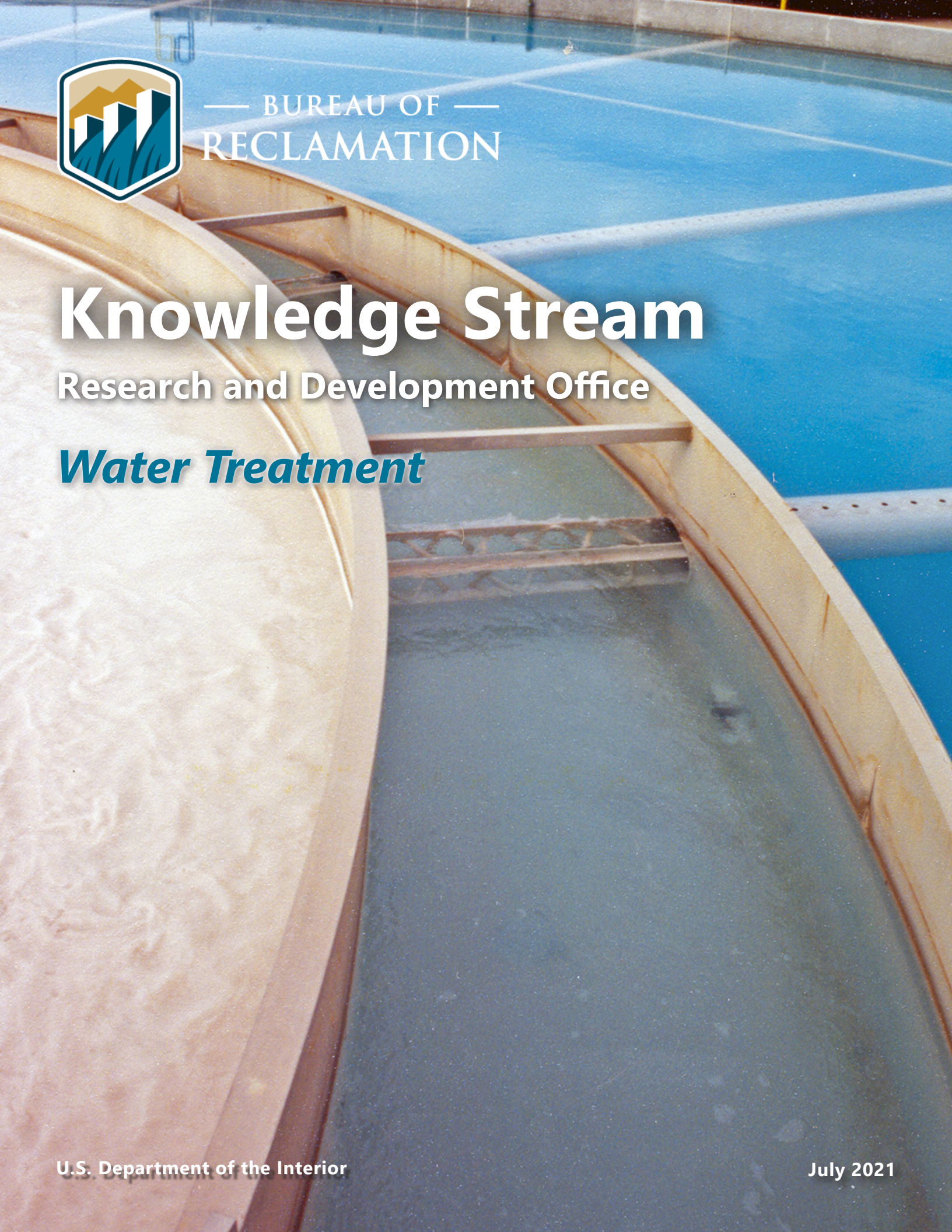

BUREAU OF RECLAMATION

Knowledge Stream

Research and Development Office

Water Treatment

U.S. Department of the Interior

July 2021

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Message from R&D

Welcome to the Summer 2021 issue of the *Knowledge Stream*! In this issue, we highlight research related to water treatment. Research and Development Office (R&D) programs support research, development, and demonstration of desalination and advanced water treatment technologies for the purpose of converting unusable water resources into climate-resilient water supplies. Expanding water supplies through advanced water treatment is a key component to a strong portfolio of water supply options that water managers can use to address water scarcity in a changing climate.

In this issue you'll learn about the innovative work of Reclamation scientists and engineers to make advancements, including:

- External research supported by R&D's Desalination and Water Purification Research Program.
- Research led by Reclamation engineers and specialists on advanced water treatment technologies, funded by R&D's Science & Technology (S&T) program.
- Crowd-sourcing of water treatment technology solutions through R&D's Prize Competition program.
- R&D activities at Reclamation facilities, including Brackish Groundwater National Desalination Research Facility (BGNDRF), Yuma Water Quality Improvement Center (WQIC), and the Technical Service Center (TSC) Water Treatment Lab.

Crucial to these activities are the numerous partnerships that R&D programs leverage to advance water treatment innovation. You'll learn about R&D partnerships with Reclamation's Regional and Area Offices, federal and non-federal organizations, the National Alliance for Water Innovation (NAWI), New Mexico State University (NMSU), American Membrane Technology Association (AMTA), Membrane Science, Engineering and Technology Center (MAST), the federal Water Treatment Interagency Working Group (WATR), and other agencies implementing the National Water Reuse Action Plan (WRAP).

As always, we appreciate you reading about innovation funded by Reclamation's R&D programs. Please enjoy this issue of the Knowledge Stream and offer us any feedback for improving our strategies to transfer solutions to users.

About the *Knowledge Stream*

The *Knowledge Stream*, published by the Bureau of Reclamation's Research and Development Office, is a quarterly magazine bringing mission-critical news about the agency's innovations in the following:

- Science and Technology Program
- Desalination and Water Research Purification Program
- Prize Competitions
- Technology Transfer
- Open Water Data...and more.

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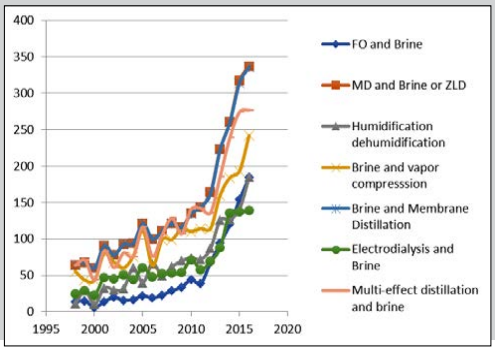

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Front Cover: Solid contact reactor at the Yuma Desalting Plant.

Back Cover: Evaporation pond at the Brackish Groundwater National Desalination Research Facility.

COMMUNITY NEEDS

Water's Value

By Yuliana Porras Mendoza
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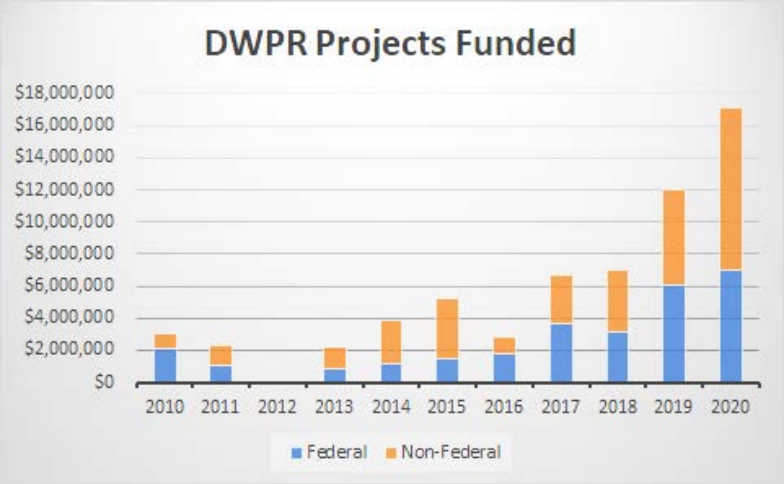
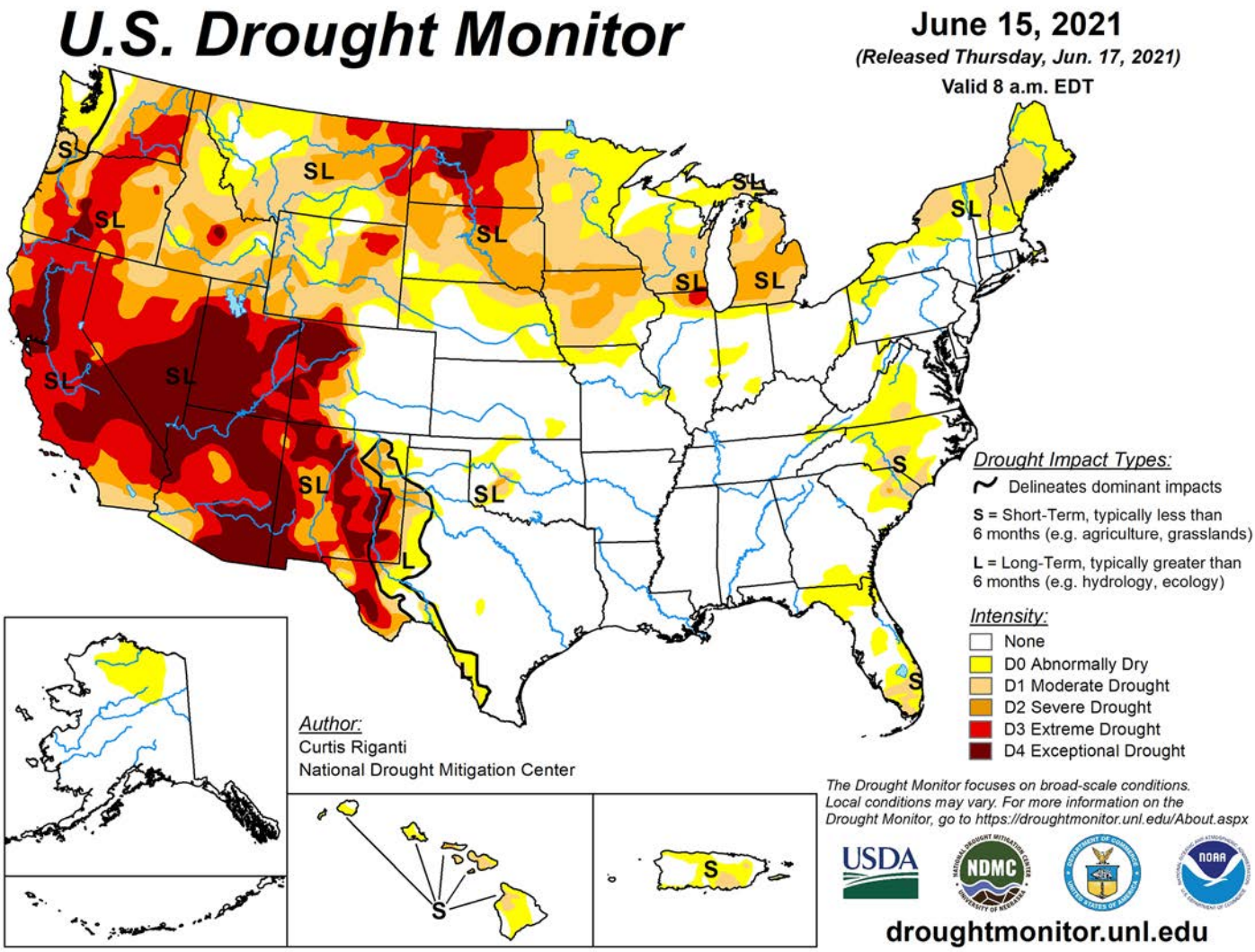
Water is essential to our survival – safe and adequate supplies of water are vital for agriculture, industry, recreation and human consumption. The Earth contains a vast amount of water, but only less than 1% of it is freshwater while the other 99% is either saline or trapped in glaciers and ice. As the various demands for freshwater continue to increase across the nation, water treatment has become a key component to augment and create new water supplies to meet that demand. According to the United States Geological Survey (USGS), the United States in 2015 used an estimated 322 billion gallons per day (988,182 acre-ft per day) of water.



The Bureau of Reclamation (Reclamation) was established in 1902 and it is the largest wholesaler of water in the country. It is a contemporary water management agency with a mission to assist in meeting the increasing water demands of the West while protecting the environment and the public's investment. One way the Research and Development (R&D) Office is working towards this mission is by leading research in the area of water treatment with a focus on augmenting water supplies while reducing costs, energy, and environmental impacts.

Reclamation has been funding water treatment research for nearly 70 years with the inception of the U.S. Department of the Interior's Office of Saline Water in the 1950s. The various offices and programs within Reclamation leading this work have continued to evolve throughout the decades. In 1996, the Water Desalination Act allowed for the creation of Reclamation's Desalination and Water Purification Research Program (DWPR) which funds researchers nationwide on the development of improved water treatment technologies for augmenting water supplies. As climate changes, droughts continue, population grows, and water scarcity concerns increase, water treatment continues to be a key component to a diverse portfolio for water managers in order to meet water supply needs and demands.

Map of Desalination Plants in the USA, 2020.
(Source: Global Water Intelligence, www.desaldata.com)



In 2008, the National Research Council from the National Academy of Sciences published, "Desalination: A National Perspective", with the support from Reclamation and the U.S. Environmental Protection Agency (EPA). This report clearly identified the lack of integrated and strategic direction to the federal desalination research and development efforts. At least nine federal agencies and laboratories, each with their own research objectives and priorities, fund efforts in the area of desalination according to the report. In 2016, Reclamation along with the U.S. Army Combat Capabilities Development Command (CCDC) Ground Vehicle Systems Center took the lead by establishing the Water Treatment Interagency Working Group (WATR). The WATR group meets annually bringing together various federal agencies such as EPA, Department of Energy (DOE), Department of Defense, and others to share information, collaborate, and learn from the various projects we are all engaged in. Reclamation has also partnered and participated in initiatives launched by others such as the National Water Reuse Action Plan and DOE's Water Security Grand Challenge.

While Reclamation invested in research on reducing the cost, energy and environmental impacts of desalination, it has also developed new innovative funding opportunities, built the Brackish Groundwater National Desalination Research Facility, strengthened our relationship with our stakeholders, increased our involvement with multiple partners and the communication and collaboration with various other federal agencies. Reclamation has always understood the value of water as it has been a core part of its foundation. As we encounter future challenges, there is no question water treatment investments will expand access to otherwise unusable water resources, and increase water supply flexibility under the risks of long-term climate change and shorter-term droughts.

KEY PERSPECTIVES

Water Treatment Across Reclamation

By Jack Simes & Meghan Thiemann, Collins Balcombe, & Jeff Papendick
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Southern California Area Office

Since 1992, staff at the Southern California Area Office (SCAO) have worked with water districts and municipalities through Reclamation's water reclamation and reuse program, known as Title XVI. That program funds projects that reclaim and reuse municipal, industrial, domestic and agricultural wastewater, and impaired ground and surface waters. Unless otherwise authorized, it provides 25% of project costs, up to $20 million.

To date, over $600 million has been provided for Title XVI and desalination projects in the Lower Colorado Basin (LCB) Region. In Fiscal Year 2020, these projects produced an estimated 358,000 acre-feet of water in Southern California, where most the LCB projects are located (just one acre-foot of water is enough for two families of four in Southern California).

Title XVI also authorized research for the reclamation of wastewater and naturally impaired ground and surface waters. Research funded through Title XVI and other Reclamation programs have helped water districts, tribes, and local communities in Southern California tackle their water supply challenges. It has also supported the development of water reuse construction projects which improve efficiency, provide flexibility during water shortages, and diversify water supply.

Albert Robles Center (ARC) process area in Los Angeles, California; process area with reverse osmosis treatment trains (top), WRD workers loading RO membranes into the pressure vessels (bottom). See https://albertroblescenter.com/

Oklahoma-Texas Area Office

At the Oklahoma-Texas Area Office (OTAO), water treatment research plays a prominent role in helping our water users and stakeholders address important water supply needs. In the past five years alone, Reclamation's investments in water treatment-related activities in our area have exceeded $35 million, encompassing a wide range of projects related to desalination; reuse of municipal, industrial, domestic, and agricultural wastewaters; stormwater management; and other projects involving the treatment of impaired ground and surface waters. The larger investments have come through the Title XVI and WaterSMART programs, but Research and Development has played an integral role as well, primarily through the Desalination Water Purification Research and Science and Technology programs.

Reclamation researchers Katie Guerra (left) and Leah Flint (center) accompany Shawn Dewees, General Manager of the Foss Reservoir Master Conservancy District, on a tour of the District's Electrodialysis Reversal (EDR) unit. Reclamation's Foss Reservoir in southwest Oklahoma has high salinity levels. Researchers are helping the District explore options on how to improve or replace the existing EDR system which is costly to operate and maintain.

Reclamation researchers Miguel Arias-Paic (left) and Anthony Kennedy (right) inspecting resin bed columns used to remove hexavalent chromium from the city of Norman's groundwater. The city uses groundwater to supplement surface water out of Reclamation's Lake Thunderbird in central Oklahoma during drought periods. By removing the chromium-6, groundwater becomes more usable, thereby improving drought resiliency and alleviating pressure on Lake Thunderbird.

Threats to water supply reliability and drought resiliency remain one of the most pressing mission-critical needs in the Oklahoma-Texas area. Severe and extended droughts are common, creating a number of complex water quality-related issues. When reservoir storage is low, the quality of the water held in storage often declines, resulting in elevated levels of total dissolved solids in Reclamation's reservoirs. This can render the water unusable or require expensive blending with higher quality sources to maintain the quality targets needed for end users. In other cases, water treatment is needed to make impaired supplemental supply sources such as groundwater usable. In turn, the treated water source reduces demand pressures on Reclamation's supplies, thereby stretching water availability and reducing competition for limited supplies.

To help identify advanced water treatment solutions, Reclamation boasts state-of-the-art testing facilities and a talented pool of eager water treatment experts at our Technical Services Center's Water Treatment Group. Developing relationships with these experts has been key, as is communications and collaboration. The biggest successes come from projects that are led by or carried out in close coordination with area office staff and district partners who best understand the local needs. Whether it's proof-of-concept, pilot testing, planning, design, or full-scale implementation, Reclamation has the technical and funding resources to meet our water-treatment related needs. This goes a long way towards helping OTAO build relationships with our operating partners and address mission-critical needs.

South-Central California Area Office

Reclamation's Central Valley Project San Luis Unit provides irrigation water to approximately one million acres of farmland in California's Central Valley. A portion of those lands are considered drainage impaired, meaning irrigation water will pond just below the ground surface. In drainage impaired areas, agricultural drain water must be collected and removed from the root zone to prevent crop drainage. The drainage water is high in naturally occurring salts, selenium, and other trace elements that may pose environmental concerns if not properly managed. Reclamation's efforts have focused collection, treatment, and disposal of this agricultural drain water.

San Luis Demonstration Treatment Plant.

For over three decades, Reclamation's California Great Basin Region, South-Central California Area Office, Technical Service Center Water Treatment Group (WTG), and local stakeholders have worked collaboratively to address drainage issues. In the early 2000s, the WTG began investigating selenium treatment technologies. Under the leadership and technical expertise of the WTG, Reclamation has funded localized bench scale studies, pilot scale studies, and constructed the San Luis Demonstration Treatment Plant (Demo Plant). Designed using lessons learned from previous WTG studies, the Demo Plant was constructed to test competing water treatment technologies. The WTG was instrumental in the commissioning and optimization of the Demo Plant. Our Region continues to work with the WTG on testing new treatment technologies to help solve drainage treatment issues.

RECLAMATION SUPPORT FOR WATER TREATMENT INNOVATION

Desalination and Water Purification Research Program

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Reclamation's Desalination and Water Purification Research Program (DWPR) works with Reclamation researchers and partners to develop more innovative, cost-effective, and technologically efficient ways to desalinate or treat water. DWPR aligns with Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," by investing in development and application of advanced water treatment technologies that expand access to otherwise unusable water resources, thereby increasing water supply flexibility under the risks of long-term climate change and shorter-term drought. Investing in such technologies leads to development of climate-resilient, cost-effective, and low-impact solutions that bolster the ability of Reclamation, its customers, and stakeholders to cope with stresses of climate change. DWPR program activities are also aligned with other federal desalination and water treatment initiatives, including the National Water Reuse Action Plan and the U.S. Department of Energy's Water Security Grand Challenge.

DWPR funding plays a critical role in iterating an idea from the lab to a real-world demonstration, which yields products that serve the water treatment community and attract commercialization interest. Through DWPR, research sponsors partner with Reclamation to address a broad range of desalting and water purification needs. Reclamation is interested in research where the benefits are widespread and where private-sector entities are not able to make the full investment and assume all the risks. Reclamation is also interested in research that has a national significance—where the issues are of large-scale concern and the benefits accrue to a large sector of the public.

DWPR Program objectives include development of improved methods of desalination, incorporating energy efficiency into desalination processes, and reducing the costs and environmental impacts of treating impaired waters including, but not limited to, seawater, inland brackish groundwater, municipal wastewater, and produced waters from oil and gas extraction activities. Through the program's two competitive extramural Notice of Funding Opportunities (NOFOs), "Research" and "Pitch to Pilot," Reclamation awards research and development cooperative agreements with non-Federal recipients. Under the Research NOFO, laboratory scale projects are eligible to receive up to $250,000 in federal funds for projects lasting up to two years, while pilot scale projects are eligible to receive up to $800,000 in federal funds for projects lasting up to three years. Under the Pitch to Pilot NOFO, pilot projects are eligible to receive up to $200,000 in federal funds for projects lasting up to 18 months.

The program leverages investment from other federal and non-federal entities to facilitate the advancement and deployment of new technologies. Knowledge generated from this investment is made available to communities, organizations, and industry. Recent participation by the nationwide R&D community in DWPR NOFOs underscores how that community's interests align with Reclamation's desalination and water purification innovation objectives, resulting in a highly competitive NOFOs and the award of federal funds to promising research and development proposals.

Science and Technology Program - Research

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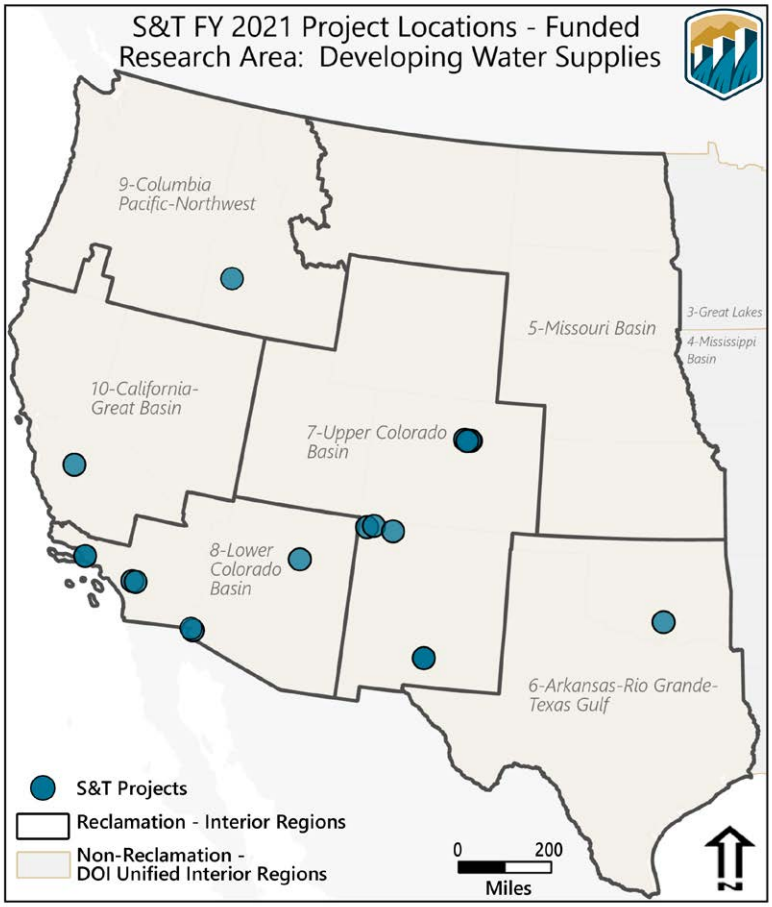
Reclamation's Science and Technology Program (S&T) research projects are mission focused, competitively selected, and internally led activities that support Reclamation's innovation in five different research areas. In the Developing Water Supplies research area, the Advanced Water Treatment research category provides an opportunity for Reclamation researchers to receive funding for projects that advance our impact to Reclamation's ability to deliver water. In this area, projects are focused on developing technologies, methods, tools and approaches to advance the treatment of impaired water sources that allow Reclamation to better utilize existing supplies, increasing existing Reclamation supplies through augmentation, or prolonging existing Reclamation supplies by expanding or developing non-traditional supplies from an outside source such as impaired groundwater or surface water.

In fiscal year (FY) 2021, S&T funded 17 research projects in this area with funding totaling approximately $1M: three are new totaling $0.5M and 14 are continuing totaling $0.5M. For a review of recently completed projects and active projects, please review the research area summary document at: www.usbr.gov/research/st/roadmaps/FY21RASWS.pdf

In FY 2022, we have identified several priorities for research projects in the FY22 Science Strategy Implementation Plan including: quantifying the non-monetized costs and benefits of potable and non-potable water reuse compared with other water supply sources; reducing the environmental impact of water treatment, developing improved techniques and data to consider hazardous events or system failures in risk assessment of water reuse, developing innovative new water treatment systems for treatment of impaired water for various uses, developing models for implementation and management of various water sources in need of one or more treatment for one or more end use, and developing innovative new materials, membranes, and/or systems and processes for treatment of impaired water.



Partnerships are one of the keys to a successful S&T research project. S&T maintains partnerships with a variety of federal, state, and local government agencies, as well as non-profits, universities, and private entities. During coordination opportunities with these partners, collaborative research opportunities are identified. This allows S&T to share the funding burden of the project and expand the knowledge base contributing to the project. In the advanced water treatment category, these partnerships are especially important as we partner with a variety of internal Reclamation partners such as the Water Quality Improvement Center, tribal partners such as the Navajo Nation, Federal partners such as the National Renewable Energy Laboratory, U.S. Environmental Protection Agency, U.S. Geological Survey, U.S. Army Corps of Engineers, state partners such as the Oklahoma Water Resources Board, and local partners such as City of Norman, Oklahoma, City of Gallup, Texas, Eastern Municipal Water District, and Southern Nevada Water Authority.

Science and Technology Program - Prize Competitions

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White Sands National Monument near Alamogordo, New Mexico.
https://www.usbr.gov/research/challenges/morewater.html

Reclamation is leveraging prize competitions to help solve some of the most critical water resource problems in the areas of Water, Infrastructure, and Environment. While prize competitions are not the right tool for every problem, they can serve as a mechanism for spurring and sourcing innovation. Reclamation competitions are advancing research and development issues that are best addressed through process and technological improvements to achieve more efficient operations of Reclamation facilities and improved management of water and related resources. Since 2015, Reclamation has launched 30 competitions and awarded over $3.25 million in prizes over a wide range of topics, including sub-seasonal climate forecasting, detecting leaks in water pipelines, downstream fish passage at tall dams, and sediment removal in reservoirs. The scope of competitions has also varied greatly, including white-paper concepts, forecasting algorithms, and technology prototypes.

In 2018, Reclamation established a collaborative relationship with National Aeronautics and Space Administration (NASA) Center of Excellence of Collaborative Innovation (CoECI). This partnership aims to advance how Reclamation's prize competitions are conducted by having a streamlined contracting mechanism and access to multiple competition vendors offering differing expertise with greater solver communities, including the international solver space. Reclamation's prize teams engage with CoECI to develop requirements that lead to the selection of a contractor. This contractor, with CoECI, works with Reclamation on all aspects of implementing a competition–from problem definition and incentive design, to post-submission evaluation and selection of solutions. This end-to-end service enables Reclamation to rapidly experiment with competition methods and innovate its own capabilities. The Reclamation-CoECI partnership is integral to furthering successes of the prize competition program and ensuring the greatest positive impact and outcomes.

One competition currently being run under the Reclamation-CoECI partnership is More Water Less Concentrate, with a focus of discovering innovative, affordable, and environmentally sound solutions to reduce the volume of concentrate and generate more usable water from inland desalination plants. Launched in October 2020, this multi-phase competition first solicited white-paper submissions describing the proposed approach to meeting the objectives of the competition. Up to 5 finalists to be named in July 2021, who will each receive up to $115,000 in prize awards throughout an 11-month prototype development phase. The competition will culminate in prototype demonstrations at Reclamation's Water Quality Improvement Center at the Yuma Desalting Plant in summer 2022, with an additional $350,000 in prizes available to the top performing teams.

Yuma Area - Water Quality Improvement Center

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The Water Quality Improvement Center (WQIC), co-located with the Yuma Desalting Plant in Yuma, Arizona, is one of Reclamation's three water technology research laboratories. The WQIC furthers Reclamation's mission to develop new sources of water by providing unique benefits not found at Reclamation's other research facilities. The WQIC offers researchers a wide variety of feedwaters for testing, a broad array of research equipment available for research on and off site, experienced operators and technicians on-site 24/7, and an on-site water analysis laboratory licensed by the state of Arizona.

The WQIC features a broad array of test equipment available to researchers from bench scale swatch testing units to a 1 million gallon per day (MGD) reverse osmosis (RO) pilot system. Examples of the research the WQIC has supported include lending CalPoly – Pomona a 12 gallon per minute RO skid to study the concentrations of contaminants of emerging concern in RO concentrate at the Inland Empire Wastewater Treatment plant. During the project, engineers and technicians at the WQIC provided close support for commissioning and troubleshooting. For another project, the WQIC lent a swatch testing unit to Harvard researchers to design a tunable graphene oxide membrane. Our unique swatch units allow simultaneous testing of nine membrane swatches in crossflow configuration greatly accelerating Harvard's research.

Future projects at the WQIC include:

The More Water Less Concentrate prize competition to find new technologies to reduce desalination concentrate volumes while producing more water more economically. The large flows provided by the WQIC's 1 MGD pilot system allows for multiple contestants to test under identical water conditions.

Electrodialysis Reversal (EDR) Pilot testing to study the use of EDR technology to desalinate brackish agricultural drainage water more efficiently by using less energy and more importantly using fewer chemicals. This technology has the potential to cheaply desalinate water at remote brackish groundwater sites throughout the southwest without the need for logistically complex chemicals required by conventional RO treatment.

Brackish Groundwater National Desalination Research Facility

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Reclamation's Brackish Groundwater National Desalination Research Facility (BGNDRF) is located in Alamogordo, New Mexico. BGNDRF hosts clients from a wide variety of backgrounds including individual innovators, large corporations, government agencies, and universities. Clients come to BGNDRF to develop and test advanced water treatment technologies. The research facility focus areas are:

- Renewable energy/desalination hybrids
- Economically viable small-scale desalination systems
- Sustainable concentrate management technologies and processes
- Treatments for produced waters from oil and gas
- Public outreach and education

The research facility also focuses on increasing opportunities for innovative research. The 43-acre grounds offer resources to clients such as:

- Water from four brackish water wells
- Indoor and outdoor testing areas
- Three evaporation pondsLaboratory space
- Spacious conference room
- Office space
- Scientists and environmental engineers with expertise in process development and design

The evaporation ponds are available for nonhazardous concentrate disposal and research (such as enhanced evaporation studies and algal growth in concentrate). BGNDRF has invested in infrastructure to support agricultural research, as in the case of the halophyte farming project for concentrate management, and a greenhouse for further support. In FY 2017, BGNDRF added a mobile solar array. The Solar Rover is available for clients to test water treatment technologies coupled with mobile, solar photovoltaics. The facility is always looking for ways to improve the client experience through adding equipment, such as the FY 2019 additions of a CoGenra Solar Concentrator and Wigen reverse osmosis skid and making infrastructure updates throughout FY 2020 and 2021.

Tribute to Randy Shaw

Randy Shaw managed Reclamation's Brackish Groundwater National Desalination Research Facility (BGNDRF) from August 2010 through December 2020. During that time the facility grew from hosting three projects per year to twenty-one projects in FY2020. Maximizing utilization of BGNDRF was one of his primary goals during his time as facility manager. Randy not only grew the facility in numbers of clients, but also in reputation for excellent customer service and community outreach.

Randy is a graduate of New Mexico State University and a licensed Civil Engineer. Prior to his time with Reclamation, Randy worked for the National Oceanic and Atmospheric Administration (NOAA) and at the NASA White Sands Test Facility. During his time with NASA, he secured a patent on an oxygen compatibility friction testing apparatus. Randy then worked several years with a private engineering firm before serving over two decades with the Bureau of Indian Affairs on irrigation projects receiving water from the Gila River and the Rio Grande.

BGNDRF solar array and water storage tanks. (Reclamation/Trent Parish)

Technical Service Center – Water Treatment Laboratory

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The Water Treatment Laboratory at the Technical Service Center (TSC) performs basic water quality analysis and evaluates water treatment processes at the bench- and pilot-scale. Commonly evaluated processes include:

- Chemical dosing and coagulation using jar testing
- Granular activated carbon (GAC) using rapid small-scale column tests (RSSCT)
- Membrane desalting (i.e., Nanofiltration and Reverse Osmosis) using a flat-sheet membrane skid
- Ion exchange
- Filtration
- Disinfection

Onsite measurement capability includes a total organic carbon analyzer, turbidimeter, and spectrophotometer, and an assortment of probes and test kits for common water quality parameters (e.g., pH, dissolved oxygen (DO), conductivity, chlorine, iron). The Water Treatment Laboratory can also mobilize for field testing at Reclamation sites. The following projects highlight recent laboratory and field work completed by Reclamation's Water Treatment Group.

The Water Treatment Laboratory at the TSC.

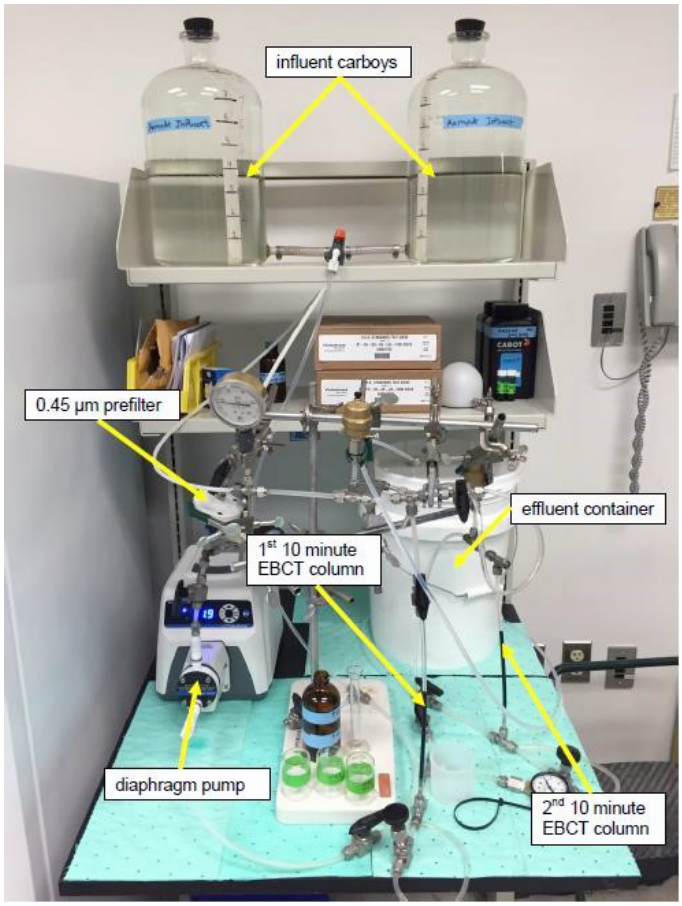
A mobile water treatment laboratory was deployed in the bed of a pick-up truck to collect time-sensitive field measurements.

Distribution system sampling for water quality analysis

Drinking water distribution systems that will be served by a Reclamation project were sampled for bulk water quality. TSC and Area Office staff collaborated with project stakeholders to conduct field sampling using a mobile water treatment laboratory. A sampling device was constructed to control water pressure and flow and collect filtered and unfiltered samples. Time sensitive measurements, such as pH, alkalinity, and chlorine residual were performed onsite, and sample bottles were prepared for off-site measurement of other parameters (e.g., metals).

Disinfection-byproduct formation at long residence times

The formation of disinfection byproducts (DBPs), which are regulated in drinking water distribution systems, were evaluated for a planned treatment plant. Using equipment in the Water Treatment Laboratory, a full-scale treatment process was simulated. River water from the proposed intake site was subjected to conventional treatment (coagulation, flocculation, sedimentation, and filtration) followed by GAC using a RSSCT (see photo) to remove organic carbon. Treated water was disinfected, then chlorine residual was maintained for eight weeks. Samples were periodically collected and analyzed for DBPs. Results of this study will inform the design and operation of a drinking water treatment plant and distribution system to ensure regulatory compliance.



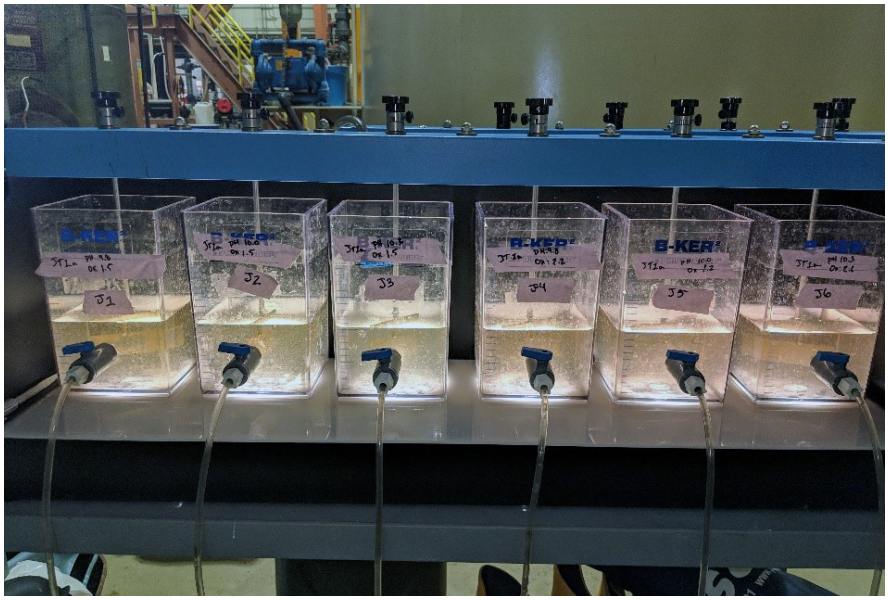
The Water Treatment Laboratory's RSSCT setup is used to evaluate GAC for organic carbon removal. The RSSCT equipment includes carboys to store influent water, a diaphragm pump and prefilter, two columns containing GAC, and an effluent container.

Comparison of powdered activated carbon and a novel biochar for organic matter removal

A novel powdered ash-treated pine biochar (PATB) was compared to powdered activated carbon (PAC) for the removal of dissolved organic matter (DOM) and organic micropollutants (OMPs) from deionized water, a raw surface water, and a treated wastewater using jar tests (see photo). PATB performance (capacity and kinetics) was the primary focus under realistic water treatment adsorbent doses (<200 mg/L) and contact times (<120 minutes).

Jar testing to determine chemical dosing

Jar testing (see photo) was conducted on-site at a Reclamation facility to screen several oxidants for improved manganese removal. Potassium permanganate, the selected oxidant, was then evaluated at multiple doses across a range of seasonal water qualities, including a challenge period, to determine design parameters for a treatment plant.



The Water Treatment Lab commonly uses jar testers to evaluate chemical treatment processes. Pictured here is on-site jar testing of an oxidant for manganese removal.

COMPLETED RESEARCH

Water Quality Impacts in the Animas and San Juan River Basins

By Alyssa Aligata & Catherine Hoffman
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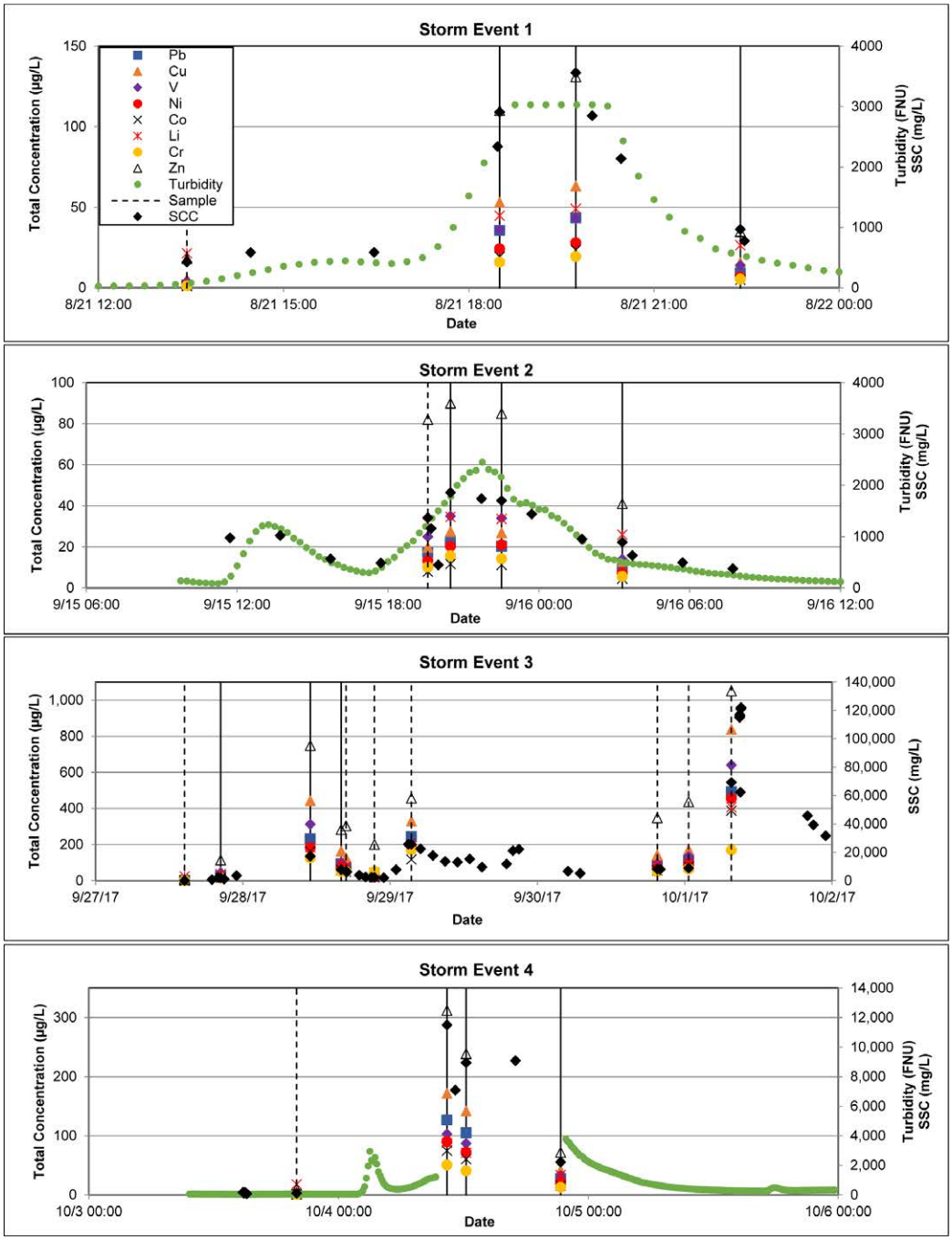
https://www.usbr.gov/research/projects/detail.cfm?id=1790

The Navajo-Gallup Water Supply Project will convey water from the San Juan River to the eastern section of the Navajo Nation, the southwestern portion of the Jicarilla Apache Nation, and the City of Gallup, New Mexico. The design and construction of the San Juan Lateral (SJL) water treatment plant (WTP) is part of this project. The SJL WTP will treat water from the San Juan River to meet Safe Drinking Water Act (SDWA) requirements. Chemical dosing and filter run times are examples of water treatment operational parameters that are dependent on the influent water quality. The primary purpose of this S&T project was to better understand the influent water conditions during monsoons, especially the duration and magnitude of the water quality fluctuations.



This project measured water quality from four storm events: three in 2017 and one in 2018. Turbidity, discharge flow rate, and suspended sediment concentration (SSC) were measured throughout the storms.

Turbidity, SSC, and several total metals concentrations in the San Juan River for each storm event. Note the differences between the scales on each axis. Turbidity in Storm Event 3 is not shown so that the scale of the SSC and total metals can be easily seen.

Other water quality parameters, including total and dissolved metals, were measured several times during each storm. The parameters that exceeded SDWA limitations during the storm events include total aluminum, total antimony, total arsenic, total barium, total beryllium, total iron, total lead, total manganese, total dissolved solids, and sulfate. Dissolved aluminum and iron were also observed at elevated levels for several samples. The duration of the water quality impacts to the river from the storms ranged from approximately 12 hours (Storm Event 1) to 4 days (Storm Event 3); however, based on the level of suspended sediment and metals, water intake may not need to be suspended for the entire storm event.

No correlation was observed between discharge flow rate and turbidity or SSC in the San Juan River near the Hogback Diversion, based on data from the four storms studied. This may be a characteristic of the San Juan River because there are many ephemeral streams in its watershed that could increase solids without increasing river flow. It is likely that the turbidimeter falsely recorded low values during Storm Event 3 because the high SSC interfered with its measurement process. When Storm Event 3 data were excluded, the overall relationship between turbidity and SSC was strong. Strong correlations also occurred with turbidity and many total metals. There is potential to use turbidity to predict SSC and several total metals if the turbidity is not near the maximum recording limit of the turbidimeter. However, an acoustic attenuation sensor would be more accurate and would not risk the same malfunction at high SSC. It is strongly recommended that this type of sensor should be tested and calibrated to the SSC in the San Juan River. This type of sensor can be an online measurement and would be a great tool to inform intake operations.

The variations in water quality during storm events could inform WTP operations by showing the benefit of halting water intake during storms where high concentrations of metals are present, particularly dissolved metals that will not settle out, which could impact finished water quality and solids disposal.

Overlooking the San Juan River Basin from Muley Point, with Monument Valley on the horizon.

Ion Exchange Pretreatment for Desalting Membrane Processes to Maximize Potable Water Production

By Miguel Arias-Paic, Leah Flint, Neal Gallagher, & Anthony Kennedy
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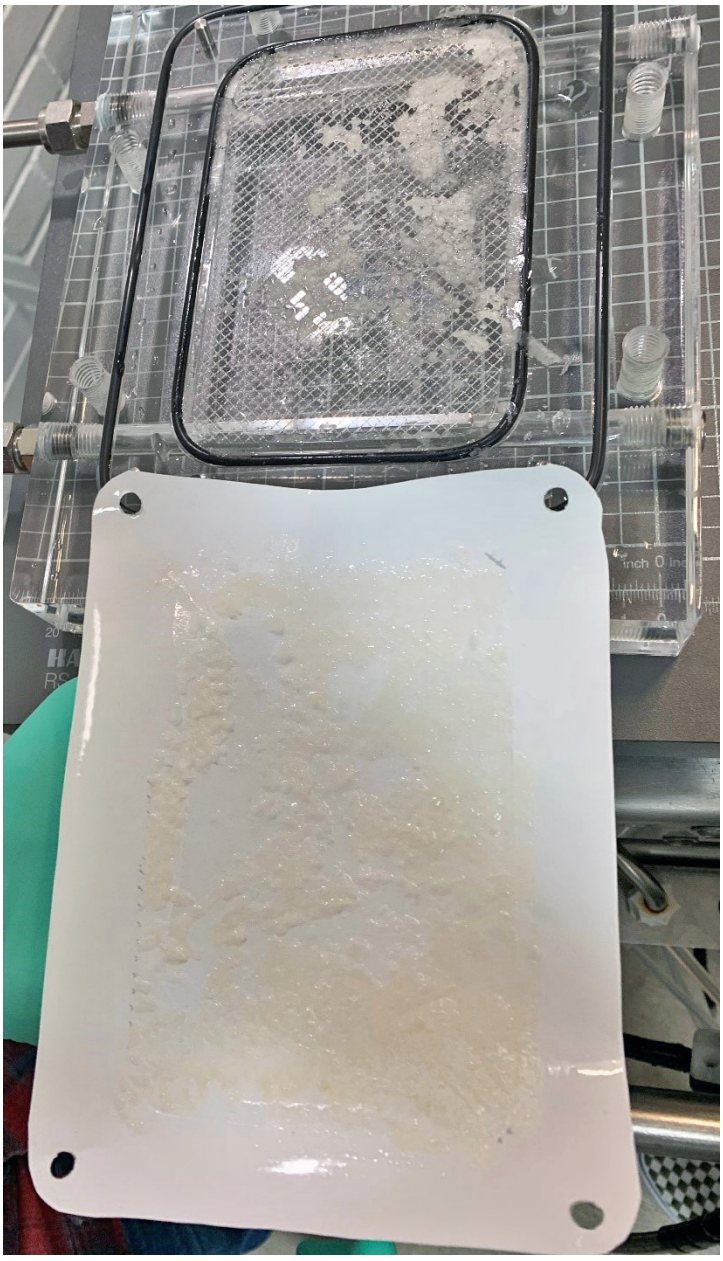
https://www.usbr.gov/research/projects/detail.cfm?id=20092

Reverse osmosis (RO) is the principal process used to produce potable water from seawater, brackish water, wastewater, agricultural drainage water, and other impaired/contaminated water sources. The principal difficulty of RO operation is recovery-limiting scale formation on the membrane surface when sparingly soluble salts are concentrated with increasing potable water recovery. Greater water recovery currently requires chemical addition to prevent these sparingly soluble salts from scaling RO membranes. Even so, overall water recovery for RO is limited and significant concentrate volume is often the primary impediment to its implementation. The proposed proprietary process will use a combination of cation ion exchange (IX) resin, nanofiltration (NF) membranes, and RO membranes operated in series to increase overall water recovery and reduce RO concentrate volume. The hybrid IX/NF/RO process will operate in a closed loop system, in that the treated water stream will feed the next process and each waste stream will be used to either regenerate the IX resin or precipitate sparingly soluble salts in a separate reactor. The process will be applied to two brackish water sources, agricultural drainage water from California (~15,000 mg/L total dissolved solids) and the Arkansas River from the Colorado/Kansas border (~3,500 mg/L total dissolved solids).



Scale formation on an NF membrane using Arkansas River water.

Recently, Reclamation has been working on efforts to mature this technology and moving toward commercialization by publishing our notice of intent to license with AYON, LLC via the Federal Laboratory Consortium (FLC) website (https://federallabs.org/licenses-list/all). Reclamation has entered into a Cooperative Research and Development Agreement (CRADA) with AYON, LLC to further this technology.

Emerging Technologies for High Recovery Processing

By Andrew Tiffenbach
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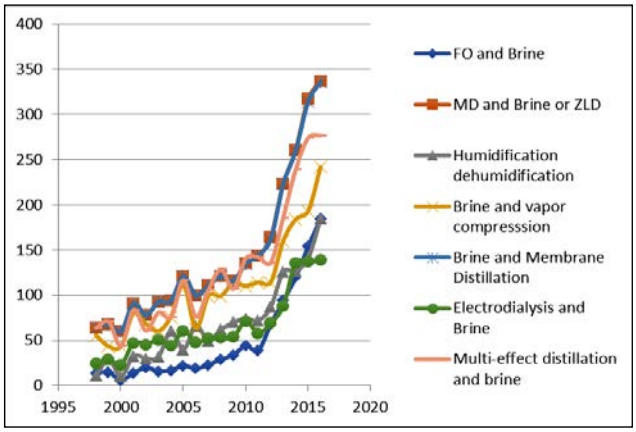
https://www.usbr.gov/research/dwpr/reportpdfs/report208.pdf

Mickley and Associates (using funding provided through the DWPR program) developed a reference document to help utilities and industries better understand the current state of high recovery processes being researched, emerging, and available commercially. High recovery processing is expensive and usually cost-prohibitive for municipal applications. There is, however, growing interest in achieving higher recovery levels in the municipal sector, where higher recovery processing can: 1) make more efficient use of water resources; 2) be an alternative to expanding an existing municipal desalination facility to produce more product water; 3) reduce the volume of final residuals to be disposed; and 4) in some cases, result in a disposal option where no other disposal option is available.

The project involved gathering and analyzing information about high recovery technologies and the companies developing and selling them. The subject matter is broad with many different technologies, many different companies, and many different applications covering a wide range of brine salinities, compositions, and complexities. The technologies reviewed include modifications of conventional high recovery technologies, as well as newer technologies being developed for high recovery processing.



High Recovery Processing Research Literature Trends.

To date, high recovery processing systems have had a limited impact on the marketplace. However, for most technologies, companies have clearly made progress in the definition of performance and cost, in definition of promising market niches, and in the number of pilots, demonstrations, and commercial installations.

Tailoring Advanced Desalination Technologies for 21st Century Agriculture

By Andrew Tiffenbach
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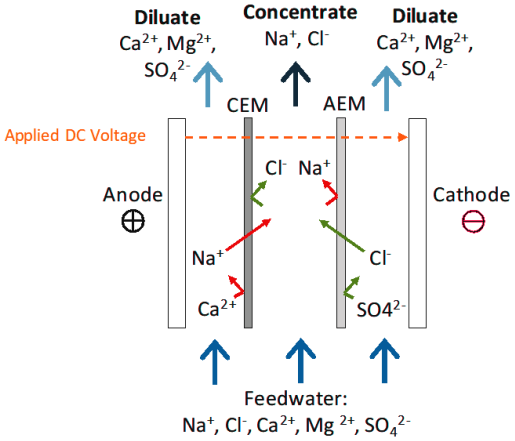
https://www.usbr.gov/research/dwpr/reportpdfs/report226.pdf

This research, performed by the Massachusetts Institute of Technology and funded through the DWPR program, sought to address water and food security issues by cost-effectively and energy-efficiently enhancing water quality and water supply in greenhouses. Greenhouses widely desalinate saline irrigation water to improve their operations. However, currently used desalination methods do not tailor greenhouse waters based on crop water quality requirements. This work investigated a fully integrated desalination solution that treats and tailors brackish-source waters in greenhouses to save fertilizer and water. Specifically, this project experimentally studied multi-ion transport in, and assesses the economic viability of, monovalent selective electrodialysis (MSED). MSED allows for the selective removal of monovalent ions damaging to crops and the retention of divalent ions beneficial for crops, unlike the widely used reverse osmosis, which removes all ions from greenhouse source water.



A simplified monovalent selective electrodialysis stack consisting of two electrodes, a cation-exchange membrane, and an anion-exchange membrane.

First, the techno-economic feasibility of MSED was compared to other brackish desalination technologies for agricultural applications. Then, a bench-scale set-up was built to experientially characterize MSED membrane properties, including monovalent selectivity, ion transport, limiting current and resistance, for multiple brackish feedwaters and for two sets of MSED membranes. Both MSED membranes show notable monovalent selectivity for all tested compositions, reflecting the potential of the technology for selective desalination in greenhouses. The measurements were also compared to a model for MSED in multi-ion solutions.

RESEARCH IN-PROGRESS

Concentrate Minimization through Development of an innovative In-line Static Mixer

By Saied Delagah
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https://www.usbr.gov/research/projects/detail.cfm?id=20058

Concentrate management and volume reduction are limited today by their associated treatment costs, thus limiting widespread use of inland desalination for water supply augmentation. Reclamation and its stakeholders have a need to cost-effectively desalinate impaired waters to meet growing water demand.

The goal of this study is to design and develop an in-line static mixer that causes precipitation with the least amount of energy input. Our previous work in this area, https://doi.org/10.1016/j.seppur.2018.09.084, https://doi.org/10.1016/j.colsurfa.2021.126473 demonstrated that mixing energy and material surfaces can increase the rate of crystallization. This study will scale up the design and fabrication of this innovative mixer based on our previous findings and performance-test it for concentrate volume minimization and overall system recovery. A techno-economic assessment will be completed to demonstrate the economic value of this mixer. Reclamation staff will partner with a team at CU Boulder who have been working with BOR on finding solutions for concentrate for the past few years. Their expertise and capabilities will be leveraged with Reclamation's resources and expertise to meet the needs of Reclamation and others needing solutions for concentrate/brine streams.

3-D printed mixer media to generate needed mixing energy for precipitation of salts.

In-line mixer with inserted media.

The expected outcome is the creation of a novel mixer that can reduce concentrate volumes cost-effectively and increase overall system recovery which will allow for more wide-spread use of desalination inland to augment water supplies.

San Juan Lateral Source Water Blending and Corrosion Study

By Anthony Kennedy
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https://www.usbr.gov/research/projects/detail.cfm?id=20008

The Navajo-Gallup Water Supply Project (NGWSP) is being constructed to convey potable water from the San Juan River to the eastern Navajo Nation, southwestern Jicarilla Apache Nation, and the city of Gallup, New Mexico. These areas currently rely on community water systems (CWSs) supplied by depleting groundwater of poor quality, inadequate to meet current and future demands. Ground water levels for the city of Gallup have dropped ~200 feet over the past 10 years and over 40% of Navajo Nation households haul water to meet daily needs.

Installing pipe along the Navajo-Gallup Water Supply Project.

— San Juan Lateral Source Water Blending and Corrosion Study continued on next page

Desalination and Water Purification Research Program

By Andrew Tiffenbach
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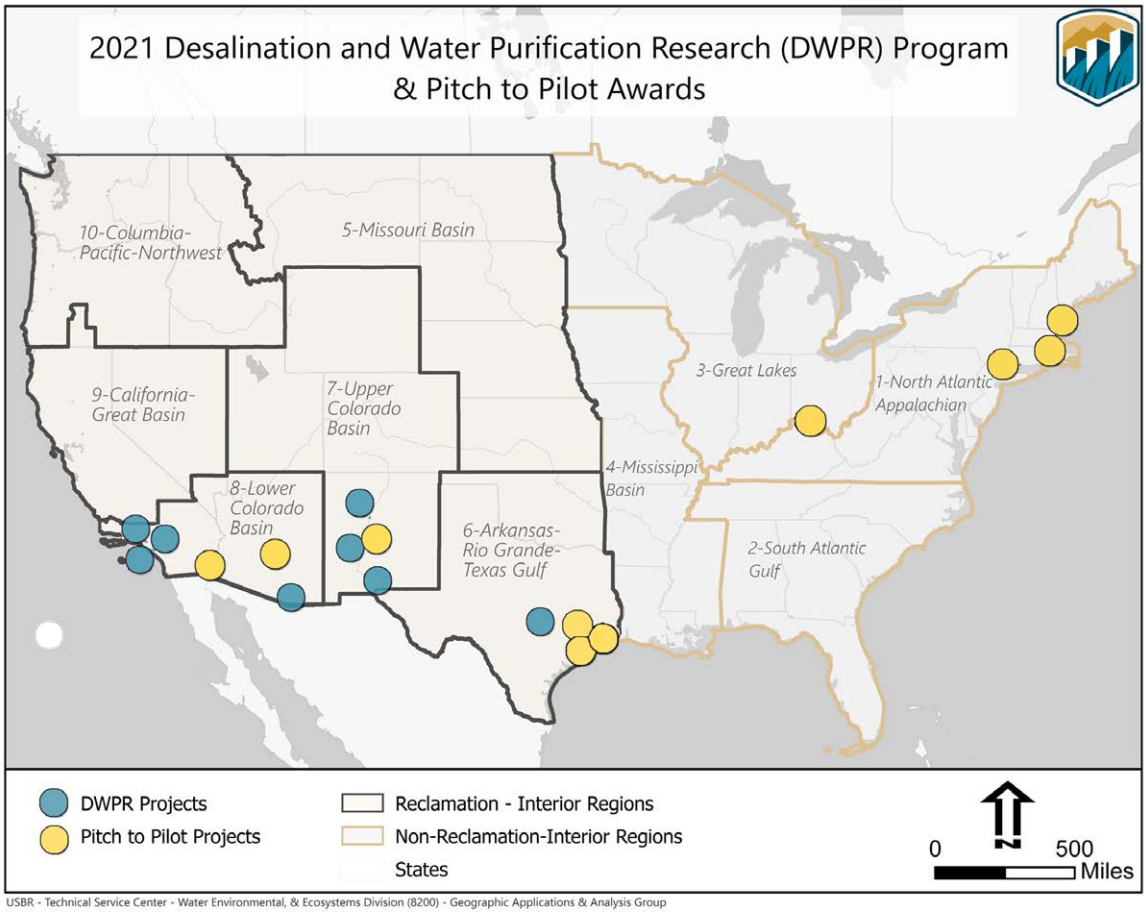

In 2021 $3.6 million was awarded to six laboratory projects and four pilot projects under Reclamation's Desalination and Water Purification Research (DWPR) Program. These projects encompass a wide variety of water treatment topics, including selenium treatment, brine management, produced water, thermal desalination, advanced membrane materials, and more. In addition to the federal funds provided through the DWPR Program, recipients will be providing $5.3 million in non-federal funds to support these research projects.

Also, in 2021, $1.2 million was awarded to eight projects under the DWPR Pitch to Pilot Program. These projects were selected through a unique two-phase funding opportunity, where selected applicants pitched their project to a panel of technical experts. Selected projects include topics such as machine learning, water quality monitoring, concentrate treatment, and more. Recipients of these awards have committed $835,000 in non-federal funds to support these research projects. Additional information on these projects:

https://www.usbr.gov/newsroom/newsroomold/newsrelease/detail.cfm?RecordID=73785

https://www.usbr.gov/newsroom/newsroomold/newsrelease/detail.cfm?RecordID=73526

San Juan Lateral Source Water Blending and Corrosion Study continued—

This project focuses on quantifying and characterizing CWS water distribution pipe to determine mitigation measures for internal pipe corrosion and scale release (e.g., iron, manganese, arsenic, lead, etc.) from changing water sources (i.e., groundwater to surface water). A change in source water for an established CWS requires in-depth analysis to ensure that chemistry changes will not negatively impact pipe and water quality at the point of use (e.g., residential, commercial, etc.).

The proposed introduction of treated surface water to CWSs to be serviced by the NGWSP requires detailed evaluation of distribution system infrastructure, water quality stability, and corrosion potential to prevent a situation like the Flint, MI, water crisis. The expected outcomes from this research can be grouped into three categories: (1) an understanding of how the treated surface water will impact existing CWSs, (2) an understanding of how distribution system constitution, layout, and operation impacts water quality, and (3) recommendations for further studies and operational plans.

DEVELOPING RESEARCH STRATEGY

Advanced Water Treatment Research Roadmap

By Saied Delagah
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The Bureau of Reclamation (Reclamation) has been a leader in advanced water treatment research and technology development since the mid-1950s with the inception of the U.S. Department of the Interior's Office of Saline Water, which later evolved into the Desalination and Water Purification Research Program in Reclamation's Research and Development Office. Throughout this time period, Reclamation's contributions have been documented in numerous water treatment process and technology patents, research reports, peer reviewed journal publications, decision support tools, and externally funded research projects. Reclamation's unique perspective as a water provider in the arid Western United States (U.S.), shown in figures 1 and 2, has informed and guided advancements in the treatment and beneficial use of impaired water sources, such as saline surface water and groundwater, seawater, reclaimed wastewater, agricultural drainage water, and industrial wastewater. These advancements have served not only the needs of the Western States, but they have also been applicable nationwide.

The dual purpose of the Advanced Water Treatment Research Roadmap (Roadmap) is to document the state of water treatment research and technology development at the time of publishing and to identify gaps in water treatment research needed to reduce barriers in implementing advanced water treatment to increase water supplies. The key factor limiting the use of advanced water treatment technologies is cost. The cost of water treatment is dependent on many variables, including feedwater quality, location of treatment, cost of energy, labor and other operations and maintenance (O&M) expenses, financing, and many other variables. The cost of developing freshwater supplies from impaired sources is justified by the value of treated water to the user relative to cost to develop other water supply alternatives.

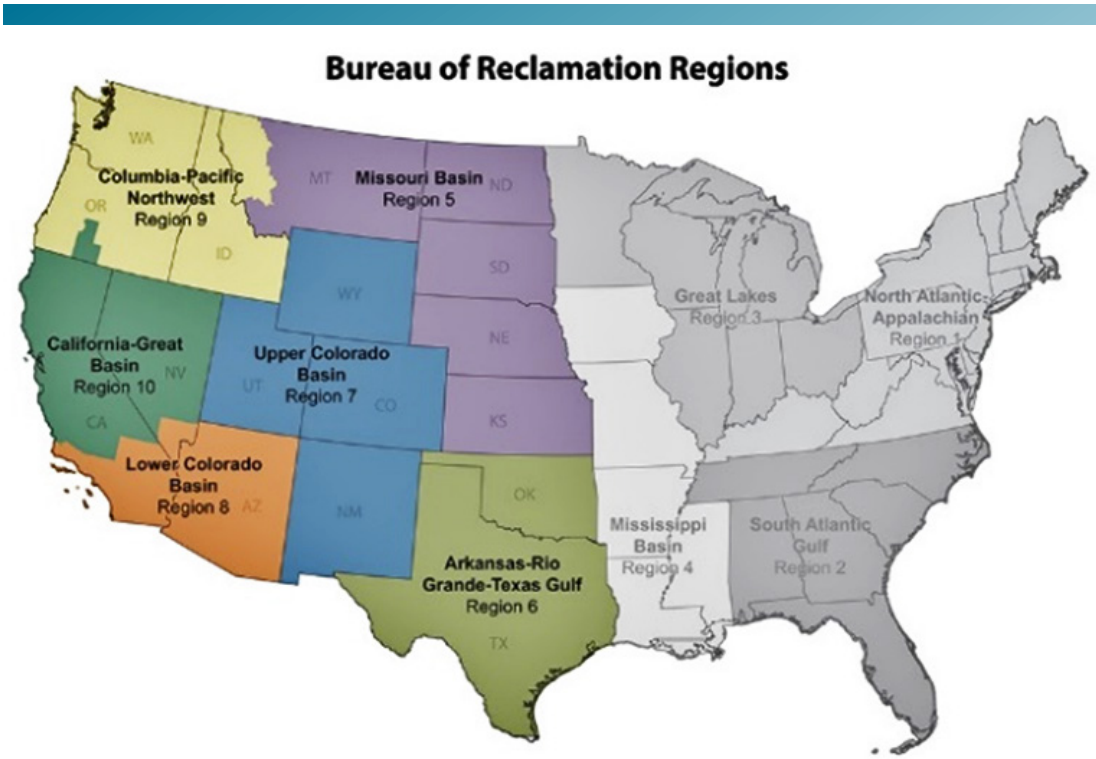

Figure 1.—Reclamation Regions and mission area. (Bureau of Reclamation, n.d.).

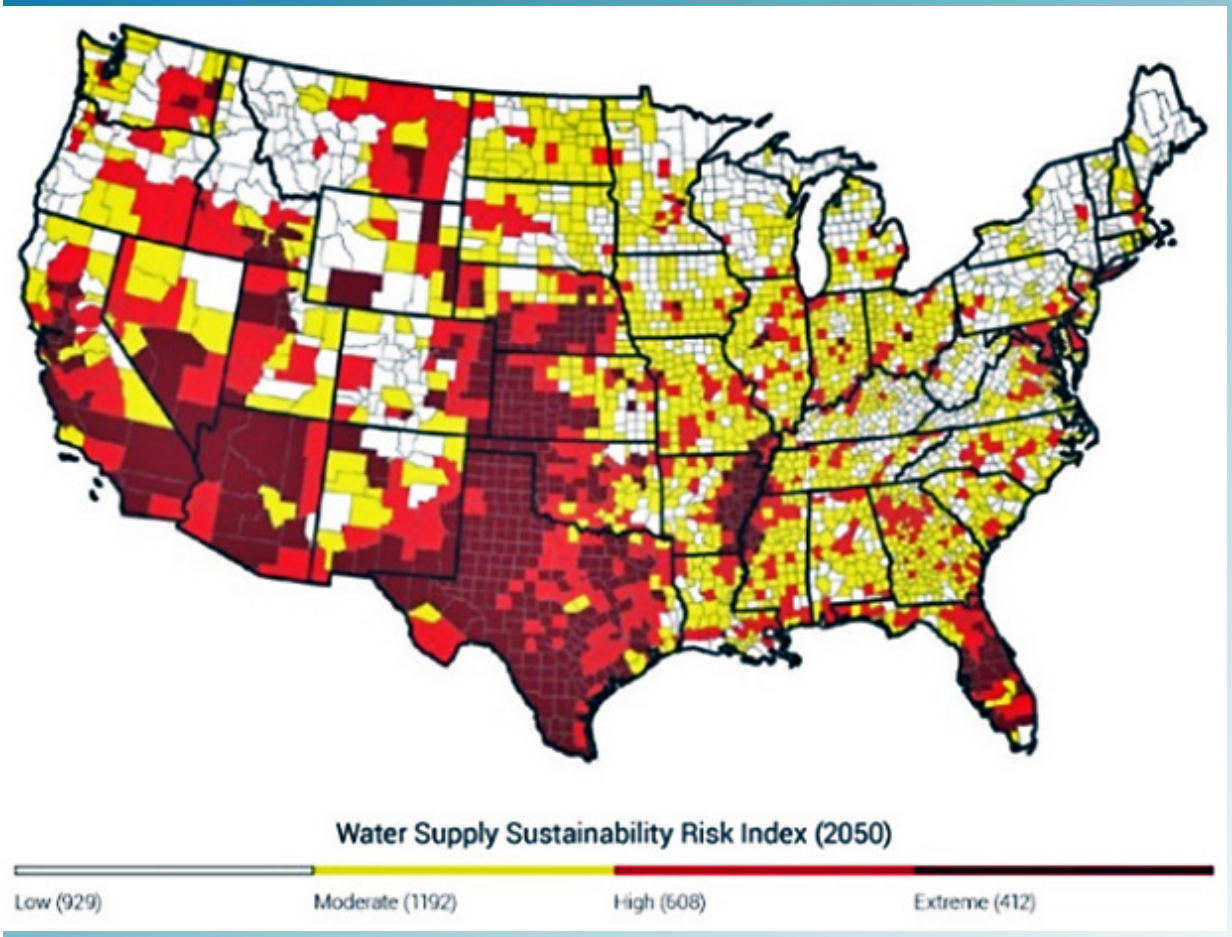

Figure 2.—Anticipated water shortages by 2050 (National Climate Assessment, 2014).

This Roadmap serves as an update to the Desalination and Water Purification Technology Roadmap: A Report of the Executive Committee, published in January 2003 (Bureau of Reclamation and Sandia National Laboratories, 2003). The 2003 document covered the time period from 2002 to 2020 and focused on technology development areas (membrane technologies, alternative technologies, thermal technologies, concentrate management technologies, and reuse and recycling technologies).

This updated Roadmap picks up where the 2003 document left off, recognizing the gains made over the past 18 years and emphasizes the key challenges associated with specific water sources and uses thus to help focus future efforts in areas with the most potential benefit.

The research needs identified in this Roadmap will inform Reclamation's priorities in both internal and external funding opportunities.

PARTNERSHIPS/COLLABORATIONS

American Membrane Technology Association/ Reclamation Fellowship Program

By Kim Shugar, Executive Director of the American Membrane Technology Association
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The American Membrane Technology Association (AMTA), as the leading professional association dedicated specifically to membrane treatment technology and research—in partnership with the Bureau of Reclamation—administers the AMTA/ Reclamation Fellowship Program for membrane innovations for water treatment.

Through generous grants from the Bureau of Reclamation, AMTA/Reclamation Fellowships are made available annually to four graduate students studying at a university or college in the United States. The fellowships are designed to support advancements that will yield new types of membrane systems or optimize existing technology that reduce the cost, energy usage and environmental impacts of membrane-based advanced water treatment and desalination.

AMTA Awards group photo.

The research supports AMTA's vision to "solve water supply and quality issues through the widespread application of membrane technology." This research is critical for meeting the water supply demand in the U.S., especially in arid areas of the west.

The AMTA/Reclamation Fellowships lead to cutting-edge innovations in membrane technology and provide career development for some of our brightest young minds.

The Fellowship awardees attend and share their research through a podium or poster presentation at the annual Membrane Technology Conference and Exposition. This premier conference allows attendees to explore the latest developments in membrane technology and new directions in water and wastewater treatment technologies, desalting and membrane bioreactor applications.

AMTA has administered the AMTA/ Reclamation Fellowship Program since 2016, with 12 recipients being awarded a Fellowship. Information on the Fellowship recipients and their research is available at AMTA/Reclamation Fellowships for Membrane Technology.

Membrane Science, Engineering & Technology Center

By Yifu Ding
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With rising challenges in water scarcity and security, the need for cost-effective water treatment technologies is ever pressing. Membrane-based separation technologies are important for addressing these challenges, thanks to their low energy cost, small footprint, versality, and high modularity. With a combination of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF) and microfiltration (MF), membranes can separate essentially any contaminants from water. Water treatment is one of the major research themes of the Membrane Science, Engineering and Technology (MAST) center, the only NSF-supported, Industry- University Collaborative Research Center (IUCRC) on membrane research. Since 1992, Reclamation has been partnering with the MAST center to develop new technologies for water treatment. This partnership has led to over 40 research projects in water treatment that are carried out in 7 different universities. Reclamation has been such a critical partner in shaping the water treatment theme of the MAST center, in collaborations with other agencies including EPA, DOD (TARDEC), DOE Labs (NREL, Sandia, and LANL), membrane manufacturers such as Dow Filmtec, Koch, Millipore, 3M, Gore, and Pall, and technology users such as Southwest Energy, UNOCAL, EPRI, Garver, Tyson Foods, Garver, Hawaii Agriculture, AkzoNobel, Lockheed in energy, food, agriculture, chemical and aerospace industries.

Those projects, precompetitive in nature, have produced unprecedented knowledge on membrane-based water treatment technologies, which is disseminated through a large volume of publications, reports, patents, and presentations. Those projects can be broadly categorized into two areas: 1) understanding and mitigating fouling in membrane processes, and 2) developing new membrane technologies. Fouling is the single most important issue that affects all liquid-based membrane separation process.

As such, half of those 40 projects have been focused on all aspects of membrane fouling including (1) fundamental understanding of fouling occur within the membranes (internal fouling) and at desalination system scale, (2) developing new real-time acoustic and optical sensor technologies for fouling detection and mitigation, (3) developing new testing technologies for rapid screening of water fouling potential, and (4) developing new antifouling, high performance membranes including new mixed-matrix membranes, surface patterned membranes. In addition, the MAST Center has heavily invested in research that focuses on developing new membrane-based processes and technologies, including membrane distillation for treating high TDS water; coupled UV-membrane processes, wafer-enhanced electrodeionization process, supercritical CO_2 extraction of foulants, magnetic field-coupled membrane process, forward osmosis, integrated photovoltaic-electrolysis and air-gap membrane distillation. In addition to desalination, these processes are being applied to remove trace organic compounds and drugs and recovery of resources including precious metals and nutrients. With expansion to 4 university sites, the MAST center is looking forward to continuing its partnership with Reclamation to address new challenges in water treatment in areas of both improving existing technologies like RO and developing next generation technologies.

New Mexico State University - Center for the Development and Use of Alternative Water Supplies

By Sam Fernald
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The Center for the Development and Use of Alternative Water Supplies is a cooperative agreement between the Bureau of Reclamation and New Mexico Water Resources Research Institute (NM WRRI) at New Mexico State University (NMSU) to increase scientific knowledge and research expertise in the area of characterization, treatment, and use of alternative waters for water supply sustainability in New Mexico and the western United States.

Alternative waters of marginal quality and not ready for use, including brackish and produced waters, represent important new water sources for sustainable water supplies in New Mexico and the western U.S., where water scarcity is pervasive. Efficiently and sustainably making use of these waters requires new treatment technology, new methods to dispose of concentrate, improved assessment of the quality and quantity of source waters, and tools to show how these approaches can be combined into effective new integrated systems and multidisciplinary approaches.

One component of this collaborative work resulted in nine funded competitive faculty research projects. Six of these projects have published technical completion reports and can be found at https://cduaws.nmwrri.nmsu.edu/research-team/. Each project has its own notable highlights, such as research resulting in a patented novel manufacturing method for producing nanopore membranes; the development of a powerful and dynamic platform for the analysis of organic compounds in water samples, contributing to expanding traditional water resource and treatment of alternative waters by developing anti-fouling, anti-adhesive, permselective and energy-efficient ion-exchange membranes; ongoing larger-scale research awarded by the Desalination and Water Purification Research Grant Program; gaining a better understanding of groundwater flow, salinity sources, and flow path mixing in the Mesilla Valley with the use of geochemical tracers and lithological chemical analyses; and many technical reports and publications in high impact journals. Two competitive faculty research projects' final reports are under review, and one is pending completion.

Another component of the project innovatively addresses the role of alternative water supplies in the water budget of the Lower Rio Grande planning region in southern New Mexico. A team of researchers at NM WRRI continues to work on the first directed research project approved under this agreement. This project is exploring the potential role of desalination in creating a new water source for the Lower Rio Grande planning region in New Mexico. The approach utilizes a system dynamics modeling framework to show the impacts of alternative water supplies and of a wide range of policy options on the water system, the viability of agriculture, and the overall economy of the region. It includes impacts of new technology and assesses interactions with other critical local uses, namely, agricultural irrigation and urban water supplies. The Lower Rio Grande Offshoot Model is coupled to the New Mexico Dynamic Statewide Water Budget, showing alternative water supply impacts on regional water budgets. The tool being created by this project is transferable and is being used to show alternative water supply impacts in other planning regions in New Mexico and beyond.

Water Agriculture Experiment (top photo); BGNDRF Tour in 2016 (bottom photo).

The cooperative agreement supports a burgeoning nexus of inland brackish water desalination research, drawing on expertise at NMSU, other regional partners, and Reclamation's Brackish Groundwater National Desalination Research Facility (BGNDRF). Research projects at BGNDRF supported by the cooperative agreement include various treatment technologies and reuse of concentrate for agricultural applications. The cooperative agreement is even opening the door to a unique partnership between Reclamation, NMSU and NM WRRI to help with staffing BGNDRF with local experts to complement the federal employees.

The cooperative agreement is even opening the door to a unique partnership between Reclamation, NMSU, and NMWRRI to assist BGNDRF with local experts to complement the research being conducted at the facility. NM WRRI and BOR look forward to continuing their collaboration beyond this 5-year agreement to increase the scientific knowledge of alternative water characterization, treatment, and use for water supply sustainability in New Mexico and the western United States. The continuation of this collaboration will enhance the research expertise at NMSU by working with Reclamation technical experts to confront the challenges laid out in this agreement and new challenges that may arise in the future.

Water Treatment Interagency Working Group (WaTr)

By Jay Dusenbury
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The Army GVSC has been a member of WaTr since its inception and was part of the collaboration which established WaTr. In fact, the Army was one of the founding members, along with the Bureau of Reclamation (Reclamation), of the forerunner to WaTr, the Interagency Consortium for Desalination and Membrane Separation Research (Consortium) and has been collaborating with the Reclamation in this area since 1991. WaTr and the Consortium have provided excellent forums to share information on projects, prevent duplication of efforts, and improve communications across government agencies. It has also provided an opportunity to network and build enduring relationships between organizations while leveraging specialized facilities, capabilities and knowledge. Benefits of participation include federal agencies assisting each other in reviewing proposals to bring a different perspective and broader expertise and background to the process, collaborative research projects on membrane treatment, sharing research results and reports to inform future programs and calls for proposals. For example, Reclamation and the Army joined forces to document methods for measuring membrane productivity in aid of ASTM effort to update the standard for membrane performance. A highlight of the relationship was a collaborative effort between the Army, Navy, and Reclamation to develop an expeditionary unit water purification system that fit in two ISO shipping containers, produced 100,000 gallons of water per day and was deployed to support Hurricane Katrina.

The National Alliance for Water Innovation

By Peter Fiske
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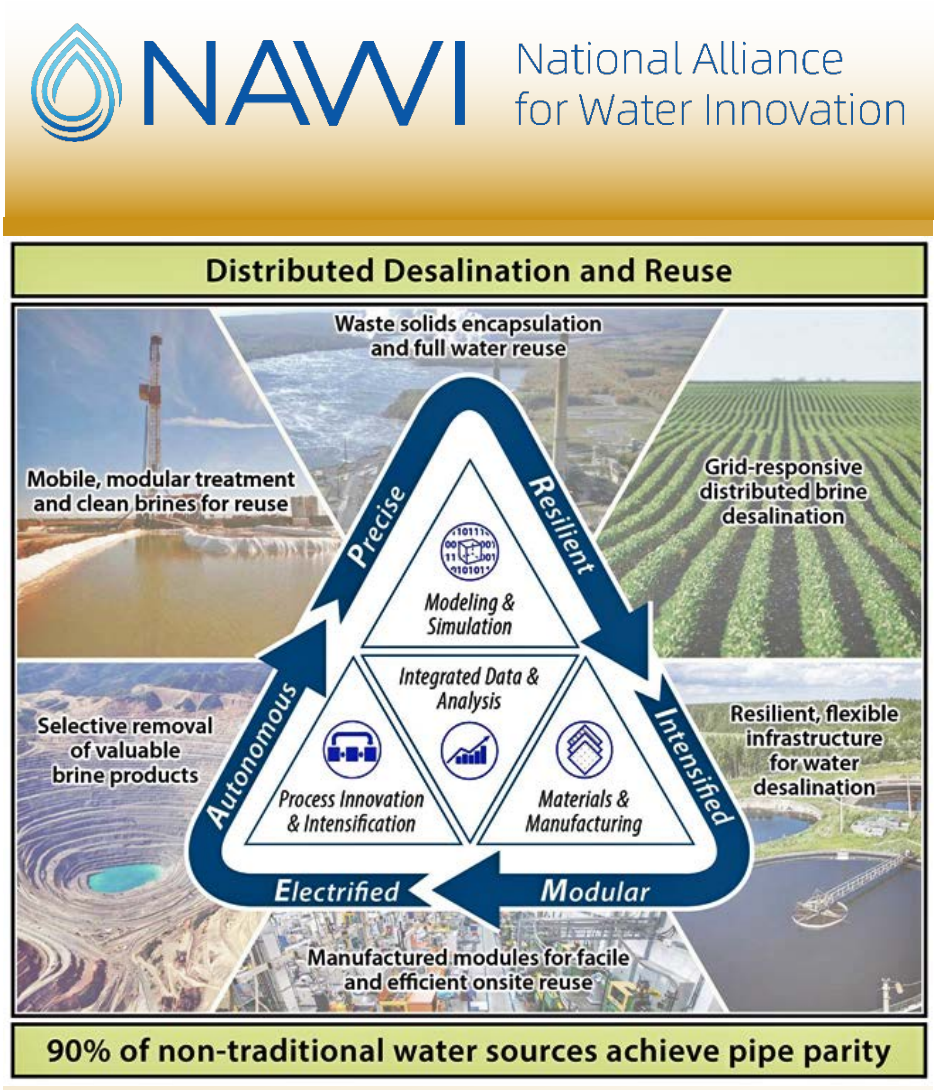
The National Alliance for Water Innovation (NAWI) is the U.S. Department of Energy's first major research investment in desalination, a space that the Bureau of Reclamation (Reclamation) has supported for decades. This 5-year, $110M program aims to rapidly advance the state-of-the-science of desalination through a program of early-stage applied research. This focus on early-stage research complements Reclamation's longstanding research focus on nurturing and piloting technologies and demonstrating desalination systems. Leveraging our partnership with Reclamation, NAWI hopes to bring forward a new "toolkit" of high-efficiency desalination technologies and supporting capabilities that will enable smaller-scale desalination systems, with a focus on enabling distributed reuse of "non-traditional" water sources such as municipal, agricultural, and industrial wastewater, and brackish groundwater.

Reclamation has been actively engaged in the creation of NAWI from the beginning. DOE consulted with Reclamation as the program opportunity was developed and Reclamation Engineer Saied Delagah was invited to be a member of the Fed panel that chose the NAWI team. Since the program started last February, Reclamation has been an active partner and "friend of NAWI". NAWI has marketed Reclamation's research funding opportunities, such as the wildly successful Pitch-2-Pilot program. Reclamation technical staff have been invited to review proposals submitted to NAWI funding opportunities as well as participating on several of the NAWI Year 1 Roadmapping teams. These study groups mapped out the future research needs for desalination research for 5 different "PRIMA" water end-uses: Power, Resource Extraction, Industrial, Municipal and Agriculture. These 5 roadmaps, and NAWI's entire library of digital content are available at the NAWI website: https://www.nawihub.org.



Overarching diagram showing NAWI's 5 challenge areas and the concept of desalination to enable water reuse.

National Water Reuse Action Plan – Collaborative Water Sector Effort Builds Local Capacity for Reuse

By Sharon Nappier, U.S. Environmental Protection Agency
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Water reuse can enhance the security, sustainability, and resilience of our water resources and help to solve local water quantity and quality challenges. Incorporating reuse as part of a community's water portfolio can serve to mitigate climate-induced impacts like drought, flooding, and land subsidence from groundwater overdrafts. However, communities may face various implementation challenges, such as technical capacity, funding limitations, and issues of public perception.

The National Water Reuse Action Plan, or WRAP, is helping to build local capacity to pursue reuse practices and enhance resilience. The collaborative features more than 40 actions from over 100 federal, state, tribal, local, and water sector partners focusing on advancing technical, financial, and institutional aspects of reuse.

In April, EPA released the WRAP Update on Collaborative Progress showcasing some of the key accomplishments of the first year of the WRAP and forecasting upcoming milestones. One of the featured actions is EPA's effort to compile and summarize the different fit-for purpose specifications, both microbial and chemical, for different applications of water reuse. With multiple end-use applications regulated by many different state regulatory frameworks, it can be daunting for practitioners to easily access and understand the scientific basis of different approaches. The compilation will rely on federal, state, and international sources to inform water reuse best practices and facilitate broader implementation of reuse projects.

The WRAP provides an important framework to advance the consideration of reuse, but our collective success is directly tied to contributions and collaborations from members of the water community, including the Bureau of Reclamation. The U.S. Bureau of Reclamation leads an action focused on the development of an Advanced Water Treatment Research Roadmap to identify research needs in this area.

I invite you to join us! To learn more about reuse activities and how to get involved in the WRAP, please visit https://www.epa.gov/waterreuse/national-water-reuse-action-plan-join-effort.

Featured Faces

Jessica Asbill-Case

Jessica Asbill-Case, Water Resources Program Manager, Phoenix Area Office has spent three years working with Denver's Technical Services Center, Colorado School of Mines, and National Renewable Energy Laboratory in a pilot study to remove salinity by reverse osmosis using on off-grid solar PV desalination unit on the Navajo Nation.

Neal Gallagher

Neal Gallagher, P.E., Civil Engineer, with 14 years experience (including graduate thesis work) in water treatment research, process development, site and facility design, construction, and operations. He recently spent 11 years working in the mining and industrial wastewater treatment industry and has particular expertise in process development for unique and challenging waste streams, the development and design of passive treatment systems for innovative applications, and anaerobic treatment of blackwater in decentralized wastewater treatment systems.

Alyssa Aligata

Alyssa Aligata, EIT, Civil Engineer, has 3 years of water and wastewater treatment experience including bench-scale testing, treatment plant investigations, source water protection planning, mine drainage treatment, and international projects. Her areas of expertise include potable water reuse and advanced treatment processes as well as harmful algal bloom mitigation.

Leah Flint

Leah Flint, P.E., Civil Engineer, has worked with Reclamation for almost 5 years on bench-and pilot-scale water treatment projects focusing on chemical and physical treatment processes, disinfection byproduct formation, source water blending, and corrosion control in distribution systems.

John Irizarry

John Irizarry XMNR (Executive Master in Natural Resources) Has over ten years of experience in water treatment and policy with small drinking water systems and has been the lead for Title XVI and WIIN projects in the Albuquerque Area Office since 2017. Worked as a Level IV Wastewater Treatment operator at a pharmaceutical facility, and has been involved in projects related to desalination, ASR, water reuse and water conveyance.

Nathan Kuhnert

Nathan Kuhnert is a hydrologist with Oklahoma-Texas Area Office and has actively worked with Reclamation's Advanced Water Treatment team on various projects including hexavalent chromium removal, Reclamation's WaTER model, produced water roadmap development and most recently constructed wetlands and a S&T internal proposal. Nathan also is a Grants Officer Technical Representative on an active Desalination Water Purification Research produced water project requiring coordination with the AWT team.

Catherine Hoffman

Catherine Hoffman, Ph.D., P.E., Civil Engineer, has 10 years of experience in water treatment research and has been working on research and design projects at Reclamation for four years. Her areas of expertise include oxidation processes, water reuse, and trace organic contaminants.

Anisha Lamsal

Anisha Lamsal, Environmental Engineer, has 2 years of water and wastewater treatment experience, including both design and laboratory work involving membranes, disinfection technologies, and disinfection byproducts.

Stephen Ogle

Stephen Ogle, M.S., Environmental Engineer, has been with Reclamation for 2.5 years. His interests for gaining expertise include produced water characterization and treatment, water reuse development, and concentrate management strategies.

Rocklyn Wortham

Rocklyn Wortham, recently acquired BA in Business Administration with Business Information Systems option. Over 20 years of administrative experience, with the last three years working with TSC-Water Treatment Group.

Meghan Thiemann

Meghan Thiemann, P.E. is a Civil Engineer in the Lower Colorado Basin. Through Title XVI, she works with water districts, primarily in Southern California, on their water reclamation and reuse projects that receive Reclamation funding. She is also GOTR for two DWPR grants, and Principal Investigator for S&T 7100, a science and technology project in the water treatment area.

Michael Kramer

Mike Kramer, Civil Engineer, has 27 years of experience in the design and construction of water and wastewater treatment plants across the United States.

Marisela Castro

Marisela Castro, EIT, Civil Engineer, has worked full-time with Reclamation for 3 years in the Oklahoma-Texas Area Office after starting as a Pathways Student. She serves in the Water Treatment Group as a Grants Officer Technical Representative for several active Desalination Water Purification Research grants.

Mark Nance

Mark Nance, P.E., Civil Engineer, has more than 20 years of water and wastewater infrastructure experience from planning through construction of municipal, commercial, and government projects, including leading the design of the first ballasted sedimentation/powdered activated carbon recirculation water treatment system in the United States.