Sydney WATER

Innovative water management for the Aerotropolis Precinct

Building a cool, green and resilient city

For best viewing of this document please set your PDF Reader view to 'Two Page View with Cover'.

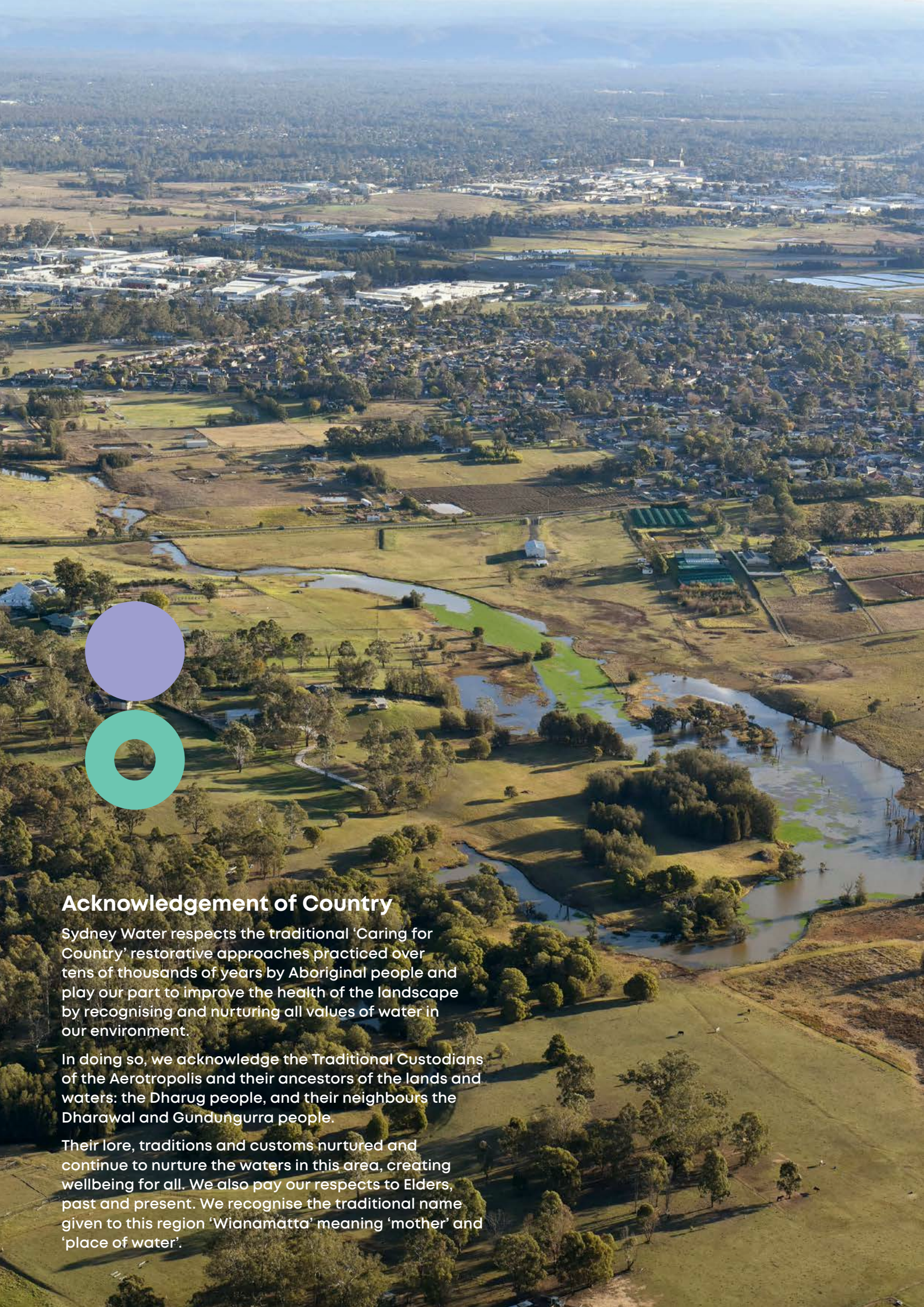
In Acrobat PDF Reader:

- Select View > Page Display > Two Page View (or Two Page Scrolling if you prefer).
- Select Show Cover Page in Two Page View.

(This ensures your spreads are positioned correctly).

The final servicing configuration, including charges, are to be approved by the Sydney Water Board and NSW Government.

Contents



Acknowledgement of Country

Sydney Water respects the traditional 'Caring for Country' restorative approaches practiced over tens of thousands of years by Aboriginal people and play our part to improve the health of the landscape by recognising and nurturing all values of water in our environment.

In doing so, we acknowledge the Traditional Custodians of the Aerotropolis and their ancestors of the lands and waters: the Dharug people, and their neighbours the Dharawal and Gundungurra people.

Their lore, traditions and customs nurtured and continue to nurture the waters in this area, creating wellbeing for all. We also pay our respects to Elders, past and present. We recognise the traditional name given to this region 'Wianamatta' meaning 'mother' and 'place of water'.

Overview

The Aerotropolis Water Strategy (the Strategy) is the first of its kind in greenfield urban planning in NSW and the single biggest stormwater harvesting scheme in Australia. Bringing total water cycle management together with strategic land use planning at the earliest stages represents a step change in the way Sydney Water plans, delivers and maintains water infrastructure. The strategy has been tailored to meet the unique needs of the Western Parkland City and responds to key NSW Government policy objectives for urban greening and cooling, water conservation, waterway health and recognising Country.

Introduction – the role of water

Water is central to the character, comfort and sustainability of our urban centres. It helps our five million customers stay hydrated and clean everyday, it greens and cools our natural environment and sustains the beaches and waterways that make our city world-class.

For 130 years Sydney Water has proudly delivered the water resources and infrastructure to look after our customers, city and environment.

We're continuing on this legacy by planning for a new city in the greenfield area of the Western Parkland City. It presents a once in a generation opportunity to rethink how we deliver essential infrastructure and services, integrating them with the natural landscape to create more sustainable, resilient and liveable places.

This is especially important in Western Sydney – the hottest and driest part of Sydney which already experiences temperatures up to 10 degrees hotter than Eastern Sydney.

The Greater Sydney Water Strategy (GSWS (draft)) recognises that, in the context of Sydney's growing population and increasing climate variability, we cannot meet the future water needs of Sydney through traditional water supply approaches.

To maintain a secure supply of water for our growing population it is critical that we use water more productively and efficiently and build capacity in our water network to adapt to a changing climate. We must identify and plan for new rainfall independent water supplies and optimise the use of recycled water and stormwater.

The unique and fragile waterways of the Aerotropolis also call for new approaches to urban water management. In order to protect and restore Wianamatta-South Creek and its tributaries, stormwater must be captured and reused to reduce the volume of contaminated urban runoff reaching these waterways. Without these waterways and riparian lands, the vision for the Western Parkland City cannot be achieved.

Harnessing the full potential of all water sources is critical to making the Aerotropolis a place where people want to live, work and visit.

The planning, delivery and operation of an integrated water management system at this scale requires a coordinated, consistent and catchment-based approach which can readily cross precinct and local government boundaries. To enable this, the NSW Government has nominated Sydney Water to be the trunk drainage authority for the Aerotropolis, including the Mamre Road Precinct. To reflect the area of Sydney Water's stormwater operations, references to 'the Aerotropolis' in this report incorporate the Mamre Road Precinct. As the trunk drainage authority, Sydney Water will be responsible for delivering, managing and maintaining the regional stormwater network and integrating this service with our drinking water, wastewater and recycled water network.

This report explains how to engage and work with Sydney Water as the trunk drainage authority for the Aerotropolis.

What is integrated water cycle management?

Integrated water cycle management (IWCM) is an alternative approach to traditional water servicing which considers the entire water cycle from rainwater to wastewater in the design and planning of all water utilities.

In the Aerotropolis, this means that drinking water, wastewater, recycled water and stormwater systems have been planned in unison and designed to maximise synergies, build resilience across the network and address a broad range of government and community objectives.

An IWCM approach in the Aerotropolis enables:

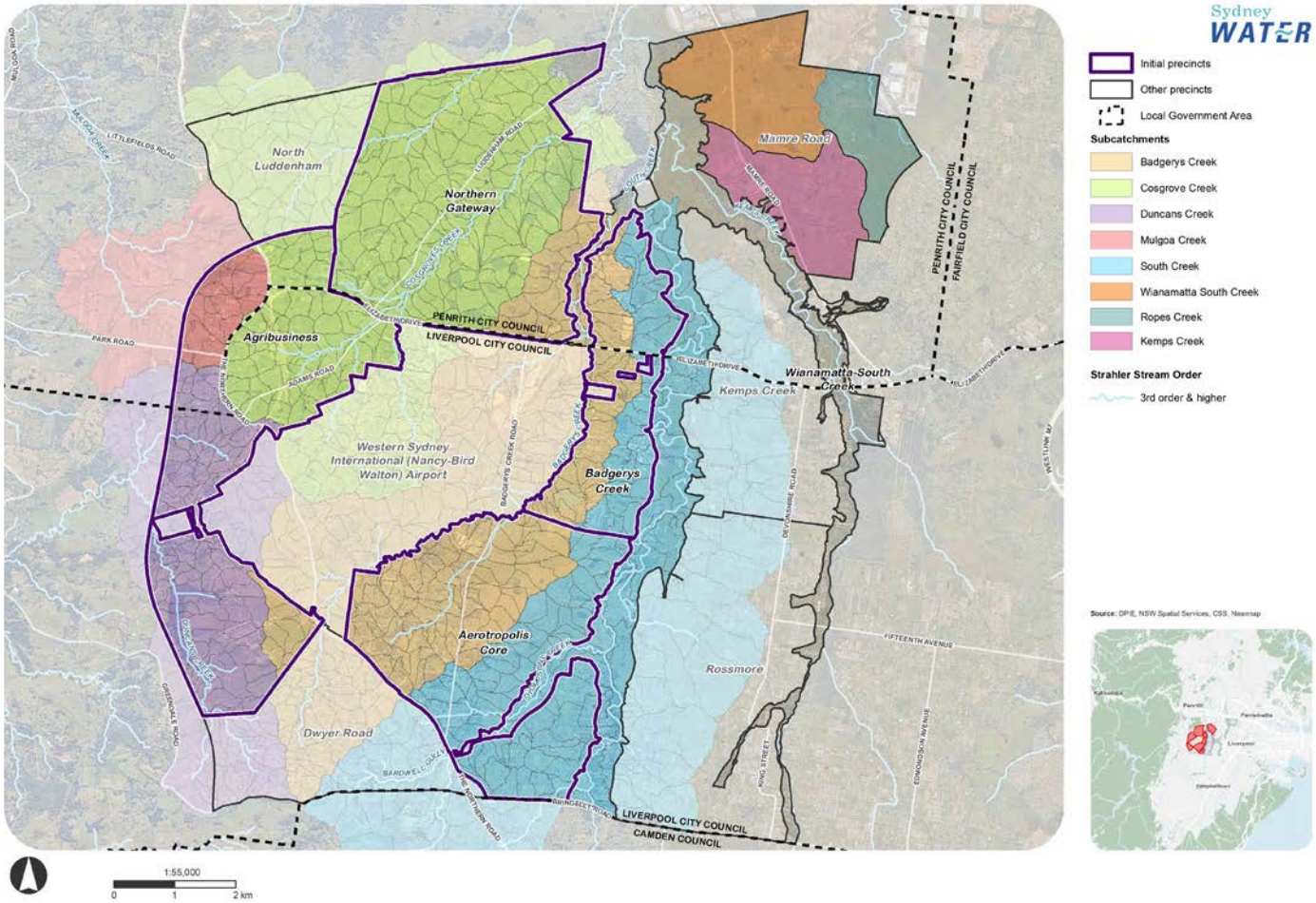
- Coordinated, catchment-based delivery, operation and management of the entire water network;
- More efficient use of developable land through the consolidation of infrastructure on otherwise constrained land;
- Climate-independent water supply for greening and cooling through integrated stormwater harvesting and recycled water;
- Sustained waterway health through effective regional management of stormwater runoff;
- Improved liveability and amenity through year-round irrigation of public open spaces and street trees, mitigating urban heat;
- Contribution to a circular economy through water conservation and reuse and opportunities for future innovations such as waste to energy.

Objectives of the Strategy

The Strategy is the first of its kind to be delivered in NSW and requires the careful balancing of many complex factors including waterway health, biodiversity, landscape values, local hydrology, airport operations, development feasibility and community and customer expectations.

With these issues in mind, the Strategy is underpinned by the following key objectives:

- Provision of essential water servicing in a timely manner;
- Enabling the achievement of the Western Parkland City vision through an integrated approach to water services;
- Building resilience in water supplies and resilience to climate change into the broader water network;
- Allowing for effective stormwater detention as development progresses;
- Utilising water sensitive urban design approaches to achieve waterway health targets in a flexible and cost-effective way;
- Ensuring sufficient land is allocated for stormwater management on private lots and in the public domain;
- Designing trunk drainage to protect property, improve biodiversity and integrate into the public domain;
- Ensuring sustainable funding for ongoing stormwater management, coordinated across catchments;
- Holistic response to meeting requirements related to recognising Country for naturalised stormwater management.



Initial precincts and creek catchments of Western Sydney Aerotopolis

(Source: Stormwater and Water Cycle Management Report, Sydney Water)

Purpose of this report

This report outlines the approach to water management in the Aerotropolis. It applies to the Initial Precincts of the Aerotropolis and the Mamre Road Precinct as shown above. The Strategy details requirements for development in these precincts as related to:

- Stormwater management, including trunk drainage;
- Water and wastewater servicing;
- Recycled water; and
- Riparian lands management.

State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (WPC SEPP) requires that Precinct Plans detail the proposed approach to integrated water cycle management. Sydney Water prepared a detailed 'Aerotropolis Initial Precincts Stormwater and water cycle management study' (December, 2021) to inform precinct planning for the Initial Precincts. Sydney Water also prepared a similar report for the Mamre Road Precinct. The full detailed technical studies can be obtained from Sydney Water.

This report is a summary of the water strategy developed through these technical studies and provides a guide for anyone who wants to understand the way in which water will be managed as the Aerotropolis is developed. It provides information on the infrastructure and services that Sydney Water will provide across the Aerotropolis, where infrastructure will be located, what land will be required and when services will be available.

It sets the expectations for water management on private land and in the public domain and it also sets the standards which development needs to achieve to contribute to a precinct-scale, integrated water management system.

Key principles

Community expectations for water are changing. Water is increasingly important to the way in which we live, work and connect. Water is part of the character of a place and can shape how we identify with our surroundings.

Recognise Country

The Aerotropolis lies mostly within the catchment of Wianamatta-South Creek. Wianamatta means 'mothers place' or 'mothers creek' in the Dharug language. Wianamatta is highly significant to First Nations people across the region who have cared for Country, including the waters of Wianamatta for thousands of years. Development in the Aerotropolis must also respect and care for these waters, as captured in Chapter Two of the Draft Western Sydney Aerotropolis Development Control Plan.

Caring for this landscape and its remnant Cumberland Plain vegetation means protecting the local waterways from the impacts of the urbanising catchment. This in turn will protect the cultural and broader community values and uses of Wianamatta-South Creek and the Hawkesbury-Nepean River. The Strategy adopts a 'landscape-led' approach, informed by Country which responds to the natural topography and hydrology of the Wianamatta-South Creek Catchment.

The objective of this approach is to preserve natural waterways and associated cultural values as urbanisation progresses.

Sustainable use of water

The Government's metropolitan water management strategy – the Greater Sydney Water Strategy (GSWS) (draft) – recognises the potential for a shortage of drinking water supply in the context of Sydney's growing population and increasing climate variability. Other Government policy directives call for a greater focus on urban greening and cooling, setting targets for tree canopy cover and highlighting the need to better manage urban heat in new developments. We know that we cannot create these cool, green places for people without a sustainable supply of water.

It is therefore critical that water is used more productively and efficiently. New climate resilient water supplies must be identified and planned and the use of recycled water and harvested stormwater optimised. The Strategy aims to generate synergies across green and grey infrastructure, improving effiency in the water network, reducing demand for drinking water and providing sustainable, climate independent water supplies for urban greening, cooling and liveability.

Efficient delivery of infrastructure

The Strategy recognises the need to deliver water services in the most efficient and economic way for customers. To do this, we must move away from past infrastructure delivery models that have resulted in a loss of productive land and significant costs associated with stormwater infrastructure. A regional approach to stormwater management, including precinct-scale stormwater harvesting and treatment has been identified by the Department of Planning and Environment's Review of water sensitive urban design options for Wianamatta-South Creek (DPE, 2022) to be the most efficient and effective way to protect waterways and achieve stormwater targets in the Aerotropolis. This approach allows for infrastructure to be consolidated in suitable locations on the fringes of the urban footprint, maximising productive use of developable land without compromising water quality or broader environmental outcomes.

Analysis undertaken by Sydney Water also shows that this approach is the lowest cost to development in the context of the new waterway health objectives and stormwater targets. To meet these requirements within the development footprint would take up significant amounts of developable land that could otherwise be productively used. Making the best use of the blue-green grid to accommodate natural stormwater assets that also contribute to greening, cooling and amenity releases the burden from unconstrained land. With all development contributing to the cost of a regional stormwater network, developable land can be freed up for housing, jobs and other critical infrastructure.

Multi-functional green infrastructure

Sydney Water's vision is creating a better life with world-class water services. In Western Sydney, this means designing a fully integrated water servicing strategy that not only has utility, but is a central feature of the infrastructure of the future community, providing liveability, sustainability and resilience. The needs of the future community of the Aerotropolis are at the centre of the Strategy, ensuring that waterways are protected and open spaces are cool and green all year round – creating liveable places for people.

Regional stormwater 'infrastructure' has been designed in such a way that it performs a variety of functions. Regional wetlands and trunk drainage channels, whilst providing a stormwater containment and treatment function, will also become green landscape features, accessible to local communities for passive recreation and amenity. The image below demonstrates how these naturalised assets interface with public open spaces and riparian corridors.

A range of recreational activities can be enjoyed within and around planned stormwater infrastructure such as cycle and walking paths, picnic spaces, playing fields and playgrounds. In this way, stormwater lands will contribute to the overall Parkland City vision through the establishment of a blue-green grid of cool, green open spaces networked throughout the urban environment.

The use of recycled wastewater for irrigation to top up harvested stormwater during dry periods also ensures that green spaces can remain green and cool all year round.

Protection of waterways and riparian land

The protection, restoration and maintenance of waterways, riparian corridors and water dependent ecosystems is essential in achieving the cultural, social and biodiversity aspirations of the Aerotropolis as well as the NSW Government's waterway health and tree canopy targets for the Western Parkland City. Creeks and associated floodplains within the Aerotropolis are home to many threatened, critically endangered and high ecological value species of fauna and flora, including those considered iconic to the area (native fish, bats and a range of birds).

To ensure the management of waterway health outcomes in the Aerotropolis meets the communities' expectations, a shift in urban water management is required. The Strategy identifies a combination of at-source controls, rainwater and stormwater harvesting and vegetated Water Sensitive Urban Design (WSUD) elements, that better mimic the existing hydrologic characteristics of the catchment and will ensure waterway health doesn't decline past key ecological thresholds as the Aerotropolis develops.

Urban typologies:

Sydney Water has been working to develop innovations in urban water management over many years, specifically aimed at the Western Sydney greenfield environment. In May 2020, Sydney Water published the 'Western Parkland City Urban Typologies and Stormwater Solutions' report outlining new ways of designing greenfield urban development to better manage urban stormwater at its source. This work was driven by NSW Government policy directives to integrate land use planning and water cycle management, address waterway health in the Wianamatta-South Creek catchment and improve liveability for future communities through urban greening and cooling. The Western Parkland City urban typologies project was recognised at the 2020 Australian Urban Design awards, achieving a Commendation. The Aerotropolis IWCM Strategy builds on this work, bringing water and urban development solutions together to provide a catchment scale, sustainable and resilient water management plan for the Aerotropolis.

The Strategy

The Strategy provides a comprehensive view of the way in which all water will be managed as the Aerotropolis develops. This includes the servicing of the Initial Precincts with drinking water, wastewater treatment and recycled water, as well as the management of urban stormwater and the protection of valuable waterways and riparian lands. The Aerotropolis presents a once in a generation opportunity to deliver a total water cycle management solution that goes beyond traditional water servicing to influence and shape the very fabric and character of a new city.

Policy context

Greater Sydney Water Strategy (draft)

The GSWS (draft) sets the direction for government, utilities, industry and the community to build sustainability and resilience in Sydney's water and wastewater networks.

Importantly, the GSWS highlights the need to integrate land use planning with managing water supply, wastewater and stormwater services and to utilise water in the most efficient ways to create cool, green urban environments – especially in Western Sydney.

The GSWS says that the cities' water systems should be integrated to meet a range of community objectives including:

- Serving the full range of needs of a growing population – not just drinking water;
- Building resilience in the water network to adapt to periods of drought and a changing climate;
- Putting water at the heart of the city and communities and using water sustainably to generate amenity, greening and cooling;
- Improving water management outcomes for Aboriginal people; and
- Protecting waterways and the natural environment.

Sydney Water's Strategy optimises all available sources of water, providing high quality drinking water, stormwater harvesting for irrigation and greening and a reliable source of recycled water for non-potable uses.

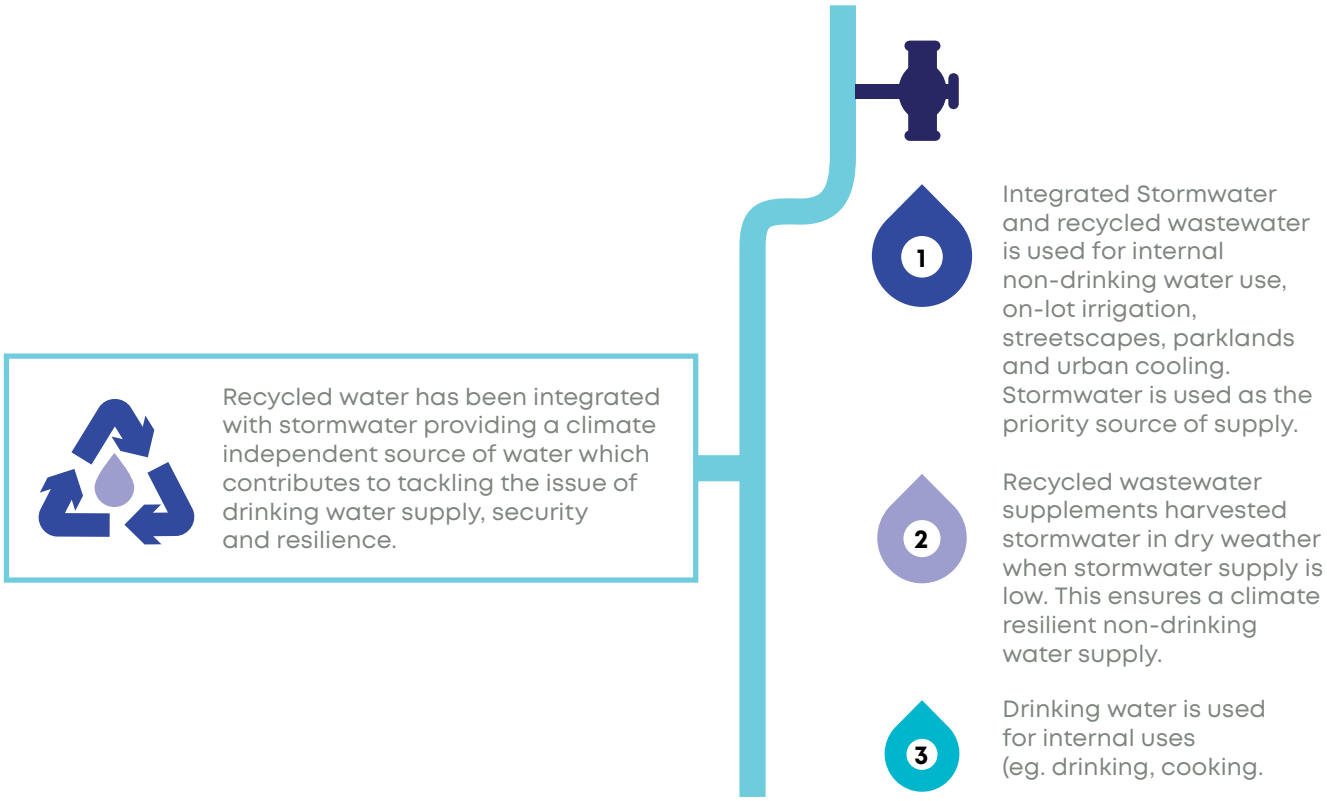
A Metropolis of Three Cities – Sydney Region Plan

The Aerotropolis lies at the heart of the Western Parkland City. Originally identified in the Greater Sydney Commission's 'A Metropolis of Three Cities', the vision is for a new city in a parkland setting, with cool, green neighbourhoods centred on Wianamatta-South Creek as the core element of liveability and amenity. This vision relies on retaining water in the landscape, encouraging green spaces with extensive tree canopy, integrating waterways into the design of the city and keeping waterways healthy so they can support the essential drainage, recreational and environmental functions expected of a cool, green corridor.

The Strategy has been developed with this vision in mind and identifies water management and servicing solutions which will enable the Aerotropolis to evolve as the new benchmark for urban development in the Western Parkland City.

NSW Government Waterway Health Objectives and Stormwater Targets

The freshwater waterways of the Wianamatta-South Creek catchment are unique and highly vulnerable to the impacts of urbanisation. The NSW Government has identified waterway health objectives for the catchment to preserve the natural values of these waterways as urbanisation in the Aerotropolis progresses and additional stormwater is generated threatening the creek ecosystems. This requires the control of water quality and stormwater quantity (flow) to limit pollution and erosion.



The Strategy responds to the Wianamatta-South Creek waterway health objectives at a catchment scale, proposing regional infrastructure that can capture and treat surplus stormwater before it reaches waterways. However, urban development will also need to include measures to manage stormwater runoff at source through permeable surfaces, street trees and bioretention measures to demonstrate compliance with the supporting stormwater management targets established by the NSW Department of Planning and Environment (DPE). These targets can be applied at a precinct or development scale using industry standard modelling techniques and will be used to assess compliance of development applications with the broader catchment waterway health objectives.

The stormwater development targets are documented in DPE's 'Wianamatta-South Creek stormwater management targets' (2022) which includes options for compliance with a series of stormwater quality and flow metrics.

Development of the Strategy

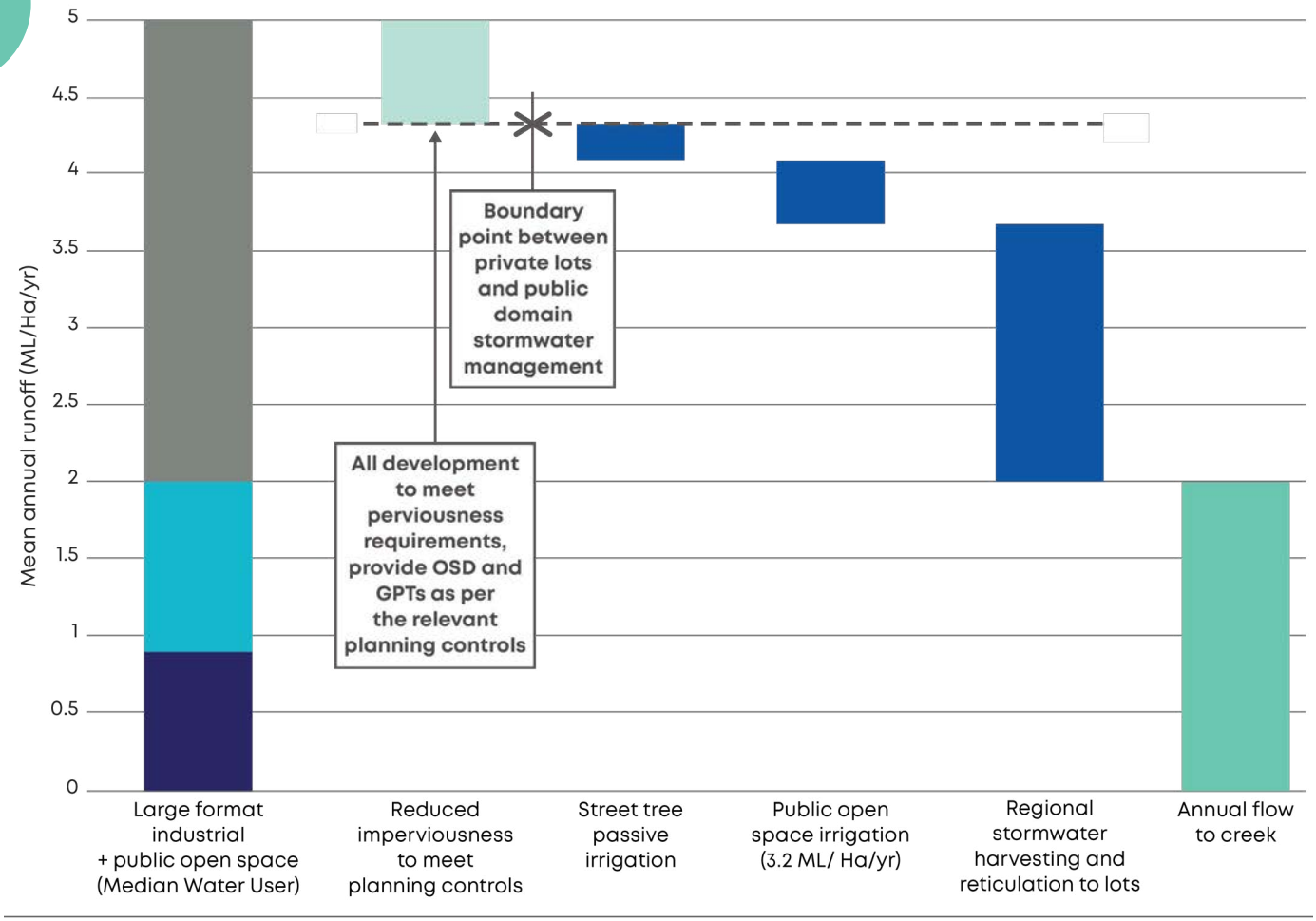
The development of the Strategy is based on the land use planning assumptions of the Aerotropolis Precinct Plans which project the expected type, density and rate of development.

This information was used to estimate how much water would be required to support the growing population and how much wastewater and stormwater would be generated. Demand estimates for drinking water as well as irrigation and other non-drinking uses have also been calculated based on existing Sydney Water data.

Once overall water demands were calculated, water balance scenarios were used to determine the sources of water best suited in the context of the principles outlined on page 9 of this report as well as the policy drivers outlined on page 12. The proportion of water demand in the Aerotropolis Initial Precincts to be met by each potential water source is shown in the diagram above.

Water supplies for non-drinking purposes could be supplied from a range of sources including rainwater, recycled water and stormwater. The Strategy considered all potential water sources and identified which should be optimised as a first priority as shown above on right. Because the challenge of stormwater volume reduction is so significant in the Aerotropolis, it was determined that non-potable water demands should be met with harvested stormwater as much as possible, with recycled water providing a year-round supply back-up for greening and cooling. Rainwater tanks can also be used for non-potable water supply but are not essential when large-scale stormwater harvesting is implemented.

Modelling also predicted the additional infrastructure required to provide the necessary water services. Upgrades to existing infrastructure



Stormwater management for waterway health outcomes.

as well as significant new infrastructure such as the Upper South Creek Advanced Water Recycling Centre (AWRC) were identified as part of a broader system of integrated grey and green infrastructure.

To meet the requirements, the following principles were undertaken to ensure efficiency:

- Combining the open space network with wetland and creek locations;
- Consolidating stormwater assets wherever possible;
- Minimising the number of private lots and the amount of developable land impacted by infrastructure;
- Consideration of environmental constraints;
- Integration into the landscape.

A stormwater 'treatment train' was developed in consultation with local Councils and estimates of how much stormwater could be treated on-site, within streets and through regional infrastructure were made to develop the optimum stormwater management system as shown in the figure above.

Finally, estimated costs and benefits of a range of servicing scenarios were modelled and outcomes were considered. The final Strategy outlined in this report delivers the greatest economic value at least cost, whilst supporting key elements of the Western Parkland City vision.

Drinking water

Currently, most of the Aerotropolis is serviced by the Cecil Park Water supply zone, which has limited capacity to service the future demands of the Aerotropolis. Drinking water servicing for the Initial Precincts will be supplied from the Prospect South delivery system via the Cecil Park water supply zone and a proposed new water supply zone.

Trunk drinking water infrastructure is planned to be delivered in stages to meet growth. Sydney Water has planned early and is already delivering major trunk drinking water infrastructure to support the Initial Precincts and future growth across the Aerotropolis. This infrastructure includes new Reservoirs at Liverpool, Cecil Park and at the Agribusiness Precinct linked by large transfer pipes which will be delivered between 2022 and 2030.

Wastewater

Wastewater treatment in the Aerotropolis will be provided by the Upper South Creek AWRC. The first stage of the AWRC is expected to be completed by 2025-2026 with further stages to be delivered in alignment with growth forecasts. Several wastewater pumping stations and deep gravity trunk mains will be required as well as new pressure mains to transfer flows to the AWRC.

Sydney Water has planned to deliver wastewater trunk networks as early as 2025 to align with the operation of the AWRC and in time to service major planned development.

Recycled water

The Upper South Creek AWRC will service the Aerotropolis with recycled water for non-drinking end uses. Recycled water is a critical addition to water services in the Aerotropolis to create a sustainable, resilient and liveable new city. All development is required to connect to a recycled water supply.

The AWRC will collect wastewater across Western Sydney and treat it to produce high quality non-drinking water fit for purpose for a range of uses, as well as producing renewable energy and biosolids for beneficial reuse. The high-quality water will be used for non-potable residential, industrial and business activities, as well as for agriculture and greening public open spaces. Construction is expected to commence in mid-2022 and the facility is expected to be operational by mid-2025.

Recycled water produced at the AWRC would be transferred to a 13ML reservoir in the Agribusiness Precinct and an 8ML reservoir in the Dwyer Road Precinct via two transfer pump stations at the AWRC. From these, recycled water will be distributed to all Initial Precincts via a network of recycled water trunk mains and reticulation.

Recycled water will be supplied for non-potable uses only, such as toilet flushing, watering gardens, industrial uses and irrigation of open space.

Indicative image – Upper South Creek Advanced Water Recycling Centre.

Stormwater

Stormwater treatment system

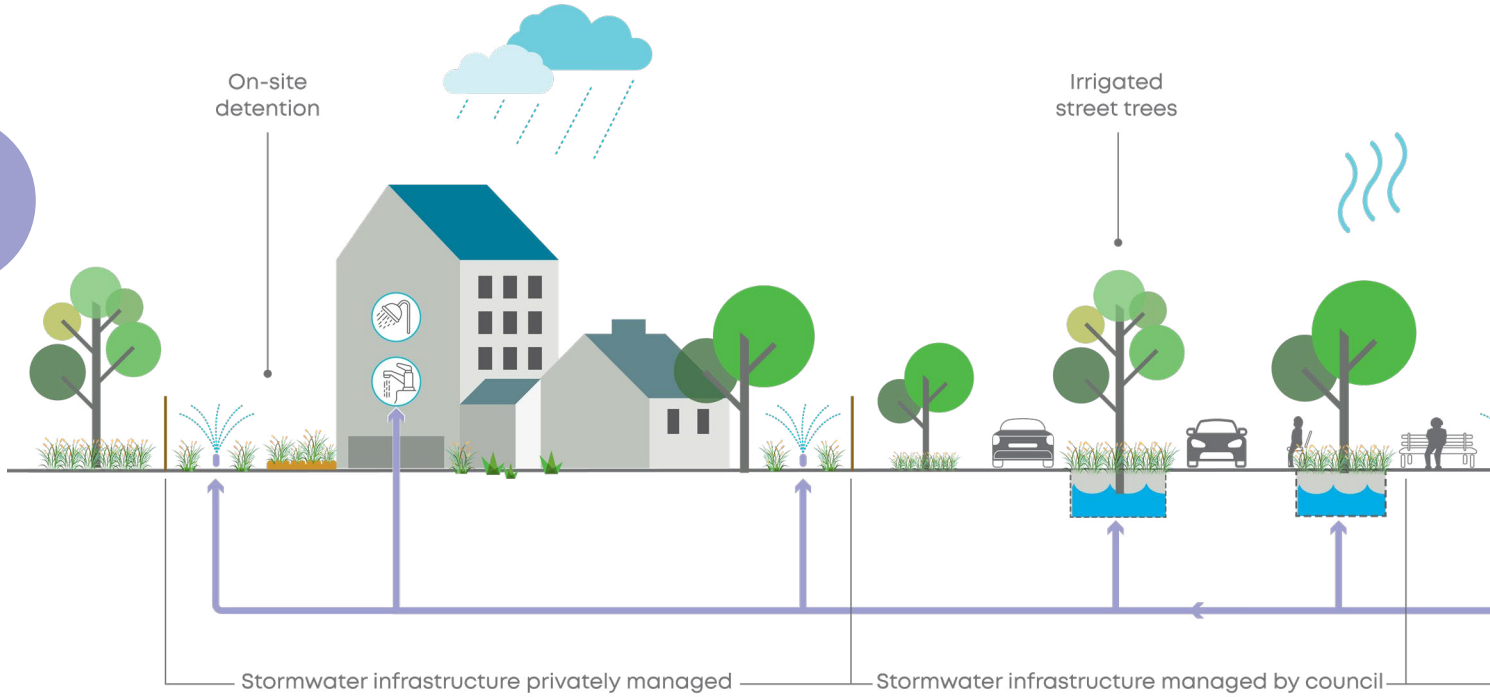
The stormwater management system for the Aerotropolis will consist of a combination of on-lot, on-street and end of pipe (regional) stormwater management measures. These measures and the links between the various levels of stormwater management is shown below. As an interconnected system, each component plays an important role in retaining and treating stormwater, as well as contributing to liveability objectives such as greening and cooling. Each of the elements is essential and must be provided in all proposed development to ensure compliance with the waterway health objectives and stormwater targets for the catchment.

Minimum perviousness requirements, on-site detention and GPTs

Passively irrigated street trees and bioretention

Consolidated, regional wetlands for storage and treatment of stormwater for harvesting and reuse

Operation and management of infrastructure



Cross section of stormwater infrastructure

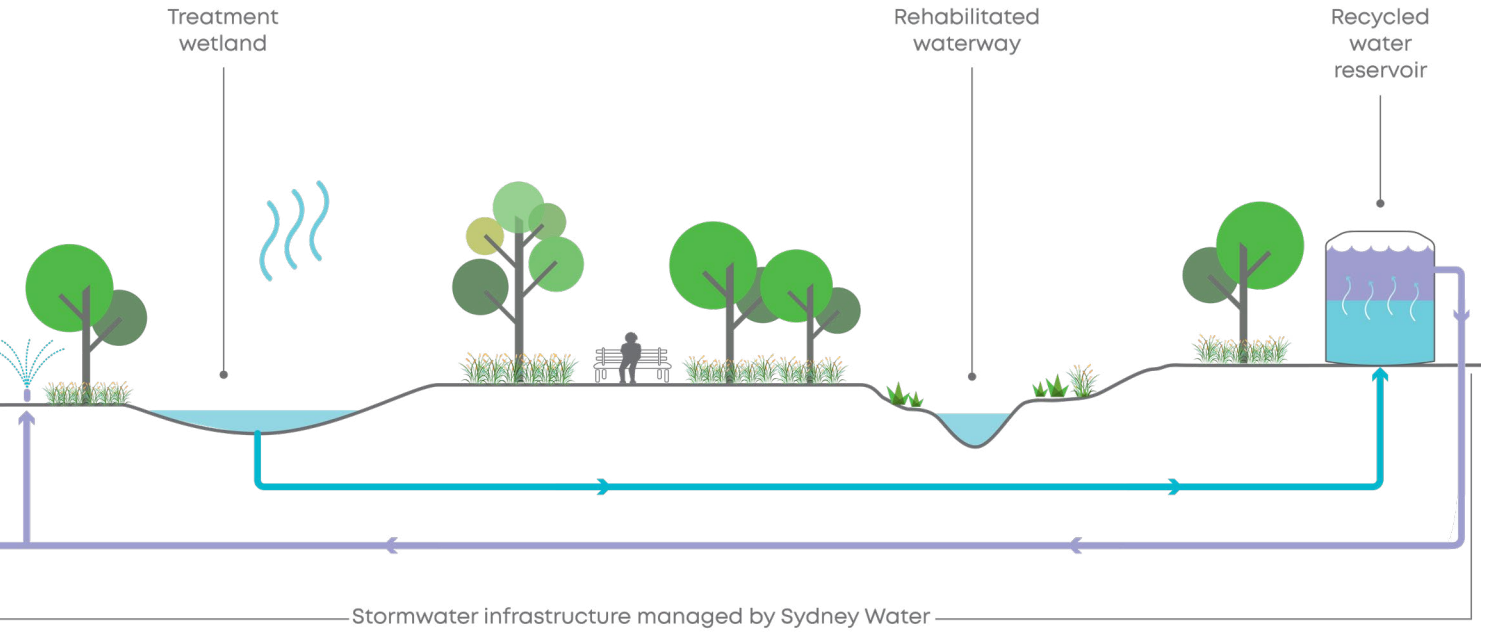
Stormwater management on development sites

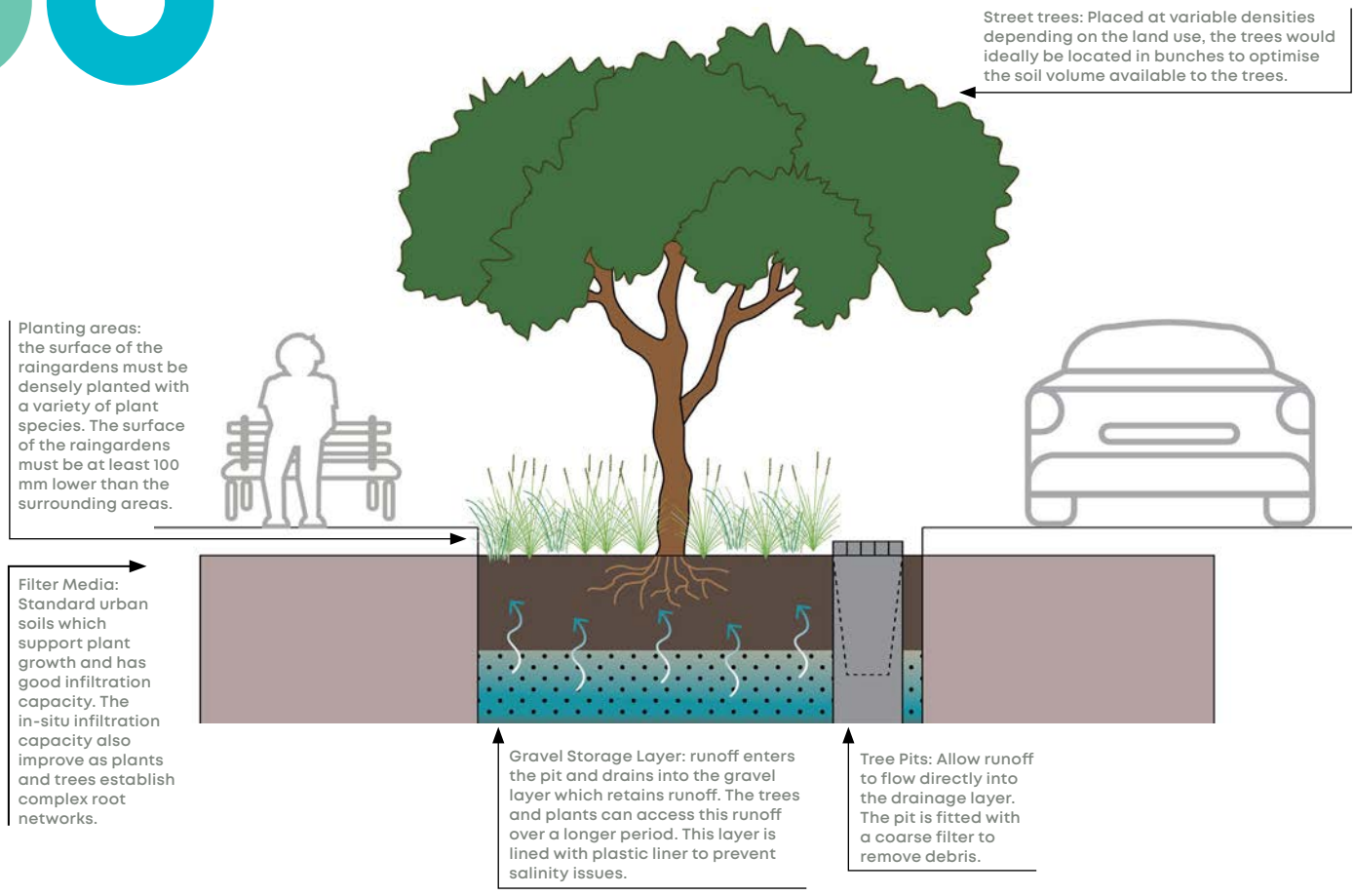
Private development must accommodate certain stormwater management measures within the development site, being:

- A minimum area of impervious comprising deep soil areas, landscaped areas, green roofs or permeable paving materials (50% pervious rating) as follows:
  - Residential – 50%
  - Mixed use/commercial – 40%
  - Industrial – 15%
- Different surfaces are assumed to have different levels of perviousness as follows:
  - Deep soil (one metre or more in depth , connected subsoil) - 100%
  - Shallow soil (less than one metre in depth, not connected to subsoil) - 75%
  - Permeable pavement – 50%
  - Hardstand – 0%
- Appropriate on-site detention, sized according to DCP requirements;
- Gross pollutant traps (GPTs);
- Irrigated Wianamatta Street Trees/bioretention designed and placed in accordance with the following specifications:
  - Street trees are to be planted at 15m intervals on all local streets (trunk to trunk)
  - Street trees are to be designed as per the diagram below, within a pit structure connected to the street drainage system.

The combination of measures proposed for each development must comply with the stormwater quality and flow targets set out in EES's 'Wianamatta-South Creek stormwater management targets' (DPE, 2022).

Note: Current and future flood planning may consider the impacts of development on overall timings of flows from contributing to the tributaries of Wianamatta-South Creek. This work and any subsequent strategy derived from this work may result in changes to the regional stormwater detention strategy and may inform future refinement of the stormwater detention requirements.





Passively irrigated "Wianamatta Street Tree"

Regional stormwater infrastructure

Regional stormwater infrastructure consists of treatment wetlands and trunk drainage channels/ creeks. This infrastructure will be designed to be multi-functional and integrated with the landscape as shown on next page.

The regional stormwater infrastructure proposed significantly reduces the footprint for stormwater management within development sites. However, it requires the allocation of sufficient, suitably located land to allow for regional stormwater assets to be provided. Land required for stormwater assets is identified in WPC SEPP and State Environmental Planning Policy (Industry and Employment) 2022 (Industry and Employment SEPP) and must be reserved for stormwater infrastructure.

In order to limit the impact of regional stormwater infrastructure on developable land, the strategy locates as much of the infrastructure as possible on land already identified for open space or subject to flood affectation. With appropriate design and treatment, stormwater assets can readily form an aesthetic feature within recreational lands. In this way, stormwater assets will serve multiple community objectives including stormwater management, recreation, urban greening and cooling and environmental protection.

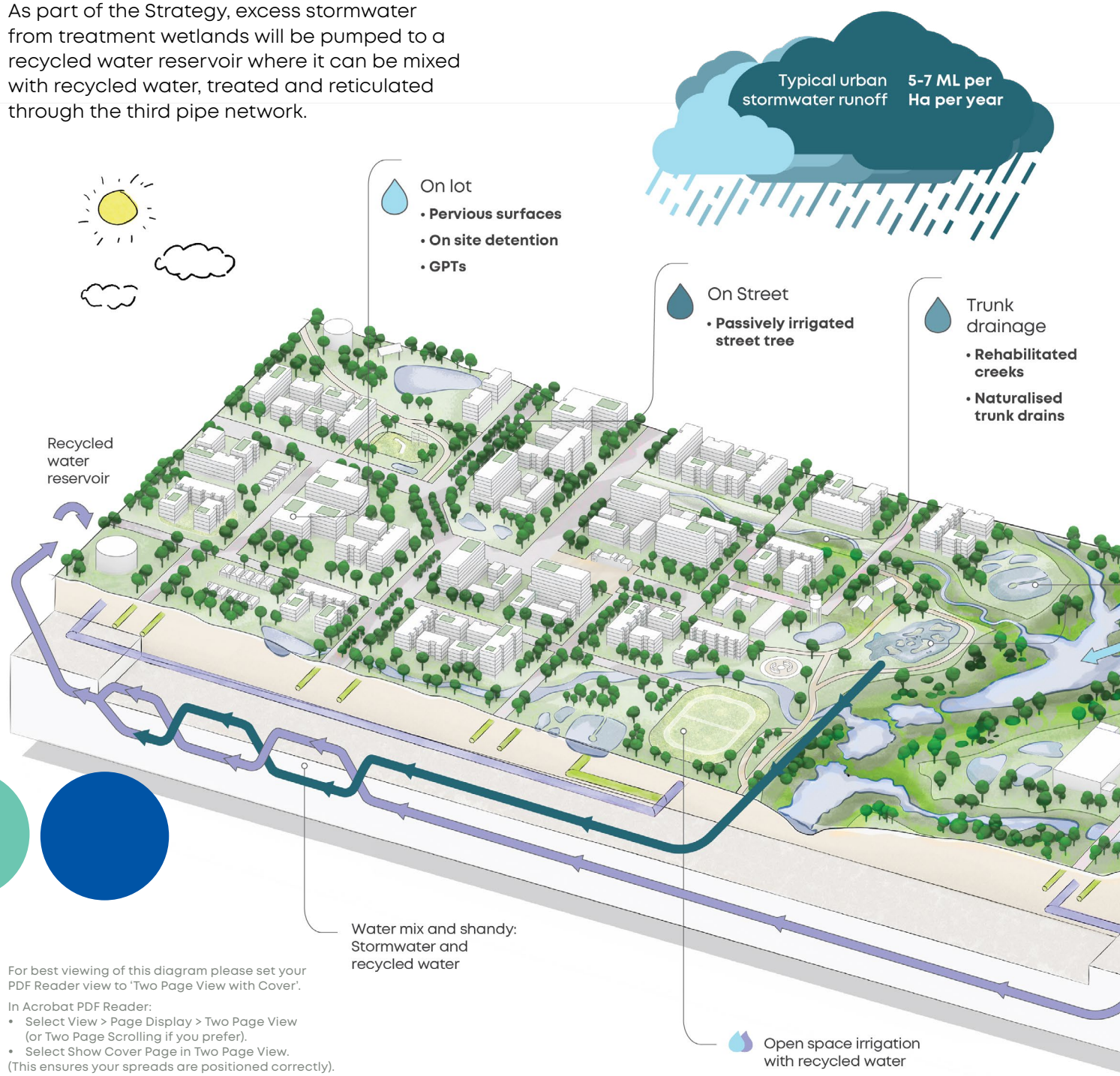
Artist impression of treatment wetlands and trunk drainage channels and creeks

Integration of stormwater and recycled water

Recycled water and harvested stormwater will be used in a complementary way in the Aerotropolis, prioritising stormwater to reduce urban runoff with recycled water providing the balance of non-drinking water supply. These alternative and sustainable water sources will be used for irrigation of trees and green spaces in the private and public domain as well as for internal non-potable water uses.

As part of the Strategy, excess stormwater from treatment wetlands will be pumped to a recycled water reservoir where it can be mixed with recycled water, treated and reticulated through the third pipe network.

This fully integrated system has been designed to enable a year-round, climate-independent source of water for non-potable uses such as irrigation. This means that even through prolonged periods of drought, water will be available to irrigate green spaces in the Aerotropolis.



For best viewing of this diagram please set your PDF Reader view to 'Two Page View with Cover'.

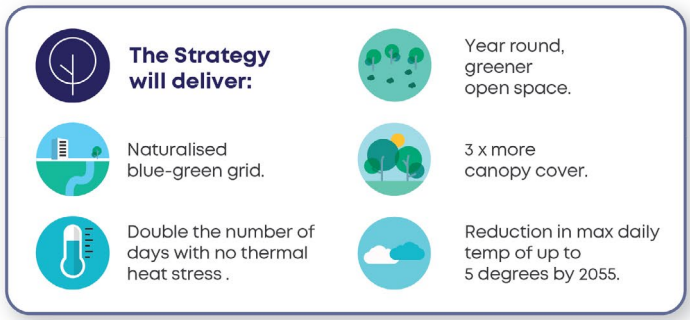
In Acrobat PDF Reader:
- Select View > Page Display > Two Page View (or Two Page Scrolling if you prefer).
- Select Show Cover Page in Two Page View.

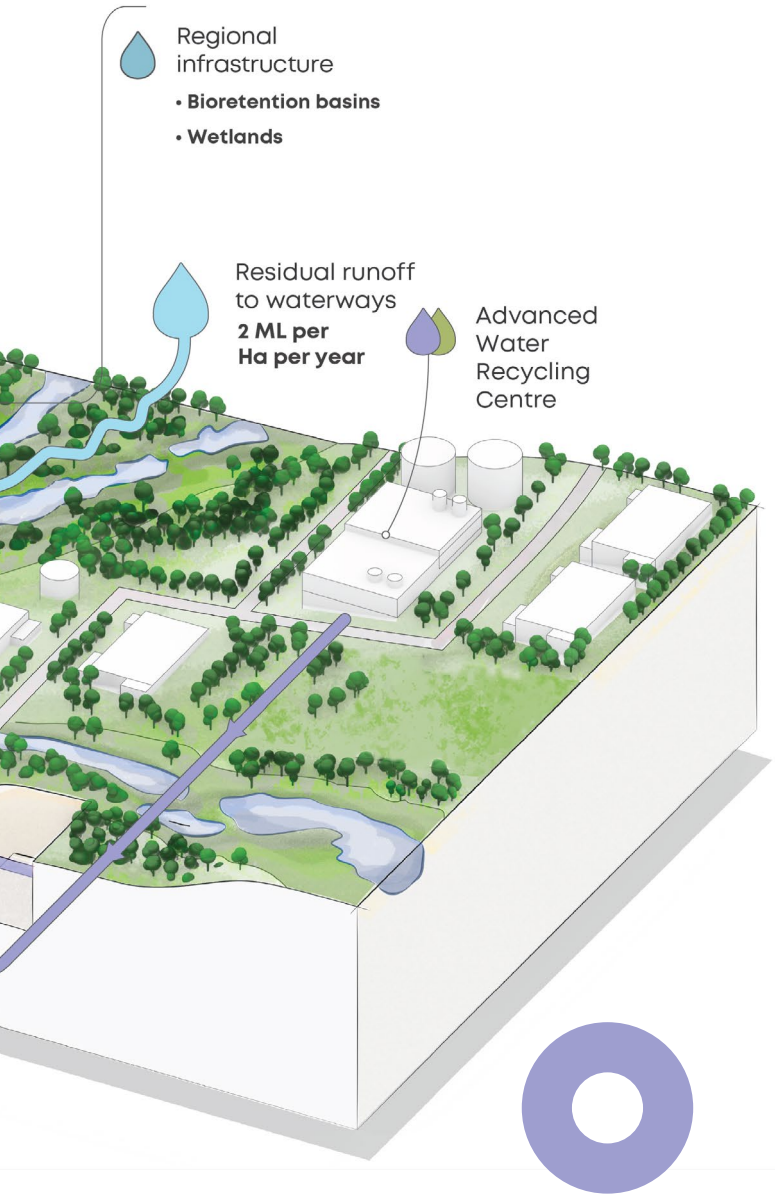
(This ensures your spreads are positioned correctly).

Note: Figures and estimated quantities from Western Parkland City: Urban Typologies and Stormwater Management report, available from Sydney Water.

Integrated water cycle management of Western Sydney Parkland City

To meet NSW Government objectives for waterway health, greening, cooling and liveability, all open spaces, areas of landscaping, parks and streets should be provided with irrigation infrastructure to make the best use of the available water and make the Aerotropolis an attractive place for people to live, work and visit.





Mitigating urban heat through irrigation and green infrastructure

The impact of population growth and the resulting increase in urbanisation, coupled with increasing temperatures due to climate change, is affecting liveability and community resilience in urban areas. The need to address urban heat islands is therefore becoming more critical and understood globally (Alavipanah, et al, 2015).

There are a multitude of methods aimed at mitigating the urban heat island effect, including adaptive urban design and planning of the built environment, and managing urban surfaces, specifically through development of vegetated areas (Mancebo, 2018). The term "green infrastructure" is used to describe the vegetated areas within a city, such as trees, parks, green walls and rooves, as well as other public and private green open spaces.

Green infrastructure helps reduce urban heat islands through a number of mechanisms, such as shade from trees and evapotranspiration, which in simple terms is the ability for vegetation to breathe out cool air, and the additional cooling that occurs through evaporation of moisture from the soil. But the most critical aspect of optimising these cooling effects is the presence of water in the soil to contribute to evaporation, and to ensure the vegetation is healthy and can "transpire", or breathe out cool air (Lobell, et al, 2008).

There are many studies that have shown the reduction in air temperature between irrigated and unirrigated areas in urban environments. These have a range of between 0.5°C and 12°C air temperature difference (Ingleton and Hirschausen, 2019). There are several factors that influence these air temperature reductions, specifically the type of vegetation, the climatic conditions of the site and the extent of healthy, irrigated green infrastructure around the monitored site. The one fundamental requirement is that water is always present in the soil to support and optimise green infrastructure and the cooling functions that it provides.

Image credit: Zion Engagement and Planning

Creeks and riparian corridors

The waterways of the Aerotropolis are central to its identity, it landscape values and its ecology. These waterways are also key elements of infrastructure for the management of urban stormwater and flooding. The Strategy must therefore address how the creeks of the Aerotropolis are to be managed as part of the IWCM approach. As urbanisation progresses and places increasing pressure on the fragile ephemeral waterway systems, Sydney Water, as the trunk drainage authority, has an important role to play in ensuring that valuable waterways and riparian lands are protected and restored.

Sydney Water will require ongoing access to creeks and waterways for maintenance and management. Sydney Water will work with landowners and developers to secure appropriate access arrangements as riparian land management programs including a response to Caring for Country are rolled out.

As part of the Strategy, creeks in the Initial Precincts have been validated and mapped and vegetated riparian zones identified. Certain creeks have been identified for retention and all of these creeks should be restored and retained in a naturalised state. Details of riparian land management can be found in the 'Aerotropolis Riparian Corridors Assessment Report' (Sydney Water, 2021).

Natural drainage in the Aerotropolis

The trunk drainage system identified in the Strategy requires existing waterways to remain open natural channels. NSW Government policy has set a clear direction that natural waterways should be protected and restored in the Aerotropolis and, where creeks have existing natural riparian structure and vegetation, this should also be preserved. The Waterways of Wianamatta continue to have important cultural, spiritual and practical values for Aboriginal people. Spatial planning and water management infrastructure design is required to prioritise the most non-intrusive and natural interventions (Recognise Country Guidelines 2021). Waterways are also protected from development under the NSW Water Management Act 2000. However, there may be opportunity to sensitively realign smaller creeks as part of the development process. This is subject to any relevant approvals required from the NSW Natural Resource Access Regulator (NRAR) as well as careful consideration of potential heritage and environmental impacts. In all cases, the restoration and rehabilitation of natural waterways is supported by Sydney Water. As the trunk drainage authority for the Aerotropolis, Sydney Water views natural waterway systems as valuable environmental assets but also recognises that they have an important drainage function as critical 'green infrastructure' to support a growing urban area. Allowing waterways to hold and carry water in a way that mimics natural hydrology, rather than via an engineered drainage system means:

- **The speed at which water flows through the system is reduced and overland flows are more safely conveyed to better protect the community and property from flash flood events;**
- **The environmental and amenity values of the waterway can be maintained for the benefit of the community;**
- **The First Nation cultural values of waterways in this area are respected and preserved;**
- **The NSW Government's waterway health objectives can be achieved through the regional stormwater management system;**
- **The approach to water management is consistent with landscape-led planning and the vision for a cool and green Western Parkland City.**

Innovative stormwater management systems integrated into urban spaces creating cool, green and liveable places.

Image credit: Bligh Tanner


JVD - 892

Implementation

As the trunk drainage authority and primary water service provider for the Aerotropolis, Sydney Water will work closely with Councils, NSW Government agencies and developers to ensure that infrastructure and services are provided in a timely manner to meet the needs of the growing Aerotropolis. Sydney Water has established policies and processes for working with developers to deliver essential water infrastructure. Details on how to engage with Sydney Water throughout the design and delivery of new development can be found in Sydney Water's 'Land development guide: What you need to know when developing'.

Planning controls and approvals

Effective water cycle management requires the integration of land use planning and water management at the earliest stages of the strategic planning process. Sydney Water worked closely with NSW Government planning agencies and Councils as precinct planning was being developed to align and embed the Strategy into the Aerotropolis planning framework. The following instruments and plans include development controls related to the Strategy and should be referenced in the design of all proposed development in the Aerotropolis:

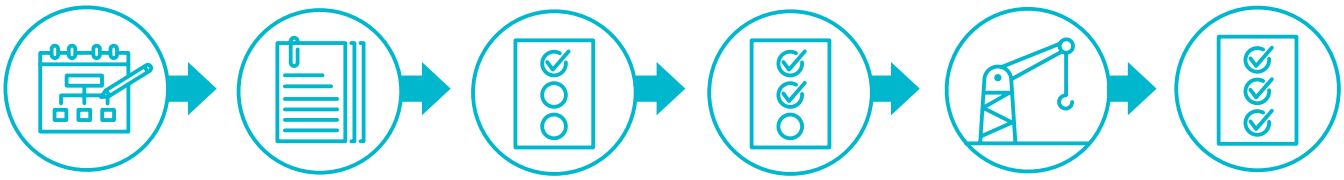
- WPC SEPP and Industry and Employment SEPP:
  - Identify land to be acquired for stormwater role in the planning process.
  - Identify other stormwater infrastructure in an overlay.
- Precinct Plans:
  - Detail stormwater flow and quality objectives to be achieved.
  - Require connection to regional stormwater infrastructure.
  - Require connection to recycled water.
  - Allow for floor space ratio incentives in certain zones for dedication of stormwater land.
- Development Control Plans
  - Provide standards and benchmark solutions for achieving stormwater objectives on lot, in streets and in open space.
  - Provide detailed controls and specifications for street trees, WSUD and provisions for street drainage and other water services infrastructure.
  - Detail on-site permeability requirements for different development types.

As the trunk drainage authority and water services provider for the Aerotropolis, Sydney Water will have a role in the planning approvals process to ensure that development addresses and responds to the Strategy for water management.

Throughout the planning approvals process, there are some key points where Sydney Water will need details on planned development and may need to review plans and specifications. The diagram below illustrates the typical interface between the planning approvals process and IWCM requirements, including engagement with Sydney Water.

Interim servicing

Sydney Water is committed to working with developers for interim servicing of early developments prior to the implementation of trunk water infrastructure. Interim solutions may include decentralised systems, tankering or temporary stormwater management infrastructure.



Prelodgement

- Review relevant Sydney Water Scheme plans for IWCM requirements.
- Consult with Sydney Water in relation to your proposal and water servicing requirements.
- Agree IWCM concepts with Sydney Water.
- Sydney Water can issue a Notice of Anticipated Requirements to guide the design of your development.

Lodgement/ Assessment

- Your development proposal may be referred to Sydney Water for review and comment.
- Sydney Water may request modifications to development proposals to meet IWCM requirements.

Determination

- Conditions of consent may be imposed to meet IWCM requirements. You may be required to deliver water infrastructure as part of your development and provide access to assets for ongoing management and maintenance.
- Once development consent has been issued, Sydney Water can issue a Notice of Requirements for detailed specifications for water infrastructure, servicing and connections.

Construction Certificate

- Sydney Water may need to see detailed construction drawings and engineering specifications for regional/trunk infrastructure to be delivered as part of development.

Delivery

- Connections to Sydney Water's trunk infrastructure and any assets to be handed over to Sydney Water for management will be inspected and signed off prior to handover of assets.

Occupation/ operations

- Sydney Water issues a Section 73 certificate to confirm compliance with IWCM requirements prior to issue of an Occupation Certificate or registration of subdivision.
- Any relevant contributions or dedication of assets will be payable prior to issue of the Section 73 Certificate.

Stormwater management

Land for acquisition

The WPC SEPP identifies the stormwater land to be acquired by Sydney Water. This is generally lands required for the construction and permanent operation of regional wetlands/ storages. Stormwater land identified for acquisition will be purchased in stages, to meet the needs of development in the Initial Precincts. All acquisition will be in accordance with the provisions of the Land Acquisition (Just Terms Compensation) Act 1991.

Trunk drainage channels are also important stormwater assets. These are typically natural creeklines which are protected under the NSW Water Management Act 2000. All trunk drainage channels are to be rehabilitated/reconstructed to a naturalised state and an easement for access is to be provided in accordance with standard terms, no cost to Sydney Water for ongoing management and maintenance.

Stormwater assets

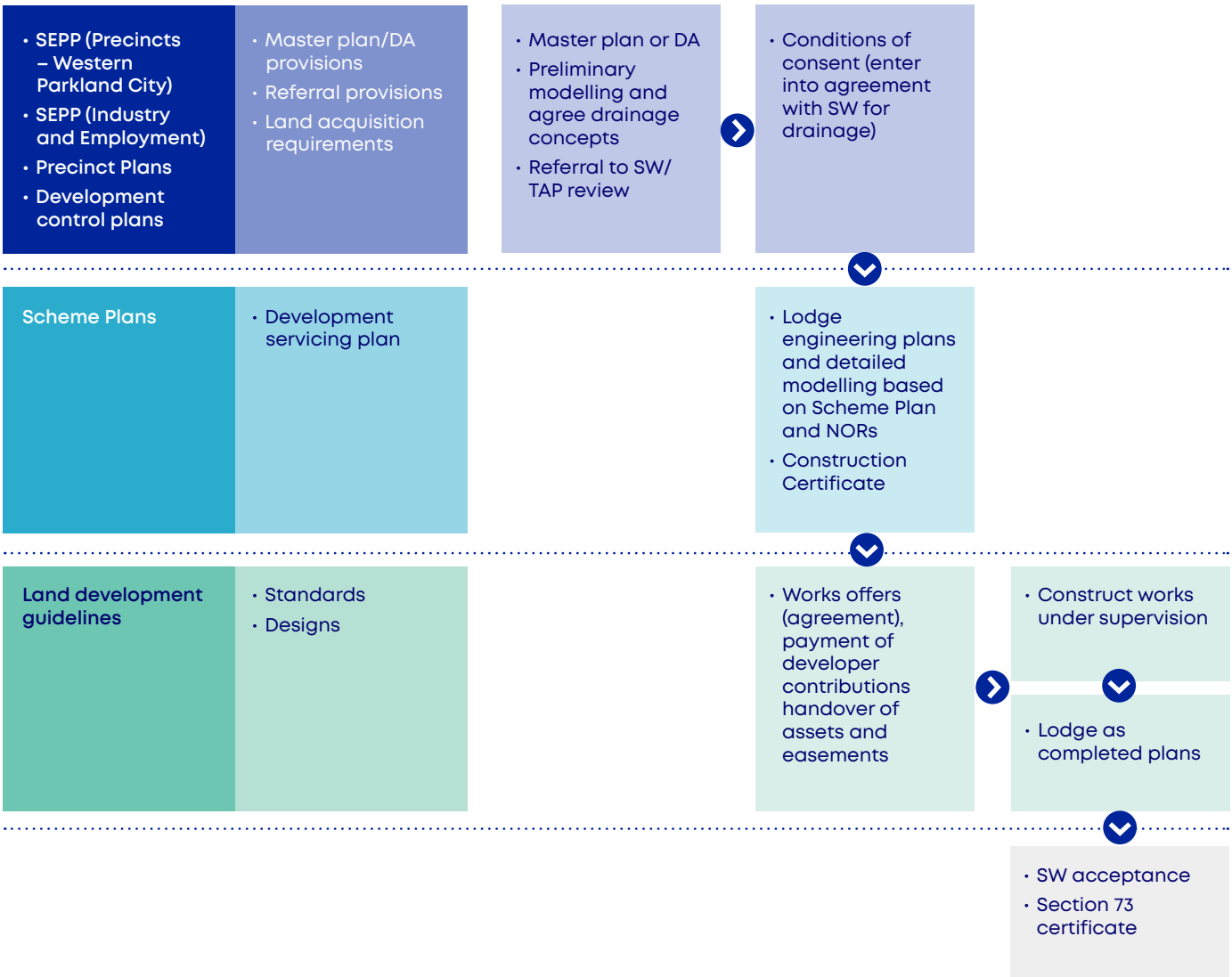
The delivery and ongoing management of different stormwater assets is outlined in the table on the following page.

Stormwater Catchment Scheme Plans are being developed for the Aerotropolis and will provide clarity on the specifics of the regional stormwater infrastructure to be delivered. Where regional infrastructure is delivered as 'works in kind', it must be delivered in accordance with the requirements of Sydney Water and dedicated to Sydney Water once completed.

Street tree cross section artist impression.
Image credit: Bligh Tanner

Infrastructure Type	Delivered by	Owned/ managed by
Private On-lot measures such as pervious areas, gross-pollutant traps, on-site detention and on-lot drainage	Landowner/developer	Landowner/developer
Local Street trees, street drainage and local drainage mains	Developer or Council	Council
Regional Trunk drainage channels and wetlands	Sydney Water or developer	Sydney Water

Stormwater approvals process



Design considerations

Environmental issues

The Aerotropolis is affected by a range of constraints that must be considered when planning for water, wastewater and stormwater. The Strategy responds to these constraints at a strategic level, however further consideration of these issues will be required in the design and delivery of water infrastructure.

The table below highlights some of the key issues that will require design responses in the implementation of the Strategy. Further details and guidance are available in the Aerotropolis DCP.

Issue	Design considerations
Waterway health	Combined on-lot, in-street and regional infrastructure must meet NSW Government waterway health targets.
Stormwater detention	Stormwater detention should be designed to meet the relevant requirements of the Aerotropolis Phase 2 Development Control Plan and Mamre Road Precinct Development Control Plan.
Riparian corridors	Refer to riparian corridor strategy for top of bank mapping and designated VRZs to inform setbacks for development and stormwater assets.
Salinity	Appropriate shallow groundwater management according to Hydrologic Landscapes Mapping to ensure no significant increase in groundwater recharge or mobilisation of salts.
Farm dams	Some farm dams are mapped for retention. Many will be removed or need to be redesigned to address issues such as dam stability, safe access, water quality, algal bloom risk, water level fluctuations and wildlife attraction.
Wildlife risk	Waterbodies can support large bird populations that pose a risk of aircraft strike. The WPC SEPP and DCP provide mapping of the extent of this risk. Wetlands and ponds to be designed and maintained to address the risk of potential wildlife strike to airport operations.
Heat and climate	Reliable and cost-effective water supplies must be available to support urban green cover and mitigate extreme urban heat. The level of service provided by stormwater assets must not be compromised by the potential impacts of climate change on rainfall intensity.

Maintenance and safety issues

All stormwater assets should be designed to minimise maintenance and lifecycle costs while still achieving their intended functionality. Design principles for stormwater infrastructure in the Aerotropolis include:

- Appropriate flood immunity with minimal impact on developable or otherwise functional land
- Elevation above frequent water levels in adjacent waterways to ensure functionality is not impeded by local flooding
- Bypassing of flows exceeding the six-month flow and up to one-year flow
- Minimising algal bloom risks in open water bodies through nutrient management on inflows, appropriate residence times and depth profiles, and management of the water column through macrophyte planning
- Allowing wet weather access to the top of any extended detention zone using a nine metre long rigid vehicle
- Consolidating maintenance activities into areas of easy and safe access and work with prevailing conditions
- Drainage without the use of pumps (where practicable) or physical attendance of maintenance staff at site

- Allow for staged maintenance without taking an entire WSUD element offline
- Avoid materials that can be vandalised or broken, or provide protection of vulnerable elements (e.g. wetland outlet risers).

Public safety is also a key consideration in the design of stormwater infrastructure, especially where it is integrated into the landscape. Community interaction with waterways and blue-green infrastructure is an aspiration for the Aerotropolis, but this must be balanced with potential risks to public safety. Design principles to mitigate public safety risks include:

- Flood risk and flow patterns are not worsened on existing development by generally avoiding the 1% AEP floodway
- Pedestrian/bicycle routes are inundation free and playground facilities up to the 10% AEP (one in ten year) flood level
- Ensure no more than 1.2m deep stormwater over pedestrian/bicycle routes, active open space and playground facilities up to the 1% (one in 100 year) flood level
- Ensure pedestrian egress paths lead away from high flood hazards, along grades no steeper than 1(V):6(H)
- Risk of drowning and fall injury minimised through appropriate level changes, internal batter slopes for egress and inclusion of balustrades where necessary
- Appropriately timed irrigation periods and disinfection where necessary to minimise risk of human exposure and/or ingestion of pathogens.

Stormwater and recycled water charges

A Development Servicing Plan (DSP) will be prepared for the Aerotropolis Initial Precincts. The DSP will identify the recycled water and stormwater infrastructure and ongoing servicing required to provide an appropriate level of service to new development in these areas.

The DSP will detail the capital and operational costs of providing these services to the Aerotropolis Initial Precincts and apportion the costs equitably across all customers.

To ensure that contributions and charges are fair and reasonable, the Independent Pricing and Regulatory Tribunal (IPART) will undertake a review of Sydney Water's proposed servicing plans and set the prices that can be charged for all of its products and services including recycled water and stormwater. Any contributions set through this process must be paid in full prior to issue of a Section 73 certificate.

It is important to note that stormwater contributions and charges under the DSP will be limited to regional infrastructure and services only. Local stormwater infrastructure such as street drainage and street trees will not be covered by the DSP and any contributions required will be included in the relevant local contributions plan. There is no overlap or duplication between Sydney Water's DSP and council local contributions plans.

Supporting documents

This report provides an overview of the Strategy for the Aerotropolis which was developed based on the Aerotropolis Initial Precincts 'Stormwater and water cycle management study' (Sydney Water, 2021). Technical details and options analysis can be found in the study at Western Sydney Aerotropolis (Initial precincts) Stormwater document. Further supporting information to assist in the design and delivery of IWCM infrastructure can be found in the following key documents:

Issue	Reference document
Integrated water cycle management	Sydney Water (2021) 'Stormwater and water cycle management study'.
Riparian land management	Sydney Water (2021) 'Aerotropolis riparian corridors assessment report'.
Connection to/delivery of Sydney Water infrastructure	Sydney Water. 'Land development guide: What you need to know when developing'.
High ecological value mapping	DPE (2022). Mapping the natural blue grid elements of Wianamatta-South Creek: High ecological value waterways, riparian vegetation communities and other water dependent ecosystems. NSW Department of Planning and Environment, Parramatta.
Stormwater objectives	DPE (2022). Performance criteria for protecting and improving the blue grid in the Wianamatta-South Creek catchment: Water quality and flow related objectives for use as environmental standards in land use planning. NSW Department of Planning and Environment, Parramatta.
Stormwater development targets	DPE (2022). Wianamatta-South Creek stormwater management targets. NSW Department of Planning and Environment, Parramatta.
Water Sensitive Urban Design Options	DPE (2022). Review of water sensitive urban design options for Wianamatta-South Creek. NSW Department of Planning and Environment, Parramatta.
Stormwater technical guidance	DPE (2022). Technical guidance for achieving Wianamatta-South Creek stormwater management targets. NSW Department of Planning and Environment, Parramatta.

(Contact DPE for these documents)

For further information on Sydney Water's integrated water infrastructure, please go to www.sydneywater.com.au

The final servicing configuration, including charges, are to be approved by the Sydney Water Board and NSW Government.