WaterNSW

Greater Sydney's Water Supply System Yield

January 2025

Table of contents

Current Yield

Greater Sydney's water supply system yield was re-calculated in December 2022 following the release of Greater Sydney Water Strategy 2022 (GSWS).

Greater Sydney's water supply system yield is currently 540 GL/a.

Background and Context

The Surface Water Supply System

WaterNSW supplies raw water for treatment and distribution by Sydney Water. The Sydney Desalination Plant (SDP) supplies treated water directly into the potable water supply distribution system. The water supply system servicing Greater Sydney is configured and operated to optimise yield, taking into account all sources of water.

The WaterNSW water supply system for Greater Sydney is an integrated network of dams, pipelines, canals, tunnels and rivers that has been designed, and is operated, to optimise overall water supply outcomes. It includes:

- the Warragamba system: comprising Warragamba Dam and the pipelines that connect the dam to the Prospect Water Filtration Plant and Prospect Reservoir
- the Shoalhaven system: comprising Tallowa Dam, Fitzroy Falls and Wingecarribee reservoirs, pipelines, canals and pumping stations which supplies local communities and Sydney via transfers either to the Warragamba system or the Upper Nepean system
- the Upper Nepean system: comprising Cataract, Cordeaux, Avon and Nepean dams, two diversion weirs and the Upper Canal that delivers water into Prospect Water Filtration Plant and/or Prospect Reservoir; this system supplies water to Sydney, the Illawarra, Macarthur and surrounding villages of Picton, Bargo and Thirlmere
- the Prospect system: comprising Prospect Reservoir and the Prospect Raw Water Pumping Station that delivers water into the Prospect Water Filtration Plant
- the Woronora system: comprising Woronora Dam, and supplies Sutherland and adjacent villages
- the Blue Mountains system: comprising the Cascades (x3), Greaves Creek and Medlow dams that supply the upper Blue Mountains. Water can also be transferred to the upper Blue Mountains from the Fish River Water Supply Scheme, which originates at Duckmaloi Weir.

All of the systems in the network contribute to WaterNSW's capacity to supply water, and any changes to the system infrastructure, or the operating rules that apply in any part of the system, affect the overall system yield.

Sydney Desalination Plant

When operating at full capacity, Sydney's desalination plant at Kurnell can produce 91 giga-litres of water a year (about 17 percent of greater Sydney's current potable water demand).

Water from the desalination plant can be distributed to approximately 1.5 million people across the Sydney CBD, inner west, eastern suburbs, southern Sydney and parts of the Sutherland shire, and at times as far west as Auburn.

The desalination plant was commissioned in January 2010. The operating rules for the plant have been changed to full time flexible operation (2022 GSWS).

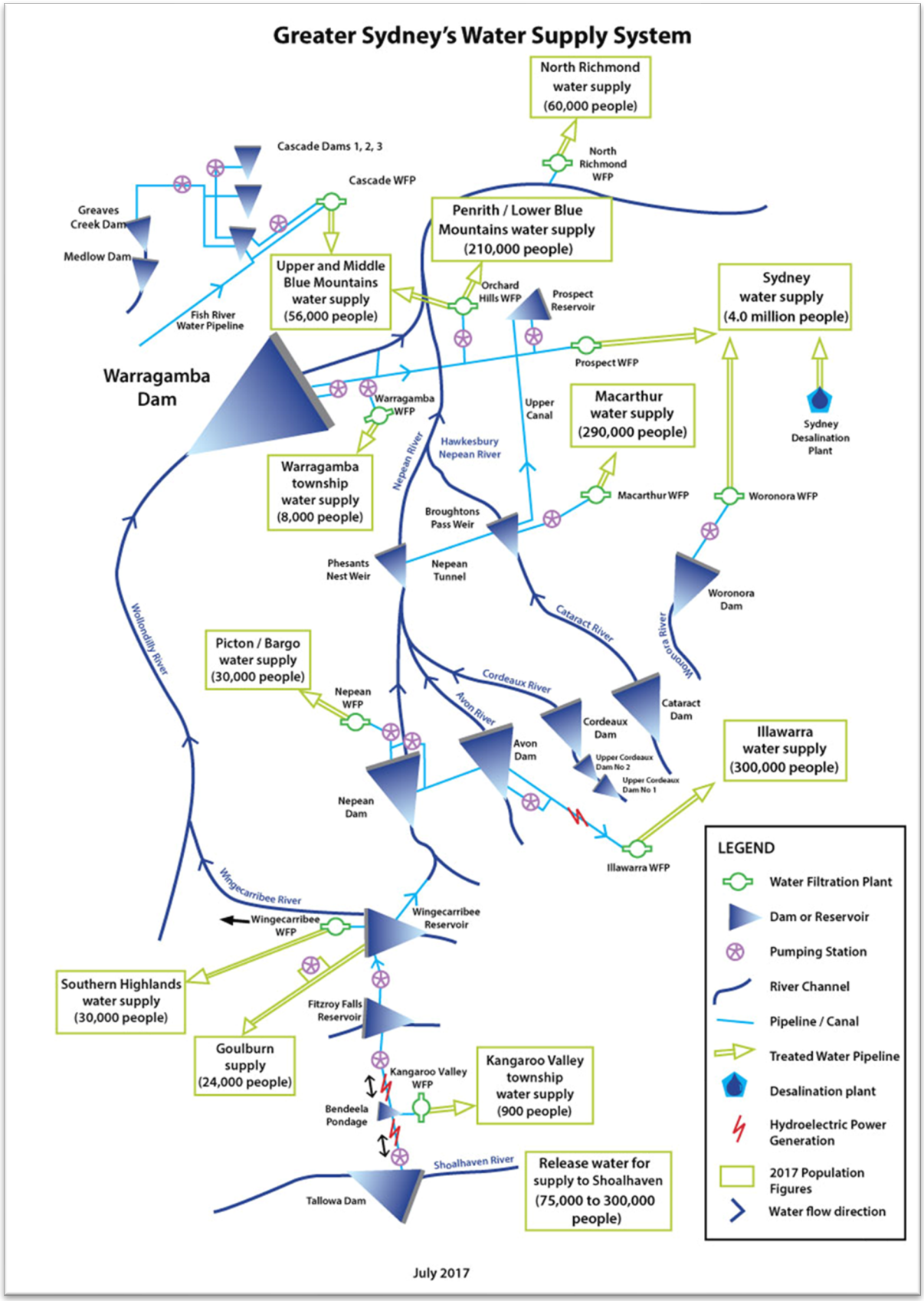

Figure 1: Greater Sydney water supply system

Regulatory Context

Under Clause 35(5), the 2024-28 Operating Licence requires WaterNSW to make available online:

a) The system yield, and a report explaining how it was calculated and
b) The design criteria.

Additionally, under Clause 35(3), the 2024-28 Operating Licence requires WaterNSW to re-determine and report any changes to its estimate of the system yield when any of the following occur:

- a drought affecting declared catchment areas concludes;
- a modification or augmentation to a catchment infrastructure work or customer's infrastructure commences that would have a significant impact on WaterNSW's supply of water in and from declared catchment areas;
- the Minister makes material change to the operating rules [of the water supply infrastructure]
- the department makes a material change to the design criteria; or
- the Minister requests WaterNSW to redetermine the system yield.

Calculating Yield

What is Yield?

The yield of the water supply system is the maximum amount of water that can be supplied annually on a sustainable basis, taking into account the constraints of the water supply system design criteria, and considering not just surface water but all sources of available water including desalinated water and drought triggered supply sources.

Yield is the average annual demand for water that can be met sustainably over the long term.

Yield is not static. It changes over time as inflows, infrastructure, demographics, the system design criteria and the operating rules for the system change.

How WaterNSW uses Modelling to Calculate System Yield

WaterNSW uses the Water Headworks Network (WATHNET5) software package to simulate the operation of the water supply system to calculate the system yield value against the design criteria.

WATHNET5 draws on 111 years of inflow data (1909-2019), and then replicates these flows by stochastic modelling to provide 10,000 synthetic inflow sequences each containing 111 years of inflows in order to estimate the system yield meeting the design criteria. The modelling incorporates both surface water inflows and desalinated water production, modelled with appropriate operating rules. All water recycling initiatives are treated by the model as 'negative demands' on the water supply system; in other words, these volumes are subtracted from the estimated water use (or demand).

This modelling allows WaterNSW to plan the optimal use of the water supply system based on a wider range of scenarios than the historical data alone. For example, it allows WaterNSW to plan how to

manage the water supply system during droughts that are more severe than any on historical record (the worst drought occurred in the period 2000-2006).

WaterNSW is also using this modelling capacity to participate in research that aims to assess the potential impacts of climate change on hydrology and system yield.

Water Supply system design criteria

The system design criteria used to determine the yield define the minimum 'standards of service' and are built into the model that estimates the likelihood of running out of water or facing water restrictions.

The design criteria for Greater Sydney reflect the length and frequency of water restrictions that is regarded as 'acceptable', as well as ensuring that water supplies are not depleted.

They are:

- **Security** - storages should not approach emptiness (defined as 5% of water in the storage) more often than 0.001% of the time, or one chance in 100,000 in any one month.
- **Robustness** – imposed water restrictions should not occur more often than once in every ten years on average. That is, restrictions should not be too frequent.
- **Reliability** – imposed water restrictions should not last longer than 5% of the time on average, or 5 months in 100 months.

.

Yield calculation

The maximum volume of water that can be extracted from the water supply system when all three system design criteria are satisfied is the system yield - the average annual demand for water that can be sustainably met over the long term.

Estimates of yield are based on assumptions about the likelihood of severe droughts occurring, as well as the historic experience with the water supply system and its hydrology. Yield is a long-term construct, however, and periods of low inflows (droughts) may see the design criteria temporarily exceeded.

While relaxing the design criteria increases the system's yield, it also increases the frequency or duration of water restrictions and/or increases the risk of water storages emptying. Whenever water restrictions are introduced, they too influence the system yield. For this reason, modelling work incorporates assumptions regarding the expected reductions in demand for water that can be achieved from the imposition of water restrictions

The calculation of yield is based on the design criteria and the characteristics of the water supply system and is based on these 1,110,000 years (10,000 replicates x 111 years) of synthetically generated inflows.

Analysing yield

Yield analysis can be used as a planning tool to help investigate a range of options for providing future water needs. For example, yield analysis can be used to assess the potential impacts of climate change or to investigate a range of possible management changes, including for example:

- implications of different desalination plant operating rules and staging;
- impacts of introducing environmental flows;

- short to medium term drought response measures;
- system optimisation (operating rules);
- asset reliability impacts;
- characterisation of floods and droughts;
- determination of dam depletion rates.

Contingent Drought Measures

The 2006 Metropolitan Water Plan (MWP) identified that if Sydney entered severe drought, several bore-fields could be built to tap into underground water sources (groundwater). Groundwater investigations were undertaken at Kangaloon and Wallacia/Leonay, but the plan to use groundwater was shelved in 2008 as the dams recovered at the end of the drought. The 2010 MWP reaffirmed that a decision to extract groundwater would be made in the event that Sydney's total dam storage falls to a level consistent with severe drought and with regard to seasonal weather outlooks and demand at the time.

2017 MWP did not include use of groundwater as a drought measure. However, it identified a number of possible drought measures including temporary desalination plants.

2022 GSWS has removed all drought triggered construction of desalination plants from the yield calculation and included continuous operation of existing desalination plant. The 2022 GSWS strategy has revised the reliability criterion from 3% to 5%.