to Downstream Location	37-92-305(3)	Restore flows between old and new downstream point of diversion	Water Court	N/A	If circumstances are not met for a simple change, must then quantify water right	No	N/A; Decreed Use	N/A; Decreed Use	YES; *Breem Ditch*
Strategic Retirement of Water Right	N/A	Restore flows, or protect against future depletions	Private agreement	Permanent	Retire conditional or absolute water right, particularly useful in reaches with existing but junior ISFs.	No	N/A	N/A	YES; *Three Sisters Ditch*
ISF Water Acquisition – Lease Fallowing Pilot Projects	37-60-115(8)	Restore flows with senior water right; preserve or improve the natural environment s	CWCB and DWR approval required for both pilot project and also for temporary change	3 years in 10 years	More complicated than equivalent tools	Yes	Yes	Yes	Not for ISF Use

COLORADO WATER TRUST

Table of Available and Potential Tools to Protect and Restore Flows

Tool	Statute, C.R.S.	Use	Approval Process	Term	Comment	Water Administrable for Instream Use?	Protections for HCU?	Protections from Abandonment ?	Used Before?
ISF Water Acquisition – Water Bank	37-80.5-101	Restore flows using stored water and temporary approvals; preserve or improve the natural environment	Partner with CWCB & WCD; DWR promulgates rules for each water bank	Unclear	Rules would dictate	Yes	See Note[4]	Yes, 37-92-103(2)(b)(VI)	Not by Water Trust
Agricultural Water Protection Water Right	37-92-305(19) & 37-92-308(12)	Restore flows with senior water rights	CWCB[2], Water Court, DWR for SWSP approval	SWSP approval for 3 years, renewable without limitation	Complicated and expensive to establish	Yes	Yes, quantified	Yes, 37-92-103(2)(b)(VI)	NO – Rulemaking process not yet complete
Storage Water Delivery for Decreed Uses	N/A	Storage releases add water to rivers when delivered for downstream decreed uses such as augmentation, municipal, or other uses	Private agreement	Contractual	Contractual delivery of storage water for decreed use	Depends on decree; possible incidental flow benefits between points	N/A; Decreed Use	N/A; Decreed Use	YES; *Florida River ISF augmentation; Muni-rec contracts; Stagecoach Res 2016*
Storage Release for In-channel Piscatorial Use	Upper Gunnison, 838 P.2d 840	Restore flows with reservoir release	Water Court	At discretion of owner, pursuant to decree	Exception to CWCB exclusive authority for ISF	Yes, decreed use	N/A; Decreed Use	N/A; Decreed Use	YES, *Taylor Reservoir*
Rotational Crop Management Contracts	37-92-305(4)(a)(IV)	Restore flows with senior water rights	CWCB[2]	Contractual	Useful with a group of irrigators	Yes	Yes, 37-92-102(3)	Yes, 37-92-103(2)(b)(VI)	NO

NOTES

* New ISF appropriations are not flow restoration tools, but are listed here for comparison purposes.

[1] CWCB New appropriation process usually requires 1-2 years to complete.

[2] CWCB water acquisition approval process requires 2 Board meetings; may require a hearing if requested.

[3] CWCB Director can approve temporary ISF leases once SEO determines non-injury; Board will confirm Director's decision at subsequent meeting.

[4] No specific statute, but Case Law may provide protections: *"By enacting these statutes, the General Assembly has authorized short-term changes that do not penalize the appropriator in any subsequent change of water right proceeding. The methodology for calculating historic consumptive use of the water rights over a representative period of time for a permanent change will not count or discount the years of authorized temporary use. The legislature clearly intended to promote flexibility in the administration of water rights, especially in the circumstances of temporarily transferring water from agricultural use to municipal use on a contract basis. It did not intend to penalize owners of decreed appropriations for properly taking advantage of these statutes according to their terms."* ISG, LLC v. Arkansas Valley Ditch Ass'n *120 P.3d 724, 734 (Colo. 2005)*

Attachment 3

A Review of the Upper Colorado River Endangered Fish Recovery Program's Recovery Actions and Endangered Species Response in the Colorado River

U.S. Fish and Wildlife Service, 2022

Excerpt on Flow Protection

A Review of the Upper Colorado River Endangered Fish Recovery Program's Recovery Actions and Endangered Species Response in the Colorado River

as called for in the U.S. Fish and Wildlife Service's

FINAL PROGRAMMATIC BIOLOGICAL OPINION FOR BUREAU OF RECLAMATION'S OPERATIONS AND DEPLETIONS, OTHER DEPLETIONS, AND FUNDING AND IMPLEMENTATION OF RECOVERY PROGRAM ACTIONS IN THE UPPER COLORADO RIVER ABOVE THE CONFLUENCE WITH THE GUNNISON RIVER
DECEMBER 1999

ES/GJ-6-CO-99-F-033

Prepared by the
The Upper Colorado River Endangered Fish Recovery Program Director's Office

Reviewed by the
Recovery Program's Biology and Management Committees
June 2021

Submitted for Approval to:
U.S. Fish and Wildlife Service, Regional Director, Legacy Region 6 – Mountain-Prairie
November 2021

Executive Summary: Program Progress and Relevant Trends Pertaining to

15-Mile Reach Species Recovery Efforts to Date

Recovery Action Plan Action	Program Progress: Successes (+), Shortcomings (~), and Remaining Uncertainties (?)	Notable Trends: Encouraging (+) and Concerning (~)
Habitat Protection (Flows) (Section 3.1)	**+** Progress reducing shortages to base flow targets; since 1998, the Program has augmented 15-Mile Reach (15MR) base flows during the Aug-Oct period on average by more than 400 cubic feet per second (cfs) **+** Progress enhancing peak flows in nearly 50% of years with an average of more than 33,000 acre-feet of deliveries through voluntary coordinated reservoir operations **~** In spite of substantial Program flow augmentation and collaboration by water users to augment flows, 15MR flows frequently fall short of PBO recommendations, particularly in dry years	**+** Successful acquisition of additional water for 15MR augmentation in recent years **+** 10-year running average depletion analyses indicate no net new depletions to flows since 2000 (Section 2) **~** Natural runoff in this basin in the July-through-October base flow months is likely to decrease with climate change
Habitat Development and Maintenance (Section 3.2)	**+** Fish passages have been installed at all four target locations in Grand Valley; fish now have unrestricted access to the entire 240 miles of designated Critical Habitat (CH) in the Colorado River from the Green River confluences to near Rifle, Colorado, including the previously inaccessible upper 55 miles of CH in the Colorado River **+** Fish screens have been installed at all major Grand Valley diversions (at all three target locations) **+** Diversion canal fish salvage operations conducted annually since 2002 have salvaged approximately 300,000 native fish, including (19) RBS and (15) bonytail through 2018 **?** 592 acres of floodplain habitat have been acquired and enhanced along Colorado and Gunnison Rivers, which is less than the Program originally thought possible, but reflects the participation by willing landowners	**+** Increased endangered fish use of passages in the Grand Valley since 2007 **+** Improved reliability of fish screen operations over time **+** Improved Program understanding of effective floodplain operation and management ~Irrigation fish screens and passages are not operated continuously, as low flow periods preclude the ability to maintain screens and passages
Native fish stocking (Section 3.3)	**+** More than 220,000 razorback sucker have been stocked in the upper Colorado River basin (UCRB) system since 1995, generally meeting annual targets for numbers and size **+** More than 145,000 bonytail have been stocked in the UCRB system since 2000, generally meeting annual targets for number and size	**+** Growing numbers of juvenile and adult razorback sucker are being found in upper basin primarily because of stocking efforts; evidence of recruitment still very rare but increasing **~** Very low recapture rates and low survival of stocked bonytail

Nonnative fish control (Section 3.4)	**+** Since 2004, ~$2.5 million has been expended on nonnative predator control in the Colorado River between Rifle, Colorado and Westwater Canyon **+** Through electrofishing, backwater seining, and selective removal at fish passages, thousands of nonnative fish are removed annually from the UCRB system. ~Abundances of smallmouth bass and walleye remain problematic throughout the Grand Valley and downstream + States are more effectively controlling off-channel sources of nonnative fish through various activities, including installation of measures to prevent reservoir escapement, removal of bag limits associated with certain problematic species, shifting sportfishing management to species that are compatible with recovery, and fishing tournaments targeting non-natives	**~** Since PBO was written, the threat of non-native fish predation and competition has increased greatly ~ Despite monumental control efforts, smallmouth bass (the most problematic predator) still demonstrate capacity to spawn successfully and in large numbers during most years ~The emergence of walleye as a predator of juvenile Colorado pikeminnow is troubling + Northern pike are now very rare in the Colorado River and smallmouth bass have been reduced upstream of the GVWUA diversion ~ Continued illegal introductions of nonnative fish require expensive reservoir treatment and screening
Research, Monitoring, and Data Management (Section 3.5)	**+** SSA and 5-Yr Review for Colorado pikeminnow (CPM) completed in 2020 **+** SSA and 5 Yr Review for Humpback chub (HBC completed in 2018; a proposed rule + 4(d) to downlist was published in January 2020 **+** SSA and 5-Yr Review for Razorback sucker (RBS completed in 2018; a proposed rule + 4(d) to downlist was published in January 2021	**+** The population of Colorado pikeminnow in the Colorado River has demonstrated long-term stability since 1992 **~** However, the CPM population basinwide has been in decline since 2005 and is currently at historically low levels largely because of impacts from nonnative species + HBC populations in Black Rocks and Westwater canyons declined through 2007 but have increased or stabilized since that time. The combined population estimate of these two populations (~3,600 to 3,800) exceed the 2002 adult demographic criterion of 2,100 + RBS larval, young-of-year, juvenile, and adult numbers continue to increase as the result of continued stocking and spawning successes

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3 Recovery Actions and Endangered Species Response

3.1 Flow Protection

The Colorado River's 15-Mile Reach is a particularly important reach of river for Colorado pikeminnow and razorback sucker, and is considered critical to the recovery of these species' Colorado River populations (Osmundson 1996). Providing and protecting adequate instream flows is of high importance due to the quality and extent of habitat available for endangered fish in this reach, as well as in the river reaches above and below (Osmundson 2000). The PBO (p. 37) notes that the 15-Mile Reach is important to endangered fish for several reasons:

- The 15-Mile Reach provides valuable spawning habitat for Colorado pikeminnow and razorback sucker;
- The 15-Mile Reach provides an optimum balance between temperature and food availability for adult Colorado pikeminnow in the Colorado River; and
- The 15-Mile Reach provides an important refuge for endangered fishes should a catastrophic event cause a loss of populations in the Gunnison River or in the Colorado River below the Gunnison River confluence.

Osmundson (2000) further elaborated on this reach's important role in the overall life history of the Colorado pikeminnow. The Colorado River reach downstream of Moab, Utah, provides the most important rearing habitat for young pikeminnow, while the reach upstream of Westwater, Utah, evidently provides the most important adult habitat in the Colorado River.

> "Upstream of Westwater, the 33-mile long Grand Valley [18 river miles in Colorado downstream of the Gunnison River confluence, plus the 15-Mile Reach above the confluence] consistently supports the greatest concentrations of adult Colorado pikeminnow. The relatively high gradient, clear water, broad floodplain and a diversity of habitat types make these upstream sections of river more productive than more downstream sections. Higher standing stocks of periphyton and invertebrates support relatively high numbers of forage fish, in turn providing greater food availability for the rivers top [native] piscivore, the Colorado pikeminnow." (p. i)

Efforts to maintain adequate instream flows in the 15-Mile Reach are complicated by its location immediately downstream of several large senior-priority water diversions, and upstream of Gunnison River inflows. Thus, many of the Recovery Program's recovery actions are targeted at protecting and augmenting flows in this reach.

Flow recommendations for the Colorado River 15-Mile Reach generally fall into two categories: elevated spring peak flows that are intended to mobilize streambed sediment, maintain channel complexity, and provide spawning cues; and lower base flows that provide over-summer foraging and sheltering habitat, support the food base, and allow for fish movement.

3.1.1 Peak Flows

3.1.1.1 Spring Peak Flow Recommendations for the 15-Mile Reach

The clean cobble bars found in the 15-Mile Reach provide some of the most suitable spawning conditions for the Colorado pikeminnow and razorback sucker. Coarse bed materials that build those bars are mobilized, cleansed of fine sediment, and redistributed during very high spring runoff, which contributes to channel habitat complexity supporting these species' reproduction and survival.

Spring peak flow recommendations for the 15-Mile Reach by Osmundson et al. (1995) are incorporated into the PBO. They describe recommended magnitudes and frequencies of peak flows (Table 1), as well as mean monthly flows considered capable of producing these peaks while maintaining the natural shape of the spring hydrograph (Table 3).

Table 2. Target peak spring flows in the 15-Mile Reach in cubic feet/second (cfs)

> 23,500 cfs (5 in 20 years) – "Wet" years **21,750 cfs** (10 in 20 years) – "Wet/Average" years **16,700 cfs** (16 in 20 years) – "Dry/Average" years **12,900 cfs** (20 in 20 years) – "Dry" years

Table 3. Mean Monthly Flow Recommendations for the April-July Peak Runoff Months in the 15-Mile Reach, in cfs

	Percent Exceedance			
	25	**50**	**80**	**100**
APR	3,210	2,440	2,260	1,860
MAY	10,720	9,380	7,710	7,260
JUN	15,660	14,250	11,350	6,850
JUL	7,060	5,370	3,150	1,480

These recommendations represent refinements to the earlier flow recommendations of Osmundson and Kaeding (1991) by incorporating the results of subsequent streambed monitoring studies. Field work by Osmundson et al. (1995) indicated that the spring runoff in 1993, which peaked at 25,900 cubic feet per second (cfs), was capable of moving coarse bed materials and winnowing accumulated fine sediments from the channel substrate. Based on preliminary results from hydrologic modeling (Pitlick and Van Steeter 1994), Osmundson et al. (1995) determined that a peak of 23,500 cfs (the wet year target) would be capable of moving bed materials.

Peak flows in excess of 12,900 cfs (the dry year target) were recognized by Pitlick et al. (1996) as being important because these appear to be capable of flushing accumulated fine sediments from the bottoms of backwaters, thereby restoring backwater depths.

3.1.1.2 Recovery Program Actions / Reservoir Operations for Spring Peak Flows

Coordinated Reservoir Operations (CROS) to augment spring peak flows in the 15-Mile Reach were first implemented in 1997. Under CROS, upper basin reservoir operators voluntarily coordinate and bypass inflows to enhance the Colorado River's natural spring peak. Augmentation of the peak occurs when (1) peak flows are forecast to be between 12,900 cfs and 26,000 cfs in the 15-Mile Reach, and (2) when

participating reservoir operators voluntarily agree to coordinate their bypass of flow to significantly boost the peak flow. The goal of CROS is to increase both the magnitude and duration of the spring peak without impairing the water rights and yields of participating reservoirs.

The 26,000 cfs upper limit respects potential flooding concerns. The flood stage elevation on the Colorado River at the U.S. Geological Survey (USGS) Cameo gage (#09095500) has been established as 12.5 feet by the National Weather Service[5]. According to provisional February 2020 USGS rating curve data, this stage elevation corresponds to a discharge of nearly 26,000 cfs. During unusually wet years, peak flow at this location exceeds 30,000 cfs without augmentation.

Conditions have been conducive in 11 of the 23 years from 1997 through 2019 for coordinating an enhanced peak flow through CROS implementation. These 11 years of CROS operations, and the corresponding bypasses/releases from participating reservoirs to augment peak flows, are summarized in Table 4. As noted therein, collective reservoir releases for peak flow augmentation during CROS years have ranged from 6,949 to 73,971 AF.[6]

Table 4. Voluntary CROS contributions from upstream reservoirs, 1997 through 2019, for coordinated peak flow augmentation in the 15-Mile reach (in AF).

Coordinated Reservoir Operations (CROS)					Augmentation of Peak Flows (AF released/bypassed)					
Reservoir	**Homestake**	**Lake Granby**	**Green Mtn**	**Ruedi**	**Williams Fork**	**Willow Creek**	**Windy Gap**	**Wolford Mtn**	**Moffat Tunnel**	**Total AF**
1997			3,568	693	946			10,635		**15,842**
1998			12,482	5,106	1,672			4,431		**23,691**
1999		8,515	11,010	3,602	1,543	6,631		8,555		**39,856**
2006			6,788	6,297	6,625			9,007		**28,717**
2008			2,101	4,848						**6,949**
2009			14,113	5,858	5,044	2,638	2,061	13,069		**42,783**
2010			34,666	10,050	19,982			9,273		**73,971**
2015		18,002	11,292	4,599	2,733	8,000	906	4,587		**32,117**
2016	1,430		8,632	4,007	4,893			8,452	1,960	**29,374**
2017			14,410	4,502	3,293	7,206		4,245	2,079	**35,735**
2019	655		21,223	5,998	9,273		2,007			**39,156**
Sum	**2,085**	**26,517**	**140,285**	**55,560**	**56,004**	**24,475**	**4,974**	**72,254**	**4,039**	**368,193**

3.1.1.3 Recovery Program Historic Performance in Meeting PBO Spring Peak Flow Recommendations

Although CROS operations were first implemented in 1997, reservoir releases intended to improve habitat conditions for the endangered fish in the 15-Mile Reach began in 1991. Figure 2 illustrates ranked spring peak flows at the top of the 15-Mile Reach as measured at the USGS's Palisade, Colorado

[5] This flood elevation was resurveyed by NWS in 2010, at the request of the Recovery Program.

[6] For reference, a release of 10,000 AF is equivalent to a release of about 720 cfs for a period of seven days. Flow losses and attenuation en route to the 15-Mile Reach typically would result in some reduction of the flow magnitude.

stream gage (#09106150) from 1991 through 2017. During this period, peak flows ranged from 4,520 cfs in 2002 to 32,700 cfs in 2011. The red line in Figure 2 illustrates the recommended frequency of peak flows of various magnitudes over this period as established by the Program (Table 2), while the blue bars demonstrate the observed distribution of hydrologic conditions over this series of years. Asterisks in the figure denote years in which CROS releases augmented peak flow in the 15-Mile Reach. While the delivery pattern differed in each of the 11 CROS years, the average amount of bypassed water during CROS operations (33,469 acre-feet) is equivalent to 2,410 cfs for seven days; it is reasonable to conclude the 15-Mile Reach peak flow in CROS years was typically increased by a similar magnitude.

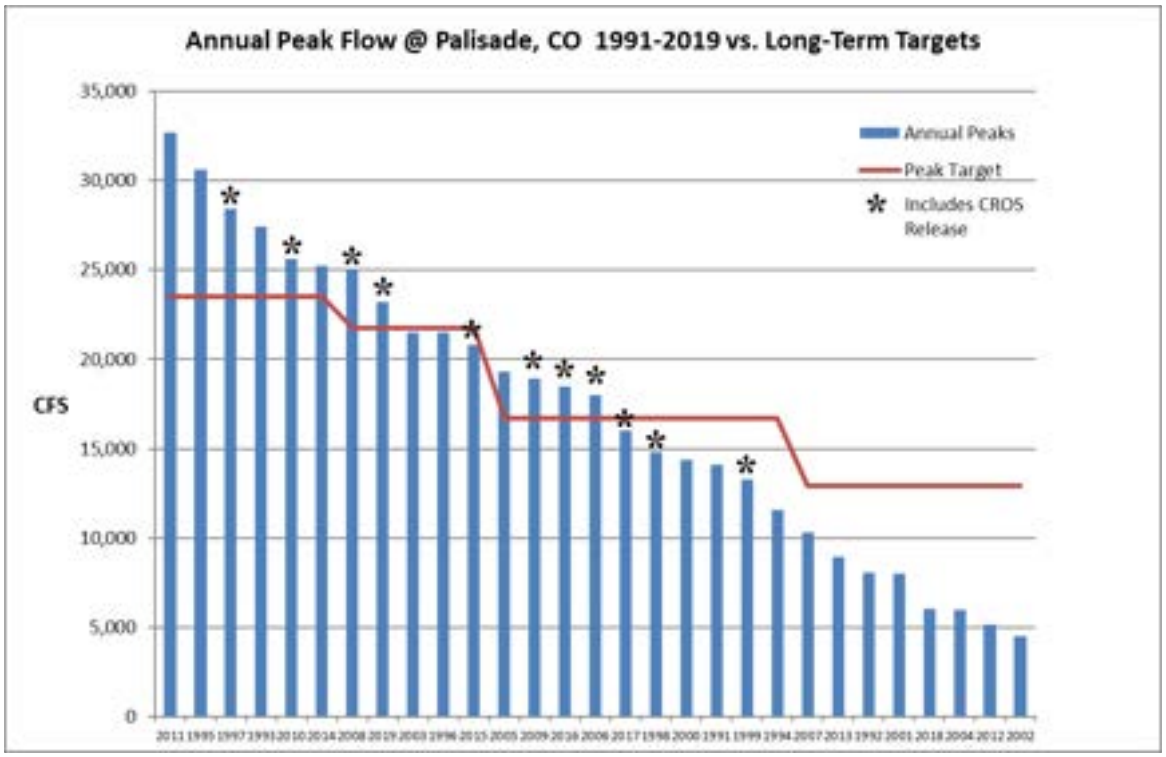

Figure 2. Annual peak flows at the top of the 15-Mile Reach, including augmented flow from CROS releases. The red line illustrates the recommended frequency of peak flows of particular magnitudes based on the actual distribution of runoff season hydrologic year types observed over this period.

Over these 29 years, flows have exceeded the 'wet' year target of 23,500 cfs seven times, surpassing the Program's target of six years. CROS contributed to peak flow in three of these years. Eleven years during this period exceeded or came within 5% of the 'average-wet' year peak flow target of 21,700 cfs, compared to 11 years in which this target was applicable, with CROS operations augmenting five of these events. Conversely, peak flows have generally fallen short of the target magnitudes over the drier half of this 29-year distribution.

As already mentioned, peak flows in excess of 12,900 cfs are recognized in the PBO as being important because they sweep fine sediments from backwater habitats in the 15-Mile Reach (Pitlick et al. 1996). Since 1991, peak flows in excess of this magnitude have occurred in 69% of years (20 of 29). CROS augmented the peak in 11 of those 20 years.

In summary, the 15-Mile Reach is experiencing high peak flows (>23,500 cfs) at greater than recommended frequencies, aided substantially by CROS releases. However, the lower peak targets corresponding to drier-than-average years are not met at the recommended frequency. The recommended minimum peak to be met in all years (>12,900 cfs) has been met in only 69% of years since 1991. As discussed below, a review of pre-Program peak flows in the 15-Mile Reach suggests that the 12,900 cfs dry-year target may not be realistic.

3.1.1.4 Reconsidering Minimum Peak Flow Targets

The Program's recommendation to achieve a minimum peak flow of 12,900 cfs in all years, based on the Pitlick et al. (1996) recommendation, does not appear to align well with the recent historic flow regime at this Colorado River location. An evaluation of historic flows since 1943 suggests that annual peaks exceeding 12,900 cfs in the 15-Mile Reach have occurred with a frequency of only around 53% to 76%, depending on the time period considered (Figure 3). Three periods are illustrated in Figure 3: The red line plots peak flow exceedance frequencies for the 1943-1968 period, which was a very active period of dam construction upstream of the 15-Mile Reach (Green Mountain Reservoir, Lake Granby, Williams Fork Reservoir, Dillon Reservoir, and Ruedi Reservoir all became operational during this period). The blue line plots peak flow exceedance frequencies for the 1969-1990 period following the most active dam construction phase, but before the Recovery Program began managing flows. The green line plots peak flow exceedances for 1991-2019, during which time the Recovery Program has been active. In light of the peak flow distributions observed over these 77 years, the Service needs to be aware how difficult it has been and will be to achieve a spring peak of 12,900 cfs in the 25% driest years. We recommend the addition of a task and timeline to the Recovery Implementation Plan (RIPRAP) to evaluate the need to revise or qualify the 12,900 cfs minimum peak flow target based on these historical analyses and the Recovery Program's past efforts to achieve it.

The Recovery Program recently completed a strategy to evaluate peak flow recommendations throughout the upper Colorado River basin overall (LaGory et al. 2016). As part of that strategy, a recommendation was made to monitor fine sediment mass balance at a variety of locations including in the mainstem of the Colorado River above and below the confluence with the Gunnison River. The intent being that monitoring fine sediment mass balance may help inform the Program's understanding of flows necessary to maintain satisfactory channel conditions under the current sediment budget. The Program chose to initiate fine sediment transport studies in 2017 on the middle reach of the Green River, its highest priority monitoring location. Based on lessons learned on the Green River (under Project 85f; Topping 2020), similar fine sediment mass balance work could be implemented on the Colorado River as future priorities are identified, and annual work plans developed.

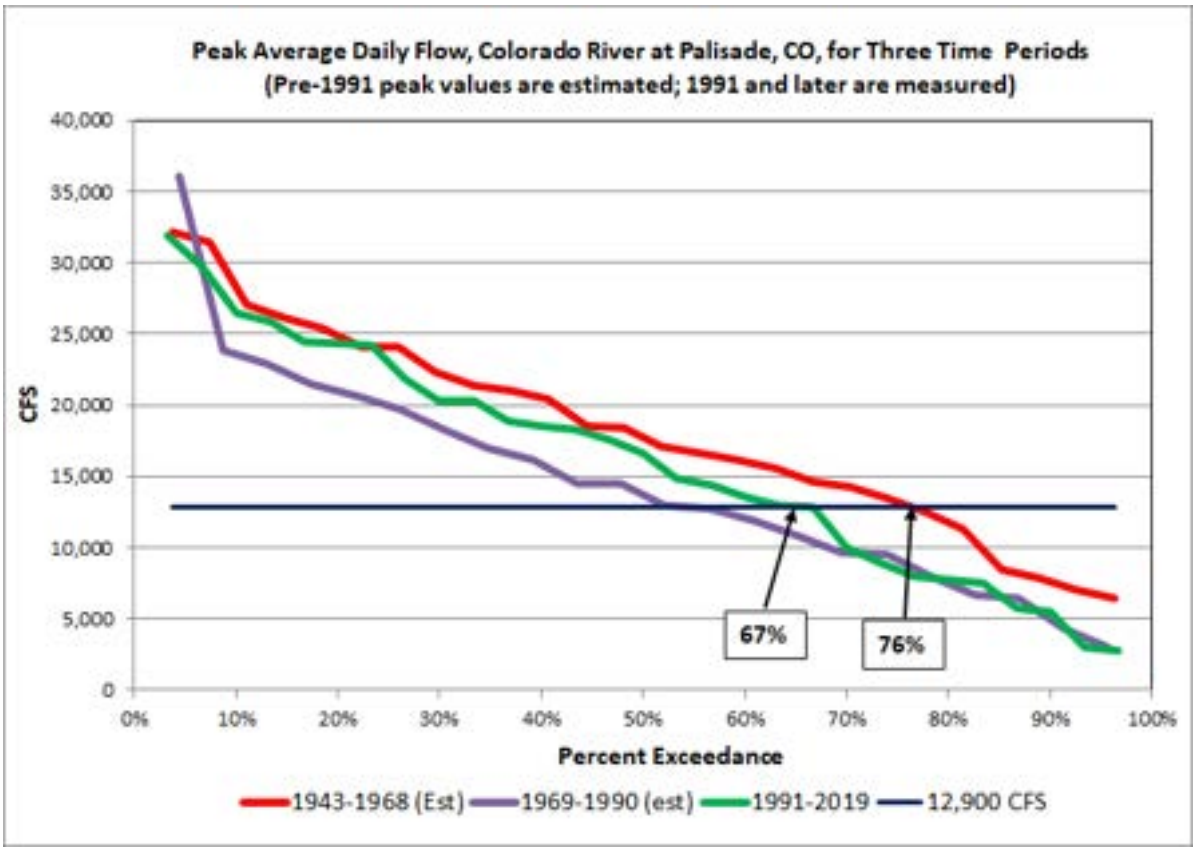

Figure 3. Historic peak mean daily flow at the Palisade, CO gage location for three consecutive periods of record.

Coordinated Facilities Water Operations

Additional options for providing and protecting supplemental peak flows to the 15-Mile Reach are being evaluated under an effort called the Coordinated Facilities Water Operations Study (CFOPS). Phase I was completed in 2001, Phase II in 2003 (Brown and Caldwell 2003). These studies evaluated the flexibility that may exist in water management facilities and operations to further enhance spring flows for endangered fish. The enhancement water would come from pools in reservoirs designated for base flow enhancement. The intent is to provide up to approximately 20,000 AF/year of additional water to enhance the spring peak flow without diminishing project yield nor causing water users to incur significant costs. (This volume of water, when made available, could provide an additional ~1,000 cfs of flow for a period of up to ten days.)

As of 2019 no additional water has been provided under CFOPS. Water users participating in the Program voluntarily assumed responsibility for developing the Phase III CFOPS report to assess the physical and legal feasibility of using Recovery Program fish pools in various reservoirs that are normally used to augment summer low flows to enhance spring peak flows. With assistance from the State Engineer's Office, the CWCB, and reservoir owners, the Service identified reservoirs that could participate in CFOPS. The amount of additional water that could be released would be designated by the Service around May 5 of each year from existing reservoir environmental pools used to augment base flows. In years when augmentation would be needed through use of CFOPS, the Service would

review hydrologic conditions, determine if additional augmentation is needed, and assess the level of augmentation justified based on conditions in the 15-Mile Reach. As of this writing, Water Consult Engineering and Planning Consultants (Loveland, Colorado) continues work on a final draft of the Phase III CFOPS report.

3.1.2 Base Flows

Diversions and depletions affect base flows within the 15-Mile Reach more than in any other critical habitat of the Colorado River because, in addition to the diversions and depletions occurring throughout the contributing drainage basin, several large diversions occur immediately upstream of this reach.[7] Extremely low water conditions can occur during the late summer and early fall months that dramatically reduce available habitat for Colorado pikeminnow and razorback sucker, and compromise the available food base. As a result, many Program recovery actions are focused on improving base flow conditions in the 15-Mile Reach.

3.1.2.1 Base Flow Recommendations for the 15-Mile Reach

Mean monthly flow (MMF) recommendations, summarized in Table 5, are intended to provide sufficient habitat preferred by adult Colorado pikeminnow (Osmundson et al. 1995). The MMF recommendations shown for August through March (ranging from 810 cfs to 1,630 cfs, depending on month and hydrologic condition) represent the minimum monthly average base flows recommended in the PBO during this lower-flow period.

Table 5. Recommended mean monthly flows (cfs) for the top of the 15-Mile Reach. August through March are considered the 'base flow' months. 'Percent Exceedance' identifies the percent of years for which it is recommended flows meet or exceed the identified targets. For example, in the wettest 80 percent of years, flows in October should average at least 1,240 cfs; stated another way, this recommendation should be met in 16 of every 20 years. (Osmundson et al 1995).

	Percent Exceedance			
	25	50	80	100
AUG	1,630	1,630	1,240	810
SEP	1,630	1,630	1,240	810
OCT	1,630	1,630	1,240	810
NOV	1,630	1,630	1,630	1,240
DEC	1,630	1,630	1,630	1,240
JAN	1,630	1,630	1,630	1,240
FEB	1,630	1,630	1,630	1,240
MAR	1,630	1,630	1,630	1,240

The August–October base flows identified should provide adequate depth and stability in backwater and other low-velocity channel-margin habitats most sensitive to changes in river stage (Osmundson et al. 1995). An increase in the availability of these habitats should increase the success of pikeminnow recruitment. Base flows during winter months also are important for meeting habitat needs of the endangered fish. During the winter, adult Colorado pikeminnow mostly use pools and backwaters

[7] These diversions serving irrigation, municipal, and industrial uses in the Grand Valley occur through the Government Highline Canal, the Grand Valley Canal, and the Orchard Mesa Canal systems.

(Osmundson et al. 1995). The flows recommended for winter months in Table 5 should provide adequate depth in these habitats for over-winter survival. Because diversions and depletions are minimal during this time of the year, obstacles to meeting flow targets are reduced.

15-Mile Reach base flow targets are established by the Service during each irrigation season based on hydrologic conditions in the basin, including consideration of antecedent flows, developing water demands, weather outlooks, and projected runoff. While the 15-Mile Reach irrigation-season target flow typically is set in late June, natural flow in the 15-Mile Reach normally remains above the base flow target through at least the middle of July, usually making flow augmentation measures unnecessary until late July or August.

A question remains as to whether 810 cfs is a reasonable and appropriate base flow target for all dry years, as an analysis of historic flows suggests this target was rarely met in dry years prior to Program implementation, both before and after storage project construction (Appendix II). Nevertheless, conditions for the endangered fish are clearly enhanced when summer flows can be maintained at this level or greater. The lowest flow evaluated by Osmundson et al. (1995) was 557 cfs, which corresponded to a reduction in the weighted useable area of preferred summer Colorado pikeminnow habitat by approximately 17% relative to conditions at 810 cfs. In personal communication (Dec. 8, 2015), Osmundson recalled that at a flow of 557 cfs, the fish could "make it", but there were locations where the entire channel was a riffle. Fish traversing those riffles would be highly vulnerable to avian predation unless fish movements occurred after dark. In April 2018, Service biologist Dale Ryden (personal communication) added that below 400 cfs, a considerable portion of river channel goes dry, and because portions of the 15-Mile Reach are braided, there may be in these areas only a few inches of water remaining in each of the multiple wetted channels. Terrestrial predators then become more of a concern, in addition to avian predation. In addition, the exposed riverbed loses its productivity as an invertebrate food base for fish, and endangered fish are forced to either leave the 15-Mile Reach, or become increasingly crowded into semi-isolated pools with deteriorating habitat conditions, including increased vulnerability to predators.

3.1.2.2 Base Flow Recovery Program Actions / Reservoir Operations for 15-Mile Reach

Multiple sources of water are annually available, or potentially available, to augment base flows in the 15-Mile Reach for purposes of promoting species recovery and complying with the PBO. These sources are discussed below. They include dedicated environmental storage in reservoirs, water obtained through temporary leasing arrangements, water determined to be surplus to other needs at Green Mountain Reservoir, and improved water management practices in the Grand Valley.

Each year approximately 20 meetings and/or conference calls between interested parties are held between June and October to manage releases from Green Mountain, Ruedi, Granby, and Wolford Mountain reservoirs, to coordinate irrigation and power diversions in the Grand Valley, and to attempt to meet the target flows in the 15-Mile Reach during the critical late summer and early fall months. These meetings are coordinated by Reclamation, which presides over the discussions and provides notes and summary documentation annually.

Dedicated Storage

Specified quantities of storage water in several different reservoirs are made available annually to the Recovery Program pursuant to permanent or long-term multi-party agreements to provide this water to the 15-Mile Reach for the benefit of endangered fish (Table 6).[8] This includes 15,825 AF of water considered a firm supply available every year, plus up to 11,000 AF of additional water available in most years, depending on the extent of reservoir filling.[9]

Table 6. Contracts and agreements that provide a firm supply of water for late summer base flow augmentation in the 15-Mile Reach for ESA compliance. [Modified Wolford amount to read "Up to 6,000 (depending on reservoir filling); long-term average estimated at 5,650 AF"]

Contractor/Contract No.	Amount (AF)	Notes	Period of Use	Expires
Ruedi Reservoir				
CWCB #0-07-60-W0540	5,000 + 5,000 (4 out of 5 years)	Signed 2/21/1990 for 40 years w/ renewability	January 1 – December 31	2030
River District #139D6C0024	5,412.5	West Slope contribution to 10,825 water.	January 1 – December 31	Perpetuity
Granby Reservoir				
Northern Water # 4310J	5,412.5	East Slope contribution to 10,825 water.	August – October	Perpetuity
Wolford Mountain Reservoir				
1998 Wolford Biological Opinion	Up to 6,000 (depending on reservoir filling); long-term average est. 5,650	Can carry-over 1 year to protect this junior fill right	March 1- December 1	Until fish are delisted

Green Mountain Reservoir Historic User Pool Surplus

In 1996, an agreement known as the Orchard Mesa Check Case[10] was reached among multiple parties, including the United States of America (with Reclamation taking the lead) and water users in the Grand Valley. This complex agreement provides up to 66,000 AF annually from the federal Green Mountain Reservoir power pool to augment base flows in the 15-Mile Reach.

This 66,000 acre-foot pool, also known as the 'Historic Users Pool' or 'HUP', represents the largest single pool of water potentially available annually to augment base flows in the 15-Mile Reach. However, in

[8] On occasion, collaborative exchanges of water between these and other reservoirs add flexibility to operations. For example, when an inspection takes place that requires a reduction in Wolford Reservoir releases, Williams Fork Reservoir may supply water that Wolford otherwise would have provided for the 15-Mile Reach, even though no dedicated Program fish pool exists in Williams Fork Reservoir. Under this scenario, Wolford Reservoir would later release water to meet a downstream demand that otherwise would have been serviced by a Williams Fork Reservoir release.

[9] This 11,000 acre-foot figure consists of 5,000 AF from Ruedi Reservoir available only in years when Ruedi Reservoir fills (statistically, about 4 out of 5 years), plus up to 6,000 AF from Wolford Mountain Reservoir (not all of which may be available in a given year, depending on reservoir inflow).

[10] Colorado District Court, Water Division Number 5, Case No. 91CW247 Stipulation and Agreement.

order for some or all of this water to be released for 15-Mile Reach instream flow purposes, an 'HUP surplus' must be declared by the Grand Valley irrigators and Reclamation in the subject year. [11] As per the terms of the Orchard Mesa Check Case, certain operational conditions must be met, and it must be determined there is additional water in the power pool surplus greater than the needs of the HUP beneficiaries (surplus).[12] Declarations of surplus are based on runoff forecasts, current and projected Grand Valley irrigation demand, current and projected Green Mountain reservoir contents, past experience, and reference to reservoir drawdown curves incorporated into the Agreement. Once a surplus is declared, this HUP water can be released from Green Mountain Reservoir and legally protected to the 15-Mile Reach (minus transit losses) to enhance instream flows. This surplus, if declared, typically becomes available in August and September, and can greatly improve flow and temperature conditions in the 15-Mile Reach. From 1998 through 2019 HUP surplus releases from Green Mountain Reservoir averaged 40,230 AF/yr in the years releases were made (no surplus was declared nor releases made in 2002, 2012, or 2018), with a maximum of 61,433 AF released in 2008.

The legal mechanism for protecting these HUP surplus releases to and through the 15-Mile Reach is a municipal-recreational contract between Reclamation and the municipalities of Palisade, Grand Junction, and Fruita. Reclamation initially contracted with these entities in 2002; in 2007 the contract was renewed through the end of 2012. The most recent municipal-recreational contract for this purpose (#14XX650133) was signed in April 2015 and expires December 31, 2054.

Leased Water

Water also has been made available to augment 15-Mile Reach flows through temporary lease agreements. From 2015 through 2019, CWCB supplemented available water by establishing a short term lease with the Ute Water Conservancy District (Ute WCD) for use of their storage in Ruedi Reservoir (Ute Lease CMS #83182; Ute Contract #139D6C0111) to supplement existing instream flow water rights to preserve and improve the natural environment of the 15-Mile Reach. By agreement between Ute WCD and CWCB, these leases are now authorized through 2025, and exercised through the optional establishment of a delivery contract between CWCB and Ute WCD on a year-by-year basis. From 2015 through 2019, a total of 37,687 AF was leased and released to augment 15-Mile Reach base flows from August through October. Ute WCD made this leased water available to CWCB at a cost of $7.20 per acre-foot.

An additional 626 AF of augmentation water was provided to the 15-Mile Reach in 2019 by means of temporary Ruedi Reservoir water leases arranged by the Colorado Water Trust (327 AF) and the Roaring Fork Conservancy District (299 AF). The former was a lease of Colorado River Water Conservation District (Colorado River District) water for delivery to the Grand Valley Power Plant in Palisade, Colorado, and then to the 15-Mile Reach, under a contract with Reclamation that authorizes use of Grand Valley

[11] "Surplus HUP water" is water in excess of the needs of the HUP beneficiaries as defined in paragraph 8 of the Green Mountain Reservoir Operating Policy (Federal Register, Volume 48, Number 247, December 22, 1983, as amended in Federal Register, Volume 52, Number 176, September 11, 1987) and the Stipulation and Agreement of the Orchard Mesa Check Case (Colorado Water Division 5, 91CW247).

[12] Among the HUP beneficiaries are various water users in the Grand Valley who receive "direct deliveries" of Green Mountain Reservoir HUP water to meet their diversion needs; this water is normally diverted before reaching the 15-Mile Reach.

Project conveyance facilities for this purpose when unused capacity is available. The latter water also was leased from the Colorado River District, representing the remaining portion of 3,500 AF leased by the Roaring Fork Conservancy District not released to the Fryingpan River over the preceding winter to avoid 'anchor ice'. Additional leases of this kind are likely to occur in the future.

Additionally, in 2020, CWCB entered into a five-year lease agreement with Garfield County for 350 AF of storage water in Ruedi Reservoir for release to supplement existing instream flow water rights to preserve and improve the natural environment of the 15-Mile Reach during the base flow season.

Other Stakeholder Contributions

Additional, "opportunistic" sources of water are occasionally provided by Program partners and stakeholders to benefit flows in the 15-Mile Reach. A notable example is Colorado River District efforts to strategically time their releases from Wolford Mountain Reservoir for reservoir maintenance to also provide benefits to the 15-Mile Reach. The Recovery Program greatly benefited from 18,812 AF of such propitiously timed Colorado River District deliveries during the unusually low flows of summer 2018, and an additional 2,676 AF was provided by the District in late summer 2019. Another example occurred in 2018 when Exxon Mobil Corporations (and their subsidiary XTO Energy, Inc.) freed up 5,000 AF from their pool in Ruedi Reservoir (Reclamation Contract No. 2-07-70-W0544) for delivery downstream for multiple uses including support of flows in the 15-Mile Reach. Exxon Mobil generously made that same volume of water available again in 2020.

Grand Valley Water Management

In addition to the various sources of augmentation water described above, the Program has assisted water users in the Grand Valley of Colorado with improvements to their water diversion and delivery systems to benefit 15-Mile Reach flows by reducing diversions.

Grand Valley Water Users Association (GVWUA): A 1997 assessment of GVWUA canal operations showed that August-October spills at the downstream terminus of the Government Highline Canal averaged 31,400 AF from 1992-1994 (ITRC, 1997). To improve the efficiency of the canal system, the Recovery Program provided approximately $7.2 million in funding for GVWUA to install additional check structures and modify existing check structures, install a pump station at Highline Lake, build a new Palisade Pipeline turnout, implement Supervisory Control and Data Acquisition (SCADA) systems, install 21 radio-linked Remote Terminal Units, and modify the Orchard Mesa Power turnout.

The resultant savings to the 15-Mile Reach have averaged 45,159 AF/yr.[13] Some of these savings are redirected immediately to the Colorado River, through the Palisade Pipeline or Bypass (see Table 7), immediately above the 15-Mile Reach. The majority of these reduced canal spills contribute to increased storage in Green Mountain Reservoir's HUP, much of which may later become available to the Program as HUP surplus.

[13] 2002-2016 estimates from the Western Colorado Area Office of Reclamation, using 1998 operations as the baseline for comparison.

Orchard Mesa Irrigation District (OMID): OMID also has worked with the Recovery Program to improve efficiency in its canal system, with funding of approximately $16.5 million provided by the Program to date. This includes constructing a canal automation system comprised of 33 check structures, an 87 AF regulating reservoir, pumping plants, upper/lower canal interconnect pipeline, replacement of open channel laterals with pressurized pipelines, and an integrated SCADA system. The objective of the canal automation system is to reduce the volume of water diverted from the Colorado River for irrigation use, redirect it to generate more hydroelectric energy, and increase return flows to the head of the 15-Mile Reach. Construction of the 33 canal check structures was completed prior to the 2014 irrigation season, and the structures have been operational since that time. In addition, the 87-AF regulating reservoir was completed and put into operation in 2017. Conservative estimates indicate that approximately 17,000 AF/yr can be redirected to improve instream flows in the 15-Mile Reach of the Colorado River at full build-out of the OMID improvements (Uilenberg 2017). However estimated savings associated with the improvements implemented to date is closer to 6,600 AF/yr. OMID anticipates that substantial additional water savings eventually will be realized after piping the Mutual Mesa Lateral and the final piping of approximately 15,000 feet of Canal #2, however the timing of those improvements is unknown. The Recovery Program annually reimburses OMID for operation and maintenance costs associated with these canal system improvements, but does not make any per-acre-foot payments based on the corresponding water savings.

3.1.2.3 Base Flow Deliveries for Endangered Fish

Table 7 summarizes the irrigation-season releases since 1998 from the sources identified above (and others) to augment base flows in the 15-Mile Reach. The average of annual deliveries from all sources for base flows over this period has been 78,037 AF, ranging from a low of 17,093 AF in 2002 to a high of 114,666 AF in 2010. For reference, 78,037 AF delivered at a constant rate for 100 days equates to about 393 cfs.

Table 7. Summary of water volumes (in AF) released from upstream 'fish pools' (1998 – 2019) to augment base flows in the 15-mile Reach. Releases from Ruedi and Wolford Reservoirs began earlier, in the early 1990's, but are not included here. 'Palisade Bypass' does not represent a reservoir release, but rather water diverted from the Colorado River into the Governmental Highline Canal above Palisade that was returned to the top of the 15-Mile Reach unconsumed.

Releases (AF) to augment baseflows in the 15-Mile Reach for endangered fish, July through October

Reservoir	Lake Granby	Green Mtn	Ruedi	Williams Fork	Willow Ck	Windy Gap	Wolford Mtn	Palisade Bybass*	Total AF	Total AF Reservoirs Only (not incl. Palisade Bypass)
1998		31,736	20,803				11,516		**64,055**	**64,055**
1999	26,914	29,277	20,418	1,825	649		4,939		**84,022**	**84,022**
2000		47,187	19,064	3,858			11,072		**81,181**	**81,181**
2001		34,656	21,345	5,369			8,577		**69,947**	**69,947**
2002		-	10,975	3,757			308	2,053	**17,093**	**15,040**
2003		47,526	20,434	3,757			286	10,161	**82,164**	**72,003**
2004		119	15,981	2,678			-	13,654	**32,432**	**18,778**
2005		31,200	17,163	3,814			1,000	19,143	**72,320**	**53,177**
2006		25,358	20,045	5,712			10,842	10,812	**72,769**	**61,957**
2007		32,745	14,650	2,624			7,037	10,625	**67,681**	**57,056**
2008	849	61,433	20,423	9,389		764		15,997	**108,855**	**92,858**
2009	3,144	56,290	20,822	5,411			8,747	18,302	**112,716**	**94,414**
2010	992	57,813	20,825	5,113		893	8,413	20,617	**114,666**	**94,049**
2011		37,132	15,251	5,412			8,413	20,466	**86,674**	**66,208**
2012		-	20,596	5,412			5,320	14,616	**45,944**	**31,328**
2013	5,412	2,514	10,412				1,501	15,937	**35,776**	**19,839**
2014	5,413	59,342	15,413				3,000	19,317	**102,485**	**83,168**
2015	5,415	54,610	24,412	1,289			4,712	8,162	**98,600**	**90,438**
2016	5,413	55,390	27,413				5,766	12,210	**106,192**	**93,982**
2017	5,409	46,216	21,413				6,000	20,272	**99,310**	**79,038**
2018	4,805	2,356**	19,496		607		24,812	10,198	**59,918**	**49,720**
2019	5,413	53,833	20,726				8,676	13,359	**102,007**	**88,648**
Average (in years of release)	6,289	40,230	19,004	4,361	628	829	7,047	14,217	**78,037**	**78,388**
Sum	**69,179**	**764,377**	**418,080**	**65,420**	**1,256**	**1,657**	**140,937**	**255,901**	**1,716,807**	**1,460,906**

*Unlike other columns, these are totals are for the entire April-October period

** This release was made in April 2018 to alleviate an 'April Hole', and is not included in these totals

Since that time, CWCB has obtained two instream-flow water rights that can protect water provided to support base flows in the 15-Mile Reach from July through September:

- In 1996, the Colorado Water Court (Case 5-92CW286) granted CWCB a 581 cfs instream flow right (3/5/1992 priority) for water in the 15-Mile Reach from July 1 through September 30 (from the tailrace of the Grand Valley Pumping Plant to the confluence with the Gunnison River). This rate of flow equates to the combined discharge of the Grand Valley Power Plant and the OMID hydraulic pumps when those are operating at full capacity;

- On the same date (Case 5-94CF330), CWCB was granted an additional 300 cfs instream flow right (11/4/1994 priority) for water accretions occurring in the 15- Mile Reach from July 1 through September 30. This right applies to only the downstream two miles of the 15-Mile

Reach (27.5 Road gage to the confluence with the Gunnison River), and is based on the amount of irrigation return flows that typically accrue to the river in the 15-Mile Reach.

Because these instream flow rights have very junior priorities, they provide limited protection of natural flow in this reach of the Colorado River in light of the many senior diversion rights upstream. However, these rights allow the State Engineer to legally protect water acquired and delivered to the 15-Mile Reach for purposes of augmenting endangered fish flows.

These rights do not protect such water from appropriators downstream of the location of the water right. However, the substantial Gunnison River inflow at the downstream terminus of the 15-Mile Reach, and the modest volume of water withdrawn along the "18-Mile Reach" downstream of the 15-Mile Reach from the Gunnison River confluence to the western end of the Grand Valley near Loma, Colorado, maintains better flow conditions for the endangered fish in this important stretch of critical habitat. Most of the water delivered to the 15-Mile Reach also benefits flows in this 18-Mile Reach.

Water rights associated with the Grand Valley diversions that produce many of the return flows to and downstream of the 15-Mile Reach are among the most senior rights in the basin, and therefore can call out the majority of upstream water rights. This helps ensure that water is delivered to the headgates of the Grand Valley project in De Beque Canyon, even in dry years, which in turn helps support flows in the 15-Mile Reach via returns from the Grand Valley Hydropower Plant and other water uses.

3.1.2.4 Recovery Program Performance in Meeting Base Flow Recommendations

In the 15-Mile Reach PBO, the Service recognized that prior to the specific flow augmentation efforts that began in 1991, summer/fall base flow targets in the 15-Mile Reach (Table 2) were seldom met. When historical exceedance curves are examined (dating back to 1902) it is apparent that flow targets were not met even in the early 1900's when upstream storage was not fully developed (Appendix II). The Service anticipated that with full implementation of flow-related recovery actions identified in the PBO, "base-flow targets for August–October will be met in most years" (PBO page 65), although the basis for making this assumption is not entirely clear.

Table 8 summarizes the Recovery Program's performance in meeting recommended mean monthly flows in the 15-Mile Reach during each month of the year, 1991 – 2019. In this table, the 'hydrologic year type' for the period reviewed (wet, wet/avg, dry/avg, and dry) is based on a ranking of the estimated calendar year 'naturalized flow' for the Colorado River at Cameo dating back to 1906[14]. Using this metric, the 1991 – 2019 flow years are skewed slightly toward more drier years, but these years reflect a reasonably representative range of flow conditions, and include the second wettest year in this 116-yr period of record (2011).

[14] 'Naturalized flow' means streamflow that would have occurred in the absence of human diversion, storage, or use of this water. Naturalized flow estimates for the Colorado River system are developed by the U.S. Bureau of Reclamation Upper Colorado Basin Region. They are updated periodically, and made available at www.usbr.gov /lc/region/g4000/NaturalFlow/current.html

As indicated in the table, average monthly recommended flows were achieved most often during wet years and during the winter months of dry years. During the irrigation season of drier years (April through October), recommended flows were achieved with low frequency. If Osmundson et al.'s (1995) lowest recommended minimum monthly flows (MMF) of 810 cfs is used as the metric for establishing the minimum desirable base flow, it is evident that:

- Flows in the 15-Mile Reach dropped below this MMF in three months of the eight years classified as 'Dry / Average', i.e. in 5% of the irrigation season months (3 out of 56); and

- Flows fell below the MMF in 22 months of the eight years classified as 'Dry', i.e., 39% of the time (22 out of 56 irrigation season months in dry years).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
'Wet' Year (<25% Exceedance) - Avg Monthly Flow Targets	**1,630**	**1,630**	**1,630**	**3,210**	**10,720**	**15,660**	**7,060**	**1,630**	**1,630**	**1,630**	**1,630**	**1,630**
2011	1,627	1,642	2,041	3,230	10,320	26,430	16,130	2,879	1,762	1,777	2,221	1,840
1997	2,179	2,122	2,798	3,402	12,870	20,860	5,213	3,574	2,461	2,560	2,484	2,370
1995	1,429	1,449	1,749	962	5,415	20,040	16,010	3,897	1,339	1,477	2,373	2,198
1993	1,449	1,544	2,015	2,540	14,160	15,830	6,702	1,788	1,287	1,279	1,837	1,873
2008	1,566	1,813	1,933	2,192	10,300	17,290	6,816	1,877	1,703	1,510	2,127	1,839
2014	1,703	1,816	2,200	3,892	10,120	13,740	4,435	1,837	1,786	1,945	2,094	1,928
'Wet / Avg' Year (26 - 50% Exceedance) - Avg Monthly Flow Targets	**1,630**	**1,630**	**1,630**	**2,440**	**9,380**	**14,250**	**5,370**	**1,630**	**1,630**	**1,630**	**1,630**	**1,630**
2019	1,274	1,364	1,845	2,421	5,658	15,820	11,550	2,330	1,285	1,248	1,980	1,612
1996	2,093	2,416	2,787	4,837	11,820	12,360	4,105	876	1,085	1,423	2,248	2,200
2009	1,831	1,770	1,874	2,337	11,720	11,870	4,841	1,461	1,127	1,413	1,870	1,453
1998	2,375	2,292	2,913	3,361	10,400	7,931	4,184	1,849	1,284	1,550	2,332	1,910
2005	1,677	1,429	1,512	2,140	7,808	10,030	4,154	1,353	1,305	1,528	2,272	2,015
2006	1,849	1,782	2,229	4,364	9,305	6,140	2,044	1,152	1,271	1,996	2,166	1,880
2015	1,747	1,755	1,990	1,441	6,096	14,980	4,921	1,045	1,241	2,379	1,827	1,520
'Dry / Avg' Year (51-80% Exceedance) - Avg Monthly Flow Targets	**1,630**	**1,630**	**1,630**	**2,260**	**7,710**	**11,350**	**3,150**	**1,240**	**1,240**	**1,240**	**1,630**	**1,630**
1999	1,939	1,854	1,789	996	4,794	11,000	4,556	2,183	1,771	1,837	2,054	1,780
2017	1,581	1,686	2,089	1,902	4,870	10,690	3,269	1,296	1,130	1,664	1,865	1,420
2016	1,585	1,698	1,776	1,642	6,932	12,530	2,706	957	955	1,114	1,636	1,532
2010	1,526	1,508	1,568	2,243	4,561	12,780	2,012	1,362	891	1,106	1,893	1,855
2003	1,145	1,156	1,336	710	5,906	7,244	1,052	611	1,088	1,078	1,419	1,403
1991	1,280	1,297	1,302	1,148	5,059	8,488	2,168	797	979.8	853.9	1,918	1,502
2007	1,565	1,705	2,368	1,795	6,132	5,951	1,616	893	1,353	1,553	1,870	1,825
2000	1,931	2,002	1,930	1,927	7,040	6,017	1,272	912	986	902	1,701	1,496
'Dry' Year (81 - 100% Exceedance) - Avg Monthly Flow Targets	**1,240**	**1,240**	**1,240**	**1,860**	**7,260**	**6,850**	**1,480**	**810**	**810**	**810**	**1,240**	**1,240**
1994	1,794	1,903	2,109	1,802	4,874	4,585	745	558	650	843	1,220	1,460
2001	1,322	1,352	1,476	973	5,149	3,764	995	1,133	1,014	807	1,573	1,345
1992	1,378	1,475	1,684	1,773	4,603	3,164	1,196	822	801	628	1,628	1,423
2013	1,137	1,147	1,204	308	4,043	4,306	743	727	1,272	1,288	2,031	1,707
2004	1,322	1,300	1,597	1,086	3,297	2,976	974	498	830	1,078	1,801	1,487
2018	1,400	1,418	1,490	911	4,123	2,369	424	642	265	755	1,395	1,260
2012	1,765	1,600	2,026	1,131	1,840	1,052	615	454	372	529	1,404	1,188
2002	1,405	1,286	1,396	1,010	1,016	935	161	115	241	526	1,618	1,217

observed average monthly flow target met

observed average monthly flow target not met, but > minimum monthly (810 cfs)

observed average monthly flow < 810 cfs

Summer flow conditions in the 15-Mile Reach were at their lowest in 2002, the most severe drought year in the basin since the beginning of the Recovery Program. In August 2002, the average monthly flow at the Palisade, Colorado stream gage (#09106150) was 115 cfs, and the average daily flow dropped below 60 cfs on August 19th (see 2002 hydrograph in Appendix I).

Appendix II provides an overview / update of Osmundson et al.'s (1995) analysis of historical August, September, and October monthly flows at Palisade, Colorado for three periods of time: 1902 – 1942, which represents the least amount of water development[15]; 1954 – 1984, which represents a period after considerable development had occurred; and 1991 – 2019, during which the Recovery Program has been managing summer base flows. As is apparent from these graphs, in all three of these months flows in the driest years (>80% exceedance) have been highest since the Recovery Program started augmenting flows. Summer flow conditions in the 15-Mile Reach would have been worse had it not been for the various sources of augmentation water discussed above, and the associated deliveries of water from those pools summarized in Table 7. Figure 4 illustrates the substantial difference that Recovery Program flow augmentation made to mean monthly flows in the 15-Mile Reach in August, September, and October of the six 'Dry' years since establishment of the PBO. Nevertheless, it is also apparent that historical flows frequently fell short of the MMF target of 810 cfs in dry years, and that even with Recovery Program augmentation this dry-year target is likely to remain difficult to routinely achieve.

Base flow hydrographs for the 15-Mile Reach for all years since 1998 are provided in Appendix I, where observed conditions are compared to 'what flows would have been' without the Recovery Program's flow augmentation efforts. In some years this reach of the river would have nearly or completely dried-up without this augmentation[16]. Even in the record drought year of 2002, approximately 17,000 AF of water was delivered to sustain flows in the 15-Mile Reach.

Figure 4. Proportions of the total mean monthly flow in the 15-Mile Reach in August, September, and October of the six 'Dry' hydrologic years occurring since 1999 provided by 'natural' and other non-Program sources (blue) versus Program flow augmentation (green).

[15] The Grand Valley Irrigation Company (GVIC diversion), constructed in 1894, was operational through this entire period of time; the Grand Valley Project diversion was completed in 1904.

[16] Data from 2018 indicate that flow in the 15-Mile Reach would have effectively dropped to zero for multiple days in late September, were it not for the supplemental flow provided by the Recovery Program.

'April Hole'

Of note in Table 8 are two occasions when the mean monthly flow in April dropped below 810 cfs: in 2003 (710 cfs) and in 2013 (308 cfs). Unprecedented conditions surrounding spring 2013 hydrology, not anticipated in the 15-Mile Reach PBO, combined to create extremely low April flows in the 15-Mile Reach, i.e. an 'April Hole.' Those conditions included: 1) cooling air temperatures that temporarily slowed mid- and high-elevation snowmelt runoff; 2) initiation of routine irrigation diversions; 3) "relaxation" of the Shoshone Hydropower Plant call, which allowed drought-impacted reservoirs with junior rights upstream to divert out of priority; and 4) the occurrence of all these events over a weekend, reducing the ability to coordinate a response to rapidly-changing conditions.

The Shoshone Hydropower Plant is owned by Xcel Energy and located on the mainstem of the Colorado River in Glenwood Canyon. Its senior 1902 non-consumptive water right of 1,250 cfs is often relied on to keep water in the Colorado River and sometimes prevents storage under junior water rights upstream (e.g., Denver Water's Dillon and Williams Fork Reservoirs, the Colorado River District's Wolford Mountain Reservoir, and Reclamation's Green Mountain Reservoir). Beginning in 2006, an agreement with Denver Water (valid through 2032) allows for a "relaxation" of the Shoshone call under certain defined water shortage conditions,[17] allowing Denver Water and other junior upstream reservoir operators to store more water than they otherwise would if they could not store out of priority. In exchange, Denver Water compensates Xcel Energy for the lost power revenues and guarantees Xcel additional water for its east-slope power operations. In April 2013 the Shoshone call was relaxed in accordance with this agreement, which permitted reservoirs impacted by the previous year's drought to operate in the absence of a senior call by the Shoshone hydro plant. Upstream junior reservoirs were permitted to divert and store water for a possible dry summer season, following a drought year in which reservoir storage was substantially depleted. This greatly impacted Colorado River flows downstream of the Shoshone hydropower plant, including flows in the 15-Mile Reach.[18]

During April 2013, flows measured at the Palisade gage dropped below 400 cfs for 24 days, and instantaneous flow dropped below 60 cfs on April 12 and April 27. Participants in the weekly CROS and HUP conference calls realized that the best strategy to reduce a repeat of an 'April Hole' would be to remain vigilant (primarily with respect to forecasted stream flows and weather conditions) and make necessary real-time adjustments (e.g., consider preemptive releases from Ruedi Reservoir, coordinate with the irrigators and their diversions, coordinate with the operators at Shoshone Power Plant). Since

[17] Specifically, a "water shortage" is triggered by Denver Water's projection that reservoir storage in their system on July 1 will be at or below 80% full, and the most probable forecast of April-July streamflow at the Colorado River at the Kremmling stream gage is less than or equal to 85% of average.

[18] Another flow protection element is the Shoshone Outage Protocol (SHOP). This is an agreement signed by several major water users upstream of the Shoshone Power Plant (including Denver Water, Aurora, and the Colorado-Big Thompson Project) to manage their diversions during a shutdown at the Shoshone Power Plant as if the Plant were still operational and calling its senior water right. The SHOP signatories are not bound to this protocol under certain specified conditions, such as when unusually dry hydrologic conditions meet the criteria of a 'Water Shortage' in the river basin.

2013, the CROS / HUP participants have conducted periodic 'State of the River' conference calls to closely monitor 'April Hole' conditions, which have recurred, but not with the same severity.

Climate Change Concerns

The Recovery Program's future ability to maintain and improve flow conditions in the 15-Mile Reach for endangered fish may be affected by changes in the hydrology and demand for water in the upper Colorado River basin. Recent studies suggest that runoff in the upper Colorado River basin is likely to decrease in the 21st century. For example, a report developed by the Western Water Assessment at the University of Colorado in collaboration with the Bureau of Reclamation notes that "warming temperatures observed across the [Colorado River] basin in the last few decades have discernibly impacted snowpacks, melt and runoff timing, runoff efficiency, and total basin runoff. It is unclear whether the period of below-normal precipitation since 2000 is indicative of future precipitation, but unless average basin precipitation increases substantially, system runoff and water supply are expected to decline over the next several decades due to warming alone." (Lukas and Payton 2020).

Further complicating the impact of a warming climate is uncertainty surrounding the social and economic changes that may affect water management, consumptive use, and water rights administration under a warming scenario, as individual water users, local communities, and the upper basin states implement new strategies to respond to actual or anticipated changes in runoff quantities and timing. The Recovery Program will continue to monitor changes in Colorado River flows and water management that may be attributable to climate change, and, as appropriate, propose adjustments in recovery actions to respond to observed or proposed changes.

Water Quality Considerations

The 15-Mile Reach PBO is "limited to addressing water depletions above the confluence of the Gunnison River (water quantity), however changes in water quantity affect water quality, which is a primary constituent element of critical habitat" (p. 54, PBO). The PBO notes that Colorado River depletions could reduce the diluting effect that relatively clean headwater inflow has on heavy metals, selenium, salts, polycyclic aromatic hydrocarbons, pesticides, and other contaminants, and that "selenium may be of particular concern due to its effects on fish reproduction and its tendency to concentrate in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers."[19]

As described earlier, since 1998 the Recovery Program has delivered more than 1.4 million acre-feet of water from reservoir storage originating high in the river basin to supplement low flows in the Colorado River during the August-through-October period. To the extent these deliveries have diluted the contaminants identified in the PBO, they have undoubtedly improved water quality conditions for the endangered fish.

[19] An additional water quality concern is the potential impacts post-wildfire runoff on river water quality, including delivery of ash, sediment, fire retardant, debris, or constituents that affect aquatic pH. This is a growing concern in light of a warming climate and increased landscape vulnerability to wildfire.

Separate from the Recovery Program (which, as noted in the PBO, is "not intended to offset any point or nonpoint discharges of pollution"), various upper Colorado River basin activities have been addressing high-priority water quality concerns. This includes, since 2009, a major selenium remediation effort in the Gunnison and Uncompaghre river drainages funded by Reclamation and the CWCB (Bureau of Reclamation 2020) in accordance with the Gunnison River PBO (USFWS 2009a). While the Gunnison River discharges to the Colorado River below the subject 15-Mile Reach, historically it has exhibited some of the highest selenium loads in the Colorado River system, and this selenium may adversely affect endangered fish using the mainstem Colorado River. In addition, the Service participates in the Colorado River Basin Salinity Control Program that works to reduce salinity concentrations across the Colorado River basin. One effect of the Salinity Control Program is to not only reduce salinity, but also reduce selenium loading (Colorado River Basin Salinity Control Forum Technical Work Group, 2016).

For more information on water quality, a report from the U.S. Geological Survey (Spahr et al. 2000) summarizes major findings regarding water quality in the upper Colorado River basin based on an assessment conducted between 1996 and 1998 through its National Water Quality Assessment (NAWQA) Program. Additionally, the Colorado Department of Public Health and the Environment (CDPHE) annually publishes an *Integrated Water Quality Monitoring and Assessment Report* that summarizes water quality conditions in the State of Colorado by major river basin (e.g., CDPHE 2020).

3.1.3 SUMMARY

Multiple partners and stakeholders in the Recovery Program have demonstrated a strong, ongoing commitment to improving both spring peak and year-round base flows in the 15-Mile Reach. Through Recovery Program actions, including flow augmentation, funding of improvements in irrigation project efficiencies, and other collaborative efforts among stakeholder interests in the Colorado River basin, the Program has substantially augmented flows in the 15-Mile Reach at those times of the year that provide the greatest benefits for the endangered fish. Program actions have also established other substantial habitat improvements (floodplain acquisition, fish passages, fish screens) described in the following section of this report.

Based on this history and these substantial accomplishments, and on the demonstrated enhancement to flow conditions, the Recovery Program does not at this time deem it necessary to reinitiate or amend this PBO for purposes of providing habitat improvement and flow management actions in compliance with the 15-Mile Reach PBO.

Our principal observations with respect to Program efforts to protect habitat in the 15-Mile Reach are summarized below:

<u>Peak Flows</u>

Over the 29 years (through 2019) that the Recovery Program has managed flows affecting the 15-Mile Reach:

- Annual peaks have exceeded the 'wet' year target at the Palisade gage location (23,500 cfs) with about the same frequency (24%) as proposed by the PBO (25%), in spite of relatively few wet years since 2000;

- Peak flows in 38% of years have exceeded or come within 5% of the target the PBO established for the wettest 50% of years.

- Voluntary Coordinated Reservoir Operations (CROS) have proven to be an important contributor to enhancing peak flows in the 15-Mile Reach and in helping to achieve peak flow targets with increased frequency. In 11 of 29 years (38%), peak flows were supplemented with CROS releases, which averaged more than 40,000 AF in years these releases were made. These operations should be continued, or further expanded, to help sustain and enhance Program success.

- Peak flows have generally fallen short of the PBO targets over the bottom (dry) half of the peak flow distribution, and the current peak flow recommendation to be met in all years (>12,900 cfs) has been met in only 69% of years since 1991. However, analysis indicates that prior to the Program, this target was met with a similar frequency (71%), which suggests that it may be an unrealistic dry-year target that should be re-evaluated.

Base Flows:

- The Recovery Program's base flow management has improved flow and habitat conditions, especially during periods of unusually dry hydrology, and especially when considering the long-term (100+ year) record, as shown in the data presented in Appendices I and II. Since 1998, dedicated reservoir fish pools and other sources have provided a total of more than 1.7 million AF of water to supplement flows in the 15-Mile Reach, for an average of more than 77,000 AF annually.

- Water leased for flow augmentation in the 15-Mile Reach has increased in recent years, most notably due to an annual leasing arrangement established between CWCB and the Ute Water Conservancy District beginning in 2015, but also through efforts of other entities including the Colorado River District, the Colorado Water Trust, and the Roaring Fork Conservancy and via donations from Exxon Mobil.

- Stakeholders working in cooperation with the Recovery Program have further enhanced base flow conditions in the 15-Mile Reach through voluntary actions including propitious timing of reservoir maintenance releases (Colorado River District) and making facilities available for temporary water exchanges to support water delivery to the 15-Mile Reach at the times of greatest benefit (Reclamation, Denver Water, and Colorado River District).

- In 'dry' years (>80% exceedance), the mean monthly flow target of 810 cfs frequently is not achieved during the months of August through October. Nevertheless, Program actions have generally improved low-flow conditions in these dry years when compared to conditions that existed prior to 1991, or would have otherwise occurred.

- The Osmundson et al. (1995) recommendation for a mean monthly flow of 810 cfs in dry years is not a flow level that historically (since 1902) was met on a regular basis, and thus may be an unrealistic dry-year target. The Program should re-evaluate this recommendation.

- Changes in hydrology and demands for water associated with a warming climate will be monitored by the Recovery Program. As appropriate, the Program Director's Office will propose adjustments in the Program's recovery actions to help the Program maintain recommended flows in the 15-Mile Reach.

- The Recovery Program should continue to diligently manage the available sources of augmentation water to reduce shortages to target flows, and should seek additional sources of augmentation water to achieve the recommended mean monthly flows with a greater frequency.

Attachment 4

Summary Table of West-slope CWCB Instream Flow Rights Downstream from the Bureau of Reclamation Water Supply Projects

Prepared for WRA, March 2023 (draft analysis)

Bureau of Reclamation Projects and Downstream River Reaches in Colorado River Tributaries with ISF Rights

March 2023*

Reclamation Project	Downstream River Reach	ISF Decree	AF Potential Annual Benefit 30-pctl / median / 70-pctl	Season of Maximum Potential Added Benefit
Colorado-Big Thompson	**Colorado River** Blue River to Piney River confluence	5-11CW159	4,021 / 17,971 / 24,820	Winter (Nov-Mar)
Colorado-Big Thompson and other projects below	**Colorado River** GVIC diversion to Gunnison River confluence	5-92CW286	0 / 0 / 2,902	Late Summer (Jul-Sep)
Fryingpan-Arkansas	**Fryingpan River** Rocky Ford to Roaring Fork Confluence	5-73W1945	353 / 615 / 862	Late Summer (Aug-Oct)[1]
Fryingpan-Arkansas	**Roaring Fork River** Fryingpan River to Crystal River confluence	5-85CW639	0 / 0 / 0	N/A
Silt	**Rifle Creek** Rifle Gap Reservoir to Colorado River	5-80CW321	36 / 113 / 175	Winter (Nov-Mar)
Dolores	**Dolores River** San Miguel River to Bridge	15-CW3111	7,700 / 39,112 / 93,702	Spring Runoff (Apr-Jul)
Dallas Creek	**Dallas Creek** E & W Fork confluence to Ridgway Reservoir	4-98CW234	318 / 716 / 1,387	Spring Runoff (Apr-Jul)
Uncompahgre	**Taylor River** Spring Creek to East River confluence	4-87CW264	0 / 0 / 178	Late Summer (Aug-Oct)
Florida	**Florida River** Salt Creek to Animas River confluence	7-77W1764	52 / 264 / 989	Winter (Nov-Mar)

[1] A disproportionate share of flow shortfalls to ISF targets during these 'irrigation season months' appear to occur in the latter half of October. Entities such as Colorado Parks and Wildlife prefer to see Fryingpan River flow rates drawn down to 'winter base flow levels' well before the end of October, to avoid adverse impacts to brown trout spawning. Thus, the potential benefits quantified here are arguably an artifact of practices that, in fact, benefit Fryingpan River fisheries.

San Juan-Chama	**Rio Blanco** Diversion dam to San Juan River	7-74W1295	1,559 / 2,177 / 2,508	Late Summer (Aug-Oct)
San Juan-Chama	**Navajo River** Oso Reservoir to New Mexico state line	7-74W1296	319 / 2,066 / 3,031	Late Summer (Aug-Oct)
Paonia	**North Fork Gunnison River** Coal Creek to Elk Creek confluence	4-84-CW400	0 / 77 / 799	Winter (Nov-Mar)
Aspinall Unit of CRSP	**Gunnison River** USGS gage #09128000 to N Fork Gunnison River confluence.	92CW0107	0 / 0 / 0	Winter (Nov-Mar)

*The preparer of this table has made every effort to assemble the most accurate information possible, but makes no guarantee the information in this report is error-free. This table is intended to provide an easily reviewable, thumbnail summary of very detailed analyses; additional details for each of these project analyses are provided in a longer accompanying document describing the gage records evaluated.

If you have questions about the content please contact Western Resource Advocates.

Attachment 5

Summary Table of West-slope CWCB Instream Flow Rights Downstream from non-Bureau of Reclamation Transbasin Export Projects

Prepared for WRA, 2023 (draft analysis)

Non-Bureau of Reclamation Projects that Export Water from the Colorado Basin in Colorado and Downstream River Reaches in Colorado River Tributaries with ISF Rights

March 2023*

Non- Reclamation Project(s)	Downstream River Reach	ISF Decree	AF Potential Annual Benefit 30 Pctl / Median / 70 Pctl	Season of Maximum Potential Added Benefit
Windy Gap Project - Northern Water Subdistrict	**Colorado River** Windy Gap diversion to Williams Fork confluence	5-80CW447	2,306 / 3,305 / 3,856	Winter (Nov-Mar)
Homestake Project - Colorado Springs Utilities	**Middle Eagle River** Gore Creek to Lake Creek confluence	5-80CW134	6 / 44 / 193	Late Summer (Aug-Oct)
Columbine, Ewing, Wurtz, and Wurtz Extension Ditches - Pueblo Board of Water Works	Same as above	Same as above	Same as above	Same as above
Homestake Project - Colorado Springs Utilities	**Lower Eagle River** Brush Creek confluence to Colorado River	5-80CW124	0 / 0 / 0	Late Summer (Aug-Oct)
Columbine, Ewing, Wurtz, and Wurtz Extension Ditches - Pueblo Board of Water Works	Same as above	Same as above	Same as above	Same as above
Independence Pass Transmountain Diversion System - Colorado Springs Utility	**Upper Blue River** Swan River confluence to Dillon Reservoir	5-86CW217	0 / 0 / 62	Late Summer (Aug-Oct)
Dillon Reservoir Operations - Denver Water	**Lower Blue River** Straight Creek confluence to Willow Creek confluence	5-87CW294	0 / 0 / 16	Spring Runoff (Apr-Jul)

Moffat and Williams Fork Collection Systems - Denver Water	**Fraser River** Crooked River confluence to Colorado River	5-90CW308B	0 / 0 / 0	Late Summer (Aug-Oct)[1]
Berthoud Pass Ditch - Northglenn - Golden	Same as above	Same as above	Same as above	Same as above
Busk-Ivanhoe Tunnel - Pueblo Board of Water Works - City of Aurora	**Upper Fryingpan River** North Fork confluence to Ruedi Reservoir	5-73W1955	3,219 / 4,134 / 6,742	Spring Runoff (Apr-Jul)
Twin Lakes Tunnel Collection System - Colorado Springs Utility - Pueblo Water Board - City of Aurora	**Upper Roaring Fork River** Difficult Creek to Maroon Creek confluence	5-10CW184B	6,666 / 7,954 / 8,504	Winter (Nov-Jun)
Busk-Ivanhoe Tunnel - Pueblo Board of Water Works City of Aurora	**Middle Roaring Fork River** Fryingpan River to Crystal River confluence	5-85CW639	0 / 0 / 0	N/A
Twin Lakes Tunnel Collection System - Colorado Springs Utility - Pueblo Water Board - City of Aurora	Same as above	Same as above	Same as above	Same as above

*The preparer of this table has made every effort to assemble the most accurate information possible, but makes no guarantee the information in this report is error-free. This table is intended to provide an easily reviewable, thumbnail summary of very detailed analyses; additional details for each of these project analyses are provided in a longer accompanying document describing the gage records evaluated.

If you have questions about the content please contact Western Resource Advocates.

[1] The subject stream gage has been operated only seasonally in most years, such that daily flow data are missing for most days beginning in October/November through March/April of most years. Thus the 'Season of Maximum Potential Benefit' may be skewed by this incomplete record. Based on these seasonal measurements, in only about 26% of years could any seasonal benefit have been realized, thus the 0 / 0 / 0 characterization of benefits in the 30-50-70 percentile years.