Quantitative Assessment of Future Sustainability Performance in Urban Water Services using WaterMet²

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Extended abstract

Urban water services are likely to face challenges in the future, mainly due to population growth, climate change, increasing urbanization and ageing infrastructure. These factors are expected to impose significant strains on the performance of urban water services. This would subsequently decrease the capacity and quality of services in the urban water system (UWS) and thus negatively affect different dimensions of the sustainability framework (i.e. economic, environmental, social, asset and governance) presented by Alegre *et al.* (2012). Performance of future sustainability in the UWS can be evaluated by using simulation of metabolism-based processes in the urban water cycles over a pre-specified horizon. The WaterMet² model developed in the TRUST project quantifies the metabolism-based performance of the integrated UWS (Behzadian *et al.* 2014a). The integrated modelling of the UWS implies the whole processes and components in an urban area related to water flows as a complex and interrelated system. A mass balance approach of water is followed within the system. Figure 1 illustrates the main flows and storages modelled in WaterMet² comprising of four main subsystems.

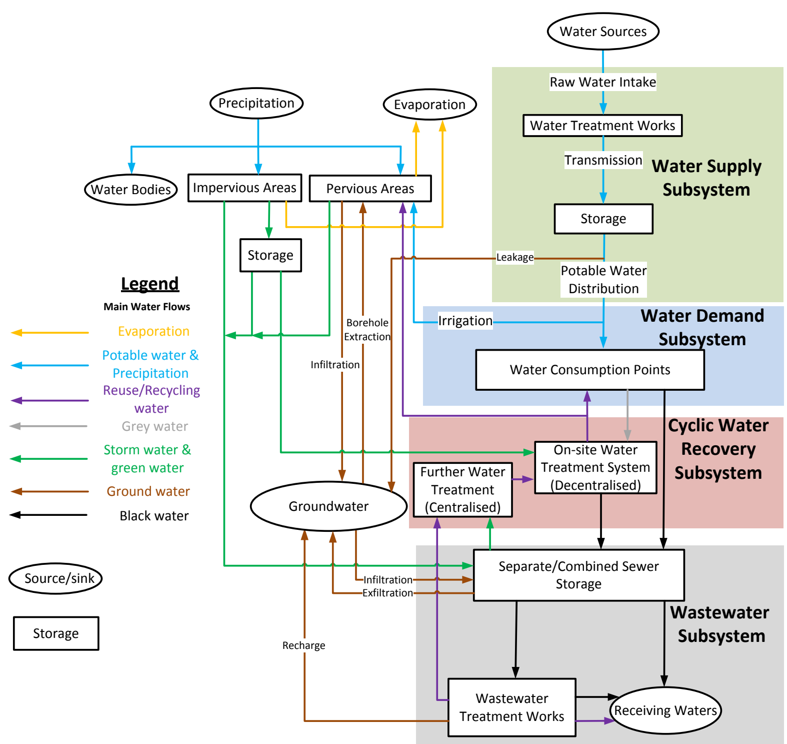

Figure 1 Main flows and storages in the WaterMet² metabolism model (Behzadian *et al.* 2014a)

WaterMet^2 enables the calculation of quantitative key performance indicators (KPI) of urban water services over a long-term planning horizon. These KPIs encompass various aspects of water systems sustainability such as cost (economic), GHG emissions (environmental), water supply reliability (social) and leakage (assets) WaterMet^2 can support various intervention strategies by calculating the relevant quantitative KPIs which can be used for a multi-criteria decision analysis in a decision support system framework. The overall KPI values (calculated on a per-capita basis) obtained from the UWS can be used for comparing sustainability indicators of water services among different cities. The comparison of KPI values in the main UWS components reveals the critical components for which appropriate intervention options should be undertaken.
The capabilities of developed WaterMet^2 model are demonstrated here in two real-world case studies of UWS (i.e. a northern European UWS and Kerman UWS in Kerman city, Iran) shown in Figure 2. Further information of modelling the case studies can be found in Behzadian *et al.* (2014a) and Behzadian and Kapelan (2014) for the northern European case and Nazari *et al.* (2014) for Kerman case.

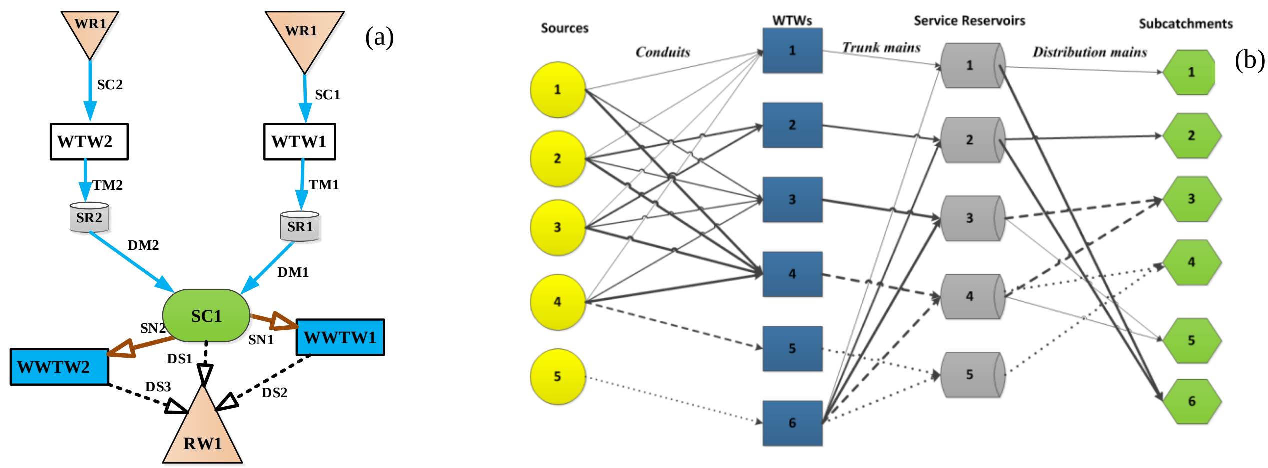

Figure 2 Schematic representation of main components in the WaterMe^2 model for: (a) Northern European city UWS (b) Kerman UWS; Note that WR=water resource, SC=supply conduit; TM=trunk main; SR=service reservoir; SN=sewer network; DS=; WWTW=wastewater treatment works; RW=receiving water;

The WaterMet^2 model is able to successfully simulate the trend of metabolism-based performance in both case studies over a long-term planning horizon. Results also show a comparison of the most critical components with the highest contribution to each KPI value between the two case studies (Behzadian *et al.* 2014b and Nazari *et al.* 2014). This can lead to an effective exploration of potential intervention strategies in order to alleviate the negative environmental aspects and improve the social and asset-related aspects of the future sustainability without incurring high capital investments and operational/maintenance expenses.

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