Natural disasters in the United States, Caribbean, Nigeria, and Norway have led to catastrophic flooding and are highlighting the criticality of stormwater management. The impacts of these events on system resilience, asset management, and future infrastructure investments are being felt throughout the water industry. In fact, this year’s Strategic Directions: Water Industry Report found that climate change is overall becoming more of a concern for water utilities. From only 14.6 percent of respondents indicating climate change was affecting their sustainability efforts last year, that same figure jumped to 18.8 percent in 2017. 

So what can utilities and community leaders do to mitigate these impacts? Depending on geography and each region’s needs, the solutions will vary. Throughout the Asia Pacific region, however, several leading utilities are taking on innovative projects and deploying advanced stormwater management strategies. The proven impacts from these proactive endeavors carry lessons to be learned and adapted for other flood-prone regions.

Asia Pacific prioritizes stormwater management
Climate-related events and projections for population and economic growth are driving increased investment in stormwater management throughout Asia and neighboring regions. Ongoing urban development underscores the urgency of proactive strategies as availability of land to develop related infrastructure is becoming more and more limited. These factors, along with rising seawater levels and devastating rains in recent monsoon seasons, are contributing to mounting concerns about flooding.

Leading utilities in the region are designating capital expenditure toward these challenges, focusing on optimizing resources to bolster resilience while mitigating risks. Many are exemplifying the need to invest in diverse infrastructure and management strategies to holistically manage wet weather events, land use and changing economic/social environments. Findings from a Black & Veatch 2016 survey of stormwater utilities in the United States reflect these priorities, naming regulatory compliance, flood control, and community

Sustainable Water Supply
Turning Asia’s flood challenges into opportunities

Water utilities in the Asia Pacific region are leveraging integrated water resources in order to improve flood control and to increase water supply. James Currie, Prabha Kumar, and Andy Kwok of Black & Veatch report on current, proactive stormwater management strategies in Hong Kong, Singapore, and Australia that strengthen their resilience to climate change.

James Currie, Prabha Kumar, and Andy Kwok of Black & Veatch report on current, proactive stormwater management strategies in Hong Kong, Singapore, and Australia that strengthen their resilience to climate change.
The Happy Valley Underground Stormwater Storage Scheme (HVUSSS)

Underground solutions are integrating more intelligent storage schemes. For example, the Happy Valley Underground Stormwater Storage Scheme (HVUSSS) project in Hong Kong was developed to provide off-line flood retention in the Happy Valley catchment. The project included the construction of an inlet structure, twin cells diversion box culvert with overflow side weir system, an underground storage tank of 60,000 m³ and a pump house with a pumping rate of 5,400 m³/hr. A movable crest weir system and Supervisory Control and Data Acquisition (SCADA) monitoring of water and tidal levels ensure that the volume of water in the storage tank is adjusted in real-time to prevent stormwater overspill. The storage system facilitates collection of a considerable amount of surface runoff from sports pitches, irrigation water, and groundwater via the sub-soil drainage system as water sources of stormwater reuse, effectively enhancing Hong Kong’s flood relieving capacities. The Drainage Services Department (DSS) of the Government of the Hong Kong Special Administrative Region also plans to refurbish sports pitches with artificial turf as well as develop other community amenities aimed to enhance quality of living.

New technologies used at HVUSSS are now being considered for the Tai Hang Tung Stormwater Storage Scheme (THTSSS), Hong Kong’s first large-scale underground storage scheme, which alleviates flooding from the central Kowloon area.

Holistic Source-Pathway-Receptor approach in Singapore

With almost six million people packed into an island nation that measures approximately 50 kilometers (kms) across and 27 kms north to south, space is at a premium. Singapore’s national water agency, PUB has been taking a holistic approach for its stormwater management to enhance flood protection for the nation since 2012. Beyond implementing traditional Pathway solutions such as drain upgrading, new diversion canals, and centralized detention tanks, PUB also examined areas where stormwater runoff was generated (Source) and where the runoff can flow to (Receptor). Since 2014, PUB requires development sites larger than 0.2 hectares to install source solutions including detention tanks and retention ponds to slow down the runoff flowing into the public drainage system. The agency also works with developers on receptor solutions such as flood barriers, minimum platforms and reclamations levels to better protect developments from floods. These multi-pronged drainage solutions will introduce flexibility and adaptability to the nation’s drainage system.

Sponge cities in China

In China, flooding in major cities such as Beijing has overwhelmed drainage capacity and disrupted city services. To enhance the country’s infrastructure to better cope with torrential rains and increase water availability for other purposes, the State Council issued a guideline in October 2015 on building “sponge cities.” The guideline named 16 cities in which buildings, streets and wetlands were built to absorb, store and release rainwater, like a sponge, to better serve the country’s urban development. “The aim of constructing such cities is to flexibly control the rainwater, address waterlogging in cities, thus achieving a city development mode during which the rainwater can be naturally stored, permeated and purified,” according to the guideline.

Under the guideline, cities in China will collect and use 70 percent of rainwater, with 20 percent of urban areas mandated to meet these targets by 2020. The goal proportion of rainwater collected will increase to 80 percent by 2030. Collaboration at all levels of government with private developers on receptor solutions including detention tanks and retention ponds to slow down the runoff flowing into the public system.

The Next Frontier: Valuing stormwater as a service

Distinct stormwater service tariffs in the Asia Pacific region would help to fund and prioritize stormwater infrastructure and management strategies. Key factors that would facilitate the success of integrated stormwater management strategies include the following:

Public awareness

Stormwater services are as critical as water and sewer utility services in ensuring public health, safety, and quality of life. Therefore, for sustainable and resilient stormwater management, it is critical to enhance public awareness of (1) the value of stormwater management; (2) the need for dedicated funding; and (3) effective approaches to equitable cost recovery.

Sustainable stormwater funding

A user-fee funded stormwater program has a greater potential to build fiscal and operational resilience through revenue stability, a dedicated funding stream, and a stronger nexus between stormwater management costs and user fees.

Equity of cost recovery

Stormwater user fees are typically based on the imperative area, which directly correlates to the demand a property places on the stormwater system. However, taxes are often based on aspects such as a property’s value or the level of sales, which have no direct correlation to the stormwater contributed to the system.

According to Black & Veatch’s 2016 Stormwater Utility Survey, a more equitable cost recovery can be achieved when utilities strive to recover their full cost of stormwater service through stormwater user fees rather than recover costs through a combination of “user fees,” and other “non-user fees” such as taxes. When the fee reflects the full cost of a service, customers can better understand the true costs a utility incurs in providing that service.

Onsite stormwater management

Establishing a stormwater credits and incentives program in conjunction with a dedicated stormwater user fee will give utilities the ability to encourage and incentivize decentralized private stormwater management practices that reduce the stormwater contribution to the public system.

THE AIM IS TO FLEXIBLY CONTROL THE RAINWATER.

The Happy Valley Underground Stormwater Storage Scheme project in Hong Kong provides off-line flood retention. Photo by Black & Veatch


Integrated Water Management

developers will be necessary to meet State Council guidelines and oversee construction efforts in new districts, industrial facilities and throughout communities. Older towns and neighborhoods will also require renovation as part of the widespread initiative.

Connecting water with communities in Singapore and Australia

Singapore PUB’s Active, Beautiful, Clean Waters (ABC Waters) Programme was launched in 2006. The program integrates the country’s pervasive network of waterways and bodies of water with the surrounding environment to enhance the recreational uses of streams, rivers, and lakes. The Programme designs and encourages communities to connect and enjoy Singapore’s waterways so that, in turn, help keep the waters clean.

In Melbourne, Australia, investments to upgrade retarding basins are helping reduce flooding. The basins, which are low-lying areas of land set aside to store rainfall, are progressively becoming vital to the city’s drainage system. The retarding basins are critical in urban areas as pavements, driveways, and other hard surfaces restrict infiltration and create more stormwater run-off. Like in Singapore, the retarding basins serve the community as recreational areas.

Building a business case for stormwater funding

Adequate stormwater funding will always be a common roadblock, and the absence of dedicated stormwater service tariffs in the Asia Pacific region makes financing infrastructure and management strategies particularly difficult. In case studies from the Asia Pacific region and elsewhere, utilities are evaluating other parts of their business model to help creatively fund necessary stormwater projects.

Community engagement. Stormwater services are as critical as water and sewer utility services in assuring public health, safety, and quality of life. Stormwater utilities can take a nod from similar efforts from other water utilities to enhance public awareness of the value of stormwater management, the need for dedicated funding, and effective approaches to equitable cost recovery.

Implementing user fees. A user fee funded stormwater program has a greater potential to build fiscal and operational resilience through revenue stability, dedicated funding stream, and a stronger nexus between stormwater management costs and user fees.

Cost recovery mechanisms. According to Black & Veatch’s 2016 Stormwater Utility Survey, a more equitable cost recovery can be reached when utilities strive to recover their full cost of stormwater service through stormwater user fees rather than recover costs through a combination of “user fees,” and other “non-user fees,” such as taxes. When the fee reflects the full cost of a service, customers can better understand the true costs a utility incurs in providing that service.

Onsite stormwater management. Establishing stormwater credits and incentives program in conjunction with a dedicated stormwater user fee will give utilities the ability to incentivize decentralized private stormwater management practices that reduce the stormwater contribution to the public system.

Moving forward

The trends in Asia clearly point to stormwater management opportunities, where leveraging integrated water resources management proactively can help mitigate risks from future flooding events. In many of these initiatives, there is also a longer-term sustainability play, which helps achieve multiple goals and supports the business case for project development. In each of the aforementioned case studies, success has, and will continue to, rely on coordination with community stakeholders to ensure proper land and water use and identify the most ideal solutions for each community.

Authors’ Note

James Currie is a director of Black & Veatch Australia, based in Melbourne. Andy Kuok is a director of Black & Veatch Hong Kong, based in Hong Kong. Prabha Kumar is a director in Black & Veatch management consulting team, based in New York, USA. This article is adapted from Black & Veatch’s 2017 Strategic Directions: Water Industry Report, released in June. For the full report, visit www.bo.com/reports.

The Happy Valley Underground Storage Scheme facilitates the collection of surface runoff to alleviate flooding from the central Kowloon area. Photo by Black & Veatch

The absence of dedicated stormwater service tariffs in the Asia Pacific region makes financing infrastructure and management strategies particularly difficult.

Six stormwater management strategies to keep Asia dry

1. Expansion and improvement on existing drainage systems (pipe and/or river system) to increase the flow capacity and facilitate more effective collection of surface runoff
2. Interception and diversion of storm flows from upland catchments (e.g., tunneling works) for direct discharge into the sea, thus avoiding the storm flows from overloading the downstream drainage system
3. Creation of stormwater storage facilities to temporarily retain storm flows from upland catchments to attenuate the peak runoff loading on the downstream drainage system
4. Stormwater pumping schemes to pump storm flows from flood-prone areas directly to the sea
5. Village flood protection schemes comprising a protective bund to stop storm flows from entering into low-lying villages and stormwater pumping stations to pump away storm flow collected within the villages
6. Creating stormwater tariffs that reflect the true costs utilities incur in providing stormwater services.