SUSTAINABLE URBAN STORMWATER MANAGEMENT AND SPONGE CITIES

EDITORIAL BY ANGELOS N. FINDIKAKIS

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Conventional stormwater management in urban areas is based on the principle of draining all runoff by collecting it and directing it through a network of conduits and detention and temporary storage facilities to a central system for discharge into a nearby river, lake or the sea. As cities grow rapidly, the cost of the required infrastructure for the conventional approach to stormwater management has been rising. In addition, in many cases this approach has undesirable environmental impacts and it is unable to provide adequate protection from flooding. In response to growing economic and environmental concerns, alternatives to conventional stormwater management have emerged over the last thirty years aiming at minimizing the dependence on infrastructure by mimicking natural features. Such alternatives are based on the concept of managing rainfall close to where it falls, by replicating local hydrologic processes that existed prior to urbanization, facilitating infiltration to recharge local aquifers, and improving flow and water quality conditions in nearby streams. Emphasis is placed on small-scale, low-cost, decentralized measures as opposed to the high-cost, large-scale infrastructure required for conventional urban stormwater management. Examples are bioretention areas, pervious pavements, green roofs, water harvesting, vegetated swales and other landscape features. The underlying philosophy of these measures and techniques is known as Low Impact Development (LID). The term Green Infrastructure (GI) is also used in conjunction with the approach to water management that mimics the natural water cycle, focusing on actions that enhance landscape features such as wetlands restoration and tree planting. The LID principles, whose development started with the introduction of the bioretention technology in Maryland about thirty years ago, have now been adapted in many parts of the world. For example, in the United States the Environmental Protection Agency has been providing guidance used by many cities and counties to develop and implement their own LID programs. In the United Kingdom, the Construction Industry Research and Information Association (CIRIA) published the Sustainable Drainage Systems (SuDS) manual, which describes the new philosophy and approach to managing surface runoff and provides technical details and guidance for their implementation.

The largest scale program for the application of LID principles is the "sponge city" initiative launched in China in 2013 aimed at providing financial support and other incentives to cities to incorporate these principles in their approach to stormwater management. The use of the term "sponge cities" emphasizes the idea that a key element of the new approach to stormwater management is maximizing water retention and infiltration, with urban areas acting essentially as sponges. In 2015 the Chinese government selected 16 cities for the first phase and another 14 for the second phase of a pilot program, during which local authorities and agencies will be testing and exploring ways for dealing with the challenges posed by introducing a totally new way of thinking about stormwater. Issues that must be dealt with include the inertia of the conventional approach to stormwater management, the coordination of the work of the many parties involved in the program, securing financing for the required projects, and capacity building for adapting the program in cities under different climatic conditions. The article by Jia, Wang and Yu in this issue of Hydrolink presents an overview of the sponge city program in China and provides recommendations for its successful implementation on the way forward.

One of the first pilot sponge cities is Xiamen on the southeast coast of China. The article by Liu, Xiang, Shao, and Luan describes the initial implementation of the program in Xiamen, which includes the use of LID methods to control surface runoff with the goal of accommodating 70 percent of the rainfall in the city, measures to increase the storage capacity of the local river-lake system, control pollution sources, improve the local aquatic environment; and the construction of infrastructure to prevent urban flooding and waterlogging. To address water pollution, which is a major problem in the city, Xiamen is exploring innovative solutions such as the use of distributed wastewater treatment facilities and ecological improvements in drainage channels.

Many of the technical and institutional issues that affect the application of the sponge city concept have been identified and are being addressed in other parts of the world. An example is the research at the Grupo de Enxeñería do Auga e do Medio Ambiente (GEAMA) of the University of A Coruña in support of Water Sensitive Urban Design (WSUD) applications in different cities of Spain, as explained in the article by Puertas, Anta, and Suárez. The problems associated with the poor coordination between multiple agencies often involved in stormwater management and the resistance to the implementation of non-structural measures and land use regulation needed for integrated flood management are discussed in the article by Paoli. The same article then describes the steps taken to overcome these barriers in the city of Santa Fe, Argentina, which had experienced catastrophic flooding in the past.

International collaboration and knowledge sharing contributes to the advancement of sustainable urban stormwater management. Special meetings such as the International Low Impact Development Conference in Beijing earlier this year provide a forum for the exchange of ideas in this field. In addition, special bilateral agreements facilitate technology transfer between countries facing similar problems. An example is the recent collaboration agreement between China and the Netherlands for further development of the sponge city concept. The Dutch living in a severely flood-prone area have developed over the years elaborate water management systems for low-lying lands, a good part of which in the western part of the country have been developed into a large metropolitan urban area. The article by Mynett and Zevenbergen discusses how the two countries are planning to work together on integrated urban water management issues.

As more experience is gained on the application of the LID/GI principles and the number of cases demonstrating their effectiveness in providing flood protection and improving environmental quality grows, more cities around the world are expected to embrace them. International organizations and associations, like IAHR, have a role to play in facilitating the exchange of ideas for finding innovative and creative ways to overcome the many challenges associated with making the concept of sponge cities a reality.