LAYING THE FOUNDATION

Permeable pavement as post-structural BMP for storm water management

By Glenn Herold

Urban sprawl, which results in the proliferation of impervious surfaces over the land, is most commonly associated with increased storm water runoff. Not only does it result in more downstream flooding, but the higher volume and velocity flows gather sediments and ground pollutants, which ultimately are deposited in concentrated quantities downstream.

The other side effect that is not so apparent is reduced water infiltration; this change in the hydrogeologic conditions reduces both aquifer recharge rates and baseline flows into the streams and rivers, the two primary sources of drinking water. The issue is exacerbated by the increased water demand associated with urban sprawl.

While traditional storm water management focuses on collecting the storm water in pipe networks and transporting it off site, many municipalities are becoming more aware of their environmental footprint and are seeking solutions to decrease their net impact. Low-impact development (LID) or redevelopment practices are being adopted so that the post-development hydrology and hydrogeology mimics predevelopment conditions. Some LID practices, including permeable interlocking concrete pavement (PICP), are commonly referred to as post-structural BMPs.

PICP Properties

At the surface, PICP consists of solid concrete pavers with the joints (openings) filled with specially designed aggregates. Below the surface are the base aggregates, which are a series of progressively larger-sized stones, similar to what is seen along railway lines.

As water rains down on the pavement, it begins its journey by seeping around the pavers through the joints, and then through the base aggregates, with the jointing and base aggregates removing pollutants via several mechanisms, including filtration. Once the water reaches the natural underlying soils, it either recharges back into the ground or is stored until discharged in a controlled fashion. The storage takes place in the voids within the base aggregates, which even when saturated can handle pedestrian and vehicular traffic on the surface.

In the case of parking lots, permeable pavement solves not only the need for parking space, but also the need for storm water management. This two-birds-with-one-stone approach makes PICP an ideal site solution for storm water management.

From the Field

Murfreesboro, Tenn., in the Nashville metropolitan area, has stringent requirements for water quality, streambank protection and flood management. Coupled with a goal for LEED certification for a mixed-use property, these storm water management issues set a project team for a new community in the city on the course for a permeable pavement solution.

Gateway Village is a mixed-use project with 62 residential units and 61,500 sq ft of office/retail space spread over three buildings. Owner Joe Swanson and the project team—engineer SEC, architect Ragan Smith Associates/Alan Thompson and contractor Parsley Brothers—needed a paving solution that could host a tremendous volume of traffic. While parking was available in a subsurface garage, the paving area needed to be able to receive a variety of vehicles, including an estimated 2,000 passenger vehicles each day. It also needed to handle garbage trucks on a normal cycle as well as other single unit or van-type delivery vehicles on a daily basis.

A combination of Belgard permeable pavers (Primary Aqua-Bric Type 4) and

PICP Benefits

Infrastructure:

- Space is conserved on site by combining roadway and storm water management;
- Storm water retention ponds are reduced or eliminated, creating more usable site space; and
- Storm water conveyance works are reduced or eliminated, lowering development costs.

Environmental:

- Downstream erosion is reduced;
- Water quality is improved;
- Water heating (an adverse impact associated with surface storage practices) is prevented;
- Groundwater recharge is increased;
- Tree survival is promoted by providing air and water to the roots; and
- Light-colored pavers reduce urban heat island effect.

Health & Safety:

- Puddling and flooding in parking lots is eliminated; and
- Risk of accidents, injuries or pests associated with retention ponds is eliminated.

Regulatory:

- Impervious cover quantities, which are regulated in some areas, are reduced;
- Snow melt drains faster and de-icing salt use is reduced; and
- The site has greater eligibility for LEED credits.

standard pavers (Mega Bergerac Circles) were chosen for the 92,000-sq-ft parking/driving areas to help the project achieve the desired aesthetic appearance, meet certain LEED certification objectives and achieve the mandates set by the local municipality. To ensure worst case scenarios, one- to 100-year storms were accounted for in this design. Because the subgrade at Gateway Village is a mixture of bedrock and silty clay, the substructure to the permeable pavers provided adequate storage volume to meet environmental requirements and slowly allow natural infiltration to mimic the pre-development conditions.

Working with a grant from the city of Murfreesboro, the Concrete Industry Management program at Middle Tennessee State University studied water quality and quantity using an Isco sampler situated at the site for two years. During that period, there were 41 in. of rain (2.3 million gal of water), but the university found that there was no water discharge at the outlet located at the back of the site. All of the water from the rooftops and parking surface infiltrated into the soil and replenished the groundwater aquifer system. The system is working as it was designed.

Gateway Village became the first permeable paving project to be completed in the city of Murfreesboro, and an example of a successful post-structural BMP for storm water management. SWS

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