

Charming Charleston, S.C., is well known for its beautiful coastal location, streets lined with grand live oaks covered with Spanish moss and rich history—all of which draw millions of visitors every year. What is less familiar, however, is Charleston's wastewater collection system, which lies beneath the city's historic district.

By Neda Simeonova

Beneath Charleston's Charm

The original tunnel system was built in the late 1960s and was designed to collect wastewater from sewer lines and deliver it to the Plum Island Wastewater Treatment Plant (WWTP). While the original system kept up with Charleston wastewater collection needs, over time the corrosive environment deteriorated the carrier pipe inside the tunnel along with the tunnel structure.

After discovering the damage in the late 1990s, Charleston Water System (CWS), the city's water and sewer public utility, began an aggressive, multi-phased project to replace the tunnels—South Carolina's largest-ever sewer infrastructure project. Construction of the new system began in 2004, and the project's estimated total cost of \$224.5 million was funded primarily by revenue bonds and sewer rate increases, according to CWS.

specified throughout the project to preserve the historic heritage of downtown Charleston. Several studies were conducted to minimize the impact of the project on the city: an archeological study where pre-digs were monitored at all shaft sites by an archeologist; a building/structure assessment study where structures near a shaft site were completely surveyed and cataloged; tight specifications and contract requirements research; and an environmental study.

"Some of the key challenges included the aggressive schedule and 'postage-stamp' shaft sites necessary to maintain the historic charm of Charleston," said Jason T. Swartz, P.E., civil engineer for Black & Veatch.

Community Impact

Replacing a collection system of this size was not easy. To minimize the impact the project would have on the residential and business community, CWS put a lot of effort into gaining the support of residents and community leaders.

"Construction of several of the drop shafts were literally on the front doorsteps of historic, residential structures," Swartz said. "The community outreach program led by CWS and supported by the entire team played an integral part in informing the public and mitigating potential issues before serious problems could arise. The outstanding efforts of the team can be summarized in the following excerpts from an unsolicited letter from one of the residents: 'CWS has completed a monumental task with minimal impact and respect for the historic fabric of the city ... it took such an exceptional team to make this such a blue ribbon project ... this is a success not often seen in municipal projects around the country.'"

Benefits

With an estimated total cost of \$224.5 million, replacing the deep sewer tunnels is the single most costly project in CWS history; however, the project was worth every penny. The design, construction and management of nearly 50,000 ft of new sewer tunnels under the historic city center of Charleston was awarded the 2009 Engineering Excellence Honor Award from the state's division of the American Council of Engineering Companies.

Beyond this prestigious recognition, the completion of the project means a reliable wastewater conveyance system for years to come for the residents of Charleston.

"Future generations will be able to continue to enjoy the charm and beauty that has made Charleston what it is today," Swartz said.

James McKelvey, Black & Veatch associate vice president and tunnel practice leader, added: "This has been one of the most satisfying projects that I have been fortunate enough to have contributed to in my career. The technical challenges, public outreach during design and through to the end of construction, as well as provision of a sustainable, long-term solution to transfer all the wastewater from Charleston and Daniel Island to the regional treatment plant on Plum Island, was delivered within budget and major milestones—a commendable achievement. The single most important aspect was how the team from CWS, the engineers and notably the contractor worked together to address and resolve the inevitable problems that arise during underground construction. I am grateful for the opportunity I had to work with every member of this extended team." WWD

Neda Simeonova is editorial director of *Water & Wastes Digest*. Simeonova can be reached at 847.391.1011 or by e-mail at nsimeonova@sgcmail.com.

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An overview of Charleston's water system sewer tunnel replacement program

ARTICLE SUMMARY

Challenge: The wastewater collection system serving the city of Charleston, S.C., experienced long-term corrosion in its tunnel structure and carrier pipe; repairs needed to be made quickly and with minimal downtown disruption.

Solution: Project leaders carefully orchestrated various phases to construct a three-tunnel wastewater conveyance network that runs from the full service area to a WWTP across the river.

Conclusion: By ensuring Charleston a reliable wastewater conveyance system for years to come, this project has received praise and recognition from residents and a national engineering council.

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Overview

The project features a network of three tunnels designed to convey wastewater from the full service area to the Plum Island WWTP across the Ashley River. Black & Veatch, in association with Hussey, Gay, Bell & DeYoung, Inc., was the lead design consulting engineer and construction manager for the 12,000-lin-ft Ashley River Sewer Tunnel, 18,000-lin-ft Cooper River Sewer Tunnel and 19,000-lin-ft Daniel Island Extension Tunnel.

The project required route alternative investigation, surveying, design, permitting, contractor prequalification, bidding, construction administration and observation. Affholder, Inc. (closed by its parent company Insituform in 2007) completed the tunnels and their associated shafts and civil works.

Challenges

In order to address immediate concerns about the deteriorated state of the existing system, the project also required the development of a contingency plan. In the event of a tunnel blockage, the contingency plan provided the means to bypass-pump the wastewater into the next downstream collection basin within a matter of hours.

Additionally, Charleston lies in a relatively high earthquake zone and is near the epicenter of the Aug. 31, 1886, 7.3-magnitude earthquake—one of the largest earthquakes ever recorded in the southeastern U.S. Therefore, Charleston's shafts and deep tunnel system were designed to withstand a maximum credible earthquake event, according to Black & Veatch.

Ranging in diameter from 5 to 8 ft, the sewer system is located 120 ft beneath the city's historic district, which presented many challenges during the four-year construction. Innovative construction techniques were