Water Sensitive Cities – Science-Policy Partnership

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ABSTRACT

"Water Sensitive Cities" is an emerging concept for considering the total water cycle of cities as an integral part of the urban form and culture. Transition to a water sensitive city requires significant changes to the way in which water is planned, managed and used in cities. Government policy for water resource management, environment protection and land use planning and development plays a key role in shaping the practices that define a water sensitive city.

Victoria's Water Sensitive Cities Science-Policy Partnership was established in December 2010 to provide a pathway between Monash University's Centre for Water Sensitive Cities and the policy development of the Victorian Government's Department of Sustainability and Environment. The partnership aims to support the application of science to inform policy decisions for the development of urban water policy.

The partnership has examined the science and policy frameworks for the environmental health of urban waterways and its interactions with stormwater management. The key findings recommend clarification to the objectives for stormwater management, identify gaps in the existing policy frameworks and identify needs for further science to support the implementation of reforms.

KEYWORDS

Water sensitive cities; science policy partnership; integrated urban water management; policy reform.

INTRODUCTION

This paper describes a science-policy partnership for water sensitive cities that has been established between the Victorian government's Department of Sustainability and Environment and Monash University.

Victoria is Australia's most densely populated state, and has a highly centralised population, with almost 75% of Victorians living in Melbourne, the state capital and largest city. TheVictorian Parliament makes laws regarding water resource management (Water Act 1989), the protection of the environment (Environment Protection Act 1970), the development and use of land (Planning and Environment Act 1987) and other matters related to natural resource management.

Melbourne's water resource systems development

Melbourne was founded in 1835 and developed rapidly during the 1850s gold rush period. The city's first water supply systems commenced in 1857. Brown *et al* (2009) describe the development of Melbourne's water systems as a series of city states of Water Supply,

Sewered, Drained and Waterway cities and suggest a forward trajectory to the Water Cycle and Water Sensitive Cities.

The Water Supply City is characterised by supply hydraulics to establish safe and secure water supply. The Sewered City protects public health through the provision of a separate sewerage system. Flood protection through drainage systems characterises the Drained City. In contrast, the Waterways City values the social and environmental amenity provided by urban waterways and requires pollution control and environmental management to protect and enhance these values. The water supply and demand constraints from managing limited natural resources leads to the integration of different sources of water (with different 'fit for purpose' potential uses) into a Water Cycle City. A Water Sensitive City takes the integration of water cycles further to link with other environmental aspects (for example, urban microclimates) and social dimensions (for example, the liveability benefits of alternative urban design for stormwater systems).

As illustrated in Figure 1, Melbourne's journey through the city states is reflected in the pattern of development of the city. While all parts of Melbourne have the characteristics of a Water Supply City, progressively fewer parts of the city reflect the more advanced city states with only limited parts of the city having Waterways and Water Cycle characteristics.

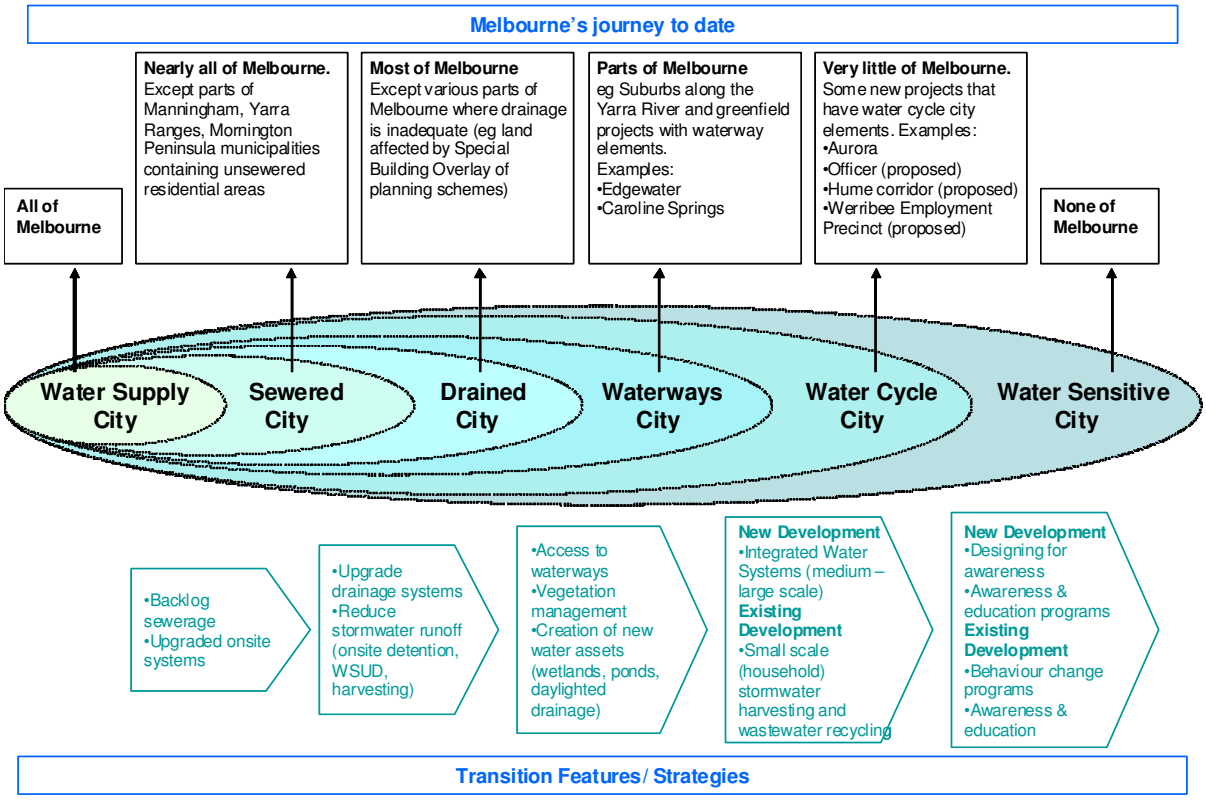

Figure 1 The status of various parts of Melbourne against the city states of Brown *et al.* (2009) and the programs and activities that are associated with each transition.

Recent developments progressing Melbourne towards a Water Sensitive City

Much of Melbourne's progress in the last decade or so towards being a Water Sensitive City has been through the development of stormwater and recycled water as alternative water sources, coupled with the application of water sensitive urban design that improves the environmental management of stormwater systems.

Some of the tangible milestones in this journey are:

Improved stormwater management

- Publication of Best Practice Environmental Management Guidelines for Urban Stormwater (Victoria Stormwater Committee 1999). (Available from the CSIRO website http://www.publish.csiro.au/nid/197/issue/3822.htm)
- Victorian Stormwater Action Program (2000-2006) to 'improve the quality of Victoria's water environments through better environmental management of urban stormwater' (EPA 2007).

Alternate water source development

- The Stormwater and Urban Water Conservation Fund (established in 2004), and the subsequent Stormwater and Urban Recycling Fund for projects that demonstrate innovative approaches to reducing demand for potable water. (see http://www.water.vic.gov.au/saving/towns/surf)
- The Central Region Sustainable Water Strategy (State of Victoria DSE, 2006) established policy commitments and targets for potable water substitution. (see http://www.water.vic.gov.au/programs/sws/central)

Planning and development

- 5 star building standards (introduced in 2005), that require installation of either a rainwater tank or a solar hot water system. (see http://www.sustainability.vic.gov.au/www/html/2035-5-star-homes.asp)
- Clause 56.07 of the Victoria Planning Provisions (introduced in 2006) require integrated water management for residential subdivisions. (see http://www.epa.vic.gov.au/water/stormwater/stormwater_clause56.asp)
- Local planning provisions based on a model proposed by the Association of Bayside Municipalities Clean Stormwater a Planning Framework (Kay *et al* 2004) (available from http://abmonline.asn.au/index.php?option=com_content&id=79&Itemid=64)

Water scarcity

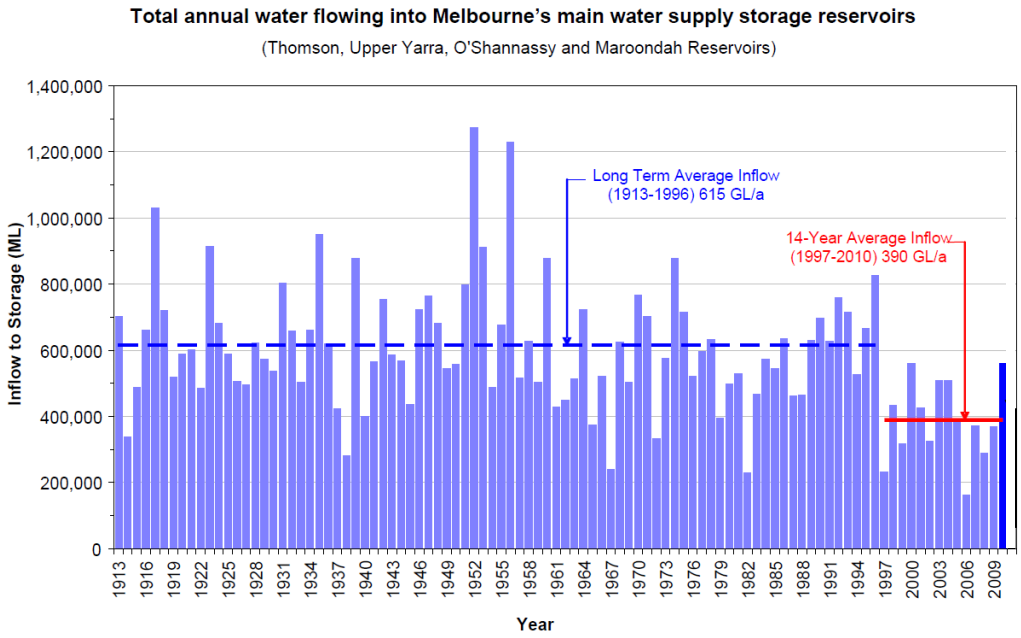

Figure 2 Total annual inflow into Melbourne's main water supply storage reservoirs. (source Melbourne Water).

The development of, and progress, towards a water sensitive city has proceeded in an environment of growing water scarcity. As illustrated in Figure 2, Melbourne has experienced an extended period of low rainfall and reduced runoff into Melbourne's main water supply storage reservoirs. This has focussed attention on the potential for stormwater and recycled wastewater to be developed as resources to meet non-potable water needs and demands.

While the 2010-2011 summer has provided relief from drought, through an intense *La Nina* event, water security remains a high priority. The prospect that climate change, coupled with increasing population growth and urban development, will continue to put pressure on water supplies makes the ideas of water sensitive cities particularly attractive.

Policy context

Victoria elected a new Government in November 2010 that, as part of its election platform policy for water (Victorian Liberal Nationals Coalition Plan for Water, 2010), committed to a Living Melbourne: Living Victoria plan that aims to:

- Establish Victoria as a world leader in liveable cites and integrated water cycle management with a visionary plan to make our urban landscapes more sustainable and liveable.
- Drive generational change in how Melbourne uses rainwater, stormwater, and recycled water to provide better water service and reduce Victoria's footprint with regard to energy and water use.
- Drive integrated projects and developments in Melbourne and regional cities to use stormwater, rainwater and recycled water to provide Victoria's next major water augmentation. This water will be used to replace drinking water for non drinking purposes such as for sporting ovals, streetscapes, urban parks and gardens, water features and third piping systems in homes.

This policy provides a political commitment for the development of the "Three Pillars of Practice", as described by Wong and Brown (2009), which characterise water sensitive cities.

Water sensitive cities science

Monash University's Facility for Advancing Water Biofiltration and the National Urban Water Governance Program have provided scientific understanding that has supported the transition towards water sensitive cities. The Centre for Water Sensitive Cities (CWSC), established in February 2010, consolidates these programs with key researchers from the faculties of Arts, Engineering, Science and Business and Economics to form a multi-disciplinary team and a stronger understanding of the complexities of water sensitive cities.

The research activities of CWSC are directed at the following three main defining themes of a water sensitive city, reflecting Wong and Brown (2009)'s three pillars of practice:

- ***Cities as Water Supply Catchments*** Key research areas include (i) urban stormwater as a cost-effective and safe water resource; (ii) integrated water management systems that optimise different local water opportunities to deliver the best value to communities; and (iii) opportunities for utilising waste heat (eg from commercial and/or industrial systems) for treatment of stormwater and wastewater for reuse.
- ***Cities providing Ecosystem Services*** Key research and development activities will develop technological and architectural designs of urban landscapes and green infrastructure that link urban water systems, particularly stormwater treatment and harvesting, with microclimates and the mitigation of urban heat island effects.

- ***Building Social and Institution Capital for Sustainable Urban Water Management*** The CWSC will examine the transformational pathways required to enable communities, institutions and policy-makers to further embrace sustainable practices.

SCIENCE-POLICY PARTNERSHIP FOR WATER SENSITIVE CITIES

Victoria's journey towards water sensitive cities has a legacy of been assisted by the engagement between government agencies, water utilities and academic research centres. For example, the development of the Best Practice Environmental Guidelines for Urban Stormwater Management (published in 1999) grew from a collaborative effort of Victoria's Environment Protection Authority, Melbourne Water and the former Co-operative Research Centres (CRCs) for Catchment Hydrology and Freshwater Ecology. The Science – Policy Partnership has been developed to build on the strengths of this collaborative approach and ensure that water sensitive cities policy development continues to draw on sound scientific evidence and is stimulated by emerging scientific ideas.

As illustrated in Figure 3, scientific knowledge and understanding can influence practice and the delivery of social, environmental and economic outcomes through building industry and community capacity and through policy development.

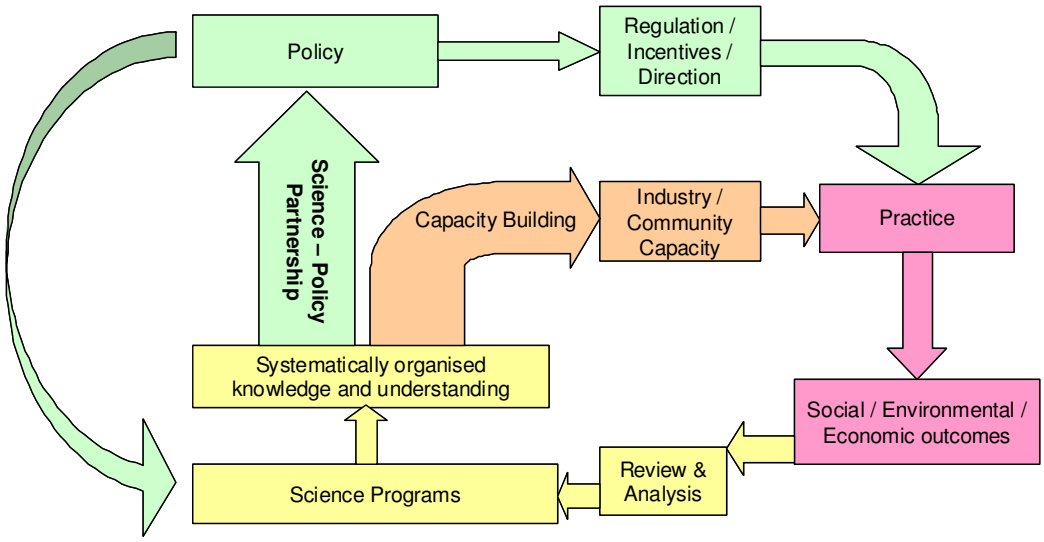

Figure 3 A conceptual framework for linking science programs, policy development and capacity building to practice and the delivery of social, environmental and economic outcomes.

The Science-Policy Partnership was established in December 2010 to provide a pathway from CWSC to practice, through the policy development of the Victorian government's Department of Sustainability and Environment (DSE). This pathway is complemented by a capacity building program ('Clearwater'), a separate partnership between CWSC and Melbourne Water to build industry and community capacity.

The purpose stated for the Science-Policy Partnership is "to support the application of science to inform policy decisions for the development of urban water policy particularly related to the development of water sensitive cities in Victoria".

The Science-Policy Partnership has a broad scope that allows it to work across a wide range of areas that affect the development of water sensitive cities:

- Physical sciences and engineering– eg hydrology, water treatment
- Climate sciences – eg urban heat island effects and microclimates, adaptation to climate change
- Social sciences – eg institutional governance, socio-political systems
- Environmental sciences
- Economics
- Planning and urban design

The partnership is formalised through a Memorandum of Understanding (MoU) between CWSC and DSE. The MoU sets the key components of the partnership's governance and resources. Under these arrangements, the program is established for three years with DSE providing a Program Director (seconded from DSE to CWSC) and annual program funding. The CWSC houses the program, providing access and engagement directly with the research programs and activities.

The partnership workprogram is agreed to by both DSE and CWSC through the partnership steering committee. The workprogram provides a focus on the priority issues for progressing water sensitive cities in Victoria. The key activities centre on the development of discussion and issues papers through consultation and workshops with scientists and policy officers. The following case study outlines the partnership's approach to a key issue for progressing water sensitive cities.

CASE STUDY - STORMWATER AND INTEGRATED URBAN WATER MANAGEMENT

Issue

The Victorian Government's Living Melbourne: Living Victoria policy is seeking to improve the liveability of urban environments, improve the environmental health of Victoria's rivers and waterways and make Victorian cities more water self sufficient through adoption of integrated water management. The urban stormwater system extends from the impervious surfaces in urban catchments, through the drainage systems, to infiltration and discharge to waterways. A challenge is to reform the management of urban stormwater systems from their drainage and flood protection focus into an integral part of a managed total urban water cycle.

Science and policy context

The science of urban stormwater and its interactions with both urban development and receiving environments is reasonably well developed and forms the basis for the 'Stream Ecology and Effects of Stormwater Harvesting' research program of CWSC's Cities as Catchments program. Walsh *et al.* (2005) discuss the role of urban development and stormwater management in contributing to the ecological degradation of streams with urban catchments (the "urban stream syndrome"). The flashier hydrograph and elevated concentrations of nutrients and contaminants of runoff from urbanised catchments result in altered channel morphology and reduced biotic richness, with increased dominance of tolerant species. They conclude that the best opportunities for ecological restoration lie with redesigning drainage systems to counter the hydrological impact of contemporary drainage.

Integrated water management, in a water sensitive city context, is multi-objective – seeking to achieve environmental, amenity and resource management outcomes. Currently, Victoria's policy framework for urban stormwater focuses on drainage and flood protection

requirements. Complementary policy objectives for environmental, amenity and resource management outcomes need to be considered to ensure that the outcomes and benefits of a water sensitive city can be delivered.

Partnership process

A process to connect and align scientific understanding of urban stormwater systems with a policy framework for integrated urban water management has involved:

- Analysis of the current policy frameworks.
- Analysis of scientific knowledge and understanding of Victoria's urban water systems.
- Consultation and engagement with key scientists, policy analysts and advisors and operators from delivery/implementation agencies – through individual contacts and interdisciplinary workshops.
- Identification and development of policy objectives and determination of the policy framework(s) that may assist delivery.
- Development of policy reforms and identification of the science programs needed to address key knowledge gaps and underpin and support implementation.

Findings

The partnership process has identified a number of areas where improvements, or reforms, can be made to existing programs and arrangements to deliver a more effective stormwater management system. The draft findings (as of April 2011) are:

Clarification of stormwater management objectives:

- Discharge from stormwater systems to waterways is an environmental externality. In addition to protecting the environments of urban waterways, discharge control objectives can set the boundaries for stormwater management.
- Within these boundaries there are opportunities for developing stormwater as a resource and for improving the liveability outcomes from stormwater systems (eg by conversion of stormwater systems from piped drainage to vegetated swales).

Identification of policy gaps:

- The institutional and administrative arrangements that confer responsibility, accountability and governance for components of the stormwater system need to be further developed to allow effective planning and management.
- Regulatory systems need to be developed to establish obligations on the stormwater managers for environmental performance, liveability outcomes and water resource management of stormwater systems.
- Integrated planning systems are needed to integrate the design of urban stormwater systems with the total urban water cycle and with land use planning to ensure that the most efficient and effective systems are developed.

Identification of science needs:

- Performance measures are needed that link stormwater system design characteristics to environmental quality objectives for receiving environments (ie performance measures for stormwater discharge). In addition, subordinate performance requirements for components of the stormwater system to contribute to system wide objectives (eg allotment and/or precinct scale objectives) are also needed to support integrated stormwater management systems.

- If improved liveability outcomes are adopted as a policy goal for stormwater systems then performance measures for liveability outcomes of stormwater systems will need to be developed.
- Stormwater is a highly variable resource. Mechanisms are needed for determining the sustainable allocation of stormwater from within stormwater systems.

CONCLUSIONS

The Science-Policy Partnership for Water Sensitive Cities is founded on a framework of broad principles that has applicability across a range of situations where complex, multi-disciplinary issues exist.

The specific arrangements for the partnership have been designed in response to the particular issues for progressing water sensitive cities in Victoria and in the context of the pre-existing relationships between Monash University and the Department of Sustainability and Environment.

The initial investigations of the partnership into the relationships between urban stream ecology, stormwater harvesting and integrated urban water management show that the partnership can provide a means for progressing complex and challenging issues. The outcomes of the partnership can help to shape and direct future policy development and scientific investigations to provide useful outcomes.

ACKNOWLEDGEMENTS

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