Desalination and Water Purification Research Program: 2023 DWPR Pitch to Pilot Projects

California

Natural Ocean Well Co.: Submerged Water Filtration: A Climate-Resilient, Eco-Friendly, Underwater Filtration Package

Reclamation Funding: $236,877 **Total Project Cost: $485,484**

This project proposes Submerged Water Filtration (SWF) as a simple, modular, point-source filtration solution to the problems associated with conventional water filtration systems. SWF is an unconventional water filtration method in which its process filters and pumps are submerged and operate deep underwater. This naturally protects SWF systems from atmospheric climate risks and, if designed thoughtfully, can eliminate ecological harms, such as waste accumulation and aquatic life mortality. Depending on its source salinity and depth, SWF can also cut energy requirements by as much as half compared to land-based systems, by leveraging the natural hydrostatic pressure of a water body. The project will install a SWF package in the Las Virgenes Reservoir and monitor its performance/impacts over the testing phase.

Orange County Water District: Separation and Destruction of Per- and Polyfluoroalkyl Substances (PFAS) in Potable Reuse RO Concentrate

Reclamation Funding: $211,626 **Total Project Cost: $425,620**

The objective of this study is to evaluate the feasibility of removing PFAS from reverse osmosis concentrate (ROC) by coupling adsorption technology with destruction of PFAS from the spent media solid waste. The project will evaluate the effectiveness of treatment of ROC by adsorbent media such as granular activated carbon (GAC), ion exchange (IX) resins and novel alternative adsorbents followed by destruction of the PFAS in the spent media via a promising destruction technology. The overall concept is to evaluate whether it will be feasible to, in a stepwise approach, remove PFAS from ROC and then destroy the PFAS. Proposed project outcomes will broadly benefit the water, wastewater, and recycled water “one water” community, particularly entities faced with disposal of PFAS-laden concentrates and exhausted media.

Stanford University: Nitrogen Recovery from Reverse Osmosis Concentrate Using Electrochemical Stripping

Reclamation Funding: $300,000 **Total Project Cost: $364,149**

The overarching goal of the proposed work is to use electrochemical separations to selectively remove and recover high purity ammonia from reverse osmosis concentrate (ROC) generated by wastewater reuse. The project specifically aims to develop pilot-scale electrochemical stripping (ECS), an approach that achieves high recovery efficiency and selectivity toward ammonia from various wastewaters, including ROC. In addition, the project will implement electrodialysis and nitrate reduction (EDNR), a novel process configuration that expands the pollutant portfolio by converting nitrate to ammonia. The project aims to validate the feasibility of pilot-scale ECS to manage ROC and quantify enhanced nutrient recovery and energy efficiency.

Colorado

Widefield Water and Sanitation District: Comprehensive Evaluation of PFAS Treatment on an Impaired Groundwater Source with High Hardness and TDS: Ion Exchange, Hollow Fiber Nanofiltration, Electrocoagulation, and Treatment Interactions

Reclamation Funding: $300,000 **Total Project Cost: $636,174**

This project seeks to treat two aquifers contaminated with PFOA, PFOS, and PFAS, making them unsuitable for use under current standards. Key areas of investigation will include understanding how inorganic ions impact the removal of PFAS, exploring the potential benefits of hollow-fiber direct nanofiltration in reducing energy and chemical use while removing PFAS, and assessing the effectiveness of electrocoagulation for integrated PFAS and hardness removal. By exploring these areas, the project aims to reduce costs and energy requirements for water treatment, improve the detection and characterization of PFAS, and evaluate novel treatments for PFAS separation and destruction.

Iowa

Pani Clean, Inc.: Pilot Testing of a Solar-Powered Electrochemical Unit for Separation and Conversion of Nitrates from Impaired Waters

Reclamation Funding: $300,000 **Total Project Cost: $468,800**

This project will demonstrate a modular off-grid solar-powered electrodialysis/electrolysis unit that utilizes nitrate-contaminated water sources to capture and convert nitrate to ammonia and generate potable water. The proposed solution leverages two electrochemical principles, electrodialysis to capture nitrates and electrolysis to reduce the concentrated nitrate brine to ammonia. If successfully implemented, the proposed solution has the potential to significantly enhance water recovery and reuse from water sources impaired from agricultural land-use practices. The goal of the project is to pilot-test a photovoltaic-powered electrochemical denitrification system that can treat effluents from wastewater plants and nitrate-contaminated public water supply wells while generating potable water and ammonia.

Massachusetts

Harmony Desalination Corporation: Batch Desalination with a Flexible Bladder for High-recovery Desalting of the Edwards Aquifer for Irrigation and Livestock in Lockhart, Texas

Reclamation Funding: $300,000 **Total Project Cost: $450,000**

This project includes piloting a high-recovery batch RO desalination system combined with batch nanofiltration (NF) brine concentration. This approach aims to meet the irrigation and livestock water needs of a local farm. By achieving a water recovery rate of 70% with a batch RO system and targeting a further enhancement to 90%+ through batch NF brine concentration, the project seeks to reduce costs and energy consumption compared to conventional RO and dehydrators. Overall, the project seeks to address the limitations of current desalination approaches and technologies by introducing the energy-efficient batch reverse osmosis process with low salt-rejection membranes.

Texas

Rice University: PFAS Destruction in Saline Waters Using a Boron Nitride-enabled Photocatalytic Reactor Pilot

Reclamation Funding: $289,371 **Total Project Cost: $523,214**

To address the need for technology that can destroy PFAS in reverse osmosis-based water reclamation systems, this project will investigate boron nitride (BN)-based materials that have excellent potential for low-cost, chemical-free PFAS destruction with due to their ability to photocatalytically degrade PFAS in water matrices relevant to brackish water, including salinity and dissolved organic carbon. The objectives of this project are to (1) further evaluate the photocatalytic activities of BN-based materials in the treatment of PFAS and co-contaminants in brackish groundwater and reverse osmosis concentrate (ROC) streams, (2) extend and optimize the ROC post-treatment capabilities to the pilot-scale using the Photo-Cat Reactor to improve energy efficiency for water reclamation and (3) pretreat brackish water for PFAS at the pilot scale to determine cost effectiveness and energy efficiency, and compare to the economics of ROC post-treatment.

Washington

Pure Blue Tech Inc.: Nanopatterned Ultrasonic Reverse Osmosis (NURO) for Anti-Fouling, Efficient, and High Recovery Desalination and Water Purification

Reclamation Funding: $300,000 **Total Project Cost: $606,712**

This project involves the manufacturing and field piloting of novel anti-fouling Nanopatterned Ultrasonic Reverse Osmosis (NURO) membrane elements for efficient, high-recovery desalination of brackish water and purification of surface water. The proposed NURO is a new spiral wound membrane element that includes membrane with nanoscale surface imprints and a low-wattage, thin, and flexible ultrasound transducer spirally wound with commercial off-the-shelf element components. These innovations inside the NURO enable the membrane element to resist membrane fouling, scaling, and concentration polarization by increasing nanoscale and macro turbulence and mixing at the membrane boundary layer and preemptively, continuously delay and reduce fouling, salt precipitation, and concentration polarization. As a result, this membrane element can increase sustained flux, reduce pressure drop, reduce chemical cleanings, and increase recovery.