PROPERLY OUTFITTED

Retail outlet center looks to underground storm water solution

By Gina Carolan

Everyone loves a good bargain, and Tanger Factory Outlet Centers Inc. in Bluffton, S.C., offers just that. Located between Highway 278 and Bluffton Parkway, the recently updated facility houses 42 tenants and offers outlet shopping to the local community and visitors.

When Tanger began redeveloping its almost 25-year-old center, it turned to longtime consultant Ward Edwards Inc. to engineer the project. The engineers designed the 20-acre site's infrastructure to include new water and sewer systems, parking and landscaping. A key step in the redevelopment of the center was designing a new storm water management system to replace a network of detention ponds constructed 20 to 30 years ago.

"There were no records to show the design of the existing storm water system, so we designed the replacement detention and water quality system to make the post-redevelopment discharge rate less than a predevelopment rate," said Willy Powell, P.E., of Ward Edwards.

The engineers calculated predevelopment discharge rates at 17.26 cu ft per second (cfs) for a two-year, 24-hour storm; 32.99 cfs for a 10-year, 24-hour storm; and 43.1 cfs for a 25-year, 24-hour storm using the Cultec chamber tool built into Streamline Technologies' Interconnected Channel and Pond Routing Model.

Site Constraints

The redesigned facility offered little space for a conventional storm water system. Four retail buildings occupied 177,000 sq ft, and about 1,000 parking spaces were planned for Tanger. An underground chamber system became the solution to the land-constraint challenge.

"The ability of [the] system to allow the efficient use of land was a huge benefit to the economic viability of the project," Powell said. "The primary parking area was built over the underground system, affording hundreds of shoppers an easy access to all of the retail outlets."

Had the engineers used a conventional storm water system, they would have lost about 10% to 15% (2 to 3 acres) of the development area, according to Powell.

High groundwater, predominantly located at elevation 13 ft mean sea level, presented the engineers with yet another challenge by restricting the depth of the underground system. Cultec's Recharger 150HD, a lower-profile model (33 in. wide, 18.5 in. tall), was able to address the depth concern.

Storage Capacity

The subsurface system was designed to handle a 25-year storm event and offered 168,958 cu ft of storage. To ensure the system would have the capacity to receive and route the largest of storms without any adverse impact on buildings or other permanent site features, the 24-hour state-record rainfall was modeled. Soil tests from the seasonal high groundwater table were used to ensure no infiltration from the water table. The chamber system was designed to function as a detention solution with no infiltration.

"The new storm water system had to accommodate a large volume of runoff because we are located in a hurricane-prone county," said Carl Close, project manager for Tanger. "Cultec's system gave us the needed storage capacity and, at the same time, fit in the tight space allowed by the high water table."

To distribute runoff, the site contains three separate discharge points. These multiple locations help reduce velocities and distribute flow while allowing for additional points of emergency discharge. Post-redevelopment rates are 15.74 cfs for a two-year, 24-hour storm; 31.48 cfs for a 10-year, 24-hour storm; and 42.53 cfs for a 25-year, 24-hour storm.

Storm water enters the system through a series of inlets and box structures that capture and route it into the underground chambers. In many areas, runoff first is directed into two bioretention swales for the first-level water quality treatment. The swales also provide additional storage volume. To comply with state and local water quality ordinances, the storm water system slowly releases detained runoff to a nearby wetland through engineered outfalls incorporated into the storm water management system.

By using the underground detention system, engineers avoided increasing storm water discharge into the wetland. The wetland flows north, with a direct connection to the Colleton River—a shellfish harvesting water that is classified as Outstanding Resource Water. The wetland accounts for nearly 10% (310 acres) of the 3,300-acre subbasin flowing into the Colleton River.

An underground chamber system solved the site's land-constraint issues and was designed to function as a detention solution with no infiltration. *(Photo courtesy of Tanger.)*

The detention system included 4,402 units of the Recharger 150HD installed in eight beds under the parking area, which featured both impervious and pervious surfaces in a 2 to 1 ratio.

According to the engineer, the underground storm water system became the final solution for the project due to its ease of installation. It employed its own in-line side portal manifold, eliminating the need for a costly external pipe header. Such a system was easier to install than a conventional manifold system and proved to be more cost-effective.

"The system went together so easily and without the need of any specialty tools," Close said.

LEED Certification

The redesigned center is the first U.S. Green Building Council Leadership in Energy and Environmental Design (LEED)-certified retail location in

Water use reduction, reserved parking for environmentally friendly vehicles and reflective roof materials contributed to the retail center's LEED certification. *(Photo courtesy of Tanger.)*

South Carolina. Contributing design elements included 50% water use reduction; reserved parking for low-emission, alternative-fuel and fuel-efficient vehicles; reflective roof materials; and regionally sourced materials.

The use of the storm water system contributed to Tanger's certification based on the SS Credit 6.2: Stormwater Design: Quality Control. To achieve the credit, the engineers used a combination of structural and nonstructural best management practices (BMPs), including the chambers as the primary structural BMP, concrete permeable paving and bioretention.

The BMPs provide a treatment train approach to runoff reduction and water quality treatment. The removal percentage was estimated using the LEED recommendation that, for humid watersheds, 90% of the average annual rainfall (AAR) is equivalent to 1 in. of runoff from the site. Based on historical county rainfall data, however, it was determined that 90% AAR was more in the range of 1.38 in. of rainfall; therefore, this number was used as the benchmark for the BMP analysis.

The total storage volume for each BMP was determined, and a percentage of the AAR was calculated using historical rainfall data. The engineers calculated that the underground detention system would store 1.04 in. of rainfall (64% AAR), the permeable paving would store 0.4 in. of rainfall (26% AAR), and the bioretention would store 0.06 in. (4% AAR).

For Tanger, the underground storm water system provided a modern solution that accommodated the site's high groundwater and freed up space for additional parking. Its ability to help earn a LEED certification was an added benefit for this eco-conscious retail development. SWS

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