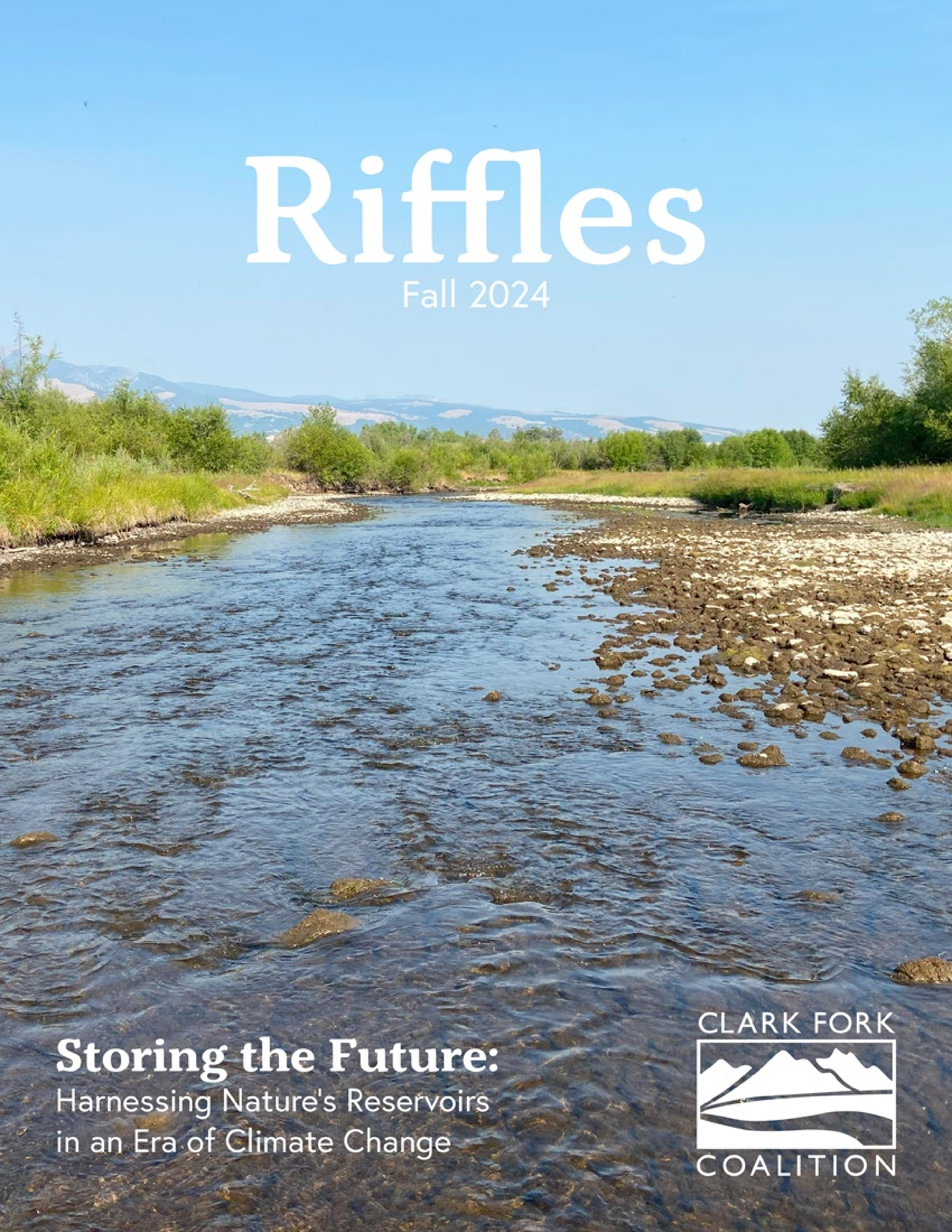


# Riffles

Fall 2024

## Storing the Future:

Harnessing Nature's Reservoirs in an Era of Climate Change

CLARK FORK COALITION

# The Future of Storage in the Clark Fork River Watershed

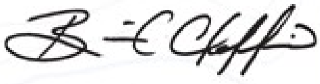
With the arrival of fall in western Montana comes magical days of sunshine and perfect temperatures, as well as much needed fall rains and the renewal of our yearly water cycle. Yes, happy hydrologic new year! Each year in October, our rivers, creeks, and groundwater systems begin to recharge their seasonally tapped water supplies in preparation for a hydrologic refresh, mostly in the form of winter snowpack. October marks the start of the seasonal hydrologic cycle of precipitation, storage, runoff, and renewal of life-giving network of Montana's waterways as snowmelt and spring rains meet longer days and increased temperatures.

Storage of water—as snowpack, in lakes and reservoirs, soil and wetlands, and in groundwater aquifers—is a critical element of the yearly hydrologic cycle. Water storage on the landscape drives the seasonal rhythms of flow in our rivers and streams and creates the conditions for renewal of aquatic habitat and fish populations through the provision of clean, cold, consistent water flows. Storage is also a key consideration for water management and planning—irrigated agriculture, recreational opportunities, and river restoration activities rely on storage for consistent water supplies during late summer and in critical times of drought.

In this installment of our *Riffles* newsletter, we dive deep into the concept of water storage in the western Montana landscape, a concept that rests in the forefront of our minds as we continue to pursue innovative approaches to protect clean water, abundant fisheries, and healthy river ecosystems and human communities. In what follows, you'll hear from our Staff Scientist, Dr. Sam Carlson, about the role of storage in the seasonal cycles of water across the landscape and how storage is critical for ecosystems and human communities alike. You'll also here from staff members Gretchen Watkins and Lily Haines about specific CFC projects designed to renew the storage capacity throughout the watershed in both the urban and rural places we work.

In my short time at the helm of CFC, I have been consistently impressed and inspired by our commitment to weaving science-informed approaches into our efforts to ***protect and restore*** the Clark Fork watershed. Our engagement with the concept of water storage is no exception. I hope you enjoy this exploration into the potential that utilizing natural and engineered storage provides for creating and sustaining a healthy, connected Clark Fork River watershed.

See you on the river. Best, Brian



Brian Chaffin, Ph.D.
Executive Director
Clark Fork Coalition

The Upper Clark Fork River near Deer Lodge, taken in early August during a period of critically low flow.

# Rivers of Change:

## Adapting Water Storage in a Warming World

by Dr. Sam Carlson, Clark Fork Coalition Staff Scientist

On a late summer day, the Clark Fork River provides welcome relief from the hot and dry landscape of western Montana. This reliable, year-round presence of water in streams and rivers is foundational to both the ecosystems and human communities of our region, and it flows from the water storage capacity of our watersheds.

Although water storage is difficult to measure at the scale of a large watershed, the effects of water storage are plainly visible. Precipitation is intermittent across western Montana, and multi-week periods without any precipitation are common in the summer. During these dry periods, we expect that our streams and rivers will continue to flow, fed by stored water from previous rainfall and snowmelt. The streams and rivers of the Clark Fork watershed usually meet this expectation, yet this system is strained by our changing climate, population growth, and increasing demand for water resources. Altogether, this begs the question: **What do we know about water storage in the Clark Fork watershed, and how can we protect, restore, and enhance this water storage capacity to prepare for future challenges?**

Snowpack is a major component of water storage, and the seasonal patterns of storing water as snow during the winter and releasing it into headwater streams during the spring and summer are the defining characteristic of the hydrology of our region. Climate change presents a serious threat to this important form of water storage, as a larger portion of our precipitation is coming as rain instead of snow, and even high mountain snowpacks are melting earlier in the year.

In addition to the consequences for seasonal snowpack dynamics, climate change is leading to increased intensity of precipitation. These intense precipitation events often overwhelm the infiltration capacity of soils, reducing groundwater recharge and leading to a 'flashy' high flow response in streams and rivers. Minimizing the impermeable areas in urban and suburban landscapes can reduce this flashy response, but as with the decrease in snowpack, there are no management or restoration approaches that can directly override these effects of climate change. This challenging situation highlights the need to address climate change by reducing greenhouse gas emissions, while also adapting to climate change by restoring and enhancing water storage across the watershed.

High flows from rapid snowmelt or intense rainfall present an opportunity to slow down, spread out, and store floodwater. In many natural river and stream corridors, there is a tight connection between the channel and the adjacent floodplain. During high flow events, floodwater naturally spreads out across this floodplain, and soaks into rich floodplain soils and underlying aquifers. However, historical modifications of stream and river corridors have degraded the size and function of floodplains, and degraded the connection between river channels and floodplains. Further, a loss of in-channel structures such as log jams or beaver dams has decreased the amount of water and sediment that gets pushed up on the floodplain and has led to simplified and incised streams and rivers. In contrast to a natural and complex stream or river ecosystem, these simplified and incised channels are very effective at moving water downstream, but have a minimal capacity to slow down floodwater, and store this water in floodplains or groundwater aquifers. Although challenging, restoration of these natural processes can yield a reduction in flood intensity as well as an increase in the storage of water during high flows, and the release of this stored water during dry times of year when additional water sources are critical for rivers, fish, and human communities.

Photo of a restored flood plain along Miller Creek that successfully trapped sediment during a flood event in August.

# Slow It Down. Soak it In.

## Stream Restoration & Groundwater Recharge

by Gretchen Watkins, Clark Fork Coalition Restoration Project Manager

In today's fast-paced world, the relentless drive to achieve more in less time is taking a toll on our health and well-being. Throughout human civilization, we have manipulated the course of available freshwater to make way for infrastructure like roads and buildings and diverted water for our use in food production, domestic uses, and recreation. Water runs off these manipulated surfaces more quickly, warms up, and carries pollutants, affecting humans, fish, and wildlife that rely on functional flow patterns.

At my stage of life with kids going off to college and parents turning 80, I often think about what I learned from working with water as an eco-engineer. The main principle that sticks with me is: slow it down and soak it in. In stream restoration—and in life it seems—this advice is paramount to reconnection and sustainability.

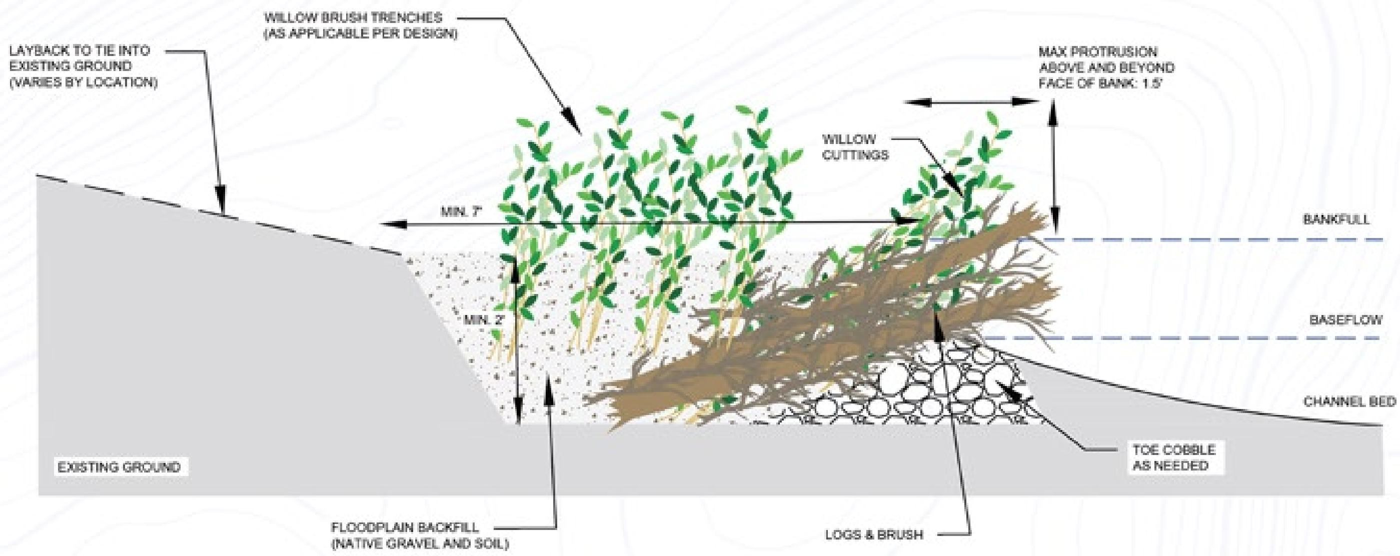
The CFC's restoration efforts span from headwater storage to reconnecting floodplains, adding roughness, and increasing stream length and volume. One key goal is to improve floodplain connectivity by lowering incised stream banks to add volume during high flows that restore floodplain function to store water. Think of sponges along the creek edge soaking it up and releasing it later. This is further enhanced by increasing



riparian woody vegetation cover, which reduces evaporation and increases roughness, effectively slowing down water flow and allowing it to soak in.

Miller Creek exemplifies this restoration approach. The CFC, in collaboration with partners like the Missoula Conservation District, Natural Resource Conservation District, FWP Future Fisheries, Department of Environmental Quality, and local landowners, has worked to restore this area since 2018. The restoration at MPG was tested and showed it has increased resilience to extreme storms by restoring natural systems to slow down water flow and soak it in. Reconstructed floodplains and restored woody corridors have increased floodwater storage areas and reduced flood damage, as seen after the Miller Creek fire. Restored areas captured water and sediment in the upper reaches of the stream during a flash flood after the Miller Creek Fire. Maintaining floodplains as undeveloped areas for floodwater storage is vital not only for building resilience to extreme storm events but also for combating drought. Life is not a race to the finish line. Instead, let's meander our way through, ***slow it down, and soak it in.***

WOODY DEBRIS MATRIX
SECTION VIEW



# Beavers: The Original Ecosystem Engineers

## Low Tech, Process Based Restoration

by Lily Haines, Clark Fork Coalition Community Programs Manager

One of the most dramatic losses to western watersheds, once rich with biodiversity and natural water storage, was the near eradication of North America's largest rodent, *Castor canadensis*, the beaver. As these "ecosystem engineers" disappeared, the intricate web of dams, ponds, side channels, and backwaters they created vanished. Along with that went the beaver-driven processes that store surface water, recharge groundwater, and sustain wetlands. Today, beavers occupy a mere 15% of their historic range in the Clark Fork watershed. While the full impact of this loss is difficult to quantify, it's clear that the decrease in natural water storage across the landscape has been massive. A quick review of recent research—and a bit of simple math—connects the dots.

The Beaver Restoration Assessment Tool (BRAT), developed by Utah State University, helps conservationists figure out where beaver restoration might be effective. In the Lolo watershed, it predicts that beavers could occupy nearly 90% of stream miles. A conservative estimate suggests that the perennial tributaries of the Lolo watershed alone could support around 1,500 beaver dams and ponds. However, current surveys by the Clark Fork Coalition (CFC), the Lolo National Forest, University of Montana researchers, and dedicated community science volunteers count fewer than 50 dams across the entire watershed.

Scientific research over the past two decades demonstrates the impact of beaver dams and ponds on mountain streams like those in the Clark Fork watershed. Those dams increase water storage, improve floodplain connections, and support healthy stream flows. In short, a watershed with beavers is a wetter, healthier watershed. By combining the BRAT model's predictions with research on water storage in beaver ponds[1], we can estimate that the Lolo watershed alone is missing out on tens of millions of cubic feet of water storage. If historical conditions match today's science, the loss of beavers likely led to the disappearance of nearly 100 million cubic feet of groundwater storage and 50 million cubic feet of surface water in the Lolo Watershed.

In the face of a warming West, keeping watersheds wet is critical. That's why the Clark Fork Coalition is committed to restoring natural, process-based water storage in our tributaries and headwaters. Beavers are key to tackling this pressing environmental challenge.

## How is this happening?

Clark Fork Coalition staff are active members of the Montana Beaver Working Group, a team of about two dozen conservation professionals dedicated to:

- Integrating beavers into stream and wetland restoration projects.
- Educating the public on the benefits of beavers and beaver-related restoration.
- Simplifying legal and policy hurdles to beaver habitat restoration and relocation.

With funding from the Broad Reach Foundation, CFC is also working with wildlife managers, forest managers, and universities to answer key questions that limit beaver restoration. Where are beavers now? Where were they historically? What habitats are suitable for beavers today? Our team is working to answer these questions by mapping current beaver populations in priority watersheds and comparing beaver numbers in protected areas with those in places open to trapping.

Understanding where beavers are—or could be—is essential to reintroducing them into areas they haven't been able to recolonize. This includes encouraging natural migration, supporting existing beaver populations by enhancing habitats, and, in some cases, relocating beavers to suitable areas.

Where beaver populations are absent, conservationists are using hand crews and heavy equipment to build structures that mimic beaver dams. Made from logs, stones, and other local materials, these structures slow down water flow, increase water retention, and restore the ecological processes that beavers naturally provide. CFC-funded studies are exploring how well these structures mimic beaver activity and balance restoring degraded streams with protecting native fish, like cold-water trout.


Installation of a beaver analog dam.

As climate change continues to alter the landscape, beaver restoration offers a cost-effective, sustainable solution to water scarcity. In the Clark Fork watershed, these efforts are strengthening beaver populations and restoring natural water systems through collaboration with landowners, state agencies, and research institutions. While we can't create more water, we can work to return lost water storage capacity, ensuring that Montana's rivers remain healthy for generations to come.

[1] Dittbrenner, Benjamin J., Jason W. Schilling, Christian E. Torgersen, and Joshua J. Lawler. 2022. " Relocated Beaver Can Increase Water Storage and Decrease Stream Temperature in Headwater Streams." Ecosphere 13(7): e4168. https://doi.org/10.1002/ecs2.4168

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# Clean Rivers. Clear Conscience.

As western Montana's waterways face increasing pressure from drought, population growth, and aquifer over-extraction, the Clark Fork Coalition is stepping up with innovative, sustainable, science-driven water storage solutions to protect our rivers, environment, communities, and way of life. We're leading efforts to rethink how we capture, store, and use water in ways that safeguard ecological and human health for generations to come. *But we can't do it alone.* Your donation today enables us to continue and reimagine this crucial work and ensure that the Clark Fork remains resilient, regardless of what awaits it. Help us write a bright future for the river.

**Together, we can protect the best and restore the rest.**

Scan the QR code, visit clarkfork.org/donate, or use the enclosed envelope to donate today.

SCAN ME