Chapter 23

Designer water: One utility's unique approach to industrial sustainability

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23.1 INTRODUCTION

The West Basin Municipal Water District ('West Basin') is widely known for treating and delivering five types of 'designer water' to a variety of recycled water customers. In order to maximize the use of recycled water in the region, West Basin has adopted a 'fit for purpose' approach to treating wastewater, in which five different treatment processes ensure that the water quality meets the specific needs of each customer. While this approach requires West Basin to meet a variety of stringent water quality standards, it has allowed us to satisfy the needs of our diverse municipal and industrial customer base.

The amount of water Southern California receives from the Sierra Nevada Mountains (via the State Water Project) and from the Colorado River (via the Colorado River Aqueduct) has historically been reduced by factors that include prolonged droughts, varying snow and precipitation, and regulatory limits to protect endangered species in the Sacramento River Delta. By adding locally produced water (recycled, conserved, and desalted groundwater) to its portfolio, West Basin is able to significantly enhance the reliability of its water supply. Currently West Basin manufactures as much recycled water as the volume used by more than 130,000 households annually. However, in order to further reduce its reliance on imported water supplies, it must have customers who can use its 'designer water' in place of existing potable supplies.

Each of the 17 cities and unincorporated portions of Los Angeles County (California, USA) served by West Basin is home to a wide range of water users. Under the guidance of its Board of Directors,

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West Basin's engineering and operations teams utilize the best available wastewater treatment technologies to meet the needs of the communities it serves, whether irrigating public parks and sports fields, injecting recycled water in the ground to augment groundwater supplies, or treating water to specification to serve the region's many industrial water users. This approach allows West Basin to maximize the use of recycled water. The five types of recycled water served by West Basin include the following:

(1) *Irrigation water*: Wastewater filtered and disinfected to California's 'Title 22' standards for turf irrigation and a variety of other non-potable uses;
(2) *Cooling tower water*: Wastewater filtered, disinfected, and nitrified to remove ammonia through a biological process for use in industrial cooling towers;
(3) *Seawater barrier and groundwater replenishment water*: Wastewater filtered through microfiltration and reverse osmosis membranes and disinfected prior to pumping underground to form a barrier against seawater intrusion into local groundwater supplies;
(4) *Low-pressure boiler feed water*: Wastewater filtered through microfiltration and reverse osmosis membranes for use as low-pressure boiler feed water; and
(5) *High-pressure boiler feed water*: Wastewater filtered through microfiltration membranes and passed twice through reverse osmosis membranes for use as feed water for high-pressure boilers.

23.2 ECLWRF: THE HEART OF THE PROCESS

West Basin's Edward C. Little Water Recycling Facility (ECLWRF), located in the city of El Segundo, is the largest water recycling facility of its kind in the United States. ECLWRF is designed to filter and disinfect over 150ML/day (40 mgd) of partially treated effluent from the City of Los Angeles Hyperion Treatment Plant, turning wastewater into useable water. Nearly one-third of that highly treated flow (up to 50 ML/day or 12.5 mgd) can be treated by a combination of microfiltration and reverse osmosis membranes for use in a range of industrial settings, including cooling towers and low- and high-pressure boilers. In addition, nearly 20 ML/day (5 mgd) is treated to potable standards and pumped into local groundwater supplies to protect them from seawater intrusion (Figure 23.1).

The ECLWRF was recognized by the National Water Research Institute in 2002 as one of only six national centers for water treatment technologies, and the only one in the United States producing five different qualities of recycled water ('designer water') to meet the specific needs of West Basin's municipal, commercial, and industrial customers. The ECLRWF also houses a 60,000 square foot solar power generating system that has reduced emissions of carbon dioxide by over 356 tons over one year. These emissions reductions are equivalent to planting nearly 100 acres of trees or not driving 890,007 miles.

23.3 SATELLITE FACILITIES

In addition to the primary ECLWRF, West Basin also owns and operates three satellite facilities:

- The Chevron Nitrification Facility (El Segundo) which treats approximately 20 ML/day (5 mgd) of recycled water from ECLWRF through a nitrification process for industrial applications. The Phase V Expansion Project will provide the facility improvements to accommodate an additional 2 ML/d (0.58 mgd) of nitrified water demand.
- The Juanita Millender-McDonald Carson Regional Water Recycling Plant (Carson) treats 15 ML/d (3.5 mgd) of recycled water from ECLWRF through microfiltration, reverse osmosis, and nitrification to provide water for boiler-feed and cooling tower applications in an adjacent refinery. The Carson Facility capacity will be expanded by 4 ML/d (1 mgd). The treatment capacity of the Carson

Figure 23.1 West Basin's Edward C. Little Water Recycling Facility (El Segundo, CA) treats 150 ML/d (40 mgd) of secondary effluent to non-potable and potable standards for municipal and industrial reuse. (*Credit*: West *Basin Municipal Water District*)

Facility will also be modified to add ultraviolet (UV) disinfection and advanced oxidation processes (AOP) in order to supply water to the Dominguez Gap Barrier to prevent seawater intrusion into local groundwater supplies.

- The Torrance Refinery Water Recycling Plant (Torrance) is located in the Torrance Refining Company facility. This recycling plant nitrifies recycled water to remove ammonia prior to introduction into cooling towers and as boiler feed water. Since 1995, this major industrial customer has used recycled water at a daily average rate of over 20 ML/d (6 mgd).

23.4 FROM CONCEPT TO IMPLEMENTATION

23.4.1 Institutional challenges

Leadership and outreach are two major factors in West Basin's success. West Basin was created in 1947 to reduce groundwater over-pumping by providing new sources of water. In 1948 West Basin joined Metropolitan Water District of Southern California, which sells imported water from the Colorado River and Northern California to more than two dozen cities and water agencies in Southern California. After a severe drought in the late 1980s taxed Metropolitan's ability to supply all its retailer demands, West Basin's Board decided to implement aggressive water conservation and reuse to bolster its reliability and protect against future shortages. West Basin remains committed to being a leader in the water industry by exploring new methods and technologies that enhance reliability in the region's water supply, including seawater desalination.

West Basin's leadership was demonstrated early on in its development of a number of productive collaborations, beginning with its agreement to purchase secondary-treated wastewater from the City of

Los Angeles. West Basin also executed agreements and maintained productive working relationships with its many retail water customers, including the California, Cal-American, and Golden State water companies, the cities of Inglewood, El Segundo, Manhattan Beach, and Lomita, and the Water Replenishment District of Southern California, the regional groundwater manager. Along with the cost of water, these agreements included a range of operational details such as minimum pressures and flows and maintenance of transmission and distribution infrastructure. West Basin's customized agreements with its larger retail industrial customers (including the Chevron, Marathon, and Torrance refineries) stipulated water quality and price and established protocols for communication between the utility and the industrial customer.

Another challenge was financial. West Basin staff obtained a number of federal and state grants and loans to help limit the impact of the project on local ratepayers. However, industrial water users were responsible for on-site retrofitting, including investment in new equipment. Customers were also responsible for the cost of water which varied with the level of treatment, and for low- and high-pressure boiler feed water was actually higher than the cost of potable water.

With respect to outreach, from the beginning West Basin conducted an extensive education campaign to inform the public, business community, and community leaders about the value of using recycled water. Through this effort, West Basin reduced public fears about health risks related to a process some disparaged as 'toilet to tap', and built community trust in the treatment technologies and the recycled water product. In addition to health issues, industrial customers were concerned about the uniformity of water quality, especially since the quality of the effluent from the City of Los Angeles (the influent to West Basin facilities) could vary over time. In response to these concerns, West Basin worked with the customers to set up and maintain communication channels where utility staff could advise industrial plant operators about pending deviations in water quality.

23.4.2 Engineering challenges

Operating a system designed to meet the needs of different communities presents many challenges. In addition to constructing satellite treatment facilities to produce water of appropriate quality for its industrial customers, West Basin has invested in roughly 160 km (100 miles) of purple pipeline (the color designated for non-potable water), with an additional 100 km (60 miles) of pipeline planned. Delivering recycled water further and further from the ECLWRF will also require additional pump stations and satellite treatment facilities, which could have significant cost impacts on system operations.

West Basin's recycled water system was designed and constructed to deliver recycled water to 'high volume' industrial water users (refineries), or anchor customers. Using the pipelines constructed to deliver recycled water to the anchor customers, West Basin was able to build individual laterals to supply additional recycled water to parks, sports fields, and other industrial water users. To facilitate their design and implementation of water reuse projects, West Basin performed water audits for its industrial customers to help them use water more efficiently and to determine if recycled water is available for their specific needs. By reducing water demand by industrial customers, West Basin is able to make more recycled water available for others.

23.4.3 Industrial challenges

The term 'designer water' is part marketing and part technology. West Basin coined the term to reflect the way the utility designs and treats water to meet the needs of its customers. Every community served by West Basin is unique, and so are the industrial users in those communities. As specific problems were encountered, such as the sensitivity of admiralty metals to ammonia, West Basin adjusted its water quality specifications to the needs of its industrial customers. To ensure that these water quality needs

are always met, West Basin routinely tests its recycled water for some constituents not required by state health regulations (e.g., silica). There are several factors that impact the utility's ability to meet those specifications, such as a higher influent contaminant concentration at the West Basin treatment facility resulting from reduced wastewater flows into the City of Los Angeles' Hyperion wastewater plant. When changes in recycled water quality occur, West Basin staff communicate directly with the affected customers to ensure that no processes are impacted.

Despite the utility's efforts at outreach and communication, some companies did not immediately embrace the change in their water supply. This caution is understandable, since altering an industrial facility's water supply has the potential to create an assortment of 'unknowns' that might impact plant operations. In those cases, it was often up to the plant manager to demonstrate the leadership required to recognize the benefits of reducing water demand and using water more efficiently.

23.4.4 Lessons learned

Past challenges to implementing the designer water program included limited public acceptance of recycled water (in California) and low demand for recycled water by industry. However, the water industry and trade associations together have done an excellent job of educating the public; where West Basin once had to 'sell' recycled water to a potential water user, the utility is now contacted by customers who want to purchase recycled water. Equally important, the regulatory community has developed trust in the recycled water agencies and their use of technology to safely produce recycled water for potable and non-potable uses.

West Basin's experience demonstrates the value of tailoring the quality of recycled water to maximize its use by industrial customers. Moving forward, the new challenge might be that reduced wastewater flows due to conservation will create a competitive market for plant effluent, forcing some recycled water utilities to look for new sources of water to supply their industrial customers. Currently, several large Southern California utilities – including the Metropolitan Water Districts and the City of Los Angeles – are developing plans to reuse even more water for potable purposes over the next 10 years. In that meantime, West Basin will continue to provide high-quality 'designer water' specifically suited to its industrial customers, helping them save water and energy now and in the future.