RECLAMATION
Managing Water in the West
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Water Operation and Maintenance Bulletin

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Thank you.

On the Covers:

Front: Collage of photographs of grout repair at Gerber Dam, Klamath County, Oregon.

Back: Informational canal maintenance handout on herbicides.

CONTENT

Aquatic Weeds Choking Canals

Aquatic weeds infiltrate canals, laterals, and drainage ditches and create water delivery problems if left un-managed. The Klamath Project has struggled with a major aquatic weed problem. The Klamath Irrigation District (KID) operates and maintains over 200 miles of irrigation canals and 200 miles of drainage ditches.

Reclamation requires water district or others to have approved Integrated Herbicide Management plans before applying herbicides. Pesticides must be registered and administered according to labels. See back cover for more about using herbicides.

Filamentous algae form long visible chains, threads, or filaments, which intertwine, forming a mat that resembles wet wool. Algae grows along the bottom and sides of canals and laterals in shallow water and/or attaches to check structures and rocks or other aquatic weeds. In the past, KID used a very labor-intensive solution. KID dragged a panel along the concrete liner to break the algae loose. As the canal was cleaned, the water surface dropped by at least three inches. Thus, uncontrolled vegetation resulted in reduced canal capacity and increased operating levels in the canal system. Additionally, freeboard in the canal is reduced due to these operating conditions.

Moreover, these mats plug pump screens, trash racks, and pipes in the system, significantly increasing operating costs for KID. When the weed problem is at its worst, gates have to be cleaned three to four times a day. During parts of June and July, the aquatic weeds begin to break loose in the A canal and travel through all of the canals, laterals, and headgates which are served by the A canal.

This picture, taken July 13, 2012 at the C Hydro Plant, shows a small part of a much larger aquatic weed problem in the A canal. This pile of aquatic weeds was accumulated in a single day (24 hours) on just one set of grates only, which has two sets of gates.

Although large mats of filamentous algae causes problems, other weeds such as curly leaf pondweed, sago pondweed, horned pondweed, and waterweed pose the greatest problems. By controlling these weeds, the filamentous algae can no longer attach to these weeds and restrict flow.

Management options are limited and expensive. However, KID found a solution that works for them. They obtained an NPDES permit to apply Cascade® near the beginning of the irrigation season at the head end of their water source. Cascade®, an aquatic herbicide, controls all of these aquatic weeds, except for the waterweed (*Elodea*). This chemical then flows through all of the district's canals and laterals. KID used this for the past three years and have "had good season-long results each year. This herbicide allows us to move water through our system. We can't use mechanical means fast enough to deliver water to everyone." Darin Kandra reports.

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Klamath Irrigation District website: www.klamathirrigation.com

Center pier wall at Check 19 of the Central Arizona Project (CAP) Canal.

Fixing Cracks Before Corrosion Sets In

While a certain amount of cracking may be expected in structural concrete, wide cracks could allow water to come into contact with the reinforcing steel (rebar). Reinforcing steel in the presence of water will create a corrosion cell. The corrosion causes the reinforcing steel to expand which increases the stress in the concrete. The stress is relieved with further cracking of the concrete which allows more of the reinforcing steel to come into contact with water. Thus, concrete deteriorates more as the corrosion cell continues to grow.

Crack on the center pier wall.

In January of 2014, the Central Arizona Water Conservation District's periodic inspections noted significant cracks in the center pier wall at Check 19 of the Central Arizona Project (CAP) Canal. Check 19 has two radial gates, each with one arm that is directly supported by the pier wall. Because the check gates of the CAP Canal provide the operational control of flow within the canal, the integrity of the center pier wall is critical. The cracks were about a quarter of an inch wide along a 10-foot length of the pier wall. The District determined that the cracking on top of the wall was caused by inadequate rebar or too much cover over the rebar, thus causing the temperature tension cracking. The cracked pier wall would need to be repaired to prevent further deterioration.

To make the repairs safely, the District closed the gate upstream and downstream and followed proper tie-off procedures for fall protection. A hydraulic lift provided a working platform to access the cracked pier wall.

The District's maintenance crews chipped away the cracked concrete until resistance was encountered, showing that firm, solid concrete had been reached. During the chipping process, rebar was never encountered, which indicates that cracking had not yet allowed corrosion of the rebar to begin. The District used a cementitious grout, Five Star Structural Concrete® to fill the void after solid concrete was reached. A sealant, SikaFlex®, was used to fill any remaining cracks that were smaller in width to prevent water from entering the cracks.

After this experience with Check 19, the District's maintenance engineers added an inspection of the pier walls at the other 38 check structures to their monthly inspections. While some minor cracking was observed at the other check structures, none have been severe enough to require repair.

Left: Removing damaged concrete.
Right: Finished concrete repair.

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Central Arizona Water Conservation District website: www.cap-az.com

Gates: Doorways to Your Canals

Canal gates are the heart of your system, and they are exposed to weather, water pressure, debris, and sediment. Thus, a regular gate testing program will:

- ❖ Ensure reliable control if a quick reservoir or canal drawdown is needed
- ❖ Keep fluids and surfaces clean of debris and operable
- ❖ Identify failures and other problems in a controlled environment
- ❖ Remove minor organic growths and corrosion and move lubricant to wear and sealing surfaces

Follow your documented standard operating procedures for meeting testing and maintenance requirements. Tips to follow:

- ❖ Establish a baseline to determine if your gate performances change over time, (record pressures, voltages, and currents; take photos; and document findings)
- ❖ Develop a plan for maintaining historical information: on a tag at the gate, on a map, or in a database
- ❖ Document how staff will retrieve this information when required in the future

Test the gates

Full travel exercise

Full travel exercises: ensures gates function completely in a controlled test; verifies that structural movement hasn't occurred; distributes lubricants; loosens minor dirt, corrosion, and organic matter; and cleans wear surfaces. When the canal is dry or has minimal flows, open gates to their fullest extent and then close them completely. If your canals run continuously, then install stoplogs or wait for a low water surface. Exercise gates both before watering up and dewatering if possible.

Performance testing

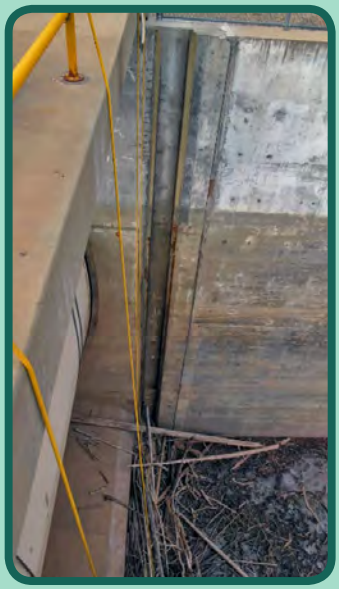
Full-head performance tests identify corroded, sticky, and worn parts that need to be repaired or replaced. To test the gates, monitor their performance when the gates are operating. The higher the head, the more rigorous the test. Conduct a performance test at least once a year (usually as part of normal operations).

Power use

Measure and record voltage and amperage on hoist motor or hydraulic system pressure at least every six years or whenever an operational problem is suspected.

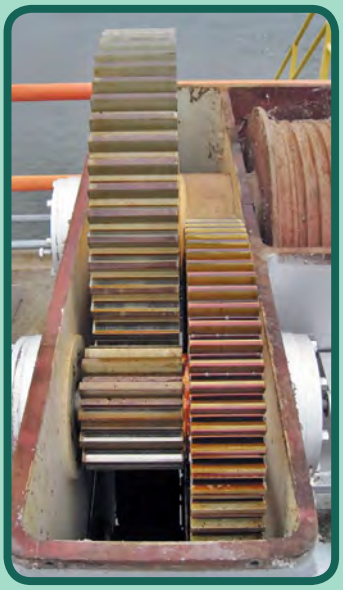
In both full travel exercises and performance testing, look for:

- ❖ Missing/broken fasteners
- ❖ Debris in moving parts
- ❖ Broken supports
- ❖ Bent stems
- ❖ Corrosion or coatings failure
- ❖ Hydraulic system
  - Leaks
  - Operating pressures
  - Clogged filters
  - Color and level of oil
  - Unusual noise, vibrations, or heat
- ❖ Water leaks
  - Seals
  - Joints
  - Piping/fittings
  - No leaks between gate frame or thimble and concrete



Debris

Leaks



Lubrication (gears should be in an oil bath)

Uneven flow and rope tension

Improper alignment

Automation glitches

Align and adjust supports and moving parts to:

- ❖ Prevent binding
- ❖ Ensure free operation and uniform flow
- ❖ Maintain proper clearances
- ❖ Guarantee proper gate position: when gates are open they should be out of the water flow and when closed, they should provide a complete seal
- ❖ Metal on metal sealing surfaces

Lubricate:

- ❖ Chains
- ❖ Gear mechanisms
- ❖ Trunnion pins
- ❖ Wire ropes to reduce friction between individual wires and protect wires from corrosion both inside and outside the wire

For more information contact:
Kyle Converse, Hydraulic Engineer, Hydraulic Equipment Group, Technical Service Center, Reclamation, 303-445-2859, kconverse@usbr.gov.
Technical Service Center website: www.usbr.gov/tsc

The Right Grout for the Job

Gerber Dam, an 84.5-foot-high concrete arch dam in Klamath County, Oregon, was completed in 1925. The left side of the dam suffered concrete deterioration: several joints and concrete lift lines were leaking water. Grouting with chemical grout was determined to be the best solution, since it could be injected into the leaking joint and cracks and would react with the water to form a seal. For the work to progress in the best possible manner, conditions had to be right: low reservoir levels, sufficiently warm weather, and skilled staff. Due to schedules and site access, the work was planned for late November and early December. As Gerber Dam is typically not accessible in the winter months due to snow and weather conditions, crews had to haul in equipment on all-terrain vehicles for the downstream access and travel via boat on the lake for upstream access.

Since access to the leaking joints was from the upstream face of the dam, safety concerns were paramount. Crews used a special hoist with wire ropes and a 10-ton anchor fashioned from three foot diameter Ponderosa pines. One person was in charge of the rigging operations. Rigging was done manually with chain falls and hand winches.

Using grout to stop leaks.

Grouting can be used to control seeps, leaks, and high volume flows by repairing cracks and filling voids and joints. In addition, due to very low water levels, the team decided to inject grout from the upstream face. Injecting from the positive pressure side is usually the best option if access can be provided, since it prevents water from entering the leak in the first place.

Many different types of grouts can be selected as a temporary or permanent fix to repair many materials, such as rock, soils, concrete, or masonry. Grouting sooner rather than later can prevent further damage or leakage that may occur if damage is left untreated, saving resources in the long run.

What should you think about when planning your grout operation?

Careful planning is the key to success in any grouting endeavor. Many factors need to be considered, including safety, job objectives, best available material or combination of materials, exposure conditions, access conditions, and environmental conditions.

What grout should you use?

A qualified engineer should select the proper grout to successfully meet the objectives and service conditions. Choices available include cementitious and polymeric grouts. Different materials yield different end products: from very rigid materials to flexible gels, foams, and solids. Different grouts also have different mixing and placing requirements.

What to watch out for when grouting?

When grouting, great team work, safety, and communication are essential. Health and safety requirements must be developed and followed. For packaged grout materials, follow the manufacturer's recommendations and make sure you have the correct equipment and use the proper application procedures. In many grout applications, the operators cannot see where the grout is going, so always be prepared for changes while on the job, and stay aware of where grout may be flowing. Know the expected grout material properties and perform appropriate tests to ensure the grout is mixed properly and performing according to specifications. Monitor all equipment to ensure it is operating properly.

For more information contact:
Westin Joy, Concrete, Geotechnical, & Structural Laboratory,
Technical Service Center, Reclamation, 303-445-2382, wjoy@usbr.gov
Technical Service Center website: www.usbr.gov/tsc

Connections

Funding Opportunities

Reclamation has several new funding opportunities. Details are available at http://ww.grants.gov by searching on the title or the Funding Opportunity Announcement (FOA) number.

The Milk River Project – Drop chutes on St. Mary diversion system. Photo courtesy of the Bureau of Reclamation.

- **Water and Energy Efficiency Grants (FOA BOR-DO-17-F012).** Request up to $1,000,000 for larger scale projects that result in quantifiable and sustained water savings and address a significant water management concern. Projects include canal lining and piping, more comprehensive installation of irrigation flow measurement or canal automation improvements, and installation of water meters. Deadline: January 18, 2017, at 4:00 p.m. MST.

- **Small-scale projects (FOA BOR-DO-17-F011).** Request up to $75,000 for small-scale water efficiency improvements, such as installing flow measurements or automation in a specific part of a water delivery system, lining a section of a canal to address seepage, small rebate programs that result in reduced residential water use, or other similar projects that are limited in scope. Deadline: April 27, 2017, at 4:00 p.m. MDT.

- **Drought Contingency Planning (FOA BOR-DO-17-F009).** Request up to $200,000 to develop a new drought plan or to update an existing drought plan. Deadline: February 14, 2017, by 4 p.m. MST.

- **Drought Resiliency (FOA BOR-DO-17-F010).** Request up to $750,000 for projects that will increase the reliability of water supply; improve water management; implement systems to facilitate the voluntary sale, transfer, or exchange of water; and provide benefits for fish, wildlife, and the environment to mitigate impacts caused by drought. These projects have helped many irrigation districts. For example, Dave Taylor, Manager of the Waurika Master Conservancy District in Oklahoma, said: *"This project is crucial to the long-term longevity of Waurika Lake. We now have a water supply that is sustainable and available through all phases of the worst drought of record. Over 25,000 acre-feet of the lake is now accessible and can be used as water supply. We appreciate the help from the Bureau of Reclamation and their staff through the conceptual and design phases. We can now achieve the vision of having water for a quarter of a million people through all phases of the drought and wet cycle."* Deadline: February 14, 2017, by 4 p.m. MST.

- **Watershed Management (FOA BOR-DO-17-F013)**. Request up to $100,000 for collaborative, locally-led, and community-based water resource management projects. This is Reclamation's new funding opportunity under the Cooperative Watershed Management Program. Deadline: February 15, 2017.

Visit the* WaterSMART Cooperative Watershed Management Program *website or contact Avra Morgan (aomorgan@usbr.gov) for more information.

Reclamation's Canal Operator Training and Canal Maintenance Training Classes

Canal operators play an important role in ensuring the reliability of the nation's conveyance infrastructure. Reclamation is offering two courses, each four hours long. These provide an excellent opportunity for irrigation districts to discuss maintenance concerns with Reclamation staff and other irrigation districts. To schedule a class, contact Rosemarie Spano (rspano@usbr.gov).

The Canal Operator Training class discusses operations and maintenance topics that are important to ensuring delivery of project water. This training reviews operational issues that can result in maintenance issues or concerns if not performed correctly. Topics include: watering up, freeboard, dewatering, and overtopping. Additionally, this class discusses the importance of various maintenance activities and how to perform these maintenance activities correctly. Maintenance topics include vegetation, rodent burrows, seepage, urbanization impacts, concrete lining, and public safety features.

The Canal Maintenance Training is a follow-up class for those who have attended the Canal Operator Training class. Canal Maintenance Training provides more comprehensive information and techniques to address typical canal maintenance activities, including: aquatic weeds, embankment vegetation control, rodent control methods, repairs of concrete linings and structures, maintenance of gates and pumps, placement of embankment fill and structural backfill, maintenance plans, and public outreach.

Your Job In the News

Want to tell your friends all about the work you do, but haven't figured out how? Well, just send them to this great video about ditchriders:

http://tinyurl.com/ditchridernews

Irrigation Leader

The Irrigation leader, published by Water Strategies, provides additional experiences and knowledge for water industry professionals.

Available at www.waterstrategies.com/irrigation-leader.html.

Canal Maintenance Training: Herbicides

Herbicide: General Steps

- Determine the need for an herbicide
- Use only the amount you need
- Rotate herbicides and other methods
- Work with experts
- Use only approved, permitted, registered products in accordance with product labeling
- Understand product names
- Understand when permits are required
- Follow all legal requirements, permits, and orders
- File proper plans
- Understand how the herbicide works
- Anticipate where the herbicide will go
- Coordinate and consult with the appropriate agencies
- Post appropriate notifications
- Dispose of herbicide container and other wastes properly

Contacts

County Extension Office, found at **http://npic.orst.edu/pest/countyext.htm.**

Pesticide Specialists at the National Pesticide Information Center (NPIC) can provide scientifically valid toxicological and environmental fate data (sponsored by the Environmental Protection Agency and Oregon State University). 800-858-7378 (**http://npic.orst.edu/contactus.html**)

Consult with your state and local environmental departments, and if needed, with:

- The Environmental Protection Agency Office of Chemical Safety and Pollution Prevention (OCSPP) **http://offices.sc.egov.usda.gov/locator/app**
- Your local USDA Service Center
- Pesticide Labeling Questions and Answers are at **www.epa.gov/pesticide-labels/pesticide-labeling-questions-answers**