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Surveying

U.S. Department of the Interior

Content

Mission Statement

This *Water Operations and Maintenance Bulletin* is published quarterly through the Asset Management Division of the Dam Safety and Infrastructure Directorate. It serves as a medium to connect personnel who operate and maintain Bureau of Reclamation water supply systems.

History

The *Water Operations and Maintenance Bulletin* has been published quarterly since 1952. Past issues may be read and downloaded at Water Operations and Maintenance Bulletins, where you can also search the entire Bulletin database by subject.

Contact

We welcome suggestions for future issue topics, contributing authors, and comments on the Bulletin. Please direct all inquiries to drowateroandm@usbr.gov.

Cover photo: Wildflowers in Wyoming's Bighorn Mountains (Bureau of Reclamation).

Editor's Note

The Bureau of Reclamation (Reclamation) is responsible for the operations and maintenance (O&M) of facilities that are often approaching or exceeding their original design life. An essential part of understanding how these assets age, their interdependencies, and the conditions and vulnerabilities of surrounding landscapes is through state-of-the-art surveying. With a robust inventory of survey data and expert analysis, we are further equipped to serve our mission as stewards of the Nation's water management resources.

This summer issue would not be possible without contributions from our talented authors and Asset Management Division (AMD) staff. Erin Bell wrote on exciting developments with Geographic Information Systems (GIS), Meyer Jay and Matthew Klein co-authored an article on two surveying projects conducted using uncrewed aerial systems (UAS), and Charles Hardes described several key aspects of dam and dike monitoring surveys and survey control from a forthcoming best practices manual. Finally, Mike Studiner authored "Solar Over Canals," an overview of a recent project to cover canals with solar panels to generate renewable energy and increase water efficiency.

We had the pleasure of interviewing Karl Stock, California-Great Basin (CGB) Regional Director, for this summer Q&A. Stock, who was named Regional Director on December 21, 2023, spoke with us about his past work in the Reclamation Law Administration Division, pressing challenges facing CGB, and how he helps facilitate communication throughout the Region's many groups and functions.

Thanks for reading! And happy summer!

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Asset Management Division

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Writer-Editor
Dam Safety and Infrastructure

Around O&M

The three-day Review of Operation and Maintenance (RO&M) Workshop is held annually and sponsored by AMD. This workshop provides tools for how to inspect and review high- and significant-hazard potential dams and associated facilities such as low-hazard potential dams, bridges, pumping plants, canals, buildings, levees, and more. It is tailored for supervisors, managers, watermasters, and others responsible for the O&M of water systems.

The 2024 RO&M Workshop was held April 9-11 at the Rancho Cordova Marriott in Sacramento, California, and had over 70 registered participants. This year's workshop included classroom training, networking, roundtable discussions, and a site visit to Nimbus Dam and Folsom South Canal.

Nimbus Dam, Folsom, California, as seen at 2024 RO&M Workshop.

Post-workshop survey results commended the following sessions:

- How to Prepare for an Inspection
- Tunnel Inspections: Spring Creek and Clear Creek
- Documenting and RO&M Examination
- O&M Flow Chart/How to Write a Recommendation
- Inaccessible Features Guidance
- Canal O&M Fundamentals
- RO&M Program/Directives and Standards Guidance

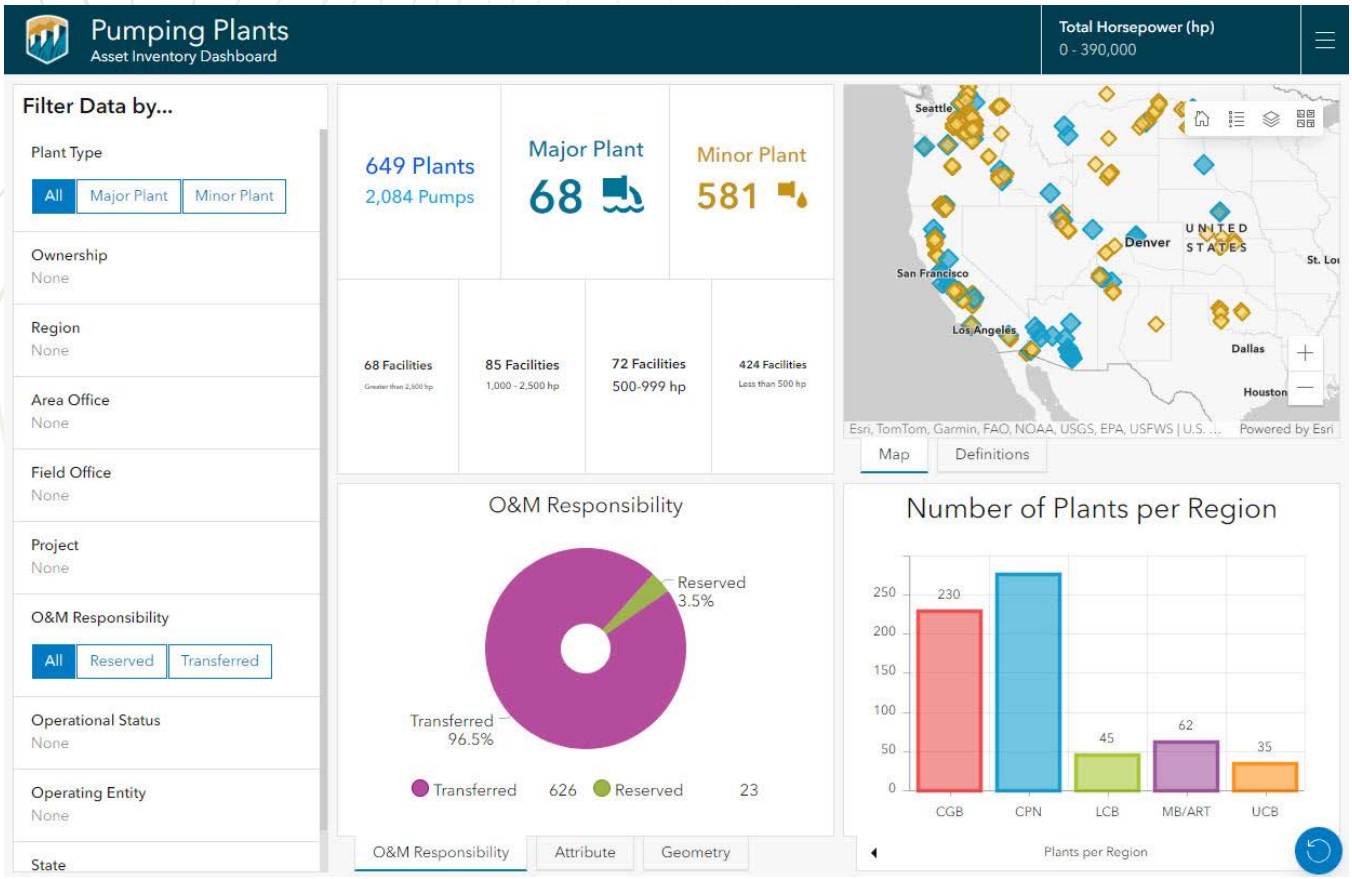
Thank you to all those who completed the 2024 RO&M Workshop survey. We received 26 responses and will attempt to address all feedback. Notable survey recommendations concerned:

- Create time for extended discussion of ideas presented
- Recruit the actual operators to help lead site visits
- More Slido engagement and roundtables

We hope to see you at the 2025 RO&M Workshop in the Missouri Basin Region!

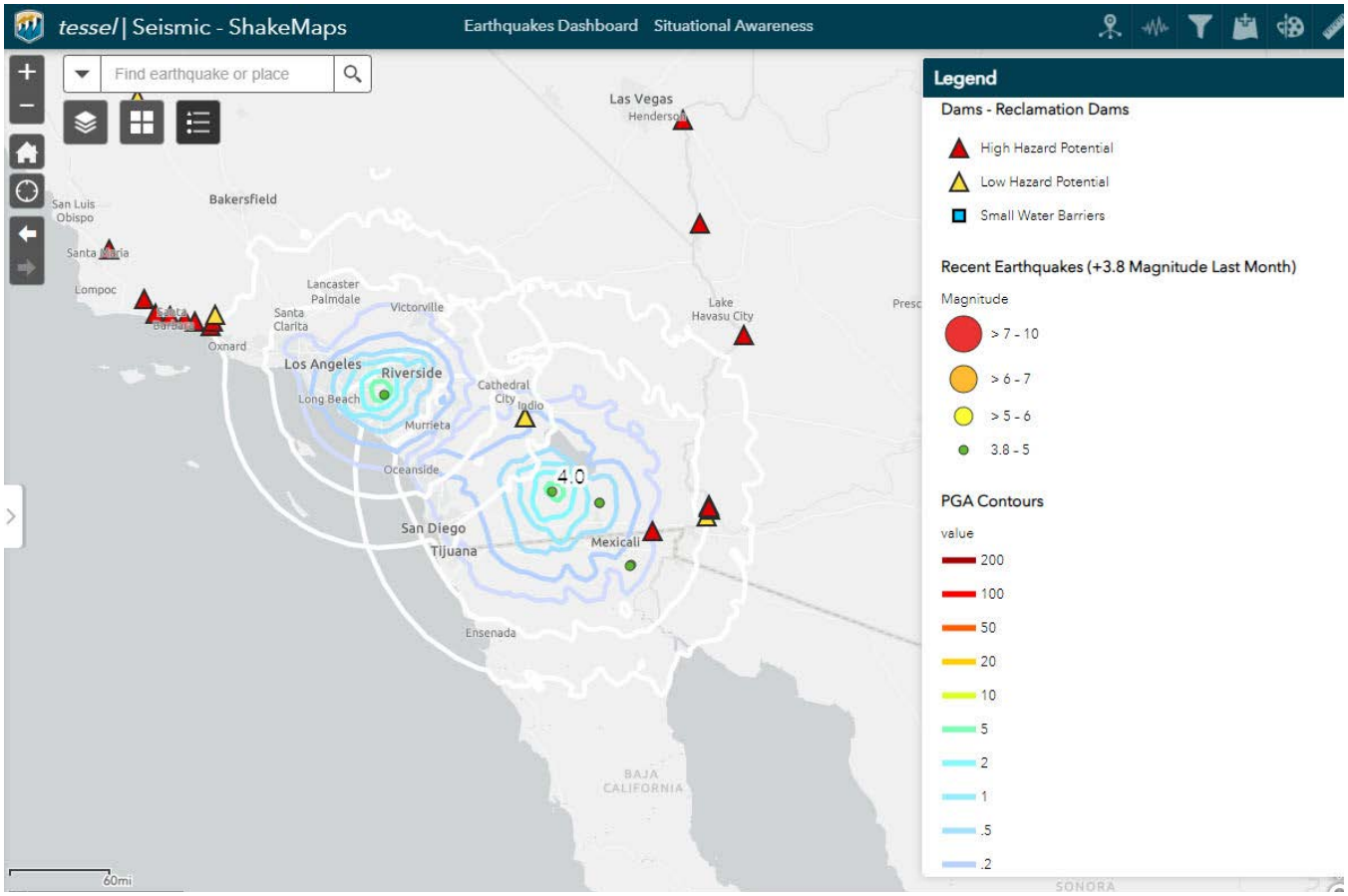
Geographic Information Systems (GIS): Never Boring

Erin Bell
GIS Coordinator, Operations and Maintenance Branch, Asset Management Division



Pumping Plants Dashboard interactive view of the Pumping Plants Asset Class data from the Asset Registry.

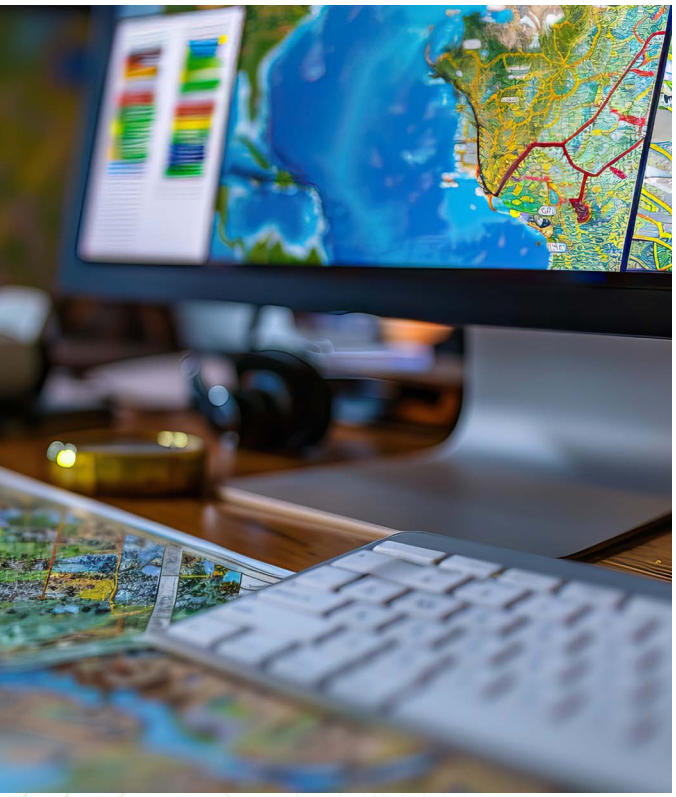
Despite being around for decades, the power of Geographic Information Systems (GIS) to serve as a collaborative platform across the Bureau of Reclamation (Reclamation) is only beginning to be realized. With Esri's suite of software, tools, and access to its ArcGIS Online cloud platform, the possibilities for mapping and analysis seem endless. We are using it to inventory and describe our assets, track natural events like earthquakes near our facilities, perform inspections using mobile devices, and create cartographic figures.



The Seismic – ShakeMaps web app shows recent earthquakes in southern California near several Reclamation dams.

One of GIS's biggest accomplishments to date has been spearheading and implementing the Enterprise Asset Registry (Asset Registry). The Asset Registry is the single, authoritative source for Reclamation's asset data within our authorized Projects. It is built on Reclamation's enterprise GIS (i.e., BORGIS), where we can capture asset locations, creating a holistic view of how our assets form an interconnected network. Related asset information such as Asset Name, Managing Region, Ownership, Operational Status, etc. are managed in the Asset Registry as well. Our established workflows enforce data validation by subject matter experts, display data in relation to other assets, and visualize the Asset Registry data in dashboards highlighting statistical information about assets.

Reclamation's GIS staff have created innovative ways to display and interact with GIS data. One good example of a tool created for Reclamation's operations and maintenance (O&M) staff is ShakeMaps. ShakeMaps is a web application referencing the United States Geological Survey's recent earthquake data. The app shows the earthquake location, magnitude, and peak ground acceleration contours in relation to our assets mapped within the Asset Registry. Reclamation Earthquake Notification Service automatically sends alerts to subscribed O&M staff whenever a tremor with a magnitude greater than or equal to 4.0 occurs, informing staff which assets are



within a 161 km radius and may have been structurally impacted by the earthquake. These notifications could trigger a special O&M inspection to assess any damage that may have occurred.

Leveraging the Esri cloud environment, we can bring GIS into the field using our cell phones and tablets to collect asset information and perform routine or on-demand inspections of our assets. Many offices are building workflows using Esri's Field Maps and Survey123 for ArcGIS mobile applications. These workflows allow engineers to capture inspection observation points and take digital notes related to an asset while performing activities such as Review of Operation and Maintenance inspections or a special inspection following an earthquake. Some workflows also incorporate Survey123 into their scheduled Ongoing Visual Inspection Checklist routine at both reserved and transferred works facilities.

One capability we are further exploring is connecting Survey123 to Microsoft Power Automate. This can allow users to submit surveys, triggering Power Automate to autogenerate reports and emails to appropriate user groups. Automating this process can significantly reduce the amount of time it takes to get important information out to our stakeholders.

The various GIS tools and applications Reclamation is currently using are too numerous to list, but it's clear that GIS is an invaluable program essential to accomplishing Reclamation's mission. The future of GIS in Reclamation is bright with integrated daily workflows increasing the need for more GIS savvy employees in the Bureau. The desire to connect the Asset Registry to all of Reclamation's other asset information systems (e.g., Capital Asset and Resource Management Application, Dam Safety Information System) increases each day along with the need to share our asset inventory outside of Reclamation.

New project ideas propose leveraging uncrewed aerial systems (UAS) and remote sensing for conveyance line inspection mapping and seepage detection. There is also potential to start using artificial intelligence and machine learning tools to expand analytical capabilities, for example predicting the assets at highest risk of failure. With so much to explore and learn about GIS, a GIS specialist's job within Reclamation is never boring!

Uncrewed Aerial Systems (UAS) Surveying: Imaging and LiDAR Modeling

Meyer Jay
Natural Resource Specialist, Oklahoma-Texas Area Office, Missouri Basin Region

Matthew Klein
Civil Engineer, Concrete and Structural Laboratory, Technical Service Center
Uncrewed Aerial Systems Lead Instructor, Department of the Interior

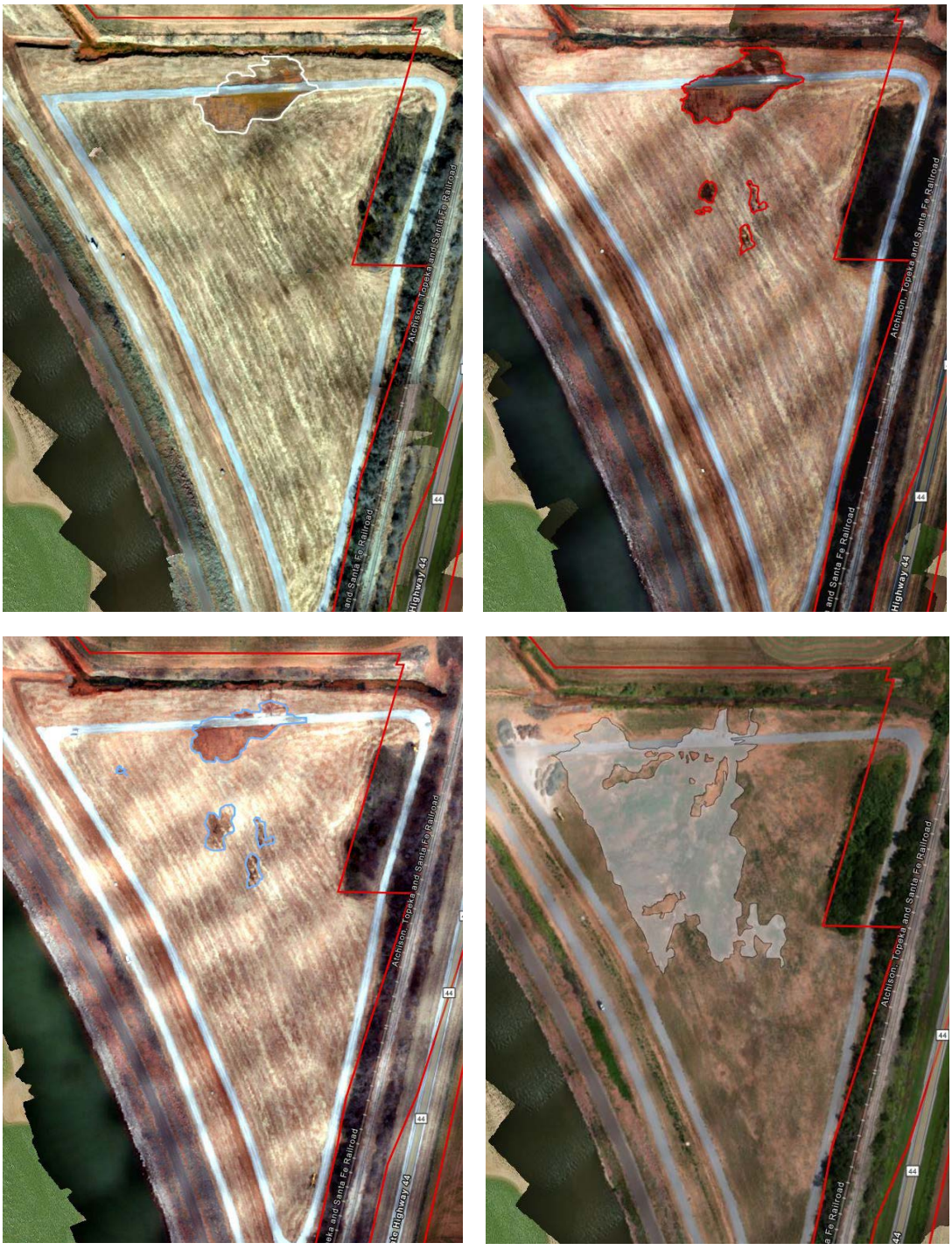
WingtraOne Gen II vertical-take-off-and-landing airframe at Pueblo Dam and Reservoir, Colorado.

Most of the Bureau of Reclamation's (Reclamation) Uncrewed Aerial Systems (UAS) capabilities began in 2017 and have since proven to be a beneficial tool to collect a variety of data, including high-definition video of trespasses, inspections of bridges and surge tanks, footage for public relations, and geospatial data, including digital elevation models, topographic data, and point clouds. Utilizing UAS as a survey tool contributes to risk reduction and increases data collection efficiency. Below are two projects where UAS was used for survey purposes.

In 2015, a corrective action study was completed to cost effectively reduce the probability of dam or dike failure under both static and hydrologic loadings at the W.C. Austin Project in southwest Oklahoma. The study recommended that the drainage trenches be backfilled with sand filters, a perforated drainage pipe encapsulated in gravel drain material at several of the dikes, and raising all dikes to crest elevation

1573 feet. Reclamation decided to identify onsite soil borrow areas that the contractor could use to raise the dikes. During construction, an average of 10 feet of soil was removed from Borrow Area 3B.

In 2018, after modification, the Lugert-Altus Irrigation District reported unusually high piezometer readings and damp areas in Borrow Areas 3A and 3B. Oklahoma-Texas Area Office (OTAO) staff inspected the seepage areas and marked the current seepage extent with wooden stakes. Following the initial inspection, areas downstream of multiple dikes experienced increased seepage.



W.C. Austin Project 2019 seepage extents in Borrow Area 3B: January 8 (top left), February 1 (top right), March 7 (lower left), and July 17 (lower right).

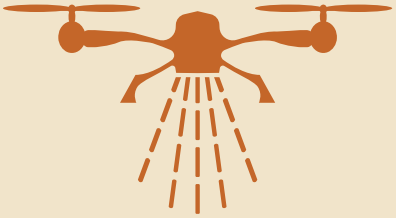
To ensure that the areas reported as damp were not due to a drainage issue related to construction, OTAO used UAS to survey the area to produce topography of the seepage areas and monitor the extent of the seepage areas. January 8, 2019, was the first UAS flight, followed by February 1, March 7, June 19, and July 17. With every UAS survey, OTAO was able to monitor and track the seepage growth of the areas.

At that point, no additional flights were conducted due to declining lake levels that appeared to correlate with improved conditions of the seepage area. OTAO determined that UAS was the most efficient tool due to the site's conditions having little to no vegetation, and it was also deemed the safest tool due to wet and saturated site conditions.

On April 24, 2024, Reclamation Technical Service Center (TSC) UAS pilots, along with TSC LiDAR operators, conducted data collection at Pueblo Dam, Colorado, for 3D modeling in and around the 10,000-foot-long by 200-foot-tall embankment and concrete buttress dam.

The UAS team operated the WingtraOne Gen II vertical-take-off-and-landing (VTOL) airframe to collect about a square mile of 0.87 inch-per-pixel resolution images after setting out a total of 30 global navigation satellite system (GNSS)-enabled ground control points (GCPs). Using a 2019 survey, eight of the GCPs were placed over the project benchmark with seven other monumented control points used to check the error of the GCPs. A GNSS receiver was also placed over the project benchmark for the purpose of collecting atmospheric data to correct the georeferenced UAS imagery using post-processed kinematic (PPK) technology, thus increasing the accuracy of the imagery from feet to inches. At an average height of 400 feet above the ground, a total of about 90 minutes of flight time was recorded over four flights to collect just under 3,000 images. On April 29, the UAS team returned to the dam to collect high-resolution images (0.15 inches per pixel) of the right concrete abutment crest (on the south side), three of the south buttress bays, and the spillway area using the Skydio X2D subject-based navigation platform. A total of 10 GNSS-enabled GCPs were placed to georeference this data though only four GCPs were visible in the model. This time the UAS distance from the structure was about 26 feet, and a total flight time of 187 minutes was logged over nine flights to capture just under 6,000 images.

The LiDAR team used the RIEGL VZ-2000i 3D Laser with 1.5-mile range and 0.2-inch accuracy (1-sigma at 330-feet) to collect data of the upstream and downstream embankment faces and all eight spillway buttress bays. The terrestrial LiDAR was set up at three, 45-minute, long range scans at upstream and downstream locations



The purpose of the data collection at Pueblo Dam was two-fold. The first was to use the UAS photogrammetric and terrestrial LiDAR data in a comparison between two methods as part of a joint WaterSMART and Dam Safety Program research project being led by TSC hydraulic engineer Melissa Shinbein. This comparison will factor not just the modeling results such as coverage and accuracy, but also the:

Data collection effort

Environmental operating conditions

Set-up time

Ease of use

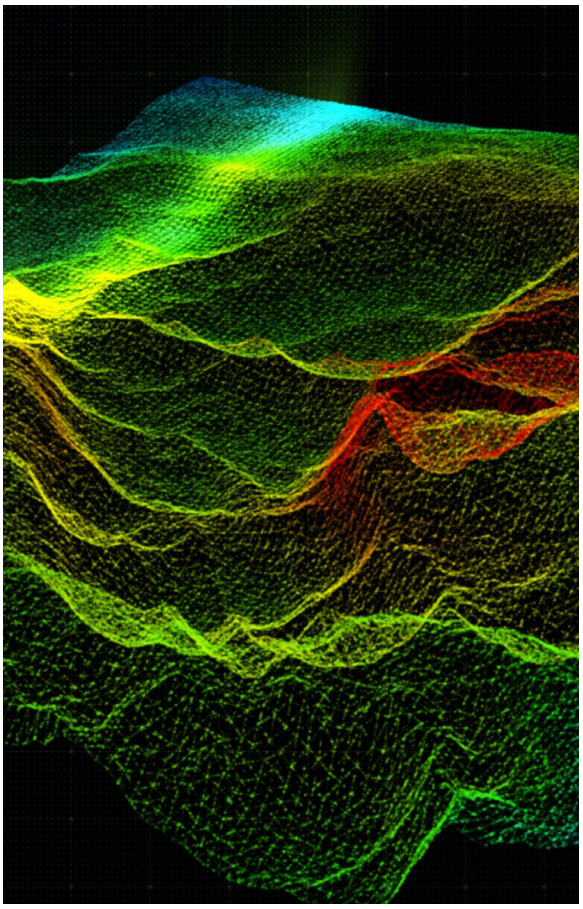
Training requirements

Processing and registration times

Accessibility of the processing software

Ability to share the results and data products

The second purpose was to demonstrate UAS and LiDAR data collection techniques at the June 11-14, 2024, International Course on Geotechnical and Structural Monitoring held in Golden, Colorado.



and an additional nine, 15-minute, short range scans in the buttress bays and from the edge of the concrete crest and spillway. The data was georeferenced using the on-board GNSS receiver, but that data was not corrected (though a real-time kinematic or RTK receiver is available and will be used for future projects to correct the scan location to inch level accuracy).

The VTOL UAS data was processed in Agisoft Metashape Pro to produce a point cloud, textured 3D model, digital surface model, and high resolution orthophoto after the image georeferencing post-processing. The root means square error (RMSE) between the eight benchmark/control points and GNSS GCPs was 0.63 inches with a maximum of 1.2 inches of error. The photogrammetric processing RMSE was reported as 0.1 inches (recall the image resolution of 0.87 inches per pixel), and the RMSE between the PPK photogrammetric positioning and the GNSS GCPs was 2.26 inches with a maximum of 5.8 inches.

The subject-based navigation UAS data was also processed in Agisoft Metashape Pro to generate a point cloud, textured 3D model, and orthophotos of the crest and downstream face. The GCP RMSE was 0.71 inches with a maximum error of 1.1 inches. The photogrammetric processing RMSE was reported as 0.025 inches (with the image resolution of 0.15 inches per pixel), and the agreement between the GCPs and photogrammetric model resulted in an RMSE of 2.71 inches and a maximum error of 4.2 inches.

Because of the unavailability of upstream scan locations (due to inaccessibility of the reservoir during the scanning) and limited downstream scan locations due to time, a model of the entire dam was unable to be generated. However, a colorized point cloud of the concrete spillway portion of the dam including each buttress bay was successfully registered and modeled. At the time of this article, the registration accuracy report was unavailable but can be assumed to be about 0.12 inches (1 sigma) for each individual scan with a positional accuracy of about 30 feet.

For the analysis between the photogrammetry and LiDAR modeling, a partial overlapping section of the three southern spillway buttress bays was used. The model alignment was conducted manually since the LiDAR georeferencing was highly inaccurate and resulted in fairly close geometry with the average error of around 1 inch and a max error of about 4 inches. This comparison was done roughly, and with better LiDAR scaling and photogrammetric noise reduction along with more accurate georeferencing, there is a high likelihood that the actual errors are less than an inch.

While more analysis and comparison will need to be conducted and refined, this quick exercise revealed several things about UAS imagery and LiDAR as tools for modeling and condition assessments. Accurate ground control is an essential though time-consuming aspect of scaling and referencing both types of digital models. And if the best accuracy is required, a licensed land surveyor should be involved. Multiple LiDAR setups are required to consistently register the scans. Greater noise can be found in photogrammetric data where the images are underexposed, and overlap should be planned and monitored to increase redundancy and accuracy. These preliminary conclusions demonstrate that there are efficiencies and applications where each technology is best employed and where they also overlap, and more studies should be undertaken to help refine the assumptions.

GNSS-enabled GCPs with Pueblo Dam in the background.

Dam and Dike Monitoring Surveys and Survey Control

Charles L. Hardes, PLS
Land Surveyor, Montana Area Office, Missouri Basin Region

Survey control point BBES-3, established for monitoring Big Bull Elk Landslide, Bighorn Reservoir, Montana.

This article includes key points from the upcoming best practices manual that further details guidelines for conducting monitoring surveys on Bureau of Reclamation (Reclamation) dams and dikes, including associated survey control. Although developed with experience at Montana Area Office facilities, the guidelines should apply throughout Reclamation. Survey procedures used in the collection of survey monitoring data for embankment measurement points, structural measurement points, collimation (deflection surveys), and various instrumentation positions must provide consistency in the accuracy and precision of survey monitoring data. Monitoring surveys within Reclamation are scheduled based on the Schedule for Instrument Monitoring (L-23) posted in the Data Acquisition and Management System.

Education and Training

The foundation of land surveying competence is a formal education. Those individuals in a professional position should have a bachelor's degree in Land Surveying, Geomatics, or Survey Engineering, while those in a technical role should have an associate degree in these fields. As with any highly technical, rapidly changing field, continuing education and training is critical. Major surveying technology companies provide multiple sources of training and support. State associations for land surveyors typically provide continuing education opportunities through their annual conferences. Land surveying encompasses far more than boundary surveys.

Surveying Technology

There have been significant advances in surveying technology in recent decades. It is important to remember that these advanced technologies are only tools. To assure a reliable survey product, all tools must be used properly and in the appropriate situations.

Surveying technology cannot replace education, mentoring, and experience. Realizing what you do not know is as important as what you do know.

When new survey technologies are introduced, do not abandon established horizontal and vertical datums at a Reclamation facility. Original vertical datums, in particular, are referenced in literally thousands of historic and current documents for that individual facility. When survey project files are properly configured in the office software or survey controller, any horizontal and vertical datum requirement at an individual facility can continue to be used, whether that datum is assumed, outdated, or current. To indicate otherwise disregards the capabilities of new survey technologies and is incorrect.

Two widely available and tested newer technologies appear as viable replacements for current monitoring systems: Terrestrial Stationary Scanners using LiDAR and Uncrewed Aerial Systems (UAS) using LiDAR.

- Terrestrial Stationary Scanners using LiDAR can be used to map an entire concrete structure to produce a three-dimensional surface. Comparison to a previous surface could identify heave/settlement and horizontal movement within current survey tolerances or, better, allow for evaluation across the entire concrete structure rather than just at specific points.
- UAS using LiDAR can be used to map the entire embankment and abutments of a dam or dike to produce a three-dimensional ground surface. Comparisons to a previous surface could identify heave/settlement within ~0.1 foot while allowing for evaluation across the entire embankment and abutment surface. Without defined points, only larger horizontal movement could be detected.
- Certain groups within Reclamation have the equipment but may lack expertise (Professional Land Surveyors and American Society for Photogrammetry and Remote Sensing Certified Mapping Specialists) with these types of mapping, whether for implementing internally or for evaluating contracted products. Fully embracing these methodologies would help area offices and the Technical Service Center to fully evaluate surface movement.

Scanning and imaging the radial gates at Canyon Ferry Dam, Montana.

Protective fencing for survey control point NDA-1 (1993) at Nelson Dikes, Montana.

Georeferencing AutoCAD Drawing Files

Horizontal datum (reference frame) parameters can be entered into the drawing settings in an AutoCAD drawing file, further documenting the survey project datum metadata and allowing for more direct importing of various georeferenced files such as aerial photographs.

Survey Control

The basis of all accurate and precise monitoring surveys is stable survey control and standardized survey procedures, as both have been the main factors in corrupting survey monitoring data. There are not always easy determinations of survey control monument stability. With no easily discernable visual indications, 9-inch diameter, 10-feet long concrete survey monuments have shown substantial horizontal and vertical movement, while at the same facility simple 5/8-inch diameter, 30-inch long rebar have maintained remarkable stability. Stable survey control must be available for all scheduled and unscheduled surveys, including emergency surveys, as required in L-23.

- Original and other pre-existing survey control for a facility should be recovered, re-surveyed, and documented. Official Reclamation drawings in eDRAWS, standing operating procedure binders, comprehensive facility review binders, survey control field books, and field, area, and regional office records are good sources. For transferred works facilities, irrigation district offices often possess drawings and survey field books.
- Closed circuit differential leveling is the primary method for checking vertical stability between benchmarks. Static Global Positioning System (GPS)/Global Navigation Satellite Systems (GNSS), Robotic Total Station, and real time kinematic (RTK) GPS/GNSS may be suitable depending on site topography and distances involved.
- Static GPS/GNSS, Robotic Total Station, and RTK GPS/GNSS are the primary methods to check horizontal stability between control points.
- An average of long-term observation National Geodetic Survey Online Positioning User Service solutions can be used to establish new permanent horizontal survey control based on a national horizontal datum (reference frame), allowing for referencing existing local survey control to a national horizontal datum. Those same average solutions can be used to reference an original construction vertical datum to a national vertical datum (reference frame).

- New permanent survey control monuments should be set if existing survey control is inadequate for preserving survey control through the years to follow. Ideally, survey control monuments should be located in undisturbed natural ground or substantial rock formations and situated for maximum usefulness.
- If practical and possible, avoid installing survey control monuments in any area being monitored for movement. Monuments installed on concrete structures within the facility cannot be assumed to be stable without multiple-year proof of stability. Indeed, structures such as concrete dams are expected to have regular movement.
- Survey control monuments and monitoring points are susceptible to disturbance or destruction, particularly during construction activities. Surveyors must be proactive in the early stages of facility modifications to protect these features.

Solid steel "T" fence posts are commonly used and have proven to be one of the best witness posts for protection and easy recovery of survey control monuments and monitoring points. In vulnerable areas, permanent fencing, large boulders, or concrete barriers can be used to encircle a survey control monument. Regardless of the protection selected, it should not interfere with setups over or otherwise disturb the monument.

Purpose

Establishing guidelines should ensure proper survey procedures are followed at all Reclamation facilities. Adopting consistent procedures throughout Reclamation can enhance data accuracy and facilitate meaningful comparisons across different projects. Guidelines can improve the efficiency of our survey processes and strengthen the integrity of the data collected. Ultimately, this enables Reclamation to make more informed decisions, allocate resources effectively, and better serve the communities and environments that rely on our projects. We can uphold the highest standards of professionalism and accountability in our survey practices, ensuring that our work contributes positively to the mission of Reclamation now and in the future.

Solar Over Canals

Mike Studiner, P.E.
Program Manager, Structures Operations and Maintenance, Asset Management Division

Conceptual rendering of solar panels spanning the 110 foot-wide Turlock Irrigation District Main Canal, California (Solar AquaGrid LLC).

Section 50232 of the Inflation Reduction Act of 2022 (Public Law 117-69) (Canal Improvement Projects) appropriated $25 million for the design, study, and implementation of projects (including pilot and demonstration projects) to cover canals associated with a Bureau of Reclamation (Reclamation) project with solar panels to generate renewable energy and increase water efficiency. As a result, Reclamation's Dam Safety and Infrastructure Directorate's (DS&I) Asset Management Division (AMD) took on the role and responsibility of developing and administering the program that has become effectively known as Solar Over Canals.

Solar Over Canals is a relatively novel technological application. Western India's Gujarat State pioneered this technology around 2012, initially planning to cover 11,800 miles of canals with solar panels. However, due to unforeseen circumstances, only a handful of smaller projects have been established. In the United States, the Turlock Irrigation District, in partnership with Solar AquaGrid, University of California-Merced researchers, and the California Department of Water Resources, has developed Project Nexus. Project Nexus is underway and expected to be completed in 2024 as one of the first projects in the Nation. The State of California committed $20 million in public funds to the pilot project, which will look at the viability of the Solar Over Canals concept over both wide-span and narrow-span canals.

There are many direct benefits anticipated to be derived from Solar Over Canals. The first benefit is the generation of renewable energy. This renewable energy can be used directly by the system to offset energy usage of pumping stations and other equipment or infrastructure, or it can be connected to the energy grid to benefit local communities. Additional direct benefits may include water conservation due to reduced evaporation from direct sunlight or wind exposure, increased water quality and reduced maintenance due to less vegetative and algal growth in the canals, and reduction of a project's carbon footprint.

Indirect benefits include the fact that these canal systems are an already disturbed and used area, and incorporating solar panels over them creates a dual-use system. Placing them over already developed canals creates land savings by maintaining other open spaces for public, agricultural, and industrial use. Environmental compliance and permitting associated with previously disturbed areas, like canal systems, is also less difficult to establish.

There are two main solar panel application types at this time. One is canal spanning solar panels, which feature panels installed on truss support systems or cables that span across and over the canal. The second application is canal floating solar panels where panels float directly on the surface of the canal and are tethered to anchors on the bank.

To implement Solar Over Canals, during summer 2023, AMD developed an Internal Call for Proposals that laid out eligibility information, the review and selection process, proposal requirements, and evaluation criteria. Eligible projects were defined as those that featured a canal associated with a Reclamation project that is operated and maintained by a transferred works operator or that is associated with an authorized Reclamation project. Evaluation criteria included operations and maintenance (O&M) considerations; non-Federal cost share and support for the project; project implementation and readiness to proceed; clean energy, water efficiency, and additional benefits; and safety and security considerations and benefits.

Few projects of this scope currently exist in the world, and Reclamation is hoping to use this opportunity to better understand the impacts of Solar Over Canals to its systems and facilities; minimize the impacts to O&M; and work with technical partners, including the National Renewable Energy Laboratory, to understand the scale of these efforts and the corresponding benefits that can be claimed.

Anticipated benefits of solar panels over canals:

1. **Renewable Energy**
2. **Water Conservation**
3. **Water Quality**
4. **Reduced Maintenance**
5. **Reduced Carbon Footprint**

Workers installing solar panels covering the Narmada Canal at Chandrasan village, outside Ahmadabad, India (AP/Ajit Solanki).

Four projects were announced for selection and award:

Upper Colorado Basin Region

Weber Basin Water Conservancy District,
Solar Panels Over the Layton Canal Project

Project Funding Awarded: $1,500,000.00

Layton Canal, Weber Basin Water Conservancy District, Utah.

The Weber Basin Water Conservancy District (District) proposes to cover existing canals with canal spanning solar panel structures in the upper portion of the Layton Canal near West Haven, Utah. The project will serve as a five-year demonstration of data collection and monitoring to allow for evaluation of technical capability, economic feasibility, and viability for full-scale implementation for both Reclamation and the District. The purpose of the project is to build resiliency to climate change and invest in domestic energy production. The project expects to increase water quality by reducing algal blooms along the canal, produce renewable energy to offset pump station use or sell back to the utility, and significantly reduce water loss to evaporation. The District estimates the feasibility study beginning as soon as October 2024, with design beginning as soon as April 2025, and construction and installation complete as early as August 2027, pending agreement with Reclamation.

Lower Colorado Basin Region

Gila River Indian Community,
Solar-Over-Casa Blanca Canal Project

Project Funding Awarded: $5,650,000.00

The Gila River Indian Community (GRIC) will construct canal spanning solar panels over the Casa Blanca Canal within the Gila River Indian Reservation (Pinal County, Arizona). The project will feature a five-year study period serving as a pilot for Reclamation and GRIC. This pilot project will provide important information for GRIC's future projects that include solar panels over 18.5 miles of canals. The project is shovel ready, with all design, environmental and cultural resources compliance, right-of-way procurements, and feasibility studies completed. Selection of the GRIC *Solar-Over-Casa Blanca Canal Project* was announced in December 2023. GRIC anticipates construction beginning in early 2024 and completion at the end of July 2025, pending agreement with Reclamation.

Columbia-Pacific Northwest Region

North Unit Irrigation District, *Main Canal Floating Photovoltaics Project*

Project Funding Awarded: $2,550,000.00

The North Unit Irrigation District (NUID) proposes to construct floating photovoltaic (FPV) solar panels on the Main Canal of the Deschutes Project located near Bend, Oregon. The project will allow the novel technology of floating solar panels on a canal to be evaluated, designed, and constructed to study the water efficiency gains and amount of clean energy produced for future larger scale implementation and as a pilot for Reclamation. NUID anticipates installation beginning by December 2025 and completion by March 2026, pending agreement with Reclamation.

California-Great Basin Region

San Luis and Delta-Mendota Water Authority, *Delta-Mendota Canal Floating Solar Project*

Project Funding Awarded: $15,000,000.00

Aerial view of the Delta-Mendota Canal and California Aqueduct.

The San Luis and Delta-Mendota Water Authority proposes a public-private-academic collaboration to assess the impacts of FPV solar arrays on the Delta-Mendota Canal (DMC) near Santa Nella, California. The pilot intends to deploy multiple (up to three) potential floating solar technologies to assess the viability, costs, and benefits of floating solar over canal technologies on large conveyance facilities like the DMC. Each technology selected for assessment will have multiple segments of floating panels for data gathering and analysis, and multiple potential project sites have been identified. The pilot will also validate FPV design for moving water, identify and address issues related to maintaining a canal with FPV on it, explore power generation potential, and develop methods to quantify ancillary benefits such as reduced evaporation and algae growth. The project is expected to be in operation no later than early 2027, pending agreement with Reclamation.

Q&A Karl Stock

Regional Director, California-Great Basin Region, Bureau of Reclamation

Karl Stock was named Regional Director of the California-Great Basin Region (CGB) on December 21, 2023. He succeeded Ernest Conant, who had been in the role since January 2019. Stock joined the Bureau of Reclamation (Reclamation) in 2001. Prior to becoming Regional Director, he most recently served as Manager of the Reclamation Law Administration Division (RLAD). Stock met with us in May to discuss his work prior to Reclamation, how managing RLAD helped prepare him to direct CGB, and unique challenges facing the Region.

What inspired you to pursue a career in water management?

I was doing 80 hours each week running fast food restaurant franchises. I was ready for a change. Having grown up on a farm, on a Reclamation project, and with a fascination for moving water, Reclamation and water management spoke to me. I was griping to a friend about my heavy schedule, and he said, "Didn't you get a degree in economics?" His office was hiring for an economist. He talked it up. I'd never imagined myself working for the Federal government. But I put in for it and then quickly realized the great thing I'd stumbled on.

Can you describe your different roles since joining Reclamation in 2001?

I started as an economist in the Provo Area Office and was hired by our current Upper Colorado Basin Regional Director, Wayne Pullan. I did repayment contracts and planning studies. I was in the area office for four years, and then I jumped to the Policy Office in 2005. I spent the next 18 years working in or managing pretty much every division of the various iterations of the Policy Office, including the Asset Management Division (AMD) for several months, Human Resources for over a year, acting Policy Director for over a year, and several interspersed details as regional director or deputy regional director. Quite a few different roles, but a lot at headquarters level with a great view of how different program areas play out across all five regions.

Who have been your mentors? What lessons did you learn from them?

Wayne Pullan has been an outstanding mentor to me throughout my career. A fellow economist who brings a cost-benefit trade-off perspective to difficult challenges. David Palumbo is another outstanding mentor. His pairing of knowledge, strength, and kindness is a leadership formula I hope to get better at emulating. I also had the privilege of working with Bob Johnson on many occasions. His ability to hear you out and then make a different decision than what you wanted and yet make you feel good about it was legendary. It's a special magic that I am trying to figure out how to do a little more of myself.

How did your work as Manager of RLAD help prepare you to serve as CGB Regional Director?

RLAD administers the unique provisions of Federal reclamation law. Working in RLAD gave me an appreciation of the living nature of Federal reclamation law and its flexibilities and constraints. That is super relevant to the work our team is doing in CGB. I worked with the policies and processes that make the Federal government run and allow administrations to enact their agendas, while also being able to see how that plays out across the bureau. Each region has a unique mix of customers, authorities, and stakeholders. Embracing the One Reclamation Team concept allows us to build relationships with those with whom we might disagree. Needs are different across the regions, and I believe our headquarters staff work hard to understand what goes on in our regional and field offices and the challenges they face. Learning how to support the development of a diverse, motivated, and close-knit team with the folks in RLAD was one of my most valuable career experiences.

How would you describe the Regional Director's responsibilities?

Every morning, I invite anyone on my team to come to my office and have coffee with me one-on-one. It's my way of staying connected to those who do our frontline work. I've had coffee with our supply technicians, plant mechanics staff, and supervisors from our financial management division, just to name a few. Keeping us focused on supporting their work is one of my most important responsibilities. A particularly important aspect of that is to help build a diverse and inclusive workforce equal to the incredible challenges CGB faces now and in the coming years as climate change dramatically alters our environment. Another responsibility is to think about how we fit CGB's interests into the broader Reclamation interest and that of the American people. The work is done by a great team. We need more of them. We have 1300 people budgeted to do the work of the Region, and we need every one of them. We have about 980 on board. Getting back to full staffing is our top priority. Watch for our vacancy announcements!

What is a unique challenge facing CGB?

We have incredibly complex operations. Take the Bay Delta, that's one of the most environmentally sensitive and yet economically productive geographies in the West. Different stakeholders with competing interests. Endangered Species Act issues. Critical but

Stock speaking on April 4, 2024, at the announcement of awards for Solar Over Canals Inflation Reduction Act-funded projects.

Left to right: Stock, Principal Deputy Regional Director Adam Nickels, and Commissioner Camille Calimlim Touton at the Investing in America Agenda for Drought Resilience in San Joaquin Valley event May 21, 2024.

aging infrastructure. Kristin White, our Deputy Regional Director for Operations, leads a rock star team that works through the challenges this presents every day. Another challenge is in the Klamath Basin, where we have a species that needs the water in Upper Klamath Lake, and there's a species that needs the water downstream in the river. One is overseen by the Fish and Wildlife Service, and one is overseen by the National Marine Fisheries Service. The Upper Lake has Native American Tribes to whom those endangered species are critically important to their culture. The same is true with Tribes for whom we have tribal trust responsibilities in the Lower Basin. There often isn't enough water to meet the needs of both of these species, let alone deliver irrigation water to those whose livelihoods rely on it. I recently announced Lanie Paquin as our new Deputy Regional Director for Technical Services. She has the Klamath Basin in her portfolio and is perfect for the challenge.

How do you help support communications between planning, design and estimating services, construction, and operations and maintenance?

It starts with planning. That's how you move from a conceptual idea to look at options and bring all affected stakeholders into the same place to build support as you evaluate a wide range of options and ultimately find your preferred solution. Once you go through planning, you can start thinking about design. And then how do you construct that and how do you operate that? We are giving significant attention to how we develop and articulate those phases of project development and how we assign roles and responsibilities of our different offices. Our Principal Deputy Regional Director, Adam Nickels, knows CGB inside and out, and he knows our Denver offices that oversee programs that will help us get funding and can provide support in different project phases.

The Bipartisan Infrastructure Law and Inflation Reduction Act have allocated unprecedented appropriations to help support infrastructure across the West. Can you describe a couple of projects in CGB that are benefiting from this funding?

We had the first big project from the Aging Infrastructure Account (AIA). RLAD teamed up with our Lahontan Basin Area Office to get the planning study completed and then advocate for funding. It was about $35 million for the Truckee Canal lining project. It's the first

major extraordinary maintenance project funded from the AIA that has been substantially completed. It's going into repayment, and that money is going to start going back into the AIA to be re-used for future needs. A shout out to our Area Manager, Jack Worsley, and his leadership on that.

Another is the Trinity River Hatchery Modernization Project. That's a tribal trust responsibility. We have Tribes and other entities that were impacted by our diversion of the Trinity River over to the Sacramento River for the Central Valley Project. We promised we would run a hatchery to help recover affected species. We've done a good job, but that building is old. I toured it as one of my first site visits in CGB. It's been a herculean effort from our team to keep it running. They worked up a plan with CGB and our Technical Service Center to design a major upgrade. And we've got it funded. That was a great partnership between AMD, RLAD, and CGB.

What advice can you share for those just starting careers in Reclamation?

Never stop being curious. My curiosity has led me to a lot of opportunities in Reclamation that were not necessarily a part of my job. A second one is to seek out and build relationships with those who think differently than you. When we surround ourselves with people who think like us, that saps our creative problem-solving and our ability to engage productively in conflict. Finally, it's important to appreciate the business service functions that make our mission accomplishment possible. I have worked on both sides of the organization – mission and mission support. Both are equally challenging and equally rewarding.

What do you like to do when you're away from work?

I've always pushed work-life balance. I still do, but that looks different for people at different stages of their life. I keep a home in Milwaukee. That's where my husband lives. Yet, I have a job in Sacramento. Lately, I joke that my work-life balance right now is when I'm in Sacramento I work, and every other weekend I go home for balance. I love mountain biking and snowboarding – two things I fell in love with in Colorado that I intend to keep up in California. And I enjoy good food and wine with friends and family.

Truckee Canal Public Safety Improvement Project Phase 1 construction, which began in November 2022, was announced as complete on May 22, 2024.

Reclamation's Pit River Bridge carrying Interstate 5 on the top deck and the Union Pacific Railroad/Amtrak on the bottom deck over Shasta Lake, California. $32,500,000 in FY 2024 AIA funding has been provided to continue work on a planning study and environmental compliance efforts associated with replacement of the highway portion of the Pit River Bridge.

Updates & Due Dates

Fiscal Year (FY) 2025 Aging Infrastructure Account (AIA) Application Period Now Open

Background

Public Law (Pub. L.) 116-260 added a new subsection to Pub. L. 111-11 (43 USC 510b(d)), creating the AIA "to provide funds to and provide for the extended repayment of funds by" eligible applicants. Eligible applicants are transferred works operating entities and project beneficiaries responsible for reimbursable Operation, Maintenance, and Replacement costs. Once the applications are approved by the Secretary of the Interior and reported to Congress, applicants may enter repayment contracts to receive aging infrastructure funding allocations to complete extraordinary maintenance (XM) work on Bureau of Reclamation (Reclamation)-owned assets.

Benefits

Because funding awards from the AIA are repaid back into it, using the AIA for present XM needs helps ensure funding for future XM needs. Congress appropriated $3.2 billion to the AIA to be made available through the application process over a five-year period. $670.4 million will be made available in the FY 2025 application cycle. The funding represents a strong and significant commitment to advancing aging infrastructure projects. This unprecedented investment of Federal funding is an opportunity for operators to apply for funds for aging infrastructure and extended repayment.

Key Dates

The FY 2025 application period opened June 3, 2024, and will close on July 19, 2024. Please reach out to your regional representative to apply.