WRC Project K5/2441

Regional Water Sensitive Urban Design Scenario Planning for Cape Town using an Urban (geo)hydrology Model

Led by Delta-h Water Systems Modelling

In partnership with Hydrologic Consulting, and the City of Cape Town (advisors)

Water Research Commission project K5/2441, "Regional Water Sensitive Urban Design Scenario Planning for Cape Town using an Urban (geo)hydrology Model", commenced in April 2015 and was awarded in response to an unsolicited proposal submitted in 2014. Below describes the background motivation for the project, and what the project seeks to achieve:

Motivation

Cape Town, like other urban areas, has impacted significantly on its natural water systems: reticulated water is imported to the urban area from the neighbouring Berg catchment; runoff within the urban area is captured and delivered to canalized water courses and storm water drains, and eventually to oceanic discharge points; infiltration is dramatically reduced by hard surfaces; and water quality in the urban environment is affected from a variety of sources.

Cape Town also experiences several water-related challenges, some of which are a result of these urban influences on the natural water systems. Large areas of informal settlements do not have access to waterborne sewage and hence storm water can be poor quality. Informal settlements in low-lying areas routinely experience flooding from a high and rising groundwater table (DWAF, 2008). The Cape Flats Aquifer underlies the vast majority of the urban area and small-scale farmers in the Philippi Farms area are dependent on the resource for their livelihoods. Produce from this area has a significant contribution to food security of low-income groups in Cape Town (EMG, 2014). The aquifer could also be considered an important resource for meeting future demand to the urban Cape Town, yet the groundwater quality is considered one of the key hindrances as there is concern for impact from various pollution sources (Flower, 2014). Surface water resources have also been impacted: "Significant stretches of most rivers have been canalised, have poor water quality, modified flows and abundant alien fish and plant life. The ecological functioning and delivery of goods and services by these rivers have been severely reduced" (DWAF 2005).

Recognizing the impact that urban areas have on the water cycle, Water Sensitive Design (WSD) is an approach that aims to manage all parts of the urban water cycle (from water supply to wastewater treatment and storm water management) in a way that mimics natural hydrological regimes, protects the natural environment, and reduces negative impacts of flooding and pollution. Aware of the impact that the urban area has had on water resources, and the water-related challenges that face Cape Town, the City has embraced the principles of WSD, and is working to promote them throughout Cape Town (CCT, 2014). The City has established an internal WSD group that is cross-cutting across the relevant departments (Water and Sanitation, Roads and Drainage, Infrastructure) (Flower, 2014). To date, the group has developed and implemented a policy requiring new developments to use surfaces that minimize contribution to storm water drains and maximize infiltration.

However, the net effect on surface and groundwater systems, and hence the feasibility of, transitioning to optimal implementation of WSD across Cape Town ("up-scaling WSD"), has not been assessed. As WSD aims to mimic the natural water cycle, the general assumption is that there would be net benefit. But, not all WSD interventions will work everywhere. For example, increasing infiltration in particular areas may increase flooding by rising groundwater levels, or encouraging greater use of groundwater for garden watering may impact negatively on groundwater availability to agricultural users in the Philippi area.

This project intends to carry out a quantitative assessment of the natural system feasibility i.e. the impacts and benefits of "up-scaled" WSD on groundwater and surface water, and thus determine the most appropriate scenario(s) for "up-scaled" WSD. Numerical surface and groundwater models will be established and coupled for this purpose, with representation of urban influences on surface and groundwater. It is intended that the outcomes can guide planning and implementation of WSD.

In summary, the project aims to:

1. Quantify the water balance under optimal implementation of WSD
2. Determine the impact and feasibility of up-scaled WSD using a numerical urban (geo)hydrology model
3. Determine the optimal design for up-scaled WSD using a numerical urban (geo)hydrology model
4. Test and demonstrate the use of an urban (geo)hydrology model for WSD scenario testing

WSD Scenarios

Various stakeholders came together for a project workshop in May 2015, at which possible WSD futures for Cape Town were developed, and translated into the following 7 model scenarios:

1. Conjunctive use of treated effluent and groundwater
2. Managed aquifer recharge for food security
3. Up-scaled groundwater use for garden watering
4. Optimum abstraction to minimise flooding
5. The impact of up-scaled implementation of WSUD policy
6. Reduced storm water contribution from informal settlements
7. Ecological restoration of surface water

The feasibility (impact and benefit) of these scenarios will be tested in a numerical urban (geo)hydrology model.

Numerical modelling

The models required are currently being constructed, and results are expected later in 2016. The final project report is due in October 2016.