China's Inaugural Sponge City & LID Technology Practice Conference – Part One

By Steven D. Trinkaus, PE

Steven D. Trinkaus, PE is the principal engineer for Trinkaus Engineering, LLC. Mr. Trinkaus has over thirty-five years of experience in the land development field. He is an internationally recognized expert in the application of Low Impact Development (LID) strategies. He has been an invited presenter in Taiwan, China and South Korea on Stormwater and LID topics. He also has been a consultant to Pusan National University, Land and Housing Institute and HECOREA in South Korea for various aspects of LID. He has designed a LID retrofit in Zhenjiang, China.

Low impact development (LID) is a new technology in China, one that holds much promise for the country. To learn more about LID techniques and standards, the China Water Industry held a conference this past May in Zhenjiang that featured LID experts from the United States. The author, Steven Trinkaus, was invited to speak, and he shares his experiences in China with readers in a two-part series. This first article tells about the conference, and the second article, which will run in the next issue, explores subsequent applications of LID in China.

China has been experiencing rapid development in many of their large urban cities over the past few years. One major consequence of this new construction is the creation of more and more impervious areas, which has led to a significant increase in the frequency and depth of urban flooding in low lying areas of the major cities.

Cities in China, like most urbanized areas, rely on a network of conventional conveyance systems to remove runoff from urban areas and to discharge it into the large river systems. When rainfall events occur, the water surface in rivers quickly rises, thus slowing down or preventing discharge of runoff from urban drainage systems. This situation results in backwater conditions, creating flooding in low lying urban areas, generally in close proximity to the river.

Figure 1: Secretary General Yingxia Zhang delivers the keynote address at the inaugural conference.

Partners in Learning

In December 2013, General Secretary Xi Jimping presented the concept of a "Sponge City" which would feature natural accumulation, permeation and purification within urbanized areas and would promote ecological water drainage technology to solve urban inland inundation and non-point source pollution. The "Sponge City" concept would be achieved by using Low Impact Development (LID) strategies developed in the United States. LID is a new technology in China, and to learn more about LID techniques and standards, the China Water Industry decided to hold a conference and invite LID experts from the United States to present on their experiences.

Dr. Nian She of Shenzhen University on behalf of Yingxia Zhang, Secretary General of the International Sponge City Low Impact Development Engineering Practice Communication Institute, invited the author, Mr. Steven Trinkaus, to be a featured presenter at this first conference in Zhenjiang, China in May of 2015.

Mr. Trinkaus has designed many types of LID systems in Connecticut, including bioretention and permeable pavement systems. In addition to addressing water quality and groundwater recharge requirements associated with the ninety percent rainfall event, Mr. Trinkaus also has been able to use LID concepts to prevent increases in runoff volume for much larger, although infrequent, rainfall events from developed sites.

Figure Two - The event drew more than 400 attendees.

Mr. Trinkaus' presentation in China focused on using LID systems to mitigate the runoff volume impacts associated with larger rainfall events and marginal soil conditions. In discussing how one can use LID systems to lessen the effect of larger or more intense rainfall events, he explained that the most important aspect of designing this type of LID system is to determine the infiltration rate of the soil at the bottom of the proposed LID system.

Once this infiltration rate is known, the LID system, particularly bioretention, can be sized by fully containing the volume of the water above the soil media surface. The additional storage associated with infiltration into the underlying soil is not included in the design. The surface area of the bioretention system is increased, as well as the thickness of the stone reservoir layer through an iterative process using twenty-five to thirty percent of the observed infiltration rate in the hydrologic model, until the post-development runoff volume is reduced nearly to the desired level. Depending upon the infiltration rate, it may not be feasible to infiltrate all of the runoff volume from a larger event, but any reduction of runoff will lessen the frequency and extent of localized urban flooding.

As an example, if four inches of rain fell in a twelve-hour period and two inches of it could be infiltrated, the surface runoff would be reduced so that urban flooding would be lowered, depending upon the drainage area and the number of LID systems installed within the area.

Practical Examples

After the presentations, attendees visited some recent installations of LID systems in Zhenjiang. Participants observed some bioswales installed along a new roadway (Figures Three and Four), as well as a parking area with interlocking concrete permeable pavers and bioswales (Figure Five). All of the systems observed in the field were located in slow draining clay soils (0.25 centimeters an hour), so storage was provided at the bottom of the system to account for the soil infiltration rate.

The bioswale along the roadway featured an interesting process for encouraging runoff to enter the system. As seen in Figure Three, two different types of notches were cut into the granite curbing. Some are open (top left of the photo), while others are cut through the bottom of the curb. They are placed at very close intervals (less than half a meter), center to center.

When the author asked about the spacing, he was told that the engineers wanted ample openings to assure that all of the runoff from the adjacent roadway (four lanes wide) would enter the bioswale. This approach is conservative, and the technique is common when working with a new technology. Mr. Trinkaus suggested that the designers could consider wider openings (one meter) at a greater spacing

Figure Three - Bioswale along new roadway

(ten meters) on center, as the road has both a longitudinal slope as well as a cross slope. The design suggested by the author would be less work to create and to maintain over the long-term.

In Figure Four, attendees saw a second bioswale that is experiencing erosion at the inlet location, resulting in sedimentation at the bottom of the bioswale. In this case, the notches are very narrow, thus concentrating runoff from the road and increasing the flow velocity. Since the velocity is higher, it has a greater ability to erode the soil, which is what occurred in this example. This lesson and many others is all part of the learning curve when implementing LID systems.

Figure Five shows a small parking area of paver stones that are set on a base of porous

Figure Four - Bioswale with erosion at the inlet, resulting in sedimentation at the bottom.

concrete with medium-coarse sand placed between the pavers to facilitate infiltration. The porous concrete base is being used to provide additional structural support for vehicles. An underdrain from the pavers directs runoff to an underground storage system under the bioswale.

China clearly is embracing the concept of LID, but as with anything new, there is a steep learning curve. Fortunately, professionals in the United States are willing to share the lessons they have learned, lessons that the Chinese are receptive to and eager to learn.

At the request of Dr. Nian She of Shenzhen University, Mr. Trinkaus was invited back to the City of Zhenjiang at the end of June 2015. He was tasked with designing LID stormwater retrofits for the Zhiye New Town Area located in the eastern portion of Zhenjiang. The second article in this series explores this trip and will run in the April/May 2016 edition of the magazine.

Figure Five – Site with interlocking pavers and bioswale