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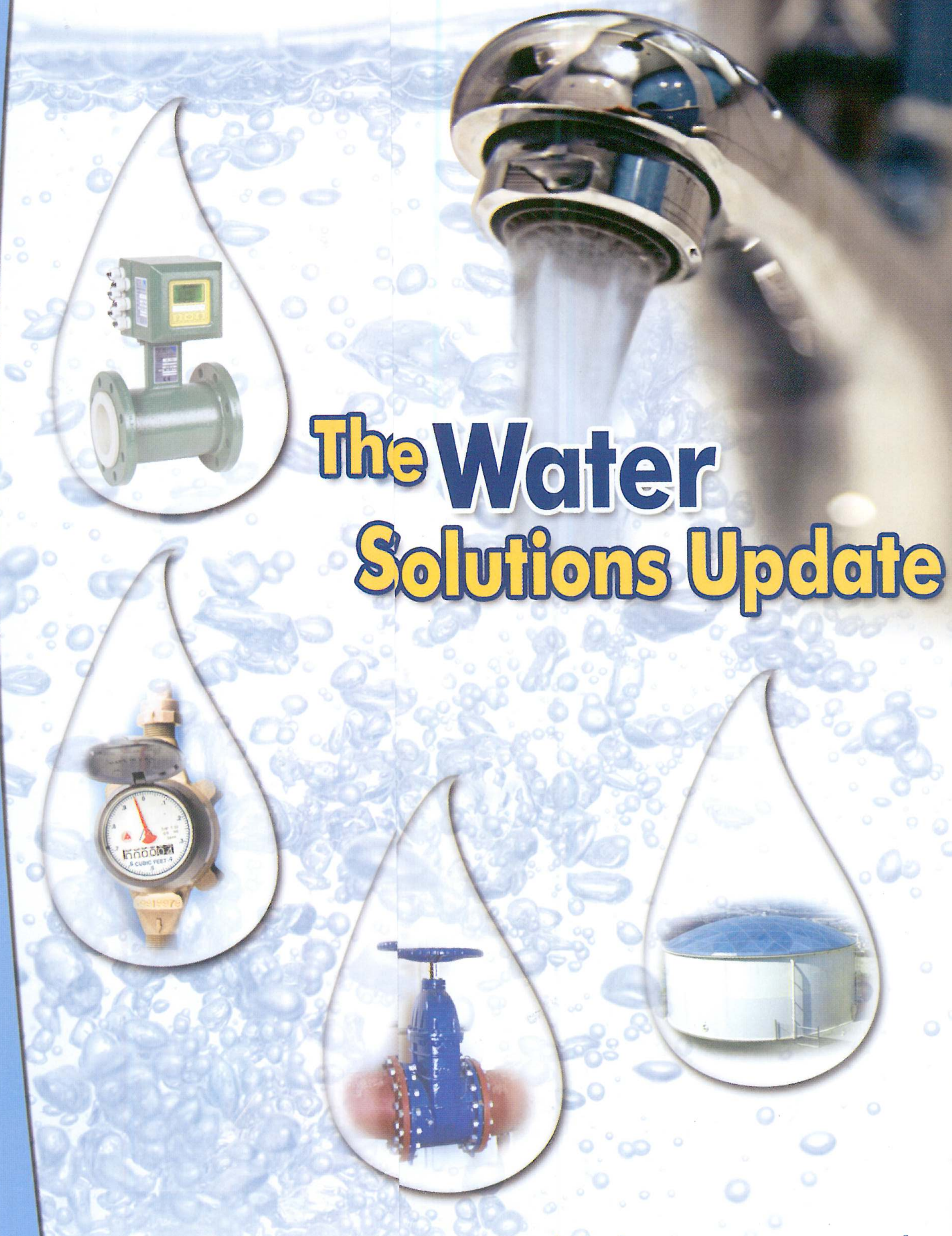

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The Water Solutions Update

Desert Water Emergency: City of Yuma, AZ

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In the Southern Arizona desert communities, water is a precious resource. This is especially true for the city of Yuma, AZ where the average yearly rainfall is only two inches. What makes water even more precious in Yuma is that the city is the third fastest growing community in the United States. Between the years of 1995 and 2000 the city of Yuma's population increased by more than 50%. As the population increased due to the expanding industrial and military presence, residential housing areas have developed, contributing to the ever increasing need for potable water. Currently the population of Yuma proper is over 88,000 and growing at an even greater pace than previously seen.

Yuma provides water to more than 103,000 people. Most of the drinking water comes from the Colorado River and must be treated before being made available to the community. Under the Safe Drinking Water Act (SDWA), the United States Environmental Protection Agency (EPA) is responsible for setting national limits for hundreds of substances in drinking water and also specifies various treatments that water systems must use to remove these substances. Each treatment system continually monitors for these substances and reports to its local, state, or federal Department of Health Services if they are detected in the drinking water. The U.S. EPA uses the data to ensure that consumers are receiving clean water. In Yuma, the raw water is delivered to the Main Street Treatment Facility via the Arizona canal system. This system has a design capacity of 40 MGD (million gallons per day) and regularly produces more than 30 MGD during the summer months.

Photos by Don Pollard Photography and Imaging

Iron and manganese removal system equipment consists of three 84-inch diameter filter vessels with stainless steel wedge flow laterals, electric operated valves, flow meters, flow control valves, and a PLC filter system control panel for fully automatic operation.

Faced with the ever increasing need for more potable water, the city of Yuma began the process of building a second surface water treatment plant to serve the east side of the city. Unfortunately, the time required for design, construction, and commissioning of the proposed Agua Viva Water Treatment Facility (WTF) could not meet the anticipated demand for clean water. Since building a new plant would not meet the city's immediate needs, the solution was to treat the two existing wells on the east side of the city that were contaminated with iron and manganese. The Agua Viva Water Treatment Facility Interim Phase Improvements were developed to provide a series of cost-effective enhancements to the existing Agua Viva WTF that could be quickly implemented to meet the rapidly increasing water demands. Increasing water production capabilities to keep pace with growth in the East Mesa area of the city had significant economic and social impacts. The city also contemplated placing a moratorium on building in the East Mesa area until the new 20 MGD Agua Viva WTF could be brought on-line to meet the water demands associated with the existing, upcoming residential and industrial development.

Residential construction was consuming a large portion of the 1 MGD production from the Agua Viva WTF and was forcing the city to stress their existing Main Street WTF to help supply the growing East Mesa

Spent backwash water is pumped from the filter vessels to a reclaim storage tank. Backwash water is given adequate time for suspended sludge to settle to the bottom of the storage tank. The clarified water is reclaimed and passes back through the filter. Sludge is then pumped from the storage tank to solar drying beds.

area. Implementing the Interim Phase Improvements provided the necessary water production to allow building activities in the East Mesa area to continue without negatively impacting the water system.

Similarly, increasing the water production capabilities of the Agua Viva WTF site allowed industrial growth to continue in the East Mesa area. In addition to the industrial facilities in the area, several new vegetable processing/packing industries began operation, and several others are planned in the near future. Yuma's existing water production facilities could not have accommodated these high water demand businesses, and would have resulted in significant economic impacts. However, implementation of the Interim Phase Improvements was able to accommodate the growth of the vegetable processing/packing industry in Yuma.

The Interim Phase Improvements project found an economical approach to meeting interim water demands during the planning, design, and construction of the ultimate 20 MGD Agua Viva WTF. An additional 6 MGD of production capacity and 3 MGD of distribution capacity were provided for a construction cost of just slightly over 4.8 million dollars (excluding preconstruction services). Utilizing existing groundwater resources allowed the city of Yuma to avoid the potentially lengthy and costly process of acquiring additional surface water supplies. In addition, the Interim Phase Improvements project was designed to serve as a backup source of water supply to the final Agua Viva WTF. Therefore, the improvements represented an investment by the city in future water production.

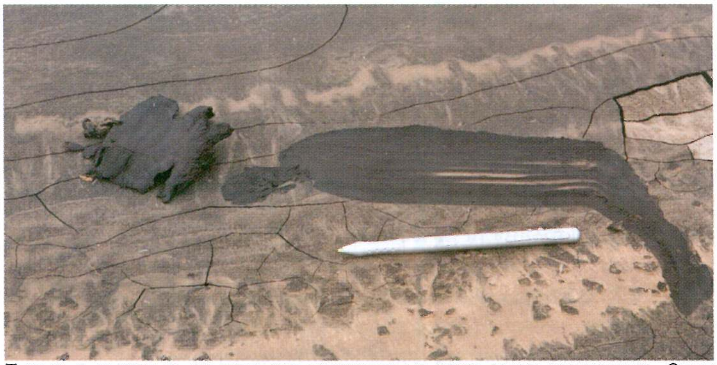
The complexity of the Interim Phase Improvements project lies in the procedures and methods that were utilized to allow the project to be substantially completed within the established 10-month construction schedule. The city elected to use the Construction Manager at Risk (CMAR) delivery method to construct the Interim Phase Improvements. The city of Yuma, Carollo Engineers (Phoenix), Clear Creek and Associates (Phoenix), and Pureflow Filtration Division (Whittier, CA) worked closely with J.R. Filanc Construction Company (San Diego) and the CMAR to obtain long lead items early in the project and minimize any potential project delays.

During conceptual design, Carollo Engineers and Clear Creek and Associates evaluated the productivity of the aquifer beneath the Agua Viva WTF site and the feasibility of increasing the production capacity of the existing groundwater well. Various treatment technologies were considered to address and treat odors and high iron and manganese concentrations in the groundwater, including chemical sequestering and removal-based treatment processes. The city of Yuma's critical need to immediately increase potable water production led the design team to initially implement a chemical sequestering process to allow use of available groundwater while a more robust removal-based treatment system was constructed.

Iron and manganese treatment systems were pilot tested to determine their ability to remove iron and manganese concentrations in the groundwater to below EPA secondary standards and to eliminate odors associated with the groundwater. Pilot testing also helped establish the parameters necessary for a complete and detailed design of the groundwater treatment system. Essentially, pilot testing confirmed the treatability of the well water, demonstrated the effectiveness of Pureflow PM-100 filter media for the required service, and determined the optimum chemical pretreatment dosage rates.

One of three solar drying beds used for the Agua Viva Water Treatment Facility Interim Phase Improvements. Sludge is pumped from the backwash water reclaim system into the drying bed for dewatering by solar evaporation. The process has proven so efficient in the City of Yuma that only two of the drying beds are currently used.

In an effort to provide an immediate source of treated groundwater for distribution to the East Mesa area while the ultimate groundwater treatment system was constructed, a chemical sequestering process was initially installed at the Agua Viva WTF site. The sequestering process delivered a polyphosphate-based chemical to the groundwater to sequester dissolved iron and manganese, to prevent precipitation of the iron and manganese solids (resulting from chlorine application) within the distribution system, consumers' homes, and businesses.



THIS IS A CLOSE-UP OF IRON AND MANGANESE SLUDGE AFTER DEWATERING. ONCE SUFFICIENTLY DRY, THE IRON AND MANGANESE SLUDGE IS REMOVED BY TRUCK FOR PROPER DISPOSAL.

Based on the analysis of treatment technologies conducted during the conceptual design, and pilot studies, which determined the exact levels of contaminants, Carollo Engineers and the city of Yuma selected a groundwater treatment system to address the iron, manganese, and hydrogen sulfide odor concerns. The selected groundwater treatment system was a removal-based treatment process that oxidizes dissolved iron and manganese in the groundwater and removes the resulting iron and manganese precipitates through a catalytic adsorption media filtration process. The system was designed with a 6 MGD treatment capacity and includes a backwash water reclaim system to recover spent filter backwash water. Spent filter backwash water and groundwater bypassed around the groundwater treatment system during backwash are discharged to the reclaimed water storage tank. The reclaimed water tank was designed as a settling vessel, allowing sufficient detention time for the settling of iron and manganese residuals. Following settling, reclaimed water pumps draw clarified water from the tank through a floating suction mechanism (which minimizes disturbance to the settled sludge) and returns that water to the head of the groundwater treatment system. A solids handling system was also designed to store and dewater iron and manganese sludge in the spent filter backwash water through the use of solar drying beds. This automated process assists in providing an effective and efficient treatment system, which maximizes system efficiency and requires little operator attention. Chemical feed systems associated with the removal-based groundwater treatment system include sodium hypochlorite for oxidation of dissolved iron and manganese, and sodium bisulfite to assist in mitigating sulfide-based taste and odor problems in the groundwater, and for use as a post-filter dechlorination agent.

The Agua Viva WTF Interim Phase Improvements exceeded the city of Yuma's expectations by providing an economical solution to meeting rapidly increasing water demands. The Interim Phase Improvements represent a unique use of existing groundwater resources to accommodate continued growth in the East Mesa area and the attendant economic and social benefits that accompany that growth. The city was extremely pleased with the design of the groundwater treatment system and the ability to integrate the system into the future Agua Viva Water Treatment Facility. The development of groundwater resources at the site provides the city with a redundant and reliable raw water source for the East Mesa area of the city of Yuma.

The high level of automation incorporated in the design allowed the system to be easily and effectively operated without requiring significant operator attention. City of Yuma operators were pleased with the system operation and their ability to operate and monitor the system remotely through a SCADA system located at their Main Street Water Treatment Plant.

Approximately one year after the commissioning of the iron and manganese removal-based system, the city of Yuma determined that an increase in the daily production at the Agua Viva WTF site was necessary. Initially, the city expected that additional filtration equipment would be required. After discussions with Corollo Engineers and Pureflow Filtration, it was suggested that a simple increase in the filter loading rate and an increase in the chemical pretreatment dosage would accommodate the additional flow requirements. Once again, a pilot study was conducted to verify if this recommendation would produce the required additional water quantity and quality. The pilot study concluded that a simple increase in the chemical pretreatment dosage, combined with the increased loading rate would produce water within EPA guidelines. This approach increased the system flow rate from 4,200 GPM to 6,000 GPM and saved the city a significant amount of money, and time, compared to the capital costs associated with expanding the water treatment plant by providing additional filter vessels.

The original aggressive project schedule, the Interim Phase Improvements were online and operational to meet peak winter 2004/2005 demands associated with vegetable packing and winter visitors in the East Mesa area of the city. The total construction cost of just over $4.8 million represents a capital cost of approximately 80 cents per gallon of water production capacity, providing a cost-effective solution to the city of Yuma's water production needs.