Fostering Surface Water Supply

By Judy Horning

California city reduces dependence on groundwater by maintaining surface water supply

Located 15 miles northwest of Sacramento, in the agricultural fields of the Central San Joaquin Valley of Northern California, the cities of Woodland and Davis, and the University of California, Davis (UC Davis) have grown immensely, with many additions to their communities. Several major chain stores opened and numerous subdivisions were built recently. As part of the Sacramento metropolitan area, the cities, with a combined population of approximately 120,000, have retained their small town community atmospheres, with agriculture playing an important role in their economies.

Both cities and UC Davis depend entirely upon groundwater as their potable water supply source. This has become a challenge as the reliability and quality of the diminishing groundwater supply has declined. In addition, more than two-thirds of the groundwater wells owned by the cities of Woodland and Davis are more than 30 years old and near the end of their expected service lives. Faced with aging drinking water supply wells, declining groundwater supply, and increasingly stringent drinking water quality and wastewater discharge regulations, it became important to diversify their water supply.

Regional Surface Water Project

In response to these issues, the Woodland-Davis Clean Water Agency (WDCWA), a joint powers authority including the cities of Davis and Woodland, and UC Davis, was established in September 2009 to implement and oversee the development of a new regional surface water source from the Sacramento River. The project plans included a jointly owned and operated intake on the Sacramento River, raw water pipeline connecting the intake to a new regional water treatment plant, and pipeline to both cities for treated water. The new regional surface water treatment facility, located in Woodland, is designed to supply up to 30 million gal of water per day (mgd), with an option for future expansion to 34 mgd. Project procurement is done through a design-build-operate contract with CH2M. Design of the plant began in November 2013 and construction began in April 2014. Once in operation, by the end of 2016, the project will improve drinking water quality, water supply reliability and wastewater treatment plant discharge quality for both cities.

Preparing for Surface Water

Improvements to existing water supply systems varied for each city in preparation for accepting water from the new surface water treatment plant. The city of Woodland selected West Yost Associates as well as other specialty consulting engineers to assist in the evaluation and development of the infrastructure to accommodate the new water supply. The city's existing water facilities consisted of an elevated water storage tank, a network of distribution pipeline, pump stations and 20 groundwater wells. The need for a larger ground storage tank was determined after an engineering analysis indicated that the existing elevated water tank did not have sufficient capacity and the western portion of the city experienced low water system pressures during high-demand periods. The city determined it needed to construct a new ground-level storage tank and booster pump station, which was the first of its kind for the city. The Woodland Southwest Area Tank and Pump Station Project tank has a storage capacity of 3 million gal and the booster pump station has a rated capacity of 6,000 gal per minute. Future population growth was taken into account, but the primary purposes of the project were to deliver reliable service to existing customers, improve water pressure, provide additional water capacity during emergencies such as fires, and help meet the city's peak hourly water system demands.

Tank Construction

DN Tanks was subcontracted by general contractor Myers & Sons Construction to perform structural design, build and prestress of the 3-million-gal circular, concrete water storage tank conforming to AWWA D110 Type I Standards and the Uniform Building Code for seismic criteria. The floor, footings and walls were designed and constructed with concrete. The city selected a prestressed concrete tank for its durability, long life span, seismic performance and low maintenance. The tank was designed with an inside wall diameter of 130 ft and a wall height of 35 ft, 3 in. The 10-in.-thick cast-in-place core wall utilized 480 cu yd of concrete, the 6.5-in.-thick floor consumed 403 cu yd of concrete, and the free-standing concrete dome roof used 283 cu yd of concrete.

Seismic Considerations

Design requirements were based on site-specific geological and seismic conditions. A machine-wrapped, prestressed concrete storage tank was chosen because of its inherent ability to withstand seismic ground accelerations. Specialized seismic connections were incorporated between the wall-to-wall footings, similar to a base isolation system in essential buildings, to account for the high seismic forces anticipated over the service life of the tank. The seismic connections were designed to allow for maximum ductility under a seismic event to ensure the structure would continue to perform should the tank undergo horizontal and vertical ground accelerations.

The tank core wall was both circumferentially and vertically prestressed by DN Tanks. Vertical prestressing involved the use of 99-by-1.25-in.-diameter high-strength threadbars, which subsequently were grouted with epoxy. The tank was circumferentially prestressed by DN Tanks' strandwrapping machine, which applied the desired force of 14,950 lb to the 22 miles of 3/8-in.-diameter, hot-dip-galvanized, seven-wire prestressing strand. The machine continuously and electronically monitored the stressing force as it was applied. By keeping the core wall in compression along with the independent connections, a long-life, liquid-tight structure was ensured. After the strand was placed on the wall, it was encapsulated with several coats of machine-applied shotcrete. The shotcrete served as corrosion protection to eliminate maintenance over the life of the tank. This application process ensures that the necessary quality control was consistently monitored and maintained.

Aesthetic & Security Concerns

Due to their location in a park amid residential neighborhoods, several measures were taken to reduce the visual impact of the water tank and pump station. Modifications to the original design reduced the prestressed concrete tank's diameter and visible height. Upon completion, the tank was partially (40%) buried approximately 18 ft below the ground's surface, thereby reducing the tank's visible height and diameter. The tank was painted light green to blend into David Douglass Park's surroundings and nearby residential neighborhoods. Vegetation was selected to provide a year-round green color when mature, including extensive trees and landscaping surrounding the facility to blend the tank with the surroundings. Walking and jogging trails, benches, picnic areas and a public restroom were additional community enhancements. For security purposes, the entire area is surrounded by an 8-ft-tall aesthetic black steel fence.

Moving toward a more sustainable water supply, the city of Woodland has taken preemptive steps toward diversifying its water portfolio. The city's first prestressed concrete water storage tank provides critical infrastructure as the new surface water treatment plant comes on line. This tank and pump station provide the city's needed redundancy, as it is the equivalent of three or four groundwater wells. By reducing its dependence on groundwater and increasing the reliable surface water supply, the cities of Woodland and Davis have a more sustainable water system to serve the region's needs for both existing customers and future growth. w&wd

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