

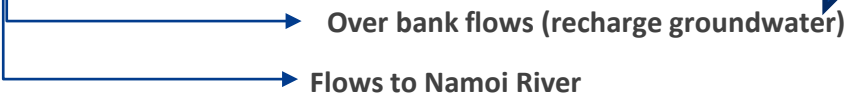
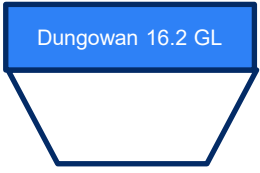
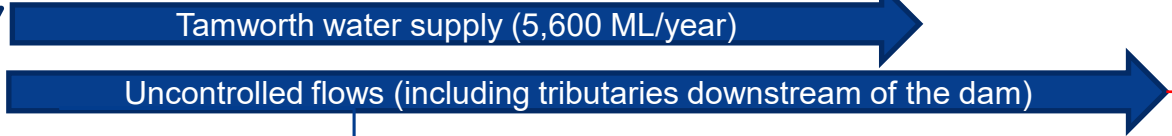
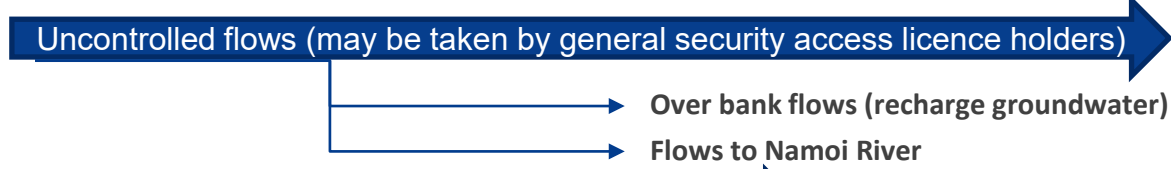
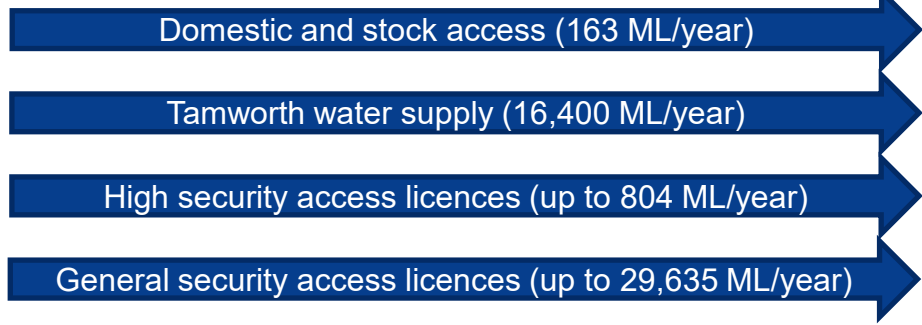
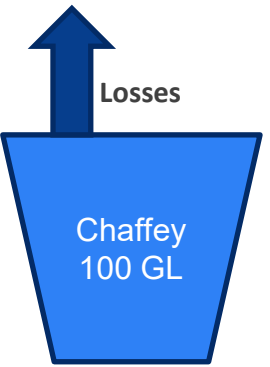
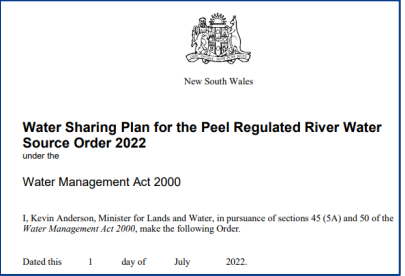
Urban water supplies and potential hydrogen-based demand

Stuart Khan

School of Civil & Environmental Engineering, UNSW

Australian Graduate School of Engineering, UNSW

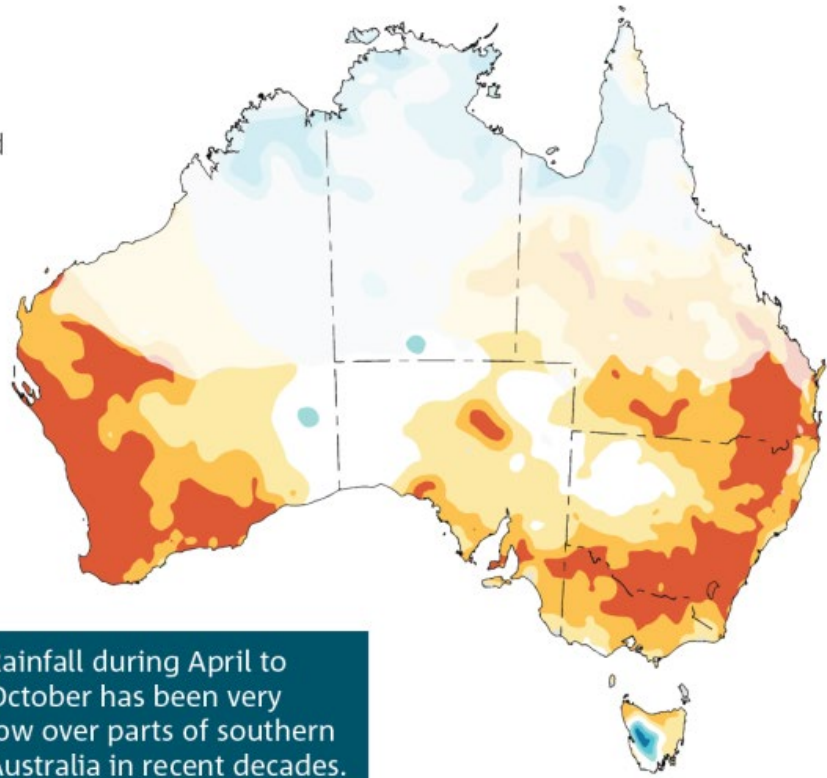
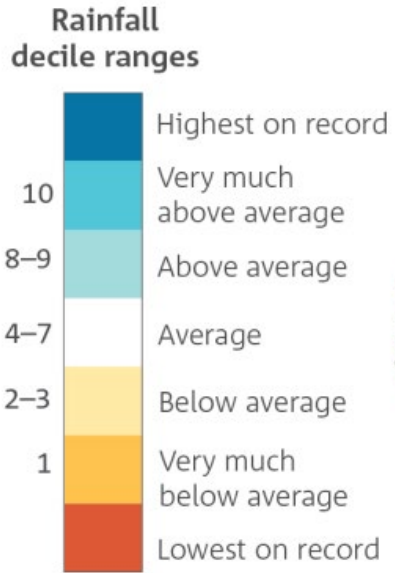




Total extractions limited by Namoi Surface Water Resource Plan (MDBP)



April to October rainfall deciles for the last 20 years (2000–19)

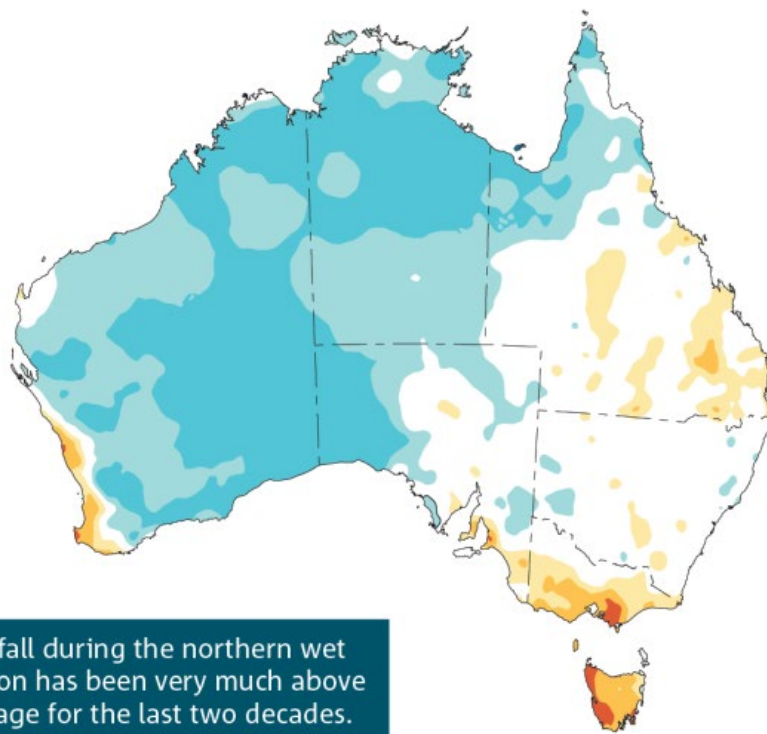
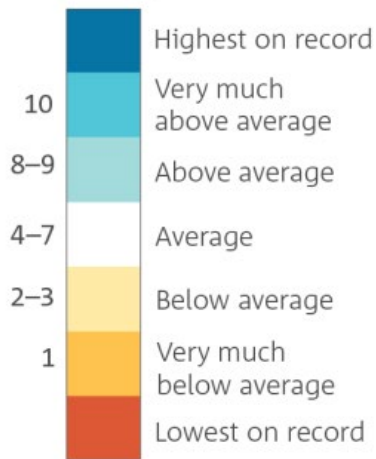


Source: Bureau of Meteorology

Rainfall during April to October has been very low over parts of southern Australia in recent decades.

Northern wet season (October–April) rainfall deciles for the last 20 years (2000/01 to 2019/20)

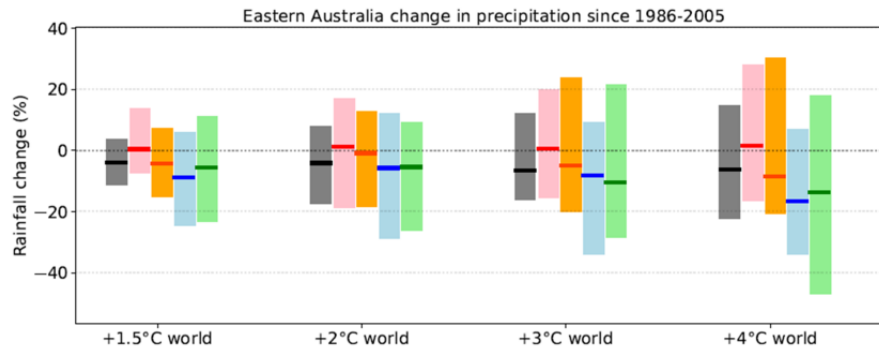
Rainfall decile ranges



Source: Bureau of Meteorology

Rainfall during the northern wet season has been very much above average for the last two decades.

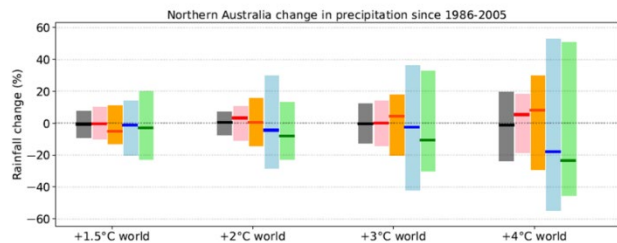
- Regions**
- Eastern Australia
 - Northern Australia
 - Rangelands
 - Southern Australia



- Annual
- Dec to Feb
- Mar to May
- Jun to Aug
- Sep to Nov

Decrease more likely than increase in winter and spring

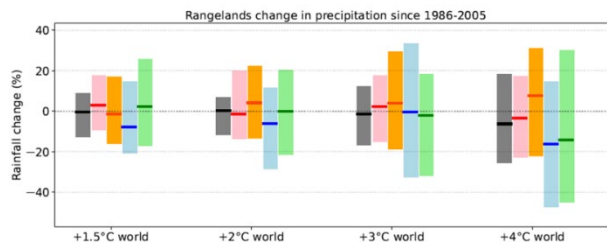
Significant change is possible at higher warming levels



- Annual
- Dec to Feb
- Mar to May
- Jun to Aug
- Sep to Nov

Projection uncertain – significant increase or decrease both possible

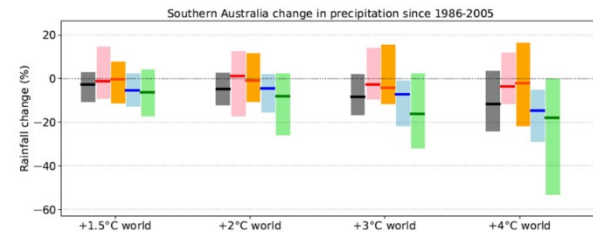
Note June to August and September to November is seasonally dry



- Annual
- Dec to Feb
- Mar to May
- Jun to Aug
- Sep to Nov

Change uncertain in most cases

Autumn and winter changes different at each warming level



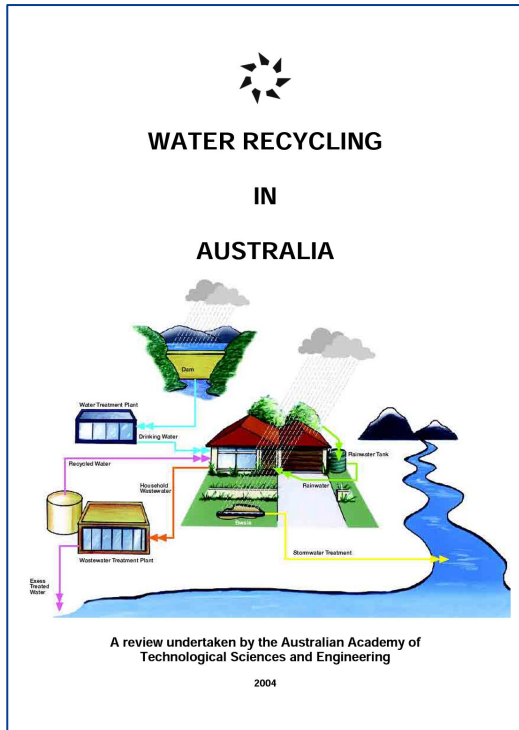
- Annual
- Dec to Feb
- Mar to May
- Jun to Aug
- Sep to Nov

Change 'signal' larger in magnitude through higher warming levels

Projection uncertain in summer and autumn

Drier in winter and spring, driving decrease in annual rainfall, but large range of possible change

In 2004...



State Capital	% recycled water use
SYDNEY	2.3
MELBOURNE	2.0
BRISBANE	6.0
ADELAIDE	11.1
PERTH	3.3
HOBART	0.1

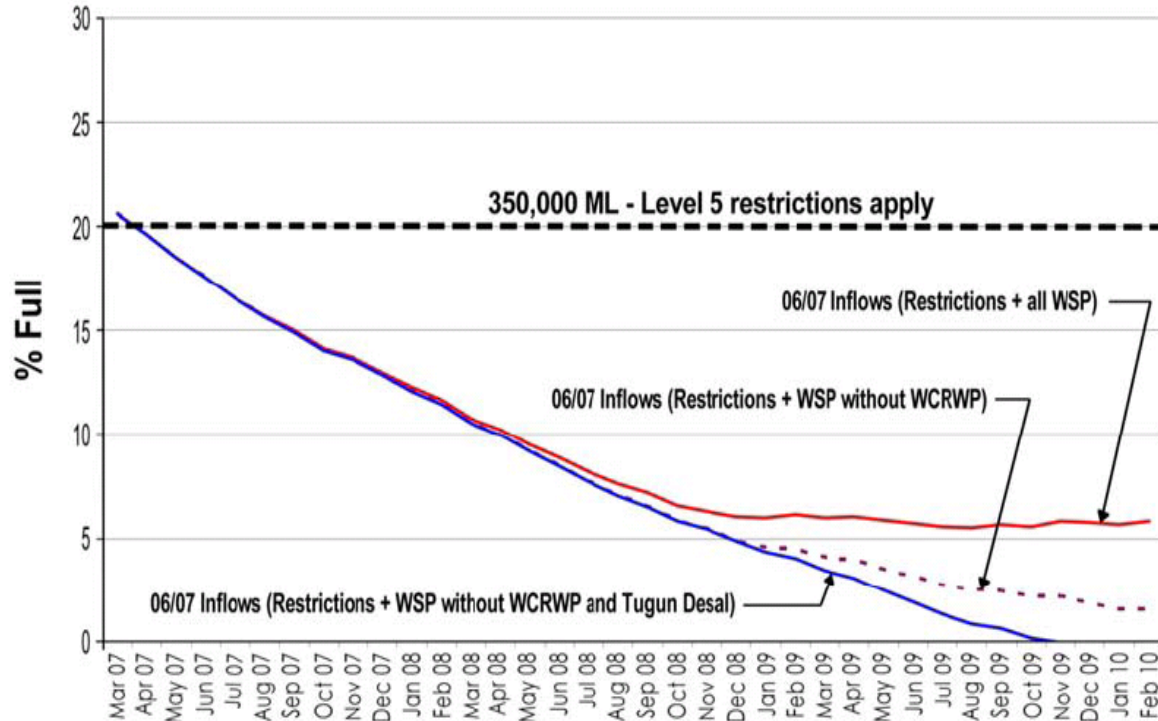
Wagga Wagga City Council



- Urban reuse ~6 GL/year
- Much used for sports ground irrigation
- Reduces potable water costs payable to Riverina Water County Council
- Reduces sewage discharge costs to Murrumbidgee



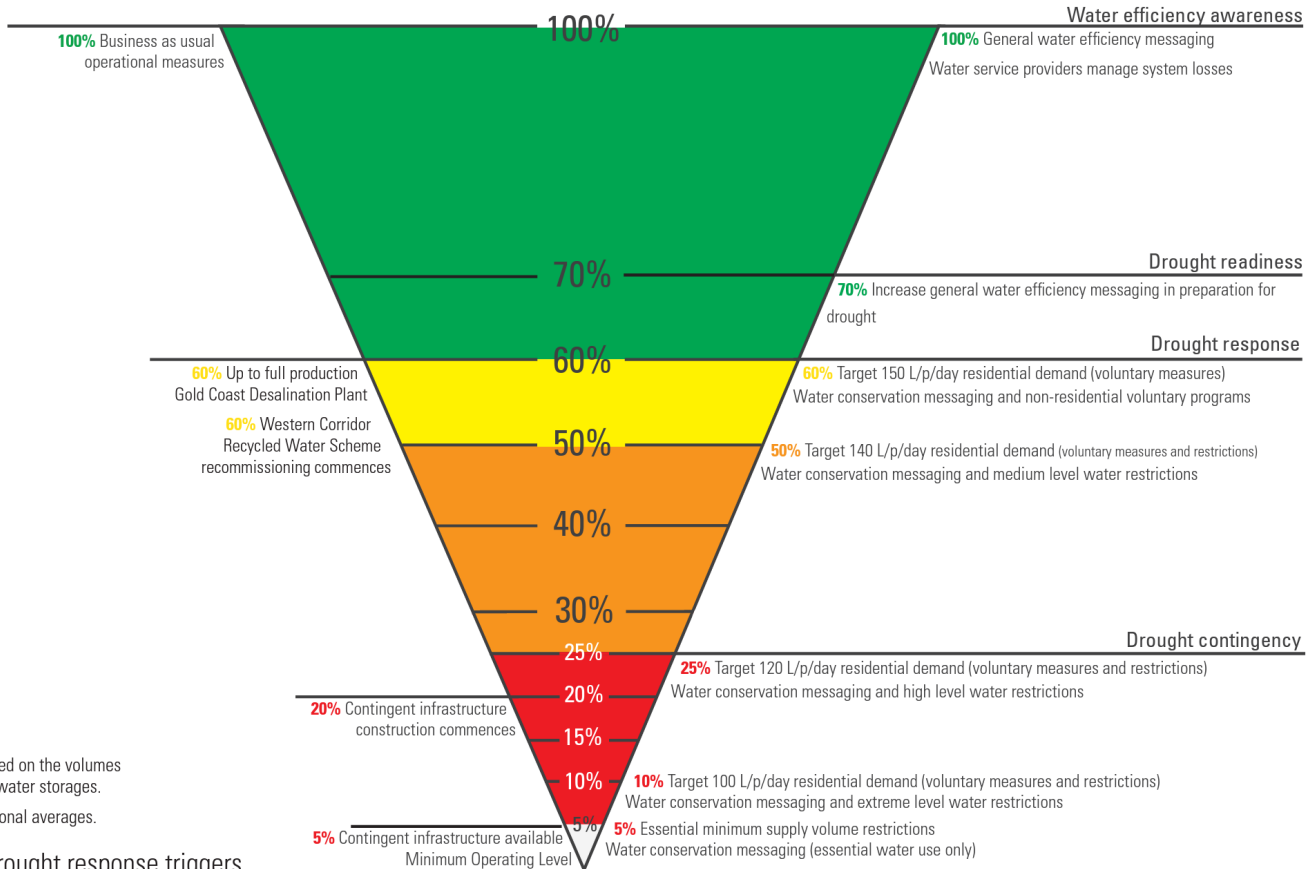
In 2007...



Forecast Dam Levels with Level 5 restrictions

WSP = Water Supply Projects

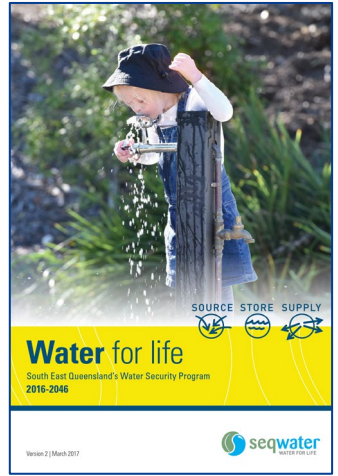
WCRWP = Western Corridor Water Recycling Project



Notes:

1. Percentages are based on the volumes of the SEQ key bulk water storages.
2. Targets are SEQ regional averages.

Figure ES-4 Drought response triggers



WA's groundwater replenishment scheme set to double

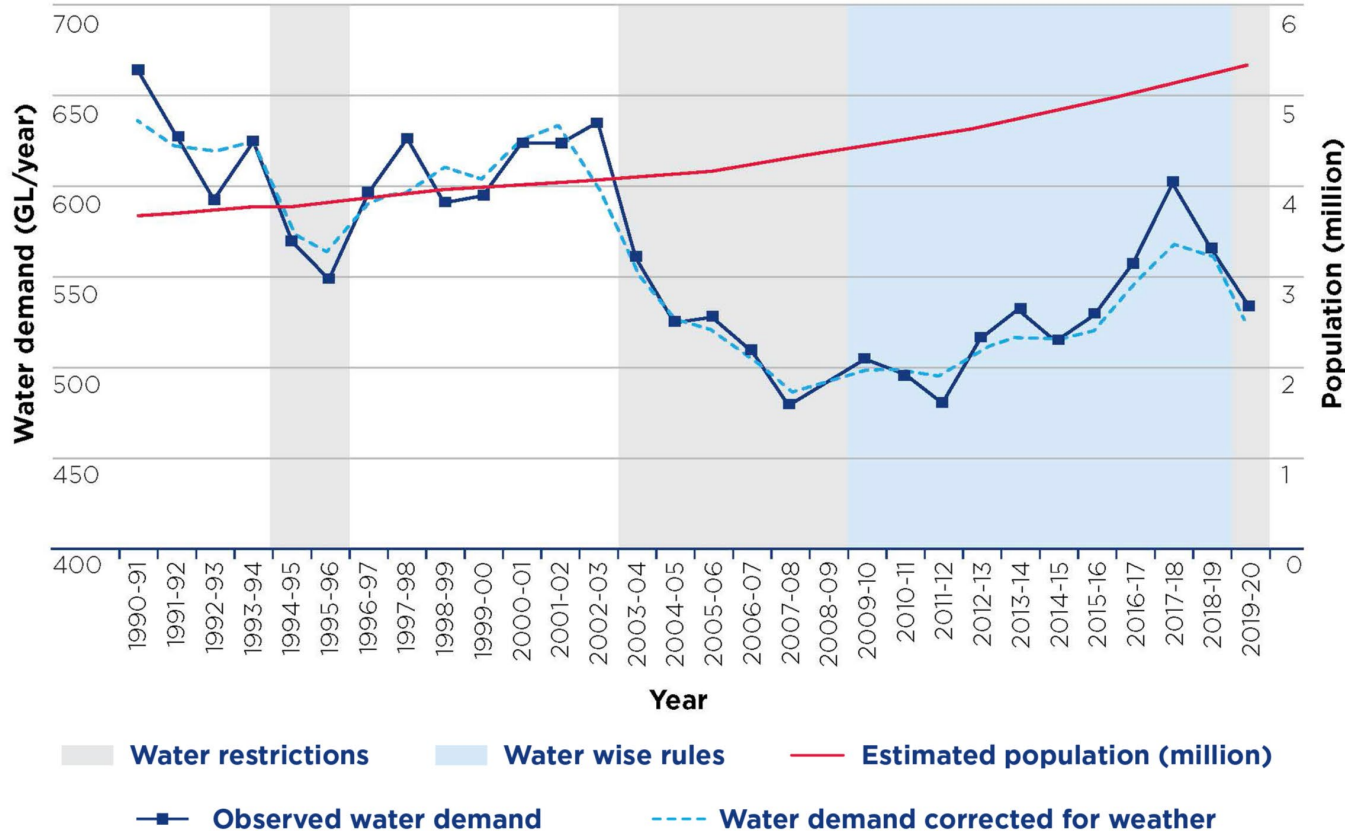
Oct 11, 2022 | 3 mins read

 by Cecilia Harris

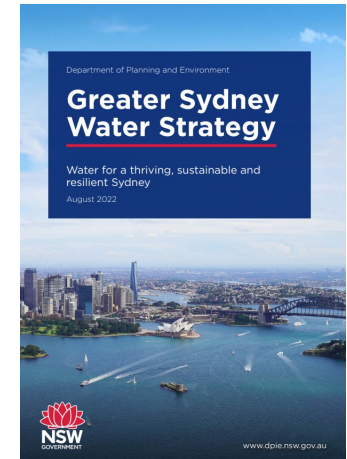


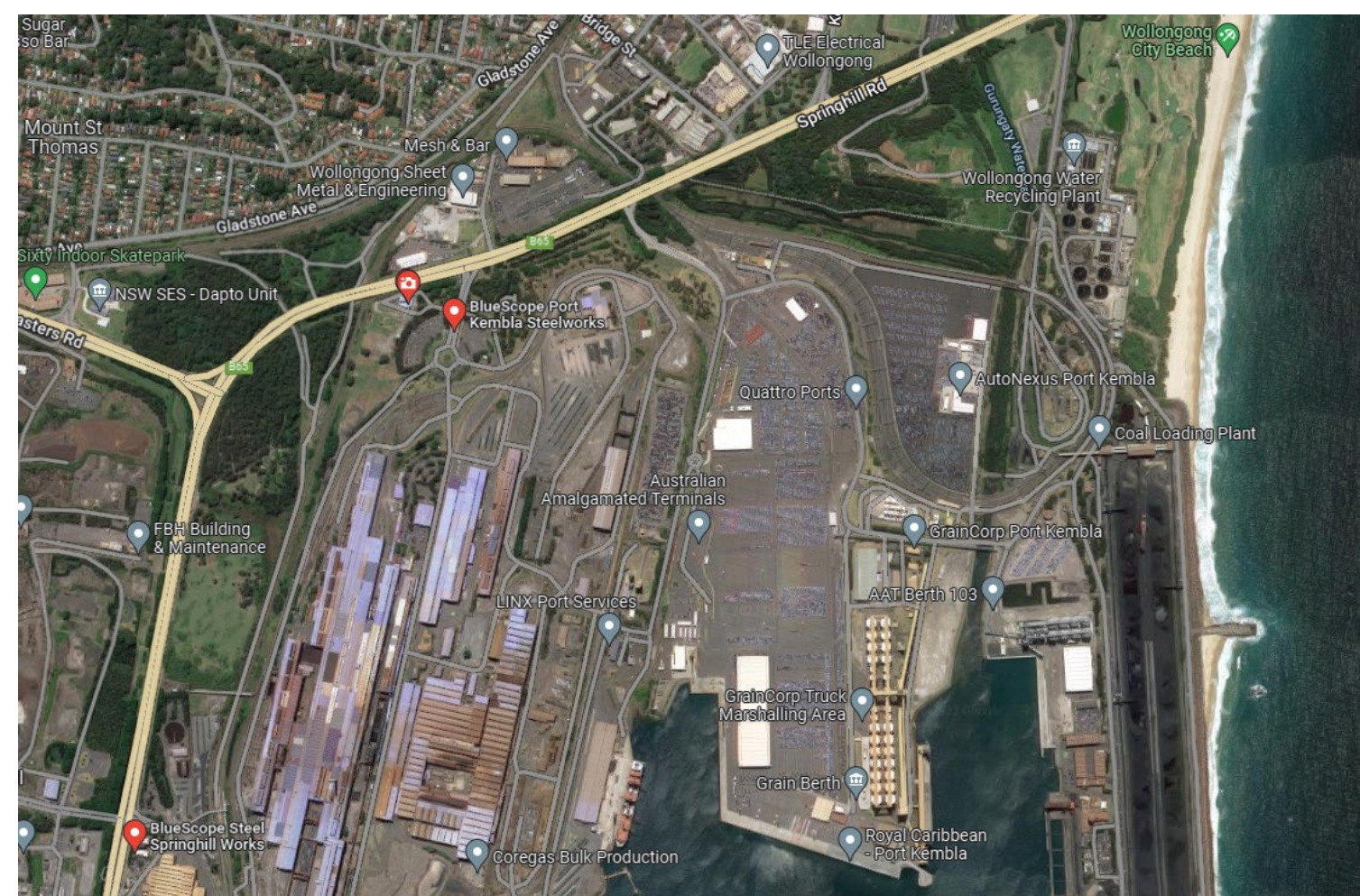
Water Corporation has taken a leap forward in securing Perth's water security with the commissioning of stage two of its groundwater replenishment (GWR) scheme, which now has a total annual capacity of up to 28 billion litres.

Historical demand for drinking water



Current demand: ~550 GL/year





BlueScope extends recycled water agreement

Wednesday, May 20, 2020

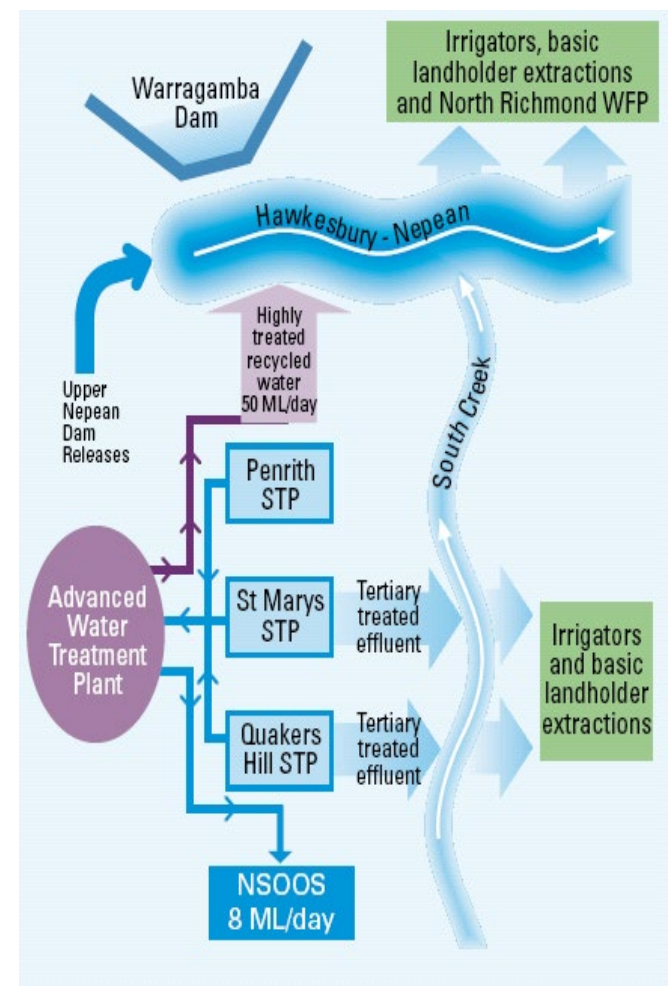


BlueScope has renewed its agreement with Sydney Water to use recycled water at the Port Kembla Steelworks.

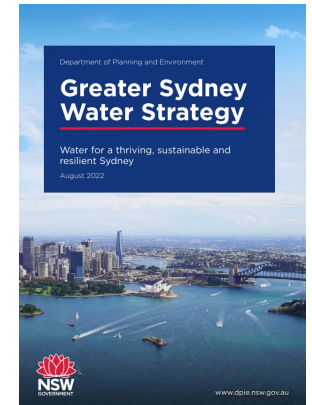
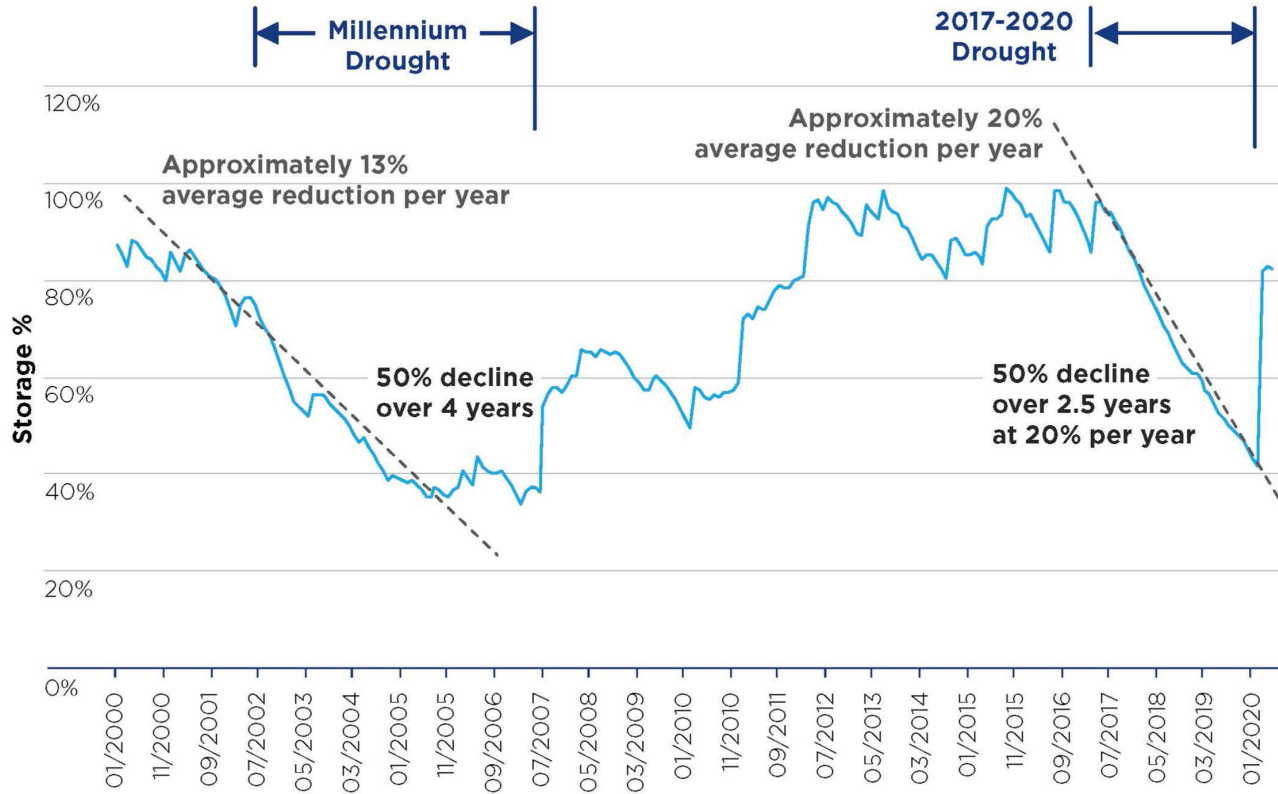
Watch the clip to hear more from John Nowlan, Chief Executive Australian Steel Products, Roch Cheroux, Managing Director Sydney Water, The Hon. Melinda Pavey MP, NSW Minister for Water, The Hon. Gareth Ward MP and Paul Scully MP.



The 'Replacement Flows' Project (Sydney, NSW)



Greater Sydney storage level profile 2000-2020



Department of Planning and Environment

Greater Sydney Water Strategy

Water for a thriving, sustainable and resilient Sydney

August 2022

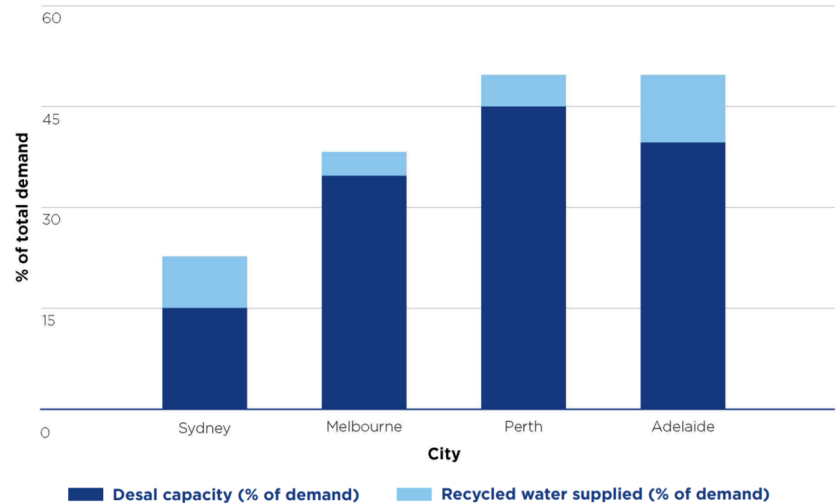


- **Greater Sydney has a low proportion of rainfall-independent supply**

Compared to other Australian cities, Sydney has a low level of rainfall-independent water supply (see Figure 6). Only the Sydney Desalination Plant (which provides around 15% of daily demand when operating at full capacity) and water recycling plants (providing up to only 8% of daily demand in Sydney) are rainfall-independent. By comparison, Melbourne (which has the next lowest level of rainfall independence) can meet 34% of

its water supply from rainfall-independent sources. This low level of rainfall-independent supply makes Greater Sydney vulnerable to rapid onset and prolonged drought. Increasing our proportion of rainfall-independent supplies would allow us to enter a future drought with higher water levels in our dams, slow down depletion rates during future droughts and enhance our ability to respond to other shocks in the system such as challenges to water treatment or network outages.

Figure 6. Rainfall-independent water supply: Sydney versus other cities



Sources: Australian Water Association, Desalination Fact Sheet, Bureau of Meteorology 2021, National performance report 2019/20, urban water utilities, part A.



By conserving more water and using it more efficiently,

we can save up to 49 GL/year by 2040 at a relatively low cost.



By changing the approach to operation of the Sydney Desalination Plant,

we can produce an additional 20 GL/year which would result in higher storage levels at the start of a drought and slow the rate of dam depletion during a drought.



By investing in a Demonstration Plant for purified recycled water

and engaging with customers we can highlight the safety of this proven technology and the range of beneficial uses for purified recycled water, including for supporting greening and cooling across our city. The plant does not form part of Sydney's drinking water supply and any future decision to include purified recycled water would be subject to community consultation and require stringent Government approvals.



By investigating portfolios of options for new sources of rainfall-independent supply, we can explore

various combinations of desalination and recycling options, including purified recycled water, that can provide up to 140 GL/year over the next twenty years. Any new water supply option, including desalination and purified recycled water, would only be introduced to Sydney's water supply system following community consultation and stringent Government approvals. Investigations into new rainfall-independent sources is targeted at increasing overall supply for potable and non-potable uses.



Building over time a level of enduring supply

capable of meeting the communities' minimum needs during periods of prolonged and extreme drought, irrespective of how long the drought lasts and the impact of climate change.

Department of Planning and Environment

Greater Sydney Water Strategy

Water for a thriving, sustainable and resilient Sydney

August 2022



www.dpie.nsw.gov.au

CURRENT

STAGE 1 2021-2025

STAGE 2 2026-2029

POTENTIAL STAGE 3 OPTIONS 2030-2060



Normal Operation

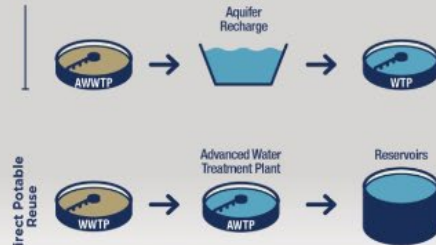
WTP - Water Treatment Plant
 WWTP - Waste Water Treatment Plant
 ANWTP - Advanced Waste Water Treatment Plant



Dry Period (Water restrictions imposed)

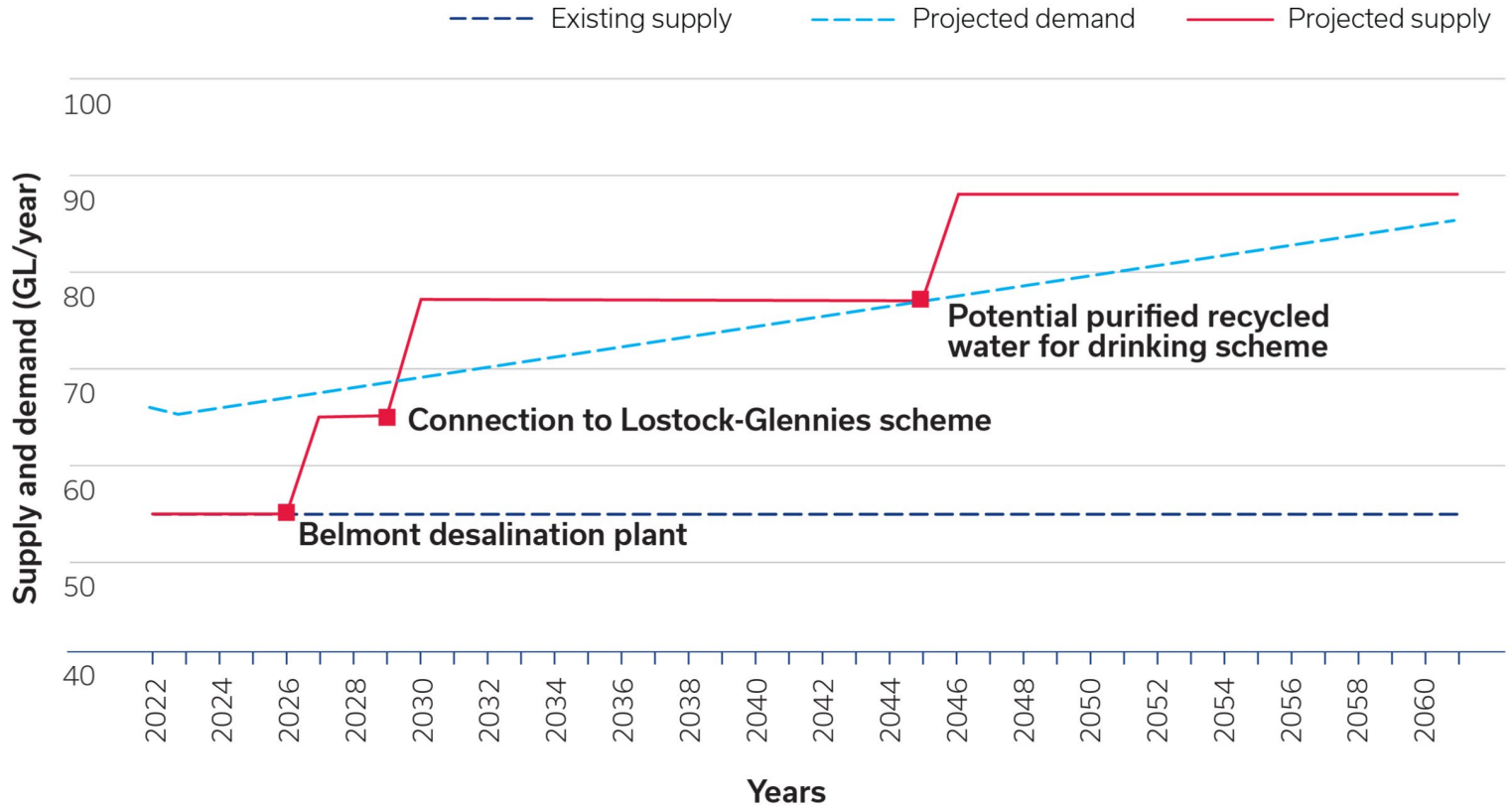


Emergency (Level 5 water restrictions imposed)



Possible desal locations include: Byron Bay, Lennox Head and South Ballina.

Lower Hunter Water Security Plan (2022)



4.2.3 Pillar 3 - Develop new rainfall independent supplies for an adaptive future

Purified recycled water at Wyong South WWTP



All water is recycled through the natural water cycle.

PRW purifies or treats wastewater to a level that makes it safe and suitable to go back into the drinking water supply.

Such schemes are already part of the water supply mix in over 35 cities around the world, including Australia.

Many towns and cities discharge treated wastewater into rivers and creeks, with further downstream extraction for drinking water supply.

PRW provides a reliable, climate independent source of water and is often lower in cost and more energy efficient than other climate independent options like desalination. It also reduces the water taken from the environment by reusing wastewater and reduces nutrient discharges to waterways.

The results of the online deliberative forums and public consultation indicated that the Central Coast community showed support for purified recycled water for drinking as a future water supply option.

Our approach in developing this option has four main actions:

- 1. Enhance our common understanding of PRW within the community:** We will work with NSW Government, Hunter Water Corporation, Sydney Water and the Water Services Association of Australia (WSAA) to further inform our community of assurances, processes and benefits of PRW.
- 2. Work with our regulators to develop confidence in PRW:** We will work with NSW Health to develop a comprehensive Human Health Risk Assessment compliance and monitoring program to ensure Human Health is protected in accordance with the Australian Guidelines for Water Recycling framework and the water produced meets the Australian Drinking Water Guidelines (ADWG) for all new sources of water.
- 3. Construct PRW facilities at Wyong South Wastewater Treatment Plant (WWTP):** We will develop our plans for PRW at Wyong South WWTP in a staged approach. This means we will:
 - complete a thorough drinking water risk management assessment of source water and treatment process at Wyong South to ascertain the risk management actions and treatment process required to protect public health
 - action the finding of the risk assessment to develop the treatment plant concept in the following phases:
 - develop a demonstration plant at Wyong South (this water will not be used within our drinking water system at this stage). This demonstration plant will develop:
 - regulatory compliance
 - required engineering and operational approach for full operations
 - a demonstration of the facility to demonstrate to the community understanding of this option through tours, engagement and education.
 - develop a full operational plant at Wyong South with an estimated potential production capacity up to 12 ML/d of purified recycled water for use within our drinking water system. It is envisaged at this stage that PRW will be delivered to Wyong River, upstream of the water supply weir. The water would be mixed with surface water from Wyong River and then be pumped to Mardi Dam where it would be mixed with surface water from Ourimbah Creek and Mangrove Creek Dam. Subject to the development of this program there are options to put it directly into Mardi Dam, Mardi Water Treatment Plant or directly into the water supply network which would improve the overall efficiency.
 - Water will only be provided to customers after satisfying a rigorous testing and monitoring regime to ensure it meets the ADWG.
- 4. Subject to 1-3 consider expanding PRW to other Wastewater Treatment Plants:**
 - We will monitor the performance of the PRW program for rigorous consideration in expanding this program to other facilities.

Initially we have assumed that approximately 6 ML/d of purified recycled water will be produced from Wyong South WWTP and transferred to Mardi Dam, via the Wyong River.

The proposed location of the advanced water treatment plant for PRW is at Wyong South WWTP (**Figure 20**).

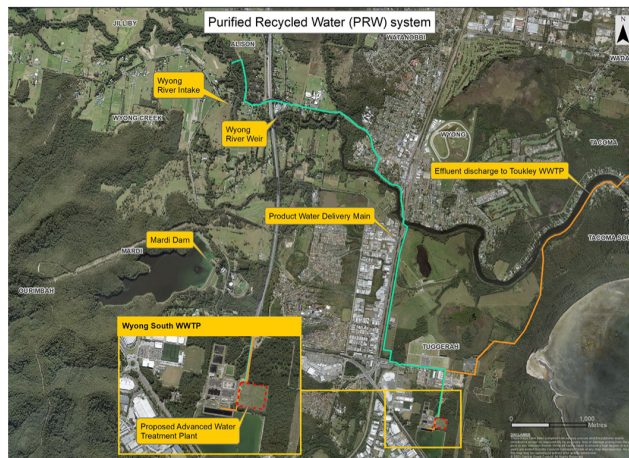


Figure 20: Location of the proposed PRW advanced water treatment plant

Benefits of purified recycled water:

- reduces the amount of water extracted from the environment for consumption
- reduces the amount of treated wastewater we discharge to the ocean
- enhances our drought response and resilience of the system by providing additional climate independent supply.



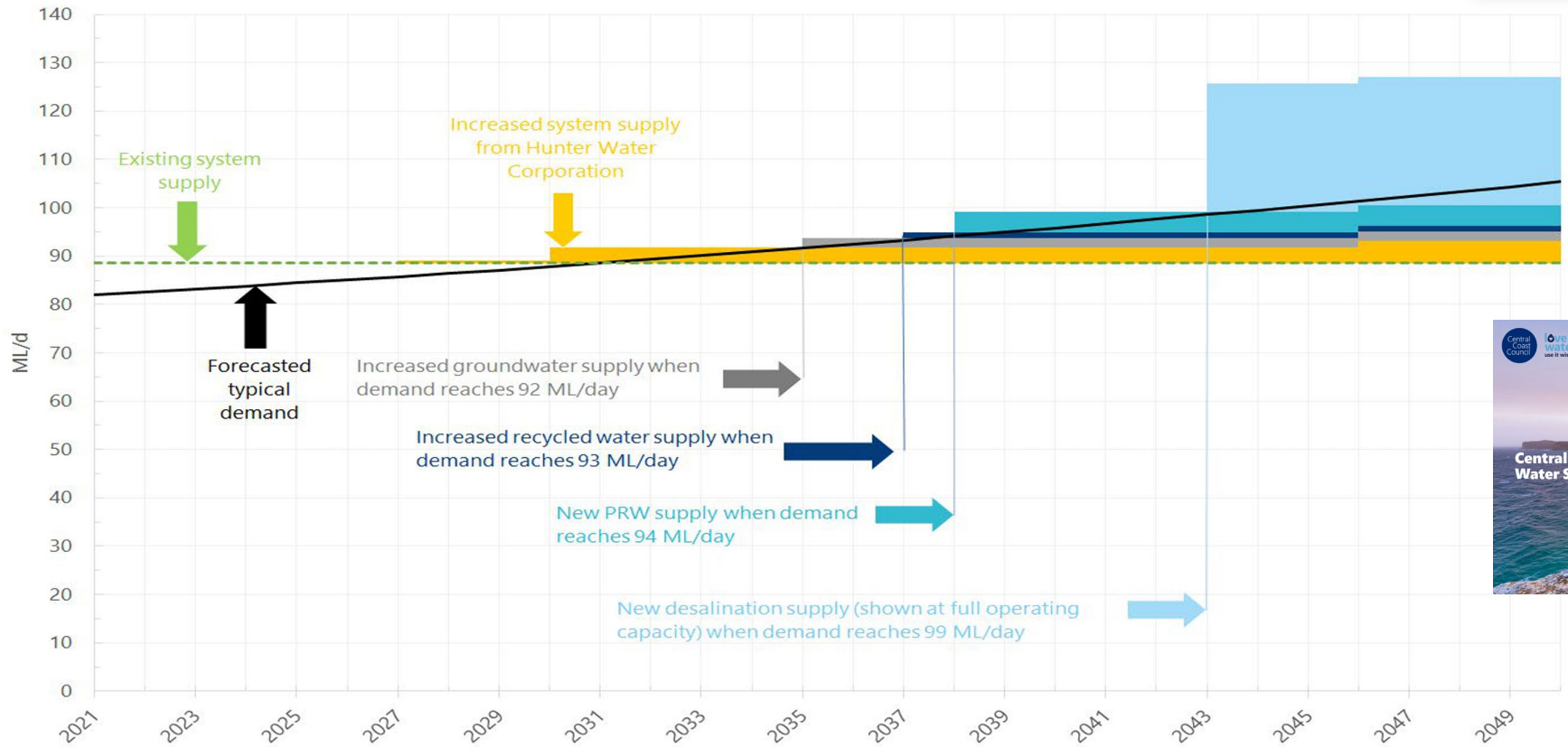


Figure 22: Indicative timing of new supplies

JUNE 24 2019 - 5:30AM

Should Tamworth recycle its wastewater in to drinkable water?



Jamieson Murphy

Latest News

[f SHARE](#) [TWEET](#) [MAIL](#) [COMMENTS](#)



RECYCLED IDEA: Mark Rodda has asked council to investigate if the city can recycle wastewater in to drinking water. Photo: Peter Hardin

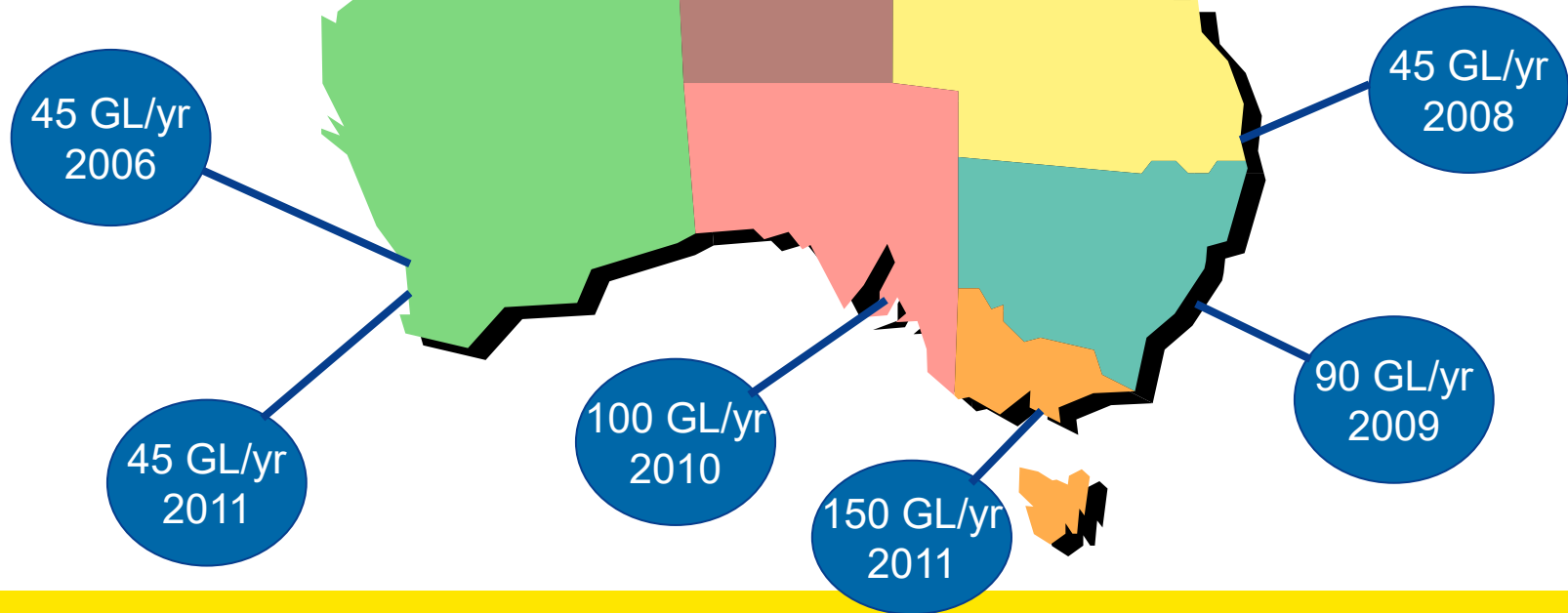
IN a city as dry as Tamworth, recycling wastewater in to drinking water is a "no-brainer", a local councillor says.

Mark Rodda says he's lost count of the times he's been asked by a member of the community why the city doesn't purify its wastewater.

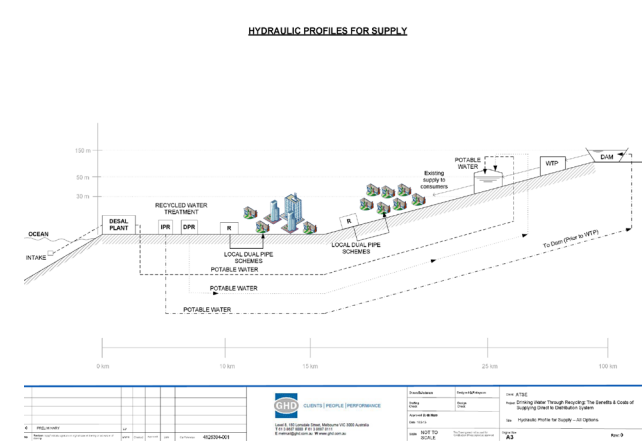
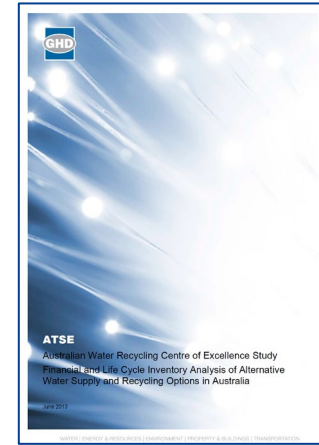
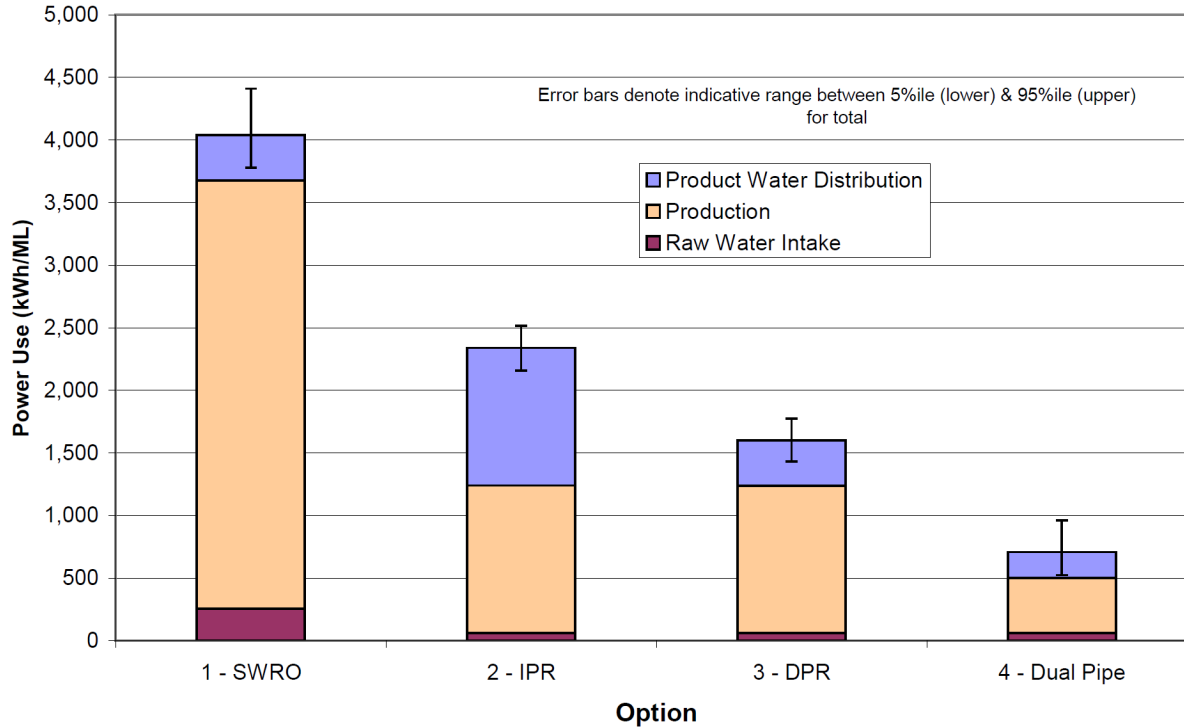
So at Tuesday night's council meeting, Cr Rodda will ask council staff to prepare a report in to the viability and cost of recycling the water at the Westdale Waste Water Treatment Plant in to "potable purified water for use in the reticulated water supply"

Seawater desalination

15-40% of local
potable supply

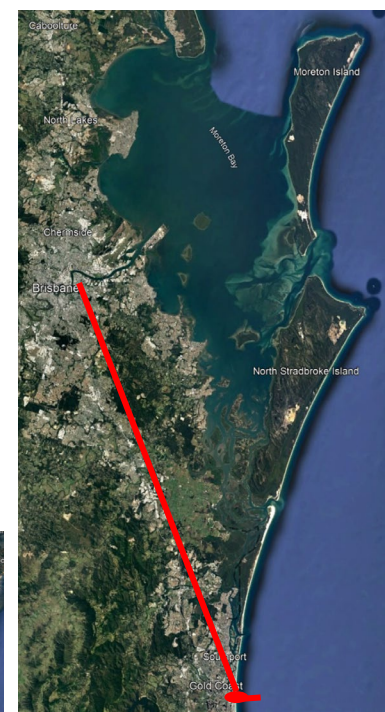
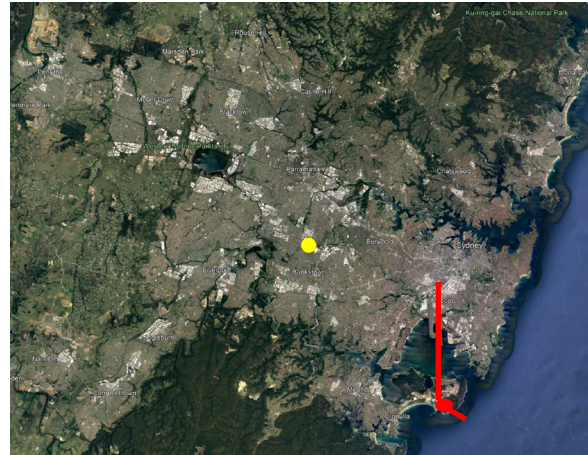
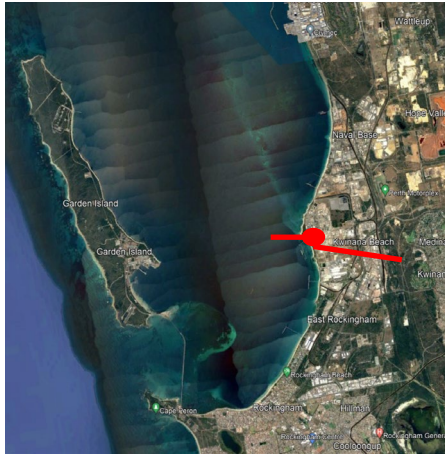


Flow-specific Power Use Breakdown, based on Product Water Flow (kWh/ML)



Some desal sites easier than others

- Intake
- Discharge
- Neighbours
- Power supply
- Water delivery/storage...



Questions

- Could hydrogen production help balance variable demand for water?
 - Potential significant advantages to water supply if AWTPs were instantly ready
- If seawater desalination is used then a very strong incentive to operate by the coast
 - How much is this incentive balanced by:
 - » Variable land costs?
 - » Variable energy costs?
 - » Costs to transport hydrogen?