BURNS McDONNELL

CASE STUDY

# Horizontal Water Well Provides Additional Clean Water for Midwest Metropolis

**Jefferson County, Missouri, benefits from the adoption of a specialized well water system that helps produce a cleaner, more reliable and environmentally friendly water supply.**

## Challenge

The Jefferson County Water Authority (JCWA) is the provider of treated water for Festus and Herculaneum, two communities south of St. Louis. JCWA operates a water treatment plant that obtains its raw water from a single horizontal collector well (HCW), located in the flood plain of the Mississippi River.

Historically, during low river conditions, the pumping capacity of the existing HCW has not been sufficient to meet water demands. When the HCW is out of service for any reason, Festus and Herculaneum must rely on their old bedrock wells for water supply. The water from these bedrock wells is mineralized, high in hardness and is not treated by the water treatment plant.

It was determined a second collector well was needed to: maintain a high-quality water supply for current customers; provide a reliable water supply for the future; and avoid having to supplement the water supply from groundwater wells.

## Solution

JCWA's existing collector well never achieved the desired yield of 4 MGD because of fluctuating river levels. The additional well was further necessitated by the need for redundancy and increased capacity related to regional economic growth.

To address the need for a more reliable and resilient water system, JCWA selected Burns & McDonnell to assess its system and construct a second HCW. The initial scope of services included identification of a new collector well site, as well as field testing, planning, cost estimating, and preliminary design and construction. The team also executed detailed design, permitting, procurement, construction, startup and performance testing.

Shortly after the $10 million project began, JCWA experienced an emergency with its existing HCW. Water quality plummeted and the utility struggled to meet demand. Our team worked with local contractors to perform a bathymetric survey of the Mississippi River, identify the issues and develop a plan that included design and repair work. Initial design to completion for the repair took less than five months.

Once emergency repairs were completed, the long-term work moved forward as a progressive design-build project that would provide redundancy and add raw water capacity. It included the design and construction of a 3.5-MGD horizontal collector well along the banks of the Mississippi River. The goal of the project was to create a more robust system. Additionally, the new collector well was designed to eliminate the reliance on neighboring utilities when demands exceed raw water capacity while allowing critical maintenance activities to be occur.

The collector well consists of a 13-foot inner diameter caisson to bedrock, approximately 70 feet below grade with a pump house approximately 20 feet above grade for flood protection. The well has five 200-foot-long laterals projected in a fan orientation under the Mississippi riverbed. The project also includes a 250-kW emergency backup generator that provides standby power to the newly constructed collector well and the existing collector well approximately 700 feet away.

The caisson was constructed of round cast-in-place concrete sections and incrementally placed into the ground via hydraulic means. A concrete "deadman" was initially cast to support the hydraulic equipment used to force the caissons into the ground. As the caissons were deployed, a crane and clamshell were used to remove spoil material from the center of the well. Following placement of sufficient caisson sections, each new section was situated, without additional force, until reaching bedrock.

Water is extracted from beneath the Mississippi River via laterals that protrude horizontally from the bottom of the caisson to the fresh water underneath the river. This source water is particularly clean due to riverbed filtration and is more resilient to drought given that water is extracted from beneath the river rather than through a surface intake. Further, the laterals do not interfere with fish or wildlife in and along the river.

Sump pumps were installed to pump water from the bottom of the wet well as crews constructed the new well. Portions of the pump house that extend beyond the limits of the caisson are supported by H-piles; these portions include decking to hold the 250-kW emergency backup generator and electrical room.

Construction of this collector well was fairly complex, as there is only one specialty contractor (Ranney Collector Wells) who performs this type of work. Burns & McDonnell worked closely with the contractor to facilitate its specific approach, protocols and methods for pouring and sinking sections of the caissons. Acting as the design-build management team, our group confirmed safety protocols were met, and the team facilitated confined-entry training for construction-site personnel.

## Results

Construction adjacent to the Mississippi River requires special consideration of excavation, hydraulic uplift and potential for catastrophic flooding during critical construction sequences. Our team adeptly evaluated and mitigated risks along the way by employing best practices for subsurface investigation, monitoring hydrological conditions and optimizing our design to suit potentially impactful circumstances. The team successfully completed the project without encountering any unanticipated conditions.

More concrete was used on this project than the average well because no other material would be suitable for the extreme conditions. Given the depth and lateral earth pressures at the base of the structure (70 feet below grade), the flooding potential (project sits within 100- and 500-year flood plains) and the needed resilience to floating debris, no other material would be viable for constructing a horizontal collector well.

As a result of this project, JCWA's new collector well is providing a cleaner, more reliable water supply that has a lower impact on the surrounding environment. The original HCW now serves as a redundant backup supply.

The project was delivered on time, within budget and with zero safety incidents. The new water system will serve the surrounding areas for decades, if not centuries, to come.

## About Burns & McDonnell

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