CAP
CENTRAL ARIZONA PROJECT

2024

BIOLOGY

ANNUAL REPORT

Central Arizona Water Conservation District
Water Transmission Division

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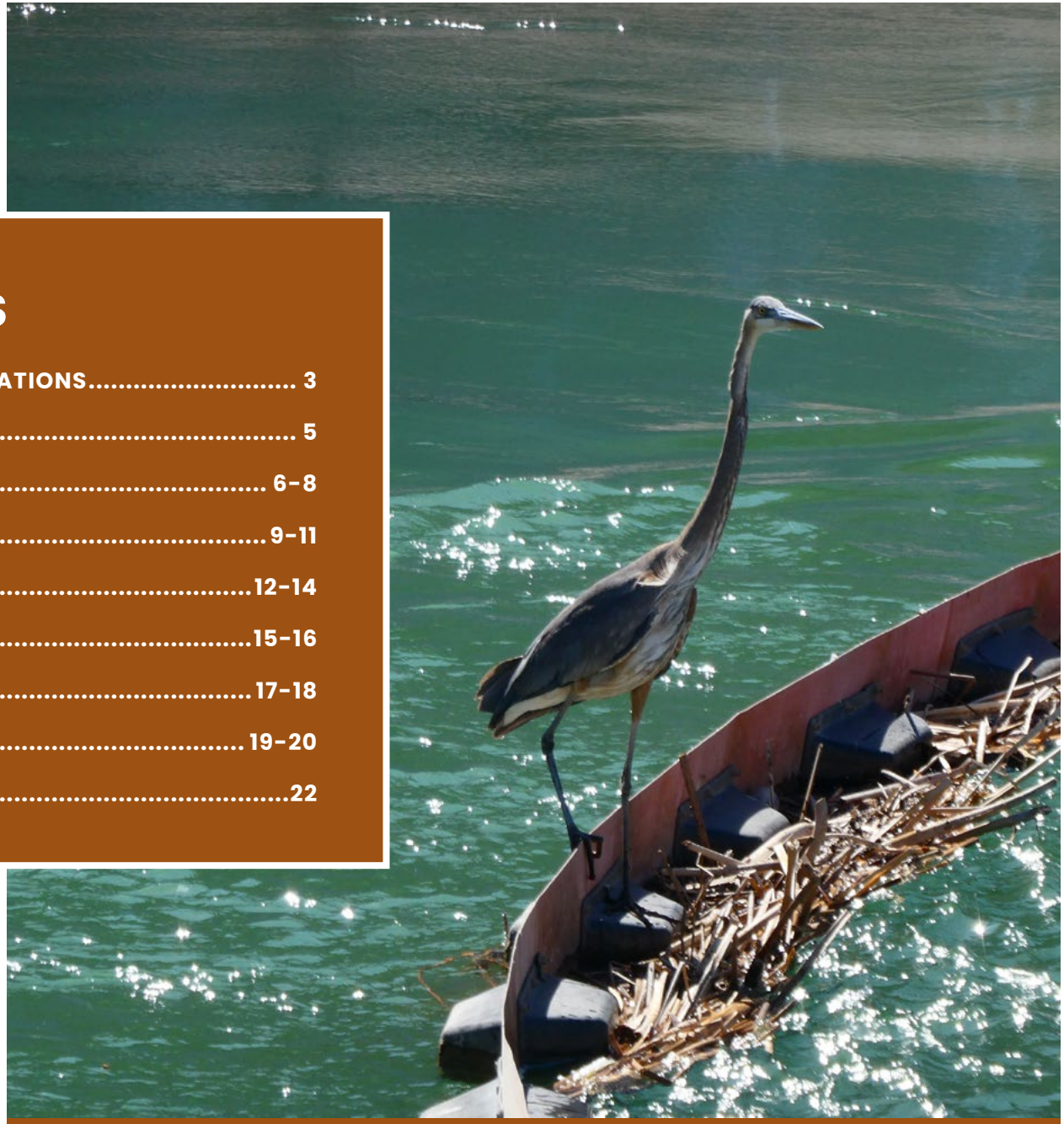


GREAT BLUE HERON AT MWP

VARIOUS FISH SPECIES IN THE CAP NEAR CHECK 22

PUMPING PLANT AND TURNOUT ABBREVIATIONS

MWP	MARK WILMER PUMPING PLANT
BSH	BOUSE HILLS PUMPING PLANT
LHQ	LITTLE HARQUAHALA PUMPING PLANT
HSY	HASSAYAMPA PUMPING PLANT
WAD	WADDELL PUMP/GENERATING PLANT
SGL	SALT GILA PUMPING PLANT
BRD	BRADY PUMPING PLANT
PIC	PICACHO PUMPING PLANT
RED	RED ROCK PUMPING PLANT
TWP	TWIN PEAKS PUMPING PLANT
SAN	SANDARIO PUMPING PLANT
BRW	BRAWLEY PUMPING PLANT
SXV	SAN XAVIER PUMPING PLANT
BLK	BLACK MOUNTAIN PUMPING PLANT
HMRP	HIEROGLYPHICS MTN. RECHARGE
PXATO	PHOENIX-ANTHEM TURNOUT
SROTO	SANTA ROSA TURNOUT
CMATO	CENTRAL MAIN TURNOUT
SMATO	SOUTH MAIN TURNOUT

RED COACHWHIP (AKA RED RACER) AT CAP HEADQUARTERS

CAP BIOLOGY PROGRAM

The CAP Biology Program was created in 2011 to address the variety of biological issues that can affect CAP's 40,000 acres of property, the 336-mile aqueduct, and CAP's ability to deliver water. The program focuses on a long-term monitoring program to provide responsible management recommendations based on sound techniques and robust data.

In 2024, the extended drought continued, as it was the warmest year in recorded history in Phoenix and much of the Southwest. Official annual rainfall totals in Phoenix (4.54") were just over 50% of "average". As a result, CAP's water supply continued to be low, with just over 890,000 acre-feet available for deliveries.

Despite the hot, dry weather and decreased water supply, there were few noteworthy biological events in 2024. Although quagga mussels continue to be prolific throughout the CAP system, infestations are still considered to be low and caused only minor issues. Aquatic vegetation growth within CAP's intake channel at Lake Havasu returned to moderate levels after being suppressed by high turbidity in 2023 (as a result of Alamo Lake releases). The caddisfly hatch appeared to be much less impactful than previous years, possibly due weather related changes. Finally, it appears that the low flow conditions may have caused a larger filamentous algae bloom than typical in the western portion of the aqueduct in spring 2024.

The long-term monitoring program implemented by the Biology Program was designed to capture these environmentally-driven changes and measure the responses of the various organisms that utilize the CAP. Now more than ever, the continued monitoring program will help us to make data-driven management decisions as we navigate erratic weather patterns and shortage conditions that will be more common in the coming years.

The following annual report is a summary of the work completed in 2024, as well as strategies for monitoring and research in 2025.

SMALLMOUTH BASS AT HSY

QUAGGA MUSSEL SHELLS AT THE GLENDALE PYRAMID PEAK WTP

QUAGGA MUSSELS

BACKGROUND

The Western invasion of quagga mussels was first discovered in Lake Mead on the Colorado River in January 2007. Soon thereafter, the mussels were found throughout the Lower Colorado River from Lake Mead to Yuma, including CAP's water source, Lake Havasu. In early 2008, microscopic young quagga mussels (veligers) were observed in plankton samples in the CAP aqueduct and its storage reservoir, Lake Pleasant. When CAP began intensively monitoring the mussels in 2009, large numbers of veligers were found throughout the system, but few adult mussels were found.

Although it was originally hypothesized that various factors would restrict mussel invasion in the aqueduct, adult settlement has occurred throughout the system. In most cases, infestations do not impact water deliveries or maintenance of the system. However, there are some instances when more critical systems are affected. CAP's typical response is to increase maintenance frequency (e.g. cleaning of filtration systems, strainers, and cooling systems) to ensure reliability. However, more severe infestation issues in recent years have created the need for alternative approaches, including the use of foul-release coatings and chemical treatment.

APPROACH

Quagga mussel infestations and impacts within pumping plants are monitored with monthly bio-box checks. Trash rack inspections are completed annually at MWP and WAD, and every three years at other plants. In 2024, only MWP and WAD were inspected. In addition, plant and aqueduct personnel report irregular findings related to quagga mussels as conditions dictate. Finally, the chemical injection system installed at MWP (2021) to treat the cooling water system is evaluated annually using a videoscope.

FINDINGS

There were no quagga in the bio-box at MWP, which is similar to observations over the past several years. This is likely due to a re-piping of the system that included extensive copper. Quagga mussels were observed on various equipment in the MWP forebay, so the lack of quagga in the bio-box is a positive sign that infestations within the pumping plant are minimal.

Throughout the rest of the CAP pumping plants, there were very few quagga found in bio-boxes. BLK experienced the highest numbers, but there were never more than 15 individuals in the tank at any one time. At SGL, three quagga were the most observed, while there was a single quagga mussel at HSY in December.

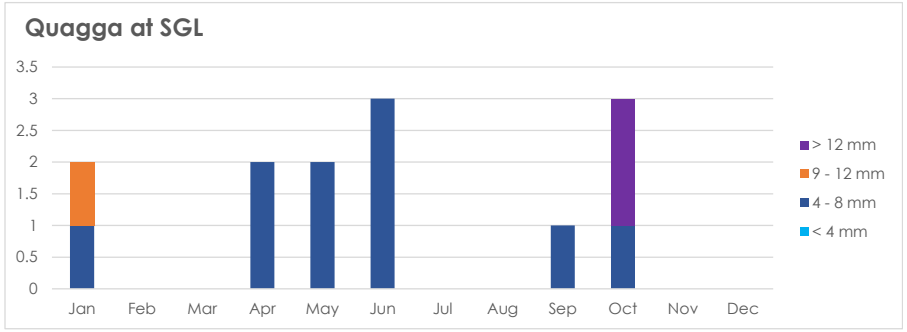
In 2023, there were high numbers of quagga at SGL, presumably due to spring releases from Lake Pleasant. Those releases did not occur in 2024 and as a result, quagga numbers in the SGL bio-box were low throughout the year.

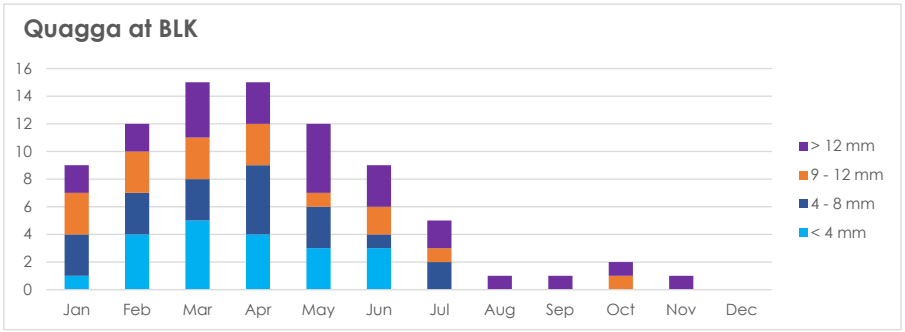
Trash rack inspections at MWP and WAD showed moderate fouling from colonial hydroid (Cordylophora), but just light quagga infestation at the two plants. Additionally, there was light algae growth on WAD trash racks. No levels of fouling required attention.

Videoscope evaluations of the MWP unit cooling systems showed that the chemical treatment system, which was installed in 2021, has continued to reduce and/or eliminate quagga and colonial hydroids in this critical infrastructure. Coolers were inspected in late June 2024 and only Units 3 and 6 had visible quagga. Unit 3 had just a small pocket of quagga that appeared to be dead. Although Unit 6 has not been cleaned since 2019 (prior to treatment), only a light infestation was observed. No hydroid were observed in any of the six unit coolers. Prior to treatment, unit coolers were disassembled and power washed on a regular basis at a considerable cost. The relatively inexpensive treatment has eliminated the need to clean the coolers and there have been no forced outages related to unit overheating since the program began in 2021. Due to the effective treatment at 0.75 ppm, dosage was reduced in June 2024 to 0.5 ppm for all units.

In May 2024, flow meters at PXATO were not properly functioning. Upon further inspection, quagga mussel shells had accumulated to an unusually high level in the turnout barrel (see photo page 8). Divers were contracted to clean the turnout and restore functionality to the flow meter. The build-up likely occurred over a number of years as a result of quagga discharged from Lake Pleasant and the extremely slow water flow moving through the turnout. More frequent turnout inspections have been recommended to avoid the excessive build-up in the future.

MONTHLY QUAGGA INFESTATION AT BLK AND SGL IN 2024.





In June 2024, Pyramid Peak Water Treatment Plant (City of Glendale) notified CAP that excessive quagga shells were backwashed from their system and had filled several dumpsters. Since the turnout had been cleaned just six months prior, the source of the shells was unknown. CAP investigated the potential causes, including underwater video inspection of the upstream pool. There was no visible source of the shells, although the timing of the event suggests that shell debris in Waddell Canal may have been carried downstream and followed flow into the turnout.

STRATEGIES FOR 2025

In 2025, we will continue to monitor quagga infestation and growth rates in bio-boxes, trash racks, and MWP cooling water systems. We will also continue to rely on maintenance personnel and stakeholders to communicate any issues and address those problems as they arise. Effectiveness of the chemical injection system will also continued to be monitored. We will also continue to work with the City of Glendale to pinpoint the source of quagga shells that impacted the plant in 2024.

QUAGGA ATTACHMENT AND SHELL DEBRIS AT PXATO

UNIT 1 COOLER AT MWP AFTER 30 MONTHS OF TREATMENT WITH EARTHTEC.

AQUATIC VEGETATION - MWP

BACKGROUND

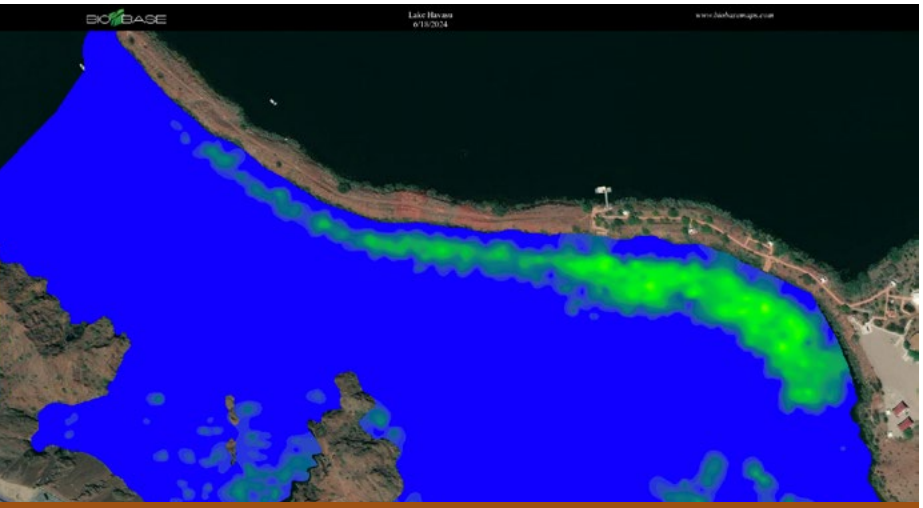
Aquatic vegetation growth in Lake Havasu has increased significantly since the discovery of quagga mussels in 2008. The direct relationship between quagga mussels and vegetation growth has not been proven; however, it is widely speculated that quagga have increased water clarity and nutrient loading in the reservoir, which in turn has led to an increase in weed growth. When the vegetation dies and floats to the surface during summer and early fall, the impacts are felt by CAP. Weeds become entrained in the flow of the intake channel, either as individual plants that have been dislodged or as floating mats of dead material, and threaten the reliability of the pump systems and ultimately, CAP's ability to transport water.

To prevent weed mats from approaching and impacting the pumping plant, CAP began collecting and disposing of the mats in 2010 using a combination of a weed harvesting boat and a long-reach excavator. In 2016, CAP installed a trash rake system at MWP to help ensure the reliability of the system and reduce/eliminate the need for the weed harvesting boat. However, due to the frequent breakdowns and the uncertainty in the reliability of the trash rake system, it was largely abandoned in 2018. CAP now primarily relies on the weed harvesting boat and herbicide treatments to minimize the risk posed by the weed mats.

The distribution and density of aquatic vegetation within the CAP intake channel has been mapped using sonar since 2012. The mapping helps weed harvesting crews to target problematic areas and identify areas in need of treatment (herbicide). Mapping also provides a long-term "picture" of how vegetation growth has changed over time and helps CAP to understand what changes might occur as a result of river shortage conditions.

SMALL MATS OF VEGETATION WITHIN THE CAP INTAKE CHANNEL IN 2024.

CURLYLEAF PONDWEED WAS COLLECTED IN 2024 TO AID IN A UNIVERSITY OF MINNESOTA GENETICS STUDY



MODERATE WEED GROWTH WAS PRESENT PRIOR TO TREATMENT IN JUNE 2024.

APPROACH

Aquatic vegetation growth was monitored from April through September within the 65-acre CAP intake channel using downscan sonar and StructureScan (Lowrance HDS Live 9). Data was uploaded to BioBase® to create bathymetric maps and vegetation heat maps. During the "weed season" (July through September), CAP weed harvesting crews were on stand-by to collect any floating vegetation mats using the weed harvesting boat. In late June, a targeted herbicide treatment was applied to approximately 16 acres of the intake channel using both liquid and granular forms of aquathol.

Also, researchers from the University of Minnesota ask CAP to assist with a curlyleaf pondweed genetics study. In June 2024, the CAP field crew collected samples of the unique pondweed species throughout the Bill Williams National Wildlife Refuge. As this is part of a larger study, results of the research are not expected for a few years.

FINDINGS

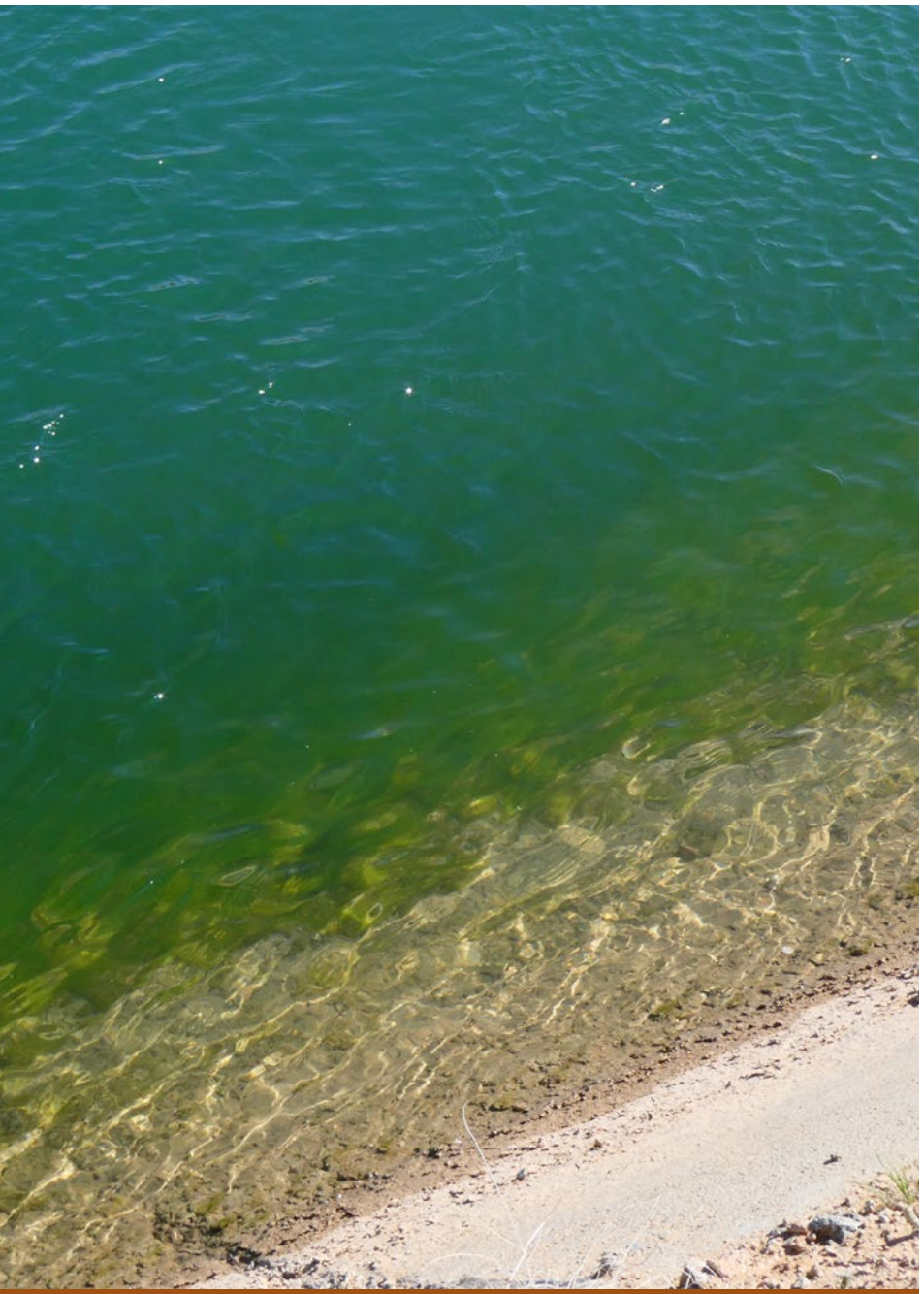
The 2023 Alamo Lake releases caused extremely high levels of turbidity which prevented aquatic weed growth in the CAP intake channel. The effects of that high turbidity were still evident in 2024, as mapping of vegetation growth showed only approximately 20% of what is typically measured. Regardless, the amount of growth still warranted an herbicide treatment. Granular herbicide (Aquathol Super-K) was applied in deeper water to control spiny and southern naiad, while liquid herbicide (Cascade) was applied in shallow water to control pondweed species. Both treatments were extremely effective in nearly eliminating the existing vegetation and minimizing future growth.

Weed harvesting crews collected just 18 cubic yards of material from June through October 2024. As a comparison, weed crews collected 2,300 cubic yards of material in 2013, when there was no herbicide treatment. The success of the treatment in 2024 allowed maintenance crews to focus their efforts in other critical areas.

STRATEGIES FOR 2025

Monthly mapping of the intake channel will be conducted in 2025 to continue the long-term data set. CAP will replicate the herbicide treatment in 2025, targeting specific areas of heavy growth. The treatment will be completed in June, prior to the weeds reaching the water surface. Pre- and post-treatment vegetation coverage and plant height will be mapped bi-weekly to evaluate the effectiveness of the treatment.

DRONE PHOTO OF VEGETATION GROWTH WITHIN MWP INTAKE CHANNEL IN PRIOR TO TREATMENT IN JUNE 2024.
Photo by Michael Rogers



FILAMENTOUS ALGAE GROWTH IN POOL 2 IN APRIL 2024

AQUATIC VEGETATION - AQUEDUCT

BACKGROUND

Weed growth within the aqueduct has historically been somewhat sporadic, but can be substantial. At times, filamentous algae will bloom in various sections of the canal, while rooted aquatic vegetation growth is generally restricted to slower moving areas. Pool Bouse has traditionally been a problem area for rooted vegetation, and Waddell Canal appears to go through cycles of filamentous algae problems. Chemicals have not typically been utilized in the canal to suppress vegetative growth. Instead, grass carp are stocked as a biological control.

TRIPLOID (STERILE) GRASS CARP ARE STOCKED INTO THE CAP TO PROVIDE VEGETATION CONTROL.

APPROACH

Visual inspections are conducted periodically by aqueduct crews and any potential issues are reported to CAP's biologists. Additionally, CAP stakeholders often provide information to CAP during times when vegetation is impacting turnouts. Control of aquatic vegetation in the aqueduct is achieved utilizing triploid (sterile) grass carp; however, filamentous algae is not a preferred food item for grass carp, so control is sporadic.

FINDINGS

In 2024, there was no rooted aquatic vegetation growth observed in the canal. Grass carp were stocked in the southern portion of the CAP system in 2024, as nearly 1,500 fish were stocked between Waddell Canal and SXV.

Filamentous algae was problematic in the western portion of the aqueduct during spring. CAP Operations indicated that they were not able to "push" enough water through a section of canal between BSH and LHQ (Pools 1 and 2) without overtopping the liner. Upon inspection, there was significant growth of filamentous algae just downstream of Cunningham Siphon in Pool 2. Although the growth did not appear to be atypical compared to previous years, it may have been enough to create excessive friction and slow water flow. The relatively heavy growth extended approximately 5 miles downstream. Despite the heavy growth, downstream pumping plants experienced relatively minor issues related to floating algae mats.

In Pool 19, just downstream of Lake Pleasant, there was significant filamentous algae growth in summer months. However, downstream stakeholders did not report any problems related to the algae growth in 2024.

STRATEGIES FOR 2025

Aqueduct crews and other field personnel will visually monitor the system for growth of rooted aquatic vegetation, filamentous algae, and Cymbella. Any problematic growth will be communicated to CAP maintenance personnel and stakeholders. Although grass carp do not prefer algae, stocking in 2025 will be targeted at Pool 2 in an attempt to provide some level of biological control on the algae issue.

FILAMENTOUS ALGAE CAN CLOG TURNOUTS WHEN IT DETACHES FROM THE CANAL LINER

TRIPLOID GRASS CARP ARE BROUGHT IN FROM ARKANSAS, HELD IN CAP TANKS, AND THEN DISTRIBUTED INTO THE CANAL IN SMALL BATCHES.

CADDISFLIES

BACKGROUND

In 2004, a nuisance insect was reported to CAP by Phoenix and Scottsdale residents. The insects were identified as Smicridea, a common genus of caddisfly that is indigenous to the Colorado River. Although 2004 was the first record of complaint by nearby residents, caddisflies were found in relatively high numbers in the CAP as early as 1993. It is likely that caddisfly swarms have been common since the canal was constructed, but were largely undetected because neighborhoods were not yet constructed near the canal. The emergence of large numbers of adult caddisflies causes a nuisance because they tend to swarm around people, making outdoor dining and entertaining uncomfortable during periods of high activity.

Based on recommendations from an RNT Consultants report, CAP has stocked channel catfish in the canal since 2011 to help control the caddisfly population. Although the fish stocking does not eliminate the nuisance caddisflies, it does provide some level of relief for residents living adjacent to the canal.

CADDISFLIES BECOME A PUBLIC NUISANCE WHEN LARGE HATCHES OCCUR IN SPRING AND LATE SUMMER

APPROACH

Channel catfish are stocked annually during early March. In 2024, approximately 7,000 catfish were stocked into Pool 20, 21 and 22. These fish averaged 8-12 inches and weighed approximately one-half pound each.

Names and addresses of residents filling out forms on CAP's website, or calling with concerns about the caddisflies, are recorded to determine where the caddisflies create a significant nuisance.

Additionally, CAP's biologist communicates regularly with a variety of local and nationwide specialists to share ideas about potential control efforts.

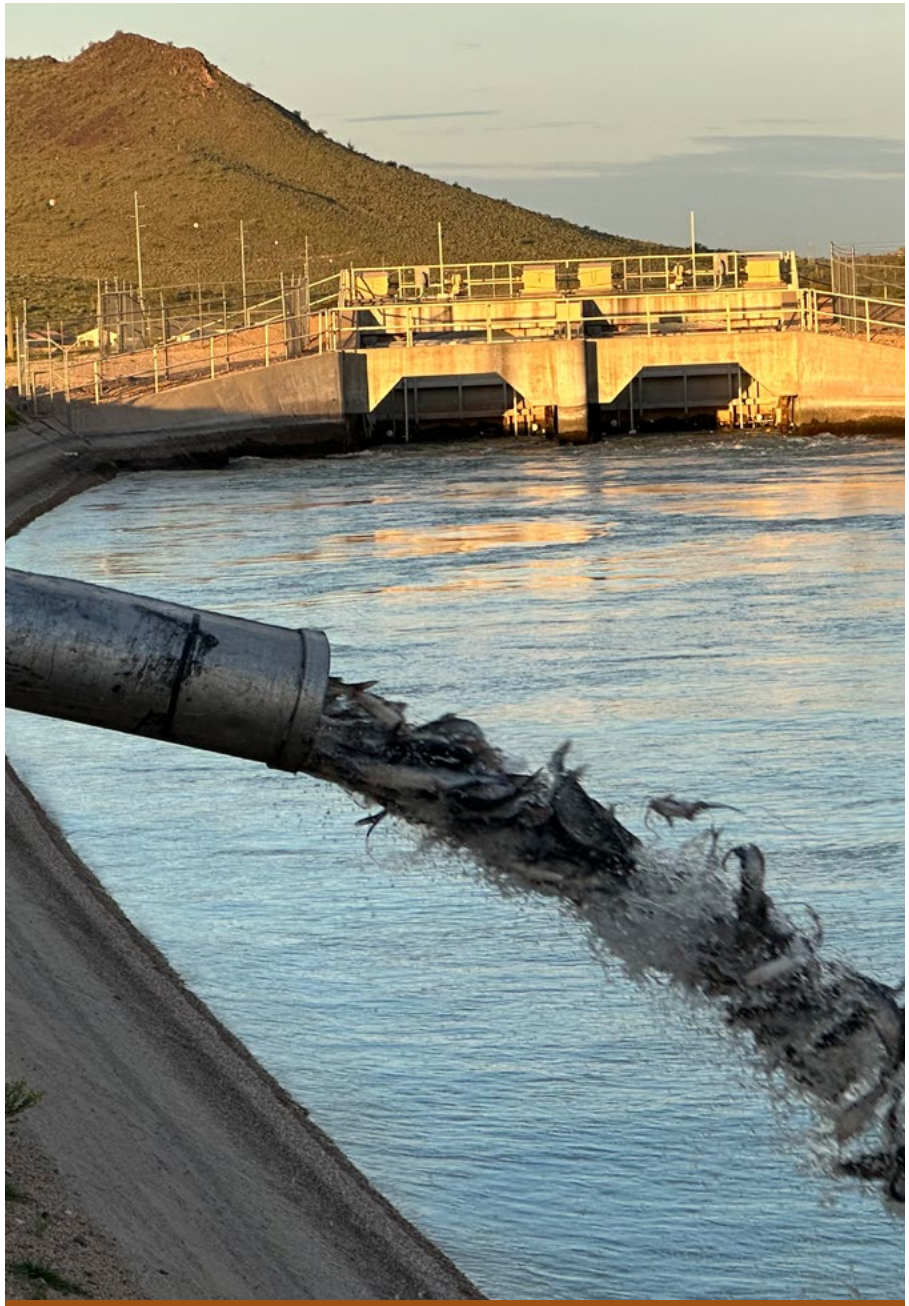
FINDINGS

In 2024, CAP received four notifications in October from the public regarding caddisflies. Notifications came from residents living near the canal in Pools 20 and 22 and the primary complaint was that caddisflies were swarming in backyards. Field crews reported seeing "swarms" in 2024, but indicated that they were not as significant as observed in previous years..

Catfish stockings in early 2024 were concentrated in Pools 20-22, where a majority of public notifications have originated in recent years. Target population numbers of fish in each pool are determined by the estimated magnitude of the caddisfly issue and take into account previous stockings and an estimated mortality rate. Future stockings will be aimed at maintaining those population levels.

STRATEGIES FOR 2025

The catfish continue to provide a level of control, which appears to be improved with the stocking of smaller fish in more recent years. CAP will continue to stock small catfish (one-half pound) in Pools 20-24 in 2025. CAP will also continue to work closely with researchers studying control techniques and consider additional mitigation if warranted.



CATFISH ARE STOCKED IN PROBLEMATIC AREAS TO PROVIDE SOME LEVEL OF CADDISFLY CONTROL.

CYMBELLA ("ROCK SNOT")

BACKGROUND

Since the time of their discovery in the CAP (1997), stalk-forming diatoms have occasionally become a nuisance for both CAP and its stakeholders. Cymbella (aka rock snot) can cause issues when mats detach from the canal liner and are floating on the water surface. When attached to the liner, the long stalks create excessive friction and reduce the flow of water. This impacts the ability of CAP's Water Operations team to deliver the requested volume of water to downstream water users. When floating on the surface, the mats of organic material may be drawn into pumping plants. Critical filters, strainers, and pumps have the potential to become clogged, which in turn affects the ability to properly cool motor components and provide service water throughout the plant. CAP water users can also be impacted, as clogged intakes, filters, strainers, and pumps reduce their ability to effectively deliver water to end users.

APPROACH

CAP field crews and stakeholders are asked to report any instances of rock snot observed in the canal. If necessary, mechanical removal is used to scrape the canal liner.

FINDINGS

Although there were occasional reports of rock snot in the canal during 2024, there were no significant blooms observed. In February, rock snot growth was noted downstream of SGL on turnout intake grates. In July, floating Cymbella was observed in the southern portion of the system, especially near SXV. There were no impacts reported by stakeholders.

STRATEGIES FOR 2025

Field personnel will continue to report any observed Cymbella growth and CAP's Biologist will periodically check specific areas for activity. Efforts will continue in determining operational control that may minimize growth of Cymbella in the future.

CYMBELLA AT SXV IN JULY 2024.

ROCK SNOT GROWTH ON RWCD INTAKE GRATES IN FEBRUARY 2024.

SEDIMENT

BACKGROUND

During the design phase of the CAP, it was recognized that sediment deposition could be problematic. Engineers looked into the inclusion of structures like sediment traps and desilting plants, but ultimately determined that they were ineffective. Instead, forebays were designed to collect sediment near the intakes and it was suggested that regular cleaning would ensure that sediment deposition did not become a problem. However, due to costs, logistics, and the perception that sediment was not causing operational or maintenance issues, there was no formal removal process implemented. Occasionally, attempts have been made to remove sediment using a variety of methods, including clamshell dredging, highline buckets, pump dredges, "mucking" with loaders and excavators, and "vacuuming" using divers. Although each method has had various levels of success, most would consider these attempts to be ineffective and inefficient. Furthermore, there is considerable debate as to whether sediment removal is even necessary.

CAP's Water Operations team has indicated that water deliveries are rarely affected by sediment deposition. However, from a maintenance perspective, anecdotal evidence suggests that the sediment renders flow meters inoperable, clogs strainers and filters, causes premature wear to critical components (such as wear rings, impellers, and casings), degrades piping in cooling water systems, and causes wear and misalignment to trash rake systems. Nonetheless, increased maintenance and replacement of parts has not been quantified with data, so the impact of sediment deposition remains disputable.

SEDIMENT (TURBIDITY) INCREASES WHEN FLOWS IN WESTERN ARIZONA ARE INCREASED.

APPROACH

Bathymetric mapping is conducted in each forebay and major turnout on an annual basis (since 2013) to help better understand patterns in sediment deposition. Data from the mapping is used to estimate total sediment volume in each forebay. Sediment removal is only attempted when opportunities arise, such as a forebay dewatering, or when conditions become degraded to a point where removal is necessary (e.g. flows in turnouts are restricted).

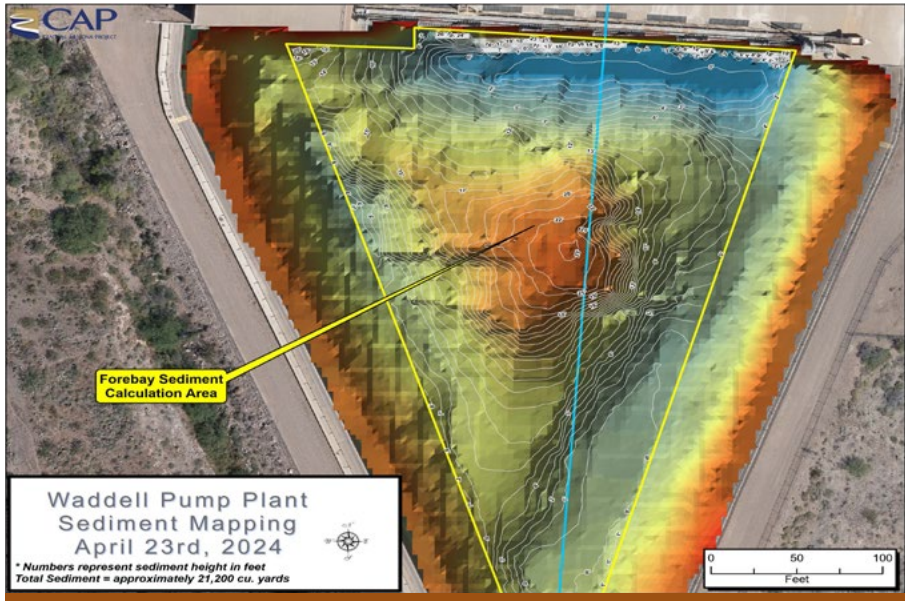
FINDINGS

In 2024, estimated sediment deposition in pumping forebays and major turnouts increased from 117,595 cubic yards in 2023 to 127,775 cubic yards in 2024; a nearly 9% increase. A majority of the increases were realized at some of the western and central plants, including LHQ (7%), HSY (12%), WAD (23%), and SGL (28%). This can likely be attributed to high sediment loads from Alamo Lake releases in spring 2023. Conversely, sediment volume decreased slightly at most southern pumping plants and major turnouts.

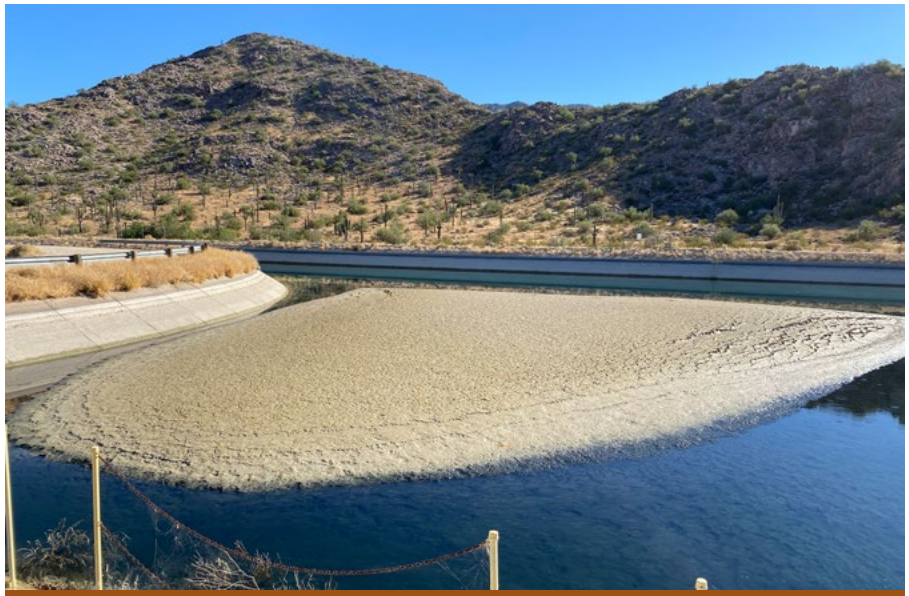
The sediment deposition decreases the operational capacity in each forebay, and it some cases, can be significant. For example, in most of the western and central pumping plants (except BSH), sediment occupies 25-30% of the forebay capacity. While at BRD, PIC, and SAN, sediment occupies 35-40% of the capacity. In the three major turnouts (SROTO, CMATO, and SMATO), sediment fills 45-70% of the forebay capacity. Despite the seemingly large amount of sediment in the system, operations has not been affected. However, the continued increasing system-wide trend should be monitored closely.

STRATEGIES FOR 2025

Sediment mapping in the pumping plant forebays will continue so that long-term trends can be evaluated. Results of the mapping will identify where sediment removal may be beneficial.



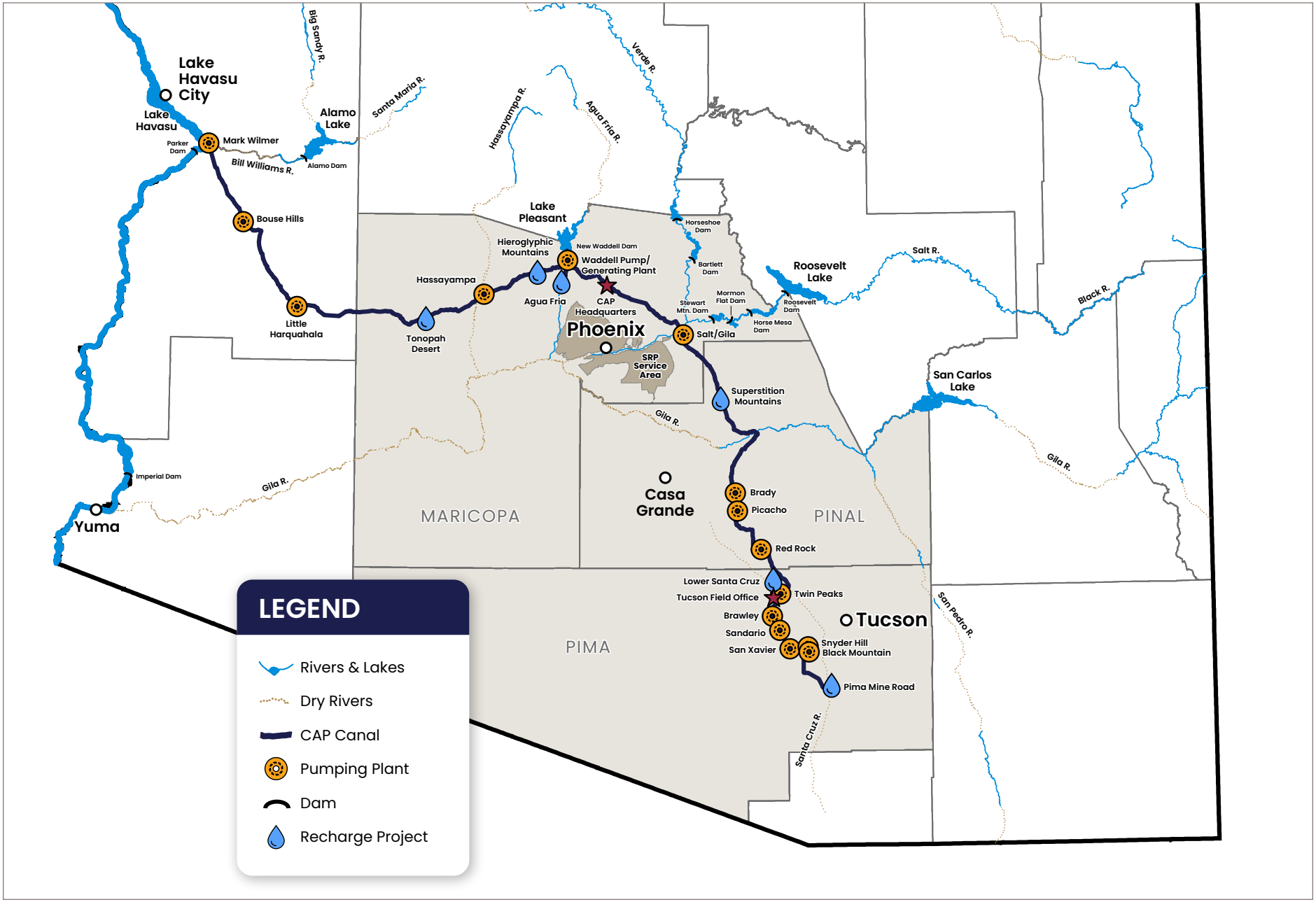
SEDIMENT MAPPING HELPS TO DETERMINE WHERE DEPOSITION MAY BECOME PROBLEMATIC.



SEDIMENT ACCUMULATION IN MAJOR FOREBAYS SOMETIMES EXCEEDS THE WATER LEVEL, CREATING AN ISLAND EFFECT.

IN MEMORY OF JUSTIN CONLEY, CAP WATER RESOURCES FIELD ENGINEER

CAP SYSTEM MAP



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CENTRAL ARIZONA PROJECT

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