COLORADO
Colorado Water Conservation Board
Department of Natural Resources

Colorado Water Conservation Board

Water Plan

Water Project Summary

Name of Applicant	American Rivers
Name of Water Project	Frozen Assets: Innovative Groundwater Management and Recharge Strategies in the Rio Grande
Grant Request Amount	**$199,761.00**
Primary Category	$199,761.00
Agricultural Projects	
Total Applicant Match	**$1,234.00**
Applicant Cash Match	$1,234.00
Applicant In-Kind Match	$0.00
Total Other Sources of Funding	**$144,722.00**
Bureau of Reclamation	$129,100.00
Wetland Dynamics	$5,000.00
Ducks Unlimited	$10,622.00
Total Project Cost	**$345,717.00**

Applicant & Grantee Information

Name of Grantee: American Rivers
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Description of Grantee/Applicant

American Rivers protects and restores rivers and clean water for people and nature.

Type of Eligible Entity

☐ Public (Government)

- [ ] Public (District)
- [ ] Public (Municipality)
- [ ] Ditch Company
- [ ] Private Incorporated
- [ ] Private Individual, Partnership, or Sole Proprietor
- [x] Non-governmental Organization
- [ ] Covered Entity
- [ ] Other

Category of Water Project

- [x] Agricultural Projects
  Developing communications materials that specifically work with and educate the agricultural community on headwater restoration, identifying the state of the science of this type of work to assist agricultural users among others.
- [ ] Conservation & Land Use Planning
  Activities and projects that implement long-term strategies for conservation, land use, and drought planning.
- [ ] Engagement & Innovation Activities
  Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website.
- [ ] Watershed Restoration & Recreation
  Projects that promote watershed health, environmental health, and recreation.
- [ ] Water Storage & Supply
  Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap.

Location of Water Project

Latitude	37.938240
Longitude	-106.143760
Lat Long Flag	Precise coordinates: Project coordinates are readily definable and precisely define the location of the project
Water Source	Groundwater
Basins	Rio Grande
Counties	Saguache
Districts	20-Rio Grande

Water Project Overview

Major Water Use Type	Agricultural
Type of Water Project	Study
Scheduled Start Date - Design	10/13/2025
Scheduled Start Date - Construction	

Description

This project explores innovative water management strategies that mimic natural processes by building winter sheet ice across landscapes targeted for restoration, enhancing flexibility, and informing water administration across the Rio Grande Basin. Phase I, supported by this grant, will collect data to evaluate winter sheet ice as a management tool. The study focuses on using groundwater wells—permitted for wildlife use—during the winter at the Russell Lakes State Wildlife Area. Objectives include calculating consumptive use, monitoring groundwater

levels, assessing ecological benefits, and outreach to water users. Colorado Parks and Wildlife will complete a complementary consumptive use analysis and has submitted an application for a Substitute Water Supply Plan. Partners will conduct a groundwater study, document beneficial use for wildlife, and identify future implementation sites. Deliverables will include workshops, presentations, and a case study demonstrating the potential to restore native plant communities. Phase II, planned for 2027, will apply Phase I findings to implement winter sheet ice on fallowed fields. This next phase will also integrate microtopography to support groundwater recharge and native plant restoration. Together, these efforts advance a scalable, nature-based approach to water and land management in the Rio Grande Basin, supporting both ecological health and regulatory compliance.

Measurable Results

	New Storage Created (acre-feet)
	New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive
	Existing Storage Preserved or Enhanced (acre-feet)
	New Storage Created (acre-feet)
	Length of Stream Restored or Protected (linear feet)
	Length of Pipe, Canal Built or Improved (linear feet)
	Efficiency Savings (dollars/year)
	Efficiency Savings (acre-feet/year)
360	Area of Restored or Preserved Habitat (acres)
	Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)
44,000	Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning
500	Number of Coloradans Impacted by Engagement Activity
Other	

No additional measurable results provided

Water Project Justification

This project will develop supporting information and data regarding winter sheet ice, an innovative approach to water management that mimics natural processes to mitigate declines in the water table resulting from groundwater pumping and long term drought conditions, provides operational flexibility to land managers in the Rio Grande Basin, and fosters resilient wildlife habitat. Ice reservoirs, or winter sheet ice, have historically been used at high altitude locations with short growing seasons, specifically in some areas of Colorado's Rio Grande Basin (Basin) to spread water across lands during the winter to 'store' it for early spring use. These ice reservoirs are a nature-based solution that directly meet the goals of the Colorado Water Plan (CWP, 2023) and Rio Grande Basin Implementation Plan (BIP Vol 1 and 2, 2022): healthy watersheds, sustainable aquifers, adaptive and flexible, water administration, and vibrant and resilient agriculture and recreation.

CWP and BIP goals will be met by equipping water managers with a tool that can significantly improve operational flexibility to provide early season availability of water resources in a basin that faces declining aquifers, over-appropriated groundwater wells, and restrictions on use of resources outside of the irrigation season (presumptively April 1 to October 31 annually). A primary goal of the BIP is to support diverse and multi-purpose water projects (BIP Vol 1 2022, page 3), and this innovative water management approach using winter sheet has the capacity to positively impact water administration, agriculture, and the environmental and recreation sectors. The groundwater study incorporated in this project was identified in the 2015 and 2022 BIPs and has been expanded to include a wider range of water use sectors to be multi-beneficial (BIP Vol 1 2022, Chapter 4). Additionally, winter sheet ice has the ability to help address the Basin's primary resource concern of continued declining water resources and aquifer sustainability, which impacts all sectors including agriculture.

Climate change impacts and groundwater challenges have implications for the timing of agricultural production schedules, as well as the availability of suitable habitat for migratory species, particularly waterfowl and cranes. Colorado's Upper Rio Grande watershed, which encompasses the San Luis Valley (SLV) has endured consistent drought conditions since 2002 and is 1 of 2 basins in Colorado with the largest decreases in snowpack (BIP, 2022; Colorado Climate Assessment 2024). Since 2002, artesian pressure has declined (due to climate impacts and groundwater pumping) by approximately 1/3, resulting in diminished availability of water resources during the irrigation season, including areas for wildlife like Russell Lakes State Wildlife Area (RLSWA).

To help address diminishing aquifer levels, Groundwater Rules and Regulations (Rules) were established in 2015 with all 6 groundwater sub-districts in effect in 2021, putting in place programs for well reductions, fallow programs, changes to crops that use less water, and other initiatives that have unfortunately not prevented further declines in the aquifer. In a locally led effort to reduce surface water injury and recharge/sustain aquifers, Sub-District #1 set a goal of retiring up to 40,000 irrigated acres to meet aquifer sustainability requirements in their Plan of Water Management (BIP 2022, page 46). The BIP's strategic vision states that 'the Roundtable will pursue strategies that promote sustainability and resilience' (BIP, 2022) and lists achieving confined and unconfined aquifer sustainability as directed by the Rules as a Basin Challenge that crosses all water user sectors.

This project studies how winter sheet ice contributes to aquifer recharge potentially allowing for springtime irrigation and early season recharge of the aquifer, critical wildlife habitat, and improved native vegetation for producers which directly helps to meet identified challenges in the BIP and serves as an economic driver.

While historically a traditional practice in the SLV, winter sheet ice adjudications are rare today in the Rio Grande Basin. However, a few exist to allow water users to divert and utilize surface water from creeks in the winter for this purpose. Some landowners along with the Saguache Creek Water User's Association have adjudications acknowledging the beneficial use of diverting water to develop winter sheet ice for agriculture, November through March. As ice undergoes freeze/thaw cycles, it creates dynamic wetland-like conditions—shallow water, open pools, and ephemeral edges—that offer temporary foraging and resting habitat during a critical migration window for waterfowl and cranes when permanent wetlands and surface water resources are still frozen or no longer exist due to the irrigation season restrictions. Winter sheet ice decrees exist in Saguache Creek, San Luis Creek and a few other areas in the San Luis Valley. A Saguache Creek decree states: "2) water storage in the form of icing up of lands to provide waters for recharge and irrigation in the spring; and 3) aquifer recharge through artificial means" (District Water Division Three Case # 03CW5 – Saguache Creek Water Users Association in Saguache County, Nov. 1, 2010).

Project partners, including Colorado Parks and Wildlife (CPW) and Wetland Dynamics, LLC (WD) staff, have discussed the advantages of using three irrigation wells on the RLSWA during the winter season to develop sheet ice to support quality habitat when migratory birds, primarily waterfowl and cranes, are present in the SLV. Three large capacity wells at RLSWA have wildlife decrees and have been used for the past 20+ years to create winter sheet ice, mimicking a natural function that would have been prevalent prior to modern human settlement and widespread water development. This 4,650 acre site is mandated to provide at least 3,000 acres of waterfowl habitat annually to meet mitigation requirements associated with the loss of wetlands from the construction of the Closed Basin Canal. CPW has a 99-year Memorandum of Understanding with the Bureau of Reclamation (BOR) to manage the wells on RLSWA for wildlife habitat to meet mitigation requirements. All the wells at the RLSWA are free flowing (operated solely under artesian pressure, and not with pumps).

As part of their non-contributing match to this grant, CPW will be conducting a consumptive use analysis (described in detail below) and have submitted a Substitute Water Supply Plan (SWSP) to the Division of Water

Resources (DWR) for approval, which make up the administrative water law component of the project, and are integral and complementary to all tasks on this project. CPW contracted with Agro Engineering to develop a SWSP on RLSWA. The SWSP was submitted on April 2, 2025 and is pending approval from DWR. If approved, CPW will implement the SWSP during water year 2026. Site observations, including open water habitat, irrigated area, soil types, and native plant rooting depths, will be documented prior to and during operations. Detailed water use will be recorded at biweekly intervals during operations. Three wells have been incorporated into an SWSP to operate from November 1 through March 31 to promote winter sheet ice on wildlife habitats associated with each of the wells. The SWSP is an annual plan that can be renewed for up to 5 years. Future SWSPs may be modified depending on the results of the data collection. CPW is solely responsible for satisfying the legal requirements for changing/operating its water rights.

To pave the way for other water users who are interested in using winter sheet ice on their lands, this consumptive use analysis and SWSP may provide a model for others to follow. Data collected will be utilized to inform future SWSPs for winter water use.

Russell Spring forms the headwater of Russell Creek. Perennial artesian flows at the Russell Spring, particularly winter flows, would have presumably resulted in broad expanses of winter sheet ice along the Russell Creek corridor. Over time, the pumping of groundwater across the valley floor has reduced the artesian pressure, consequently reducing the discharge at Russell Spring, or water that was historically tributary to RLSWA. Further, well records at RLSWA shows that the artesian flow at RLSWA wells decreases during the irrigation season, when other irrigation wells in the surrounding area are operated to deliver water to center pivots to irrigate crops. Finally, since the drought of 2002, records show that artesian flow has dropped by about a third of the historic capacity. The data that CPW collects to complete the consumptive use (CU) analysis will help demonstrate that winter sheet ice can support wildlife habitat and justify a change in beneficial use from irrigation to wildlife, and will inform operational changes authorized under future Substitute Water Supply Plans (SWSPs) and a future water rights change case.

Well use in the winter (to create winter sheet ice) would occur when artesian pressure is higher, increasing CPW's ability to deliver water to wildlife habitat when compared to the current practice during the irrigation season. The Rio Grande Decision Support System groundwater model and groundwater response functions presume a consumptive use of 60% for wells that flood irrigate in the SLV, including those at the RLSWA. However, this presumption is based on typical irrigation practices during the presumptive irrigation season. DWR has recognized that there is 'negligible' evaporative loss from ice and a very low crop consumptive demand during the winter, the CU analysis performed as part of CPW's non-contributing match will collect data to support a consumptive use analysis when the irrigation practice is adjusted from the summer to the winter to support wildlife habitat and native wet meadows. CPW, with partners and outside engineering support, will begin this work in the fall of 2025 to document the impact from the change in operations. Data collected will support the current SWSP, and inform future SWSPs if adjustments need to be made based on the data collected. A CU analysis will demonstrate to water users, DWR, and the water court that the operational change will not result in an expansion of use or injury to other water users, and will supplement and complement the activities completed by project partners on this grant.

CPW will reoperate three irrigation wells at the RLSWA to promote winter sheet ice in two locations, as approved by the SWSP when it is approved. CPW staff will document biweekly artesian flow at 3 existing large capacity wildlife decreed wells and biweekly flows at the three irrigation wells operating under the SWSP. CPW will evaluate the wildlife habitat, irrigated areas, soil types, native plant rooting depths, and surface topography to support the CU analysis.

Winter sheet ice offers multiple benefits that support the outcomes and strategies outlined in the BIP to 'achieve

sustainable groundwater supplies for farmers, ranchers, towns, and wildlife habitat' (BIP Vol. 1, 2022, p. 21). When using groundwater resources to create winter sheet ice, valuable early spring migration habitat for waterfowl and cranes are created which also helps improve water table levels in the spring that help maintain wetland habitat into the summer. Russell Springs no longer flows due to groundwater declines and decades of drought conditions. Today, creek flows are simulated with groundwater inputs that continue to provide late winter and early spring waterfowl habitat while positively impacting downstream private landowners and producers. Saguache Creek water users with surface water winter sheet ice decrees create sheet ice by allowing creek flows through their delivery system, building ice on and across their ranches. These areas are then typically used for native hay and cattle pasture during summer months, benefiting from the early-spring watering attained through the slow melting of sheet ice. Winter sheet ice supports native vegetation communities and habitats by mimicking natural processes with respect to the timing, duration, and depth of the water delivered.

Creating ice reservoirs has been the single most important water management tool at RLSWA to help meet habitat mandates for the BOR. Similarly, the Monte Vista National Wildlife Refuge (MVNWR) has, in the past, also utilized winter sheet ice at times to manage for wildlife. Maximizing resource availability during this time is critical for wildlife. Spring waterfowl migration monitoring from 2008 through 2018 on RLSWA showed significant preference by waterfowl for areas with sheet ice and also indicated that peak migration was shifting about 1 day earlier each year (unpublished dataset, WD and CPW). Migrating waterfowl face a growing challenge in the SLV resulting from changes in climate that causes birds to arrive earlier each year when wetland resources they depend upon are increasingly limited. This mismatch is compounded by the legally defined irrigation season, which does not begin until April 1 along with declining water tables. As a result, water that could support critical wetland habitat is unavailable partially due to physical scarcity/drought conditions, but also due to groundwater pumping and man-made regulatory timelines. Each spring, more waterfowl arrive before irrigation water can legally be applied to the landscape, leaving them with fewer resting and feeding opportunities at a time when they need them most. This growing disconnect between ecological needs and administrative schedules underscores the importance of exploring flexible, nature-based water management strategies that can better align with changing migration patterns while meeting the needs of the agricultural community and abiding by water law.

Funds from the CWCB grant will expand upon existing information from water monitoring efforts throughout the Rio Grande Water Conservation District and sub-districts. This includes utilizing existing and new piezometers that will document water table levels across public and private lands with wildlife and winter sheet ice decrees. These groundwater data points are expected to show that ice reservoirs support and improve agricultural operations that utilize flood irrigation beginning April 1 by extending the duration and consistency of water tables into the growing season. Additionally, funding will allow us to document beneficial use of wildlife on areas with ice reservoirs requested by DWR to support the water decrees. If ice reservoirs as a tool can be shown to be a beneficial use of water resources with lower CU as demonstrated by CPW's complementary study, this project could help state and federal agencies as well as private landowners support change-in-case water decrees for winter well use that have the same or less CU during a season of use.

Overall, this project will support more sustainable land management through a nature based tool that utilizes historic practices to achieve multiple CWP and BIP benefits, providing water managers with an alternative type of strategy that has a presumed lower consumptive use, reduces conflicts amongst water users as this tool will be used at a time of the year when a majority of users are not using water, all while supporting wetland and riparian habitats that have been threatened by limited resource availability exacerbated by climate change and declining water tables. This project supports an innovative water management strategy that can be adapted across the Basin, throughout Colorado, and across the western U.S. It offers an alternative approach that enhances operational flexibility for water managers, improves water supply reliability, has the potential through Phase II to

show that it can address air and water quality concerns associated with fallowed fields, promotes the restoration of native vegetation, reduces noxious weeds, and helps sustain the aquifer by lowering groundwater pumping demands.

Related Studies

Many studies, plans, and assessments have been completed in the SLV and elsewhere that provide background, support, and justification for the necessity to develop and implement tools that meet multiple benefits for water users across the SLV. Historically, the natural phenomenon and development of ice reservoirs were created by perennially flowing streams or by natural springs that fed perennially flowing streams throughout the winter months, providing aquifer recharge and early spring habitat. Research around benefits of sheet ice in the Indus Basin in India found that ice reservoirs that sequentially capture thin layers of water creating thin overlapping sheets of ice, seasonally store water for early irrigation prior to melting of the snowpack or in that region with glaciers (Nusser et al 2019). Using sheet ice to 'store' water during the winter, a period of time when evapo-transpiration is at its lowest point, can be an integral nature-based tool for water managers to provide operational flexibility for irrigation management as water resources continue to decline. In the Rio Grande Basin, the Saguache Creek Stream Management Plan (SMP) was completed in 2020 and identified a variety of water resource issues, challenges, and needs to help address threats to water supply to meet Rio Grande BIP goals. The SMP provided detailed stream health condition assessments including: hydrologic regime, geomorphic condition, riparian vegetation, aquatic species, water quality, recreation, and diversion infrastructure needs to help meet declining water resources. The SMP informed a subsequent CWCB grant with Ducks Unlimited and identified additional project locations downstream of the SMP. The private land parcels included in this Project were identified as important locations in the DU study and are included in an awarded WaterSMART Cooperative Watershed Management Plan Phase I grant that will help plan and design upgrades for water control infrastructure to better handle and deliver winter sheet ice decrees throughout that stretch of the creek. The SLV Wetland and Wildlife Conservation Assessment (SLV WWCA, 2019) and subsequent CWCB water plan grants prioritized and identified resilient areas across the Basin including areas within the Saguache Creek watershed, specifically the private land parcel and Russell Lakes State Wildlife Area in this proposal. Winter sheet ice surface water adjudications exist within the Saguache Creek corridor along with groundwater well adjudications for wildlife that create winter sheet ice conditions on the RLSWA. The SMP and subsequent projects, plans, and stakeholder discussions involving winter sheet ice decree holders were instrumental in targeting this watershed. The goal was to augment existing groundwater modeling to support ice reservoirs as a DWR recognized beneficial use of water. This approach can be extrapolated to other areas in the SLV and beyond as a nature-based solution that offers flexibility.

Taxpayer Bill of Rights

Not applicable