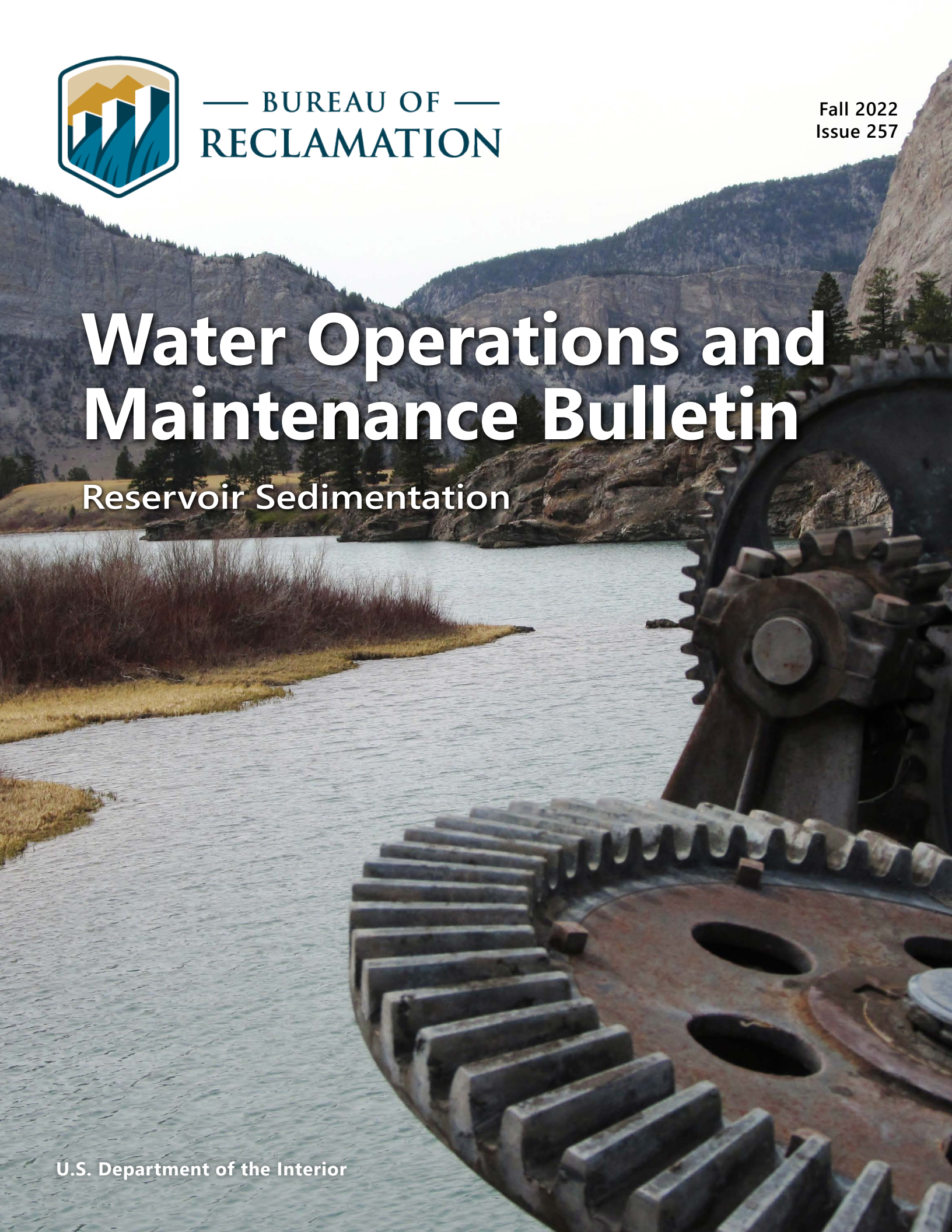
BUREAU OF RECLAMATION

Fall 2022
Issue 257

Water Operations and Maintenance Bulletin

Reservoir Sedimentation



U.S. Department of the Interior

Contents

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: Bob Marshall Wilderness (Montana) beyond the river outlet works gate hoist gears of the Sun River Diversion Dam (Joe Rohde).

Editor's Note

Welcome back! We hope you were able to get out and experience the natural beauty of the 17 Western States this summer. Our fall issue came together with the help of several sedimentation subject matter experts and contributions from tireless staff (including detailees) throughout the Asset Management Division. We're excited to feature so much important Reclamation work on sedimentation in this *Bulletin*.

Understanding sedimentation, surveying sediment levels, and employing strategies to reduce sediments are essential to Reclamation's mission. "Addressing Reclamation's Growing Reservoir Sedimentation Challenge" identifies facilities where sedimentation has impacted operations and proposes a Reclamation-wide Reservoir Sedimentation Survey Team to help foster collaboration and improve surveying. "Reclamation's Reservoir-Storage Capacity: an Effort to Acquire, Centralize, and Share Reservoir-Survey Data" discusses creating and maintaining a survey data repository to show how sedimentation has impacted reservoirs' storage capacity. And "Reservoir Sedimentation Economics Model" details how sediment gathers in reservoirs and at dams, while also sharing sediment management alternatives and their associated costs. Finally, "Autumn Operations and Maintenance: Cooler Weather and Lower Water" provides an overview of seasonal O&M best practices.

We wish to thank Karen Knight, Director of Dam Safety and Infrastructure, for participating in this issue's Q&A. She spoke to us about teamwork, her start at Reclamation, challenges posed by a changing climate, and her love for the people of Reclamation. Enjoy!

Darion Mayhorn, P.E.
Supervisor, Operations and Maintenance
Asset Management Division

Andrew Daigle, Ph.D.
Writer-Editor
Dam Safety and Infrastructure

Photo (right): Lake Berryessa in the morning (Reclamation/Jeanne Graham).

Around O&M

- **Eight Federal Lands Transportation Program (FLTP) Projects for Fiscal Year (FY) 2025-2026 were announced in August.** $13,960,000 in total FLTP funds were awarded, and each of the five regions is represented. The projects are:
  - Hoover Dam Lower Portal Road Safety Improvement Project (LCB, NV/AZ)
  - Elephant Butte Historic District – Additional Funds to Rehabilitate Roads and Parking Lots (UCB, NM)
  - Hayden Arch Bridge Construction – Construct New Access Road and Repair Historic Bridge (MB, WY)
  - Natural Bridges Access Project – Design Funds to Improve Access Road and Parking Lot (CGB, CA)
  - Blue Mesa Road Improvements (UCB, CO)
  - Upper Vista House Repaving – Visitor Center Parking Lot at Shasta Dam (CGB, CA)
  - Sportsman's Park Transportation Improvements – Repave Access Road, Parking Lot, and Trails (CPN, ID)
  - Causey Spillway Bridge Widening Project – Design Funds to Widen or Replace One-Lane Bridge (UCB, UT)
- **Field review of the Conveyance Lines Asset Class is now complete and in active management for the Enterprise Asset Registry**. This process, which added one of the largest asset classes to the Enterprise Asset Registry, incorporated about 2,000 miles of Reclamation-owned conveyance lines into the inventory, a 20% increase since the class was last inventoried. Information contained in the conveyance lines asset class will help support inspection scheduling, maintenance management, and condition assessments.
- **Build America, Buy America Act** (P.L. 117-58, Section 70911 et seq.): the Bipartisan Infrastructure Law (BIL) established that Federal financial assistance programs for infrastructure must comply with domestic content procurement preferences. This applies to all iron, steel, manufactured products, and construction materials used for infrastructure under an award. For more information: Executive Order 14005, Office of Management and Budget (OMB) Memorandum M-22-08, OMB Memorandum M-22-11, and "Buy America" Domestic Sourcing Guidance and Waiver Process for DOI Financial Assistance Agreements.

Addressing Reclamation's Growing Reservoir Sedimentation Challenge

Ali Warren, P.G.
Engineering Geologist, Engineering Geology and Geophysics, Technical Service Center

Reservoirs owned by the Bureau of Reclamation (Reclamation) provide essential water storage and economic stability in the arid Western United States. Reservoir storage is used for irrigation, municipal and industrial water supply, recreation, flood control, and hydropower. The accumulation of sediments within these reservoirs causes continued storage loss, which reduces water security, energy reliability, and the ability to mitigate floods.

Reclamation constructed most reservoirs with a sediment design life of about 100 years to allow storage space for reservoir sedimentation before the dam's function was impacted. This sediment design life determined the intake elevation of the dam outlet works. The lower the elevation of the intake, the smaller the volume of dead space in the reservoir, but the more susceptible it is to impairment by sedimentation. Paonia Reservoir in western Colorado accumulated over 70 feet of sediment infilling from 1961 to 2014, blocking the outlet works intake and impairing the ability of the dam to release water.

Over half of Reclamation reservoirs are over 60 years old, about 20 percent are over 80 years old, and 7 reservoirs are over 100 years old, which means many reservoirs are reaching the end of their original sediment design life. In addition to sedimentation infilling caused by normal operations, wildfire – particularly the production of ash and decrease in erosion resistance caused by destruction of vegetation – and changes in the hydrologic regime are exacerbating the issue. In the absence of sediment management, dam decommissioning is the most likely outcome for reservoirs infilled with sedimentation to the point of inoperability.

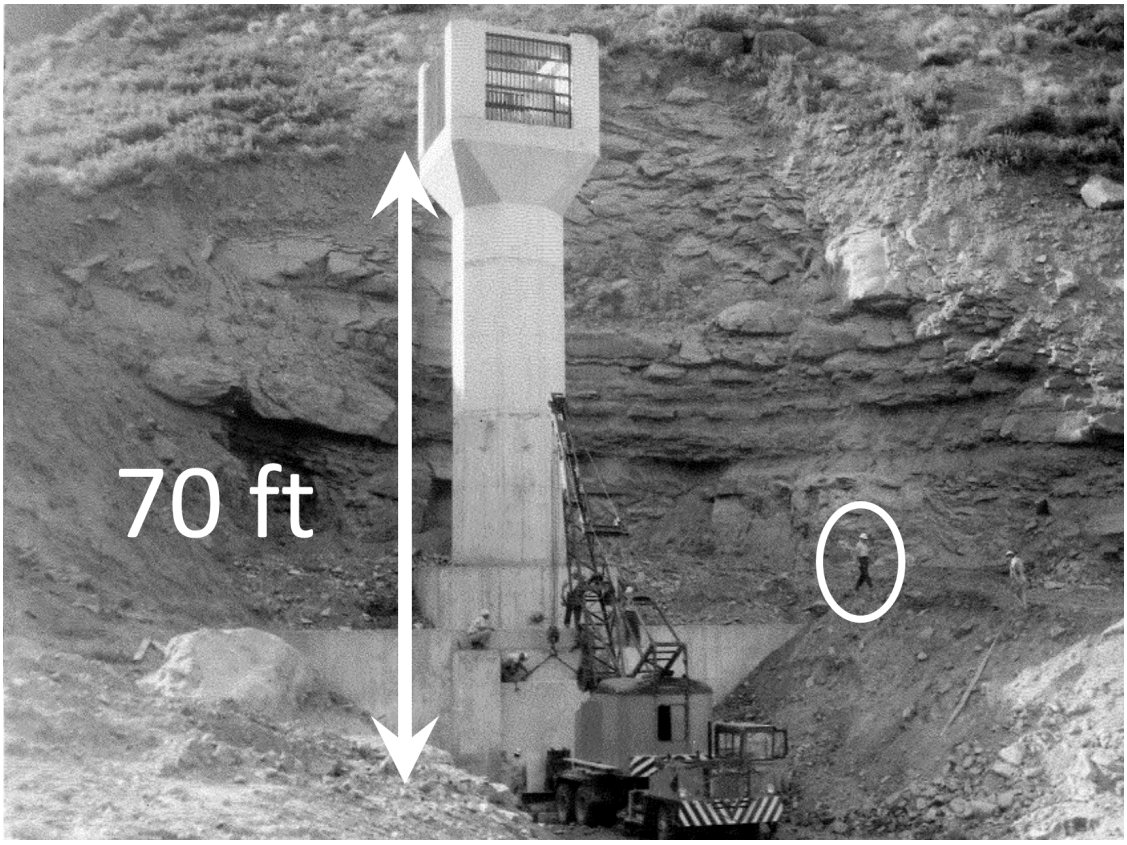
Reservoir surveys are needed to deduce sedimentation rates, estimate when sedimentation impacts will impair reservoir function, and properly plan sediment management actions or dam decommissioning. Only monitoring, through periodic reservoir surveys, can reliably provide the data to predict when impacts will occur.

There are few, if any, early warning signs of sedimentation impacts prior to facilities' impairment. Reservoir surveys are needed about once every decade or two to determine remaining storage capacity, estimate when sedimentation will impact dam and reservoir facilities, and assess if an improved sediment management plan is prudent. Knowing the actual storage capacity during droughts has become especially important for water management.

Given the large number of reservoirs that have not been surveyed since original construction, prioritizing surveys will be necessary to implement additional monitoring and further populate the sediment impact table of storage loss. Reclamation's Sedimentation and River Hydraulics Group in the Technical Service Center (TSC) maintains a recommended bathymetric survey priority list. However, this list skews heavily towards recommending the largest of Reclamation reservoirs and considering the time since last reservoir survey. These priorities do not account for the economic value of the reservoir storage capacity or other local or regional considerations.

A new requirement was recently incorporated into Reclamation Manual (RM) Directive and Standard (D&S) FAC 02-01, *Operating Practices and Procedures for High and Significant Hazard Potential Dams (and other facilities, as applicable)*, to address the current deficit. Regional directors are now required to "coordinate, schedule, and budget for Reclamation's costs in the development of reservoir sedimentation plans for storage reservoirs at high and significant hazard potential facilities that do not have a reservoir sedimentation monitoring plan in place."

Prioritizing reservoir surveys will require input from regional and area offices to account for a variety of management considerations. If reservoir surveys are conducted more frequently, understanding sedimentation issues at Reclamation reservoirs will continue to improve.



Photograph of outlet intake tower at Paonia Dam and Reservoir taken in July 1961 showing 70 feet of elevation from the bottom of the reservoir to the intake.

View of Paonia Reservoir from Paonia Dam in 2014, showing the impact of infilling with 70 feet of sediments. The top of the outlet works tower is on the left side of the image.

Top of Paonia outlet intake tower taken in 2014. Over 70 feet of sediment accumulated between 1961 and 2014, and the outlet was blocked by several feet of sediment and could no longer release water.

To support the regions in fulfilling this D&S, a Reclamation-wide Reservoir Sedimentation Survey Team (Sedimentation Survey Team) is proposed. The Sedimentation Survey Team will help to foster regional cooperation, meet region-specific needs, and share resources and training, thus significantly increasing Reclamation's capacity to survey its reservoirs. The Sedimentation Survey Team will consist of representatives from each region and the TSC, and it will function as a sub-group of the Facilities Operation and Maintenance Team.

Cochiti Dam in New Mexico, an Army Corps of Engineers facility where existing sedimentation was made worse from sediment-laden runoff after wildfire.

The Sedimentation Survey Team will be stood up temporarily for the duration of a three-year pilot program, which will serve the purpose of providing guidance and oversight to the regions to take action to meet the D&S requirements. Region-wide strategic plans and an initial reservoir-specific monitoring plan will be formulated by each region as part of the pilot program.

Implementation of best practices on survey methods and agency-wide coordination would help ensure Reclamation has comparable and optimized methods to survey reservoirs. Some reservoir survey and data processing methods are less accurate, and the use of different methods by different crews can produce inconsistent results. The use of consistent best practices, established by the Sedimentation Survey Team, would provide accurate estimates of water storage capacity and sedimentation volumes. Nearly all Reclamation reservoirs were designed and are operated in a local vertical survey datum. The Sedimentation Survey Team would also implement important steps to ensure the surveys are properly converted to meet the needs of reservoir operators, while ensuring consistent implementation of Department of the Interior and Reclamation safety training and policies necessary for conducting reservoir surveys.

While sedimentation of reservoirs will continue to be a challenge for inventory and water management, the Sedimentation Survey Team will be an exciting new initiative to address these challenges and continue the longevity of infrastructure. The collaboration between the TSC, regions, and Asset Management Division will foster new cooperative opportunities and ways to identify, manage, and address reservoir survey needs.

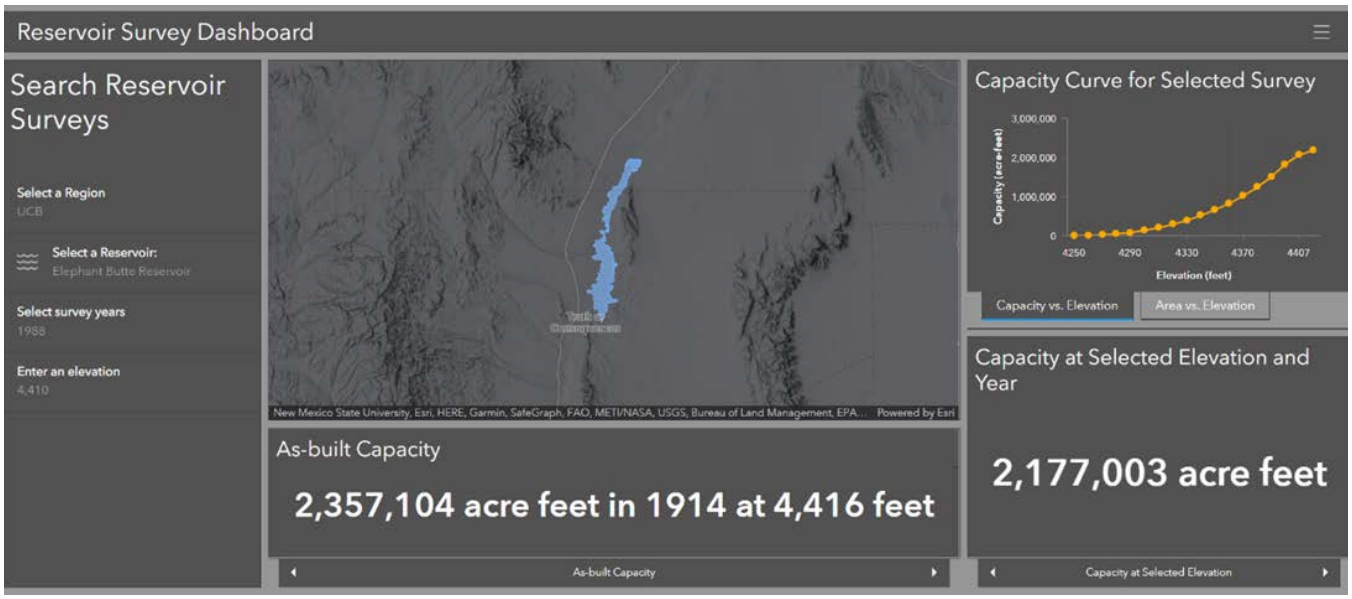
Reclamation's Reservoir-Storage Capacity: an Effort to Acquire, Centralize, and Share Reservoir-Survey Data

Melissa A. Foster, Ph.D., P.G.
Fluvial Geomorphologist, Sedimentation and River Hydraulics Group,
Technical Service Center

Reservoir storage capacity is one of the Bureau of Reclamation's (Reclamation) most important assets, enabling water delivery, flood mitigation, and hydropower production. Prior to dam emplacement, a detailed topographic survey is typically conducted to quantify the reservoir's original area-capacity table at the time of dam closure. An area-capacity table shows the reservoir's water-surface area and the below-water capacity (volume of water) at a range of elevations, typically between the minimum and maximum water-surface elevation.

While we know the design capacity of our reservoirs, we have limited data available to quantify the current storage capacity across Reclamation. This is because the available capacity reduces through time due to reservoir sedimentation. Rivers naturally transport sediment downstream, and high-trap efficiency dams can block over 95% of sediment from moving downstream. A combined topographic-bathymetric survey can demonstrate where sediment has accumulated in reservoirs; these surveys are used to create updated area-capacity tables. Modern surveys also support data needed to fulfill Reclamation's vision to protect and/or enhance conditions for fish, wildlife, land, and cultural resources. To date, only approximately one-third of our assets have been resurveyed, and many of these resurveys are outdated, as the mean time since the most recent resurvey is 25 years. In addition, these data are not available or easily accessible Reclamation-wide.

In 2020, two collaborative projects were selected through the WaterSMART Internal Applied Science Tools Program that focused on reservoir survey data management and communication: (1) "Mapping and Disseminating Reservoir Storage Capacity and Remaining Storage Life" (David Salas) and (2) "Populating Reservoir Sedimentation Databases" (Blair Greimann and Melissa Foster). The goal of



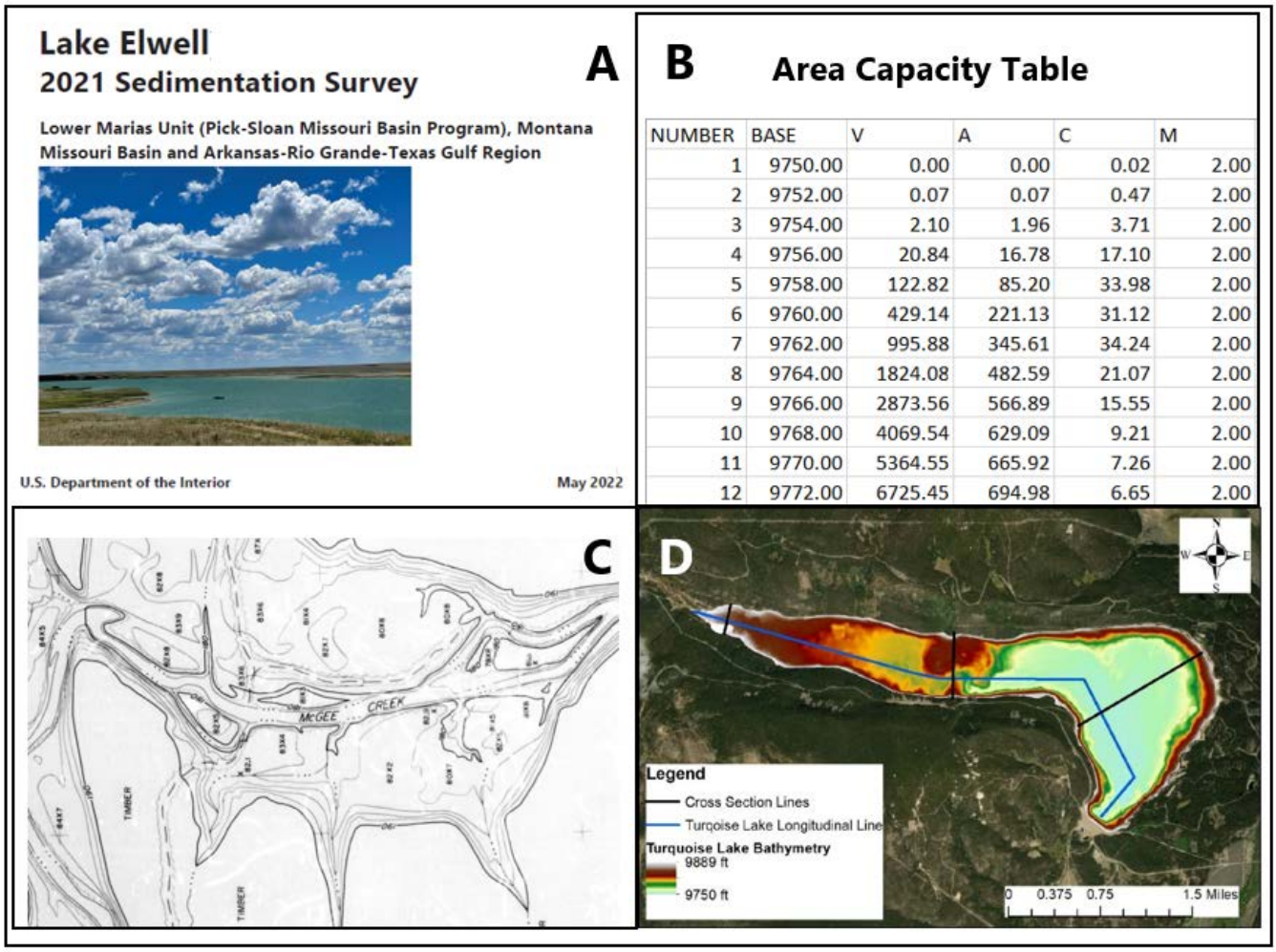
ArcGIS dashboard associated with the reservoir survey repository. On the left, the user can select the region, reservoir, survey year, and optional elevation of interest. The central map displays the reservoir. The bottom central panel shows the as-built capacity (arrows below scroll through a graph of available surveys within the regions, a cost estimate to survey the selected reservoir, and the most recent survey capacity). Along the right are graphs of capacity and elevation or area and elevation (capacity here). The bottom right shows the capacity data for the selected survey-year and elevation (the arrow will scroll to the area at the selected elevation) (Nate Bradley and David Salas).

these projects is to develop a centralized Reservoir Survey Data Repository (RESDATA), including new and historical surveys, and an easy-to-use interface that allows users to query and download data. This effort will create a large reservoir-survey database, which we hope will function as an informative tool for operators and Reclamation's offices. In addition, this data repository will enable researchers utilizing reservoir capacity data to skip the time-consuming step of contacting individual offices for survey data.

The survey data repository stores three key data items associated with any survey: (1) a report detailing the survey methods, data, and metadata; (2) an updated area-capacity table generated from the survey; and (3) the geospatial topographic and bathymetric surface used to generate the area-capacity table. At this time, we have compiled over 300 area-capacity tables at 200 reservoirs, which includes original and re-survey data. We documented recent-digital formats of topographic and bathymetric data and scanned paper maps for future digitization, centralized survey reports available on Technical Service Center network drives, and developed an initial version of the ArcGIS online dashboard that displays the status of survey availability and incorporates planning tools such as estimated survey costs. In addition, the Asset Management Division (AMD) made the entire reservoir asset table viewable to Reclamation users on ArcGIS online through the Enterprise Asset Registry.

Communication between Reclamation offices is key to the success of the reservoir survey data repository. Establishing communication pathways will facilitate quick resolutions for any problematic or incomplete data flagged during quality-control queries. We will soon issue a data call to the regional offices to acquire additional data and contact information for reservoir survey data stewards. Moving forward into fiscal year 2023, we hope to coordinate with the new Reclamation Reservoir Survey Team Board to define the proper communication contacts and data types. For example, who is the reservoir data manager for a particular region? Is the reservoir manager responsible for updating hydrological databases, reservoir capacity allocation, and standing operating procedures, or are these tasks assigned to different staff in each region? We also need to define acceptable data-file types and the critical metadata associated with any survey, whether it is conducted by Reclamation or a third-party contractor.

We look forward to working closely with the reservoir survey teams, AMD, regions, operators, and researchers to create tools for planning and survey prioritization. The centralized data repository is already being used to detect trends in sedimentation and relationships between sediment yield and parameters such as climate zone, stream density, precipitation, basin relief, land use, and soil cover under a related WaterSMART project, "Developing predictive equations to forecast reservoir sedimentation rates" (Melissa Foster). We intend to add these sediment-yield predictions into our dashboard as a planning tool. We welcome requests for and feedback on other beneficial tools, data query abilities, and data access useful to all Reclamation users at TSCreservoirsurvey@usbr.



NUMBER	BASE	V	A	C	M
1	9750.00	0.00	0.00	0.02	2.00
2	9752.00	0.07	0.07	0.47	2.00
3	9754.00	2.10	1.96	3.71	2.00
4	9756.00	20.84	16.78	17.10	2.00
5	9758.00	122.82	85.20	33.98	2.00
6	9760.00	429.14	221.13	31.12	2.00
7	9762.00	995.88	345.61	34.24	2.00
8	9764.00	1824.08	482.59	21.07	2.00
9	9766.00	2873.56	566.89	15.55	2.00
10	9768.00	4069.54	629.09	9.21	2.00
11	9770.00	5364.55	665.92	7.26	2.00
12	9772.00	6725.45	694.98	6.65	2.00

Examples of data requested for RESDATA. (A) Report associated with sedimentation survey. (B) Area capacity table showing elevation (Base), Capacity (V), Area (A), and variables used to interpolate data between measured elevations (C and M). (C,D) Examples of topographic-bathymetric data, including a contour map (C) and digital terrain surface (D) shown on satellite imagery.

Reservoir Sedimentation Economics Model

Timothy J. Randle, Ph.D., P.E., D.WRE.
Sedimentation and River Hydraulics Group, Technical Service Center

Todd L. Gaston
Economist, Economics and Resource Planning, Technical Service Center

You may know that reservoirs have been filling with sediment (clay, silt, sand, and gravel) for the past several decades. However, have you ever wondered what problems this can create, how the sediment can be managed, and can sediment management be economically justified? The new Reservoir Sedimentation Economics Model (RSEM) has been created to simulate reservoir sedimentation and comprehensively evaluate the economics of comparative sediment management alternatives over long time periods.

Dams and reservoirs provide substantial economic benefits to the nation, including water supply for irrigation, municipal, industrial, and firefighting use; flood risk reduction; boat or barge navigation; hydroelectric power; recreation; and fish and wildlife. However, the water storage capacity and wetted surface area that make these benefits possible are decreasing over time due to the continuing process of reservoir sedimentation.

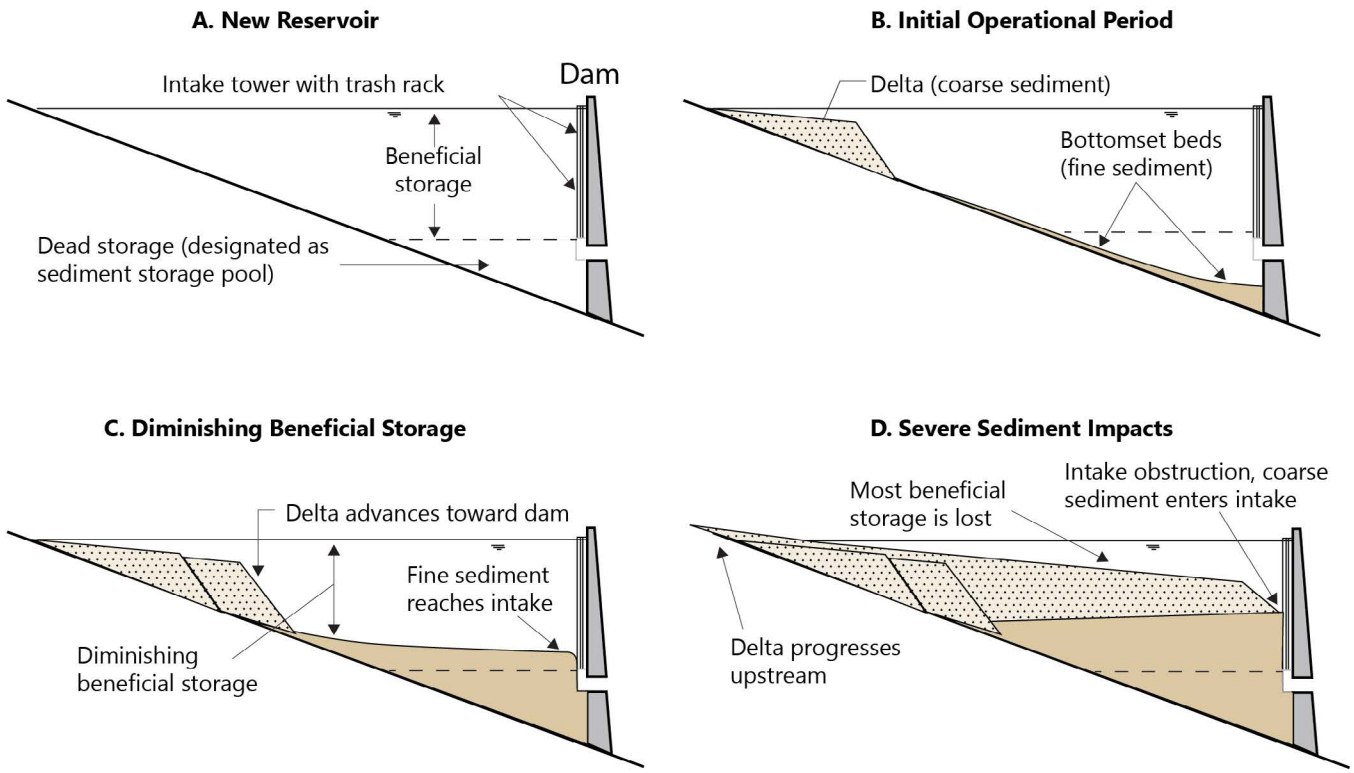
All rivers transport sediment particles (e.g., clay, silt, sand, gravel, and cobbles) that are naturally eroded from the upstream watershed, and reservoirs tend to trap this sediment. Rates of sediment erosion can be accelerated due to certain land use activities in the upstream watershed and from increased severity of droughts and floods related to climate change. Sediment trapped in upstream reservoirs reduces the sediment supply to downstream river channels and coastal deltas.

As sediment is transported into a reservoir, the coarsest particles (sand, gravel, and cobble) deposit first and tend to form deltas at the upstream ends of the wetted reservoir. Over time, a delta will often build and extend upstream of the reservoir pool. Finer particles (clay and silt) tend to be transported past the delta and deposit along the reservoir bottom or past the dam in cases where travel time through the reservoir is fast enough. In addition to reducing the reservoir storage capacity, sedimentation can bury dam and reservoir facilities (including outlets, water intakes, and boat ramps), raise groundwater and flood stage along the upstream river channel, and result in channel degradation (erosion) below the dam.

Colorado River delta of Lake Powell near Hite Marina.

The intake structure of the dam outlet is designed to be above the sedimentation level over the sedimentation design life. Initially, sedimentation does not impair dam and reservoir operations. However, once the dead storage pool has filled with sediment, the dam outlet is vulnerable to plugging and burial by woody debris and sediment, even when sediments may have only filled one-quarter to one-half of the storage capacity. Dam decommissioning and removal will be the likely outcome for high hazard dams with severe sedimentation.

Several sediment management alternatives exist to preserve the remaining reservoir storage capacity, and the new RSEM has been created to comprehensively evaluate the economics over long time periods.



Process of reservoir sedimentation. (A) New reservoir showing zone of beneficial storage and the designated sediment storage pool. (B) Initial operational period with minimal sediment impacts, showing the deposition pattern for both coarse and fine sediments. (C) Significant sediment encroachment into the beneficial pool with substantial growth of the delta. (D) Severe sediment impacts including loss of beneficial storage, intake obstruction, and upstream progression of the delta (illustration created by G. Morris).

Reservoir sediment management alternatives can be grouped into the following categories:

- Reduce unnaturally high sediment yield rates from the upstream watershed (soil erosion control, forestation, construction of check dams)
- Route inflowing sediments through or around the reservoir (sediment sluicing, venting of turbidity currents, sediment tunnel bypass)
- Remove sedimentation from the reservoir (flushing, dry excavation, or dredging)
- Use adaptive strategies to cope with sedimentation until dam decommissioning

Sustainable sediment management may be more cost effective than ignoring reservoir sedimentation until the benefits are lost and the dam is decommissioned. Recovering storage capacity from past decades of sedimentation will be difficult and expensive for large reservoirs because of the very large sedimentation volumes and high unit costs for removal. However, sustaining the remaining storage capacity by managing inflowing sediment loads on an annual basis may be economically viable.

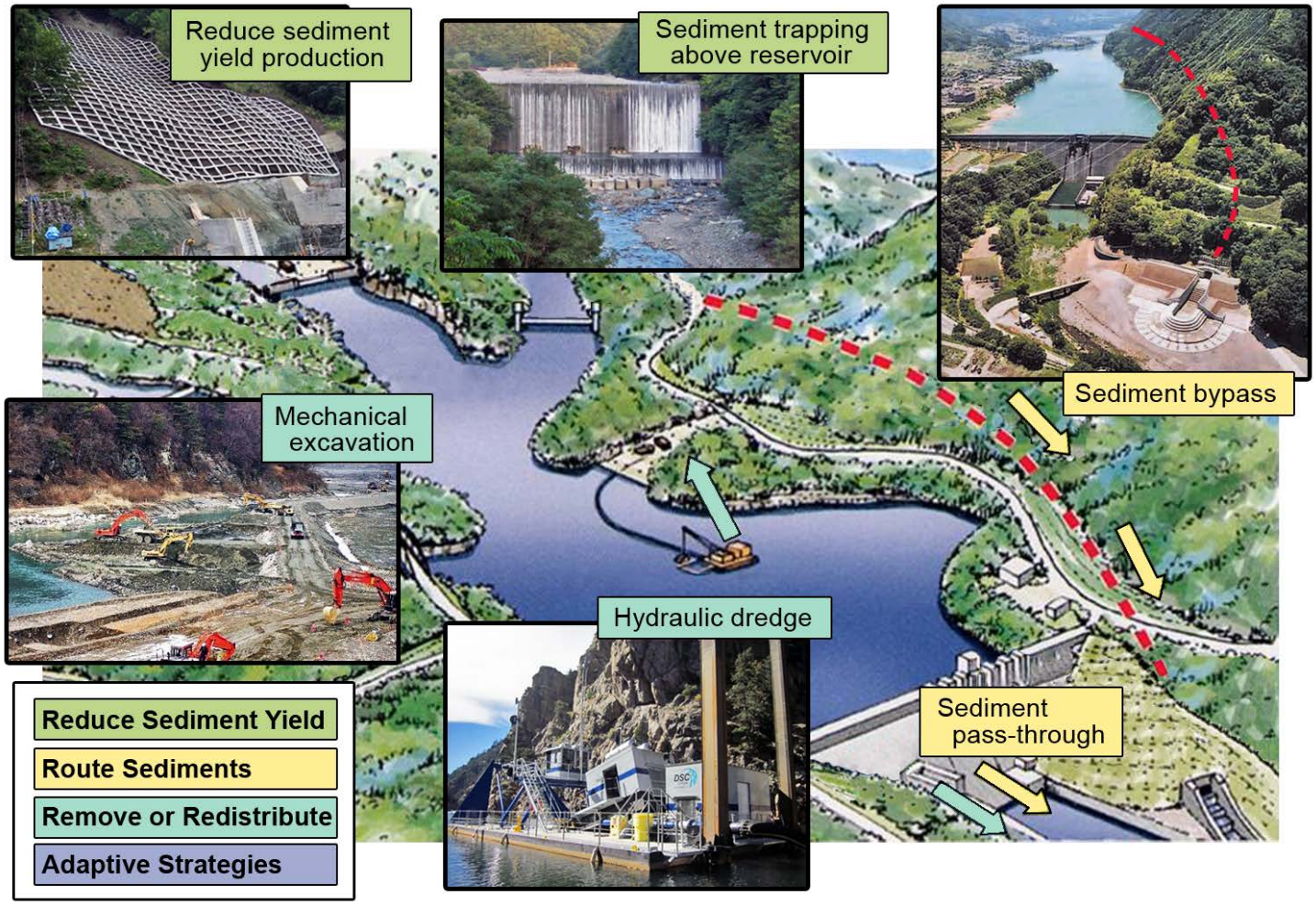
An economic analysis would be needed to determine the most cost-effective sediment management alternative for a given dam and reservoir. The period of economic analysis would need to be long enough and the spatial area of consideration large enough to include all significant benefits and costs. This approach is different than the economic analyses used to justify the construction of many dams and reservoirs. Historically, economic analyses did not consider the costs associated with upstream sedimentation, downstream degradation, and dam decommissioning, nor did they consider diminishing economic benefits due to decreasing reservoir storage and surface area.

RSEM is designed to comparatively simulate a reservoir without and with sediment management. The model can be applied to new and existing reservoirs. Annual sedimentation is simulated within the reservoir and along the upstream and downstream channels to compute aggradation and degradation respectively.

The annual economic benefits and costs are comprehensively evaluated over centuries. Economic impacts are estimated for six beneficial use categories: irrigated agriculture, municipal and industrial water supply, fish and wildlife enhancement, flood control, hydropower generation, and reservoir-based recreation. Costs include the planning, design, and construction of the dam; land acquisition for the dam and reservoir; operations and maintenance; sediment management; upstream channel aggradation; downstream channel degradation; and dam decommissioning.

The user selects one of nine economic discounting approaches and inputs a discount rate. Model results for alternatives without and with sediment management include benefit-cost ratios and net present value over a range of analysis periods. RSEM also calculates the breakeven point for when sediment management becomes economically viable and the annual payment into a dam retirement fund such that dam decommissioning costs are covered upon reaching the estimated service life.

Please contact the listed authors if you would like a list of the references used for this article.



Range of reservoir sedimentation management strategies.

Inspection of outlet works intake at Pilot Butte Dam, Wyoming.

Autumn Operations and Maintenance: Cooler Weather and Lower Water

Andrew Geister, P.E.
Acting Dams and Levees Operations and Maintenance Program Manager,
Asset Management Division

Autumn typically signifies the end of the irrigation season and also represents the time for many seasonal-appropriate operations and maintenance (O&M) activities. These activities may look different depending on the region and will usually vary by facility type and primary purpose. Weather and other conditions will fluctuate by region, but these commonly include cooler temperatures, seasonal precipitation patterns, and possibly snow and ice. A reduced need for irrigation releases can also correspond to reduced water storage needs. With this time of year comes special operational requirements, as well as opportunities to perform inspections, maintenance, and repairs in areas that are more accessible during the non-irrigation season and when impacts downstream are minimal. The range of climates and operations varies widely across Reclamation's inventory. Much of the following discussion relates to situations where reservoirs are kept lower during the non-irrigation season.

Standing Operating Procedures (SOP)

For each of Reclamation's high- and significant-hazard dams, the SOP serves as the governing document that provides specific operating practices and procedures. Other facilities, such as low-hazard dams, canals, or fish facilities, may have a written SOP, but it is not a requirement for these types of facilities. The SOP is regarded as a living document; it is maintained and updated regularly. The SOP is intended to contain all the necessary information that an operator would need to perform necessary operations, including those specific to fall and winter seasons.

Reservoirs

At many facilities, reservoirs are intentionally lowered during the fall and winter seasons in anticipation of spring rains, snowmelt, and potential for flooding. If required, the facility's SOP will specify the required reservoir elevation over the fall or winter seasons and the maximum rate of drawdown. A determination might be made on a reservoir's flood control storage requirements when a more accurate forecast of snowmelt potential is made, typically in late winter. Reclamation and the U.S. Army Corps of Engineers (USACE) work together under a flood control agreement at many Reclamation facilities where flood control is a function, with USACE taking primary responsibility for flood control operations.

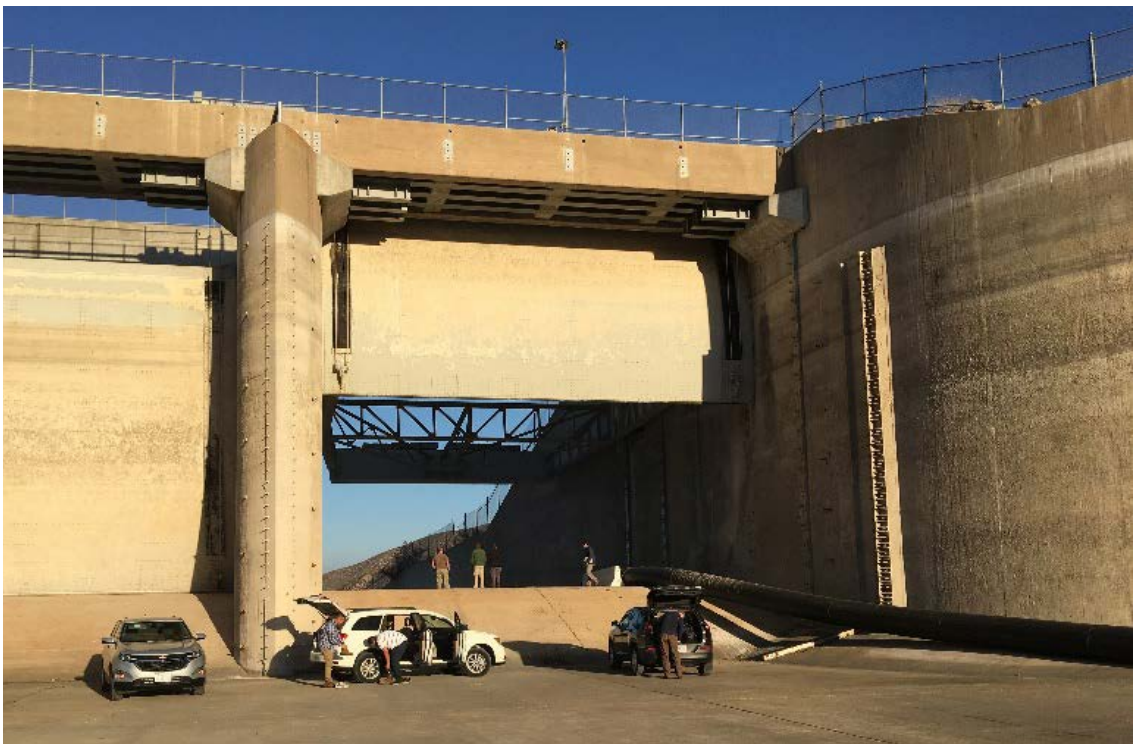
Fall and winter may be a good time to clear floating logs, trash, and other debris from reservoirs. If ice prevention measures are not in effect, ice that cannot pass over the spillway may need to be contained.

Spillways

In the event that fall and winter bring lower reservoir levels, it may also be an opportune time to inspect spillways, especially if this means they are dry. Spillway inspections may include looking at the quality of concrete for cracks, spalls, and exposed reinforcing. Other items may include observing the condition of control joints, joint fillers, sealants, and accessible drains.

During the non-irrigation season, the water surface may typically be lower and gates can be more easily accessed. This is a great time to perform inspections for condition and operation. Condition can include things like the presence of corrosion, condition of lubrication, rubber seals, coatings, and wire ropes. The ideal time for testing (exercising) gate operation is when it will have the least impact downstream. The SOPs of many facilities require exercising gates before the irrigation season.

Some hydraulic equipment, such as for opening and closing gates, may require heating in very cold weather before operation is possible. Non-flow periods of time may also be an ideal time to do repairs to gates, hoist components, and concrete structures and perform painting; however, any temperature requirements such as cold-weather restrictions on repair products should be followed.



Spillway inspection at Bradbury Dam, California.

Outlet Works

In cold weather climates, outlet works may require the operation of ice prevention systems to prevent ice build-up and to maintain operation. These may consist of blowers, agitators, bubblers, or other systems. The SOP describes when and how to operate these systems.

Any inlets that become exposed due to low reservoir levels should be adequately protected to prevent people and animals from entering. Debris may need to be removed from trashracks if releases are made during low reservoir conditions.

Fish Passage Facilities

While the migration and spawning season for most fish species has concluded before fall, special care should be taken that maintenance activities do not interfere with any fish present in the facility, reservoir, or nearby streams.

Dams

In remote locations with severe winter weather, access to the facility may be more difficult or even impossible. Routes to some facilities may change during winter when the primary or alternate road access closes during winter months. Some facilities may require travel by snowmobile or other specialty vehicle just to reach the facility during winter months.

Agitator in operation at Minidoka Dam, Idaho.

Vegetation removal is commonly performed in the fall season. In addition to helping inhibit growth during the following spring, vegetation removal improves visibility of dam surfaces, helping to facilitate inspections.

Winter conditions during mechanical inspection at Lost Lake Dam, Utah.

Inspections and Monitoring

If the reservoir is lowered for the non-irrigation season, seepage flows may be expected to decrease. Typical seasonal movement should be expected; be sure to communicate any unusual or unexpected instrument readings to the dam's assigned Technical Service Center (TSC) Instrumentation specialist.

During a low reservoir period is a good time to inspect upstream concrete and embankment dam faces for signs of damage and distress. In concrete, this may manifest as cracks, spalls, reinforcing corrosion, and offsets at joints. In embankments, cracks, holes, or depressions may be a reason for concern. Dive inspections also may be performed during fall and winter. Despite the potentially colder temperatures, lower reservoir levels and less flow velocity may improve access and visibility.

Buildings

For personnel-occupied facilities, like office buildings and control centers, fall is a time of transition from cooling to heating for building HVAC systems. It is a good idea to make sure systems are ready for winter before the weather starts to get cold. Plan ahead with backup generators in case of power failure or HVAC system interruptions during winter storms or cold weather.

Q&A
Karen Knight, P.E.

Director, Dam Safety and Infrastructure

Karen Knight has been the Director of Dam Safety and Infrastructure since 2020 and was previously the Director of Security, Safety, and Law Enforcement from 2018 to 2020. She met with us to talk about how she has valued teamwork from a young age, her start at Reclamation, the challenges posed by changing climate conditions, and why for her "it's the people more so than the projects."

Karen Knight, Director, Dam Safety and Infrastructure.

You're originally from St. Louis. Can you share how growing up there impacted your career path?

Neither of my parents attended college. And as a kid, I can always remember my dad saying that the reason he worked so hard was so his kids didn't have to, that we could get a better education than he did and not have to work as hard as he did. Both of my parents put a lot of emphasis on education. Growing up, the kids were responsible for being good students, getting good grades, things like that. I'm from a family of 10 children, so my parents weren't able to contribute financially when we were becoming college age, but eight of us still managed to go to college. I think that's amazing. I'm grateful for that foundation, that emphasis on education, on family, and on teamwork. I grew up thinking that teamwork was normal.

As for St. Louis, I remember when I was a high school student, one of the major storm sewer lines collapsed in our neighborhood, and it was a big thing because the construction would always go on at night. During the day we'd all go down to the construction site and see if we could get in there and take a look at what the big storm drains looked like. It was fascinating.

How did you become aware of and involved with Reclamation?

When I got out of graduate school at Virginia Tech, I was working for a geotechnical and environmental consulting firm, and that consulting firm had IDIQ [indefinite delivery, indefinite quantity] contracts with not only Reclamation but also with the Fish and Wildlife Service and Bureau of Indian Affairs. I was exposed to working on a lot of different Federal dams through that experience. Interestingly, I worked on SEED [Safety Evaluation of Existing Dams] reports. They used to be called SEED reports in Reclamation before they were called comprehensive reviews. I worked on SEED reports, I got to go out on site visits, and I did analysis on Reclamation dams. I was working on projects all over the West.

After several years, one of the geotechnical engineers I had worked with on a project reached out to me. He was a group manager at the Technical Service Center (TSC), and he wanted to know if I'd be interested in a job. So, that's how I got into Reclamation.

What are notable roles you've held at Reclamation?

I started in the TSC as a project manager or team leader in the Geotechnical Services Division. From there, I became a group manager in one of the Embankment Dams and Geotechnical Engineering Groups. Later on, I became the Chief for the Geotechnical Services Division. After that, I moved

from the TSC over to the Dam Safety Office. I became the Dam Safety Chief in 2015, and that eventually led to becoming the Director of Security, Safety, and Law Enforcement (SSLE) in 2018. The 2020 realignment in Denver was when I was named the Director for Dam Safety and Infrastructure.

Karen and seven of her (eventual) nine siblings in St. Louis, Missouri, 1967 or 1968.

Can you share a success story about a project you've been involved with?

I really can't pick the project. When I think of projects that I've been involved in that were successful, I think of the people involved in the project and not so much which dam it was or what project we were working on. The teamwork, the camaraderie, people from all different parts of the organization coming together to solve a common issue. When we were all working for the same goal, those were the most successful teams that I've worked on. It's the people more so than the projects.

How would you describe your current role and responsibilities?

My first thought is jack of all trades and master of none. The Directorate is engaged in so many aspects of managing water in the West. My job is knowing who the subject matter experts are to turn to when questions or concerns come up. I think of it as trying to bring all those different aspects together and then being able to lead people as a team to move forward.

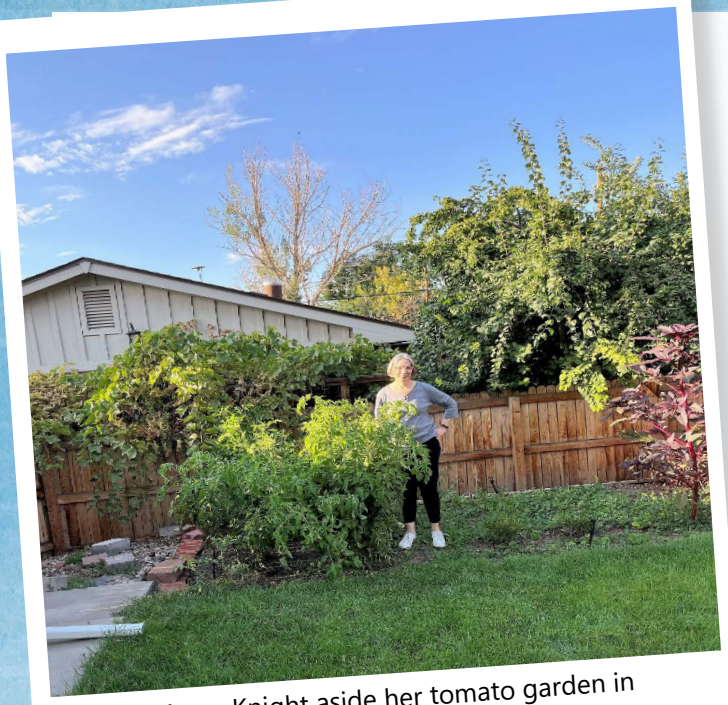
For instance, when I'm looking at larger reports that go out, for many of them, I get briefed so that I understand what's in the document and what the purpose is. I rely on subject matter experts from other parts of the organization to help me understand the more technical aspects that I am not as familiar with. But in the end, I'm looking at the conclusions and recommendations and does it all make sense.

As the Director over both the Dam Safety Office and Asset Management Division, how are you able to successfully manage two groups with different functions and organizational structures?

The common denominator for me is the assets. The management of the assets, whether it's a dam or all of the other infrastructure we have that's involved in delivering water and power. That's where the commonality comes in for the groups. One of the things that's been nice about combining these two groups, as different as they may seem, is that it actually makes a lot of sense when you're looking at it from an asset management perspective. It's given folks on the dam safety side an opportunity to see how operations and maintenance and all of the other assets work, as opposed to just how it works with dams. And for the folks on the asset management side, it's been an opportunity for them to see those dam safety projects that are focused on fixing a specific issue at a facility.

The Bipartisan Infrastructure Law (BIL) will allow for unprecedented operations and maintenance (O&M) improvements across Reclamation. How will Dam Safety and Infrastructure help put the BIL into action?

We're already doing a lot that's helping put the BIL into action. The asset registry – getting an idea of what we own and where it is, and then looking at capital investment repair needs. And now that we have an idea of what we own and where it is, well, what do we need to do to continue to maintain it? What are those repair needs, whether it's on a dam or on other infrastructure? On the asset management side, they're directly involved in helping to implement the aging infrastructure funding within the BIL. As that program continues to grow in the



Karen Knight aside her tomato garden in Lakewood, Colorado.

coming years, they're going to be engaged in helping to prioritize what those projects are that can receive the funding. And there is specific funding for dam safety. The Dam Safety Office is directly responsible for obligating construction dollars on dam safety projects.

AMD's O&M Branch annually hosts the Water Management Workshop and Review of Operation and Maintenance Workshop. Can you speak to the importance of providing training opportunities and a forum for the O&M community to connect?

For the Directorate, it's important that we become a central point for operations and maintenance. We collect a lot of information. The training is an opportunity for us to turn around and share what we're learning and how programs are evolving. And for me, a key is to get folks from more remote offices to all come together and get to know each other. They can learn who their peers and subject matter experts are. So, when they have issues, they know who to count on or who to call.

What are significant challenges for Dam Safety and Infrastructure going forward?

Drought is a huge challenge. It's touching every part of Reclamation's operations, even parts of the organization where they're still able to deliver a lot of water. The drought is huge. Moving forward, we're going to have to learn how to operate our facilities under these changing climate conditions, and we will be challenged to come up with good solutions. What's a good solution one year may not always be. We'll have to continue to evolve as the climate continues to evolve. We might have to look at how we operate a particular structure or facility, or the series of facilities on a specific river, so that we can maximize our ability to continue water and power delivery.

Directorate staff know that you're an avid gardener. What do you grow? Does engineering come into play with how you organize your garden or is it a place to disconnect from work?

It's a place for me to disconnect. This year, my garden is more flowers than vegetables. I've been focusing on that. As for engineering, I rebuilt two zones of my sprinkler system this year. That was quite a feat. I still have a couple little leaks I've got to deal with, but at least I know where they are this time instead of guessing. The other thing from an engineering aspect is I had a spruce tree that died because it got over-watered. It came out, and I planted a new spruce tree, and this one is also getting over-watered. Except I'm not watering it. My engineering mind is like, "Where is the water coming from, and why is the water not draining away from the root ball?" There's a little engineering, but mostly it's a place for me to escape.

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

Be open to opportunities. Stay curious, not only about what you do, but about what other people are doing as well. Because you never know if that connection will lead to an opportunity. We always talk about Reclamation being a family. Learn to network with your peers across Reclamation because they're going to be your greatest resource when you have questions on the job. We work with a lot of really smart people, and they have great solutions to a lot of the problems we face, big or small.

Updates & Due Dates

Aging Infrastructure Account: Background, Benefits, and Applications for Funding

Background

The Consolidated Appropriations Act of 2021 (Pub. L. 116-260) added a new subsection to the Omnibus Public Land Management Act of 2009 (Pub. L. 111-11; 43 USC 510b(d)), creating the Aging Infrastructure Account (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 Operations, Maintenance, and Replacement (OM&R) 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 Reclamation-owned assets.

Benefits

Because funding awards from the AIA are repaid 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. $649 million will be made available in the fiscal year (FY) 2023 application cycle. The FY 2023 allocation 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 2023 application period opens October 3, 2022, and closes on December 1, 2022. Please work with a Reclamation regional or area office representative to apply.

Truckee Canal, site of Reclamation and Truckee-Carson Irrigation District Extraordinary Maintenance Project.