USING SOURCE FOR WATER AND CATCHMENT MANAGEMENT IN THE AUSTRALIAN CAPITAL TERRITORY

Source models support strategic planning, policy development, catchment and water resource management in the Australian Capital Territory

The models underpin the Australian Capital Territory (ACT) Water Strategy 2014-44 – Striking the Balance and support the ACT Government to meet its obligations under the Murray-Darling Basin Plan 2012.

Together with eWater, the ACT Environment, Planning and Sustainable Development Directorate (the Directorate) have embarked on a series of initiatives to upgrade the ACT's Source models.

Improving water quality through wetlands like this is one in the Canberra suburb of Bonner is a central part of the ACT Water Strategy
(credit: Danswell Starrs, ACT Environment, Planning and Sustainable Development Directorate)

Audit of water models

The Directorate use several different Source models to inform strategic planning and decision-making regarding land use planning, urban development and climate change on water quantity and quality and the operation and maintenance of water infrastructure.

eWater was engaged to audit the Directorate's existing Source models to ensure they were fit-for-purpose and could address emerging needs, including the ability to:

- explore different policy, planning and management actions and assess potential impacts on the natural environment and water resources
- predict impacts of land development decisions on water resources and assess mitigate measures
- test new ways of operating water infrastructure
- predict future environmental states to inform policy and management decisions, such as environmental condition and future water supply/catchment yields.

The audit identified several issues with the existing models that limited their ability to meet the current and future needs of the ACT Government. eWater recommended a substantial rebuild of the models, including:

- Consolidating the existing nine models.
- Utilising human-readable input sets and data sets to run scenarios, rather than individual models.
- Reconfiguring storages and lakes in the catchment model to better represent how they operate.
- Reconceptualising and recalibrating the rainfall-runoff models.
- Incorporating the ACT water supply system.
- Establishing a current conditions baseline case for scenario assessment.
- Preparing and justifying a baseline scenario for the comparison of land use change scenarios.

Model rebuild

Following on from the audit, eWater was engaged to rebuild the ACT's catchment and planning models.

eWater built two new Source models for the ACT, a catchment and a planning model. Model performance has been improved by reducing the number of sub-catchments outside of the ACT. The new models use LASCAM (Large-Scale Catchment Model) rainfall-runoff models, allowing for physically based assessments of hydrological impacts of land use change. The catchment model now incorporates Canberra's water supply system, including storages. The consolidation of the models allows for different policy and management options to be implemented by Scenario Input Sets.

In addition to the model re-build, the project also included collaborating with the ACT Office of the Chief Digital Officer to the integrate Source models with the ACT Government Water Data Management System. This brings two main benefits, it streamlines the transfer of data and model outputs and adds dashboarding capabilities to improve the presentation of model outputs. Integrations was achieved through a customised plug-in, developed by the eWater Software Development Team.

eWater also provided customised training to Directorate staff, to ensure they understood the Source model and were able to support its future development and application.

The updated models will support the ACT Government to better manage urban stormwater and flooding risks (credit: Danswell Starrs, ACT Environment, Planning and Sustainable Development Directorate)

Implementation

The Directorate is using the models to inform a wide range of water and catchment management activities, including to:

- support investment in catchment remediation and investment, by helping identify which areas will lead to the greatest
- improvements in water quality and/or water yield
- investigate Integrated Catchment Management options across the ACT and the greater region
- understand stormwater and flooding risks in urban areas
- forecast future water supply and demand scenarios
- compare likely outcomes from different water efficiency initiatives

investigate alternative water supply options,
such as treated effluent, grey water and stormwater for consumptive and
non-consumptive uses
test different options to improve the management
of rivers and lakes, to promote recreational use and reduce risks to public
health.

Acknowledgements

This case study was prepared in collaboration with the ACT Environment, Planning and Sustainable Development Directorate.

ACT Government
Environment and Planning

MELBOURNE WATER – IMPROVING WATER SECURITY WITH INTEGRATED WATER RESOURCE MANAGEMENT

For 130 years

Melbourne’s catchments and water infrastructure have provided for the water needs of Melbourne’s growing population and industry.

Population growth and climate change are putting increasing pressure on Melbourne’s traditional water supplies. Melbourne Water is working with retail water company customers to adopt a more integrated approach to delivering water services, with the aim of a city that is water sensitive, sustainable and liveable.

By adopting an Integrated Water Resource Management (IWRM) approach, Melbourne’s water companies are investing in a range of present or future innovative water management options, at the household, street, and suburb development scale, including:

- recycling and reusing wastewater for things like agriculture, firefighting and dual-pipe systems that provide recycled water to homes and businesses for non-potable use like toilet flushing and watering gardens
- recycling wastewater on site
- capturing more stormwater for watering parks and sporting fields
- refilling groundwater aquifers with stormwater or recycled water, for later extraction and use or to support natural environments

The IWRM approach requires a complete rethinking of the analysis of water system management. Traditional water system models are limited in their ability to analyse IWRM. Recognising this, Melbourne Water, with the support of eWater, has undertaken significant work to modernise their water resource models and to develop new tools to assess the benefits of IWRM.

Melbourne Water is increasing its use of recycled water

A new approach to water resource modelling

Work has focused on three key areas:

- upgrading the bulk water supply infrastructure (headworks) model
- integration with local water supply and demand models
- new tools for improving model performance.

Source Headworks Model

For the past 25 years, Melbourne Water has used the REALM (REsource ALlocation Model) Headworks System Simulation Model. The REALM model runs on a monthly time step and is used mostly for long-term water planning. Traditional monthly timestep water resource models like REALM focus on the behaviour of the centralized bulk water supply system and have limited ability to address emerging modelling needs, such as:

Maroondah Reservoir

Melbourne Water is reducing its reliance on traditional water supplies.

- To what extent can small scale alternative water sources, such as greywater, recycled water or stormwater, be utilized?
- What is the best mix of centralized and decentralized supply options?
- How will water use change with different policy options or new approaches?

Where are the best locations for, or uses of decentralized systems?
How to leave more water for healthy river flows and reduce stormwater pollution ?

Working with eWater, Melbourne Water is in the process of replacing the REALM model with a Source model. The new model can run on both a monthly and a daily time step and includes headworks infrastructure and water supply catchments. Catchments have been added to give a better assessment of both the amount of water flowing into the reservoirs and the quality of that water. This will be important for understanding the impacts of changes in the catchment, for example after bushfires or how climate change might impact runoff and streamflows.

The monthly time step mode has been kept to support long-term water management decisions, with important improvements, including customised water allocation rules to determine allocations for primary entitlement holders, such as the water retailers and new optimization tools help assess operating strategies, to find the optimal trade-offs for different management objectives, such as cost and security of supply.

The daily time step mode supports Melbourne Water to manage environmental water in the regulated streams and to meet streamflow requirements in unregulated streams. It also facilitates smaller scale IWRM modelling and helps to better understand the potential risks to water quality. Importantly, the model has been designed to easily switch from a monthly and daily time step, allowing for better integration between short, medium and long-term operating plans.

Headworks models are designed to find the best way to meet water demands and inform the reliability of water supply. As such the representation of demands in the model is equally as important as the representation of water supplies. An innovative feature of the new model is the incorporation of spatial geographic data to better understand demand. Spatial data includes population data, dwelling types and land-use. Ultimately, it will help estimate changing water demand and the potential impact of alternate water supplies at the suburb scale.

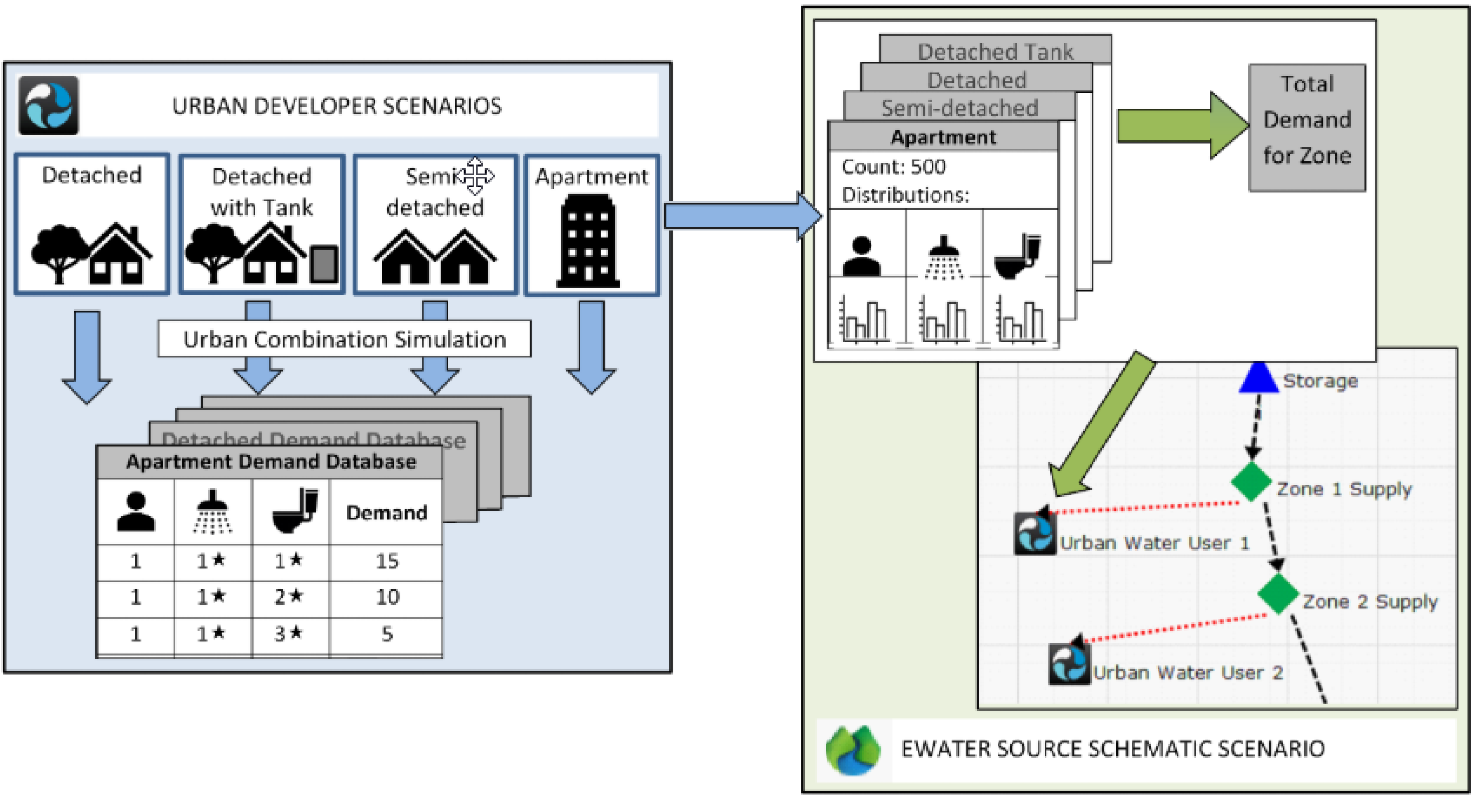
Urban Developer in Source

The upgrades to the headworks model bring a wealth of new features to support IWRM but they do not fully take into account potential alternative water supplies, such as rainwater, stormwater and wastewater, or localized demands. A second component of the project has been to incorporate eWater's Urban Developer tools into the Source platform. This allows local small scale water sources and demands to be considered in the context of overall large scale supply options.

Urban Developer can now estimate urban water demands based on a suburb's characteristics and how they might change, for example with population growth, dwelling type, the adoption of Water Sensitive Urban Design approaches or alternative water supplies like rainwater tanks. The approach was tested across four catchments and the model calibrated for the Melbourne region. The Urban Developer plugin to Source was developed to feed the outputs of the Urban

Developer demand model into the Source Headworks Model.

An important aspect of the work was looking for more sophisticated ways to estimate demand and to differentiate between indoor/outdoor water use, and commercial and industrial water use. For example, we can now test if including information on household income or lot size provides more accurate water use estimates.



The Source Urban Developer plugin allows detailed analysis of urban water use

Improving model performance

Running large, complex models for different scenarios takes a lot of computing power and time. Melbourne Water uses optimization tools to inform water resource decisions by assessing how to maximise the reliability of supply and reduce delivery costs. With the enhanced model functionality, it would take a month to process Melbourne Water’s optmisation runs on a standard computer, even longer if new requirements, such as environmental flow delivery and integrated demand management options were included.

Working with eWater, a cloud-based run manager was set up to enable large numbers of simulations to be run across hundreds of virtual machines. A common web browser interface gives access to different run locations, including a local (single PC) and the Cloud (hundreds of virtual machines). Run times have been reduced to a number of hours.

In addition to saving time, the system is easy to install and use, does not require specialist knowledge and reduces the costs associated with owning and maintaining significant amounts of hardware. A particular advantage is that jobs can be tested locally before launching on the cloud, reducing the risk of minor errors negating the final results and the modellers can continue working on other projects while the simulation is being run.

Following the initial success, work is underway to expand the type of jobs that can be run on the cloud and to make Source and the optimisation tool, Insight, more cloud friendly.

Conclusions

The project has delivered significant improvements to Melbourne Water’s modelling tools. Innovative projects like these require flexibility, new ways of thinking and a high degree of collaboration. eWater and Melbourne Water have worked closely together throughout the process, proposing and testing different methods, refining and adapting along the way. A key aspect was including Melbourne Water in the software development process and allowing them to work directly with eWater to scope and prioritise software improvements.