BUREAU OF RECLAMATION

Research Updates
R&D Office

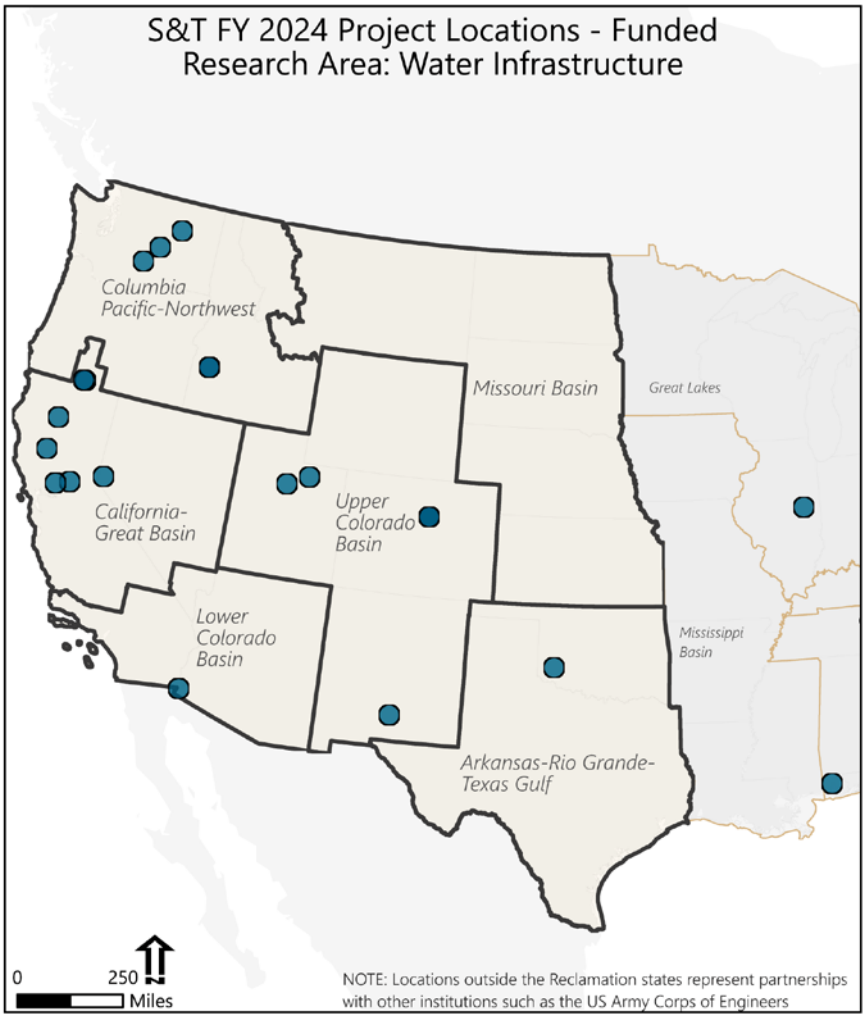
Water Infrastructure

U.S. Department of the Interior

January 2024

Executive Summary

The Water Infrastructure (WI) area of the Science and Technology Program (S&T) examines research in the following categories: Dams, Canals, Pipelines, and Miscellaneous Water Infrastructure. In FY24, S&T funded 44 projects in this area for a total of $2.8M. This includes seven new projects ($0.7M) and 37 continuing projects ($2.1M). Additionally, the new Facilitated Adoption program funded two WI projects as part of its inaugural funding cycle ($0.6M). S&T estimates a benefit-cost ratio (BCR) for WI projects each year to demonstrate the value of this research. Underwater Remotely Operated Vehicle (ROV) for Data Collection at Reclamation Sites had a BCR of 11. This project evaluated ROVs for facility inspections, and the BCR is primarily based on time savings due to reduced labor and reduced need for cranes in areas difficult to access by boat. As demonstrated, WI research is extremely valuable to Reclamation, such as by this investigation of new approaches to infrastructure inspections.



Science and Technology Program: Research Areas

Reclamation's Research and Development Office (R&D) manages the Science and Technology Program (S&T) and is focused on providing innovative solutions for Reclamation water and power facility managers and its western customers and stakeholders, primarily through research projects led by Reclamation employees.

The S&T Program has five research areas (listed below) directly related to Reclamation's mission. For more information, visit: https://www.usbr. gov/research/st/needs_priorities/index. html)

S&T Research Areas and Categories

Water Infrastructure (WI)
Dams, Canals, Pipelines, and Miscellaneous Water Infrastructure

Power and Energy (PE)
Hydro Powerplants, Energy Efficiency, Pumping Plants, and Non-Hydropower Renewable

Developing Water Supplies (WS)
Advanced Water Treatment, Groundwater Supplies, Agricultural and Municipal Water Supplies, and System Water Losses

Environmental Issues in Water Delivery and Management (EN)
Water Delivery Reliability, Invasive Species, Water Quality, Sediment Management, and River Habitat Restoration

Water Operations (WP)
Water Supply and Streamflow Forecasting, Water Operations Models and Decision Support Systems, Open Data, and Climate Change and Variability

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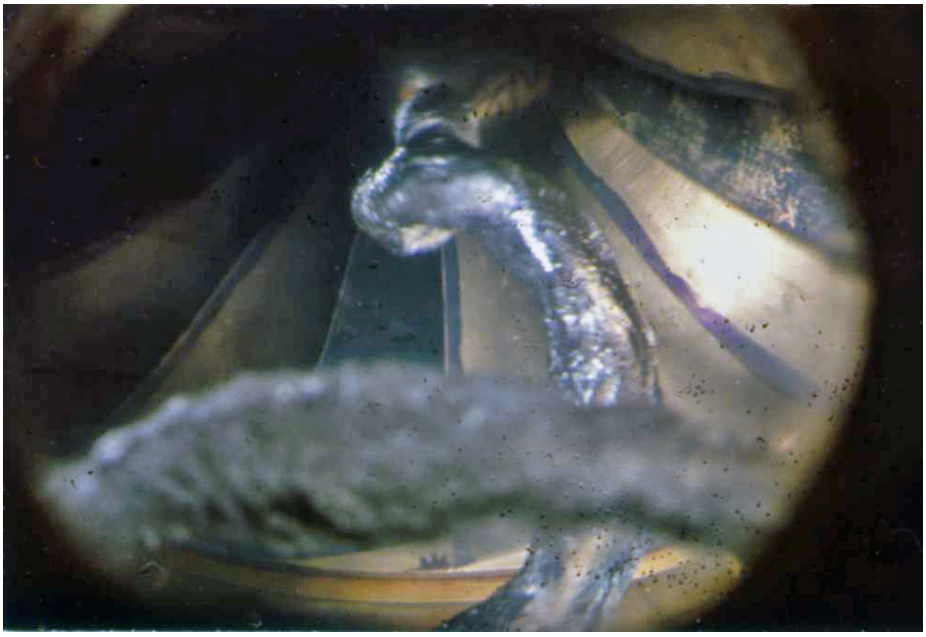
Erin Foraker eforaker@usbr.gov

Water Infrastructure

FY23 Completed Projects

20024: Laboratory Evaluation of Field Repairable Materials and Techniques for Cavitation Damage: Phase II – Allen Skaja



A cavitation vortex in a draft tube.

Currently, Reclamation's primary method for mitigating cavitation is the use of stainless steel weld overlays. This repair method is time consuming, and the overlays typically have a service life of around three years. On hydropower units, repairs may cost $100–250k every 1–3 years per unit. The objective of this research was to identify a list of candidate repair materials that could help lengthen the time between cavitation repair cycles. Of the epoxy and polyurethane coatings tested, two commercial materials were among the best-performing non-metallic coatings in cavitating water-jet testing. These materials were selected for field trials and performed well on turbine runner blades in mild and moderate cavitation zones for 1,000 hours of operation but failed in the most severe cavitation zone of the runner blades. Follow-on research will monitor the long-term performance of the field trials.

Photo of UV boat in a canal.

20041: Maintaining Canal Capacity and Delivery Feature Reliability through the use of Ultraviolet Aquatic Vegetation Control – Josh Voorhees

Canal conveyance capacities can be decreased by aquatic plants, with losses being dependent upon plant height, density, and location within the channel. Management efforts to extract or eradicate the aquatic plants are costly. A new tool using ultraviolet light (UV) has been developed to control plants, with several successful pilot studies completed. This study implemented UV control tests and set up a monitoring program to quantify plant and chemical water dynamics. There were some complications with canal test sections being partially dewatered due to drought conditions. However, laboratory and field trials from other ecosystems showed that the UV light treatment can reduce plants by up to 100% with targeted impacts to multiple plant taxa. Monitoring data indicates that plant biomass in these irrigation canals peaks in July, suggesting the best timing for intervention is during initial plant growth in June.

Cavitation machine at Federal University of Rio Grande do Sul (similar to Reclamation's) used to test durability of concrete to cavitation.

21051: Hydraulic Concrete Surfaces for Water Resource Structures *-Continued Collaboration* – Josh Mortensen

Water resource facilities operated by the Brazilian and United States Government are faced with cavitation and erosion of concrete surfaces of spillways and stilling basins, and each have made many costly repairs that impact operations. Since 2018, Reclamation and Brazilian laboratories have been collaborating to study flow-induced damage to concrete surfaces. The main objective is to develop a reliable correlation between concrete properties and local hydraulic conditions to provide updated guidance and advance the state-of-the-art in concrete design. The partnership includes parallel efforts of literature review, analysis of historical field data and experience, and laboratory testing of cavitation damage to concrete. This report summarizes research efforts made to date and highlights laboratory testing in Brazilian laboratories in 2023 which culminated in a Reclamation site visit to Brazil.

20200: Gate Design Optimization and Composite Gate Lab Scale Testing – Allison Lewis

Reclamation has used simplified analysis techniques and hand calculations for the design of bulkhead and stoplog gates for its entire history. This results in gates that are robust and safe but heavier than needed for the given design requirements. There exist many site-specific requirements where a weight reduction would result in a large cost savings to the government. This research attempted to align the results of traditional hand calculations, finite element analysis (FEA) results, and laboratory results. Scale model steel and composite bulkheads were fabricated and tested to failure. The steel bulkhead gate results were able to be aligned to the FEA simulations, allowing for increased confidence in mechanical design technical capabilities. The next steps in gate optimization would be to run tests in a real-world application, and to apply the lessons learned from laboratory testing to the design of new steel bulkhead gates or stoplogs.

Experimental setup for the steel bulkhead gate.

20074: Leak Repair Demonstrations for Pressurized Mechanical Systems – Grace Weber

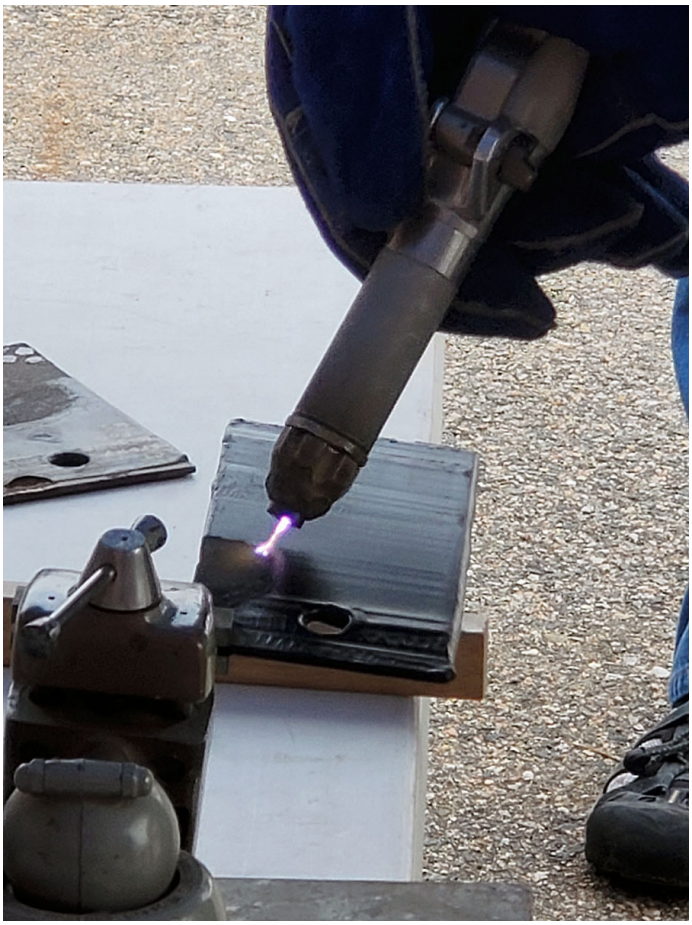
Leaks in pressurized mechanical systems can be difficult or impossible to repair without first depressurizing and drying, which may be costly or impossible. This work performed laboratory testing on five composite repair systems applied to actively leaking, pressurized pipes. Results found the repairs were only effective on very minor, weeping leaks and only for short periods of time. Information from field partners indicated success with fiberglass wraps and metallic patches and clamps for lower pressure leaks. For higher pressure leaks, field partners have not found repair options that can be applied without first isolating the leak. With much of the infrastructure at the field partner facilities nearing or passing its design life, it becomes increasingly important to find solutions that can address leaks, corrosion, and other degradation, either temporarily until the system can be isolated or permanently, if possible.

Researcher wearing personal protective equipment applying an epoxy repair to the laboratory pipe set-up.

21030: Dam Incident Investigations: Determining Best Practices for Investigations that Can Improve Future Performance of Dams – Rich Eastland

There are multiple dam failures and dam safety incidents every year in the United States, and currently no standard policy requirements for conducting investigations. To understand the state of the industry, this study reviewed 58 dam failure or incident investigation reports based on incidents in the United States from 1960 through 2022. The investigations ranged from well-known, such as Oroville Dam and Teton Dam, to little known, such as Hawkins Dam, a small dam in Washington that had a 2014 spillway failure. The investigations were analyzed for characteristics such as the length of time for the investigation team to get on site, completion time, funding source, independence of the investigation team, and other parameters. The research provides several recommendations for improving investigations in the future.

Aerial photo of Hoover Dam.



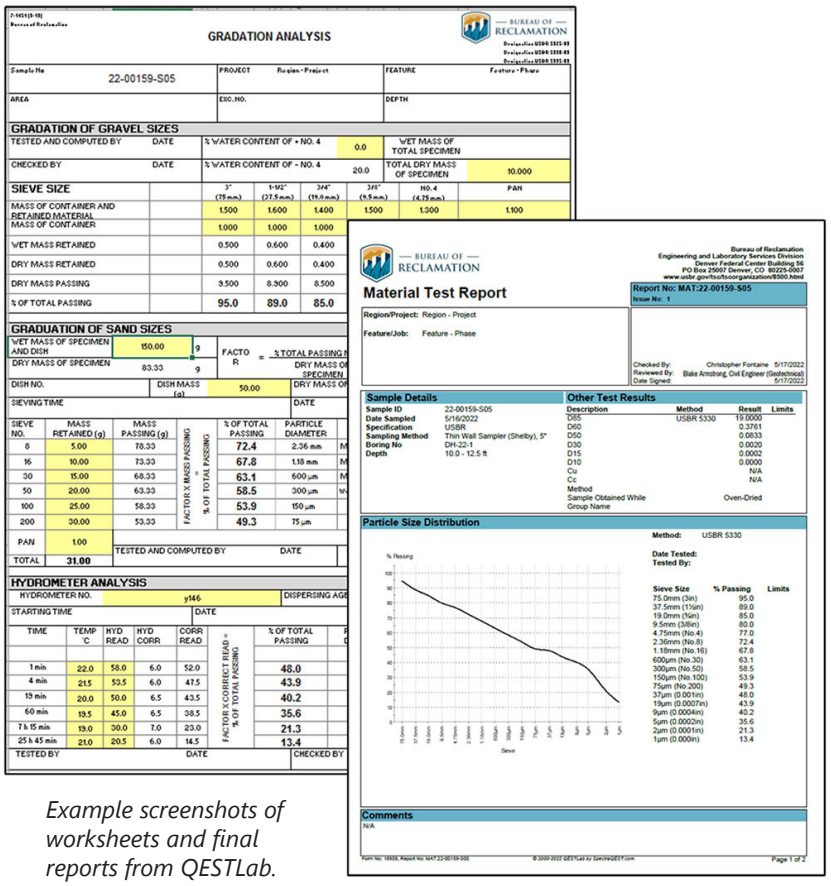
View of atmospheric plasma removing coal tar enamel from a test panel.

21062: Atmospheric Plasma Coating Removal – Kevin Kelly

The process for removing degraded linings has evolved incrementally throughout the years with advances in technology, health, and safety regulations. However, removing and containing hazardous materials in coatings is still complicated, time consuming, costly, and can be hazardous. This project investigated the use of atmospheric plasma to remove coal tar enamel (CTE). In simple terms, plasma is ionized gas molecules. When used to remove coatings, it reacts with and vaporizes the coating from a surface. Researchers performed two rounds of testing to evaluate and compare atmospheric plasma removal of CTE to traditional blast processes. The research provides results from the testing and recommendations on use of atmospheric plasma for coating removal.

21079: Implementation of a Laboratory Information Management System for Reclamation Infrastructure – Catherine Lucero

The goal of this project is to establish a common Laboratory Information Management System (LIMS) used throughout Reclamation. The historical software was custom built but antiquated, and regional labs have been unable to use it for at least 15 years due to incompatible computer operating systems. This project selected the software QESTLab, by SpectraQEST, due to its large scope of materials and equipment management and customizability. This software has been used by the Regional Laboratories beginning in 2022. Custom test screens, dynamic worksheets, and reports were created to meet Reclamation needs. The software is more intuitive than the previous systems, and queries of data are easy to perform. In addition to testing results, the LIMS assists with tracking equipment maintenance and calibration events which is crucial in obtaining and maintaining laboratory accreditation.



GRADATION ANALYSIS

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Sample No 22-00159-S05 | PROJECT Region - Project | FEATURE Feature - Phase

AREA | EXC.NO. | DEPTH

GRADATION OF GRAVEL SIZES

TESTED AND COMPUTED BY | DATE | % WATER CONTENT OF + NO. 4 | 0.0 | WET MASS OF TOTAL SPECIMEN

CHECKED BY | DATE | % WATER CONTENT OF - NO. 4 | 20.0 | TOTAL DRY MASS OF SPECIMEN | 10.000

SIEVE SIZE		3" (75 mm)	1-1/2" (37.5 mm)	3/4" (19.0 mm)	3/8" (9.5 mm)	NO.4 (4.75 mm)	PAN
MASS OF CONTAINER AND RETAINED MATERIAL		1.500	1.600	1.400	1.500	1.300	1.100
MASS OF CONTAINER		1.000	1.000	1.000			
WET MASS RETAINED		0.500	0.600	0.400			
DRY MASS RETAINED		0.500	0.600	0.400			
DRY MASS PASSING		9.500	8.900	8.500			
% OF TOTAL PASSING		95.0	89.0	85.0			

GRADUATION OF SAND SIZES

WET MASS OF SPECIMEN AND DISH 150.00 g | FACTOR = % TOTAL PASSING / DRY MASS OF SPECIMEN

DRY MASS OF SPECIMEN 83.33 g

DISH NO. | DISH MASS (g) 50.00 | DRY MASS OF

SIEVING TIME | DATE

SIEVE NO.	MASS RETAINED (g)	MASS PASSING (g)	FACTOR X MASS PASSING = % OF TOTAL PASSING	% OF TOTAL PASSING	PARTICLE DIAMETER	
8	5.00	78.33		72.4	2.36 mm	M
16	10.00	73.33		67.8	1.18 mm	M
30	15.00	68.33		63.1	600 µm	M
50	20.00	63.33		58.5	300 µm	M
100	25.00	58.33		53.9	150 µm	
200	30.00	53.33		49.3	75 µm	
PAN	1.00					
TOTAL	31.00					

TESTED AND COMPUTED BY | DATE

HYDROMETER ANALYSIS

HYDROMETER NO. 9146 | DISPERSING AGE

STARTING TIME | DATE

TIME	TEMP °C	HYD READ	HYD CORR	CORR READ	FACTOR X CORRECT READ = % OF TOTAL PASSING	% OF TOTAL PASSING
1 min	22.0	58.0	6.0	52.0		48.0
4 min	21.5	53.5	6.0	47.5		43.9
15 min	20.0	50.0	6.5	43.5		40.2
60 min	19.5	45.0	6.5	38.5		35.6
7 h 15 min	19.0	30.0	7.0	23.0		21.3
25 h 45 min	21.0	20.5	6.0	14.5		13.4

TESTED BY | DATE | CHECKED BY

BUREAU OF RECLAMATION

Material Test Report

Bureau of Reclamation
Engineering and Laboratory Services Division
Denver Federal Center Building 56
PO Box 25007 Denver, CO 80225-0007
www.usbr.gov/tsc/tscorganization/8500.html

Report No: MAT:22-00159-S05
Issue No: 1

Region/Project: Region - Project
Feature/Job: Feature - Phase

Checked By: Christopher Fontaine 5/17/2022
Reviewed By: Blake Armstrong, Civil Engineer (Geotechnical) 5/17/2022
Date Signed:

Sample Details

Sample ID	22-00159-S05
Date Sampled	5/16/2022
Specification	USBR
Sampling Method	Thin Wall Sampler (Shelby), 5"
Boring No	DH-22-1
Depth	10.0 - 12.5 ft

Other Test Results

Description	Method	Result	Limits
D85	USBR 5330	19.0000	
D60		0.3761	
D50		0.0833	
D30		0.0020	
D15		0.0002	
D10		0.0000	
Cu		N/A	
Cc		N/A	
Method			
Sample Obtained While Group Name		Oven-Dried	

Particle Size Distribution

Method: USBR 5330

Date Tested:
Tested By:

Sieve Size	% Passing	Limits
75.0mm (3in)	95.0	
37.5mm (1½in)	89.0	
19.0mm (¾in)	85.0	
9.5mm (3/8in)	80.0	
4.75mm (No.4)	77.0	
2.36mm (No.8)	72.4	
1.18mm (No.16)	67.8	
600µm (No.30)	63.1	
300µm (No.50)	58.5	
150µm (No.100)	53.9	
75µm (No.200)	49.3	
37µm (0.001in)	48.0	
19µm (0.0007in)	43.9	
9µm (0.0004in)	40.2	
5µm (0.0002in)	35.6	
2µm (0.0001in)	21.3	
1µm (0.000in)	13.4	

Comments
N/A

Page 1 of 2

Example screenshots of worksheets and final reports from QESTLab.

22024: Learning from the Past, Inspection of Historic Penstock Lining Field Trials; Shasta Penstocks and Collbran Siphon – Meredith Heilig

To evaluate the performance of various lining systems for corrosion protection, Reclamation scientists conducted field trials at the Shasta Dam Unit 5 Penstock (Shasta) in 1949 and at the Collbran Project Salt Creek Siphon (Collbran) in 1959 on 26 and 42 coatings systems, respectively. The current research is the first investigation since 1972 where lining performance at Shasta and Collbran are evaluated together in a single report. The updated data collected on the various test lining materials contributes to understanding why some products provide long-term corrosion protection, with a goal to identify and develop new products with similar characteristics. Furthermore, this work helps researchers and inspectors understand how to effectively evaluate aging coating systems.

Reclamation inspector collects EIS data from inside of Collbran Salt Creek Siphon.

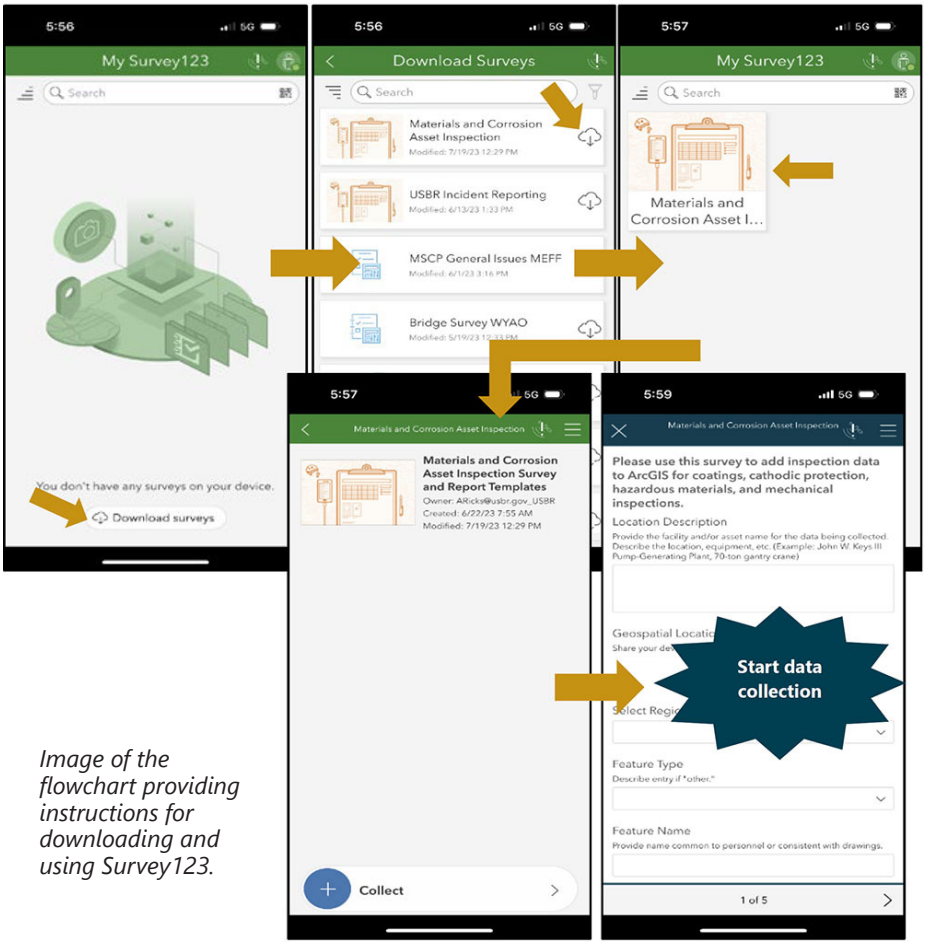

Image of the flowchart providing instructions for downloading and using Survey123.

22048: Development of Facility Corrosion Inspection Templates & Planning for a Central Database – Bobbi Jo Merten

Reclamation inspects its infrastructure to ensure adequate corrosion protection and to determine presence of hazardous materials. In-field documentation during inspections has historically followed the inspector's preference. However, with a lack of standardization or online repositories, it can be difficult to review inspection reports across facilities or agencies to obtain and analyze parallel data. This research evaluated the usefulness and appropriateness of centralized data storage for several asset inspections: coatings, cathodic protection, hazardous materials, and mechanical. Researchers developed an ArcGIS Survey123 software application-based tool with geographic information systems (GIS) for centralized storage and access to inspection data. The Survey 123 Materials and Corrosion Asset Inspection mobile app tool is now available to Reclamation ArcGIS Online users on Government phones and tablets.

23008: Refurbishment of Small Diameter Embedded Pipes in Powerplants and Dams – Allen Skaja

This scoping level project conducted market research to identify refurbishment options for small diameter (less than 24 inches) embedded pipes in powerplants and dams that have suffered extensive corrosion. Small diameter pipe is notoriously hard to repair or reline, often difficult to access, and could be embedded several feet into mass concrete, making replacement infeasible. A majority of the Bureau of Reclamation's infrastructure exceeds 50 years of age, and corrosion has compromised the integrity of these pipes. This study investigated Cured-in-Place Pipes (CIPP), Spray-in-Place Pipes (SIPP), Fiber Reinforced Polymers (FRP), Cement Mortar Lining (CML), and Polymeric Linings (PL) (epoxy) as refurbishment techniques. A flow chart was developed to help guide engineers and designers to use the best rehabilitation option for the facility situations present.

Small diameter pipe interior showing the entire surface corroded with large rust nodules.

21057: Instrumented Standard Penetration Testing (ISPT) to Increase Accuracy and Reliability in Penetration and Delivered Energy Data for Geotechnical Analysis and Liquefaction Evaluation – Chris Haynes

The Standard Penetration Test (SPT) was created in 1927 as an in-situ geotechnical test for foundation design. The test has many opportunities for error that can alter results, such as overestimation of soil penetration resistance or underestimation of liquefaction susceptibility. This project worked to develop a prototype ISPT tool that can digitally record energy at the sampler, the hammer anvil, and penetration per blow. These digital readings will allow for disparities in the SPT method to be measured and quantified, allowing for more accurate SPT analysis. The report documents the use of the prototype at several field test sites and provides recommendations for continued research.

Reclamation instrumented drill rig, a CME 850, at Conconully Dam, Washington.

FY24 New Research Projects

Science and Technology Program

24002: Investigating the Need for Corrosion Protection of Steel Reinforcements in Concrete at Reclamation – Grace Weber

This scoping study will investigate the need and benefit for Reclamation to implement corrosion protection techniques for reinforced concrete infrastructure. There are known techniques to mitigate corrosion of rebar in concrete, such as sacrificial anodes and corrosion inhibitors. This research will investigate the magnitude of cost savings that could be realized by implementing these techniques, as well as define thresholds for requiring corrosion protection in concrete.

24006: Instrumented Standard Penetration Testing (ISPT) to Increase Accuracy and Reliability in Penetration and Delivered Energy Data for Geotechnical Analysis and Liquefaction Evaluation-Continued – Christopher Haynes

This research looks to continue development of an Instrumented Standard Penetration Test (ISPT) prototype that can digitally record energy at the sampler and penetration per blow. This will introduce less error into the analysis due to the data being directly recorded by the computer system, improving data quality and security. The project objective is to create an off-the-shelf tool, allowing for wide distribution of a dependable and improved testing system. This work could result in an updated ASTM standard, which if realized, would lead to rapid integration into industry.

24010: Evaluating Rust Creep Testing Methods: Improving Metal Loss Predictions for Improved Coating Lifetimes – Meredith Heilig

The traditional rust creep test used by Reclamation has a large element of human error and neglects microscopic corrosion mechanisms that are undetectable to the human eye. This research will address these gaps by using modern automated digital light methods. The immediate benefit is an improved rust creep testing methodology which could improve protective coating specification, leading to extended service life and decreased maintenance on Reclamation's coated structures. Researchers may also present the findings to the ASTM subcommittee for the standard and work to modernize the method.

24030: Development of a Digital Twin: Coupling Building and Geologic Models for a Reclamation Dam – Evan Lindenbach

This study will demonstrate the development of a digital twin model of a Reclamation structure, leveraging existing data and commercially available software. The model will include structural health information such as concrete crack locations, piezometer data, and drain discharge. Software solutions for change and anomaly detection will be investigated such that the structure can be viewed with a time-domain. The goal of the research is to demonstrate how a digital twin can bring spatiotemporal data into an interactive interface for all stakeholders and project team members, and to develop a framework for all of Reclamation to use for developing digital twins.

24034: Reducing Canal Seepage with Innovative Materials – Evan Lindenbach

Water lost to seepage during delivery represents wasted time, money, and effort in addition to the loss of the valuable resource itself. The Water America's Crops (WAC) prize competition sought innovative concepts, methods, and technologies to incentivize new approaches to minimizing seepage in unlined canals. This research seeks to further the winning and runner-up solutions from the WAC prize competition. Reclamation engineers will partner with WAC solver teams to first perform additional testing to better understand durability, strength, and workability, and then perform a field scale installation in later years of the research.

24046: Innovative Use of the Hydraulic Profiling Tool (HPT), High-resolution K (HRK), and Nuclear Magnetic Resonance (NMR) Logging for Optimizing Dewatering System Designs – Jong Kang

In this project, the Reclamation research team will collaborate with the Kansas Geological Survey (KGS) and Geoprobe, Inc. (developers of the HPT system) to evaluate the use of HPT, HRK, and NMR for improved subsurface investigations to assist with dewatering system designs in excavations. A major benefit of HPT is the savings realized by optimizing the layout of soil borings and well installations to be used for subsurface characterization. The innovative combination of HPT, HRK, and NMR will provide a much-enhanced understanding of site conditions at lower costs than other approaches.

24060: Experimental and Numerical Modeling of Block Plucking with Applications to Spillway Erosion – Aaron Hurst

Erosion of unlined spillways can pose huge risks for dam safety, where erosion can propagate upstream via headcut and put the reservoir at risk of breach. This research will use a combination of numerical modeling and laboratory experiments to explore the relationship between flow characteristics, block geometry, bed roughness, fracture orientation, and fracture spacing on the forces responsible for block erosion. The data collected will be used to develop a new theoretical relationship between these controlling variables that can be applied to existing and future models of spillway and bedrock river erosion to generate petter predictions of erosion by plucking.

FY23 Facilitated Adoption Projects

FA24066: Laboratory Information Management System for Reclamation Infrastructure – Catherine Lucero

This project will further the standardization of materials testing within Reclamation by expanding the use of QESTLab data management system to Reclamation's regional laboratories and construction offices. Regional and area office data would become easily available to managers throughout Reclamation. Universal forms would be developed for lab and field data collections and regional staff would be trained in the use of the software.

FA24068: Sky Mirror - Unmanned Aerial Systems (UAS) Data Collection – Matthew Klein

This project will expand UAS data collection throughout Reclamation's regions with the assistance of the Reclamation Aviation Management Program through procurement, training, and demonstrations. Current UAS are outdated and no longer supported and there is a need for new airframes and training for pilots. This project will add about 6 airframes for regions and the TSC, fund the training of 5 pilots, as well as provide support for instructors. Potential demonstration sites include Shasta (CGB Region), Grand Coulee (CPN Region), Hoover (LCB Region), Buffalo Bill (MB/ARGTG Region) and East Canyon (UCB Region) Dams.

FY24 New and Continuing Research Projects

ID	Final Year	Title	Lead
19119	2024	Comparison of Traditional and New Testing Methods for Riprap Material Quality	Robert Rinehart
19206	2024	Improved Prediction of Seismically Induced Hydrodynamic Loads on Dams and Spillway Gates	Josh Mortensen
19317	2024	Field Implementation of Burrowing Animal Deterrents for Earthen Canal Embankments	Richard Bearce
20081	2024	Internal Erosion: Laboratory Testing to Identify End States in Internally Unstable Soils	Carolyne Bocovich
20096	2024	UAS Demonstration and Development for Inaccessible Features Inspections	Carter Gulsvig
21045	2024	Voids Behind Spillways, Conduits, Canals, Tunnels, and Siphons: Causes, Detection Techniques, and Repair Options	Evan Lindenbach
21049	2024	Improving Reclamation's Geologic and Geotechnical Investigations with Drill Parameter Recorder Technology	Evan Lindenbach
21062	2024	Atmospheric Plasma Coating Removal	Kevin Kelly
21067	2024	Investigating Newly Formulated Polysiloxane Coating Systems with Improved Erosion and Impact Properties	Brian Baumgarten
21076	2024	Concrete Cloth for Seepage Reduction – Field Demonstration	Caleb Nickel
21096	2024	Evaluation of Fiber Optic Technology for Use on Reclamation Critical Infrastructure	John Germann
21100	2024	Standardizing Methods for Disaggregation of Slakable Rock and Fat Clay	Richard Bearce
22004	2024	Evaluation of Plunger Valves as a New Technology for Improved Water Delivery at Reclamation Dams and Hydropower Facilities	Josh Mortensen
22017	2024	Evaluate and Model Economical, Safe and Effective Methods to Mitigate and Remove Debris from Dam Intake Structures	Juan Luna
22039	2024	Boundary Layer and Aerated Flow Effects on Hydraulic Jacking in Spillway Chutes	Tony Wahl
22081	2024	Utilization of Trained Canines to Detect Leaks in Water Pipelines	Daryl Little
22086	2024	Evaluation of Acoustic Emission Sensing Technologies for Pressurized Buried Water Pipeline Leak Detection	Atousa Plaseied
22096	2024	Alternative Methods for Collecting Data for Photogrammetric Crack Mapping of Interior Cavities of Buttress Dams: Development of Methodology and Demonstration at Stony Gorge Dam	Matthew Klein

continued—

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ID	Final Year	Title	Lead
23009	2025	Investigating Rubberized Polysiloxane Coating Formulations to Improve Durability and Long-Term Performance	Allen Skaja
23010	2025	Advancement of CP Monitoring and Control for Water Storage Tanks Phase II	Avery Schilt
23012	2024	Investigation of Innovative Exposed Lining Systems	Brian Baumgarten
23014	2025	Long-Term Coatings Lab Testing Data Analysis for Service Life Correlations and Evaluation of New Testing Methods	Bobbi Jo Merten
23016	2025	Evaluation of Infrastructure Coated with Polysiloxane Coatings	Allen Skaja
23020	2025	Ground Modification using Microbially Induced Desaturation (MID) for Liquefaction Interim Risk Reduction	Angel Gutierrez
23024	2025	The Effect of Large Earthquake Loading on Fine-grained Foundation Materials: Determining Residual Undrained Strengths at Large Strains and Corresponding Embankment Deformations	Carolyne Bocovich
23028	2025	Determination of Long-Term Durability of Concrete Containing Calcined Shale in Reclamation	Catherine Lucero
23036	2025	System Commissioning for Topical Concrete Coatings used for Algae Resistant Linings for Canals	Scott Keim
23042	2025	Hydraulic Friction Factors and Energy Dissipation of Stepped Chutes	Bryan Heiner
23043	2025	Laboratory Testing to Inform Risk Estimation of Internal Erosion Event Progression - Self-healing from Upstream Material	Carolyne Bocovich
23050	2025	Reducing Reclamation's Carbon Footprint Through Modernizing Concrete Materials, Specifications and Construction Practices	Catherine Lucero
23062	2024	Improved Air Vent Sizing Methods for Emergency Gates	Bryan Heiner
23065	2026	Demo On-line Cable Monitoring and 3-D Roof Panel Printing	David Klein
23066	2024	Comparing the Utility of LiDAR and Photogrammetry for Engineering and Scientific Analysis	Matthew Klein
23067	2026	Stilling Basin Design Downstream from Stepped Spillways	Bryan Heiner
24002	2024	Investigating the Need for Corrosion Protection of Steel Reinforcements in Concrete at Reclamation	Grace Weber
24006	2026	Instrumented Standard Penetration Testing (ISPT) to Increase Accuracy and Reliability in Penetration and Delivered Energy Data for Geotechnical Analysis and Liquefaction Evaluation - *Continued*	Christopher Haynes
24010	2026	Evaluating Rust Creep Testing Methods: Improving Metal Loss Predictions for Improved Coating Lifetimes	Meredith Heilig
24030	2026	Development of a Digital Twin: Coupling Building and Geologic Models for a Reclamation Dam	Evan Lindenbach
24034	2026	Reducing Canal Seepage with Innovative Materials	Evan Lindenbach
24046	2026	Innovative Use of the Hydraulic Profiling Tool (HPT), High- Resolution K (HRK), and Nuclear Magnetic Resonance (NMR) Logging for Optimizing Dewatering System Designs	Jong Kang
24060	2026	Experimental and Numerical Modeling of Block Plucking with Applications to Spillway Erosion	Aaron Hurst

Front cover photo: Ririe Dam and Reservoir in Idaho.
Back cover photo: Ririe Dam spillway radial gate structure in Idaho.