CoastAdapt

Climate change impacts on coastal water supply and waste water management

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Impact Sheet 12

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Contents

Introduction

Urban water networks provide three primary services: the supply of potable water, the collection, treatment, disposal and reuse/recycling of wastewater, and the management of stormwater and runoff (see Figure 1). These services are essential for public health and contribute to social development and economic growth. The public health importance of services provided by urban water networks makes them unique from other forms of infrastructure, with any disruption to quality, reliability and availability having significant social and economic consequences. Given the important role of urban water systems, climate change impacts require significant attention from government, industry and society.

The potential impacts of climate on urban water networks in Australia were highlighted during the millennium drought from 1996 to mid 2010, when decreased precipitation across much of the continent over a decade focused significant attention on urban water governance and infrastructure. Governance reforms included the establishment of the National Water Commission, a Productivity Commission review, the 2007 Commonwealth Water Act and the Murray Darling Basin Plan. Major infrastructure projects included the desalination plants in Melbourne (2012), Gold Coast (2010), Sydney (2010), Perth (2006) and Adelaide (2011) and the Sugarloaf pipeline, a 70 km water pipeline in Central Victoria.

Figure 1: Urban Water System. Source: © atelier GROENBLAUW, Madeleine d'Ersu (http://www.urbangreenbluegrids.com/water/, accessed 21 June 2016).

Today, Australia's urban water networks cover large cities, smaller cities and towns, as well as smaller communities (including some Indigenous communities). Governance and management of these networks continues to evolve. Traditionally it was a responsibility of local government, but increasingly there are a range of entities involved from state and local government, regulators (economic, public health, safety and environmental, water resource management) and water service providers (government-owned water businesses and private sector suppliers).

Climate change impacts

Climate change projections indicate significant changes to precipitation. Although there are uncertainties in these precipitation projections, we can have some confidence that future rainfall amounts will be lower in the densely-populated areas of Australia, whereas there will be increased intensity of heavy rainfall events. There are a number of other changes such as sea-level rise and increased temperature where the impacts on urban water systems should be considered within adaptation plans (and where there is greater certainty in the projections). The impacts of climate change are discussed below for the three categories of services provided by urban water networks: water supply, wastewater treatment and stormwater management.

Water supply

In Australia, urban water networks source the majority of their water from natural water bodies in the catchment such as a stream, river or an underground aquifer. In addition to catchment sources, many coastal cities in Australia can augment this supply with desalinated or recycled water. While desalinated water can be produced as required, the more prevalent rain-dependent catchment sources, typically stored in reservoirs, provide less reliable water security, requiring them to have sufficient capacity to meet annual demand with many years of below average rainfall before they are depleted. As required to supply the network, the stored water will undergo various treatment processes that remove any chemicals, organic substances or organisms that could be harmful to human health. Following treatment, water is delivered to users via a distribution system consisting of a network of mains and pipes.

Table 1 describes the key impacts of climate change to the water supply components of urban water networks.

Table 1: Climate change impacts on water supply. Source: adapted from Loftus et al. 2011, WSAA 2016 and NWC 2012.

Variable	Impact
Sea-level rise	• Reduction in availability and quality of water supply due to saltwater intrusion into groundwater aquifers and distribution networks. • Increase in maintenance costs for distribution networks due to saltwater intrusion. • Increase in maintenance, operation and repair of infrastructure such as desalination plants exposed to inundation.
Increased intensity of precipitation events	• Reduction in capacity of reservoirs due to increased overland flows and erosion. • Increase in costs for operations and maintenance of treatment plants as inflows will have increasing levels of suspended solids and other contaminants. • Conflicts between drinking water storage and flood mitigation capacity of water storages. • Increase to damage costs to low lying water treatment plants exposed to inundation hazards. • Increase in costs to maintain and repair distribution networks due to increasing erosion hazards caused by overland flows. • Decrease in groundwater recharge, as heavy precipitation exceeds soil infiltration capacity and increases surface runoff.
Decreased precipitation volumes	• Reduction in availability and quality of water supply due to reduced streamflow, and increased pollution concentrations in storages. • Reduction in groundwater aquifer levels due to limited recharge. • Increase in penetration of saline waters into estuaries and aquifers which may reduce water supply quality. • Increase in operations, maintenance and repair costs for water treatment systems due to lower quality inputs. • Increase in operations, maintenance and repair costs for distribution networks as soil moisture decreases and saline intrusion increases. • Water service providers need to build greater numbers of capital-intensive rain-independent desalination and recycled water plants to provide adequate water security for coastal cities.
Increased air and water temperatures	• Reductions in catchment water sources due to increases in evapotranspiration. • Increase in water treatment costs as quality of inflows decreases due to: lake stratification and fewer destratification (mixing) events; post-bushfire runoff of dissolved materials into receiving waters; changes in turbidity and chemistry of water; increased occurrence of eutrophication and toxic algal blooms in rivers, reservoirs and lakes. • Reductions in groundwater levels due to improved growth conditions increase biomass and increased evapotranspiration. • Increase in operations, maintenance and repair costs for distribution networks as saline intrusion increases.

Wastewater

Each Australian produces approximately 70 000 litres of wastewater per year, which combines with industrial and commercial sources to produce large volumes of wastewater. If discharged directly into the environment, this wastewater would cause a range of negative consequences. Wastewater treatment systems collect domestic, commercial and industrial wastewater at the source, transport this wastewater to centralised treatment facilities, then treat the water, and finally discharge the resulting effluent and solids to the environment.

Table 2 describes the key impacts of climate change to the wastewater components of urban water networks

Table 2: Climate change impacts on wastewater. Source: adapted from Loftus et al. 2011, WSAA 2016 and NWC 2012.

Variable	Impact
Sea-level rise	• Increase in costs of maintenance and repair of outfalls due to increasing damage during extreme events. • Increase in operations costs of outfalls and wastewater collection network as increasing sea levels reduce the viability of gravity flows and require pumping to transport and discharge wastewater. • Increase in maintenance, operation and repair of infrastructure such as treatment plants and collection networks exposed to inundation and saline intrusion.
Increased intensity of precipitation events	• Increase in frequency and/or volumes of treatment plant overflows to the environment (causing potential contamination of natural water bodies and potable water supply) due to higher precipitation event volumes. This will require costly system upgrades to handle the increased flows. • Increase in maintenance and repair of treatment plants and collection networks due to inundation damage. • Increase in treatment costs as increased inflows, with higher concentrations of nutrients, pathogens and toxins, require more treatment. • Changes to flooding risk will require water service providers to build more resilience into their networks. For example, if a plant is out of action, a water/wastewater grid would need to be able to source water from another location. Alternatively, investment to enhance the flood resilience of existing plants would need to be considered.
Decreased precipitation volumes	• Reduction in available soil moisture, leading to degradation of wastewater pipes. • Increase in operations and maintenance costs of treatment plants and collection networks due to decreasing flows and less dilution with lower precipitation.
Increased air and water temperatures	• Impact on temperature-related wastewater treatment processes (for example, reduction of oxygen levels and transfer rates). • Reduction of oxygen content in wastewater effluent-receiving waters, leading to additional wastewater treatment requirements. • Corrosion of sewers.

Stormwater

Stormwater is runoff from urban areas, with large volumes occurring during storm events. Stormwater systems must also cater for dry weather flows from sources such as groundwater, garden watering, wash-down, leaking water pipes and illegal discharges. The traditional priority for management of stormwater has been to dispose of it as quickly as possible to avoid any potential inundation hazards, and this is achieved through the design, construction and maintenance of drainage systems. In recent years there has been greater recognition of the multiple uses of stormwater such as for increasing environmental flows and aquifer recharge.

Table 3 describes the key impacts of climate change on the stormwater components of urban water networks.

Table 3: Climate change impacts on stormwater. Source: adapted from Loftus et al. 2011, WSAA 2016 and NWC 2012.

Variable	Impact
Sea-level rise	• Increase in costs of maintenance and repair to outfalls due to increasing damage during extreme events. • Increase in operation costs of outfalls and drainage networks as increasing sea levels reduce the viability of gravity flows and require pumping to transport and discharge stormwater. • Increase in maintenance, operation and repair of drainage networks exposed to inundation and saline intrusion.
Increased intensity of precipitation events	• Inundation of surrounding infrastructure and assets caused by stormwater overflows. • Environmental discharges caused by stormwater overflows. • Increase in damage costs during inundation events; this will require local governments to upgrade all their stormwater systems at considerable cost in order to handle the increasing likelihood of extreme rainfall events.
Decreased precipitation volumes	• Increase in maintenance and repair costs due to reduced soil moisture and low flow in pipes leading to degradation of drainage networks.
Higher temperatures	• Increase in maintenance and repair costs for drainage infrastructure as increased temperatures damage surfaces and reduce soil moisture.

Water service providers

There are more than 150 organisations involved in the provision of water services in Australia; this includes private companies, government-owned businesses and government departments. Depending on the jurisdiction, the roles and participants vary. For example, water businesses often provide water and wastewater services, while local councils manage stormwater. Water service providers interact with industry and communities in the delivery of services as well as in planning and development decision making. Climate change projections have a number of serious implications for organisations involved in urban water networks, including restrictions on the ability to provide reliable and safe services to customers and increased costs of service provision.

The following impacts of climate change are important considerations for the management of water service providers (Wearing et al. 2016):

- **A deteriorating cost:income ratio.** Climate change may reduce water availability, requiring society to reduce consumption which will reduce income to service providers, at the same time as other impacts of climate change increase the costs of operation.
- **Service disruptions.** Climate change has impacts on external drivers beyond organisational control, such as loss of power, communications, access, and impacts on staff, suppliers and customers.
- **Supply:demand instability.** Extreme events will reduce the stability of freshwater inputs on the supply side, and on the demand side there will be spikes in demand during extreme heat events.
- **Reputation damage (negligence litigation, expectation).** Reputation and its implications for consumer confidence is of critical importance to water service providers; how organisations respond to climate change impacts through communications will be critical to maintaining reputation and confidence.

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