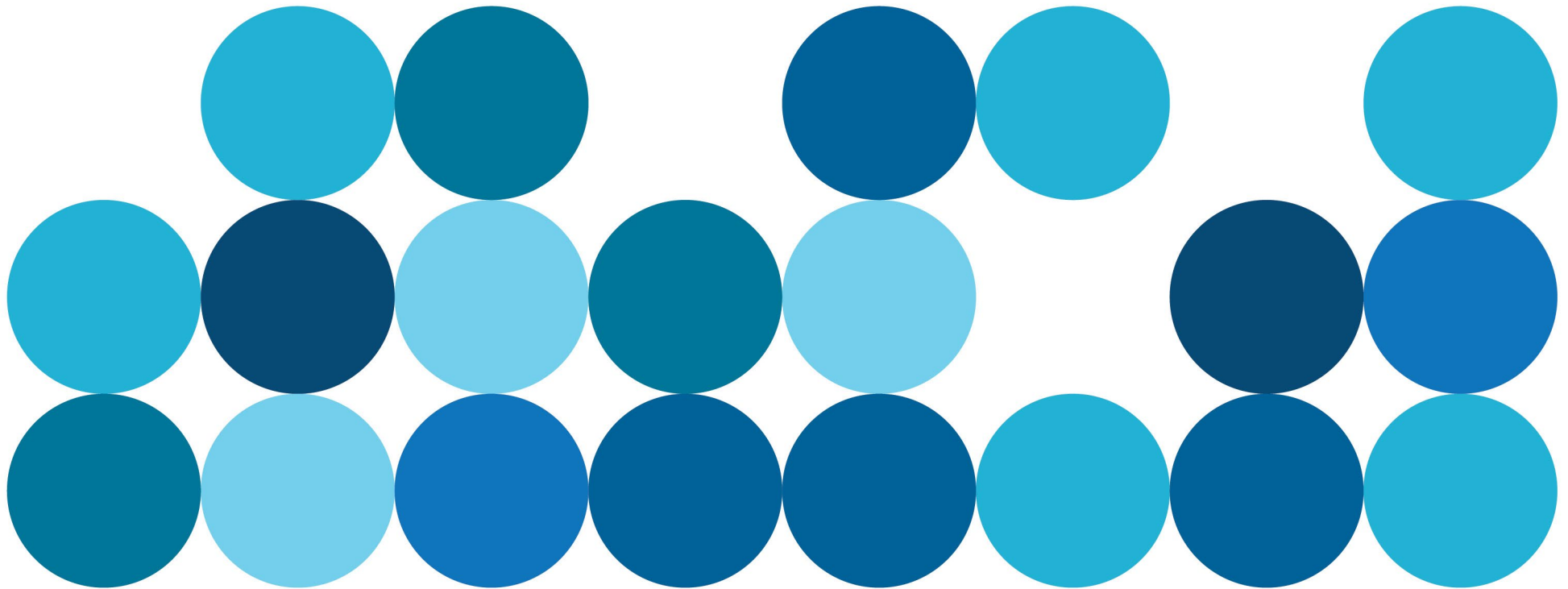


Drinking Water Quality

Annual Report 2021-22





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About this report

Water Corporation's 2021-22 Drinking Water Quality Annual Report is a review of our performance for the financial year ending 30 June 2022.

This report is designed to provide our customers and the Western Australian public with information on the quality of their drinking water.

Publication of this report allows us to meet the requirements of the [Australian Drinking Water Guidelines](#), our [Water Services Licence](#) with the Economic Regulation Authority, our [Memorandum of Understanding](#) with the Department of Health and the National Performance Reporting requirements under the National Water Initiative.

This is our 20th Drinking Water Quality Annual Report; we trust it provides our customers with the information they require about their drinking water quality.

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- Department of Water and Environmental Regulation
 - Public Drinking Water Source Areas
 - Hydrography Linear Hierarchy
- Landgate
 - Road Centrelines
 - Town sites

- Geoscience Australia
 - Australian Coastline

Further information and feedback

For further information about our drinking water quality or to provide feedback on this report:

- Call us on 13 13 85
- Visit watercorporation.com.au/drinkingwaterquality
- Email us at report@watercorporation.com.au

We acknowledge the Traditional Owners throughout Western Australia and their continuing connection to the land, water and community. We pay our respects to all members of the Aboriginal communities, their cultures and to Elders past, present and emerging.



Acronyms

Acronym	Description
ADWG	Australian Drinking Water Guidelines
AWRP	Advanced Water Recycling Plant
DBCA	Department of Biodiversity, Conservation and Attractions
BRA	Barrier Risk Assessment
CMS	Catchment Management Strategy
DoH	Department of Health
DPIRD	Department of Primary Industry and Regional Development
EBM	Event Based monitoring
EDR	Electrodialysis reversal
GAR	Goldfields and Agricultural Region
GAWS / GAWSS	Goldfields and Agricultural Water Supply / Goldfields and Agricultural Water Supply Scheme
GSR	Great Southern Region
GSTWS / GSTWSS	Great Southern Towns Water Supply / Great Southern Towns Water Supply Scheme
GWR / GWRS	Groundwater Replenishment / Groundwater Replenishment Scheme
IWSS	Integrated Water Supply Scheme
LGSTWS / LGSTWSS	Lower Great Southern Towns Water Supply / Lower Great Southern Towns Water Supply Scheme
MIEX	Magnetic Ion Exchange
mg/L	Milligrams per litre
mL	Millilitres
MoU	Memorandum of Understanding
MPN/100mL	Most probable number / 100mL
MWR	Mid West Region

Acronym	Description
NHMRC	National Health and Medical Research Council
NTU	Nephelometric Turbidity Units
NWR	North West Region
PDWSA	Public drinking water source area
PFAS	Per- and poly-fluoroalkyl substances
PFHxS	Perfluorohexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PSDP	Peth Seawater Desalination Plant
RBOM	Risk Based Observational Monitoring
RO	Reverse osmosis
RPZ	Reservoir protection zone
SCADA	Supervisory Control and Data Acquisition
SSDP	Southern Seawater Desalination Plant
SWR	South West Region
TCU	True Colour Units
TDS	Total Dissolved Solids
THM	Trihalomethanes
µg/L	Micrograms per litre
UF	Ultra-filtration
UV	Ultra-violet
WBRWSS	Warren Blackwood Regional Water Supply Scheme
WHPZ	Well Head Protection Zone
WQMS	Water Quality Management System
WTP	Water Treatment Plant



Summary

Ensuring supply of safe drinking water is our highest priority. In 2021-22, we achieved compliance with the health-related requirements and met all health targets for drinking water quality set by the Department of Health (DoH).

Health related performance

- 100 per cent compliance with microbiological guidelines
- 100 per cent compliance with health-related chemical guidelines

Non-health (aesthetic) related performance

While we strive to meet guidelines for aesthetic characteristics, this can be challenging to achieve across the diverse water sources in Western Australia.

This is especially the case in some of our small regional water schemes where there may be few sources of drinking water available and where installation of treatment can be very costly.

In 2021-22, our performance for all aesthetic analyses was 93 per cent. Although we meet all obligations under our Water Services Licence, we recognise there are always opportunities for improvement.

Customer Value Survey

For 2021-22, the feedback from our customers about their water quality was consistent. The end of year average was 6.13 for “the taste of the water” and 6.93 for “providing a consistent level of water quality” (refer to *Customer Research* on page 43 for further information on this rating).



Figure 1: Carnarvon ground level and elevated tanks



Figure 2: State-wide drinking water sources (100% compliance is in relation to requirements of Memorandum of Understanding with Department of Health)



Our commitment to you

We are committed to providing our customers with safe, high-quality drinking water that consistently meets the requirements of the [Australian Drinking Water Guidelines](#) (ADWG) 2011, our customers and other regulatory provisions.

To achieve this, we have partnered with relevant agencies to:

- Manage water quality from water source to water meter and promote confidence in the supply of safe drinking water.
- Incorporate the needs and expectations of our customers, stakeholders, regulators and employees into our planning.
- Strongly advocate source protection and the primacy of drinking water quality over other land uses.
- Use a risk-based approach to identify and manage hazards and ensure appropriate barriers to protect water quality.
- Routinely monitor our systems and use effective reporting mechanisms to provide relevant and timely information on our performance.
- Use appropriate contingency planning and maintain incident response capability.
- Meet the health-related requirements of the *ADWG and work to progressively improve the aesthetic quality of water supplied.
- Contribute to setting industry regulations and guidelines, and other standards relevant to public health and the water cycle.
- Continually improve our practices by assessing performance against corporate objectives and stakeholder expectations.

- Participate in research and development activities to ensure we continually improve understanding and management of our drinking water supply systems.

We will implement and maintain a drinking water quality management system consistent with the ADWG to effectively manage the risks to drinking water quality. All Water Corporation employees, partners and contractors are responsible for understanding their role in implementing and continuously improving the drinking water quality management and outcomes.

*We have a [Memorandum of Understanding](#) with the Department of Health that grants exemptions to the nitrate health guideline for 10 towns in the Mid West and Goldfields and Agricultural regions. We are progressively working to improve the drinking water quality in these towns (refer to [Understanding water quality test results – Nitrate](#) on page 36).

For further information please refer to our [Drinking Water Quality Policy](#) and [Drinking Water Source Protection Policy](#).

Drinking Water Quality Policy

Water Corporation is committed to effective management of its drinking water supplies to provide a safe, high-quality product that consistently meets the Australian Drinking Water Guidelines, customer and regulatory requirements, and the corporate objectives and vision.

To achieve this, and in partnership with our stakeholders and relevant agencies, we will:

Manage water source	Manage water quality from water source to water meter and promote confidence in the supply of safe drinking water.	Integrate the needs and expectations of our customers, stakeholders, regulators and employees into our planning.
Protect water sources	Strongly advocate source protection and the primacy of drinking water quality over other land uses.	Use a risk-based approach to identify and manage hazards and ensure appropriate barriers to protect water quality.
Protect water quality	Routinely monitor our systems and use effective reporting mechanisms to provide relevant and timely information on our performance.	Use appropriate contingency planning and maintain incident response capability.
Meet health-related requirements	Meet the health-related requirements of the Australian Drinking Water Guidelines, and the aesthetic quality of water supplied to our customers.	Contribute to setting industry regulations and guidelines, and other standards relevant to public health and the water cycle.
Improve our practices	Continually improve our practices by assessing performance against corporate objectives and stakeholder expectations.	Participate in research and development activities to ensure we continually improve understanding and management of our drinking water supply systems.

The Corporation will implement and maintain a drinking water quality management system consistent with the Australian Drinking Water Guidelines to effectively manage the risks to drinking water quality. All Water Corporation employees, partners and contractors are responsible for understanding their role in implementing and continuously improving drinking water quality management and outcomes.

Pat Deveney
Chief Executive Officer, Water Corporation
16/10/2021

Drinking Water Source Protection Policy

Water Corporation is committed to effective management of its drinking water supplies to provide a safe, high-quality product that consistently meets the Australian Drinking Water Guidelines, customer and regulatory requirements, and the corporate objectives and vision. Source Protection is recognised as a key component of this process.

To achieve this, and in partnership with our stakeholders and relevant agencies, we will:

Protect water quality	Strongly advocate source protection and the primacy of drinking water quality over other land uses.	Recognise robust source protection and the primacy of drinking water quality over other land uses.
Manage risks	Continually monitor robust management systems and use effective reporting mechanisms to provide relevant and timely information on our performance.	Use appropriate contingency planning and maintain incident response capability.
Monitor and respond	Routinely monitor our source protection systems and use effective reporting mechanisms to provide relevant and timely information on our performance.	Maintain robust contingency planning and incident response capability.
Protect our interests	Participate in research and development activities to ensure we continually improve understanding and management of our drinking water supply systems.	Participate in research and development activities to ensure we continually improve understanding and management of our drinking water supply systems.

Guiding principle 1 of the Australian Drinking Water Guidelines states: The greatest risk to the protection of drinking water supply catchments, protection of water sources and treatment of water is land use change and must be managed. All Water Corporation employees, partners and contractors are responsible for understanding their role in water source protection, and for implementing and continuously improving protection of our drinking water catchments.

Pat Deveney
Chief Executive Officer, Water Corporation
16/10/2021



Introduction

We provide drinking water to Perth, Mandurah and more than 220 regional towns and communities throughout Western Australia.

This year we delivered nearly 388 billion litres of drinking water to 1.35 million properties through 34,917 kilometres of water mains. This water came from 38 surface water sources, 85 groundwater sources, two major desalination plants (the Perth Seawater Desalination Plant and Southern Seawater Desalination Plant) and one groundwater replenishment scheme.

Under our [Water Services Licence](#), we comply with a [Memorandum of Understanding \(MoU\)](#) with the Department of Health (DoH). We act in accordance with the microbiological, health related chemical and radiological criteria as specified by the National Health and Medical Research Council (NHMRC) in the ADWG.

Our health performance (chemical, microbiological, and radiological) has again resulted in 100 per cent of metropolitan and country localities meeting the high standards set by the DoH.

Our extensive drinking water quality monitoring program confirms the safety of the water we provide to our customers. Microbiological, chemical and radiological analyses are carried out by independent laboratories.



Figure 3: Manjimup (Scabby Gully) Dam



Where does your water come from?

Perth Metropolitan Region

Integrated Water Supply Scheme (IWSS)

The Integrated Water Supply Scheme (IWSS) is Water Corporation's largest scheme. Just over 307 billion litres of water was delivered in 2021--22 to over two million people in Perth, Mandurah, some towns in the South West, Goldfields and Agricultural Water Supply (GAWS), and the Great Southern Towns Water Supply Scheme (GSTWSS).

The IWSS has four different water source types, including desalinated seawater, surface water, groundwater and groundwater replenishment (GWR). In 2021-22, the percentage of water from each source type was 35 per cent desalinated seawater, 26 per cent surface water, 36 per cent groundwater and 3 per cent GWR. Desalinated seawater and GWR are both climate independent sources.

The IWSS can be split into three interconnected systems:

The northern system covers from Yanchep in the north to Yokine Reservoir at the south. It also includes a standalone scheme at Two Rocks. This scheme is largely supplied through groundwater, with 135 bores in 2021-22 feeding five groundwater treatment plants.

The central scheme includes Mount Eliza Reservoir, Bold Park Reservoir and Belmont pump station to the north and Tamworth pump station and Serpentine Dam to the south. The sources include the Perth Seawater Desalination Plant (PSDP), groundwater treated at Jandakot groundwater treatment plant and four metropolitan dams. Water may also be transferred in from the northern system. Mundaring Dam exports water to the GAWS.

The southern system includes all assets south of Tamworth pump station and Serpentine Dam. Water is sourced from the Southern Seawater Desalination Plant (SSDP) and the southern dams. Water is transferred into the central system to maintain dam storages.

Desalination

PSDP, located in Kwinana produced 42.0 billion litres of water for the IWSS in 2021-22. The PSDP desalinated water enters the IWSS via Thomsons Reservoir where it is blended with Jandakot groundwater and scheme water.

SSDP, located just north of Binningup produced 74.2 billion litres of water for the IWSS in 2021-22. The SSDP desalinated water enters the IWSS via Harvey summit tanks and is transferred north through the Stirling and Serpentine trunk mains.

For further information, refer to the Desalination section in *Diversifying our sources* (page 18).

Groundwater

Groundwater is abstracted from four aquifers, Superficial, Mirrabooka, Leederville and Yarragadee, across the Gnangara and Jandakot systems. Once abstracted, groundwater is treated at one of six groundwater treatment plants. Most of our abstraction bores are located in Perth's northern suburbs. We also have independent artesian bores which pump water directly into service reservoirs.

In 2021-22, drinking water production from groundwater sources was delivered on target and within the respective water licence allocation. The total groundwater abstracted volume, including GWR was 132.1 billion litres.



Surface water

The IWSS has a total of 14 surface water dams made up of 11 supply dams (Canning, Churchmans Brook, North Dandalup, Samson Dam, Samson Pipehead, Serpentine, Serpentine Pipehead, South Dandalup, Stirling, Victoria and Wungong), one principally non-metro supply dam (Mundaring Weir, servicing the GAWS) and three pumpback dams (Lower Helena, Conjurunup and Lower South Dandalup).

In addition to collecting and storing natural inflow water, six of the IWSS dams are used to store scheme water for future source development and climate responsiveness purposes. This stored scheme water is managed through pumpbacks, transfers and direct inflows into the dams when operational capability requires. Surface water is used predominantly in planning and catering for peak demands within the IWSS.

Groundwater Replenishment

Groundwater replenishment (GWR) is the process by which secondary treated wastewater undergoes advanced treatment to a drinking water quality standard. The water is recharged to deep underground aquifers where it is stored for a number of years before being abstracted and further treated as part of the IWSS. In 2021-22 we recharged 15.02 billion litres of water.

Refer to the Groundwater Replenishment section in *Diversifying our sources* (page 18) for further information.

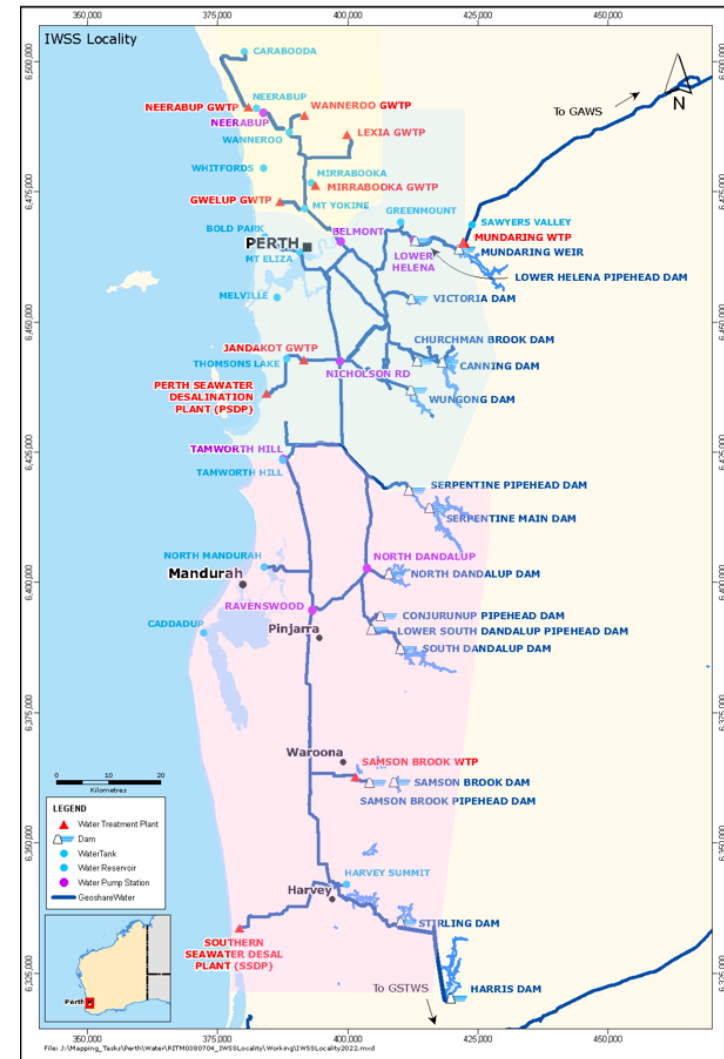


Figure 4: Overview map of the IWSS sources



South West Region

Towns in the South West are supplied with water from a number of surface and groundwater sources. The South West provided more than 14.6 billion litres of water to more than 50,000 connected properties in 2021-22.

Margaret River and Cowaramup are supplied by groundwater and surface water via Ten Mile Brook Dam. Pemberton is supplied by surface water from Big Brook Dam via Lefroy Brook Dam.

Boyanup, Dalyellup, Dardanup, Donnybrook, Dunsborough, Capel, Peppermint Grove, Preston Beach and Augusta are supplied by locally treated groundwater. Australind, Clifton Park, Eaton, Pelican Point, Millbridge, Treendale, Kingston, Brunswick Junction, Roelands and Burekup are supplied with groundwater, via water treatment plants in Australind, Eaton and Picton.

Bridgetown, Nannup, Hester, Boyup Brook, Greenbushes, Balingup and Manjimup are connected to the Warren Blackwood Regional Water Supply Scheme (WBRWSS). Millstream and Manjimup dams and a Yarragadee bore near Nannup are the main water sources for this scheme. Tanjannerup Dam supplies most of Nannup's water requirements.

Kirup and Mullalyup have been connected to the WBRWSS via a 17 kilometre Greenbushes to Kirup pipeline; enabling us to secure the supply to these towns and provide improved water quality.

Harvey, Waroona, Hamel, Binningup, Myalup and Yarloop are supplied from the IWSS (refer to *Where does our water come from? – Perth Metropolitan Region* - page 11). Quinlinup and Northcliffe are supplied with carted water from either Manjimup or Pemberton and Logue Brook is supplied with carted water from the IWSS.

The Great Southern Towns Water Supply Scheme (GSTWSS), which supplies Collie, Allanson and Darkan in the South West and 38 towns in the Great Southern region, is supplied from the Harris and Stirling dams.

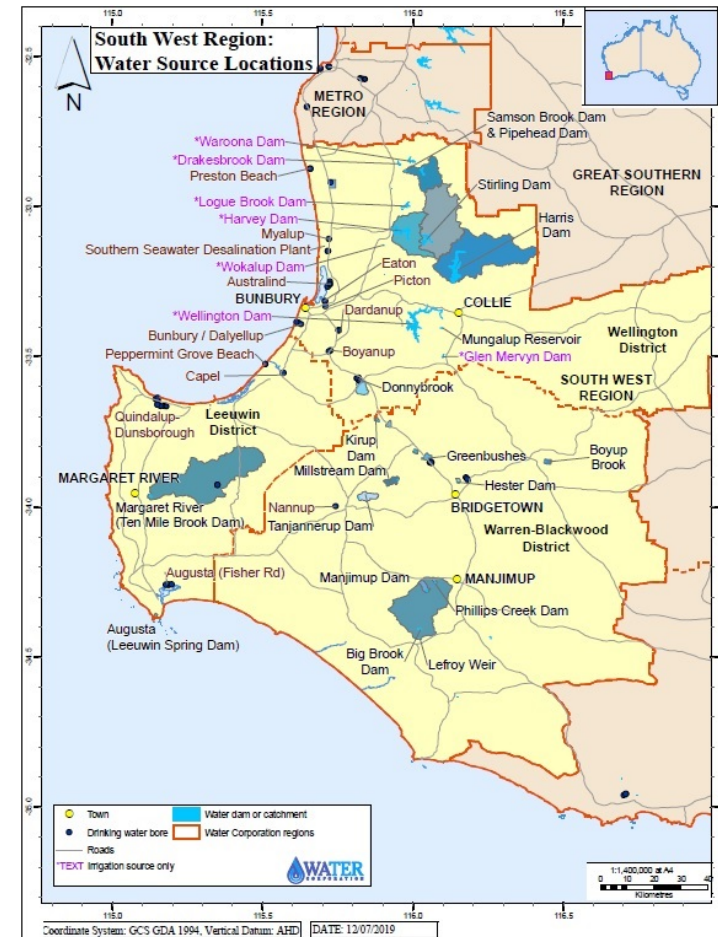


Figure 5: Overview map of the South West Region



Great Southern Region

In the Great Southern Region we have two main water supply schemes - the Great Southern Towns Water Supply Scheme (GSTWSS) and the Lower Great Southern Towns Water Supply Scheme (LGSTWSS) along with around 15 individual supplies. This year the region supplied almost 12.8 billion litres of drinking water to more than 42,600 connected properties through 4,033 kilometres of water mains.

Harris Dam, near Collie in the SWR, is the main source for the GSTWSS. Groundwater from the South Coast borefields near Albany is the main source for the LGSTWSS, although some local sources can contribute to the supply if required.

Hopetoun, Bremer Bay, Esperance, Condingup and Gibson are all supplied from local groundwater sources. Denmark, Walpole, Ravensthorpe, Frankland, Ongerup, Jerramungup, Borden and Salmon Gums are supplied from local surface water sources. The new 43 kilometre pipeline from the LGSTWSS to Denmark, completed in August 2021, can now supplement Denmark's supply.

Grass Patch, Lake King, Munglinup, Rocky Gully, Varley and Wellstead are supplied by water carted from various treated water sources such as Albany, Lake Grace, and Esperance.



Figure 6: Overview map of the Great Southern Region



Goldfields and Agricultural Region

The Goldfields and Agricultural Region provided almost 23.5 billion litres of water to more than 39,000 connected properties through 9,649 kilometres of water mains, including farms, mines and other enterprises in 2021-22.

The main water supply scheme for the region is the Goldfields and Agricultural Water Supply (GAWS) scheme, where water is sourced from Mundaring Weir near Perth before undergoing treatment at Mundaring Water Treatment Plant. Mundaring Weir is supplemented with desalinated seawater, groundwater and surface water from Lower Helena Pumpback.

In addition to the GAWS, water is carted to Broad Arrow and Menzies from Kalgoorlie and the towns of Laverton, Leonora and Wiluna are supplied from local groundwater sources. Wiluna's groundwater is treated using electro dialysis reversal to reduce nitrates, while Leonora's groundwater is treated using Reverse Osmosis (RO) to reduce nitrates, hardness and total dissolved solids (refer to *How is your water treated?* – *Desalination – Reverse osmosis and Electrodialysis reversal* sections, pages 28 and 29). Laverton has a temporary RO plant to maintain nitrates below guideline value, while a permanent solution is planned.

Chloramination is used in the GAWS to maintain a disinfectant residual across the network. (Refer to *How is your water treated?* – *Disinfection*, page 30).

There are some communities outside the towns who receive water that, although the water has been potable, may no longer be guaranteed to meet the requirements of the ADWG due to the long mains and distance from disinfection; these are called Farmland services or Services by Agreement.

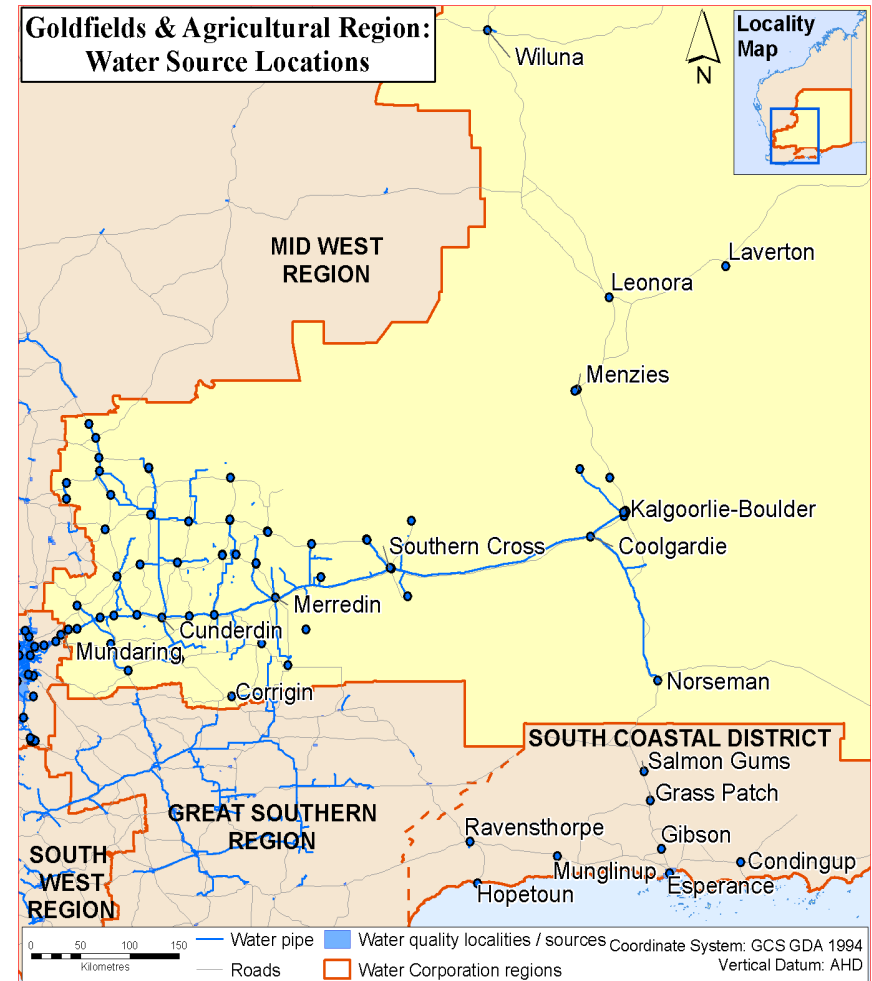


Figure 7: Overview map of the Goldfields and Agricultural Region



Mid West Region

The Mid West Region (MWR) extends along the west coast from Woodridge to Exmouth, 1,130 kilometres north of Perth, and 500 kilometres inland to Sandstone. It is divided into three districts:

- Gascoyne District
- Coastal Midlands District
- Geraldton/Murchison District

The MWR has 40 Public Drinking Water Source Areas which supply drinking water to 51 localities.

Drinking water throughout the Mid West is supplied from local groundwater sources. Independent groundwater borefields provide drinking water to 42,000 connected properties in 51 localities through 2,138 kilometres of water mains. The total drinking water supplied from these sources was almost 17 billion litres.

The Coastal Midlands has the highest number of small schemes where supply is sourced from individual borefields. Allanooka borefield, located in the Geraldton/Murchison district (supplying Geraldton and the surrounding towns of Dongara, Northampton, Mullewa, Walkaway, Greenough and Narngulu) and Carnarvon and Exmouth, located in the Gascoyne, are the largest schemes.

Three communities, Coomberdale, Nabawa and Yuna, receive water carted from nearby towns. Drinking water is also carted to some communities to maintain supply when schemes experience asset failure or water quality issues.

Gascoyne Junction, Denham and Coral Bay water sources are treated using RO and Jurien Bay has an emergency RO plant while a permanent solution is being developed. Yalgoo, Mt Magnet, Cue, Sandstone and

Meekatharra water treatment plants use electrodiolysis reversal to remove a number of constituents (refer to *How is your water treated?* – *Desalination – Reverse osmosis and Electrodiolysis reversal* sections on pages 28 and 29).

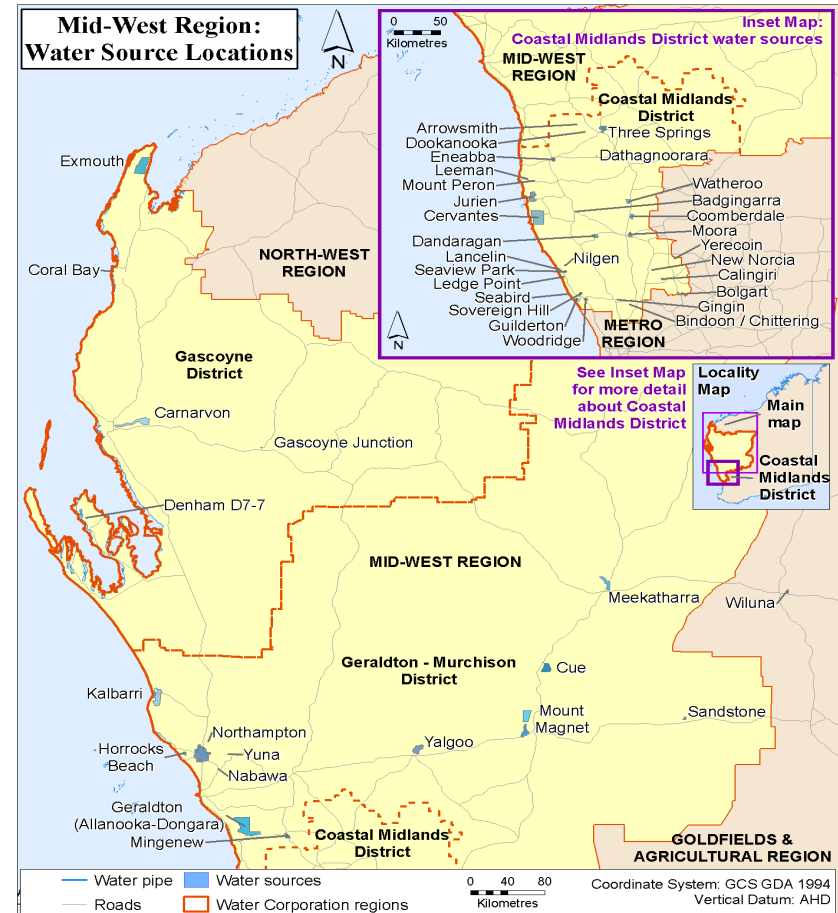


Figure 8: Overview map of the Mid West Region



North West Region

The West Pilbara Water Supply Scheme supplies customers in Karratha, Dampier and the neighbouring towns of Roebourne, Wickham, Point Samson, Cape Lambert and the Burrup Peninsula. The scheme has three sources: Harding Dam, groundwater from the Millstream Aquifer, and the Bungaroo Valley groundwater source (developed by Rio Tinto Iron Ore).

The East Pilbara Water Supply Scheme supplies customers in Port Hedland, South Hedland, Wedgefield Industrial Area and the local port operations. The scheme is supplied with groundwater from the Yule and De Grey River borefields.

In the Kimberley area, the towns of Kununurra and Broome are supplied by local groundwater sources. The remaining towns in the North West are supplied by local groundwater sources, with the exception of Wyndham which is supplied by Mooloolaba Dam.

Newman is supplied with groundwater via BHP operated borefields and water treatment plant.

Overall, the North West Region supplied more than 38.8 billion litres of drinking water to more than 35,700 connected properties through 1,512 kilometres of water mains in 2021-22.

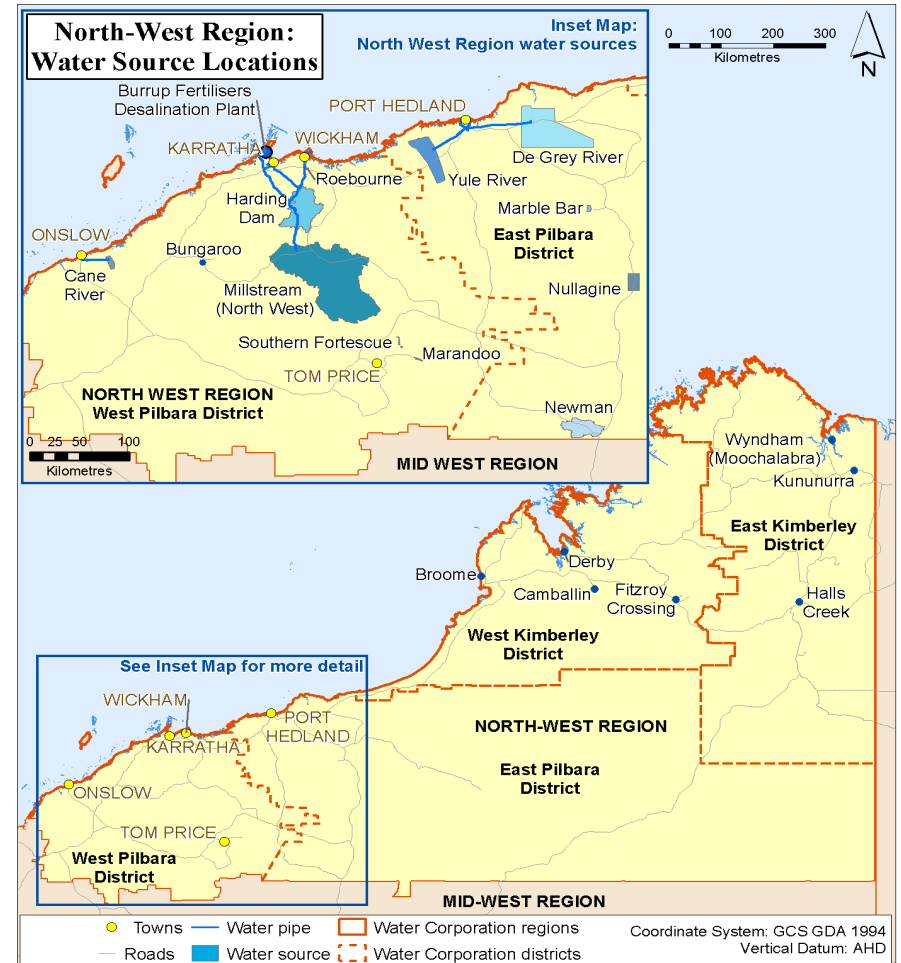


Figure 9: Overview map of the North West Region



Diversifying our sources

We have planned ahead to secure our water supplies in response to climate change, reduced streamflow and expanding population. These plans are based on a three-pronged approach to reduce water use, increase water recycling and develop new water sources such as desalination and groundwater replenishment.

Desalination

Desalination, using RO, is a membrane based treatment. This process was chosen for both the PSDP, which has been operational since November 2006, and the SSDP, that began supply in September 2011.

Desalination was the largest source of water for the IWSS in 2021-22, supplying more than 45 per cent of the drinking water for Perth (refer to *How is your water treated? – Desalination – Reverse osmosis*, page 28).

Perth Seawater Desalination Plant

The PSDP is located in Kwinana and can produce up to 45 billion litres of drinking water a year.

Southern Seawater Desalination Plant

The SSDP, located in Binningup in the South West, can produce up to 100 billion litres of drinking water a year.

Groundwater replenishment

What is groundwater replenishment?

Groundwater replenishment is the process by which secondary treated wastewater undergoes advanced treatment prior to being recharged into the confined Leederville and Yarragadee aquifers for later use as a drinking water source. Once abstracted, the mixed groundwater will be further treated before being supplied into the IWSS. Figure 10 shows how groundwater replenishment fits in to Perth's water cycle.

The Groundwater Replenishment Scheme (GWRS) in Craigie is the first of its kind in Australia. Similar schemes have been used successfully in other parts of the world, such as Orange County California, USA, since the 1970's. Water recycling schemes are also used to supplement drinking water supplies in Singapore and in Windhoek, Namibia.

Benefits of groundwater replenishment

- Does not rely on rainfall
- Sustainable water source
- Has the potential to recycle large volumes of water
- Equivalent volumes of water can be abstracted from the aquifer while reducing impacts to the environment or other water users.

Stage 1 of GWRS commenced recharge in 2017 and has a nameplate production capacity up to 14 billion litres of recycled water each year.

GWRS Stage 2 is currently being commissioned and tested and is on track to be operational in late 2022. Once operational, GWRS will effectively double the scheme capacity. Water Corporation is licensed to recharge up to 28 billion litres of water each year under the conditions of recharge, providing a climate independent water source.

Further information can be found on [our website](#).



Our water cycle

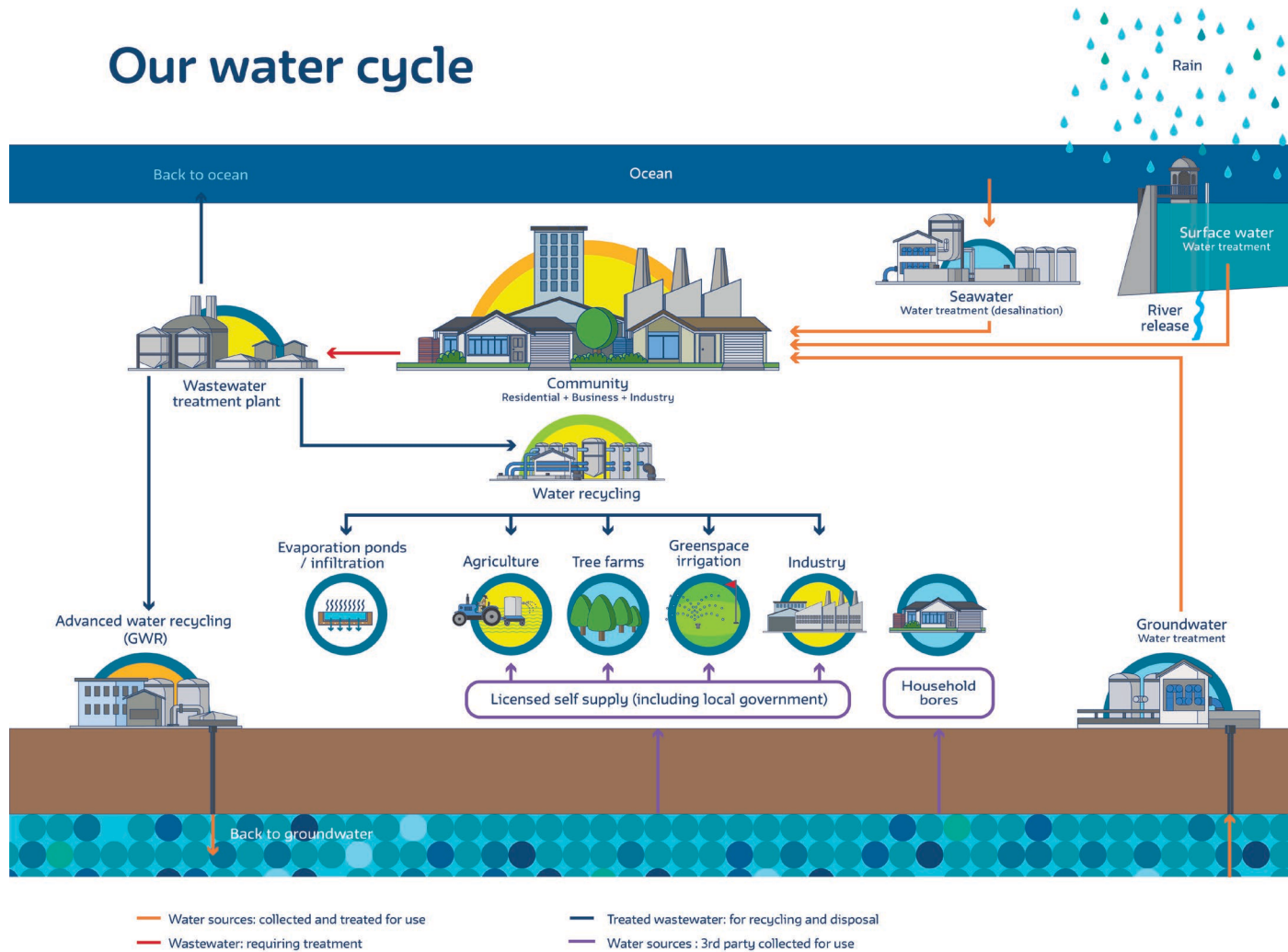


Figure 10: Groundwater replenishment in the water cycle



Drinking water quality risk management

The National Health and Medical Research Council (NHMRC) define the requirements for safe drinking water in Australia through the ADWG. These guidelines include a 12-element framework for best practice management of drinking water supplies (the Framework) designed to integrate all facets of the drinking water quality management and assurance system (refer to figure 11).

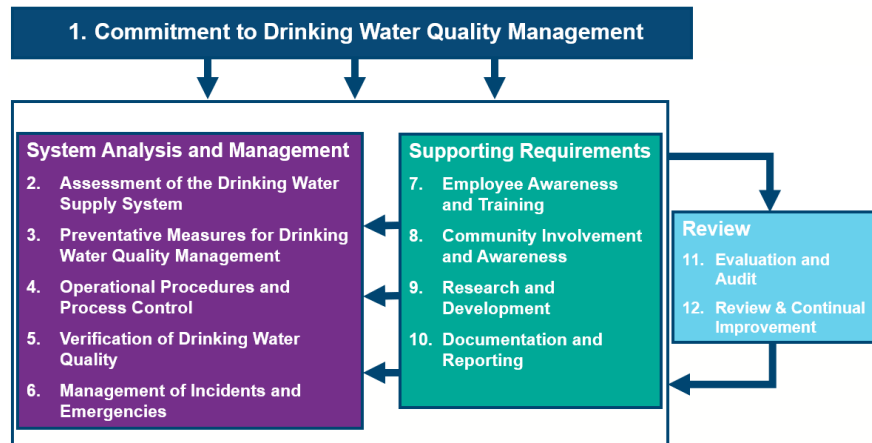


Figure 11: Framework for the management of drinking water quality (ADWG)

Engagement with Department of Health

The DoH regulates drinking water quality in Western Australia. We have an MoU with the DoH which requires us to work towards continual improvement in implementing the ADWG and the Framework. More specifically, it requires us to comply with the microbiological, chemical health and radiological parameters as specified in the ADWG, with exemptions to adherence with the nitrate guidelines in 10 towns in the Mid

West and Goldfields and Agricultural regions (refer to *Understanding water quality test results – Nitrate*, page 36). This forms part of our [Water Services Licence](#) as issued by the Economic Regulation Authority. Along with the DoH, we recognise the practices and processes used to maintain high levels of drinking water quality need to be transparent to the community.

For aesthetic parameters, the MoU states that we should comply as far as practical with the ADWG for non-health related characteristics. It is accepted full compliance with non-health related characteristics may take many years, bearing in mind the significant investment required to achieve this.

The MoU connects all facets of nationally and internationally recognised drinking water guidelines, standards, and quality management systems to ensure the safe and continuous supply of water to our customers. It requires us to notify DoH within 24 hours if monitoring results exceed a set health value or any event occurs which could pose a risk to public health.

We also provide updates to DoH throughout the year, who regularly review our monitoring results and corrective actions (refer to *Monitoring and incident management – Incident response*, page 33).

The MoU provides for the DoH to conduct reviews of the performance of our systems and databases used to manage drinking water quality. In consultation with the Economic Regulation Authority, DoH commission audits in line with our Water Services Licence.

The latest audit was commenced in March 2022 and the abridged report will be posted on our [website](#) following its presentation to the Corporation and DoH later in 2022.



Engagement with Advisory Committee for the Purity of Water

The Advisory Committee for the Purity of Water (ACPoW) is a non-statutory inter-departmental committee chaired by the DoH. As one core function, ACPoW provides advice to the Ministers for Health and Water on protecting, monitoring, and managing drinking water quality in Western Australia and fosters inter-agency co-operation on related matters. Water Corporation is an active member of ACPoW, utilising it for the ongoing review of our drinking water quality management.

The Advisory Committee created two specialist sub-committees of which Water Corporation are active members – one focussing on source protection and catchment management and the other focusing on drinking water quality management including water sampling, results and monitoring. Both sub-committees provide additional expertise to review, monitor and advise the committee on any issue affecting drinking water supplies within Western Australia, from water source to water meter.

Multiple barrier approach to drinking water quality management

Preventing contamination and minimising risk is an essential part of providing safe drinking water. The ADWG's guiding principle two states:

“The drinking water system must have, and continuously maintain, robust multiple barriers appropriate to the level of potential contamination facing the raw water supply.”

This approach ensures that if one barrier fails, the effective operation of the other barriers will ensure safe drinking water is maintained throughout the water supply.

Barriers, applied from water source to water meter, are:

- Protected catchments and groundwater recharge areas (refer to *Source protection*, page 24)
- Large reservoirs with long water detention (storage) times
- Water treatment (refer to *How is your water treated?*, page 27)
- Ensuring tanks and bores are sealed to prevent contamination
- Disinfection of water (refer to *How is your water treated? – Disinfection*, page 30)
- Sealed distribution system and maintenance of chlorine residuals throughout the system.

Some barriers, such as disinfection, are mandatory in every water supply, others are preferred, such as protected catchments and large reservoirs, however a water treatment barrier is only required if the quality of the source water requires it.

We also undertake an annual barrier risk assessment that drives necessary operational and capital improvements.

Barrier risk assessment

Quality operational information and data is critical as it informs our Barrier Risk Assessment (BRA). As a part of this process, we fully review our barrier risks annually but also update as required or when new information becomes available. The BRA details water quality risks associated with each of our drinking water schemes across the state. The data and information collected is critical as it informs how our schemes are performing from a water quality risk perspective. The BRA process assists us with identifying and understanding the need for and prioritisation of capital investments to address the identified risks.



Source protection



Large reservoirs with long detention times



Water treatment



Sealed tanks and bores



Disinfection (chlorination)



Distribution systems protection (including chlorine residuals)

Figure 12: Multiple barriers for drinking water quality protection

Water Safety Plans

A water safety plan is a comprehensive risk management document that lays out all scheme information pertinent to the safety of a drinking water scheme, including a schematic of the system, how the scheme operates, critical control point and minimum sampling requirements, incident management and contacts.

Having a water safety plan for each of our schemes is a large part of implementing the Framework. Our water safety plans provide a comprehensive review of each water supply scheme. Using a systematic risk management approach, we assess the risks to each water supply scheme from water source to water meter. This ensures appropriate preventative measures and all pertinent barriers are in place and identifies the operational controls necessary to guarantee the safety of our drinking water supplies.

We routinely review all water safety plans to re-evaluate the risks and update any site or treatment details. During 2021-22, 32 water safety plans from schemes across the state were fully reviewed. In addition, 113 water safety plans were updated to include recent capital upgrades and other modifications to those schemes.



Operator training and competence

Water Corporation has a mature nationally accredited training program for all operational staff. Operators who perform water treatment, quality management and sampling tasks are flagged to complete the program. This consists of a Certificate II, III or IV from the National Water Package (NWP). The accredited program, which is internally developed and delivered, allows employees to attain a nationally recognised qualification (refer to figure 13). Water Corporation has an auspicing arrangement with North Metropolitan TAFE who provide quality control over the course development, delivery and assessment, and issue credentials. As part of this partnership, Water Corporation offers traineeships to its new and existing workforce, and Vocational Education and Training in schools pathway.

The program also includes a suite of water quality courses which contribute to our implementation of element seven, Employee Awareness and Involvement, of the Framework. Employee awareness, understanding and commitment to performance optimisation and continuous improvement are vital to ensure a drinking water supplier's ability to successfully operate a water supply system (adapted from ADWG).

Water Corporation has a contemporary Learning Management System (LMS) which allows for the correct qualification to be assigned to each employee, to ensure they have the correct training to perform their role safely and competently. The LMS data is regularly monitored to maintain accuracy, therefore ensuring the correct training is allocated for the role being performed or the asset being operated.

Innovation in training is on-going and includes a move towards virtual delivery, exploration of visual intelligence technologies to provide hands free point of vision capabilities, and the use of eLearning to supplement existing face-to-face courses. Water Corporation is proud of the

investment made towards its workforce's current and future capability and the maturity of the process.

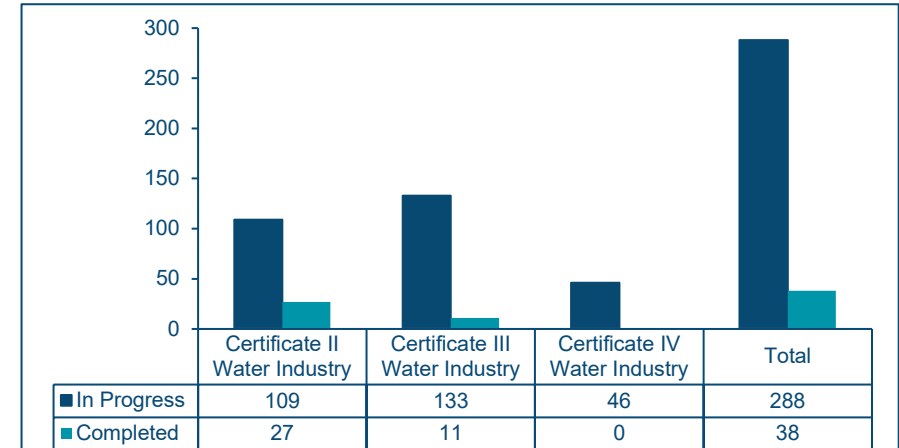


Figure 13: Drinking Water Specialisation - Certification Program 2022



Source protection

What is source protection and why do we protect our drinking water catchments?

Source protection is the protection and management of our drinking water catchments in a multiple barrier approach to providing safe drinking water to the community.

A drinking water catchment (also termed public drinking water source area (PDWSA)) is an area of land where rainfall collects in rivers and streams that flow into reservoirs, or seeps into the soil to become groundwater where it is stored in underground aquifers. The captured water later becomes drinking water for the community. Our catchments provide a significant natural barrier to contamination.

The ADWG guiding principle one states:

“The greatest risks to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised.”

By protecting our drinking water at the source, we minimise the risk of contamination and reduce the level of treatment required before it is supplied to the community. Source water protection is a crucial step to ensuring safe, good quality drinking water. The ADWG says:

“prevention of contamination provides greater surety than removal of contaminants by treatment, so the most effective barrier is protection of source water to the maximum degree practical”.

Within Western Australia, PDWSAs are gazetted under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas*

Water Supply Act 1947. Land development restrictions and by-laws may then be applied to control potentially polluting land uses and activities.

Three priority areas are established within PDWSAs to help guide land management decisions using a risk management approach.

- Priority 1 – the objective is to avoid unnecessary water quality contamination risks,
- Priority 2 – the objective is to minimise water quality contamination risks, and
- Priority 3 – the objective is to manage water quality contamination risks.

Prohibited Zones, such as Reservoir Protection Zones (RPZ), and Wellhead Protection Zones (WHPZ), may also be applied around reservoirs and bores to provide additional protection to those areas closest to the water supply.



Figure 14: Aerial view of Harding dam (North West Region)



How we protect our drinking water catchments

Department of Water and Environmental Regulation (DWER) is responsible for managing and protecting the state's water resources. An MoU for Drinking Water Source Protection between DWER and Water Corporation delegates the responsibility of catchment surveillance and by-law enforcement to Water Corporation.

We manage approximately 120 drinking water sources (surface water and groundwater) which supply 250 localities across the state. Our [Drinking Water Source Protection Policy](#) guides catchment operations and highlights our commitment to the primacy of drinking water quality over other catchment land uses.

Each of our catchments have a catchment management strategy (CMS), which helps us to know and understand our surface water catchments and borefields, as recommended within the Framework. Each CMS includes a comprehensive risk assessment which considers the risks to drinking water quality from land uses and activities within each catchment and recommends measures to prevent drinking water contamination. The CMS also identifies the operational and strategic requirements to ensure the source protection barrier is maintained within a catchment.

Additionally, in accordance with the 2011 ADWG, a process known as risk based observational monitoring (RBOM) is being progressively rolled out within our catchments across the state. RBOM is used to gather semi-

quantitative data which is used to inform operational responses and substantiate source risk levels.

We employ several strategies to effectively undertake drinking water source protection, including catchment surveillance, electronic surveillance (using vehicles, helicopters, and drones), the installation of physical barriers such as boom gates, fencing and signage, raw water sampling and community education.

Surveillance and by-law enforcement are key elements used to control potentially polluting activities in PDWSAs. In 2021-22, over 17,000 surveillance hours were undertaken state wide with 91 by-law offence prosecutions, 15 infringements and 870 warning letters issued. Further information on drinking water catchment management and protection can be found on the [visiting our dams](#) or [drinking water quality](#) pages on our website or on the [DWER website](#).

Storage barrier

The reservoir in a surface water catchment acts as a storage barrier. A storage barrier promotes natural processes that reduce microbiological contamination and provides a potential buffer to minimise the impact of inflow variation on the quality of water stored in the reservoir.

Groundwater taken from a confined aquifer, with no linkage to surface water, naturally has large storage and detention times.

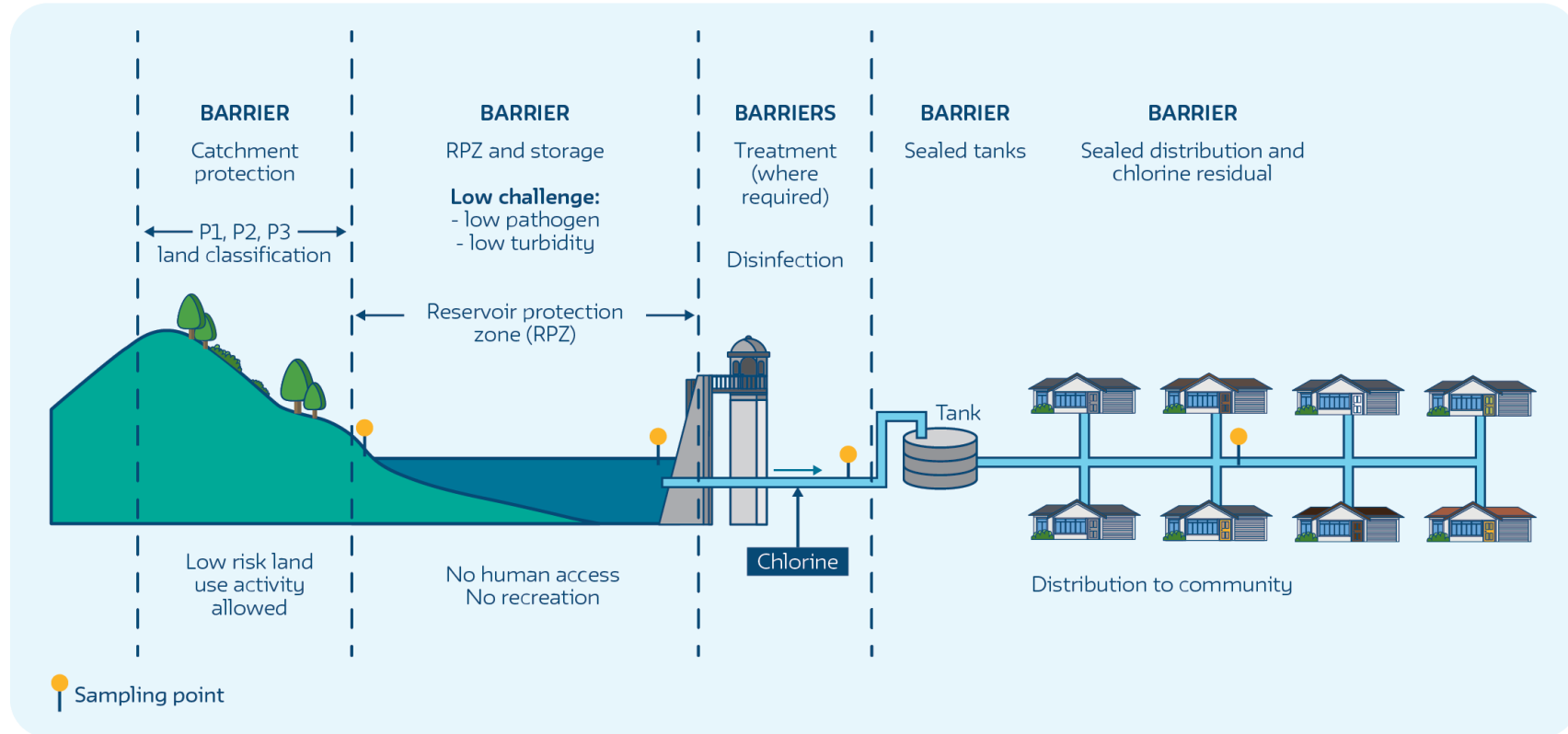


Figure 15: Surface water catchment – showing source protection and additional multiple barriers



How is your water treated?

Water treatment

The specific water quality of each source dictates the necessity of water treatment and the type of treatment required. Where water comes from large water bodies or some groundwater supplied by fully protected catchment areas, very little treatment is required – often just disinfection (as per figure 16). In other cases, more intensive treatment processes may be required to ensure the drinking water delivered to every house is safe and aesthetically pleasing. From a water safety perspective, water treatment is one of the possible barriers in a multiple barrier approach to the management of our water supplies.

Groundwater, which is pumped from underground aquifers, can be treated to remove dissolved gases, iron, manganese, colour and turbidity using a combination of oxidation, coagulation, flocculation, filtration and clarification. In Perth, groundwater treatment plants at Jandakot, Wanneroo, Lexia, Mirrabooka, Neerabup and Gwelup oxidise the water (via aeration and/or chlorination) to increase the amount of dissolved oxygen and remove both carbon dioxide and hydrogen sulphide, and also to precipitate iron and manganese. A coagulant (alum) is also added which increases the settling of fine particles caused by iron and natural organic matter. Clarified water then passes through sand filters to remove

any remaining particles. Similar processes occur in many country water schemes.

A crystallisation technology is used to reduce hardness (soften the water) at Neerabup Groundwater Treatment Plant.

Naturally occurring organic substances add colour to the water, which can increase taste and odour and provide precursors for disinfection by-products. Since 2001, we have used a water treatment technology known as MIEX® (magnetic ion exchange) to prevent an intermittent “swampy” odour that used to occur in treated groundwater supplied to Perth’s northern suburbs. Unlike conventional processes, MIEX® resin more effectively removes dissolved organic carbon, the source of potential odour and taste, from drinking water.

Ultra-filtration

Ultra-filtration (UF) treatment is where source water is forced through a membrane. It is designed to remove suspended solids, bacteria, viruses and other pathogens to produce water with very high purity.

UF is being used to treat water at Wyndham, Harding Dam, Pemberton, Denmark, Hyden, Walpole, Gascoyne Junction, Salmon Gums, Frankland and Kirup.

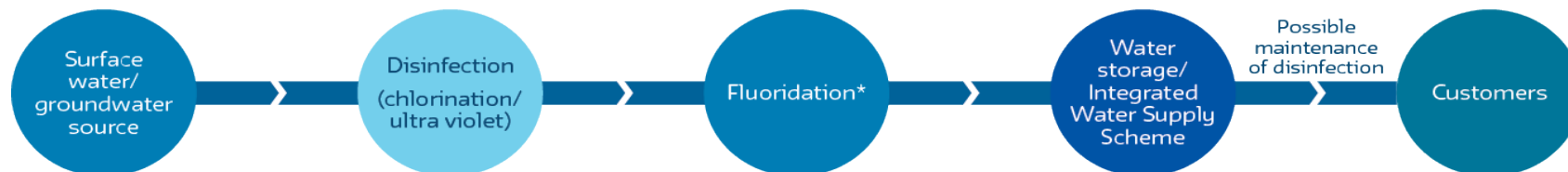


Figure 16: Example of a basic water treatment process *(see *Fluoridation* section for those towns that have fluoride added to their water)



Desalination – Reverse osmosis (RO)

Seawater desalination is the removal of salt and impurities from seawater to produce fresh water. Our desalination plants use an RO process. Seawater is pumped into the desalination plant from the ocean and passes through pre-treatment filtration to remove the majority of large and small particles.

The filtered seawater is then forced under pressure through semi-permeable membranes which reverses the osmosis process as it occurs in nature. The pores in the membranes are so tiny that salt, bacteria, viruses and other impurities are separated from the seawater; in essence they act like microscopic strainers. About half of the water that enters the plant from the sea becomes drinking water. The salt and other impurities removed from the seawater are then returned to the ocean via diffusers,

which ensure it mixes quickly to prevent impacts to the marine environment.

The desalinated water is then further treated to meet drinking water standards before it reaches our customers. Water Corporation has two large desalination plants, PSDP and SSDP which contributed 45 per cent of Perth's water in 2021-22 (refer to *Where does your water come from – Perth Metropolitan Region*, page 11)

RO is also being used to treat brackish (saline) groundwater at Denham, Gascoyne Junction, Coral Bay, Hopetoun and Jurien Bay to improve water quality. We also have RO plants at Leonora and Laverton primarily to reduce nitrates (refer to *Understanding water quality test results – Nitrate*, page 36).

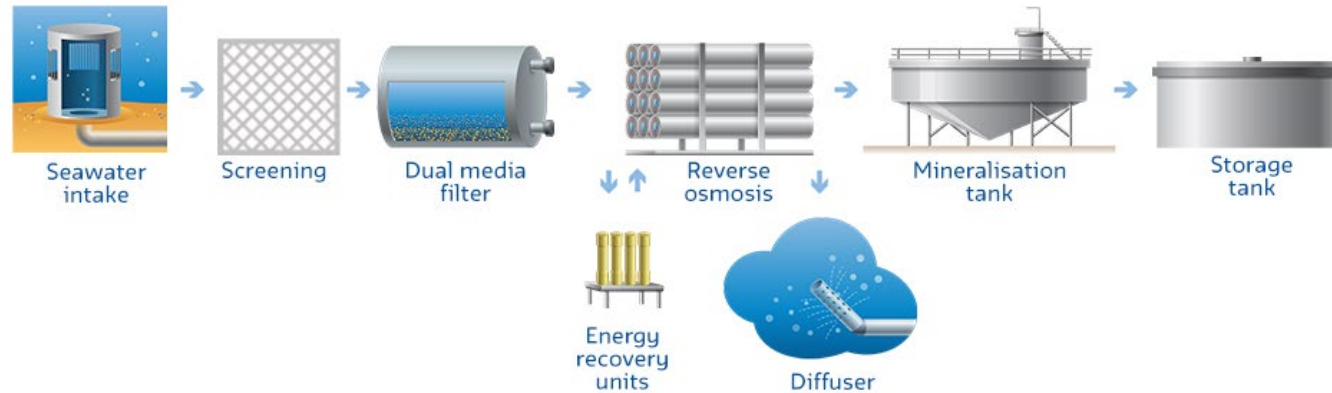


Figure 17: Typical desalination treatment process



Electrodialysis reversal

Electrodialysis reversal (EDR) is a water treatment process in which electricity is applied to immersed electrodes to pull the naturally occurring dissolved salts through ion selective membranes, thus separating the water from the salts (the 'electrodialysis' part of EDR). The process produces a stream of fresh water and a much smaller flow containing the concentrated salts. The voltage on the electrodes is reversed every 15 minutes to reduce fouling of the membranes (the 'reversal' part of EDR).

EDR is an effective tool for removing nitrate and has the side-benefit of reducing water salinity and hardness (improving water taste and soap lathering). As it only removes 'charged' particles, such as salts (NO_3^- , Na^+), from water, EDR does not remove micro-organisms or most naturally occurring organic compounds that could be present in the water. A separate water treatment step is required for this purpose. EDR has been in use at Wiluna, Yalgoo, Mt Magnet and, in 2021-22 has been commissioned in Cue, Sandstone and Meekatharra.



Figure 18: Mt Magnet EDR plant – feed pump and chemical dosing



Water treatment for groundwater replenishment

Wastewater undergoes treatment at Beenyup Water Resource Recovery Facility before entering the Advanced Water Recycling Plant (AWRP). This treatment facilitates the removal of most chemicals and microorganisms such as nutrients, detergents, heavy metals and bacteria.

Treatment at the AWRP (as shown in figure 19) further reduces the levels of chemicals and microorganisms so that it meets, and in many cases exceeds, drinking water standards. Throughout the treatment process, the water is monitored to ensure strict water quality guidelines are met.

The water is then recharged into an aquifer where it mixes with the existing groundwater. Further treatment then occurs when it is abstracted for drinking water use.

Water quality monitoring

We have systems, processes and regulations to ensure groundwater replenishment does not put public health or the environment at risk. These include:

- Water quality checkpoints (also known as critical control points) to ensure each stage of the plant works at an optimum level.
- If the water is not treated to a safe level when it reaches a checkpoint, the treatment process shuts down and water is diverted to the ocean outfall.
- The DoH set very strict water quality guidelines that the recycled water must meet at the point of recharge and in the aquifers.
- Independent, accredited laboratories test water quality samples to ensure they meet guidelines.

- Groundwater monitoring provides long-term evaluation of water and aquifer quality, as well as providing immediate notification to any changes to the groundwater environment.
- Independent third-party review of performance to ensure the quality management systems are operating to a level of best practice.

Disinfection

Disinfection is undertaken to inactivate pathogenic microorganisms that can cause disease. All our drinking water supply schemes are disinfected with chlorine to protect us against waterborne pathogenic microorganisms. Chlorine is added to our water supplies in sufficient quantities for disinfection and to ensure a residual of chlorine or chloramine is maintained, within a narrow range in the water. This ensures ongoing disinfection in the distribution system, with a minimal effect on the taste of our water.

Chloramination involves the use of chlorine and ammonia to produce chloramine as a longer lasting disinfectant compared to chlorine alone. Chloramination is used extensively in the GAWSS to maintain a disinfectant residual along the length of the extensive pipe network.

Ultraviolet (UV) light is used at some water treatment plants across the state for additional disinfection where there are increased microbiological risks from activities in the catchment. UV does not provide a residual disinfection barrier, so it is used in combination with chlorination.



Advanced water treatment process

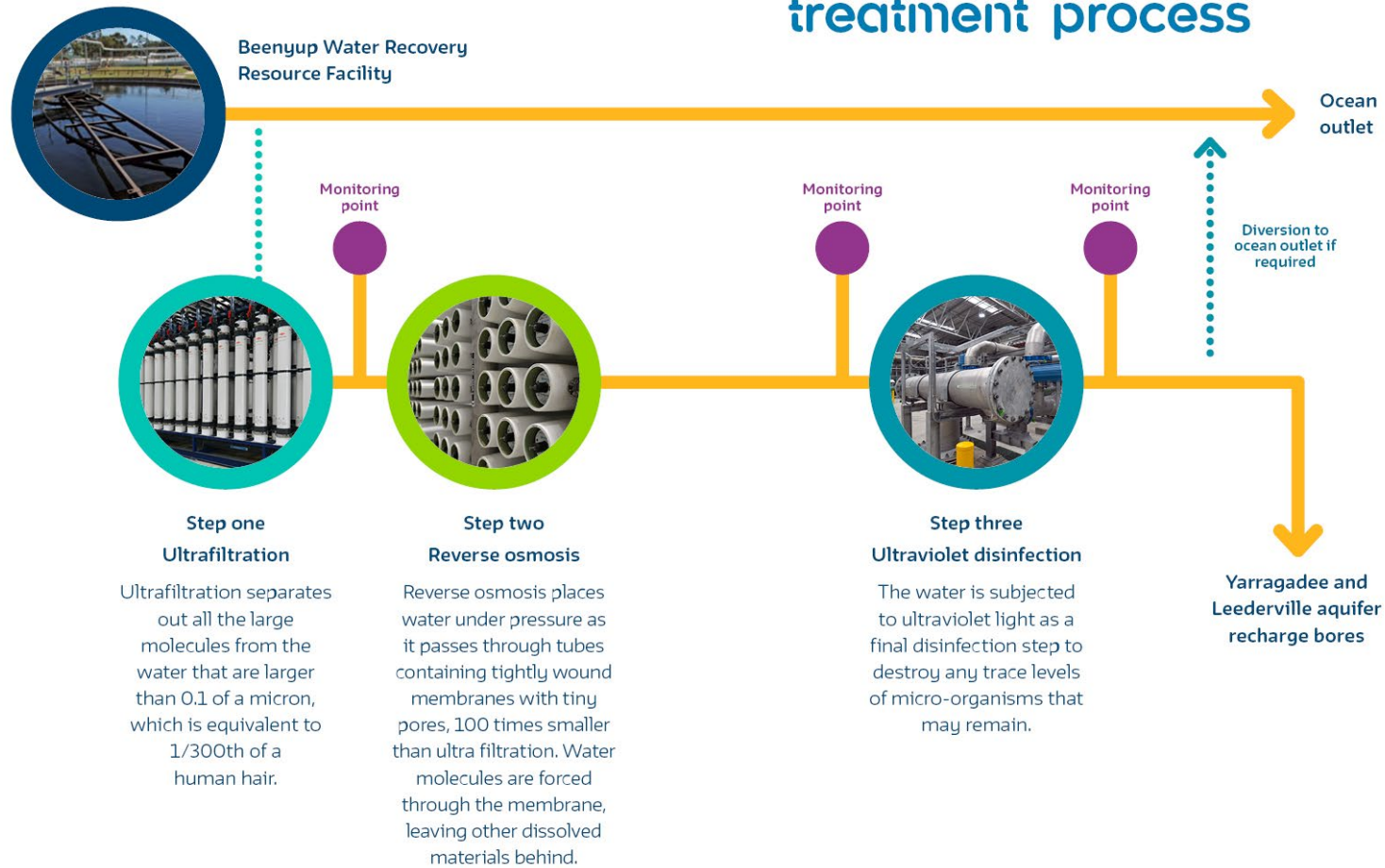


Figure 19: Advanced water treatment process



Fluoridation

In Western Australia, fluoridation of community water supplies is regulated by the *Fluoridation of Public Water Supplies Act 1966*, which is administered by DoH. The Fluoridation of Public Water Supplies Advisory Committee oversees fluoridation and makes recommendations to the Minister for Health who may issue or rescind directives as appropriate.

Community water fluoridation is an important, cost-effective public health measure which plays a critical role in reducing dental decay and improving oral health.

Fluoridation of community water supplies is backed by authoritative health research agencies and government bodies worldwide, including the World Health Organization, the Australian Dental Association, the Australian Medical Association and the National Health and Medical Research Council.

Water fluoridation was introduced in Western Australia in 1968. Today, the vast majority of the WA population is provided with fluoridated drinking water, principally in the Perth metropolitan area and most regional centres, as well as a number of smaller communities supplied from the same source or treatment plant as regional centres. Fluoridation is undertaken to provide fluoride levels in the water within a narrow, required range specified by a directive.

Some regional centres in WA have naturally occurring levels of fluoride in the water supply. Dunsborough water undergoes de-fluoridation, as fluoride occurs naturally high in the raw water and needs to be maintained below ADWG health guidelines.

¹ AS/NZS 4020:2018 – Testing of products for use in contact with drinking water

The water fluoridation process involves adding either fluorosilicic acid or sodium fluoride, in a controlled manner, to result in fluoride levels within the required range. Purity and quality control standards for chemicals added to drinking water are strictly controlled by DoH.

Fluoridated water supplies are monitored continuously via an online fluoride analyser at the dosing point. Localities at which fluoride is added to the water are sampled at least weekly to confirm acceptable fluoridation performance, while other localities are sampled at least six monthly. Fluoridation performance is reported quarterly to the DoH. The data tables in Appendix C show the localities that receive fluoridated water. More information is available on the [DoH website](#).

Chemicals and materials in contact with drinking water

The MoU between DoH and Water Corporation requires all chemicals and materials that come into contact with drinking water are approved by DoH or are ¹AS4020 compliant. In addition, Water Corporation may utilise a self-assessment process, as agreed with DoH, and provide all information associated with the self-assessment to DoH.

All chemicals and materials that are approved to be used in the provision of drinking water are listed on the [DoH website](#).



Monitoring and incident management

Verification monitoring

In accordance with the ADWG, we run an extensive drinking water quality monitoring program to confirm the safety of the water we provide. In 2021-22, we took more than 74,200 water samples from water sources, treatment plants and pipe networks which supply our customers, and had more than 346,000 individual analyses performed by our contracted analytical laboratories.

All our water quality monitoring and reporting is coordinated through our water quality management system (WQMS). WQMS provides many aspects of water quality management and acts as the central database for all information on drinking water quality including sampling program design, sampling analysis, monitoring and reporting.

Additionally, WQMS automatically issues alerts for results outside guideline and operational limits and prompts remedial action as defined by our water safety plans.

Critical control points

A critical control point (CCP) is a point in a drinking water supply scheme where control of a process can be applied and which is essential to prevent a hazard or reduce it to an acceptable level.



Figure 20: Suburban water sampling point

Water Corporation has processes in a water supply scheme that will always have an associated CCP. Every Water Corporation drinking water scheme has at least one CCP, including chlorination for disinfection. Water quality CCP operational targets and limits are formally set through the water safety planning process and listed in the water safety plan for each scheme (refer to *Drinking water quality risk management - Water safety plans*, page 22 and *Case Study – Ensuring safe drinking water*, page 34).

We continuously monitor the performance of CCPs based on set target levels. Where issues are identified we strive to improve barrier robustness and performance.

Incident response

We are committed to protecting our water sources and supply schemes with multiple barriers and have plans in place to manage any issues with minimum impacts on water quality and the community.

We maintain a fleet of mobile UF and chlorination plants which allow us to rapidly restore high quality drinking water supplies. Our UF plants can be mobilised quickly to provide a minimum of 500,000 litres of high quality drinking water per day. Other treatment units, including an RO unit, are available for specialised applications.

In addition, we conduct incident scenarios with DoH to continually improve our incident management processes.



Case study – Ensuring safe drinking water

The ADWG guiding principle one states ‘the greatest risk to consumers of drinking water are pathogenic microorganisms. Protection of water sources and treatment are of paramount importance and must never be compromised’. Microorganisms, such as bacteria, viruses and protozoa, that can cause illness are called pathogens. If they are introduced into the body, for example by consumption, they can cause illness within as little as a couple of hours.

The multiple barrier approach to drinking water scheme management provides a redundancy of physical and treatment barriers to ensure the water that reaches your water meter is safe (refer to *Drinking water quality risk management - Multiple barrier approach to drinking water quality management*, page 21).

There are two primary methods to ensure no live pathogens remain in the drinking water (refer to *How is your water treated*, page 27):

- Disinfection, the process of killing or deactivating pathogens, is done through dosing chlorine or applying of ultraviolet (UV) light. Disinfection of the water just prior to distribution is one of the most important barriers and is mandatory in every drinking water scheme.
- Filtration is the process of physically removing pathogens and is required for schemes where there is a risk of pathogens resistant to chlorine.

Careful assessment of a water source is undertaken to determine the source risk. Physical properties of the water source, such as type of water source and catchment land uses, are all taken into account. The risks of source contamination are carefully judged and then confirmed with microbiological testing of the water source.

This assessment, undertaken in all water schemes, determines the combination of physical and disinfection barriers to be employed to ensure each scheme provides microbiologically safe water. These barriers become our CCPs for a water supply (refer to *Monitoring and incident management – Critical control points* section, page 33).

To provide surety of safe water supply CCPs must be performing well at all times. If one of these barriers is not operating properly, processes and equipment in place are designed to attempt to fix the issue or, if unable to be fixed, it will shut down until a technician can attend to and correct the problem.

There are almost 250 CCPs around the state, all of which are selected, implemented and monitored to ensure safe water is delivered to our customers.

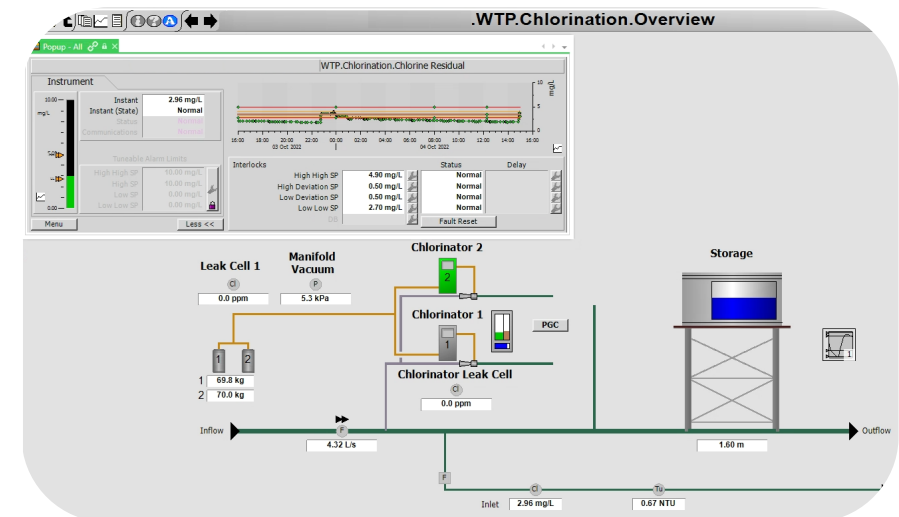


Figure 21: Continuous chlorination monitoring



Understanding water quality test results

The following summaries are intended to assist you with interpreting the results presented in Appendix C of this report. Additional information can be obtained by referring to the Fact Sheets contained in the ADWG published by the National Health and Medical Research Council.

The tables in Appendix A show the ²guideline values for all parameters included in the *Summary of test results* tables in Appendix C. For the purposes of this report, all data are assessed in relation to the ADWG unless otherwise stated.

Escherichia coli (*E. coli*)

Most human pathogenic microorganisms are found in the gut and faeces of humans and other warm-blooded animals. The bacteria *E. coli* is found in abundance in the intestine of humans and other warm-blooded animals. While most *E. coli* species are not pathogenic to humans, they indicate possible recent contamination by human or animal faecal waste. As it is impractical to test for the presence of all pathogenic microorganisms in water, the ADWG recommends testing for the microbial indicator bacterium *E. coli* to indicate the presence of faecal contamination or pathogenic organisms.

We employ a multiple barrier approach (refer to page 21) to prevent microbial contamination of water supplies, however, if there is an *E. coli* detection it is immediately addressed to ensure the water supplied is safe.

² ADWG defines these as the concentration or measure of a water quality characteristic that, based on present knowledge, either does not result in

Thermophilic *Naegleria*

Naegleria are free living amoebae which are almost ubiquitous, being found in fresh water, soils and sediments. It is not associated with human waste. They grow more freely in waters between 27 to 46°C but may survive for long periods in cyst form in much colder waters and, under certain conditions, may proliferate in pipework and tanks. As they proliferate in warmer water they are referred to as thermophilic or *Naegleria* tolerant to 42°C. This organism is safe to drink but the species *Naegleria fowleri* can cause the disease primary amoebic meningoencephalitis if it enters the body, under pressure, through the nose. Adequate levels of chlorine or chloramine can control *Naegleria* in water. Any detection of thermophilic *Naegleria* is responded to immediately to ensure the potential risk to public health is managed and to ensure the water supplied is safe.

Fluoride

Fluorine is one of the most abundant elements in the Earth's crust and is typically found as the fluoride ion or as organic or inorganic fluoride compounds. It is found naturally in groundwater supplies and is present in most food and beverage products and toothpaste. Additional fluoride is added to a number of water supplies in Western Australia as directed by the Minister for Health (refer to *How is your water treated?* - Fluoridation , page 32). While the ADWG health guideline value is 1.5 mg/L, the fluoride concentration after dosing should not exceed the range set by the Fluoridation of Public Water Supplies Advisory Committee, to a maximum limit of 1 mg/L.

any significant risk to the health of the consumer (health guideline), or is associated with good quality water (aesthetic guideline value).



Nitrate

In Western Australia, elevated nitrate concentrations are usually due to the natural process of plant decay that has occurred underground over geological time. Some agricultural practices have also led to elevated nitrate concentrations of underlying groundwater. The ADWG specify a health guideline for nitrate of 50 mg/L (as nitrate) for bottle-fed infants less than three months old and a guideline of 100 mg/L (as nitrate) for adults and children over three months old. Health effects due to elevated nitrate concentrations in drinking water are very rare and no issues have been recorded in Western Australia.

All our water supplies meet the ADWG guideline limit for adults and children over three months. We currently have infant nitrate exemptions from DoH for 10 towns in the Mid West and Goldfields and Agricultural regions, including: Wiluna, Yalgoo, Leonora, Laverton, Menzies, Cue, Meekatharra, Mt Magnet, Sandstone and New Norcia (see Schedule 2 of our [MoU with DoH](#)). The Community Health Nurse, in each town with an infant nitrate compliance exemption, provides advice to mothers regarding the use of alternative water for the preparation of bottle feeds. We provide bottled water free of charge via the Community Health Nurse to these towns as required.

We have been progressively reducing nitrate in most of the water supply in these towns. Wiluna, Yalgoo, Leonora, and Mt Magnet have treatment by EDR or RO to reduce nitrates. Following the recent commissioning of EDR plants in Cue, Sandstone and Meekatharra, we are now managing nitrates to below the infant nitrate health guideline in these towns. Laverton has a temporary RO plant, while planning is underway to identify a long-term solution, and Menzies has water carted from Kalgoorlie. Nitrate exemptions will be surrendered following a proving period for each scheme. In New Norcia, we are in communication with DoH and the customers on this issue.

Trihalomethanes

Trihalomethanes (THMs) may be present in drinking water, forming as a by-product of disinfection using chlorination (and chloramination to a much lesser extent). We are required to comply with the ADWG health guideline of 0.25 mg/L expressed as an average long-term exposure. For the purposes of this report, THM compliance is assessed comparing the guideline with the mean annual THM concentration.

Alkalinity (as calcium carbonate)

Alkalinity is a measure of the parameters in water that have acid-neutralising ability, typically expressed in mg/L of equivalent calcium carbonate. Alkalinity can be affected by naturally occurring minerals or water treatment chemicals. There are no aesthetic or health considerations for alkalinity, and therefore the ADWG do not provide a guideline value.

Aluminium (acid-soluble)

Acid-soluble aluminium in water primarily originates from the addition of coagulants such as aluminium sulphate or poly-aluminium chloride in the water treatment process. These coagulants are added to aid the removal of constituents that impart colour and particulate matter that causes turbidity. Aluminium can accumulate in pipe sediments and be re-suspended during periods of rapid changes to flow patterns. The ADWG specify an aesthetic guideline of 0.2 mg/L. No health guideline is set.



Chloride

Chloride is present in natural waters from the dissolution of salt deposits. In surface water, the concentration of chloride is typically less than 100 mg/L while groundwater can have higher concentrations, particularly if there is saltwater intrusion. In Australian drinking water supplies, chloride levels range up to 650 mg/L depending on local water source characteristics.

Chloride is essential for humans and animals. It contributes to the osmotic activity of body fluids. Based on aesthetic considerations, the chloride concentration in drinking water should not exceed 250 mg/L (ADWG).

Hardness (as calcium carbonate)

Hardness is caused by the presence of dissolved calcium and magnesium in water. Hard water requires more soap to obtain lather and can also cause scale to form on hot water pipes and fittings. It can also be an important issue to consider when purchasing appliances, such as dishwashers.

Hardness can be expressed in a number of units of measure. To convert the hardness values presented in this report (expressed in mg/L) to dH (German degree) units, divide by 17.8. To convert hardness to millimol (mmol) units, divide by 100 and to convert to milliequivalent (mEq) divide by 50. The ADWG specify an aesthetic hardness guideline of 200 mg/L.

Table 1: ADWG guidance – Degrees of hardness

Hardness (mg/L)	Properties
< 60	soft and possibly corrosive (depends on pH, alkalinity and dissolved oxygen concentration)
60 – 200	good quality for all domestic uses
200 – 500	will increase scale formation
> 500	will cause a high-level scaling

Iron

Iron occurs naturally in water as a result of contact with iron-containing soil or rock in the catchment. It can accumulate in pipe sediments and be re-suspended during periods of rapid changes to water flow patterns. Elevated concentrations cause discoloured water and can stain laundry. The ADWG specify an aesthetic guideline of 0.3 mg/L, though we aim to manage below this guideline value due to customer impacts.

Manganese

Manganese in water can come from contact with manganese-containing soil or rock in the catchment. It can accumulate in pipe sediments and be re-suspended during periods of rapid changes to water flow patterns.

Elevated manganese can make water look black and stain laundry. The ADWG specify an aesthetic guideline of 0.1 mg/L, though we aim to manage below this guideline due to customer impacts. Manganese also has a health guideline value of 0.5mg/L. For further information regarding guideline levels for other metals relevant to drinking water, refer to Appendix A, page 48.



Per- and poly-fluoroalkyl substances

Per- and poly-fluoroalkyl substances (PFAS) are manufactured chemicals that do not occur naturally in the environment. They have been used since the 1950s in a range of common household products including clothing, carpets, paper, food wrappings and cosmetic products as well as in industrial products including firefighting foams and hydraulic fluids. As a result of widespread use, PFAS have been found to be present in low levels in soils, surface water and groundwater in most urban areas around the world, including in Western Australia.

In August 2018, the ADWG were amended to incorporate two PFAS health-based guideline values for three PFAS chemicals. These are 0.07 micrograms per litre ($\mu\text{g/L}$) for combined perfluorooctane sulfonate and perfluorohexane sulfonate (PFOS and PFHxS) and 0.56 $\mu\text{g/L}$ for perfluorooctanoic acid (PFOA).

Most Water Corporation drinking water source catchments are well protected and exclude activities that may introduce PFAS into the drinking water. However, we have conducted a risk assessment, in conjunction with DoH, based on land uses and source characteristics for all drinking water catchments to determine which are more likely to have the presence of PFAS. We are undertaking a targeted PFAS sampling program across our catchments and reporting sampling results to the DoH and DWER.

Since PFAS sampling commenced in 2019-20, detections have generally occurred at locations where land uses have been less compatible with comprehensive water source protection. At these locations water is managed to maintain supply to customers below ADWG health guideline levels. Further information can be found on the [Water Corporation website](#).

We have also engaged with research partners to better understand the risks associated with PFAS.

pH

pH is a measure of water acidity (pH 7 is neutral). The ADWG specify a lower and upper aesthetic value of 6.5 and 8.5, respectively. The guidelines allow for a pH of up to 9.2 for new concrete tanks and cement-lined pipes, which can significantly increase the pH for a short period of time. Elevated pH is often caused by calcium carbonate leaching from the protective cement lining of the pipes after long transit times, or pH may be specifically adjusted as part of chloramine disinfection (refer to *How is your water treated? – Disinfection*, page 30). These conditions may be found at a number of localities in our large water supply schemes. Where low pH is experienced, this is typically a consequence of the source characteristic rather than the influence of treatment. Buffering is a treatment process that stabilises the pH of the water.

Silica

In Australia, dissolved silica can range between 0.6 mg/L in some surface waters to 110 mg/L in ground waters. Dissolved silica can precipitate on some surfaces forming a white residue. In cases where customer complaints occur due to scale build-up, water hardness and silica concentrations are often identified as the primary cause. There are no adverse health considerations associated with silica in drinking water, but to minimise scale build up on surfaces silica should not exceed 80 mg/L (ADWG).



Sodium

Sodium is widespread in water due to the high solubility of sodium salts and the abundance of mineral deposits. In major Australian reticulated supplies, sodium concentrations range from 3 mg/L to 300 mg/L. While sodium is essential to human life, there is no agreed minimum daily intake level. Based on aesthetic considerations, the concentration of sodium in drinking water should not exceed 180 mg/L (ADWG).

Total Dissolved Solids

Total Dissolved Solids (TDS) consist of inorganic (natural) salts and small amounts of organic matter dissolved in water. TDS typically comprise sodium, potassium, calcium, magnesium, chloride, sulphate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate and phosphate.

Water with low TDS can taste flat, while water with high TDS tastes salty and causes scaling in pipes, fittings and household appliances. The ADWG provide guidance in the palatability of drinking water according to TDS concentration, as shown in Table 2.

Table 2: ADWG guidance – TDS concentration and drinking water palatability

TDS (mg/L)	Palatability
0 – 600	Good quality
600 – 900	Fair quality
900 – 1200	Poor quality
> 1200	Unpalatable

The ADWG guideline of 600 mg/L is based on taste.

True colour

Colour in water originates mainly from natural materials, such as organic matter and minerals, following water drainage through soil and vegetation in a catchment. Corroding metal pipes can also discolour the water, with iron producing a brownish colour and copper a faint blue colour. The ADWG specify an aesthetic guideline of 15 Hazen Units. Water Corporation measures true colour in True Colour Units (TCU) which are numerically identical to Hazen Units. As a guide, 15 TCU is just noticeable in a glass of water.

Turbidity

Turbidity is the cloudy appearance of water caused by the presence of suspended particulate matter. The ADWG specify an aesthetic guideline of 5 Nephelometric Turbidity Units (NTU) which is just noticeable in a glass of water.

Sampling parameters

Appendix A contains a list of regularly sampled parameters within functional groups and their respective health and/or aesthetic guideline values.



Our performance

Health related performance

We again achieved excellent microbiological performance in 2021-22 with 100 per cent of schemes complying with *Escherichia coli* and thermotolerant *Naegleria* requirements (see figure 22). We also achieved 100 per cent for chemical health performance in accordance with DoH requirements (see figure 23).

For this report, the target is achieved if the yearly average concentration for each chemical is less than the guideline value (refer to *Understanding water quality test results*, page 35).

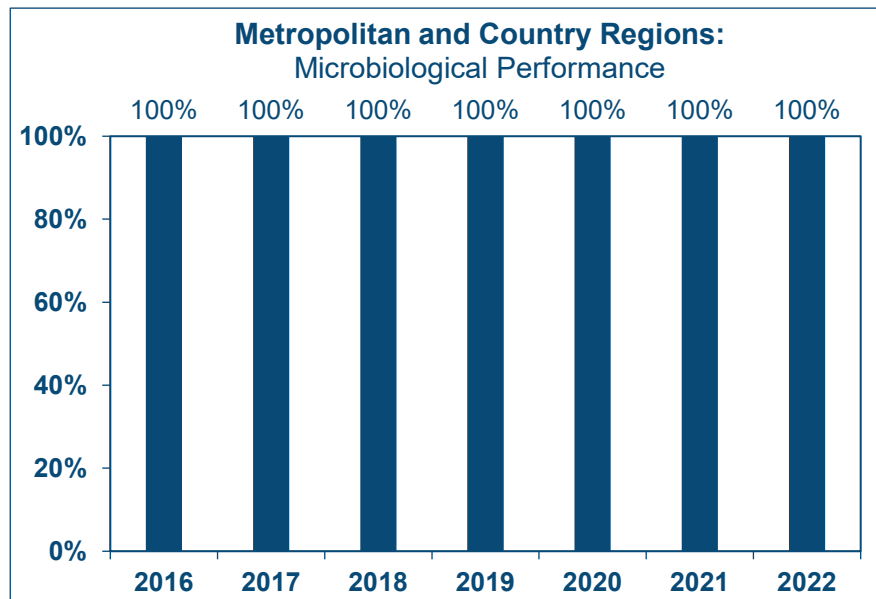


Figure 22: Seven-year microbiological (*E. Coli* and *Naegleria*) performance

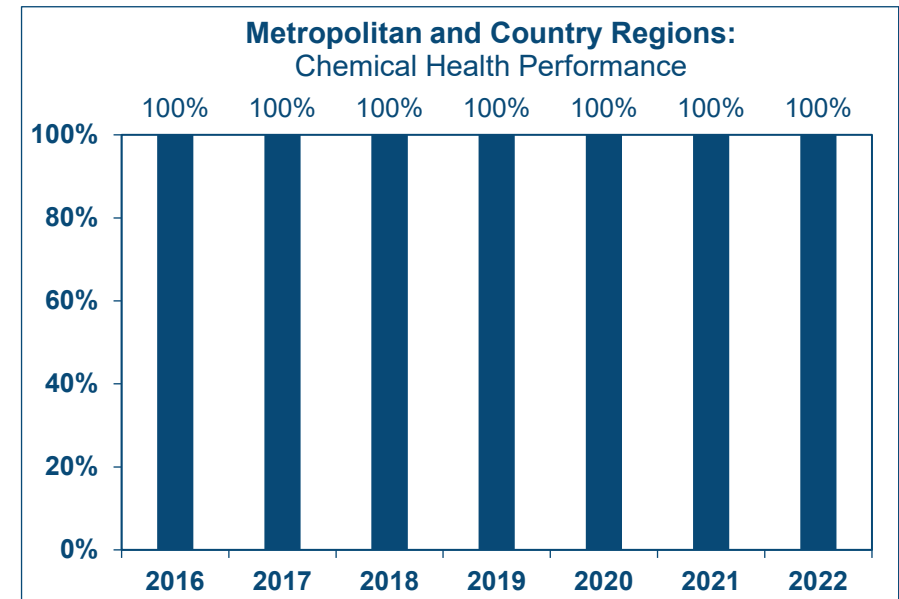


Figure 23: Seven-year chemical health performance



Non-health (aesthetic) related performance

While we strive to meet the ADWG for aesthetic characteristics, this is very difficult to achieve in a state as vast as Western Australia with such diverse water sources. We are committed to improving all aspects of drinking water quality, however, improvements in aesthetic water quality can be very costly and are often hard to achieve.

Detailed performance review for 2021-22

Appendix C provides a detailed summary of test results for each scheme throughout the state. In 2021-22, there were 157 out of 250 schemes where the mean concentration for the year for all aesthetic parameters was less than the aesthetic guidelines. Our performance for all aesthetic analyses (alkalinity, aluminium, true colour, hardness, iron, manganese, pH, TDS, turbidity, sodium, chloride and silica) across our 250 schemes was 93 per cent, with 8,290 out of 8,914 analyses complying with the aesthetic guidelines.

The results in Appendix C show a small number of exceedances above the guidelines in aesthetic quality. These exceedances are caused by the unique quality of local sources, lack of alternative sources, impact of the drying climate on groundwater production and abstraction from groundwater in proximity to the coast.

For many schemes, these excursions have no, or minimal, influence on the taste of the drinking water (refer to *Understanding water quality test results*, page 35).



Customer expectations

Customer contacts

Water quality related customer contacts (enquiries and complaints) are recorded and monitored continuously to identify any trends and areas for improvement. In 2021-22, our Operations Centre received 7,154 water quality related customer contacts (compared with 8,040 in 2020-21), of which 7,126 were customer enquiries and 28 were related to complaints. Figure 24 shows the category of water quality contacts and their proportion of the total (7,154). Note: miscellaneous contacts are predominately related to water hardness).

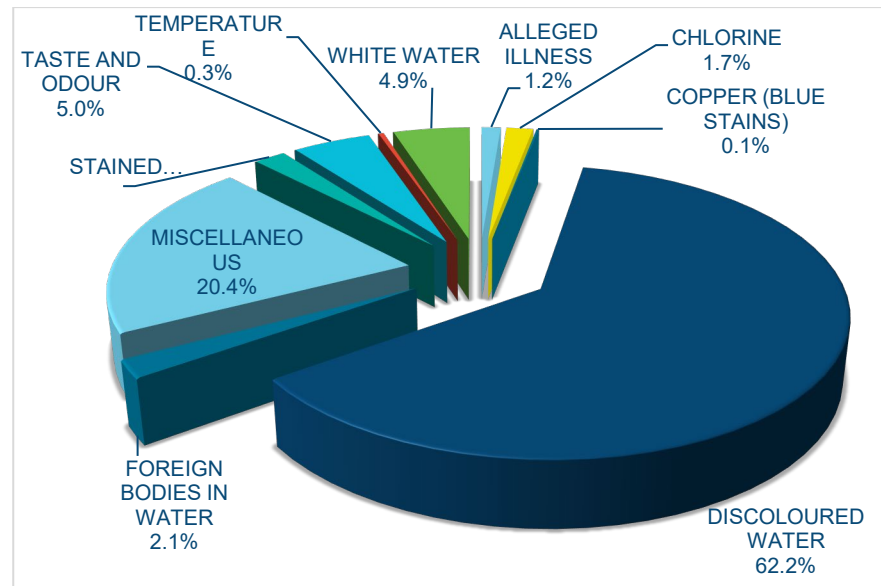


Figure 24: Water quality contacts profile 2021-22 N=7,154

Faults responsiveness

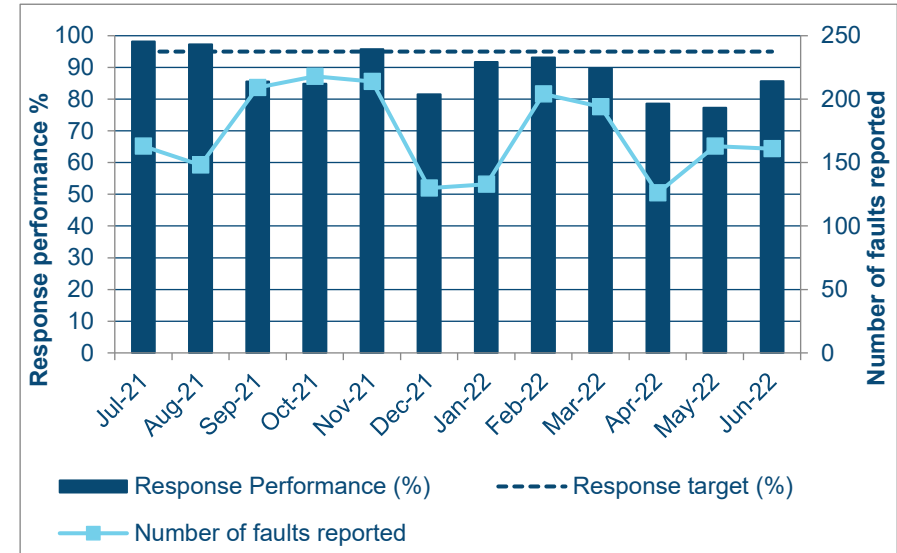


Figure 25: State-wide response performance to water quality faults

For contacts related to water quality faults our customer charter states we will respond within two hours or at an agreed time. We have an agreed customer and business target to achieve this at least 95 per cent of the time.

In 2021-22, we exceeded this target in 3 of 12 months and responded to an average of 88.6 per cent of recorded faults within two hours or at an agreed time (as shown in figure 25, the state-wide monthly faults responsiveness).



Customer research

We measure community perceptions of the quality of drinking water through our quarterly customer value survey.

In our survey, customers are asked to rate the quality of the water supplied to their home in the following categories:

- Overall impressions - thinking about the water that comes out of the tap, how would you rate the quality of the water supplied to your home?
- How would you rate:
 - The taste of the water
 - The smell of the water

- The clarity/ colour of the water
- Providing a consistent level of water quality
- The water's impact on household fixtures and appliances (e.g., shower screens, kettles)

The rating for these questions (where 1 is 'poor' and 10 is 'excellent'), for each quarter of the year, is shown in Table 3 below.

The data demonstrates consistency in the customer perceptions of aesthetic water quality this financial year compared to last year.

Refer to *Improving your water quality*, page 44, for information on improvements we have been making to water safety and aesthetics.

Table 3: Water quality customer value survey ratings

	FY20	FY21	FY22
Clarity/colour	7.24	7.26	7.14
Providing a consistent level of water quality	7.02	7.01	6.93
Smell	6.79	6.77	6.73
Taste	6.15	6.15	6.13
Impact on household fixtures and appliances	5.69	5.67	5.66

Mean score / 10



Improving your water quality

Monitoring and reporting improvements

We are continuing to strengthen the performance of our operational monitoring and critical control point compliance. These key operational and monitoring requirements are detailed within scheme water safety plans which we update regularly and review in detail on a periodic basis (refer to *Drinking water quality risk management – Water safety plans*, page 23). Day to day monitoring and responding to CCPs and other water quality issues is a key part of our business and we have a dedicated team in Operations Support undertaking this function (refer to *Monitoring and incident management – Critical control points*, page 33).

Water quality capital improvements

We continue to progress our program of water quality capital improvements. These projects ensure robust multiple barriers are in place from water source to water meter for all our schemes. Some examples of work undertaken this year are described throughout this report.

Goldfields and Agricultural Region (GAR)

We continue to move towards fully enclosing the GAWS through the construction of sealed water tanks to replace open reservoirs. Construction of sealed water tanks to replace open reservoirs at Norseman and Dedari have been completed and the construction of a sealed tank to replace the open reservoir in Merredin is nearing completion. Once the GAWS is sealed, water quality will improve, helping to maintain chloramine residuals throughout the extensive pipeline network (refer to *How is your water treated? – Disinfection*, page 30).



Figure 26: New sealed water tank in Dedari

In addition to new tanks, improvements to our monitoring, operation and control of chemical dosing and monitoring assets are progressing. Included are projects to improve operation and control at Merredin and Cunderdin and improvement of data visibility along the Goldfields pipeline and its extensions. This will be achieved through the addition of more advanced analysers that have the capability of measuring four water quality parameters, therefore providing water quality information critical for chloramination management. This includes installation of the analysers at several new sites including Meckering, West Kellerberrin, Yerbillion, Ghooli, Toodyay Tank and Burgess Siding (York).

The GAR critical valve project is underway with critical valve upgrades to be undertaken at over 30 sites. The objective of the project is to isolate or provide an enhanced barrier (air gap) between raw and treated water pipes. The project is scheduled for completion in 2023.

North West Region (NWR)

A project to construct a dedicated treated water main to the storage tanks in Nullagine, allowing greater control over reticulation chlorine residuals, will be completed in 2022.



Work is underway to deploy a newly acquired analyser, that can speciate cyanobacteria, at Harding Dam. If successful, this will be beneficial in reducing operational response time, and in optimising the use of Harding Dam.

We are changing membrane suppliers to improve the performance of our membrane plants, and all five membrane trains at Harding Dam have been or will be replaced with these new membranes by November 2022. We are also implementing an automatic membrane integrity test system which will improve reliability of the treatment plant.



Figure 27: Harding membrane train



Mid West Region (MWR)

Historical nitrate and aesthetic water quality issues at Cue, Sandstone, Mt Magnet and Meekatharra have been addressed via water treatment. The water treatment plant at Mt Magnet commenced production in October 2020, the water treatment at Cue commenced operation in September 2021, the water treatment plant at Sandstone commenced operation in November 2021, and the water treatment plant at Meekatharra commenced operation in June 2022. The plants are currently undergoing a proving period before we look to have the nitrate exemption removed from our MoU with DoH.

A project to upgrade the chlorinator at Nilgen has commenced, which will result in increased ability to manage disinfection and residual maintenance.

To address discoloured water issues at Horrocks, several additions and upgrades to the existing treatment are continuing and will be completed in 2023.

The project to replace the existing filter at Watheroo WTP has been commissioned with plant performance optimisation currently underway.

The MWR critical valve project is nearing completion year with critical valve upgrades at over 20 sites. The objective of the project is to isolate or provide an enhanced barrier (air gap) between raw and treated water pipes. The project is scheduled for completion in 2022.

South West Region (SWR)

The new supply bore for the Australind Eaton Scheme will be completed in 2024 to ensure ongoing supply to the Australind Eaton Water Scheme.

A new fluoridation plant was commissioned at Dalyellup in 2022, and Water Corporation now supplies fluoridated water to its Dalyellup customers, in accordance with requirements (refer to *How is your water treated?* – *Fluoridation*, page 32).

The SWR critical valve project has completed critical valve upgrades at over 18 sites. The objective of the project was to isolate or provide an enhanced barrier (air gap) between raw and treated water pipes.

The extension of the Warren Blackwood Regional Water Supply Scheme to Kirup and Mullalyup has been completed.

The project to build a new six million litre tank in Collie is progressing. This project will allow the removal of Worsley Tank, which requires intensive monitoring and management to maintain water quality, from the Great Southern Town Water Supply Scheme; thus, reducing water quality risk in Collie and Allanson.

Projects to install new chlorinators at Peppermint Grove and Prevelly are progressing through project planning and design phases with the intention of construction commencing in 2023.

Great Southern Region (GSR)

We continue to move towards fully enclosing the Great Southern Towns Water Supply Scheme through the construction of sealed water tanks to replace Pinwernying and Bottle Creek open reservoirs.

A new source investigation is underway for Walpole, to ensure a sustainable supply of high-quality drinking water into the future.

Projects are progressing at the South Coastal reservoir in Albany to assist with management of iron and manganese, which is the main cause of discoloured water. The projects include installation of floating oftakes; a silt curtain, and additional turbidity and chlorine analysers.



Installation of a new chlorinator upstream of the offtake to Tincurrin to improve disinfection in this area and ensure continued supply of safe drinking water is continuing and is due for completion in 2023. A temporary chlorinator is in place in the interim.

A new aeration system has been installed at Pingrup Tank. This will mitigate disinfection by-products that are due to long detention time and source characteristics.

The GSR critical valve project is in progress, with critical valve upgrades at over 20 sites. The objective of the project is to isolate or provide an enhanced barrier (air gap) between raw and treated water pipes. The project is scheduled for completion in 2023.

State wide

We are continuing to progress our chlorination program across the state, focusing on upgrading all critical chlorinators to the latest SCADA standards. These improvements will ensure enhanced alarming, automation and reporting capability.

Prioritisation of upgrades to tanks with turnover issues associated with common inlet / outlet arrangements will be undertaken according to a review of data collected from sample points that were installed following a state wide review.



Appendix A – List of sampling parameters

Table 4: Pesticide

Pesticide	Health Guideline Value (µg/L)
2,4-D [(2,4-dichlorophenoxy) acetic acid]	30 µg/L
Aldicarb	4 µg/L
Aldrin + Dieldrin	0.3 µg/L
Ametryn	70 µg/L
Amitraz	9 µg/L
Amitrole	0.9 µg/L
Asulam	70 µg/L
Atrazine	20 µg/L
Azinphos-methyl	30 µg/L
Bioresmethrin	100 µg/L
Bromacil	400 µg/L
Bromoxynil	10 µg/L
Carbaryl	30 µg/L
Carbendazim	90 µg/L
Carbofuran	10 µg/L
Chlorantraniliprole	6000 µg/L
Chlorfenvinphos	2 µg/L
Chlorothalonil	50 µg/L
Chlorpyrifos	10 µg/L
Chlorsulfuron	200 µg/L
Clopyralid	2000 µg/L
Cyfluthrin	50 µg/L
Cypermethrin	200 µg/L
Cyprodinil	90 µg/L
DDT (total isomers)	9 µg/L
Deltamethrin	40 µg/L

Pesticide	Health Guideline Value (µg/L)
Diazinon	4 µg/L
Dicamba	100 µg/L
Dichlobenil	10 µg/L
Dichloroprop	100 µg/L
Dichloropropene	100 µg/L
Dichlorvos	5 µg/L
Diclofop-methyl	5 µg/L
Dieldrin	see Aldrin
Dimethoate	7 µg/L
Diquat	7 µg/L
Disulfoton	4 µg/L
Diuron	20 µg/L
2,2-DPA (2,2-dichloropropionic acid, Dalapon)	500 µg/L
Endosulfan	20 µg/L
Ethion	4 µg/L
Etridiazole	100 µg/L
Fenamiphos	0.5 µg/L
Fenarimol	40 µg/L
Fenitrothion	7 µg/L
Fenthion	7 µg/L
Fenvalerate	60 µg/L
Fipronil	0.7 µg/L
Flamprop-methyl	4 µg/L
Fluazifop ^[1]	10 µg/L
Fluometuron	70 µg/L
Flupropanate	9 µg/L
Glyphosate	1000 µg/L
Heptachlor & heptachlor epoxide (total)	0.3 µg/L
Hexazinone	400 µg/L



Pesticide	Health Guideline Value (µg/L)
Imazapyr	9000 µg/L
Maldison (Malathion)	70 µg/L
MCPA	40 µg/L
Methidathion	6 µg/L
Methiocarb	7 µg/L
Methomyl	20 µg/L
Metolachlor	300 µg/L
Metribuzin	70 µg/L
Metsulfuron-methyl	40 µg/L
Mevinphos	5 µg/L
Napropamide	400 µg/L
Nicarbazin	1000 µg/L
Norflurazon	50 µg/L
Omethoate	1 µg/L
Oryzalin	400 µg/L
Oxamyl	7 µg/L
Paraquat	20 µg/L
Parathion-ethyl	20 µg/L
Parathion-methyl	0.7 µg/L
Pendimethalin	400 µg/L
Permethrin	200 µg/L
Picloram	300 µg/L
Piperonyl butoxide	600 µg/L
Pirimicarb	7 µg/L
Pirimiphos-methyl	90 µg/L
Polihexanide	700 µg/L
Propachlor	70 µg/L
Propargite	7 µg/L
Propiconazole	100 µg/L

Pesticide	Health Guideline Value (µg/L)
Propyzamid	70 µg/L
Pyrasulfotole	40 µg/L
Pyroxsulam	4000 µg/L
Simazine	20 µg/L
Temephos	400 µg/L
Terbacil	200 µg/L
Terbutylazine	10 µg/L
Terbutryn	400 µg/L
Thiophanate	5 µg/L
Toltrazuril	4 µg/L
Triadimefon	90 µg/L
Triclopyr	20 µg/L
Trifluralin	90 µg/L
Vernolate	40 µg/L

Notes:

µg/L = micrograms per litre; 1000 µg = 1 milligram (mg)

Results should not exceed the health guideline value

^[1] Guideline specific to WA and set by DoH

Other pesticides may be assessed as indicated



Table 5: Organic compounds

Compound	Health Guideline Value (µg/L)	Aesthetic Guideline Value (µg/L)
Acrylamide	0.2	Not set
Benzene ^[1]	1	Not set
Carbon tetrachloride	3	Not set
Chloroacetic acids		
Chloroacetic acid	150	Not set
Dichloroacetic acid	100	Not set
Trichloroacetic acid	100	Not set
Chlorobenzene ^[1]	300	10
Chlorophenols		
2-chlorophenol	300	0.1
2,4-dichlorophenol	200	0.3
2,4,6-trichlorophenol	20	2
Dichlorobenzenes ^[1]		
1,2-dichlorobenzene (1,2-DCB)	1500	1
1,3-dichlorobenzene (1,3-DCB)	Not set	20
1,4-dichlorobenzene (1,4-DCB)	40	0.3
Dichloroethanes ^[1]		
1,1-dichloroethane	Not set	Not set
1,2-dichloroethane	3	Not set
Dichloroethenes ^[1]		
1,1-dichloroethene (1,1-DCE)	30	Not set
1,2-dichloroethene (1,2-DCE)	60	Not set
Dichloromethane ^[1]	4	Not set
Epichlorohydrin	0.5	Not set
Ethylbenzene ^[1]	300	3

Compound	Health Guideline Value (µg/L)	Aesthetic Guideline Value (µg/L)
Ethylenediamine tetraacetic acid (EDTA) ^[1]	250	Not set
Hexachlorobutadiene ^[1]	0.7	Not set
Nitrilotriacetic acid (NTA) ^[1]	200	Not set
Organotins ^[1]		
Dialkyltins	Not set	Not set
Tributyltin oxide	1	Not set
Plasticisers ^[1]		
Di(2-ethylhexyl) adipate	Not set	
Di(2-ethylhexyl) phthalate (DEHP)	10	Not set
Polycyclic aromatic hydrocarbons ^[1]		
Benzo-(a) pyrene	0.01	Not set
Styrene (vinylbenzene) ^[1]	30	4
Tetrachloroethene ^[1]	50	Not set
Toluene ^[1]	800	25
Total Trihalomethanes	250	Not set
Trichloroacetaldehyde (chloral hydrate)	20	Not set
Trichlorobenzenes (total) ^[1]	30	5
Trichloroethylene (TCE) ^[1]	Not set	Not set
Vinyl chloride ^[1]	0.3	Not set
Xylene ^[1]	600	20
1,1,1- Trichloroethane ^[1]	Not set	Not set

Notes:

µg/L = micrograms per litre; 1000 µg = 1 milligram (mg)

Results should not exceed the health guideline value

^[1] These are part of the hydrocarbons suite in the sampling results tables



Table 6: Radiological

Parameter	Health Guideline Value
Radium 226 & 228	1.0 mSv (millisieverts).
Radon 222	100 Bq/L (Becquerels per litre)

Table 7: Inorganic Chemicals

Chemical	Health Guideline Value (mg/L)	Aesthetic Guideline Value (mg/L)
Chloride	Not set	250
Cyanide ^[1]	0.08	Not set
Fluoride ^[2]	1.5	Not set
Iodide ^[1]	0.5	Not set
Nitrate ^[3]	50	Not set
Silica	Not set	80
Sodium	Not set	180
Sulfate	Not set	250

Notes:

^[1] Other health related chemicals in the summary of test results tables includes cyanide and iodide.

^[2] While the ADWG health guideline value is 1.5 mg/L, the fluoride concentration after dosing should not exceed the range set by the Fluoridation of Public Water Supplies Advisory Committee, to a maximum limit of 1 mg/L.

^[3] Nitrate health guideline is for bottle-fed infants < 3 months of age. The health guideline for adults and children > 3 months is 100 mg/L.

^[4] Guideline set by DoH - ADWG has not set a guideline value for this organism.

Results should not exceed the health guideline value

Table 8: Physical Characteristics

Characteristics	Health Guideline Value	Aesthetic Guideline Value
Hardness as CaCO ₃	Not set	200 mg/L
pH	Not set	6.5 – 8.5
Total filterable solids (by summation)	Not set	600 mg/L
True colour	Not set	15 TCU
Turbidity	Not set	5 NTU

Notes:

NTU = Nephelometric turbidity units

Table 9: Microbiological

Organism	Health Guideline Value
<i>Escherichia coli</i>	0 organisms per 100 ml
<i>Naegleria</i> tolerant to ≤ 42°C <i>fowleri</i>	^[4] No sample should contain <i>Naegleria fowleri</i>



Table 10: Metals

Metal	Health Guideline Value (mg/L)	Aesthetic Guideline Value (mg/L)
Aluminium (acid soluble aluminium) ^[2]	Not set	0.2
Antimony ^[1]	0.003	Not set
Arsenic ^[1]	0.01	Not set
Barium ^[1]	2	Not set
Beryllium ^[1]	0.06	Not set
Boron ^[1]	4	Not set
Cadmium ^[1]	0.002	Not set
Chromium (as Cr[VI]) ^[1]	0.05	Not set
Copper ^[1]	2	1
Iron ^[2]	Not set	0.3
Lead ^[1]	0.01	Not set
Manganese ^[2]	0.5	0.1
Mercury ^[1]	0.001	Not set
Molybdenum ^[1]	0.05	Not set
Nickel ^[1]	0.02	Not set
Selenium ^[1]	0.01	Not set
Silver ^[1]	0.1	Not set
Uranium ^[1]	0.017	Not set
Zinc ^[1]	Not set	3

Notes:

^[1] These are part of the metals suites in the sampling results tables

^[2] Aluminium, iron and manganese are sampled as part of a general suite of samples and results are individually listed in the sampling tables

Results should not exceed the health guideline value



Appendix B – Perth localities maps

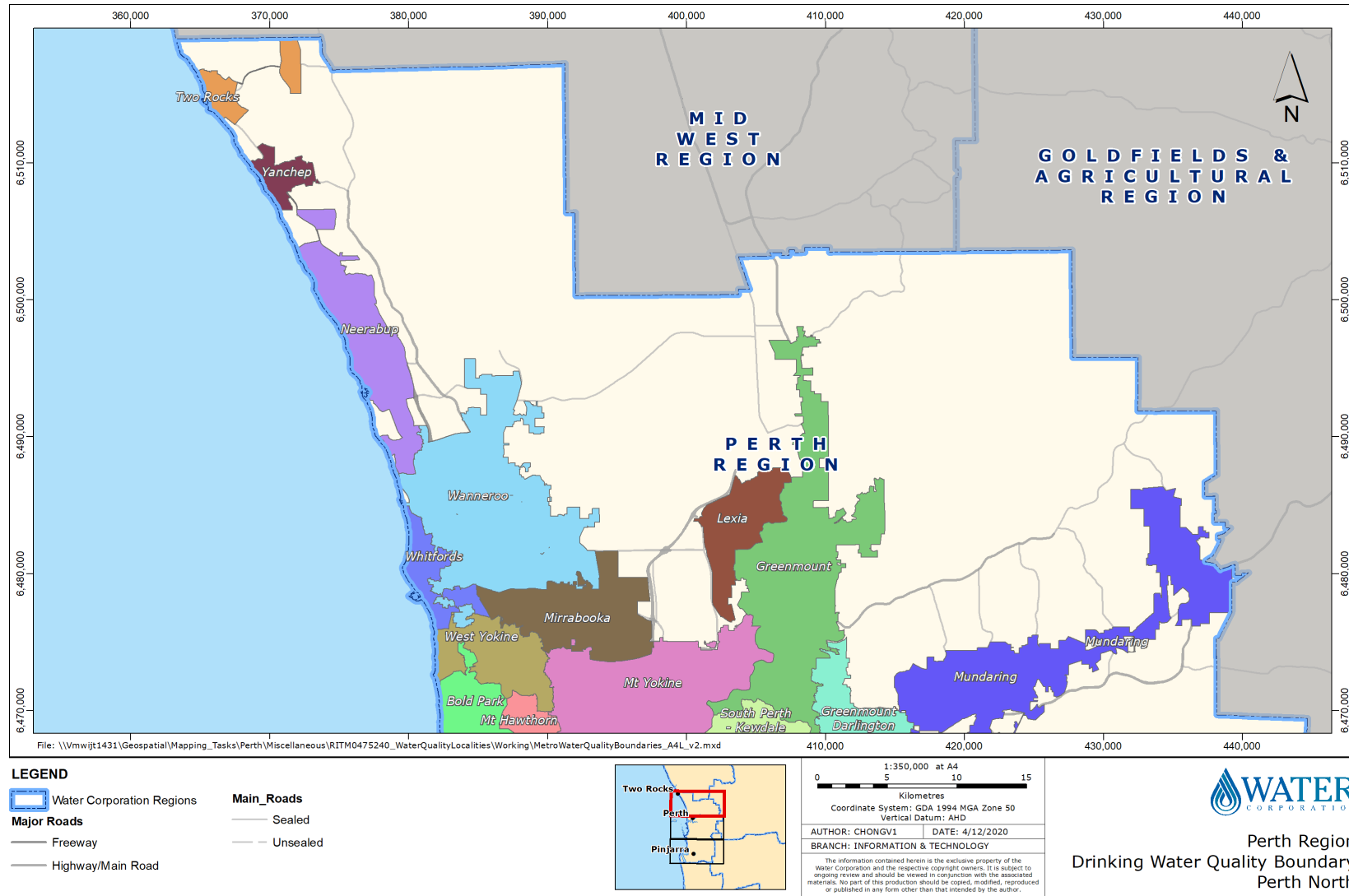


Figure 28: Perth north localities

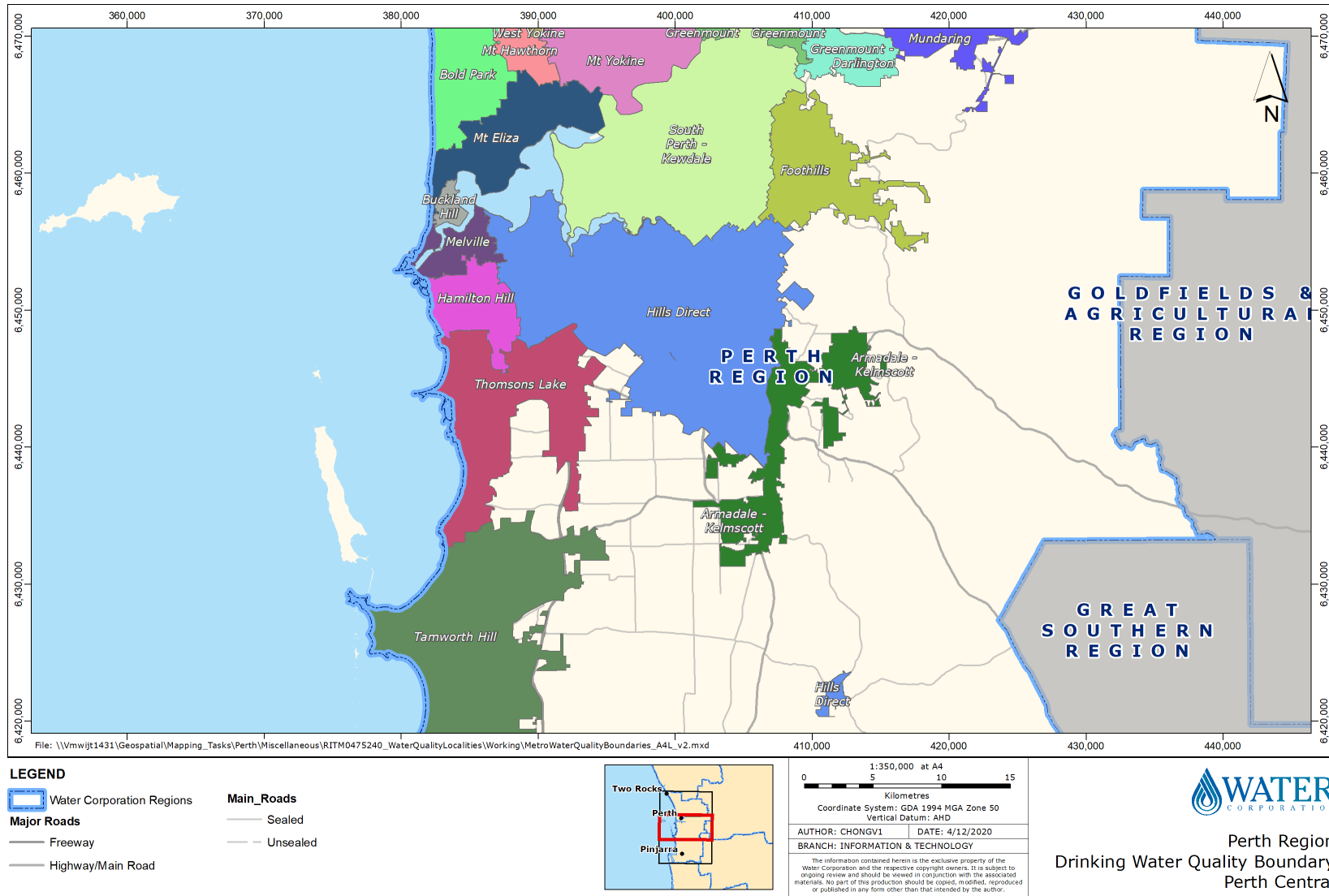


Figure 29: Perth central localities

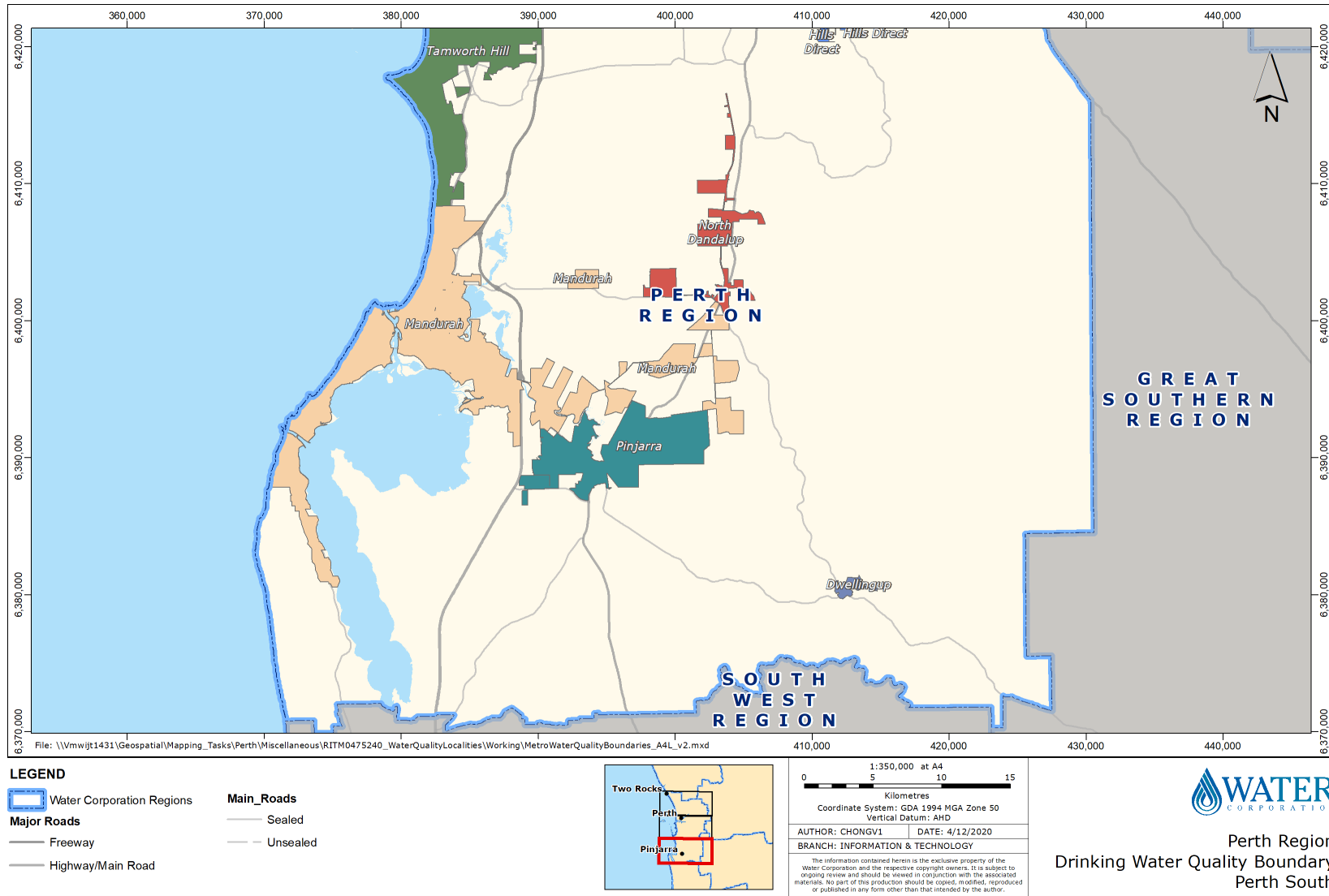


Figure 30: Perth south localities



Appendix C – Summary of test results

Perth Metropolitan Region

Health-related Tables 1 and 2

Aesthetic Tables 3, 4 and 5

Mid West Region

Health-related Tables 6 and 7

Aesthetic Tables 8, 9 and 10

Goldfields and Agricultural Region

Health-related Tables 11 and 12

Aesthetic Tables 13, 14 and 15

South West Region

Health-related Tables 16 and 17

Aesthetic Tables 18, 19 and 20

Great Southern Region

Health-related Tables 21 and 22

Aesthetic Tables 23, 24 and 25

North West Region

Health-related Tables 26 and 27

Aesthetic Tables 28, 29 and 30