The Water Report

Water Rights, Water Quality & Water Solutions in the West

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NEW MEXICO'S RIO GRANDE IN THE 21ST CENTURY

THE MIDDLE RIO GRANDE VALLEY

by John Fleck (Utton Center, University of New Mexico School of Law); Paul Tashjian (Audubon); Casey Ish (Middle Rio Grande Conservancy District); Patrick McCarthy (Thornburg Foundation); and Adrian Oglesby (Utton Center, University of New Mexico School of Law)

Introduction

The author Paul Horgan described the Rio Grande as "an adequate though never a voluminous river except in flood tide." But, four decades ago, Horgan clearly saw the challenges ahead: "In many places the river has become only a trickle, and in others entirely dry, to be replenished only by flood from otherwise dry or meager local tributaries and by diminishing ground water, this always in the face of increasing needs in both the United States and Mexico."

The 2,000-mile Rio Grande, flowing from the Rocky Mountains to the Gulf of Mexico, is fed by a 200,000-square-mile watershed. The river supplies water to 6 million people across three US states and the US–Mexico border region. In the four decades since Horgan wrote those words, the population served by the river has increased, as have accompanying community values. Now the effects of climate change are shrinking the Rio Grande.

The river nurtures a novel agricultural-urban ecological system, in which farming, the Rio Grande, and the cities located along the length of the river have become interdependent, having evolved over thousands of years of human habitation. This evolution has allowed human communities to flourish, but it has come at a cost, having left the valley's human and natural systems vulnerable to the lack of resilience that comes with rising demand and shrinking supply. Fortunately, the water management community in the Middle Rio Grande includes many collaborative, courageous, and creative people who appreciate all that the river provides.

New Mexico's Middle Rio Grande

As practitioners and scholars working in central New Mexico, our focus in this article is on what New Mexicans call the "Middle Rio Grande Valley"—the stretch of river through the central part of the state from the ancient Native American community of Cochiti, where the Rio Grande emerges from the canyons to the north, to the century-old Elephant Butte Reservoir in the south, one of the nation's first Bureau of Reclamation (Reclamation) dams. The Middle Valley is the aboriginal homeland of six sovereign Native American Pueblos and is now also home to nearly half of New Mexico's population and economy.

While our focus is on the Middle Valley, there are legal, ecological, social, and hydrological connections that make it impossible to understand our stretch of this great river without understanding its connection to regions upstream and downstream.

The Middle Rio Grande's governance structure is "polycentric," with interlocking government agencies responsible for various aspects of water management but often lacking centralized authority over the entire system. An interstate agreement—the Rio Grande

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The Rio Grande

Sediment Changes

Channelizing

Federal Assistance

Management

Compact—governs water sharing among upstream and downstream states, while two treaties ensure Mexico gets its share.

Local entities, including the Middle Rio Grande Conservancy District (MRGCD) and the Albuquerque Bernalillo County Water Utility Authority, work alongside the six Native American Pueblos that have their own substantial land and water management authority. At the level of state government, the New Mexico Interstate Stream Commission ensures compliance with the Rio Grande Compact. Four federal agencies also play crucial roles: the Bureau of Reclamation and Army Corps of Engineers manage dams and levees (in some cases sharing responsibility with local agencies); the US Fish and Wildlife Service oversees the Endangered Species Act; and the Bureau of Indian Affairs facilitates irrigation on Native American lands.

Adaptation has been a constant along the Middle Rio Grande. As human communities adjusted to the changing river, the agricultural-urban-ecosystem evolved alongside. But there is a risk that the system's ability to adapt may be approaching limits. Endangered Species Act constraints, downstream delivery obligations, outdated legal frameworks, and climate change are contributing to the unraveling of this rich, historic, and ever-evolving ecosystem.

SOCIAL SYSTEM

Before the incursion of settlers into the San Luis Valley in the mid-1880s and the arrival of the Atchison, Topeka, and Santa Fe Railway in 1880, the Rio Grande freely wandered a broad valley floor, with Native American communities—"Pueblos," from the name given them by the Spanish—and Spanish colonizers living on the highest ground.

Today, the Middle Rio Grande is one of the most heavily modified and notoriously complex basins in the country. The Rio Grande has been modified from its headwaters to its delta—which it rarely reaches anymore. Many of the modern physical challenges in the Middle Rio Grande can be traced back to the collapse of the upper watershed in the mid-to-late 1800s. The San Luis Valley in Southern Colorado was largely uninhabited until the arrival of the first Anglo settlers from the east in 1851. Over the next five decades, burgeoning irrigation efforts took more and more of the river's water, while hundreds of thousands of sheep consumed the grass. The loss of grass led to a rapid loss of soil. The combined effects of less water and more dirt in the river were felt most acutely far downstream in the Middle Rio Grande, where the river flattens out, loses energy, and drops its heavy sediment load.

The Middle Rio Grande slowly became choked. Its bed began to aggrade dramatically, causing groundwater levels to rise and inundate valuable farm and pastureland up and down the valley. Development efforts were stymied by the waterlogged conditions in Albuquerque and other developing riverside communities. The further diminishment of flows in the Middle Rio Grande created by diversions in the San Luis Valley was aggravated by the continuously rising river bed, the cumulative effect being a further reduction in the volume of water reaching the farming communities in southern New Mexico, Texas, and Mexico. When the river did flow, it was often a force of rapid destruction. The raised bed enhanced the power of flood flows that wreaked havoc through the Pueblos and non-Indian communities.

With a growing 20th century population, the communities began channelizing the Rio Grande beginning in the 1930s, with levees and drains confining the river to a narrow channel and drawing down the water table to eliminate the swamping that impeded the urbanization of Albuquerque and surrounding cities.

The work was initially done by the Middle Rio Grande Conservancy District, a local government agency created for the job in the 1920s. But the valley's economic growth proved insufficient to pay for the work.

Beginning in the 1950s, the Bureau of Reclamation and Army Corps of Engineers (Corps) stepped in with an infusion of federal funding, upgrading levees and adding a network of flood control dams to protect rapidly growing Albuquerque and its surrounding communities. That expansive federal role continues today.

Today, nearly a million people live in the four counties of New Mexico's Middle Rio Grande Valley, more than a quarter of them on the once frequently flooded Rio Grande valley floor.

The federal statutes written in the 1940s authorizing the work by the Corps and Reclamation, along with the 1938 Rio Grande Compact among Colorado, New Mexico, and Texas, continue to provide the foundation for the river's management. But shifting societal values have increased the complexity of river managment. Chief among these changes in the first decades of the 21st century was the Endangered Species Act, with water management being adjusted to meet the needs of the Rio Grande Silvery Minnow and other species. Changing community values have also led to the creation of parkland and recreational facilities along a river once seen as a "menace" because of the floods and swamps it spread across the valley floor, but now, in its narrowly channeled form, it is increasingly embraced by the community as a beloved environmental feature.

The Rio Grande

Water Use

Bird Habitat

Spring Pulse

Flooding

Farming History

MRGCD

The 1920s vision of a city surrounded by commercial agriculture in the Middle Rio Grande never materialized. While some commercial farming persists, most agriculture is now cultural, leading to adaptations in governance and water management to meet diverse needs. As a result, the majority of water consumption is for non-commercial irrigation and the riparian environment, primarily drawn from the Rio Grande, while urban water use, despite dominating the valley's modern economy and society, represents a smaller fraction of total water use.

A NOVEL AGRICULTURAL-URBAN-ECOSYSTEM

It is not uncommon to see a flock of migrating White-faced Ibis in a flooded farm field in Albuquerque in April; to hear the bugling of wintering Sandhill Cranes overhead; or see the graceful gray birds eating bugs in a harvested alfalfa field in December. It is an interdependent ecosystem where farmland and urban landscapes interface with a leveed river corridor to create a critically important flyway.

The levees bind a 1500-foot-wide river corridor that in some places resembles an urban park and in other places a wild river. Between the levees is the "bosque," the New Mexican Spanish word for a revered and now rare cottonwood-dominated floodplain forest. The urban and rural environments outside the levees lie within the river's historic bottomlands, interfacing with the river through a network of groundwater wells, irrigation diversions, drains, and returns to the river. This tree-lined arterial network provides a wetted web of habitat as well as paths that connect residents to outdoor public space. The irrigated farmlands are themselves part of this agricultural ecosystem, with water on these bottomland fields mimicking historical flooding.

Before the advent of 20th century large-scale engineering and water extraction, New Mexico's Middle Rio Grande was a wide, sand-rich, low-gradient river that meandered across its valley bottomlands through natural channel shifts. As with the Platte River in central Nebraska, the Rio Grande was often referred to as being "a mile wide and an inch deep." Much like the behavior of a river in a deltaic setting, the Rio Grande's channel would occupy a portion of the valley floor where lesser floods would build the river up in place. Flooding, especially during the snowmelt-driven spring floods, would shift the river to a new location in the valley, leaving the former channel as a location for wetlands and new riparian forests. This "spring pulse" was the primary ecological driver of the species that evolved within the corridor; all adapted to this cycle of constantly regenerating habitat with primary wetness in springtime. Reproduction of both the Rio Grande Silvery Minnow and the Fremont cottonwood are triggered by flooding in May and June, when cottonwood seeds fly and minnow eggs float, finding safety and nourishment in the inundated floodplain.

The challenge of settling the valley was both daunting and impressive. Indigenous Pueblo communities mastered it first, with small villages built on the best high ground, above the spring flows, farming the lowlands made rich by the river's annual rites. As the population in the area grew during the periods of Spanish, Mexican, and United States colonization, communities spread over more of the floodplain, irrigating with upwards of 70 *acequias*—community-operated watercourses—and struggling to confine the river to a single channel so they could farm and live in areas over which the river once regularly spread. Channelizing the Rio Grande caused the river to aggrade in place, and riverbed began to rise higher than the valley floor, which, in turn, led to the formation of saturated, salt-rich evaporitic basins in many places. The floods themselves easily and regularly swamped the lower-lying villages and destroyed the small diversion structures associated with each community ditch, making upkeep and maintenance a perennial slog.

Growth in farming upstream, beginning in the 1880s in the San Luis Valley of Colorado, further changed the river by further reducing river flows and thereby increasing the volume of sediments deposited.

The arrival of the railroad in the 1880s led to a diversification of food supply for residents of the Middle Rio Grande Valley, and a growing urban economy led to an increase in job opportunities and an expansion of the economic base, but this did not diminish the significance of irrigated agriculture in the Middle Rio Grande Valley. While farming never developed into a major part of the local economy, it became deeply integrated into the valley's developing urban landscape.

Permanently confining the river to a single channel, with more robust levees and water management infrastructure, was needed to accommodate the growing city of Albuquerque, but this work required collective action on a scale at odds with the village and irrigation ditch governance structure of the day. After a series of false starts, the Middle Rio Grande Conservancy District, a government agency with taxing authority and broad water management powers, was created in the 1920s to centralize water management.

The Rio Grande

Changing Patterns

Temperatures

Projections

Management Structure

Crops

Cultural Importance

Adaptation

CLIMATE CHANGE

Decadal-scale climate variability is a defining feature of life in the Middle Rio Grande Valley. Early societies learned to adapt to multi-year drought and pluvial trends. The "Drought of the 1950s" was significant enough to earn an enduring name, and, though its worst years fell in the 1950s, its strings of mostly dry years, interspersed with occasional wet years, extended from the late 1940s into the 1970s.

The climate turned wet in the 1980s, a pluvial trend that lasted until the turn of the century, when the climate switch flipped again to "drought." Total flow into the Middle Valley in the 21st century has been just 65 percent of the flows seen from 1980 to 2000. But with warming temperatures, what would have been a "normal" drought has been supercharged, with the temperatures in the Middle Valley in the most recent decade more than 2 degrees Fahrenheit higher than in the 1980s.

The resulting impacts on the agricultural-urban-ecosystem have been profound, with longer growing seasons and rising water demands from crops, natural vegetation, and urban gardens even as the flow of water into the system has declined.

With continued rising temperatures, scientists expect that challenge to grow. While the decadal-scale natural pattern could again shift toward a wet cycle, with continued warming, the wet periods will be drier than they used to be and the droughts will be more severe. A detailed climate change analysis for water planners undertaken by the New Mexico Bureau of Geology warned New Mexicans to expect a 25 percent decline in surface water and groundwater resources over the next five decades.

The Modern Water Management Landscape

At the heart of the Middle Rio Grande's 21st century water management landscape are government agencies responsible for delivering water to users, primarily to irrigation and municipal customers in New Mexico and Texas. Their ability to do that is constrained by hydrology, in the form of shrinking supplies, and rules that place evolving requirements on water use.

These competing demands form a "three-legged stool" of Middle Rio Grande water management, whose ability to stand depends on balancing three interconnected and sometimes competing demands.

The first leg represents irrigation and municipal water use, which are essential for maintaining the region's agricultural-urban-ecosystem. The second leg is the Rio Grande Compact, which places strict requirements on downstream water deliveries to users in southern New Mexico and Texas. The third leg, which has always been present but has gained increased recognition in recent decades, is the environment itself—the river and the multitude of species that rely on it and its riparian corridor.

For the last quarter century, the federal Endangered Species Act has provided a new regulatory structure to strengthen this environmental leg, placing requirements on maintaining flows in the river's main channel to meet the needs of the Rio Grande Silvery Minnow and other threatened and endangered species.

The impact of climate change has made managing water to meet those rules increasingly difficult.

MODERN FARMING

Since "the memory of man runneth not to the contrary"—as the old English common law describes "time immemorial"—the waters of the Middle Rio Grande (MRG) have been harnessed for irrigation. When the Spanish explorers first came into the MRG in 1541, they found the long-established Pueblo Indian communities actively engaged in agricultural production. Agricultural irrigation still represents the largest sector of human water extractions in the MRG valley. Today, nearly 60,000 acres are still irrigated from MRGCD ditches ditches threaded along the valley floor—some modern, and some following the same twisting paths they have traveled for centuries. Farm size is small, averaging just 5 irrigated acres, and is dominated by alfalfa and other forage crops. While some commercial-scale forage crops are grown for New Mexico's robust dairy market, much is sold into the local recreational horse market. Agriculture's contribution to the valley's economy is small: $11 million of net farm income in 2022, out of a gross domestic product in the four Middle Rio Grande counties of $53 billion, according to the US Department of Commerce. But irrigation's cultural importance, and the benefits of a vegetated valley floor, are immeasurably important to the Middle Rio Grande Valley's way of life.

Modern irrigators face the same uncertainties that challenged their ancestors: natural disasters, drought, insects, and economic fluctuations. However, modern irrigators now often have the benefit of reservoir storage. The water for farmers in the Middle Rio Grande is stored in El Vado Reservoir. Built in the early 1930s, the upstream face of El Vado, which is clad in steel, is now leaking. El Vado is currently in dry operations, and repairs have been suspended while Reclamation tries to develop a fix.

As water supply conditions become more uncertain in the West, farmers must continuously adapt to account for more variability in the system. Adaptation can take on many different forms and can

The Rio Grande

Uncertainty

Water Rights

Governance Models

Pros & Cons

Supply Portfolio

successfully mitigate water supply disruptions. However, the cost to upgrade infrastructure (e.g., pipelines, wells, and concrete ditches), invest in no-till or limited-till machinery, new seed, or soil improvements can be significant. A farmer's willingness to invest in these adaptation strategies can be further complicated by uncertainty about how water might be managed during short-term shortages or long-term droughts.

In the Middle Rio Grande, the "Shortage Sharing" approach to water administration presents a unique challenge. Other than respecting the Pueblos' senior water rights, the MRGCD administers all other water rights in parity, sharing shortages. The legal structure under which the Middle Rio Grande Conservancy District's consolidated irrigation structure operates was created in the 1920s to 1930s. It ensures that the six middle Rio Grande Pueblos enjoy a congressionally recognized senior right on the river for much of their irrigated acreage, while all other agriculture is managed as having an equal right to use surface water delivered by the Middle Rio Grande Conservancy District.

This approach embodies a governance style akin to the old Spanish "repartimiento de aqua." It allows for equitable water distribution but conflicts with New Mexico's "Prior Appropriation" legal doctrine through which water rights are strictly ranked. The implications of these governance models are profound. Shortage Sharing fosters collaboration but dilutes the enforcement power of senior water rights holders.

A clear distinction between Prior Appropriation and Shortage Sharing is that a farmer knows where they stand in line for water in strict Prior Appropriation, while farmers who operate within Shortage Sharing are subject to sharing shortages with their neighbors.

The advantages and disadvantages of these governance models are clear: Shortage Sharing provides flexibility that can allow more water users access to limited supplies, whereas Prior Appropriation prioritizes senior rights, often at the expense of junior users. Shortage Sharing can promote collaboration, while Prior Appropriation enables water markets to move water to the highest monetary use or value. Administering by Prior Appropriation in the Middle Rio Grande is hampered by the lack of water rights adjudication, leaving Shortage Sharing as the more practical approach to achieve equitable water distribution.

State and federal agency partnerships that promote conservation play a crucial role in helping farmers overcome these obstacles regardless of the water governance method.

Consistency in funding and flexibility in macro infrastructure such as reservoirs can help water managers mitigate some of the present and future water challenges in the West and restore a measure of predictability to a way of life that has enough to worry about without thinking about how the water will get to the field.

MUNICIPAL WATER MANAGEMENT

Municipal water management in New Mexico's Middle Rio Grande valley is dominated by the Albuquerque Bernalillo County Water Utility Authority (Water Utility), supplying tap and garden water to 650,000 people. A quasi-independent government agency, the Water Utility is overseen by a board of directors made up of a mix of elected officials from the Albuquerque city and Bernalillo County governments.

The agency's water is supplied from a mix of native groundwater (water originating from within the Rio Grande Basin) and surface water that is imported to the Rio Grande via the San Juan-Chama Project, a federal trans-basin diversion that brings water across the continental divide from the Colorado River Basin. The agency's trans-basin water is stored in Abiquiu Reservoir, which is operated by the Army Corps of Engineers. Recently, the Corps has recognized its ability to store native water in Abiquiu, which presents an opportunity for more flexible use of Abiquiu. With El Vado Reservoir offline for the foreseeable future, changes in how we manage all our reservoirs will be up for discussion.

The Water Utility in its modern form is a descendant of Albuquerque's city water department, which has since the early 20th century used groundwater to supply the city's needs. Its transition to direct use of its imported San Juan-Chama water began in the 1990s with the recognition—based on US Geological Survey studies—that the community was unsustainably depleting its aquifer. That led to an investment of more than half a billion dollars to build a new surface water treatment and distribution system, which began service in 2008. In addition, Albuquerque significantly reduced its per-capita water usage from 252 **g**allons **p**er **c**apita per **d**ay (GPCD) in 1994 to 129 GPCD in 2023.

MODERN OPEN SPACE MANAGEMENT

The Middle Rio Grande's modern environmental management regime can be dated to the 1980s when the strip of land between the levees—the main river channel and its accompanying long linear gallery forest of cottonwoods—was legally declared a state park.

The decision emerged at a time of growing community environmental values, as Albuquerque and the communities around it left behind the idea of a flooding, swampy Rio Grande as a menace and embraced the river as a beloved community asset.

Administrative Structure

The park declaration created a complicated administrative structure and a park designation that was a creature of state government. The land is largely owned by the Middle Rio Grande Conservancy District, and the park is managed by Albuquerque's Open Space Division (Open Space).

A network of popular formal and informal trails developed over time, reconnecting Albuquerque to a river from which it had been cut off when the levees and drains flanking the river were first built in the 1930s.

Open Space management took a dramatic step forward following a series of devastating fires in the summer of 2003, with the city of Albuquerque investing heavily in vegetation management to thin a forest that had become overgrown—a process that continues to this day.

Beyond the urban core of Albuquerque itself, the valley's six sovereign Native American Pueblo communities were the first entities to begin environmental river and riparian restoration efforts, drawing on their deep cultural and spiritual ties to the river and the lands around it.

Responding to Endangered Species Act requirements has added not only a layer of environmental challenges (see below) but also opportunities.

The Challenges Ahead

With climate change already reducing the Rio Grande's flow while simultaneously increasing water demand, the Middle Valley's challenges are daunting.

The 1938 Rio Grande Compact places strict legal requirements on how much water is passed from Colorado in the north to southern New Mexico, Texas, and Mexico.

The federal Endangered Species Act requires protection of the endangered Rio Grande Silvery Minnow by managing flows in the river's central channel. But the significant environmental benefits that arise from this requirement come at the expense of flexibility in managing for other water management benefits and goals.

With New Mexico's Rio Grande Compact debt—referring to the amount it has underdelivered over the last decade—climbing close to a level that could trigger a violation of the Compact, the Middle Rio Grande is approaching a breaking point.

THE RIO GRANDE COMPACT

Delivery Debt

The Rio Grande Compact created a sliding scale for water deliveries—from Colorado to New Mexico, and from New Mexico to Texas. Its complex formula, in theory, should be adaptive to climate change. In wet years, each upstream state's delivery obligations to its downstream neighbors increase. In dry years, delivery obligations decrease. But over the last decade, New Mexico has found it increasingly difficult to meet its downstream delivery obligations.

In 2013, Texas brought an original cause of action against New Mexico before the United States Supreme Court. Texas claimed that New Mexico had failed to deliver the apportionment of water to which Texas is entitled under the Rio Grande Compact (Compact) by allowing excessive diversions of both surface water and hydrologically connected groundwater.

Settlement

The three Compact states have now reached a settlement agreement that will reduce water use in New Mexico and enhance Compact administration by adding a new state-line delivery gage. The United States has objected to the proposed settlement agreement as it imposes obligations on the Bureau of Reclamation to which they have not agreed. The United States also has legal claims that are not resolved by the proposed settlement agreement, which it would have to litigate in lower courts if the Supreme Court approves the settlement. The Supreme Court is considering the United States objections at the time of publication of this article.

US Objections

Overall, for the past decade, consumptive use in New Mexico's Middle Rio Grande Valley has outpaced New Mexico's Compact delivery requirements. At the end of 2023, New Mexico was running a cumulative 122,000-acre-foot debt to Texas and southern New Mexico. This Compact debt reflects the point of delivery at Elephant Butte Reservoir, which supplies southern New Mexico, Texas, and Mexico with storage releases via the Rio Grande Project. While Elephant Butte is not physically located in Texas, it represents the delivery point for compact obligations by the State of New Mexico for central

Storage Complications

and northern New Mexico water users on the Rio Grande. The Compact allows for the accumulation of debits and credits in annual accounting, but if the debt rises above 200,000 acre-feet, it could trigger a new round of Compact enforcement actions from Texas.

The debt also complicates Middle Rio Grande valley water management in the short term. When New Mexico is running a Compact debt, the pact also constrains the ability of Middle Rio Grande valley water users to store spring runoff for use that summer, after the snowmelt pulse has passed. This threatens late-summer water management not only for irrigators, who may lack sufficient water for crops, but it also complicates environmental and municipal water-use flow management.

ENDANGERED SPECIES ACT

For the last quarter century, the Endangered Species Act (ESA) has been a critical component of the Middle Rio Grande management's "three-legged stool." Irrigation and municipal uses represent one leg, and Compact deliveries have long been a second. The stool's ability to stand depends on the river itself and the multitude of species that rely on it—some of which are protected under ESA—and the adjacent riparian corridor

Protected Species

While several species in the region are listed as threatened or endangered—including the Southwestern Willow Flycatcher, the Pecos Sunflower, the New Mexico Meadow Jumping Mouse, and the Yellow-billed Cuckoo—it is the Rio Grande Silvery Minnow that has had the most profound impact on water management decisions.

Listed as an endangered species in 1994, the Rio Grande Silvery Minnow has become a critical factor in the complex balance of water allocation among the three legs of the stool.

Overbanking

To meet the ESA's requirements, water managers have developed various strategies to support the Silvery Minnow's survival and recovery. One such tactic has been the manipulation of the spring hydrograph to optimize overbanking. Overbanking occurs when the conveyance capacity of the river channel is exceeded by the flow of the river, causing water to spill onto the adjacent floodplain where valuable habitat for fish and birds is supported during spring runoff. During low runoff years, this important ecological function requires intentional flow manipulation by water managers to trigger spawning and support life cycles of the Silvery Minnow and riparian plant species. While this management approach focuses primarily on increasing minnow population numbers, it also has the secondary benefit of inundating adjacent islands, bars, and floodplains, which encourages the growth of desirable native plants that support bird habitat.

Funding

The ESA has attracted substantial state, federal, and private funding to the Middle Rio Grande, some of which support the development of programs that improve water-use efficiency in the valley. These initiatives aim to ensure that current and future water demands can be met while also making water available for environmental purposes.

Operations

Current ESA operations are governed by a Biological Opinion issued by the US Fish and Wildlife Service in 2016 that marked a significant shift in the ESA's approach to protecting the Silvery Minnow. The 2016 Biological Opinion is unique because it required water agencies to meet minnow population targets rather than setting specific river flow targets, an approach that would allow greater management flexibility. This change has encouraged a more collaborative and adaptive approach to water management, as agencies work together to balance the needs of the Silvery Minnow with other water uses in the region.

As the Middle Rio Grande faces challenges related to climate change, population growth, and competing water demands, the ESA's influence on water management will persist. By prioritizing the needs of endangered species such as the Silver Minnow, the ESA has become an essential tool in promoting sustainable water management practices and ensuring the long-term health of the Rio Grande ecosystem.

The Search for Resilience

In natural resource management, the term "resilience" is often defined as the ability of a social-ecological system—such as the Middle Rio Grande's modern agricultural-urban-ecosystem—to withstand a shock and still retain its basic structure and function.

Drought is a good example of such a shock. The Pueblo social-ecological system in the Middle Rio Grande demonstrated clear resilience to drought by farming and hunting and gathering across a range of hydrologic ecosystems to hedge risk, by storing food from wet years for use in dry, and most importantly, by living lightly on the landscape, with a small population. Their robust health in the centuries before Spanish colonization demonstrated resilience.

But a crucial corollary of resilience thinking, sometimes less appreciated given the definition above, is that shocks are sometimes sufficient to push a system to a new equilibrium—a new "basic structure and function." The shock of the Spanish *entrada* fundamentally changed the agricultural-ecosystem, pushing it to a new and more complex equilibrium, with new crops, expanded population, and difficult cultural conflicts. The expansion of European colonialism, spurred by the arrival of the railroad, shocked the system even more, pushing the existing "agricultural-ecosystem" into its modern "agricultural-*urban*-ecosystem" form.

The question now is whether the current system is resilient. Can it withstand the shock of climate change and still retain its basic structure and function? If it cannot, how might the communities of the Middle Rio Grande valley steer the system toward a desired new future equilibrium?

The answer to those questions falls in part to adaptive governance, as the many government agencies with decision-making authority struggle to adjust to the changing reality being created by climate change.

ADAPTATION AS A PATH TO RESILIENCE

Ongoing Efforts

Adaptation encompasses the strategies, actions, and initiatives undertaken by various stakeholders to enhance the system's resilience in the face of change. In the Middle Rio Grande, these adaptation efforts take many forms, from innovative water management practices and collaborative governance approaches to targeted conservation programs and infrastructure improvements. By proactively adapting to the challenges posed by climate change, population growth, and competing water demands, the region's water managers, farmers, municipalities, and other stakeholders are working to build a more resilient future for the Middle Rio Grande's unique and precious agricultural-urban-ecosystem.

This article highlights three ongoing efforts to foster resilience through adaptation in the Middle Rio Grande.

Water 2120

Supply Planning

The Albuquerque Bernalillo County Water Utility Authority's conservation programs have successfully halved per-capita use since 1995. Combined with the previously discussed shift from relying solely on groundwater to a system that now gets most of its supply from surface water imported from another basin, the Water Utility has already moved a remarkable distance down the adaptation path.

But there is more in the works. The Water Utility is pursuing a plan called "Water 2120." Published in 2016, the plan represents efforts to establish a sustainable water supply for the community for the next century. The Water Utility attempted to lay out plans for meeting future needs considering a range of population growth and climate change scenarios. The effort based the community's water management strategy on preserving a safe minimum reserve of groundwater, to be available to meet community needs under "black swan" scenarios in which surface water was completely unavailable. The ongoing work covers a range of adaptation strategies, including aquifer storage and recovery, stormwater capture, and expansion of wastewater reuse for turf.

Pilot Conservation Program: Adapting to Variability through Collaboration and Innovation

Irrigated Acreage

In the agricultural irrigation sector, the MRGCD has pioneered an effort to reduce irrigated acreage through compensated temporary fallowing, shifting the conserved water strategically to habitat in the Rio Grande's main channel. The program, which began in 2019, is a partnership with Reclamation and the National Fish and Wildlife Foundation.

Fallowing Program

Temporary fallowing of agricultural lands in exchange for a per-acre lease payment was a new concept when launched. So, too, was the idea that MRGCD was looking to extend technical and financial support to individual farms and fields, in essence "crossing both the proverbial and physical fence line" to improve the efficiency of on-farm infrastructure. These efforts required trust, consistent messaging, and innovative partnerships. The result of the fallowing and on-farm improvements in the MRGCD has been the ability to provide the conserved water at critical locations along the river where habitat has been created or where known pockets of endangered species exist. This water serves a limited yet vital role in bridging flows between the tail end of spring runoff and monsoon rains in the late summer and fall.

Partnerships

The program has received recognition from many local partners and farmers as a viable path forward for balancing agricultural and environmental water use in the valley. This unlikely nexus has also brought about new partnerships in the non-profit sector. MRGCD and Audubon have worked collaboratively since the inception of the program to identify, improve, and monitor outfall habitat sites within the valley. Where MRGCD has expertise in moving water to these habitat features, Audubon and its contractors bring decades of experience in developing habitat plans and adaptive management frameworks.

The Rio Grande

Results

Since 2019, the program has seen a steady expansion of restored habitat at managed outfalls and a shift in the narrative from farmers. Through consistent messaging and trust-building, the program is now largely viewed as an asset or tool in a farmer's larger portfolio. Through temporary voluntary fallowing, a farmer does not have to make the hard choice of planting every acre. Rather, a farmer in the middle valley can work with MRGCD staff to understand annual water supply conditions and scale their operation in a way that suits their current needs.

In 2024, the program will return an estimated 6,500 acre-feet of water to seven environmental outfalls designed to provide precisely measured flows to key spots in the Rio Grande to maximize environmental benefits.

By providing on-farm improvements that provide a cost share to farmers for water conserved, the narrative that conservation programs want to kill farming is being rewritten.

Collaborative Program

Minnow Action Team

When the Rio Grande Silvery Minnow was listed as endangered by the US Fish and Wildlife Service in 1994, the tiny fish was simultaneously revered by environmentalists and feared by water users.

Some environmentalists saw the Silvery Minnow as a tool to ensure the river would not dry within the fish's current range from Cochiti to Elephant Butte Reservoirs. Other water users were deeply concerned about the potential taking of their water rights in favor of the needs of the Silvery Minnow. July 2024 marks the 30-year anniversary of the Silvery Minnow's ESA listing, and it is fair to say that neither expectation has been realized. River drying in some stretches of the valley is a fact of life for Middle Rio Grande water managers, and all water rights have been fully upheld and honored.

Federal money and water imported from the Colorado River Basin through the San Juan-Chama project have made the difference, keeping some stretches of the river flowing with leased San Juan-Chama water and providing funding for large-scale habitat restoration projects.

One of the most salient outcomes of the Endangered Species Act in the Middle Rio Grande has been the overall improvement in water management coordination and communication. Formed in 2002, the Middle Rio Grande Endangered Species Collaborative Program (Collaborative Program) is a partnership of federal, state, and local governmental entities, Indian Tribes and Pueblos, and non-governmental organizations that aims to protect and recover federally listed species in the Middle Rio Grande. While the Collaborative Program has experienced growing pains, today, the Executive Committee is effective and includes a broad representation of water managers focused on ecosystem health that would not collaborate at such a scale were it not for the ESA.

Communication Groups

Nested alongside the Collaborative Program are two communication groups that have played a critical role in the effectiveness of both water and species management in the Middle Rio Grande: the "Minnow Calls" and the "Minnow Action Team." As water supply diminished in the early 2000s, river drying became an annual recurrence despite extensive efforts by Reclamation to acquire and manage supplemental water for the Silvery Minnow. To effectively manage the river during times of scarcity, regular "Minnow Calls" were established to coordinate water management among a broad group of managers and discuss options for meeting all water needs within a given year's limitations. As scarcity has become the new normal, these often-daily calls serve to not just limit damage to the minnow but also coordinate all aspects of water delivery and management throughout the network of reservoirs and diversions associated with the Middle Rio Grande.

Action Team

The "Minnow Action Team" (MAT) is a group that advises water managers at the onset and, at times, during the water year as to how to effectively manage limited water supplies and resources. The MAT comprises agency scientists and on-the-ground water managers and has adopted an "outside the box" mindset through the years, providing many effective and innovative strategies for water and ecosystem management. The Minnow Calls and the MAT provide vital communication and host brainstorming events that benefit all water users within the Middle Rio Grande.

POLYCENTRIC GOVERNANCE AND "OTHER PEOPLE'S MONEY"

Both the fallowing program and the related ESA management efforts reflect the reality of what must be done to manage complex river basin systems with many players and no single central authority. Such governance requires a mix of formal and informal structures to create the framework for decision-making along with informal networks of social capital and shared knowledge, combined with the more formal management decision structures.

Both programs also reflect a sometimes concerning reality about US water management under the pressure of climate change—the need for federal spending, what water economist David Zetland referred to as "other people's money," to keep the system whole.

Future Adaptation Efforts

While the above ongoing adaptation efforts show promise, New Mexico's growing Compact debt, the perilous status of the Rio Grande Silvery Minnow, the declining health of the bosque forest flanking the river, the growing urban population, and the struggles of the valley's farmers all suggest more action will be needed. The following are options being discussed to address these challenges:

- Reservoir re-operations: Changes to the rules regarding whose water can be stored where and when, and for what purposes, in upstream dams. Conjunctive management of the Middle Rio Grande's reservoirs (Heron, El Vado, Abiquiu, and Cochiti) would add flexibility to a multi-reservoir storage system that is, at present, highly constrained by Corps operating rules established decades ago.
- Domestic wells: Wells owned and operated by individual homeowners are unregulated. There are more than 10,000 such active wells on the Rio Grande valley floor in the greater Albuquerque urban area alone, each permitted to pump an acre-foot or more of water per year. This represents a substantial source of water use that has not yet been factored into the valley's water management discourse.
- New broad water planning efforts recently authorized by the New Mexico legislature and being carried out under the auspices of the New Mexico Interstate Stream Commission.
- Settlement of unquantified Native American water rights, which could create clarity about water entitlements in the Middle Valley.
- Aquifer storage and recovery, which, while widespread in much of the western United States, is little practiced in New Mexico.
- Water conservation programs that reduce consumption equitably across domestic, commercial, municipal, and industrial use, as well as irrigated agriculture (the system's biggest water user).
- Modernizing and adapting the state's legal management framework. New Mexico already has a culturally robust water management system, including a long history of shortage-sharing. The state water code could be modified to reflect this system more accurately for easier implementation in times of shortage.

HOW MIGHT THE SYSTEM BREAK?

One of the challenges of resilience thinking is imagining the failure mechanisms. How might the system break in ways that leave it unable to adapt and retain its basic structure and function? In the case of the Middle Rio Grande valley, we see four ways, which are interrelated.

1: A Compact Crisis

Central New Mexico's quickly growing Rio Grande Compact debt to its downstream users in southern New Mexico and Texas could lead to storage restrictions in New Mexico, the release of water from New Mexico reservoirs at the call of Texas, or more interstate litigation, all with unpredictable consequences. Existing governance mechanisms have, so far, proven incapable of managing the rapidly growing problem, with a lack of tools to force human communities to reduce their use, and no clear tools for reducing non-human consumptive use through evaporation and water use by riparian vegetation along the river corridor. This presents an opportunity to rethink and redesign existing infrastructure—both natural and built—to deliver multiple benefits, including meeting Compact delivery obligations; sustaining fish, plants, and wildlife; and supporting irrigated agriculture. But it also presents a governance challenge, with state and local agencies bearing the obligation to meet Compact delivery obligations, while the responsibility for much of the infrastructure falls to the federal government.

The alternative, interstate litigation over river compacts, would have profound, and profoundly unpredictable, effects.

2: The Endangered Species Act

Litigation under the ESA has simmered in the Middle Rio Grande valley since the Rio Grande Silvery Minnow was formally designated as "endangered" in the 1990s. While it has never reached the point of restricting human communities from withdrawing water from the river, it could.

This would have complex and unpredictable effects on farming and municipal use, with lawyers on all sides armed with reasonable arguments for why their water use should not have to be cut, and not enough water to sustain their clients' levels of water use should they all succeed with their arguments.

But beyond the Silvery Minnow itself is the reminder that in the 1973 Endangered Species Act, Congress called out the importance not just of protecting individual species but also "the ecosystems upon which endangered species and threatened species depend." Regardless of the legal path—litigation or not—the loss of the Silvery Minnow and the collapse of the riverine ecosystem on which it depends would represent a profound resilience failure and a fundamental change in the structure and function of the system.

3: Loss of Irrigation

Attend each monthly meeting of the publicly elected board of the Middle Rio Grande Conservancy District, as several of the authors do, and you will hear farmers expressing anguish as they operate on the edge of what is possible with their dwindling irrigation supplies.

Cultural Impact

Given the fraction of the Middle Rio Grande Valley's economy that comes from farming, the economic impact of the loss of farming would be small. But the cultural impact would be profound, as would the unraveling of the agricultural-ecosystem that spread across the valley floor over the last century to replace the pre-development meandering river's flood plain. In the 21st century, the green space provided by this system has become an important community asset, providing respite from the urban heat island effect and values associated with modern city life. It may not have the same legal status as the ESA has conveyed to the Silvery Minnow and its endangered kin, but the water flowing through centuries-old ditches also represents a threatened ecosystem.

4: Polarization and Discord

As water supplies shrink and challenges grow, there is a risk that efforts to manage the change could lead to polarization and discord in classic "urban versus rural" or "cities/farms versus the environment" conflicts that have so often been seen across the western United States.

Competing Needs

This risk can be clearly seen in the disconnected sets of institutional responsibilities resulting from the governance structures that evolved to manage water in times when there was enough—municipal agencies have the responsibility to get water to their customers' taps; an agricultural agency is responsible for getting water to irrigators' headgates; state and federal agencies have their own narrow and specific goals for flood control, river channel maintenance, and management; and ESA protections must be in place. No one has overall authority over the whole thing, and we succeed or fail based on the cooperative efforts of those involved in that disconnected system.

In working to overcome this challenge, we are reminded of the words of the late Wallace Stegner:

> One cannot be pessimistic about the West. This is the native home of hope. When it fully learns that cooperation, not rugged individualism, is the quality that most characterizes and preserves it, then it will have achieved itself and outlived its origins. Then it has a chance to create a society to match its scenery.

A Call to Action

Funding

Communities in the Rio Grande Basin are poised to undertake large-scale water conservation and watershed restoration initiatives to tackle the growing challenges of climate change, aridification, and water scarcity. The New Mexico Legislature has appropriated unprecedented funding in recent years for infrastructure improvements in the Middle Rio Grande—$13 million in 2023 alone—and local governments, tribal sovereigns, and nongovernmental organizations have secured tens of millions of dollars in federal grants from Reclamation's WaterSMART Community Watershed Management Program and similar programs. But these well-intentioned investments are falling short: they are not building resilience fast enough or at a large enough scale, as evidenced by the systems' stresses and disruptions described above. Despite the flow of federal funds from the Bipartisan Infrastructure Law and Inflation Reduction Act, they fall short of addressing the true scale, urgency, and need for enhancing water security in the region.

Strategic Plan

To be resilient to the water supply declines and disruptions anticipated in recent scientific studies—such as the New Mexico Bureau of Geology's recent assessment of climate change effects on water resources—significant federal, state, local, and private sector (philanthropic and corporate) investment is crucial. We call on these actors to devise a strategic plan aimed at accelerating and expanding locally driven water security efforts in the Rio Grande Basin. This plan should maximize available drought mitigation funding from the Inflation Reduction Act, along with resources from the Bipartisan Infrastructure Law and other relevant federal authorities. An example of such a plan is the Yakima Basin Integrated Plan (YBIP), a 30-year resilience plan produced by "state, federal, tribal, business, and community organizations committed to addressing water, fishery, habitat and climate variability challenges to ensure a robust Yakima River Basin within its built and natural systems." The YBIP's 2020 financing plan includes full development costs of $4.1 billion, with an initial development phase totaling $953 million for strategic investments in watershed protection, habitat management, surface water and groundwater storage, structural and operational changes, enhanced water conservation, market-based water reallocation, and planning.

Other examples of basin-wide coordinated efforts that leverage resources and funding to accelerate the pace of water conservation and watershed restoration include:

The Rio Grande

Coordinated Efforts

- Chesapeake Bay Program
- Coalition for the Delaware River Watershed
- Great Lakes Restoration Initiative
- League to Save Lake Tahoe
- Puget Sound Partnership
- Multi-state initiatives of the Upper Colorado River Commission, including the System Conservation Pilot Program.

The Middle Rio Grande is a vital river basin facing water scarcity, ecological and economic disruption, and other threats driven by climate change and attendant aridification of the southwest US. Substantial and coordinated federal investment in the region would bolster water security, mitigate risks to communities and agriculture, and perhaps spur similar efforts across the whole three-state, binational Rio Grande Basin. As with the Yakima Basin Integrated Plan, the costs of such an integrated, large-scale resilience initiative could be shared by organizations that participate in polycentric governance, including the subbasin's tribal sovereigns, the State of New Mexico, county governments, the Albuquerque-Bernalillo County Water Utility Authority and other municipal water providers, the Middle Rio Grande Conservancy District, the City of Albuquerque, highly water-dependent corporations such as Meta and Intel, and local philanthropic and charitable organizations.

Challenges & Opportunities

Decades of well-intentioned but increasingly ineffective water management policies and practices and imminent shifts in climate regimes are creating unprecedented challenges to water governance in the American Southwest. This moment, when the Bipartisan Infrastructure Law, Inflation Reduction Act, and state budget surpluses offer unprecedented resources for climate adaptation and environmental justice, offers a once-in-a-lifetime opportunity to plan for resilience and invest in a secure water future for "the native home of hope."

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Casey Ish was born and raised in Santa Fe, New Mexico. He holds a bachelor's degree from the University of New Mexico in Fresh Water Conservation and Management and a master's with concentrations in Water and Natural Resource Law from the University of New Mexico's School of Law. Prior to working at the Middle Rio Grande Conservancy District, he worked for a private lake and stream consulting firm in Albuquerque. Casey has been with the Middle Rio Grande Conservancy District since 2019 and is currently their Conservation Program Supervisor.

Patrick McCarthy is the Water Policy Officer at the Thornburg Foundation and leads initiatives to modernize water management in New Mexico. As head of the Water Initiative, he oversees grantmaking and forges partnerships with public agencies, nonprofits, and academic institutions. Patrick's journey began as a Peace Corps Volunteer in central Africa, shaping his dedication to conservation and community engagement. His efforts focus on advancing scientific research, policy reforms, and fostering equitable access to water resources.

Adrian Oglesby is the Director of Utton Transboundary Resources Center at the University of New Mexico. Adrian's legal career has been focused on river and riparian restoration, agricultural preservation, efficient water management, and governmental accountability. He has advised irrigation districts, acequias, Pueblo and tribal governments, farmers and ranchers, environmental organizations, and local water providers.

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Lake Levels

GREAT SALT LAKE WATERSHED ENHANCEMENT TRUST

A TOOL TO ADDRESS GREAT SALT LAKE DECLINES

Introduction

Great Salt Lake—the largest saline lake in the Western Hemisphere—is an essential and irreplaceable ecosystem facing crisis.

Climate change, drought, population growth, and increased water diversions have all contributed to a steady downward trend in lake levels. In November 2022, the lake reached the lowest level ever recorded (Utah Department of Natural Resources). In turn, salinity in the South Arm of the lake peaked at ecologically detrimental levels. Management actions taken by the State of Utah, combined with a record-breaking snowpack in 2023 that raised lake levels, temporarily averted a disaster (Executive Order 2023-02). Lake levels have continued to benefit in 2024 from increased runoff. But thoughtful planning and preparing for the next record lows is critical for the future of Utah's economy, environment, and livelihood.

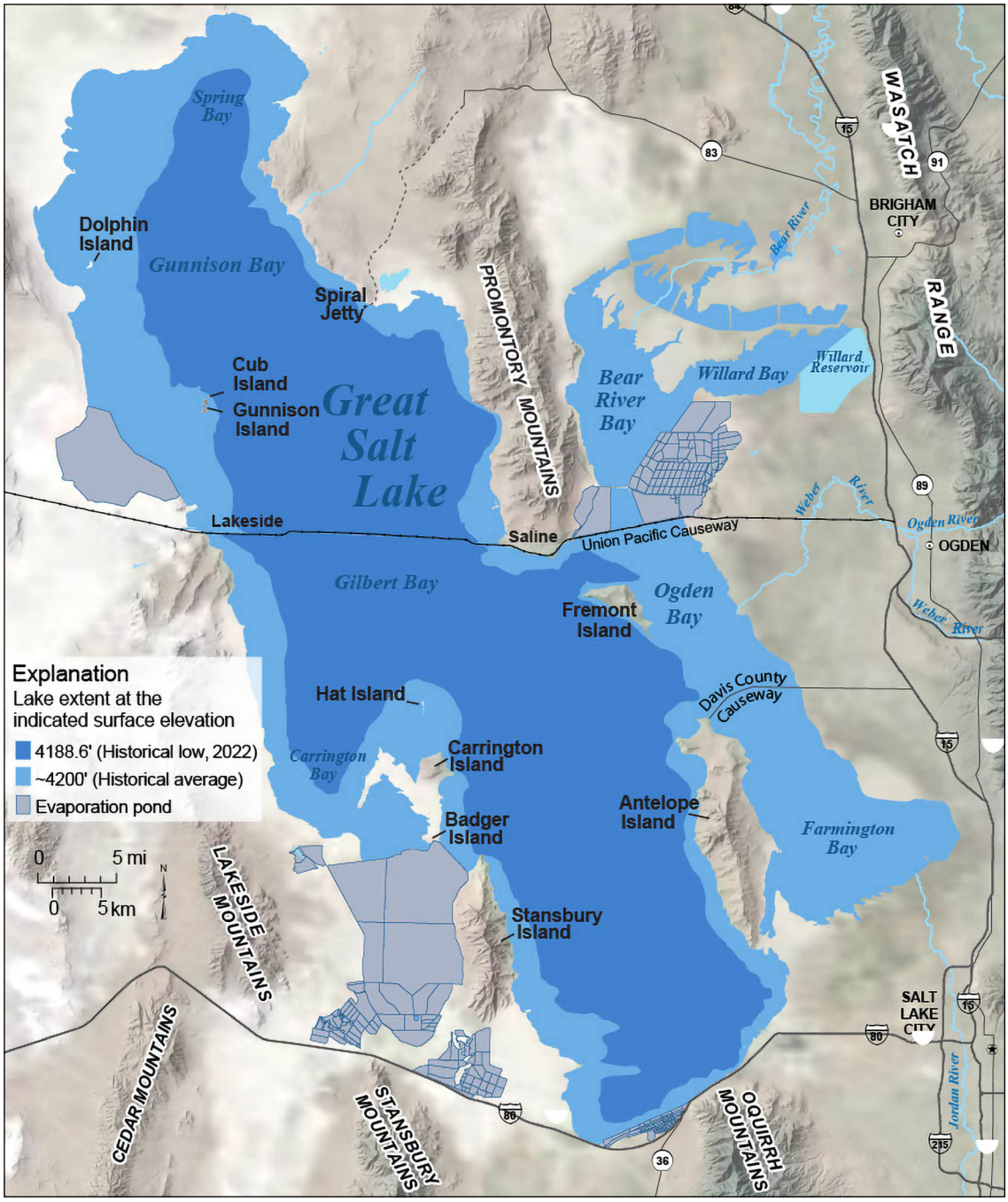

Figure 1. Map of Great Salt Lake (Source: Utah Geological Survey, modified from Clark and Baxter, 2022)

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From the tens of millions of migratory shorebirds that depend on the lake as a main stopover in the Pacific Flyway to the international dependence on the lake for the supply of brine shrimp cysts for aquaculture, and the lake's contribution to the Wasatch Front snowpack, the serious decline of Great Salt Lake threatens to disrupt systems at local, state-wide, regional, and even hemispheric levels.

Legislation

In 2022, as part of a multifaceted effort to protect the lake, the Utah Legislature passed The Great Salt Lake Watershed Enhancement Program Act (the Act) (Utah Code, Title 65A, Part 16), authorizing $40 million to establish a water trust to enhance Great Salt Lake water quantity and quality and protect and restore wetlands in the surrounding ecosystem to benefit the lake's hydrology.

Water Trust

Following a 60-day application period, the Utah Division of Forestry, Fire, and State Lands (FFSL) selected National Audubon Society's Saline Lakes Program (Audubon) and The Nature Conservancy in Utah (TNC) as grantees of the $40 million (State Grant Money) to use their organizations' expertise and experience to create and jointly manage the water trust. Audubon and TNC designated the Community Foundation of Utah to act as the independent fiduciary to hold the State Grant Money for the trust.

Water Transactions

The Great Salt Lake Watershed Enhancement Trust (GSLWET or Trust) was formally established in January 2023. The Trust's mission is to help preserve the irreplaceable wetlands and waters of Great Salt Lake by fostering collaborative partnerships and innovative water projects for the benefit of people and wildlife. The bulk of the Trust's work is focused on water transactions that bring new water flows to the lake and sustain crucial existing water flows, as well as protecting and restoring wetlands and habitats that also benefit the hydrology of Great Salt Lake.

In just a short time, through the leadership of Audubon and TNC, the Trust's success in facilitating water transactions to benefit the lake and contributing to the security of Great Salt Lake's wetlands and habitat has set a precedent for collaborative and creative problem-solving in the face of the West's unsure water future.

Tackling challenges as complex as those pertaining to Great Salt Lake requires expertise and dedication from a broad range of organizations and experts. The Trust works alongside the numerous other efforts underway to preserve Great Salt Lake.

Representation

The Trust co-managers receive guidance from a nine-member Advisory Council, which includes representatives in the following categories as designated in the Act:

- Agriculture
- A private landowner adjacent to Great Salt Lake
- A conservation organization dedicated to the preservation of migratory waterfowl
- A conservation organization dedicated to the protection of non-game avian species
- A conservation organization working on Great Salt Lake issues
- Aquaculture
- Mineral extraction
- Water conservancy district
- Wastewater treatment facilities

These representatives were selected by FFSL in consultation with the Great Salt Lake Advisory Council (GSLAC) and the Utah Division of Water Quality (UDWQ). Current members can be viewed on the Trust website (https://www.gslwatertrust.org/advisory-council).

The Trust works closely with its Advisory Council, the Great Salt Lake Commissioner, FFSL, and the Utah Department of Wildlife Resources (DWR) to increase and amplify the impact of coordinated efforts ensuring maximum efficiency in solution-oriented work. The Trust continues to build on partnerships with state agencies and local governments, as well as key water users such as agricultural producers, irrigation and canal companies, municipal and industrial users, and increase its outreach to communities, Tribes, and wetland managers.

Grant Program

Such efforts have led to a $10 million grant program to support the lake's wetlands administered by the Trust, designing a five-year strategy to ensure success into the future, and the largest-ever permanent water donation to Great Salt Lake.

In its first year of operation, the Great Salt Lake Watershed Enhancement Trust made significant progress toward its mission, proving how effective the program is and establishing it as an integral effort for the protection of Great Salt Lake and a successful case study that can be replicated and adapted for other vulnerable ecosystems across the nation.

Great Salt Lake Ecosystem and Impacts

Great Salt Lake and its surrounding wetlands are an invaluable resource and are seen as an ecological cornerstone, a landmark of cultural and spiritual heritage, a recreational refuge for surrounding communities, and an important economic engine.

GSLWET

Ecologically, the importance of the lake cannot be overstated. Each year, more than 10 million birds—338 species—utilize Great Salt Lake and its associated wetlands and uplands. As many as 5 million Eared Grebes visit Great Salt Lake (and, at times, 50 to 90 percent of the total North American population are found there), as do more than 600,000 Wilson's Phalaropes (the largest staging concentration of that species in the world, representing more than a third of the global population) (Utah Division of Wildlife Resources 2023).

Food Web

These birds are highly dependent on the complex food web of the lake and its wetlands that provides an abundance of phytoplankton, macroinvertebrates, insects, and hydrophytic vegetation. Under normal conditions, the salinity conditions in the lake's South Arm (Gilbert Bay) are optimal for a robust brine shrimp and cyst population, which is sustainably harvested under a DWR management program. Calcified microbialite formations in the South Arm sustain algae mats that feed both brine shrimp and brine fly larvae. Eared Grebes spend weeks at Great Salt Lake during their fall migration, feasting on brine shrimp to fuel their energy needs for their flight south. During this period, Eared Grebes become particularly vulnerable as their feathers molt and their flight muscles atrophy, making them temporarily unable to fly. Brine flies are the primary source of food for Wilson's Phalaropes during their fall migration (2022 National Audubon Society). As lake levels decline, salinity levels rise, and algae mats on exposed microbialites become desiccated, affecting food resources for brine fly larvae, which impacts the viability and reproductive ability of the brine shrimp population. Consequently, the high salinity levels in 2022 put the South Arm of Great Salt Lake at risk of an ecological collapse.

The need to protect these birds and the habitat they depend on is greater than ever. We've lost 3 billion birds across North America since 1970, including many from species that depend on Great Salt Lake (Mock 2019, Audubon Magazine).

Water Cycle

Great Salt Lake also plays an important role in the Utah water cycle. Evaporation from Great Salt Lake increases the moisture content of storms moving across the state that have come in from the Pacific Ocean. When these storms hit the Wasatch Range, the moisture moves upward and cools, causing precipitation known as "lake effect" snow (Utah Geological Survey). Lake effect snow can provide 5–8 percent of the base snowpack (Utah Division of Water Resources), which is critical, as snowpack provides 95 percent of Utah's water.

Snowmelt

Utah's population depends on the natural timing of the snowpack melting throughout the drier seasons to provide water year round. As lake levels decline and more of the lakebed is exposed, the snowpack is at risk of melting faster as storm systems pick up exposed dust and deposit it on the surface of the snow. The dirtier snow absorbs more of the sun's rays, resulting in a faster melt. In 2022, Great Salt Lake experienced the most dust deposition events ever recorded in the Wasatch Front and the highest snowpack dust concentrations of any year since observations began in 2009. These events resulted in the snowpack melting 17 days earlier (Lang et. al 2023). Declining lake levels combined with increased dust deposition have the potential to create a feedback loop that will only quicken the pace at which Utah's water resources diminish, thus creating an ecological disaster.

Economic Impacts

The disaster could reach beyond ecological impacts because lake effect snow also plays a key role in the economy of Utah. The state is often celebrated for having "the greatest snow on Earth," which has made the ski industry (and two Winter Olympics) possible. The ski industry alone generates $1.2 billion annually and sustains 20,000 jobs (State of Utah 2024), but it is not the only sector of the economy that benefits from a healthy lake. Great Salt Lake contributes approximately $2 billion to Utah's economy each year, supporting over 7,700 jobs (State of Utah 2024). Many industries, for example, the magnesium industry, are dependent on a healthy lake ecosystem. Great Salt Lake produces all the primary magnesium in the United States and 14 percent of the global supply. It also produces 40 percent of the world's supply of brine shrimp cysts, which are marketed internationally as an essential food source for aquaculture operations (Utah Department of Natural Resources).

The benefits of the lake and the systems dependent on the lake are not new. Long before Utah attained statehood, Great Salt Lake contributed to the survival of Native American tribes and hundreds of plant and wildlife species. However, since 1847 when lake levels began to be recorded, this crucial ecosystem has experienced drastic changes.

As the lakescape transformed, attention turned to the fate of Owens Lake—a saline lake in California that had suffered water depletion due to diversions to Los Angeles until the entire lake was dry—as a cautionary tale. As a result of the drying of Owens Lake, dust storms plagued the area, impacting the health of the surrounding communities and far beyond as it became the largest single source of dust pollution in the nation (Reheis 2019, U.S. Geological Survey).

The cost of remediation efforts to reduce the dust levels at Owens Lake has already exceed $2.5 billion (LADWP News)—a cost that could be low compared to what Utah might have to spend should Great

GSLWET

Remediation Costs

Salt Lake suffer a similar fate. One study by the State of Utah estimates dust mitigation costs will reach a minimum of $1.5 billion in capital costs with ongoing annual maintenance of $15 million if current conditions continue. Mitigating negative environmental impacts can be more costly than investing resources to prevent these crises and may not even result in the complete restoration of the preexisting services and benefits. Those estimated costs skyrocket if the affected surface area exceeds predictions. Beyond these direct financial costs, the ecological impacts are more difficult to quantify but may have far-reaching impacts if protected birds become adversely affected, which would initiate a federal response. Simply put, low water levels could damage Utah's public health and environment and threaten billions of dollars in economic activity (Identifying and Mitigating Critical Vulnerabilities in Utah).

With lake levels in decline and air quality ranking as one of Utahns top priorities, the State hired Dr Kevin Perry, an atmospheric scientist at the University of Utah, to determine the contents of the dust coming off Great Salt Lake's dry lakebed. After two years, Dr Perry determined that the dust was not only a source of pollution but it also released toxic chemicals such as arsenic and heavy metals into the air (Perry et al. 2019).

Prevention

If lake levels continue to decline, more lakebed will be exposed, leaving these concentrations of toxic heavy metals at risk of being picked up during weather events such as windstorms, impacting the health of the 80 percent of Utah's population that live downwind of the lake (Milman 2023, The Guardian). At a greater scope, all Utahns are at risk, as this dust will be deposited by wind onto the Wasatch Mountain snowpack, resulting in earlier snowmelt and polluted water sources (Potter et al. 2023). Since this has the potential to affect public health, in addition to the ski industry and other economic impacts, there is a shared sense among Utah residents and state leaders that maintaining water levels for a healthy lake is much more desirable than engineered dust mitigation.

Voluntary Water Transactions Benefit Great Salt Lake and its Wetlands

The increasing demand on limited water supplies throughout the state, as well as declining water levels at Great Salt Lake, have focused attention on a range of actions and policy changes to increase ways in which water could be conserved and water sharing arrangements could be implemented. Over the last five years, the pace of water policy change has been remarkable. Efforts have included a wide range of programs such as unprecedented funding to incentivize water conservation, promote agricultural water optimization, integrate water and land use planning, and increased flexibility for temporary, voluntary, and locally directed water leasing arrangements.

Beneficial Use

In Utah, "the basis, the measure, and the limit of all rights to the use of water" is beneficial use (Utah Code Ann. § 73-1-3). Utah courts hold that beneficial use depends upon the circumstances of the specific use and is not a static concept. Beneficial use may be modified over time as science and social values evolve (Utah case law). How and whether water could be put to beneficial use in Great Salt Lake was a question that was not fully resolved until recently. In 2021, Audubon and TNC—partnering with DWR, Rio Tinto Kennecott, Central Utah Water Conservancy District, and the Utah Reclamation Mitigation Conservation Commission—facilitated two fixed-time water donations of up to 21,313 acre-feet of water for Great Salt Lake. These multi-year fixed-time transactions relied on existing legal authorities that allowed DWR to place water to use for public benefit, wildlife, and recreation purposes in certain areas of Great Salt Lake that DWR co-managed with FFSL. These transactions were an important step in proving the concept that water could be beneficially used and delivered to the lake and were often used to illustrate how a water trust for Great Salt Lake might work.

Donation Transactions

In 2022, Utah's water law was amended to expand the scope of "instream flow" provisions to allow water to be beneficially used in the entire Great Salt Lake below the meander line (Utah Department of Environmental Quality Water Quality 2023). The instream flow modifications expanded the tools available and the potential partnerships that could deliver water to Great Salt Lake.

Through the end of 2023, Audubon, TNC and the Trust partnered with the State of Utah's FFSL and DWR, facilitating transactions, providing transaction costs, and contributing funding to water transactions of approximately 64,000 acre-feet on a diversion basis. The bulk of this water was donated, including the largest-ever permanent donation of water to Great Salt Lake from the Church of Jesus Christ of Latter-day Saints (Church). The Church donated 5,700 water shares, or up to approximately 20,000 acre-feet of water, to the lake permanently, setting a precedent for other large water rights holders to donate, lease, or sell shares for the lake.

Approximately 33,000 acre-feet of water is associated with the previously established large multi-year donations from Rio Tinto Kennecott and Central Utah Water Conservancy District, as well as an additional donation by the Jordan Valley Water Conservancy District. Single-year transactions for 2023 amounted to approximately 10,000 acre-feet. However, only 2,418 acre-feet of that amount was

GSLWET

ultimately available for delivery in 2023. The baseline for GSLWET water transactions beginning in 2024 includes up to 54,000 acre-feet of water (on a diversion basis) for the lake, a result of GSLWET's water transactions and the work of their partners (*see* Figure 2).

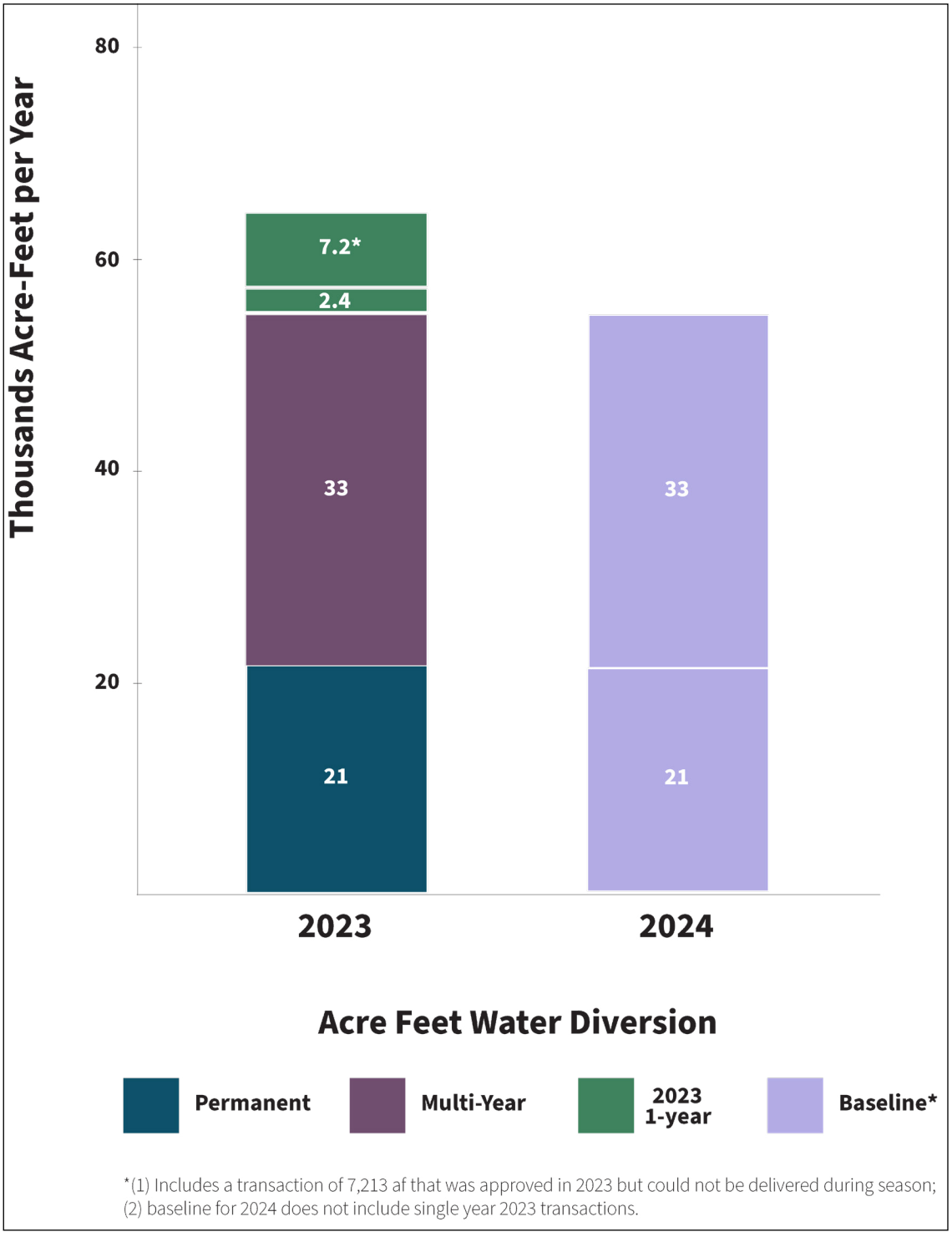

Figure 2. GSLWET Water Transactions

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Key to these water transactions are the partnerships, generous contributions of water, time, expertise, and coordination by Utah Division of Wildlife, FFSL, Weber Basin Water Conservancy District, Utah Reclamation Mitigation Conservation Commission, Irrigation Companies, and Duck Clubs in addition to the parties named above. In 2024, the Trust will continue to prioritize these partnerships, as well as expanding the relationships to more water users and water experts including agricultural producers who are key partners in the stewardship of Utah's water resources.

Ag Optimization

Policy changes in recent years provided $200 million in funding directed at optimizing agricultural water use to promote water conservation and clarified the process for the State Engineer to quantify and certificate "saved water" from agricultural optimization projects (Title 73. Water and Irrigation). This program presents opportunities to leverage Trust or other environmental flow funding for saved water and instream flow projects at the lake or across the state. The Trust is also focused on enhancing and increasing the hydrological benefits provided by agriculture to the Great Salt Lake watershed, such as return flows and associated habitats for species during irrigation season.

Having GSLWET in place to navigate the complexities of leasing or donating water rights and communicate with the necessary state agencies to finalize the agreements has made the process of securing water flows attainable and repeatable, giving many Utahns the opportunity to contribute to the future of Great Salt Lake at a level not previously possible.

Wetlands

Great Salt Lake and the variety of surrounding wetlands are an essential intertwined ecosystem that supports economic, ecological, cultural, and public health benefits. The wetlands surrounding Great Salt Lake provide crucial habitat for millions of migratory birds, flood control, water quality improvement, recreational opportunities, and they help maintain important connections that contribute water to Great Salt Lake and, therefore, quality of life for surrounding communities. Any thorough effort to stabilize and revive Great Salt Lake must also include a focus on the health and longevity of its associated wetlands.

Funding Allocation

The Act provides that no less than 25 percent of the awarded funding to the Trust be used "to protect and restore wetlands and habitats in the Great Salt Lake's surrounding ecosystem to benefit the hydrology of the Great Salt Lake."

On July 19, 2023, just seven months after its formal launch, GSLWET opened an application process for "Wetlands Protection and/or Restoration Projects." Up to $10 million was made available for such projects, depending on the number and quality of applications received. Projects supported through this effort will help to build long-term resiliency for these wetlands, particularly in the face of drought and climate change.

Project Types

To be eligible, projects had to be located within the surrounding Great Salt Lake ecosystem, which for the grant program was characterized as within 7 miles distance of the Great Salt Lake meander line. However, projects outside that 7-mile boundary were eligible if the applicant could demonstrate the project could benefit lake hydrology. Eligible project types were broken into two categories:

1. Wetland Protection, which refers to upland and wetland conservation easements or land protection that prevent the further degradation or disappearance of any existing variety of wetlands, and which benefits the hydrology of Great Sale Lake.
2. Wetland Restoration, which refers to activities that improve, restore, or establish the hydrological and ecological functions of wetlands and connected habitats. Activities can include those that restore the hydrological connectivity between wetland habitats and Great Salt Lake or otherwise facilitate water flows into wetlands and Great Salt Lake.

Applications underwent a thorough process of eligibility review and scoring by a Technical Review Committee made up of Great Salt Lake ecosystem experts. Project proposals ranged from infrastructure projects designed to improve water control structures for managing wetlands, thereby allowing for efficient delivery of water to the wetlands and Great Salt Lake, to long-term land protection efforts that will secure and enhance wildlife habitat in wetlands and dedicate water rights to wildlife and the lake. The projects also included water measuring improvements that will not only provide water flow data to wetland and water managers but also improve the ability to measure water conveyed to the lake.

Awards

Final award decisions were made by members of the Trust Advisory Council, and it was announced in October 2023 that eight projects from local, state, federal, and non-governmental entities were awarded a total of $8,525,343 in funding over the next two years to protect and/or restore wetlands and benefit the hydrology of Great Salt Lake. Applicants and partners are providing at least $6.5 million in matching contributions for these projects, which will be implemented in the next two years.

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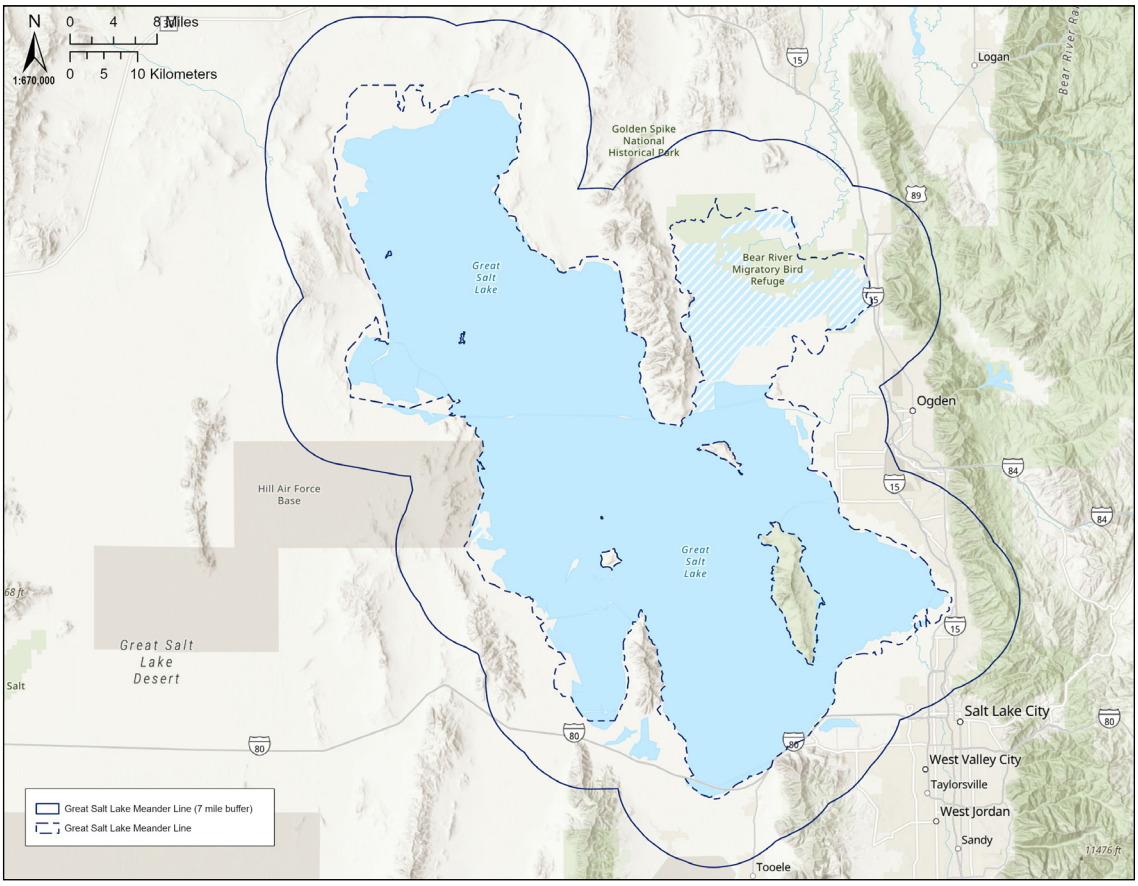

Figure 3. Great Salt Lake and the 7-mile meander line

Spread across the eastern and southern shores of the lake, the wetland projects will have impacts that will be long-lasting and significant for the wildlife that depend on the health of wetlands ecosystems. Anticipated wetland project benefits include both hydrologic benefits and wetland services.

Hydrologic Benefits

Anticipated hydrologic benefits of the wetland projects include:

- Improved water conveyance
- Protected and additional water flows
- Improved monitoring measurement

Wetland Services

In addition, anticipated wetland services from the wetland projects include:

- Protected and created wetland habitat
- Enhanced water filtration and water control to improve habitat
- Treating invasive species (including phragmites) that impact water loss and habitat

These grants have also fostered a widespread sense of collaboration and interest in future wetland funding opportunities that the Trust may make available. For more details on the wetland project grants, visit the Trust website.

The Watershed Web

State agencies, nonprofits, and even individuals are all working diligently to secure the lake's future. These various efforts often intertwine and impact each other intentionally and unintentionally. Since its founding, a key component of the Trust's success has been its dedication to partnerships within this web.

Partnerships

The Trust is focusing on developing strong relationships with key water users and providers such as agricultural producers, irrigation and canal companies, municipal industrial users, wetland managers, and government agencies such as the Utah Department of Natural Resources (DNR) as well as local governments. In addition, both Audubon and TNC have advocated for, and continue to support, the inclusion of Tribes in efforts to protect and manage Great Salt Lake.

Through these partnerships, the Trust works to ensure that mitigation and conservation efforts build on and support one another. This can already be seen through the Trust's funded wetland grant projects.

Beyond water depletion, there are many other factors putting the health and existence of Great Salt Lake's wetlands at risk. FFSL's Lands team has been working on the ground to address the removal of

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Figure 4. Wetland Restoration & Protection Grant Locations

Phragmite Mitigation

phragmites, an invasive species that has colonized significant areas of the wetlands, resulting in further habitat loss for migratory birds and other species (Rupp, Whitesides, Kettenring, Hazelton 2014, USU).

Three of the wetland projects to which the Trust awarded funding will improve water delivery to wetlands through water control structures. Increased water control throughout these wetlands will allow Great Salt Lake managers to better control invasive species, such as phragmites, that impede water from entering the lake. Combining the phragmite mitigation work by FFSL and projects such as this doubles the impact for Great Salt Lake—a key goal and element in the Trust's work.

While this is just one example, the Trust pursues and prioritizes efforts that utilize this web of work to increase the impact of projects and increase the efficiency with which we're benefiting Great Salt Lake.

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Objectives

Resilience

Conclusion

In March 2024, the Trust released its 5-Year Strategy, outlining the Trust's vision and goals for the next five years and the path to achieving them (5-Year Strategy). The plan is ambitious and pragmatic, drawing upon the scientific expertise and watershed management experience of both the National Audubon Society and The Nature Conservancy, as well as the Trust's deep network of partners.

The main five-year objectives of the Trust, which build on and are inclusive of the Trust's accomplishments to date, include:

- Water Transacted: Protect existing or secure additional flows of 100,000 acre-feet per year (diversion basis).
- Habitat Protected & Restored: Protect or restore at least 20,000 acres of wetlands and associated habitat surrounding Great Salt Lake.
- Flexible Water Distribution: Conduct studies to identify key water distribution bottlenecks and contribute to improving at least five of them.
- Leveraged Funding: Leverage or match 25 percent of total expended state grant money.

GSL WET's objectives are guided by a holistic mindset that requires not just securing water flows but also improving the lake's overall ecosystem and supporting water distribution or infrastructure so that Great Salt Lake is better equipped to face the expected pressures from the effects of climate change, changes in precipitation, and ongoing and increasing water demand. The Trust's dedication to building long-lasting collaborative partnerships across the Great Salt Lake watershed also remains at the forefront of its goals moving into the future.

While the Great Salt Lake remains at a pivotal moment, the establishment of the Great Salt Lake Watershed Enhancement Trust's provides an important opportunity for creative collaboration among the State, non-profits, Great Salt Lake experts, and many others. It will require continuous resolve and funding to ensure the Trust's work and the work of others in the watershed web is as effective as possible, for the sake of the Great Salt Lake, its wetlands, and the species and people which depend on it.

For Additional Information:

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Shaela Adams is the Communications Manager for the Great Salt Lake Watershed Enhancement Trust and National Audubon Society's Saline Lakes Program. In her current role, she is responsible for the development and implementation of an integrated communications strategy that advances the goals of the Trust and the Saline Lakes Program and maximizes the impact of their work. For nearly five years before joining the Trust, she managed and developed nonprofit communication efforts focused on the top issues impacting Utahns due to the state's rapid population growth, including long-range sustainable urban planning, improving statewide disaster resiliency, and the future of water in the West.

Marcelle Shoop serves as the Executive Director of the Great Salt Lake Watershed Enhancement Trust, which is co-managed by National Audubon Society and The Nature Conservancy. Marcelle also launched and now directs the Saline Lakes Program for Audubon. The program is part of Audubon's Western Water initiative that strives to advance balanced solutions to water use in the arid West so that birds, ecosystems, people, and economies can thrive. The Audubon Saline Lakes team leads efforts to protect the health of saline lakes across the West. In Utah, Marcelle has worked with many partners to advance water policy and solutions to benefit Great Salt Lake and its surrounding wetlands. Marcelle serves as a representative of the environmental conservation interests on the Utah Watersheds Council. She also serves on the Steering Committee for the Great Salt Lake Basin Integrated Water Plan and is a member of the Northern Advisory Council to the Colorado River Authority of Utah.

Megan Nelson is the Government Relations Director for the Utah Chapter of The Nature Conservancy. She has worked on Western natural resource, environmental, and public land issues for almost 20 years as an attorney, environmental planner, and consultant. In her current role, she fosters partnerships with government entities, conservation organizations, and private entities, and develops state and national policy to conserve the lands and waters on which all life depends. Before joining the Conservancy, she developed federal land management plans, facilitated environmental planning efforts, authored federal legislation, managed NEPA for federal agencies, and advocated for conservation. Throughout her career, she has most enjoyed working with diverse groups to find common ground.

GSLWET

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WATER BRIEFS

PFAS REGULATION US

FINAL RULE

On Apr. 10, the Biden-Harris Administration issued the first-ever national, legally enforceable drinking water standard to protect communities from exposure to harmful **p**er-and **p**oly**f**luoroalkyl **s**ubstances (PFAS), also known as 'forever chemicals.' Exposure to PFAS has been linked to deadly cancers, impacts to the liver and heart, and immune and developmental damage to infants and children. This final rule represents the most significant step to protect public health under EPA's PFAS Strategic Roadmap. The final rule will reduce PFAS exposure for approximately 100 million people, prevent thousands of deaths, and reduce tens of thousands of serious illnesses. The announcement complements President Biden's government-wide action plan to combat PFAS pollution.

Through President Biden's Investing in America agenda, EPA is also making unprecedented funding available to help ensure that all people have clean and safe water. In addition to the final rule, EPA is offering nearly $1 billion in newly available funding through the Bipartisan Infrastructure Law to help states and territories implement PFAS testing and treatment at public water systems and to help owners of private wells address PFAS contamination. This is part of a $9 billion investment through the Bipartisan Infrastructure Law to help communities with drinking water impacted by PFAS and other emerging contaminants—the largest-ever investment in tackling PFAS pollution. An additional $12 billion is available through the Bipartisan Infrastructure Law for general drinking water improvements, including addressing emerging contaminants like PFAS.

EPA is taking a signature step to protect public health by establishing legally enforceable levels for several PFAS known to occur individually and as mixtures in drinking water. This rule sets limits for five individual PFAS: PFOA, PFOS, PFNA, PFHxS, and HFPO-DA (also known as "GenX Chemicals"). The rule also sets a limit for mixtures of any two or more of four PFAS: PFNA, PFHxS, PFBS, and "GenX chemicals." By reducing exposure to PFAS, this final rule will prevent thousands of premature deaths, tens of thousands of serious illnesses, including certain cancers and liver and heart impacts in adults, and immune and developmental impacts to infants and children.

This final rule advances President Biden's commitment to ending cancer as we know it as part of the Biden Cancer Moonshot, to ensuring that all Americans have access to clean, safe, drinking water, and to furthering the Biden-Harris Administration's commitment to environmental justice by protecting communities that are most exposed to toxic chemicals.

EPA estimates that between about 6% to 10% of the 66,000 public drinking water systems subject to this rule may have to take action to reduce PFAS to meet these new standards. All public water systems have three years to complete their initial monitoring for these chemicals. They must inform the public of the level of PFAS measured in their drinking water. Where PFAS is found at levels that exceed these standards, systems must implement solutions to reduce PFAS in their drinking water within five years.

The new limits in this rule are achievable using a range of available technologies and approaches including granular activated carbon, reverse osmosis, and ion exchange systems. For example, the Cape Fear Public Utility Authority, serving Wilmington, NC—one of the communities most heavily impacted by PFAS contamination—has effectively deployed a granular activated carbon system to remove PFAS regulated by this rule. Drinking water systems will have flexibility to determine the best solution for their community.

EPA will be working closely with state co-regulators in supporting water systems and local officials to implement this rule. In the coming weeks, EPA will host a series of webinars to provide information to the public, communities, and water utilities about the final PFAS drinking water regulation. To learn more about the webinars, please visit EPA's PFAS drinking water regulation webpage. EPA has also published a toolkit of communications resources to help drinking water systems and community leaders educate the public about PFAS, where they come from, their health risks, how to reduce exposure, and about this rule.

FOR INFO: https://www.epa.gov/pfas/pfas-strategic-roadmap-epas-commitments-action-2021-2024

ENDANGERED SPECIES ACT US

FINAL REVISIONS

The Department of the Interior announced on Apr. 11 that the US Fish and Wildlife Service (Service) has finalized Endangered Species Act (ESA) revisions to improve participation in its voluntary conservation programs. The revisions promote native species conservation by clarifying and simplifying permitting under Section 10(a) of the ESA, encouraging more resource managers and landowners to engage in these voluntary programs.

President Biden's *America the Beautiful* initiative set the nation's first-ever goal to conserve and restore at least 30 percent of US lands and waters by 2030. The 10-year, locally led and nationally scaled initiative lifts up efforts to protect, conserve, connect and restore the lands, waters and wildlife upon which we all depend. One of the initiative's goals is to enhance wildlife habitat and improve biodiversity potentially preventing listings and assisting with species recovery through voluntary measures.

The revisions improve implementation of the conservation programs associated with the issuance of enhancement of survival and incidental take permits under Section 10(a) of the ESA. One way the Service achieves this is by combining safe harbor agreements and candidate conservation agreements with assurances into one agreement type called a conservation benefit agreement. The Service also adds flexibility to allow permits for both listed and non-listed species and clarifies the requirements for complete applications.

These revisions, which will increase efficiency by reducing the time and cost to develop and negotiate permit applications, will encourage more individuals and companies to engage in conservation benefit agreements and habitat conservation plans, generating greater conservation results overall. These revisions do not significantly change the current implementation of the Section 10 program or expand the requirements for species protections.

Section 10(a) of the ESA provides a voluntary mechanism for authorizing take of listed and non-listed species associated with beneficial conservation actions or otherwise lawful activities. With some exceptions, the law prohibits taking protected species unless authorized by a permit from the Service or the National Marine Fisheries Service.

The ESA was enacted in 1973 as a response to the declining populations of many species of animals and plants. The Act was designed to protect and recover species at risk of extinction and to promote the conservation of ecosystems and habitats necessary for the survival of those species as well as the communities that rely on healthy ecosystems.

The ESA provides for the protection of ecosystems, the conservation of endangered and threatened species, and the enforcement of treaties related to wildlife preservation. This landmark law has been highly effective and credited with saving 99% of listed species from extinction. Thus far, more than 100 species of plants and animals have been delisted based on recovery or reclassified from endangered to threatened based on improved conservation status, and hundreds more species are stable or improving thanks to the collaborative actions of Tribes, federal agencies, state and local governments, conservation organizations and private citizens.

The final section 10(a) rule will publish in the *Federal Register* on April 12, 2024, and is effective 30 days from publication.
FOR INFO: https://www.regulations.gov/ search >> docket number FWS–HQ–ES–2021–0152

NATURE BASED SOLUTIONS US

GRANT FUNDING

During remarks at the National Conference on Ecosystem Restoration in Albuquerque on Apr. 18, Secretary of the Interior Deb Haaland announced the availability of up to $95 million through President Biden's Investing in America agenda for projects to bolster water resources, advance ecosystem health, and support resilience in communities facing drought and other climate change impacts.

This funding from the Bipartisan Infrastructure Law will help support water conservation and efficiency projects, water management and infrastructure improvements, river and watershed restoration, and nature-based solution projects that provide significant ecological benefits while providing critical adaptation support for communities facing climate catastrophes. This year's funding opportunity builds on last year's investments, which included $51 million for 30 projects in 11 states.

Projects that provide benefits to multiple water use sectors will be prioritized under this grant application process. The funding opportunity includes two submittal periods with deadlines on June 18, 2024, and March 11, 2025.

The Environmental Water Resources Projects are part of the WaterSMART Program.
FOR INFO: Grants.gov >> Funding Opportunity R24AS00299

WATER INFRASTRUCTURE TRIBES

GRANT FUNDING

The Department of the Interior (Interior) announced on Apr. 20 that up to $320 million is available under President Biden's Investing in America agenda through the Bureau of Reclamation (Reclamation) to assist federally recognized Tribes and Tribal organizations as they plan and construct domestic water infrastructure.

The Inflation Reduction Act invests an overall $550 million to expand domestic water supplies in historically disadvantaged communities. Projects may be funded for up to 100 percent of the cost of planning, design, or construction. There is a maximum funding limit of up to $3 million for planning studies, including environmental compliance; up to $5 million for design projects, including environmental compliance; and up to $50 million for construction projects.

This funding is also advancing President Biden's Justice40 Initiative, which aims to ensure that 40 percent of the overall benefits of certain climate, clean energy, and other federal investments flow to disadvantaged communities marginalized by underinvestment and overburdened by pollution.

This funding opportunity is open to Tribes in the 17 western US states served by Reclamation, which will implement the program in two phases: phase one funding will be for planning, design or construction in fiscal year 2024; and phase two funding will be for construction in fiscal years 2027 and 2028. Receiving phase one funding is not a prerequisite for receiving phase two construction funding. However, all project proposals for construction must show that the planning and design have been successfully completed, and priority will be given to those funded under phase one. To be eligible, at least 80 percent of a project's annual average deliveries must be for domestic water purposes.

Tribes interested in obtaining assistance under this program must submit a proposal to Reclamation's Native American Affairs Office. Proposals will be accepted until August 4, 2024.
FOR INFO: https://www.usbr.gov/native/

SHOSHONE RIGHTS CO

PURCHASE COMMITMENT

On Wednesday, Apr. 3, the Grand Junction City Council unanimously approved a resolution to commit $1 million towards the purchase and permanent protection of the Shoshone water rights by the Colorado River District on behalf of a broad-based coalition. The City joins a growing list of West Slope water entities and governments who, along with the Colorado Water Conservation Board and the Colorado River District, have now formally committed a total of $44 million towards the $99 million purchase price.

The City of Grand Junction, home to over 68,000 residents, currently holds conditional water rights on the Colorado River. Permanently protecting the Shoshone water rights will sustain critical flows and water levels in the Colorado River on a year-round basis throughout the Grand Valley, especially in dry years, thereby maintaining water quality through the dilution of pollutants and sediment. Across the West, redundant drinking water sources are becoming critical for municipalities like Grand Junction which continue to experience increased pressures from the impacts of a warming climate including wildfires, drought, and diminished water quality from lower flows.

Additionally, the Shoshone flows support recreation on the Colorado River, an important driver for the City's economy. The recently constructed, recreationally oriented side channels and amenities at Las Colonias Park benefit from sustained flows and offer high-quality recreation experiences for residents and visitors.

Currently tied to hydropower production in Glenwood Canyon, the Shoshone water rights are one of the oldest and largest non-consumptive rights on the Colorado River

and help to ensure consistent flows from the headwaters to the state line.

The permanent protection of the historic Shoshone water rights has been a goal of a broad-based coalition of West Slope water entities and municipalities for over two decades. On Dec. 19, a purchase and sale agreement was signed between the Colorado River District and the Public Service Company of Colorado (a subsidiary of Xcel Energy) to transfer ownership of those rights for $99 million. Over the next few years, the Colorado River District will work closely with the State of Colorado to attach an instream flow beneficial use to the water rights to maintain the flows regardless of the status of power production at the Shoshone Hydroelectric plant.

FOR INFO: https://keepshoshoneflowing.org/

STORAGE PROJECTS US

AWARDS ANNOUNCEMENT

The Department of the Interior (Interior) announced on Mar. 27 a $35 million investment from President Biden's Investing in America agenda for six small surface and groundwater storage projects in California and Utah. The projects, each receiving funding from the Bipartisan Infrastructure Law, will increase water supply reliability, improve operational flexibility community and landscape resilience to the effects of climate change.

Bureau of Reclamation (Reclamation) Commissioner Camille Calimlim Touton announced the funding while in Toquerville, Utah. She participated in a tour of the construction of Chief Toquer Reservoir in southern Utah, where the Washington County Water Conservancy District's Ash Creek Project is receiving approximately $7 million to construct a new pipeline to run from the Ash Creek Reservoir to the Chief Toquer Reservoir. At full capacity, the new reservoir will hold 3,638 acre-feet of water, and is expected to provide approximately 1,760 acre-feet annually. The funding announced today builds on $4.7 million announced for the project last year.

The Small Storage Program, authorized by the Bipartisan Infrastructure Law, funds projects with a water storage capacity between 200 acre-feet and 30,000 acre-feet. Eligible projects completed and submitted a feasibility study to Reclamation for review.

Other projects announced Mar. 27 include:

- **$9.1 Million for Rancho California Water District's Pauba Valley Groundwater Banking Project (California).** During wet years, the project will provide approximately 5,000 acre-feet of excess imported water to recharge the Pauba Valley groundwater subunit. This water will be available for use during dry years to help serve potable water demands in the district, including agricultural demands. Construction will include new recharge basins, conveyance facilities, and four new recovery wells. The project is the final phase of a larger groundwater basin expansion program undertaken by the district to achieve greater local water supply reliability.
- **$7 Million for Imperial Irrigation District's Upstream Reservoir Storage Project (California).** The Upstream Operational Reservoir Storage Project is aimed at maximizing Imperial Irrigation District's water management efficiency within the Imperial Valley. The project has a storage capacity of 2,100 acre-feet and is projected to conserve 15,000 acre-feet per year for in-valley use.
- **$6.7 Million for San Benito County Water District's Accelerated Drought Response Project (California).** The project will provide injection and storage of up to 2,700 acre-feet per year of treated Central Valley Project water. In wet years, this is estimated to save an average of 1,035 acre-feet per year of stored water. The project will support up to five aquifer storage and recovery wells, expand the West Hills Water Treatment Plant and construct pipelines to convey water between the wells, water treatment plant, the Sunnyslope County Water District, and Hollister and San Juan Bautista, California, distribution systems.
- **$3.9 Million for Groundwater Banking Joint Powers Authority's Phase 1 of the Kern Fan Groundwater Storage Project (California).** Phase one of the project includes the acquisition of 350 acres in Kern County for the construction and operation of recharge basins, recovery wells, and water conveyance infrastructure. The storage capacity is approximately 28,000 acre-feet. The project is expected to produce 2,482 acre-feet of water annually.
- **$1.3 Million for Del Puerto Water District's Orestimba Creek Recharge and Recovery Project (California)**. Water will be stored in a local aquifer in wet years and then used in dry years to provide agricultural water supply under this small groundwater storage project. Recharge water will include available non-storable Central Valley Project supplies and flood water flows from Orestimba Creek. The projected average annual production is 1,485 acre-feet.

FOR INFO: https://www.usbr.gov/smallstorage/

WETLANDS PROTECTION AZ

FUNDING

The Department of the Interior announced on Apr. 3, a $25 million investment from President Biden's Investing in America agenda to protect and maintain two areas important for resilience and drought mitigation in the Southwest—the Yuma East Wetlands and Topock Marsh in Arizona.

Bureau of Reclamation Commissioner Camille Calimlim Touton joined leadership of the Fort Yuma Quechan Indian Tribe, the city of Yuma, the Arizona Game and Fish Commission and the Yuma Crossing National Heritage Area at the Yuma East Wetlands to make the announcement.

"Protecting these wetlands is important to the local communities as well as to the greater health of the lower basin of the Colorado River," said Bureau of Reclamation Commissioner Touton. "Through historic resources provided through President Biden's Investing in America agenda, we have the opportunity to invest in projects like these to combat the impacts of long-term drought for current and future generations."

The Yuma East Wetlands will receive $5 million to upgrade infrastructure to ensure the continued existence of the marshes for future generations. Improvements include designing and replacing the system used to move water around the wetlands, replacing pumps currently fueled by diesel with electrical pumps, extending concrete canals and bringing electrical power to the conservation area to allow for technology updates. The area is widely utilized for public recreation and provides habitat for wildlife including endangered species.

The 4,000-acre Topock Marsh in the Havasu National Wildlife Refuge will receive $20 million to install two new screw pumps, replace a failing concrete canal with three miles of pipeline, design and build a new water control structure, and bring in

electrical power for the pumps to increase efficiency of the marsh's water delivery system. Topock Marsh provides habitat to the endangered southwestern willow flycatcher and the only Northern Mexican Garter Snake population identified on the lower Colorado River.
FOR INFO: https://www.usbr.gov/bil/

ENERGY REVENUES SOUTH

LAND/WATER CONSERVATION

The Department of the Interior (DOI) announced on Mar. 29 the distribution of more than $353.6 million in fiscal year 2023 energy revenues to the four offshore Gulf of Mexico oil and gas producing states—Alabama, Louisiana, Mississippi and Texas, and their **c**oastal **p**olitical **s**ubdivisions (CPS), such as counties and parishes.

The Gulf of Mexico Energy Security Act (GOMESA) of 2006 created a revenue-sharing model for oil- and gas-producing Gulf states to receive a portion of the revenue generated from offshore oil and gas leasing in the Gulf of Mexico. GOMESA also directs a percentage of revenue to the Land and Water Conservation Fund (LWCF).

The funds, disbursed annually based on offshore oil and gas production revenue, support coastal conservation and restoration projects, hurricane protection programs, onshore infrastructure projects, and activities to implement marine and coastal resilience management plans.

With this year's disbursement, the DOI has now distributed more than $2 billion to the states and their CPS since GOMESA funds were first shared in 2009. This disbursement is the second consecutive year the maximum allowable amount under GOMESA has been shared, reflecting in part returns from record high oil and gas production under the Biden-Harris administration.

GOMESA funds are disbursed in accordance with the revenue-sharing provisions of GOMESA. During FY 2023, Interior's Office of Natural Resources Revenue (ONRR) disbursed $125 million to the LWCF and nearly $870 million to the US Treasury from bonuses, rentals and royalties paid from GOMESA leases. Disbursements to the LWCF and Treasury are made in the same year of receipt; disbursements to the states and CPS are made the year following the year of receipt.

GOMESA disbursements for the four Gulf-producing states and their CPS are subject to a revenue-sharing cap of $375 million annually and the sequestration requirements in 2 U.S.C. 901a(6)(B), and OMB Circular A-11, Section 100.4.
FOR INFO: https://revenuedata.doi.gov/how-revenue-works/gomesa/

ENERGY & WATER US

NAWI FUNDING

On Apr. 11, the US Department of Energy (DOE) announced renewed funding for the National Alliance for Water Innovation (NAWI), DOE's energy innovation hub for desalination. With $75 million over five years for this second phase of the Hub, NAWI will continue to bring together a team of industry and academic partners to examine the critical technical barriers and research needed to radically lower the cost and energy of water purification technologies. The advancements in desalination technologies will help propel the modernization of America's water infrastructure, increase access to clean, potable water for all Americans, and move the country toward a net-zero emissions economy by 2050.

"Water and energy are interdependent—water is used to produce nearly every major energy source, and energy is critical to transporting and treating water," said Jeff Marootian, Principal Deputy Assistant Secretary in the Office of Energy Efficiency and Renewable Energy. "The deep connection between these two resources demands an integrated approach that considers the challenges and opportunities inherent to both sectors. The Department of Energy is proud to be leading the nation's efforts to decarbonize the water economy, while ensuring a secure water future for communities nationwide."

Current water supply systems in the US rely primarily on fresh surface and groundwater, with a small percentage coming from desalinated salt water. However, climate change, population growth, greater industrial and agricultural demand, and changes in how communities use water are placing increasing stress on these fresh water supplies worldwide. To supply the water needs of the future, it is critical that the US develop technologies that provide alternative water sources and treat and use water in ways that are efficient, sustainable, cost-effective, and minimize energy use and greenhouse gas emissions.

NAWI and other partners across industry, government, and academia are investing in technologies to mitigate these effects on the water cycle. These technologies will focus on treating water from alternative sources like brackish groundwater and various wastewaters to create more fit-for-purpose water while reducing emissions and energy use associated with traditional water treatment. In its first five years, NAWI funded more than 60 projects, including pilots, projects across the United States focusing on a combination of water treatment, desalination unit processes, novel automation and water treatment, desalination processes, and modeling tools and analysis. This included projects from early-stage research through pilot scale. Additionally, the hub published the NAWI Master Roadmap and five sector-specific roadmaps (power, resource extraction, industry, municipal, and agriculture) as they relate to key technical challenges and research priorities in desalination and treatment of nontraditional source waters.
FOR INFO: https://www.nawihub.org/knowledge/roadmap-publication-series/

CALENDAR

May 13-16 MN

2024 Annual National Conference, Welch. Treasure Island Resort and Casino. Presented by Prairie Island Indian Community. For info: https://www.nafws.org/product/2024-national-conference/

May 14-15 TX

Environmental Trade Fair & Conference, Austin. Austin Convention Center. Presented by the Texas Commission on Environmental Quality. For info: https://www.tceq.texas.gov/p2/events/etfc

May 14-16 MN

National Adaption Forum, Saint Paul. Saint Paul River Centre. Presented by National Adaptation Forum. For info: https://nationaladaptationforum.org/register-for-the-2024-forum/

May 15 WEB

Part 2: Distribution Systems Unregulated Inorganics and Why You Should Monitor Them, Virtual Event. Presented by American Water Works Association. For info: https://engage.awwa.org/PersonifyEbusiness/Events/AWWA-Events-Calendar/Meeting-Registration?productId=226331619

May 15-16 CANADA

Smart Water Utilities Canada 2024 Exhibition & Conference: Reducing Water Leakage Across the Network, Toronto. Presented by Canada Smart Water Utilities. For info: https://www.canada.smart-water-utilities.com/booking

May 15-17 CA

Bay-Delta Tour 2024, Sacramento. Field Trip presented by Water Education Foundation. For info: https://www.watereducation.org/tour/bay-delta-tour-2024

May 15-17 NM

NM Indian Livestock, Albuquerque. Rt. 66 Hotel and Casino. Presented by New Mexico State University. For info: https://indianlivestock.nmsu.edu/

May 21-22 DENMARK

Tech Tour Water Tech 2024, Aarhus. Presented by Tech Tour. For info: https://www.techtour.com/events/2024/5/event-tech-tour-water-tech-2024%5B7%5D.html?zzz=1&pageId=7421622

May 22 WEB

Regional Water Distribution Models - What, Why and How?, Virtual Event. Presented by American Water Works Association. For info: https://engage.awwa.org/PersonifyEbusiness/Events/AWWA-Events-Calendar/Meeting-Registration?productId=226331257

June 4-6 PA

ACAP Agricultural Conservation Conference, State College. Toftrees Golf Resort. Presented by Penn State Extension. For info: https://extension.psu.edu/acap-ag-conservation-con

June 5 WEB

AI Series, Part 3: Intelligent Water Systems: Navigating the Waters of Tomorrow, Virtual. Presented by American Water Works Association. For info: https://www.awwa.org/Events-Education/Events-Calendar

June 5-6 CA

SGMA Implementation Workshop & Summit, Sacramento. Kimpton Sawyer Hotel. Presented by Groundwater Resources Association of California and Association of California Water Agencies. For info: https://www.acwa.com/events/2024-sgma-implementation-workshop-summit/

June 6-7 CO

2024 Conference on the Colorado River, Boulder. Wolf Law Building. Presented by GWC and Colorado Law School. For info: https://www.colorado.edu/center/gwc/events

June 10-13 CA

ACE 24: Transforming our Water Future, Anaheim. Anaheim Convention Centre. Presented by the American Water Works Association. For info: https://www.awwa.org/ace/Attend/Registration

June 10-12 CA

2024 Annual Meeting, Olympic Valley. Everline Resort and Spa. Presented by Western Governors' Association. For info: https://westgov.org/meetings/details/2024-annual-meeting

June 11-12 TX

AGWT 2024 Texas Groundwater Conference, Austin. Norris Conference Center. Presented by American Ground Water Trust Groundwater Education. For info: https://agwt.org/civicrm/event/info?id=374&reset=1

June 12-13 NM

2024 Animas and San Juan Watersheds Conference, Farmington. Henderson Fine Arts Center. Presented by Water Resources Research Institute. For info: https://web.cvent.com/event/e95ef7b6-2ce7-4c69-933f-c2aa7dbabd85/regProcessStep1

June 12-14 CA

California Water Institute for Teachers, Sacramento. Various sites in Butte County. Presented by Water Education Foundation. For info: https://www.watereducation.org/project-wet-event/california-water-institute-teachers-9

June 13-14 NV

Water and Environmental Law Conference, Reno. University Of Nevada, Reno. Presented by National Ag Law Center. For info: https://nationalaglawcenter.org/

June 17-18 NE

2024 Water and Natural Resources Tour, Nebraska City. Nebraska Innovation Campus (NIC). Presented by Nebraska Water Center and Central Public Power and Irrigation District. For info: https://www.eventbrite.com/e/2024-water-and-natural-resources-tour-registration-856173196077?aff=oddtdtcreator

June 17-20 CA

Toward Sustainable Groundwater in Agriculture: Linking Science and Policy, San Francisco. Hyatt Regency. Presented by the Water Education Foundation. For info: https://www.eventbrite.com/e/toward-sustainable-groundwater-in-agriculture-linking-science-policy-tickets-714778109567

June 27 CA

ACWA Region 2 Program and Tour, Paradise. Paradise Elks Lodge. Presented by ACWA. For info: https://www.acwa.com/events/acwa-region-2-event/

July 9 WEB

Compensation Survey Insights and Action Steps, Virtual Event. Presented by American Water Works Association. For info: https://www.awwa.org/Events-Education/Webinars

July 10-11 NM

AGWT 2024 New Mexico Groundwater Conference, Albuquerque. Presented by American Ground Water Trust Groundwater Education. For info: https://agwt.org/civicrm/event/info?id=376&reset=1

July 12 NM

AGWT 2024 New Mexico Water Well Workshop, Albuquerque. Presented by American Ground Water Trust Groundwater Education. For info: https://agwt.org/civicrm/event/info?id=375&reset=1

July 15-17 TX

WEF Circular Water Economy Summit 2024, Dallas. Hyatt Regency. Presented by Water Environment Federation. For info: https://showpro.cdsreg.com/EventRegistration/CWES0724/Register/New/step/02dd5997-8860-4113-a8eb-f9d7a02b4c04?regId=572031cb-8376-4556-b013-d850a4fac20c&flowId=3464de68-b362-4ad9-bd34-9a0dd5d09196

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CALENDAR

July 18-20 **NM**

70th Annual Rocky Mountain Mineral Law Institute, Santa Fe. Santa Fe Community Convention Center (SFCCC). Presented by The Foundation for Natural Resources and Energy Law (formerly Rocky Mountain Mineral Law Foundation). For info: https://www.fnrel.org/programs/ai70/overview#tab

July 18-22 **SINGAPORE**

Singapore International Water Week 2024, Marina Bay Sands. Sands Expo & Convention Centre. Presented by Singapore International Water Week. For info: https://form.gov.sg/6560ead05608a800124bfa24

July 19-20 **WEB**

Building Climate Resilience: The Link Between Historic Policies and Today's Risk, Virtual Event. Presented by Urban Waters Learning Network. For info: https://urbanwaterslearningnetwork.org/