DRIVING DEVELOPMENT

South Carolina car dealership prepares for severe storms

By Frank W. Hahne

Fred Anderson Toyota on U.S. Route 378 in West Columbia, S.C., is an automobile dealership utilizing low impact development (LID) to minimize its impact on water quality and downstream flood conditions. The owner, Fred Anderson, chose to develop an LID project rather than a conventional design to save money and address environmental concerns. The project engineer, Cox and Dinkins Inc., brought Sustainable Design Consultants Inc. on board to handle the storm water, LID and landscape design for the project.

The site is bisected by a creek, which required buffering in accordance with Lexington County regulations. The county granted a variance for reduction of the buffer widths when it was shown how bioretention within the site would be an effective approach to improving water quality of site runoff. Changing the normal landscaped islands within the parking lot and perimeter of the site to bioretention basins allowed the runoff to be captured, filtered, cooled and stored before it was released into the creek.

Built to Capture

The bioretention cells in the landscaped islands were sized to capture 1.2 in. of storm water and contain the runoff from a 3.6-in., two-year storm event. Larger storm events are directed to three separate shallow attenuation basins where rain events up to a 100-year storm can be controlled and released.

The site, which contains several acres of impervious surfaces, produces less runoff than it did in its pre-developed condition. This was accomplished by implementing other LID measures such

Top left: A rendering of a typical bioretention cell at maturity. Bottom left: The finished basins include crosswalks for customers and salespeople. Right: A bioretention basin built out of the recommended sequence. The basins built out of sequence had to be rebuilt due to sediment contamination.

as reducing impervious surfaces and efficient use of land. Parking stalls within the vehicle storage area measure 9 ft by 36 ft to allow front-to-back stacking, thus accommodating up to 350 vehicles.

Crosswalks were included within the bioretention cells in the parking lot so salespeople and buyers can cross them, and 6-in. pipes through the crosswalks allow the bioretention cells to act as one. All bioretention cells were landscaped with native grasses and plants to provide a year-round attractive feature.

Signs were installed in the public parking area to inform visitors of the owner's conscious intent to protect the environment and downstream homeowners from any adverse effects from the site. The signs also show how the bioretention basins were constructed and how they function to improve water quality.

Storing the Storm Water

The bioretention basins store 12 in. of runoff above the surface mulch layer, which consists of triple-hammered hardwood bark mulch. The mulch functions not only to retain moisture for the plants, but also to absorb hydrocarbons and heavy metals in rainwater runoff. Beneath the mulch is a sand mixture containing 85% mason or concrete sand and 15% organics to filter the runoff.

The bioretention basins contain an internal water storage zone created by upturning the under drain before it exits. This allows approximately 18 in. of water storage at the bottom, which not only creates an anaerobic condition whereby nitrogen is reduced in the effluent, but approximately 50% of the annual rainfall never leaves the site and is infiltrated to replenish groundwater.

As runoff enters the bioretention basins it slowly accumulates while infiltrating into the engineered media. Storm water in excess of the design volume is released through a grated inlet set above the maximum depth in the basin. This allows the peak of the storm to be attenuated and approximately 3.6 in. of rainfall to be removed from every storm. The cleaner, cooler portion of every storm then is collected and further attenuated in three shallow storm water basins, which release the runoff at a controlled rate.

Solving Problems

During construction there were some delays and modifications made due to changes in construction materials. For example, a segmented retaining wall at the rear of the site, which was necessary due to the slope, originally was conceived as a poured-in-place concrete wall. The geo-grid for the segmented wall conflicted with the construction of a bioretention basin adjacent to it. After consulting with the structural engineer, it was determined the top geo-grid layer could be shortened and an impermeable

liner could be placed between the bioretention basin and wall to prevent any hydrostatic pressure.

When the site contractor constructed some bioretention basins out of the recommended sequence, they had to be rebuilt due to contamination with sediment. It is critical the bioretention basins be constructed only when the contributing area has been stabilized or paved. This can be done in the final stages of construction, during which time the site landscaping and bioretention plantings are installed.

Using LID on the site not only reduced pollutants and downstream runoff, but also the site improvement costs for the owner because the bioretention cells store storm water up to a two-year event, resulting in storm drains either being reduced in size or eliminated. Additionally, the reduced outflows from the bioretention basins allowed a further reduction in the size of the adjacent attenuation basin, creating more usable land for development.

Bioretention offers the advantage of eliminating long-term irrigation, as watering is needed only until plants have been established. Afterward, the runoff alone is sufficient to provide the necessary water. Annually, an acre of land receives approximately 10 to 12 lb of nitrogen and phosphorus from rainfall, eliminating the need for fertilizer. This results in further savings on an annual basis. LID was a win-win approach to this site development as it provided savings before, during and after construction.

On Oct. 6, 2015, South Carolina experienced what some are calling "the 1,000-year storm." More than of 30 in. of rain fell in some parts of the state. A site inspection was made the following day, and even though there was erosion to the creek within the property, the bioretention basins were intact, showing no signs of damage. SWS

The overalll site plan. The creek that bisects the site required buffering in accordance with Lexington County regulations.

Frank W. Hahne, P.E., is vice president and director of storm water engineering for Sustainable Design Consultants Inc. Hahne can be reached at fhahne@susdescon.com or 803.798.2301.