Wastewater Quality

Annual Report 2022-23

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Fresh Water Thinking

WATER CORPORATION

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About this report

Water Corporation's 2022-23 Wastewater Quality Annual Report is a review of performance for the financial year ending 30 June 2023.

This report is specifically designed to provide the Department of Health, our customers and the Western Australian community with information on wastewater services and how we manage metropolitan and regional wastewater and recycled water schemes to meet quality and health requirements.

This is the fourth Wastewater Quality Annual Report made available to the public on our website. Publication of this report allows us to meet the requirements of our Water Services Licence with the Economic Regulation Authority and Memorandum of Understanding for Wastewater Services and Groundwater Replenishment (GWR) with the Department of Health.

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.

Further information

- For further information about the wastewater services we provide, or to provide feedback on this report:
- email us at report@watercorporation.com.au
- call us on 13 13 85
- visit watercorporation.com.au/wastewaterquality

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Acronyms

Acronym	Description
ADWG	Australian Drinking Water Guidelines
AGWR	Australian Guidelines for Water Recycling
AWRP	Advanced Water Recycling Plant
BOD	Biological Oxygen Demand
CCP	Critical Control Point
cfu/100ml	Colony forming units per 100ml
Cl	Chorine
DAF	Dissolved Air Flotation
DEC	Department of Environment and Conservation
DWER	Department of Water and Environmental Regulation
DoH	Department of Health
GAR	Goldfields and Agricultural Region
GSR	Great Southern Region
GWR	Groundwater Replenishment
GWRS	Groundwater Replenishment Scheme
LMS	Learning Management System
mg	Milligrams
µg	Micrograms
ML	Megalitre
MLD	Megalitres per day

Acronym	Description
MoU	Memorandum of Understanding
MWR	Mid West Region
NWR	North West Region
ng/L	Nanograms per litre
NTU	Nephelometric Turbidity Units
pg/L	Picograms per litre
PCT	Process Control Table
pfu/100ml	Plaque forming units per 100ml
RDDF	Rotating Dynamic Disc Filter
RO	Reverse Osmosis
RWQI	Recycled Water Quality Indicator
RWQMP	Recycled Water Quality Management Plan
RWQP	Recycled Water Quality Parameter
SWR	South West Region
TCL	Total chlorine
UF	Ultra-filtration
UV	Ultraviolet disinfection
WRRF	Water Resource Recovery Facility
WWTP	Wastewater Treatment Plant

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Summary

Water Corporation is committed to the safe and effective management of wastewater, recycled water, groundwater replenishment, and biosolids and sludge.

Adherence to the management process encompassed by our Wastewater Quality Framework ensures a consistent standard of wastewater quality performance.

We are committed to ensuring the regulatory compliance of all our wastewater operations, and to transparently report to and discuss with our health regulator Department of Health (DoH) any non-compliance. Our processes and procedures ensure the prompt mitigation of any wastewater incidents and complaints.

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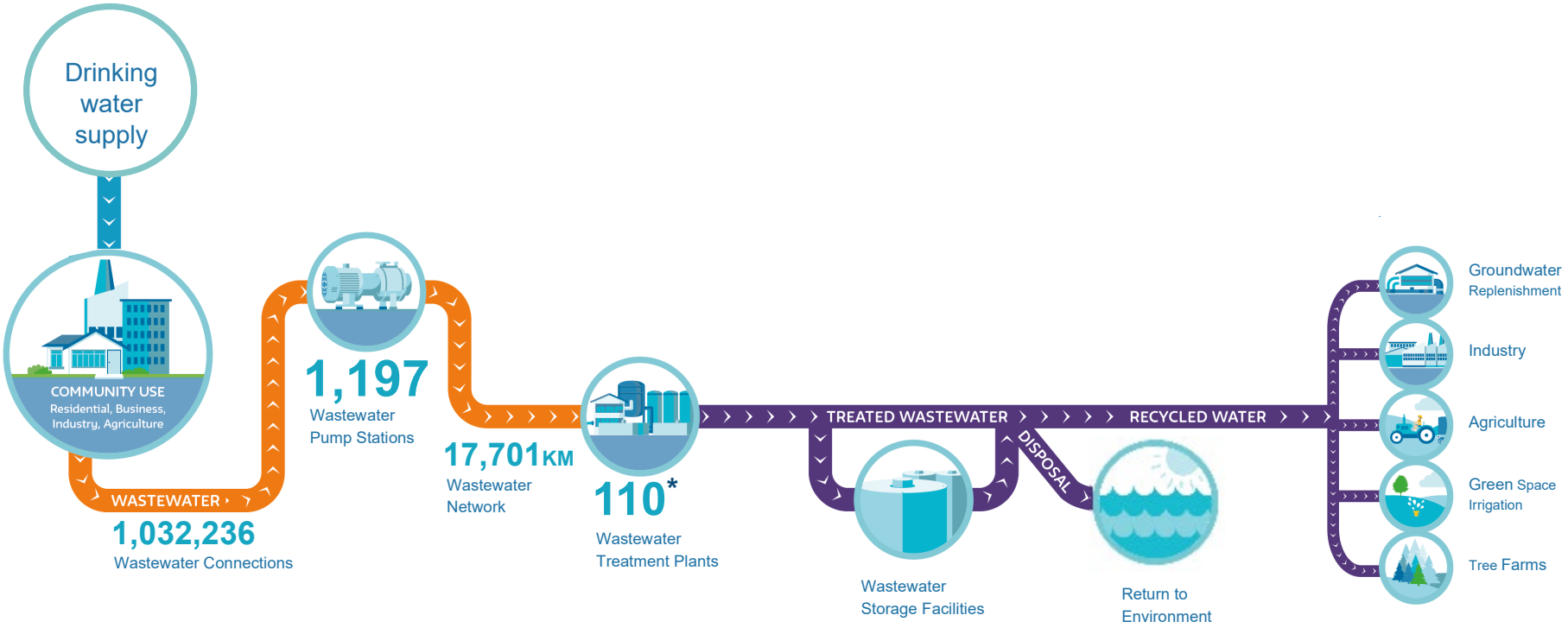

Figure 1: Wastewater assets and general scheme – as at 30 June 2023

* Includes 107 wastewater schemes owned, operated and managed by Water Corporation and three wastewater schemes operated and managed by Water Corporation in the Indian Ocean Territories; does not include wastewater recycling plants. A new wastewater scheme, Mownajum in the North West Region, was added in 2022-23.

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Our commitment

Water Corporation manages wastewater from industry and the community to meet public health, environmental and social expectations. We are committed to the responsible use and disposal of the products generated by our wastewater service to meet public health, environment and social expectations. Our products are treated wastewater, recycled water, biosolids, gaseous emissions and residual wastes. We partner with our stakeholders and relevant agencies to deliver on our commitment to:

- Implement the Wastewater Quality Framework.
- Progressively adopt a best-practice management and multi-barrier approach to manage wastewater risks from source to end point. This ensures the quality of wastewater products.
- Meet public health, environmental, social and corporate expectations in the management of wastewater services as detailed in agreements, licences, regulations and corporate standards.
- Contribute to the development of wastewater regulations, guidelines, and other standards relevant to public health and the environment.
- 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.
- Continually improve our practices by assessing performance against corporate objectives and stakeholder expectations.
- Engage with employees, contractors, stakeholders and the community to inform them of relevant issues related to wastewater management and products and listen to their expectations to maintain our social licence to operate.
- Maintain communication and partnerships with relevant agencies and users of wastewater products to continually improve wastewater quality and environmental outcomes.
- Participate in appropriate research and development activities to develop the necessary skills and knowledge to support the operation of the Wastewater Quality Framework.
- Implement and maintain processes and procedures consistent with the WA Guidelines for Biosolids Management to safely and sustainably manage biosolids and sludge recovery.

Figure 2: Carnarvon WWTP – wastewater treatment ponds

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Introduction

Water Corporation provides wastewater services throughout Western Australia and the [1]Indian Ocean Territories (Christmas and Cocos Islands). We manage the state's services through six regions: Goldfields and Agricultural Region, Great Southern Region, Mid West Region, North West Region, Perth Region and South West Region. As part of these services, we manage the daily treatment of more than 485 million litres of wastewater (more than 177 billion litres for the year) through 110[2] treatment plants across these regions and the Indian Ocean Territories.

Products that are generated following the treatment process are either reused or safely disposed to the environment. There are 76 DoH approved recycled water schemes, owned and operated by Water Corporation, local government or private industries, supplying recycled water for industrial reuse, irrigation of public open spaces, and woodlots. All wastewater treatment and recycling plants are listed in Appendix A.

To ensure we continue to provide a high level of service to customers and produce treated wastewater that is safe and fit-for-purpose, we have ongoing engagement with internal and external stakeholders, local government, and regulators.

Memorandum of Understanding

Water Corporation operates under the Memorandum of Understanding (MoU) for Wastewater Services and Groundwater Replenishment (GWR) with DoH.

The MoU applies to the entire wastewater service from collection to disposal and/or beneficial use, including the Groundwater Replenishment Scheme (GWRS).

The intent of the MoU is to ensure our wastewater services and GWR meet all required public health regulations and, therefore, do not negatively affect public health across Western Australia.

The MoU was reviewed and updated on 16 August 2021 and is regularly audited (refer to *Evaluation, audit and continuous improvement*, page 13)

Both Water Corporation and DoH are committed to ensuring wastewater is managed in accordance with state and national guidelines to ensure public health is protected.

[1] All wastewater treatment schemes are owned, operated and managed by Water Corporation, except for three schemes in the Indian Ocean Territories which are operated and managed only.

[2] Includes Mowanjum WWTP added in 2022-23

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Wastewater Quality Framework

12 Elements of the Wastewater Quality Framework

Water Corporation manages wastewater from industry and the community to meet public health, environmental and social expectations. To achieve this, we are implementing the Wastewater Quality Framework; a risk-based approach to wastewater management aligned to the AGWR.

The 12 elements of the Wastewater Quality Framework (Figure 4) covers fundamental concepts related to our commitment to deliver quality wastewater services, the analysis and management of these services, and their ongoing enhancement.

The structure of the Wastewater Quality Framework allows for and requires:

- articulation of our commitment to wastewater services quality
- clear definition of accountabilities and responsibilities across all risks
- identification of preventive measures and treatment barriers
- providing and documenting processes and procedures for operational control
- continuous improvement and review and optimisation of our systems.

Through our Wastewater Quality Policy endorsement, all employees or contractors involved in the wastewater services are responsible for understanding their role in implementing and continuously improving the Wastewater Quality Framework.

Figure 3: The 12 Elements of the Wastewater Quality Framework

Wastewater quality and wastewater recycling policies

Water Corporation's Wastewater Quality Policy supports and promotes responsible use and management of wastewater products generated by its wastewater service, including recycled water, treated wastewater, biosolids, gaseous emissions (odour/greenhouse gases) and residual waste.

Further to this, our Wastewater Recycling Policy outlines our commitment to sustainable management of WA's limited water resources by maximising wastewater recycling and providing a framework for the management of wastewater recycling schemes.

Our Biosolids and Sludge Management Policy commits us to the responsible use and disposal of biosolids and sludge products generated by our wastewater service.

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Wastewater Quality Policy

Water Corporation is committed to the responsible use and disposal of the products generated by our wastewater service to meet public health, environmental and social expectations and the corporate objectives and vision. These products are treated wastewater, recycled water, biosolids, greenhouse gas emissions (scope 1)[1] and residual wastes.

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

 **Manage wastewater services**	Implement the "Wastewater Quality Framework" through existing and new Water Corporation processes.	Progressively adopt a best-practice management and multi-barrier approach to manage wastewater risks from source to end point to ensure the quality of our wastewater products.
 **Meet health and environmental standards**	Meet public health, environmental, social and corporate expectations in the management of wastewater services as detailed in agreements, licences, regulations and corporate standards.	Contribute to the development of wastewater regulations, guidelines, and other standards relevant to public health and the environment.
 **Monitor and respond**	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.
 **Engage with stakeholders**	Maintain communication and partnerships with relevant agencies and users of wastewater products to continually improve public health and environmental outcomes.	Engage with employees, contractors, stakeholders and the community to inform them of relevant issues related to wastewater management and products and listen to their expectations.
 **Improve our practices**	Continually improve our practices by assessing performance against corporate objectives and stakeholder expectations.	Participate in appropriate research and development activities to develop the necessary skills and knowledge to support the operation of the "Wastewater Quality Framework".

All Water Corporation employees, partners and contractors are responsible for understanding their role in implementing and continuously improving wastewater quality management and outcomes.

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

Pat Donovan
Chief Executive Officer, Water Corporation

PCY327
July 2023

[1] Scope 1 greenhouse gas emissions are the emissions released to the atmosphere as a direct result of an activity or series of activities at a facility level, as defined by the Clean Energy Regulator, Australia.

Biosolids and Sludge Management Policy

Water Corporation is committed to the vision of the Waste Avoidance and Resource Recovery Strategy 2030[1], for WA to become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste. Biosolids and sludge are the largest single contributors to Water Corporation's solid waste footprint, and we aim to recover[2] 100 per cent of this valuable resource from Perth metro region, and 75 per cent from regional areas. We are committed to the responsible use and disposal of biosolids and sludge products generated by our wastewater service to meet public health, environmental and social expectations, and our corporate objectives and vision.

 **Manage biosolids quality**	Implement the *WA Guidelines for Biosolids Management* through existing and new Water Corporation processes.	Progressively adopt a best-practice and multi-barrier approach to manage wastewater quality risks from source to end point. Drive continuous improvement to ensure the quality of our biosolids and sludge products.
 **Meet health and environmental standards**	Meet public health, environmental, social and corporate expectations in the management of biosolids and sludge services as detailed in agreements, licences, regulations and corporate standards.	Contribute to the development of regulations, guidelines, and standards relevant to public health and the environment for biosolids and sludge management.
 **Maximise biosolids and sludge recovery**	Plan and design biosolids and sludge treatment processes according to the requirements of end users and available recovery markets. Only rely on third party treatment where providers demonstrate robust quality control.	Maintain access to multiple markets for sustainable management of biosolids and sludge. Use commercial agreements to ensure third parties meet quality requirements.
 **Engage with stakeholders**	Collaborate with relevant agencies, biosolids customers and industry partners to continually improve biosolids and sludge management.	Engage with employees, contractors, stakeholders, and the community by informing them of relevant issues and listening to their expectations of biosolids and sludge management.
 **Improve our practices**	Investigate, evaluate, and implement advanced treatment technologies to increase resource recovery, reduce risk, and improve biosolids and sludge management.	Collaborate with researchers and industry partners to manage emerging risks to biosolids and sludge recovery, public health, and the environment.

Water Corporation will implement and maintain processes and procedures consistent with the *WA Guidelines for Biosolids Management* to safely and sustainably manage biosolids and sludge recovery.

All Water Corporation employees, partners and contractors are responsible for understanding their role in implementing and continuously improving biosolids and sludge management.

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

Pat Donovan
Chief Executive Officer, Water Corporation

PCY310
July 2023

1 www.wasteauthority.wa.gov.au/publications/view/strategy/waste-avoidance-and-resource-recovery-strategy-2030
2 "Recovery" is defined to include reuse, reprocessing, recycling and/or energy recovery.

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Process Control Tables

Water Corporation utilises a standard process reference document for each wastewater treatment plant and wastewater recycling scheme, termed a Process Control Table (PCT). Some complex wastewater treatment plants may have more than one PCT. The PCT contains key sampling, operating and performance information. This information is used by Water Corporation's Wastewater Information Management Solution to compare laboratory/site analysis data with agreed alert and violation ranges derived from PCTs and provide notifications of potential/actual non-conformances. Corrective actions to manage such issues are undertaken, with feedback processes for continuous improvement of the PCT.

We have 117 PCTs, 11 of which incorporate a Water Corporation recycling scheme. We also have 64 separate PCTs for non Water Corporation recycling schemes. All compliance samples are scheduled through the Wastewater Quality Management System.

Critical Control Points

Critical Control Points are preventive measures that are amenable to operational control and are essential to prevent or eliminate a hazard or reduce to an acceptable level (adapted from the Australian Guidelines for Water Recycling, 2006). They are part of a risk management and preventive approach to managing our wastewater systems, especially those that recycle treated wastewater or biosolids (refer to *Biosolids product quality compliance*, page 26.and *GWR scheme overview*, pages 29-30)

Evaluation, audit and continuous improvement.

We review our provision of wastewater services from operator to senior executive to ensure all schemes are managed to meet operational and regulatory requirements. Our review processes engage all key stakeholders using internal and external reviews and audits, including an audit of the MoU for Wastewater Services and GWR with DoH.

The last MoU audit was held in 2021 and found the Corporation appears to have maintained effective mechanisms for managing its wastewater quality obligations through its Wastewater Quality Framework. More information and a copy of the abridged report can be found at: watercorporation.com.au/Wastewater-quality

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Training and awareness

Water Corporation has a mature operator training program which incorporates a detailed online Learning Plan for each operator. It is this plan that allows the business to ensure the right training is being assigned to suit the tasks being performed, and that allocated training is monitored and managed effectively to ensure competence, safety and maintain compliance.

Also central to Water Corporation's operator competence is a nationally recognised water industry certification program (Certificate II, III & IV in Water Industry Operations), a Verification of Competence program, plus overarching training in everything from safety, environment, and personal growth and development.

The nationally recognised water industry certification program is developed and delivered entirely inhouse and overseen through an auspicing arrangement with North Metropolitan TAFE as the Registered Training Organisation.

A key theme within the certification program is the inclusion of knowledge and skills centred on achieving employee awareness and training as per element seven of the Wastewater Quality framework (refer to *12 Elements of the Wastewater Quality Framework*, page 11).

General employee awareness of Water Corporation's core business process of providing and operating fit for purpose wastewater systems that protect the health of the public and environment, is also captured through various initiatives such as the eLearning module 'Water Quality Awareness', which is a mandatory requirement for all staff.

Training is complex and, constantly evolving and improving. The complexities include the coordination of all training required across the organisation, sourcing providers, managing compliance and safety, and aligning with external legislation and standards plus internal policy and standards.

Water Corporation constantly strives to be a leader in operational training, and this is borne out in the constant exploration of visual intelligence technologies that can provide hands free point of vision capabilities, and the use of eLearning to supplement existing face-to-face courses with a move towards virtual delivery. Water Corporation is also embarking on a new central operational training hub with an investment in simulated experiential learning and is part of a national benchmarking initiative to test the quality of our operator competence processes and systems.

Figure 4: Sampling and field instrument training

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Wastewater catchment

Wastewater in Western Australia generally comes from two sources, domestic wastewater and trade waste.

Figure 5: Portable sewer wastewater quality monitor

Domestic wastewater

Wastewater is usually considered to be 99.97 per cent fresh water and 0.03 per cent contaminants. Domestic wastewater is largely consistent in quality and quantity. The volume generally follows a diurnal cycle with a morning and evening peak and low overnight flows.

Controlled waste

Controlled waste is managed by Water Corporation in accordance with the requirements of the *Environmental Protection (Controlled Waste) Regulations 2004*. The substances considered to be controlled waste are listed in the regulations and include sewage waste from the reticulated sewerage system, septage waste, trade waste (e.g., from grease traps, industrial processing) and non-toxic salts. Private carriers can dispose of controlled waste to Water Corporation main sewers and wastewater treatment plants where they are licensed and adapted to receive waste. Transport of controlled waste is tracked using the Department of Water and Environmental Regulation (DWER) Controlled Waste Tracking System.

Septage

Septage, a type of controlled waste, is a by-product from the storage of household wastewater in a septic tank where the sludge accumulates over time and must be removed every 4 to 5 years and disposed in a dedicated disposal facility. Under the *Health Act (1911)* Local Government Authorities (LGAs) are responsible for the acceptance and disposal of septage and can charge ratepayers for this service. Septage, as a controlled waste, must be disposed of in a dedicated disposal facility.

Water Corporation's wastewater treatment is designed, operated and maintained to treat domestic wastewater for subsequent disposal and

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reuse. The capacity of a wastewater scheme to receive septage, without detriment to the treatment process and quality of the treated wastewater, is governed by the quality and volume of septage, as well as the design, capacity, and operation of the plant.

Although Water Corporation is not legally responsible to accept septage, a small number of wastewater treatment plants accepted septage in this financial year to assist LGAs under temporary arrangements. To ensure these plants operate continuously within their licence and performance criteria, a management framework has been developed.

The management framework ensures formal agreements exist with each contractor who disposes of septage at each wastewater scheme. These agreements define the volume and quality of the septage that can be disposed to a plant, and the cost of disposing septage. The framework provides assurance the wastewater scheme has ongoing capacity to receive septage, and the volume and quantity accepted will allow compliance with regulatory requirements for reuse and environmental disposal.

Trade waste

Trade waste is the wastewater discharged directly into our wastewater system from commercial or industrial premises other than domestic type wastewater. At the end of June 2023 there were 14,872 trade waste customers connected to Water Corporation's wastewater system state-wide. Trade waste can be highly variable in quality and quantity, and this can pose significant risks for the operation of the wastewater system. The most numerous trade waste dischargers are small retail food outlets such as restaurants and fast food chains, which generate greasy waste. Large industrial customers such as dairies, beverage manufacturers, meat processors, metal finishers, laundries and waste treatment facilities can be significant point sources of trade waste. Metal finishers, laboratories and chemical formulators typically discharge small to intermediate trade waste volumes, but these wastes may contain compounds of concern for the wastewater system.

Trade waste management and wastewater source control is focussed on five key objectives to manage wastewater input, as defined in the Australian Wastewater Quality Management Guidelines (Water Services Association of Australia, 2022):

- safety of people
- protection of assets (pipes, plant and equipment)
- protection of treatment processes
- facilitation of regulatory and licence compliance
- facilitate development of a circular economy.

Water Corporation has a centre of expertise for trade waste management. It manages trade waste operations state wide using a trade waste framework which includes:

Assessment and approval

Commercial and industrial customers must obtain approval to discharge trade waste to sewer, usually in the form of a trade waste permit. This permit will specify pre-treatment requirements and other conditions which may include limits on mass and volumetric discharge, monitoring and reporting requirements and maintenance of pre-treatment and monitoring equipment.

Fats, oils and grease management program

This program monitors the servicing of 8,149 grease arrestors (as at end June 2023) installed at businesses generating greasy waste, to ensure that the arrestors are pumped out at the required frequency to prevent the discharge of grease and solids into the wastewater system. Unmanaged

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discharges from these businesses can result in sewer blockages and overflows, and extra loading in treatment plants.

Surveillance of large and high-risk customers

An ongoing program of sampling and compliance inspections of industrial customers discharging large organic loads or waste streams of potential quality concern is maintained to monitor loading on the wastewater system and compliance with permit conditions.

Permit capture program

An ongoing program is maintained to identify, typically small, businesses discharging to sewer without a permit. Businesses are required to obtain a permit and meet the relevant permit conditions.

Acceptance criteria and other information

A set of trade waste acceptance criteria is published on Water Corporation's website. These specify the levels of various wastewater quality parameters that may be discharged to sewer by trade waste customers under a permit. Compounds not included in the acceptance criteria are evaluated on a case by case basis and, as appropriate, published in the criteria. In addition to the acceptance criteria, there is a range of other information about trade waste on our website at: watercorporation.com.au/help-and-advice/trade-waste.

Investigations

Water Corporation conducts a range of investigations to assist trade waste management, including characterising wastewater from industry sectors, assessing pre-treatment products, and investigating unusual discharges observed in the wastewater system.

Figure 6: Receival and storage tanks at a waste treatment facility

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Wastewater treatment

Water Corporation managed 107 wastewater treatment schemes across Western Australia and three in the Indian Ocean Territories, treating more than 177 billion litres of wastewater in 2022-23. The emphasis in wastewater treatment is on reducing biological oxygen demand (BOD), in the form of soluble carbon, for environmental, aquatic, and public health protection. Effective management of the whole wastewater treatment process is essential in maintaining consistent treatment performance levels. This is achieved through implementation of a wastewater treatment management framework, progression of wastewater system improvements and upgrades, and implementation of research outcomes to improve wastewater treatment practices.

How wastewater is treated

Wastewater treatment is generally classified into the following stages:

Preliminary treatment – physical removal of larger inorganic solids that may damage or block equipment in later treatment stages:

- Screens – remove items such as rags, paper, cotton buds that may block equipment.
- Grit tanks – remove sand and grit.

Primary treatment – physical removal of fine solids using gravity to settle particles, in a primary sedimentation tank followed by the mechanical removal of these settled solids. Generally, also includes the mechanical removal of floating contaminants.

Secondary treatment – follows on from primary treatment and consists of biological treatment of biodegradable dissolved and suspended organic compounds by converting them into gas and biomass. Secondary sedimentation tanks are used to separate the solid biomass from the secondary treated water prior to the water being discharged or processed further. Secondary treatment processes used by Water Corporation include:

- Lagoons or ponds – have long detention times for the wastewater in excess of one month. The larger the inflow volume the greater the area of the ponds. Treatment relies on natural biological processes at the various layers within the pond that will be anerobic at the base and aerobic at the surface. Requires less management than more complex treatment processes. May include aerators to increase the oxygen and mixing, allowing biological processes to occur at a faster rate and reduce the required detention time and pond size.
- Biological filtration systems (e.g., trickling filters) – have filter media, such as crushed stone, with a large surface area to support a biofilm. Wastewater is trickled over the filter media and the organic content of the wastewater is used by the organisms in the biofilm to grow and reproduce, thus converting the organic matter to biomass.
- Activated sludge, such as extended aeration (e.g., Intermittently Decanted and Extended Aeration plant - IDEA), oxidation ditches and sequencing batch reactors – uses returned biomass (activated sludge) and dissolved oxygen to rapidly convert the incoming organics into more biomass.

Advanced wastewater treatment (sometimes referred to as tertiary) – used when the removal of more intractable contaminants is required. This stage is generally employed to reduce nutrients (mostly nitrogen (ammonia), with phosphorus at some wastewater treatment plants) that may be required for environmental disposal options and pathogens. For more specialised reuse or disposal into sensitive environments other contaminants may also be targeted.

Disinfection – used to protect public health by decreasing or inactivating pathogenic microorganisms. Not all disposal methods require disinfection.

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All Water Corporation wastewater treatment plants (WWTPs) are designed with sufficient redundancy for BOD reduction and are able to consistently reduce BOD to acceptable levels (filtered BOD of less than 20mg/L). Most of Water Corporation's WWTPs have secondary treatment, with the majority of regional plants being pond plants, with added disinfection where required for wastewater recycling. Appendix A contains a complete list of our WWTPs showing treatment type and associated recycling schemes.

The solid waste generated by the wastewater treatment process is termed biosolids or sludge cake depending on the treatment process. Both biosolids and sludge cake are rich in nutrients and organic matter making a great natural fertiliser and soil improver (refer to *Biosolids and sludge management*, page 23). For example, we supply biosolids to farms to help grow crops such as canola. Current design of wastewater treatment plants considers the intended sludge reuse or disposal options; while some older WWTPs require upgrades to accommodate this.

Wastewater Resource Recovery Facilities

A number of our WWTPs recycle a significant amount of:

- Water for use in industry and/or irrigating public open space
- Nutrients
- Biosolids and/or
- Energy from wastewater

WWTPs that recover resources to recycle as part of the treatment process have been renamed Water Resource Recovery Facilities (WRRF) to reflect the true functionality of these facilities.

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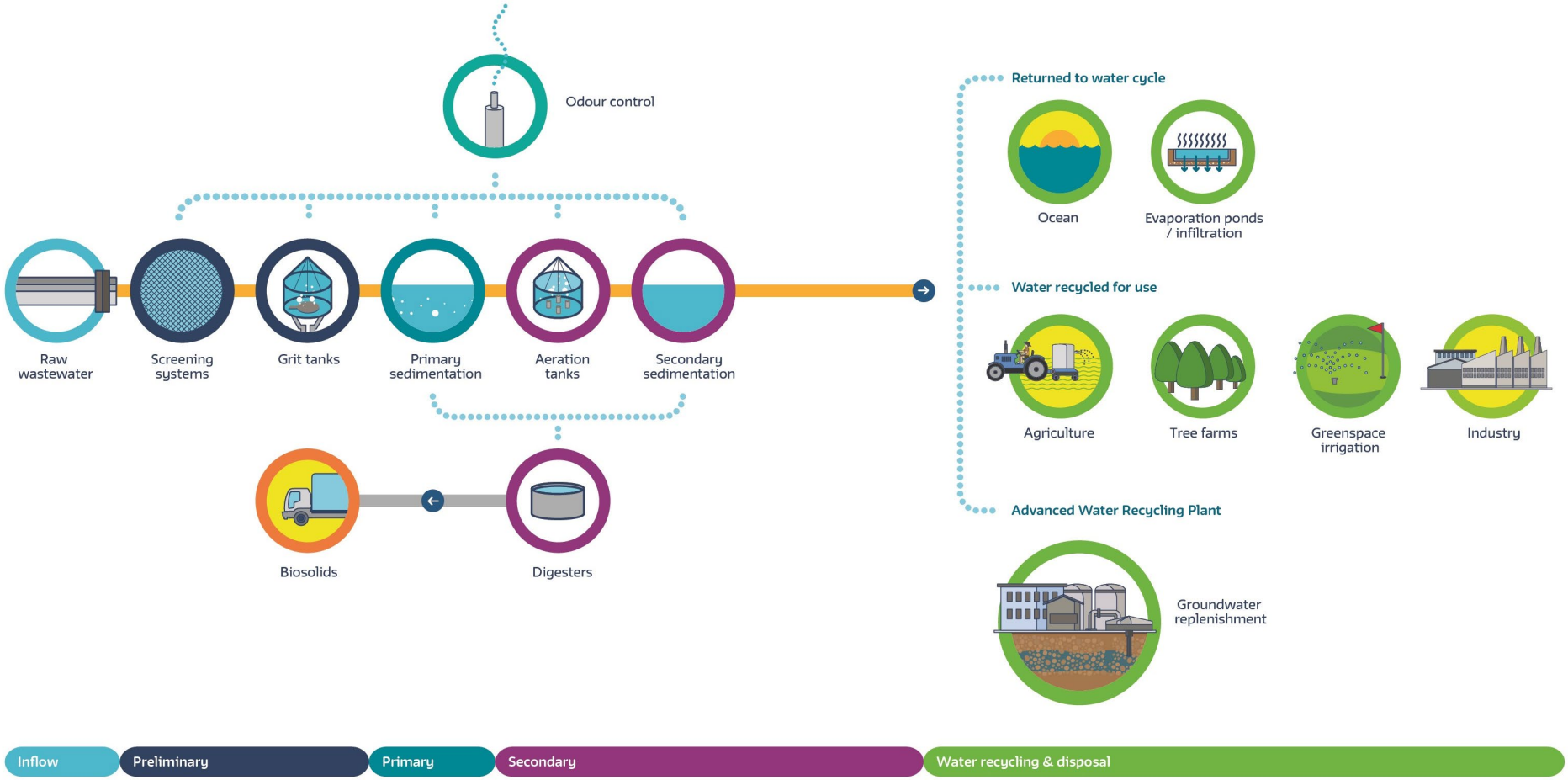

Figure 7: Wastewater treatment, recycling and disposal

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Wastewater schemes - new and upgrades

Two WWTPs, Kemerton and Collie, had upgrades completed in the 2022-23. These upgrades are part of Water Corporation's Asset Investment Program, which aims to maintain or improve wastewater treatment quality through prioritised and targeted capital expenditure. In addition, we took over the WWTP at Mowanjum in the NWR and upgraded some of its assets.

Several additional scheme upgrades were commenced or continued, but not finalised, in 2022-23, these include:

- Derby WRRF – new anaerobic pond.
- Broome North WRRF- recycle water system upgrade.
- Northam WRRF – currently at design stage to install oxidation ditch.
- Geraldton #2 WWTP – aeration system upgrade.

Kemerton WRRF and Collie WWTP new centrifuge dewatering systems

- Both systems had similar new centrifuge dewatering systems commissioned. They each included:
  - A new centrifuge building, liquid polymer and conveyor systems and sludge hopper.
  - Replacement of the old, less reliable, belt press systems.
  - Production of dewatered sludge at a percentage of total solids, meeting regulatory guidelines and saving on transportation costs.
- The Kemerton system has the capacity to dewater solids produced from a 3.6 megalitre (ML) wastewater treatment plant.
- The Collie system has the capacity to dewater solids produced from a 2.2 ML wastewater treatment plant.

Figure 8: Dewatering building at Collie WWTP

Mowanjum WWTP upgrade

- Commissioned new evaporation ponds.
- Commissioned new bore sampling points.
- Developed new Process Control Table for the plant.

Figure 9: Mowanjum WWTP pond

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Case Study – Busselton WRRF

In 2021, the Xylem Taron Rotating Dynamic Disc Filter (RDDF) was trialled at the Bridgetown WRRF as a solution to solid-liquid (phase) separation challenges associated with poor settling activated sludge (refer to *Case Study, Wastewater Quality Annual Report 2021-22* page 29). This pilot system proved to be robust, reliable, and easy to operate. RDDF technology is an attractive alternative to secondary clarification for several reasons:

- The system combines phase-separation and tertiary microfiltration in a single step.
- The system configuration ensures a very small footprint – typically about 1/8th that of an equivalent secondary clarifier.
- RDDF technology can separate mixed liquor from treated wastewater at flow rates 2-3 times greater than a secondary clarifier.
- Microfiltration performance is achieved at extremely low power consumption.
- In a prefabricated package system format, RDDF technology is considered a more fit-for purpose phase separation alternative to secondary clarification.

RDDF technology will therefore be a suitable secondary phase separation technology for several small (less than 2.0 MLD), advanced treatment plant upgrades that will be required at Water Corporation within the next 5 years.

The RDDF pilot container was transferred to Busselton WRRF in January 2023 to determine an upper limit for filter throughput capacity with good settling activated sludge, as opposed to the poor settling activated sludge in Bridgetown. This new trial commenced in early February 2023 and data was collected until the end of April 2023.

The pilot trial work at Bridgetown and Busselton WRRFs has shown that the RDDF technology is a simple, robust, and easily maintained solid-liquid separation system. Both trials have provided valuable information which may be used for the design of full-scale RDDF systems which will provide the equivalent of tertiary treatment capability in a single phase-separation step.

Figure 10: Taron RDDF at Busselton WRRF

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Biosolids and sludge management

All WRRF and WWTPs produce solid waste which, depending on the treatment method, is categorised as biosolids or sludge cake.

Biosolids is organic sludge from domestic and industrial wastewater that has undergone treatment to significantly reduce pathogens and volatile organic matter. This results in a stabilised product suitable for beneficial use in agriculture. This treatment method is only available at our larger metropolitan WRRFs.

Biosolids are classified according to pathogen grade (P) from P1 to P4 and contaminant grade (C) from C1 to C3. All biosolids are classed as P4 C3, unless proven otherwise. Biosolids with a P3 C2 rating can be used for direct beneficial use in broad-acre agriculture, forestry, or mine site rehabilitation (Western Australian Guidelines for Biosolids Management, Department of Environment and Conservation (DEC), 2012). Table 2 (page 26) shows the metropolitan biosolids compliance to these classifications.

Sludge cake is partially treated dewatered organic sludge that has not undergone the process of controlled stabilisation, and therefore requires further treatment by third party composters prior to beneficial use.

Water Corporation is committed to the vision of the Waste Avoidance and Resource Recovery Strategy 2030, for WA to become a sustainable, low-waste, circular economy in which human health and the environment are protected from the impacts of waste. Biosolids and sludge cake are the largest single contributors to Water Corporation's solid waste footprint, and we aim to recover 100 per cent of these valuable resources from Perth Region and at least 75 per cent from regional areas. We are committed to the responsible use and disposal of biosolids and sludge products generated by our wastewater service to meet public health, environmental and social expectations.

Figures 11 and 12 show the volumes of biosolids and sludge cake produced in our metropolitan water resource recovery facilities. Figure 13 depicts regional sludge cake volumes produced with table 1 (page 25) showing the percentage of this going to beneficial use. The majority of regional wastewater schemes are pond systems that do not produce a continuous solid waste stream. Sludge is, therefore, intermittently removed through an asset maintenance program called pond desludging. Consequently, annual regional sludge volumes are variable.

Water Corporation has undertaken research and development to verify sludge stabilisation in drying beds and geobags, with the aim of increasing sludge recovery in pond-based treatment plants, particularly in Mid West Region (MWR) and North West Region (NWR), to meet the 75 per cent recovery target by 2030. Research results are being evaluated and will strategically inform resource recovery opportunities with additional market development of third-party composters and other treatment providers. Ongoing research is a means of engaging with new and innovative ways for beneficially using wastewater products.

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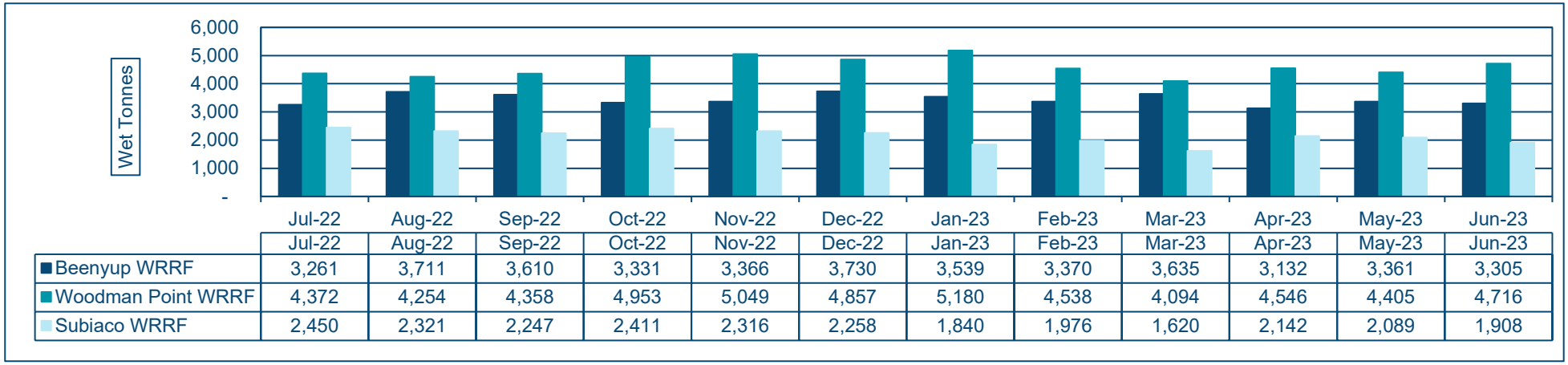
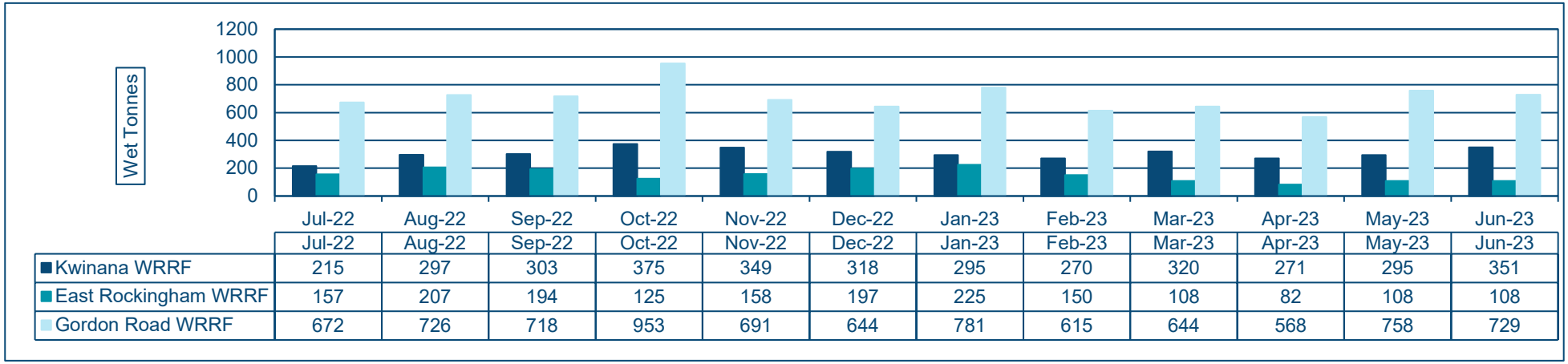
Metropolitan (Perth-Peel) biosolids & sludge cake production



	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23
Beenyup WRRF	3,261	3,711	3,610	3,331	3,366	3,730	3,539	3,370	3,635	3,132	3,361	3,305
Woodman Point WRRF	4,372	4,254	4,358	4,953	5,049	4,857	5,180	4,538	4,094	4,546	4,405	4,716
Subiaco WRRF	2,450	2,321	2,247	2,411	2,316	2,258	1,840	1,976	1,620	2,142	2,089	1,908

Figure 11: Biosolids produced for beneficial use in agriculture100 per cent recovery



	Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23
Kwinana WRRF	215	297	303	375	349	318	295	270	320	271	295	351
East Rockingham WRRF	157	207	194	125	158	197	225	150	108	82	108	108
Gordon Road WRRF	672	726	718	953	691	644	781	615	644	568	758	729

Figure 12: Sludge cake produced for beneficial use in composting100 per cent recovery

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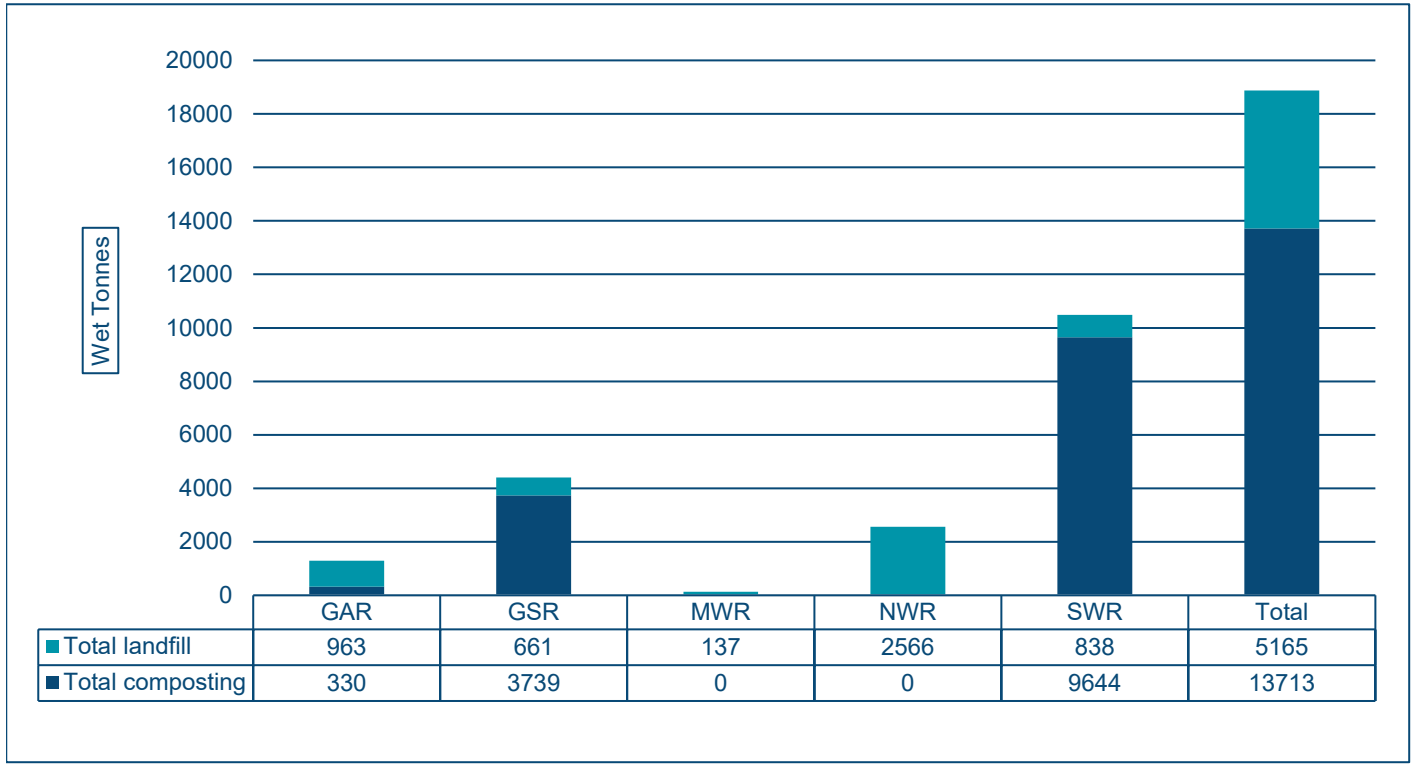
Regional sludge cake management



	GAR	GSR	MWR	NWR	SWR	Total
Total landfill	963	661	137	2566	838	5165
Total composting	330	3739	0	0	9644	13713

Note:

GAR = Goldfields & Agricultural region

GSR = Great Southern region

MWR = Mid West region

NWR = North West region

SWR = South West region

Figure 13: Regional sludge cake volume and distribution 2022-23

Table 1: Regional sludge cake recovery for beneficial use 2022-23

Region	GAR	GSR	MWR	NWR	SWR	Regional total
% Recovery	26%	85%	0%	0%	92%	73%

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Biosolids product quality compliance

As per the WA Guidelines for Biosolids Management (DEC 2012), pathogen grade 3, contaminant grade 2 (P3 C2) biosolids is suitable for direct beneficial use in broad-acre agriculture, forestry, and/or mine site rehabilitation. Critical control points (CCP) for:

- Biosolids cake from anaerobic digestion:
  - Sludge Retention Time (SRT) ≥15 days,
  - Temperature 35°C ± 3°C.
- Lime amended biosolids (LAB):
  - Lime amendment pH ≥ 12 for > 3 hrs.

Table 2: Biosolids product quality compliance

Treatment Plant	Sludge treatment process	Biosolids product name (grade)	Biosolids product quality compliance											
			Jul-22	Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23
Beenyup WRRF	Anaerobic digestion	Biosolids cake (P3 C2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Subiaco WRRF	Lime amendment	Lime amended biosolids (P3 C2)	✓	✓	✓	(1)	✓	✓	(2)	✓	✓	✓	✓	✓
Woodman Point WRRF	Anaerobic digestion	Biosolids cake (P3 C2)	✓	v	✓	✓	✓	✓	✓	✓	✓	✓	(3)	✓

Comments:

(1) Untreated Lime Amended Biosolids (LAB) did not meet P3C2. Following safe handling discussion, 5 wet tonnes of P4 lime amended biosolids was used in a remote paddock to minimise contact potential.

(2) Low pH on the Lime Amended Biosolids (LAB), violating the required process crtical control point (CCP) of a 3hr pH >12 needed for P3 classification. Following safe handling discussion, 15 wet tonnes of P4 lime amended biosolids was used in a remote paddock to minimise contact potential.

(3) The biosolids cake produced at Woodman Point WRRF had not met SRT≥15 days the Volatile Solids Reduction required to achieve P3 biosolids classification. As this can be an odour issue, application was assessed for potential odour risks and approximately 4,000 tonnes of potential P4 biosolids cake was delivered and dispersed. All other aspects of P3 classification were met.

(4) All incidents were discussed with DoH.

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Wastewater recycling and disposal

Water Corporation operates 54 wastewater resource recovery facilities (WRRF) which have one or more reuse scheme with one or more reuse recipients. All 76 recycling schemes are DoH approved, with a total of 94 third -party reuse recipients across the state. Water Corporation directly owns and manages 13 of these recycling schemes. A complete list of recycling schemes is available in Appendix A.

These recycling schemes supply recycled water for a range of purposes, including industrial uses and the irrigation of public open space and woodlots. We have 40 WRRFs with reuse only, while 14 have a combination of reuse and environmental disposal and 56 have environmental disposal only. We recycled approximately 17.84 billion litres of treated wastewater this financial year, not including the Groundwater Replenishment Scheme.

Water Corporation provides water of an agreed quality to these schemes, with further treatment and obligation to meet health department requirements being the responsibility of the third party.

Recycling scheme management

Our approach to managing the treated wastewater recycling process is based on the 12-element framework of the Australian Guidelines for Water Recycling and the DoH *Guidelines for the Non-Potable Uses of Recycled Water in Western Australia*. We have systems in place to fulfil the criteria of the 12 elements and we continue on our journey for ongoing improvement in scheme performance.

Figure 14: Irrigation of golf course with recycled water

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Water Corporation operations

Water Corporation operates 13 wastewater recycling schemes with formal DoH approval. The schemes are mostly irrigation of woodlots with one Rhodes Grass crop in Broome North. We also reuse treated wastewater internally, such as for premise irrigation and within treatment processes; however, this reuse is not subject to formal DoH approval under the Guidelines for Non-potable Uses of Recycled Water in Western Australia.

Water Corporation's water quality performance against DoH approval conditions, where Water Corporation is responsible for the scheme or to point of supply in private schemes, are presented in Appendix C. This provides a summary of almost 3,932 results from relevant sampling points. The data demonstrates water quality sampling guideline values were met.

Capital and operational investment

Capital investment within the water recycling investment portfolio to improve infrastructure at reuse only schemes continued to progress over 2022-23. Reuse scheme improvements in delivery during 2022-23 included developing a new scheme at Denmark, new disinfection facilities at Kellerberrin, Wyalkatchem, and Wundowie and expansions to the existing Broome North reuse scheme. Improvements also included upgrades to tertiary barriers such as recycled water signage at storage and irrigation sites. Planning and design are under way for improvements to the following schemes:

- Corrigin
- Northam
- Esperance
- Pingelly

Internal audit process

Water Corporation supports DoH and the ongoing compliance of recycling schemes by undertaking audits of third-party recycling schemes. These internal audits are a compliance requirement of the DoH Approval. Audits are conducted by representatives from the Water Corporation and the third party.

Water Corporation undertook 20 audits in 2022-23 and plans to undertake 22 audits across the state in 2022-23, as part of a state-wide audit plan as agreed with the DoH.

Future focus

The 2023-24 key points of focus for wastewater recycling are:

- Progress on capital projects related to treated wastewater recycling (Wyalkatchem, Kellerberrin, Denmark and Broome).
- Provide support to recipients to help them address the audit findings.
- Regularly review recipient water sampling results, to aid the proactive management of emerging water quality issues.
- Work with recipients to provide support in the development and management of key recycling documentation such as Recycled Water Quality Management Plans.
- Work to improve the environmental management of recycling schemes.

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Groundwater replenishment

Introduction

Groundwater replenishment (GWR) is the process by which secondary treated wastewater undergoes advanced treatment, at the Advanced Water Recycling Plant (AWRP). Water is produced which meets or exceeds the Australian Drinking Water Guidelines (ADWG) prior to being recharged to an aquifer for later use as a drinking water source. Groundwater replenishment has been identified by Water Corporation as a climate independent, safe, sustainable water source option for the Perth Integrated Water Supply Scheme (IWSS).

Stage 1 of the Perth Groundwater Replenishment Scheme (GWRS) gained approval to recharge in August 2017. GWRS Stage 2 commenced construction in late 2017 with above-ground infrastructure completed in late 2019. Approval for recharge of the GWRS Stage 2 expansion was granted in 2020. The Stage 2 expansion commissioning was completed in early 2023.

With the addition of stage 2, the GWRS scheme capacity has doubled and Water Corporation is now licensed to recharge up to 28 billion litres each year under the conditions of recharge, providing a climate independent water source.

For the financial year to 30 June 2023, the GWR scheme has recharged a total of 17.3 billion litres.

GWR scheme overview

The treatment systems for the GWRS include the Beenyup WWTP, the AWRPs and eight recharge bores. The scheme also includes a monitoring borefield (consisting of eight bores) which is used to monitor the flow and quality of recycled water in the Leederville and Yarragadee aquifers. They also overlay a superficial aquifer around the recharge bores, as defined by the GWR Recharge Management Zone and monitoring requirements.

Figure 15: GWR stages 1 and 2

The GWRS takes wastewater from the Beenyup WWTP. This catchment is the northern suburbs of Perth extending from Quinns Beach through to Scarborough and inland through Dianella and Bayswater to the foothills of East Midland.

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The majority of wastewater collected in the Beenyup wastewater catchment is from domestic and commercial premises. Trade waste, which is process wastewater from industrial and commercial customers, represents around 2.5 per cent by volume of the wastewater flow to Beenyup WRRF.

The details of the GWR treatment system are illustrated in Figure 16.

Beenyup WRRF discharges about 0.135 billion litres a day of treated wastewater via two adjacent outlets known collectively as the Ocean Reef Ocean Outlet, at 1850 metres and 1650 metres offshore. The outlets discharge into 10 metres of water where the treated wastewater is diluted and dispersed.

The majority of the treated wastewater is being diverted from the ocean to be utilised at the two AWRPs. Each AWRP uses a process of ultrafiltration, reverse osmosis and ultra-violet disinfection to further treat the treated wastewater before it is recharged to the Leederville and Yarragadee aquifers.

The GWRS treatment process is operated in accordance with the Hazard Analysis and Critical Control Points (HACCP) philosophy and the 12-element risk management framework (refer to *12 Elements of the Wastewater Quality Framework*, page 11). This is based on the National Water Quality Management Strategy - Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) and Australian Guidelines for Water Recycling: Augmentation of Drinking Water Supplies (Phase 2). There is a total of 20 critical control points (CCPs) maintained across the WRRF and the two AWRPs. These CCPs are continuously monitored online and assure recycled water is of drinking water quality before being recharged to the Leederville and Yarragadee aquifers. If these parameters should fall outside of specification, then an automated corrective action is implemented. The operational philosophy of the automated control system ensures that all CCPs will fail-safe. These CCPs are supported by a number of process control points.

Verification monitoring has shown that all recycled water recharged to the aquifers has met the water quality requirements specified in the Wastewater Services and GWR MoU and DWER licence.

Groundwater quality in the recharge zone is monitored via monitoring bores for each recharge bore to determine the effect of recharged water on the Leederville, Yarragadee and superficial aquifers. All treated water and bore field water samples were 100 per cent compliant with the ADWG for the period 1 July 2022 to 30 June 2023.

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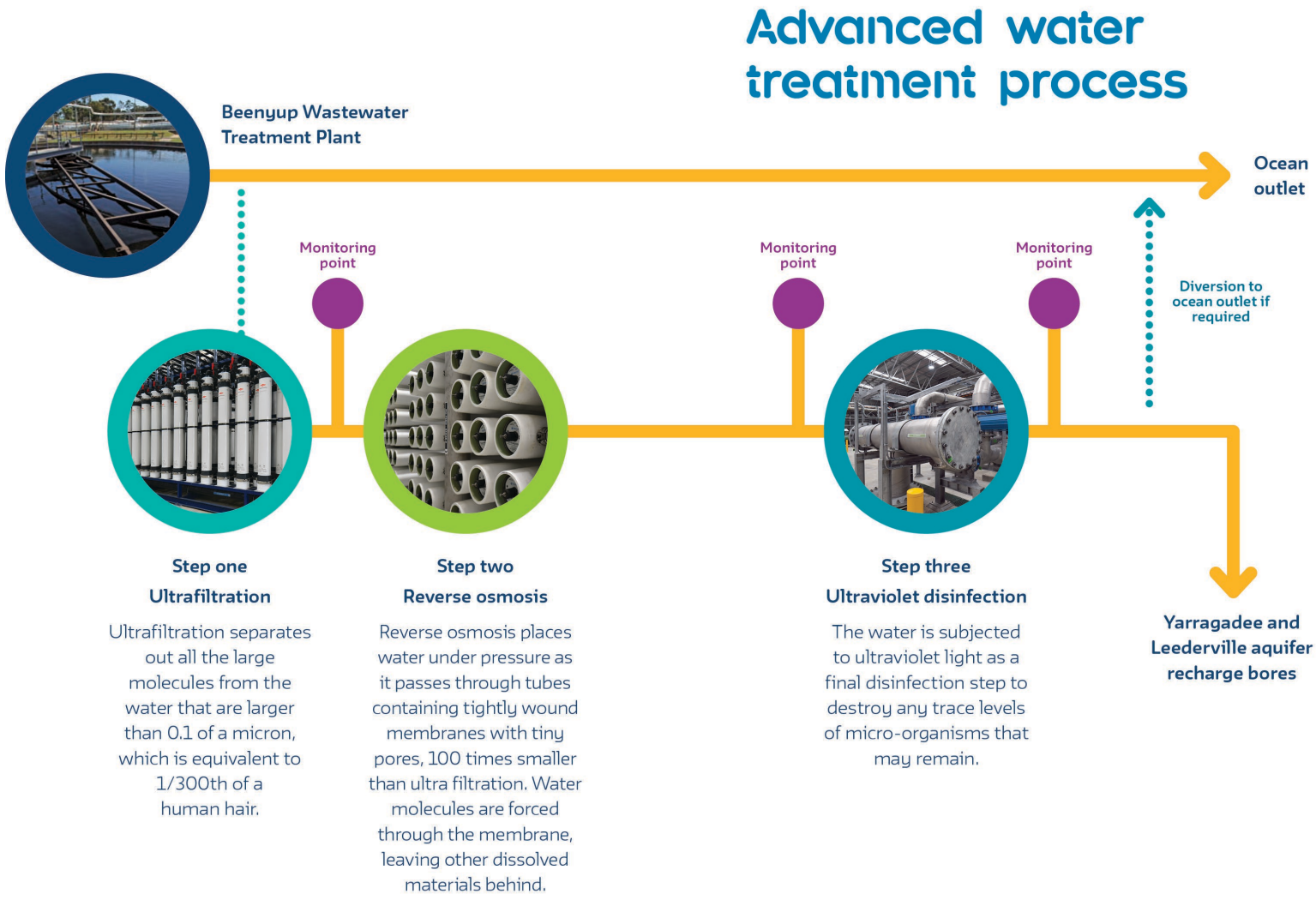

Figure 16: GWRS overview

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Water quality monitoring objectives

The monitoring of the Perth GWRS consists of testing/measurement of the following:

- Recycled water quality indicators (RWQI)
- Recycled water quality parameters (RWQP)
- Membrane integrity testing
- Groundwater monitoring to assess Leederville and Yarragadee response to recharge.

All sampling requirements for the RWQI and RWQP have been endorsed by DoH.

Recycled water quality indicators and parameters

An RWQI is an individual chemical or microbiological parameter that represents a class of chemicals or pathogens with similar characteristics. Choice of RWQI considers the parameter's toxicity and its source in the wastewater catchment. The purpose of the RWQI is to demonstrate safety of recycled water with respect to specific chemical and microbiological groups, and hence provide additional confidence that all chemical hazards are mitigated. Table 3 (page 33) provides a summary of the RWQI monitored in the GWRS from 1 July 2022 to 30 June 2023, including the chemical or microbiological groups they represent.

RWQP refers to the water quality parameters to be achieved in the treated water, as agreed with the DoH. Compliance with the recycled water quality parameters will represent protection of human health and health-related environmental values (drinking water resource and industrial water), including protection for primary industry environmental values.

We take samples for 169 RWQP at the GWRS. For the 2022 -23 year all RWQP were within the guideline as set out within the MoU and represented by the RWQI. These compliant RWQP results indicate the AWRP produced water at a quality within regulatory specifications.

All RWQP results from 1 July 2022 to 30 June 2023 are given in Appendix B.

Incident and emergency management

Water Corporation manages the GWRS incidents and emergencies as defined by the Wastewater Services and GWR MoU and outlined in the GWR Incident Management Plan. The plan defines:

- alert and violation levels
- communication protocols
- response plans for dealing with GWRS incidents

There were three reportable incidents at the GWRS from 1 July 2022 to 30 June 2023.

Two of these incidents were loss of historical data due to server troubleshooting. There was no impact to public health and improvements to our processes were instigated to prevent this event recurring.

The remaining incident was a detection of a microbiological indicator in the recycled water which was due to insufficient flushing of a tank after maintenance. This incident had minimal impact and a new tank cleaning procedure is being developed.

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Table 3: RWQI summary (1 July 2022 to 30 June 2023)

Indicator	Group Represented	Units	Guideline Value	Limit of Reporting	Total Number of Readings		Max Reported Value		Requirement Met
					Stage 1	Stage 2	Stage 1	Stage 2	
MS2 Coliphage	Microorganisms (pathogens including viruses)	pfu/100 mL	<1	1	11	12	<1	1	(1)
Boron	Inorganic compounds, metals and metalloids	mg/L	4	0.02	11	12	0.14	0.14	✓
Nitrate as nitrogen		mg/L	11	0.01	11	12	2.7	2.3	✓
N-nitrosodimethylamine	Nitrosamine disinfection by-products	ng/L	100	2	11	12	3.4	5	✓
Chlorate	Inorganic disinfection by-products	mg/L	0.7	0.01	4	4	<0.01	0.011	✓
Chloroform	Other disinfection by-products	µg/L	200	0.05	11	12	<1.0	<1.0	✓
Carbamazepine	Pharmaceuticals and personal care products	µg/L	100	0.1	11	12	<0.1	<0.1	✓
Diclofenac		µg/L	1.8	0.1	11	12	<0.1	<0.1	✓
Estrone	Hormones	ng/L	30	1	4	4	<1.0	<1.0	✓
Trifluralin	Pesticides and herbicides	µg/L	90	1	4	4	<1.0	<1.0	✓
1,4-Dioxane	Other organic chemicals	µg/L	50	0.1	11	12	<0.1	<0.1	✓
1,4-dichlorobenzene		µg/L	40	1	11	12	<1.0	<1.0	✓
Ethylenediamine tetraacetic acid (EDTA)		µg/L	250	10	11	12	<10	<10	✓
Fluorene		µg/L	140	0.001	2	2	<0.001	<0.001	✓
Octadioxin		pg/L	9,000	2	2	2	<2	<2	✓
Alpha particle activity	Radioactivity	mBq/L	500	10	4	4	<35	<34	✓
Beta particle activity (-K40)		mBq/L	500	10	4	4	<76	<71	✓

(1) All RWQI results from 1 July 2022 – 30 June 2023 were below their respective MoU guideline limit except a MS2 Coliphage detection on Stage 2 which was a result of sample contamination after tank maintenance.

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Stakeholder and community engagement

The GWRS has continued its community and stakeholder engagement strategy carried forward from the Groundwater Replenishment Trial. These engagement activities include:

- advertising,
- traditional media and public relations,
- correspondence with the Community Advisory Panel,
- updating groundwater recharge information on Water Corporation's Groundwater Replenishment website,
- use of social media channels such as YouTube, Facebook and Twitter, and
- conducting tours at the AWRP and visitor centre.

Regular presentations and meetings with internal and external stakeholders, including regulators (DoH and DWER) and local government, are conducted to keep them informed regarding the scheme's performance.

Overall, the GWRS has been positively received and publicly supported by the community, local government and stakeholders.

Figure 17: GWR visitor centre

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Wastewater performance, incidents, and complaints

Wastewater incidents background

WWTPs are designed to reduce biological oxygen demand (BOD) and have sufficient redundancy to ensure Water Corporation's wastewater treatment systems should always be able to reduce BOD to acceptable levels (filtered BOD of less than 20mg/L). Water Corporation regularly monitors the hydraulic and organic loading of its WWTPs to prioritise operational and capital improvements at plants reaching their capacity. Treated wastewater recycled on public open space or anywhere human contact may occur must be adequately disinfected to protect public health.

Required water quality may not be achieved as a result of a WWTP being organically or hydraulically overloaded, an algal bloom, a contaminant introduced in the sewerage system, or treatment issues. This may in turn impact directly on a scheme's ability to achieve appropriate quality for the receiving environment.

In addition, overflows from treatment plants or mains may occur due to hydraulic overloading or burst mains.

Wastewater scheme incident management

We report to the DoH, wastewater incidents with a potential public health impact. There were no incidents of public health impact in the 2022-23 financial year.

Wastewater quality incidents at recycling schemes

In the period 2022-23, there were two consecutive E. coli exceedances for recycled water scheme sampling at Leonora above the DoH approval target constituting one incident. This was an operational issue in relation to management of the chlorinator and effective disinfection. The system was isolated and works undertaken to reinstate an adequate chlorine residual. The risk to the public was considered low as the scheme's end use controls were in place and the system was isolated in timely manner.

Sewer network performance

The performance of our assets has a direct impact on our ability to deliver essential wastewater conveyance and treatment services.

Service interruptions are often caused by sewer main blockages and subsequent wastewater overflows. Through ongoing corrective and preventive maintenance, we keep sewer main blockages below the target limit of 40 blockages per 100 kilometres of sewer main (see figure 18). In 2022-23 there were a total of 2,185 blockages in 17,701 km of main.

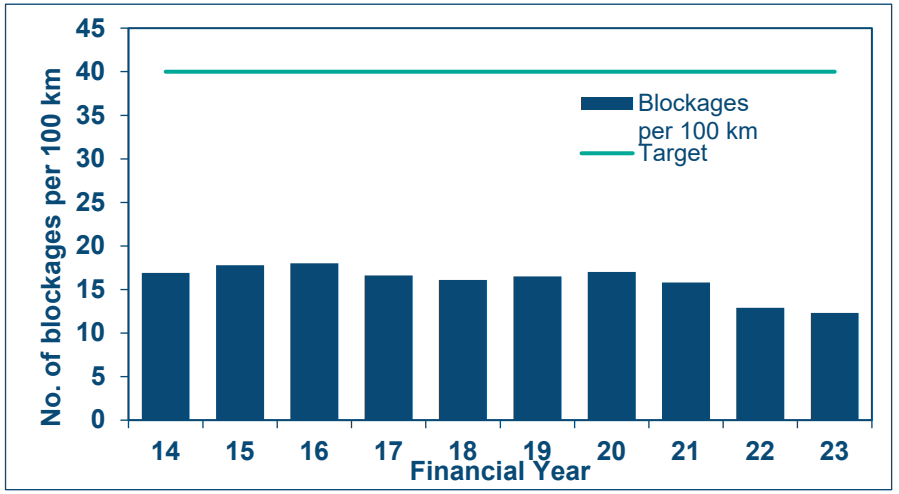

Figure 18: Sewer blockages - number per 100 km – all regions (2013-14 to 2022-23)

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Wastewater overflows

We operated with 17,701 kilometres of sewer mains and moved more than 177 billion litres of untreated wastewater through these pipes to wastewater treatment plants in 2022-23. Blockages and bursts within these pipes may result in overflows of wastewater into the environment or residential / commercial property. Water Corporation follows strict guidelines to manage these overflows to reduce both the public health and environmental impacts. DoH and/or DWER are alerted to these overflows and provide advice in their management as required.

Where overflows occur on residential or commercial property Water Corporation works with owners and occupiers to remediate any damage and reduce any inconvenience caused by the overflows.

Overflows can be symptomatic of underlying asset or scheme issues but are more often caused by tree roots or solid items that have been put into the sewer system through a sink or toilet. Items such as fats and cooking oils, kitchen scraps, cotton buds, hygiene products and wet wipes don't break down and can create a blockage in a sewer. They can also be caused by damage to our sewer reticulation. Water Corporation investigates root causes of overflows and provides recommendations for future work to decrease the number of overflows occurring each year. See watercorporation.com.au/blockage for more information.

The number of overflow events for 2022-23 was 740 and included volumes as low as 1 litre. The largest volume overflows were of treated wastewater. Figure 20 shows the numbers of overflows for the 2022-23 financial year presented by volume range, wastewater type (i.e., treated or untreated wastewater) and by location of the overflow (to the environment or residential/ commercial property). Figure 19 shows a comparison of the number of wastewater overflows for the past four years. Water Corporation is continuing to improve its reporting and response procedures.

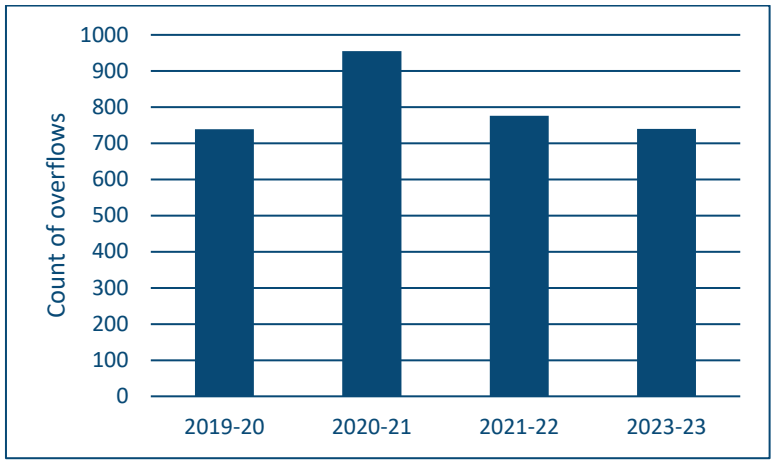

Figure 19: Comparison of wastewater overflows per year

In January 2023 there was a major flooding event in Fitzroy Crossing caused by ex-tropical cyclone Ellie. This event caused significant damage to the Fitzroy Crossing bridge, washed out the eastern bank and Water Corporation's pressure main connecting the town's sewer system to the wastewater treatment plant. The pressure main damage caused wastewater from the town to enter the Fitzroy River. From the time of damage to the pipe to the establishment of temporary repairs, an estimated volume of 3.5 megalitres was discharged to the environment. The repairs were complex to manage due to restricted road access and working with multiple state and federal agencies to safely repair the damaged pipe. See Fitzroy Crossing media release for more information.

Communications on the overflow, including public health advisories, were established to reduce any possible impacts to public health. Open and consistent communications with DoH and DWER allowed a collaborative approach to the management of the flooding and its effect on the wastewater system and ensured the establishing of temporary and more permanent repairs to the system post floods.

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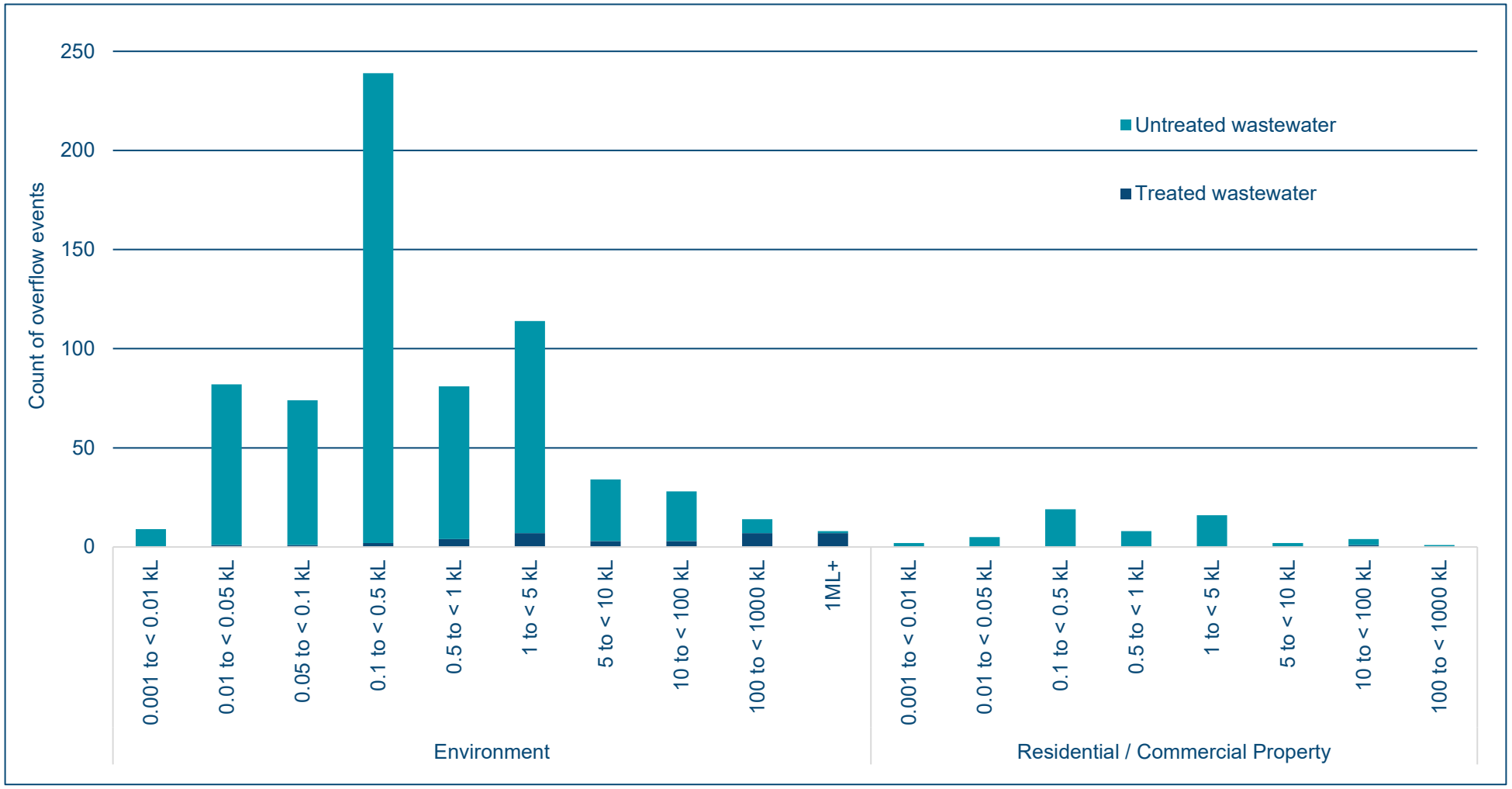

Figure 20: All wastewater overflows from Water Corporation assets 2022-23 by property/environment and range

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Biosolids complaints and incidents

There were eight incidents associated with biosolids in 2022-23:

- Three biosolids quality non-compliance at Woodman Point and Subiaco (refer to table 2, page 27).
- Four biosolids handling.
- One transport related.

All incidents were discussed with DoH.

Odour contacts

We are committed to providing high quality management of wastewater; odour buffering and treatment forms part of this management process. Odour is monitored regularly throughout the wastewater treatment process; however, due to the extensive nature of wastewater collection systems and the maintenance of wastewater treatment plants, as well as environmental factors such as high rainfall, wastewater odours can escape the sewer network or the boundaries of wastewater treatment plants.

Although wastewater odours are not a health hazard to the community, we are committed to reducing these odours to maintain the amenity and aesthetic values of surrounding land. Therefore, as part of the commitment to customers to provide wastewater services, we investigate all wastewater odour contacts.

Odours may be related to manholes, wastewater pump stations, overflows or cracked pipes in the conveyance system and, WWTP maintenance, odour scrubbers or process upsets.

A total of 860 customer contacts, relating to odour, were received for 2022-23. Of these contacts 814 were recorded as [3]enquiries and 46 as complaints.

Any instance of odour may result in numerous customer contacts, so multiple contacts related to the same odour instance may be recorded here. Figure 22 shows the total odour contacts received per region.

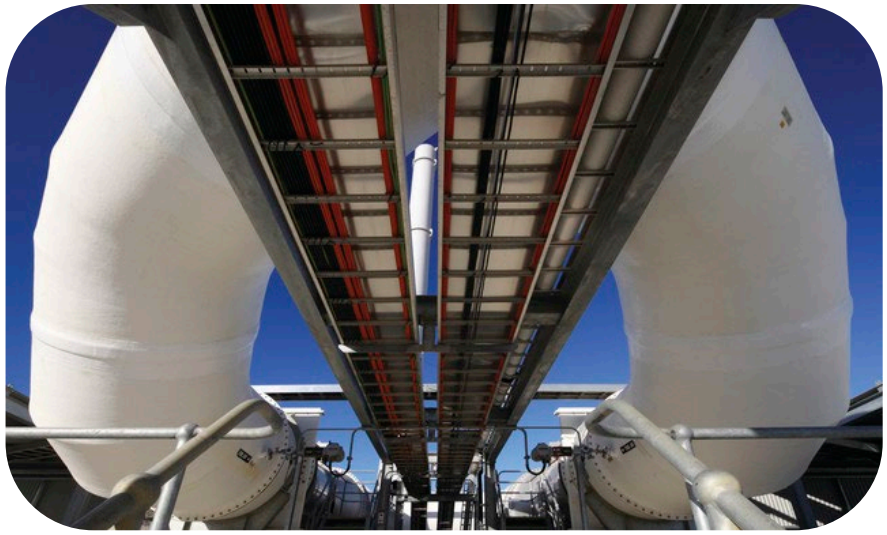

Figure 21: Alkimos WWTP odour control

[3] An enquiry is a request for information or a specific action, a complaint is recorded when an expression of dissatisfaction is made related to a wastewater odour.

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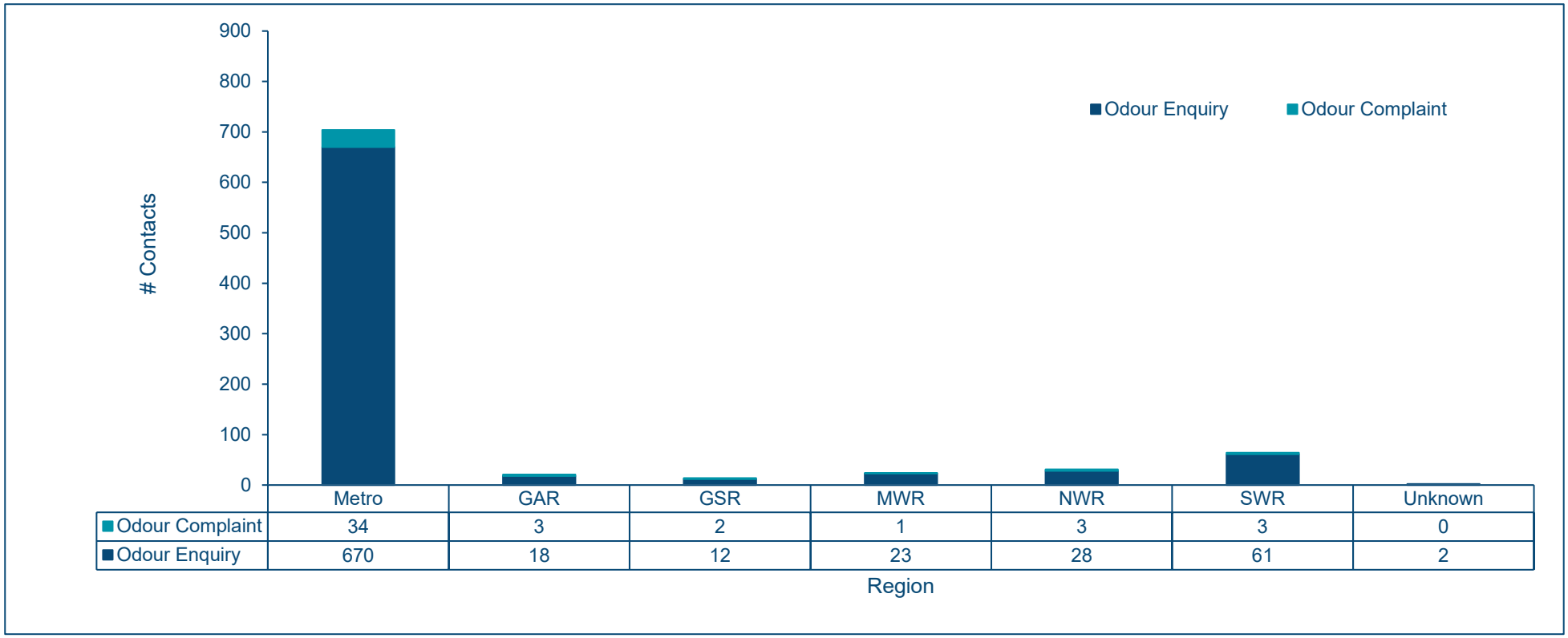

	Metro	GAR	GSR	MWR	NWR	SWR	Unknown
Odour Complaint	34	3	2	1	3	3	0
Odour Enquiry	670	18	12	23	28	61	2

Figure 22: Odour contacts from 1 July 2022 to 30 June 2023 (total contacts = 860)

Notes:

This includes biosolids odour contacts.

Unknown = odour contact where the region and district details have not been stored in the database

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Appendix A

Appendix A - Wastewater treatment plants and recycling schemes

Table 4: Goldfields and Agricultural Region

Region	Location	Treatment type	Recycling
GAR	BEVERLEY	Pond	Shire of Beverley
	BRUCE ROCK	Septic Tank Effluent Disposal	
	CORRIGIN	Pond	Shire of Corrigin
	CUNDERDIN	Pond	
	KAMBALDA	Activated sludge	Private scheme
	KELLERBERRIN	Pond	Shire of Kellerberrin
	LAVERTON	Pond	
	LEONORA	Pond	Shire of Leonora
	MECKERING	Pond	
	MERREDIN	Pond	Shire of Merredin
	MUKINBUDIN	Pond	Shire of Mukinbudin
	NAREMBEEN	Pond	Shire of Narembeen
	NORTHAM	Pond	Shire of Northam
	QUAIRADING	Pond	
	TOODYAY	Pond	Water Corporation
	WILUNA	Pond	
	WONGAN HILLS	Pond	Shire of Wongan-Ballidu
	WUNDOWIE	Pond	Shire of Northam (Wundowie and Bakers Hill Ovals)
	WYALKATCHEM	Pond	Shire of Wyalkatchem
	YORK	Pond	

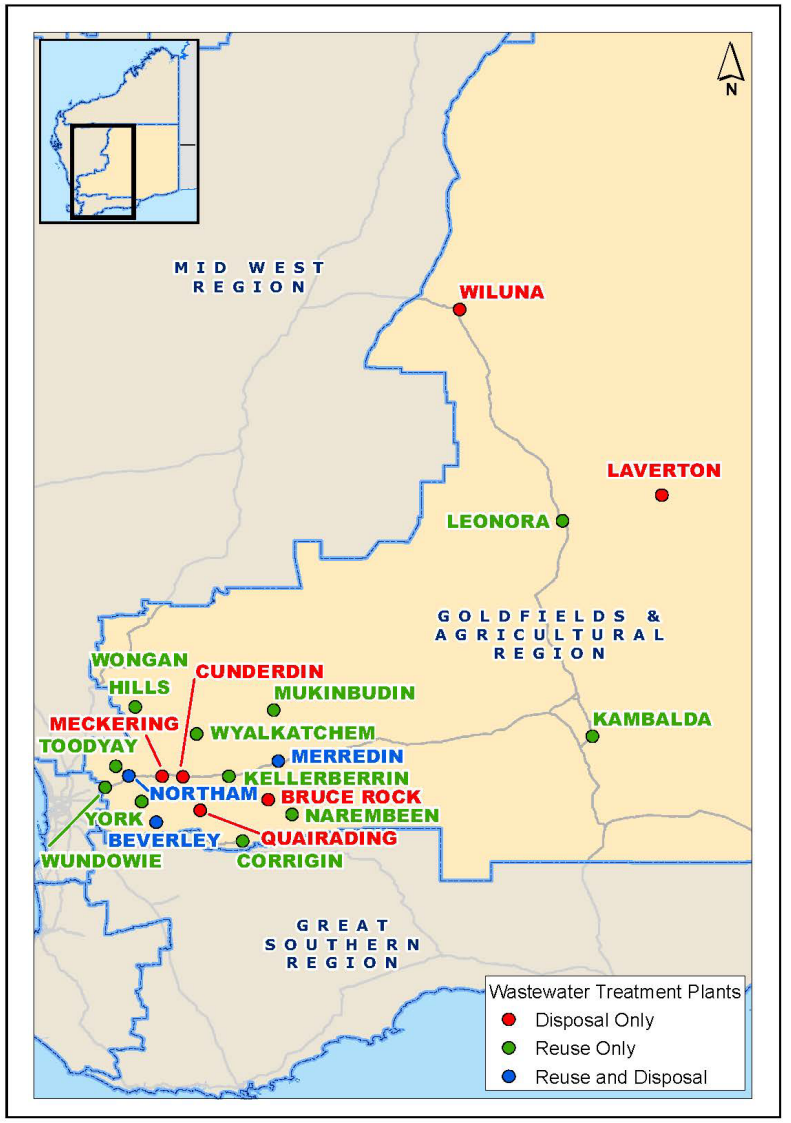

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Table 5: Great Southern Region

Region	Location	Treatment type	Recycling
GSR	ALBANY, TIMEWELL RD	Activated sludge	Water Corporation
	BODDINGTON	Pond	Private scheme
	BREMER BAY	Pond	
	CRANBROOK	Pond	
	DENMARK	Activated sludge	
	ESPERANCE	Pond	Shire of Esperance
	GNOWANGERUP	Pond	
	HOPETOUN	Pond	
	HYDEN	Septic Tank Effluent Disposal, Pond	
	KATANNING	Pond	Shire of Katanning 2 Private schemes
	KOJONUP	Pond	Shire of Kojonup
	KULIN	Pond	Shire of Kulin
	MOUNT BARKER	Pond	Water Corporation
	NARROGIN	Pond	Town of Narrogin
	NEWDEGATE	Pond	
	PINGELLY	Pond	Shire of Pingelly
	TAMBELLUP	Pond	Shire of Tambellup-Broomehill
	WAGIN	Pond	
	WALPOLE	Activated sludge	Water Corporation
	WILLIAMS	Pond	Shire of Williams

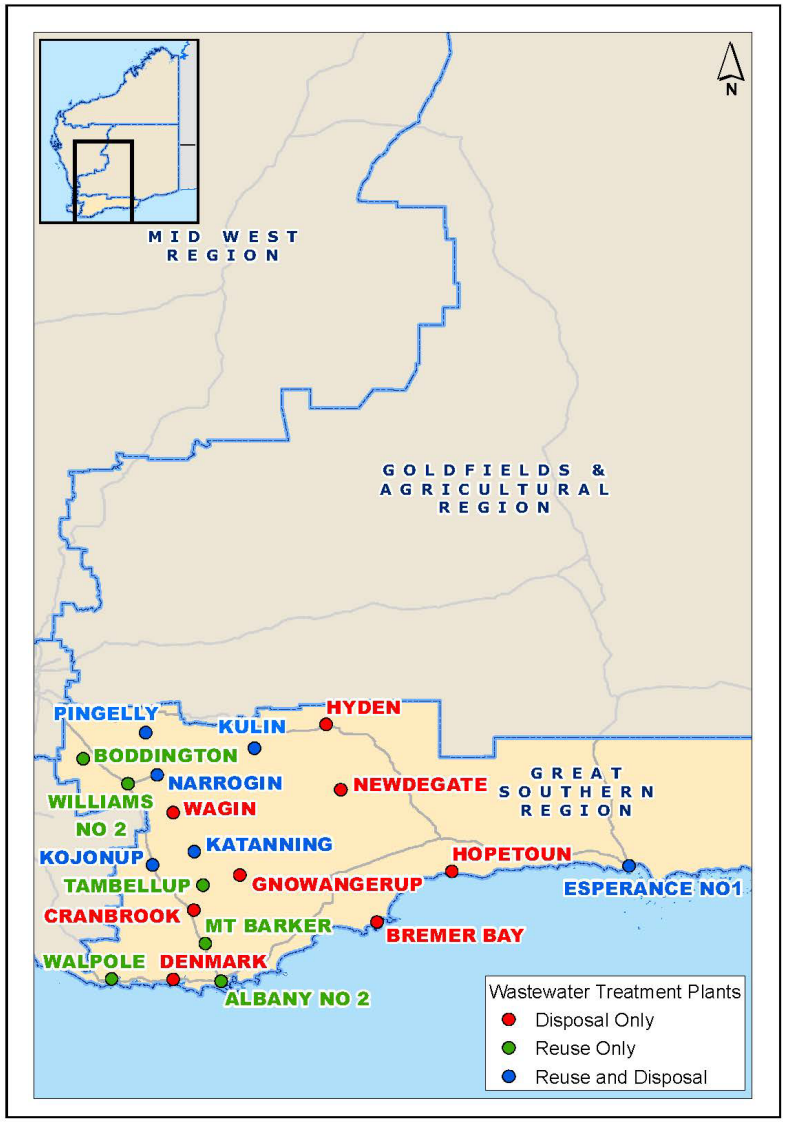

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Table 6: Mid West Region

Region	Location	Treatment type	Recycling
MWR	BOOTENAL, GREENOUGH	Pond	
	CARNARVON	Pond	Shire of Carnarvon Private scheme
	CERVANTES	Pond	
	CORAL BAY	Pond	
	DENHAM	Pond	
	DONGARA	High Performance Aerated Lagoon	Shire of Irwin
	ENEABBA	Pond	
	EXMOUTH	Pond	Shire of Exmouth
	GERALDTON NORTH GLENFIELD	Pond	
	GERALDTON 2	Pond	5 Private schemes
	GREEN HEAD	Pond	
	HORROCKS	Pond	
	JURIEN BAY	Pond	
	KALBARRI	Pond	Shire of Northampton
	LANCELIN	Pond	
	LEDGE POINT	Pond	
	LEEMAN	Pond	
	NARNGULU (SOUTH GERALDTON)	High Performance Aerated Lagoon	
	THREE SPRINGS	Pond	

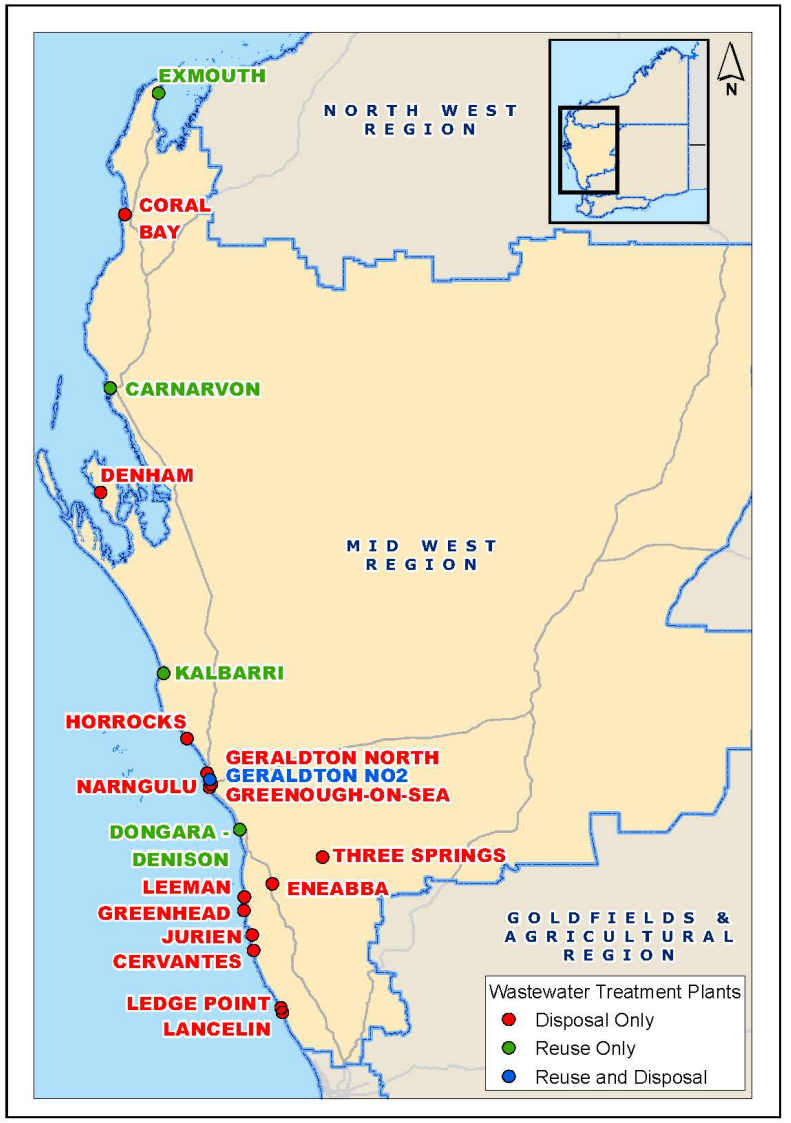

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Table 7: North West Region

Region	Location	Treatment type	Recycling
NWR	BROOME NORTH	Pond	Water Corporation Private scheme
	BROOME SOUTH	Pond	Shire of Broome 2 Private schemes
	DERBY	Pond	Private scheme
	FITZROY CROSSING	Pond	
	HALLS CREEK	Pond	
	KARRATHA 1 MILLSTREAM RD	Pond	City of Karratha Private scheme
	KARRATHA 2	Pond	
	KARRATHA 3, LIA	Pond	
	KUNUNURRA	Pond	
	MOWANJUM**	Pond	
	ONSLOW	Pond	
	ROEBOURNE	Pond	
	SOUTH HEDLAND	Pond	Private scheme
	WICKHAM	Pond UF and UV disinfection for reuse	City of Karratha Private scheme
	WYNDHAM	Pond	
	CHRISTMAS IS*	Activated sludge	
	COCOS HOME IS*	Activated sludge	
	COCOS WEST IS*	Activated sludge	

**Includes Indian Ocean Territories (IOT) owned by Commonwealth, managed by Water Corporation – not shown on map.*

***New WWTP in 2022-23*

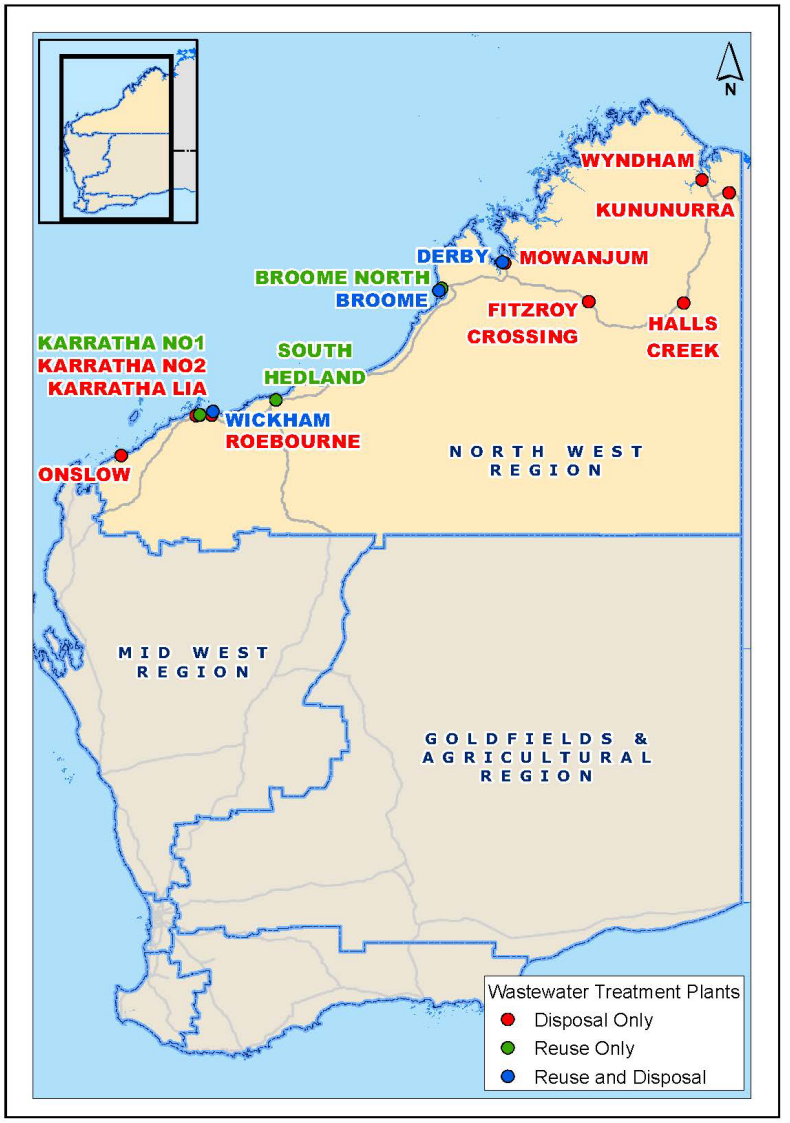

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Table 8: Perth Region

Region	Location	Treatment type	Recycling
Perth	ALKIMOS	Activated sludge	
	BEENYUP	Activated sludge UF, RO and UV Disinfection for GWRS	Groundwater Replenishment Scheme (refer to page 30)
	BULLSBROOK	Activated sludge	
	CADDADUP, MANDURAH 3	Activated sludge	City of Mandurah Private scheme
	EAST ROCKINGHAM	Activated sludge	
	KWINANA	Activated sludge	
	MANDURAH 1, GORDON RD	Activated sludge	City of Mandurah
	MANDURAH 2, HALLS HEAD	Activated sludge	City of Mandurah Private scheme
	MUNDARING	Activated sludge	Shire of Mundaring Private scheme
	PINJARRA	Pond	Private scheme
	POINT PERON	Primary; sludge thickening	
	SUBIACO	Activated sludge	Water Corporation 3 Private schemes
	WOODMAN POINT	Activated sludge UF and RO at KWRP for recycled water	5 Private industrial schemes

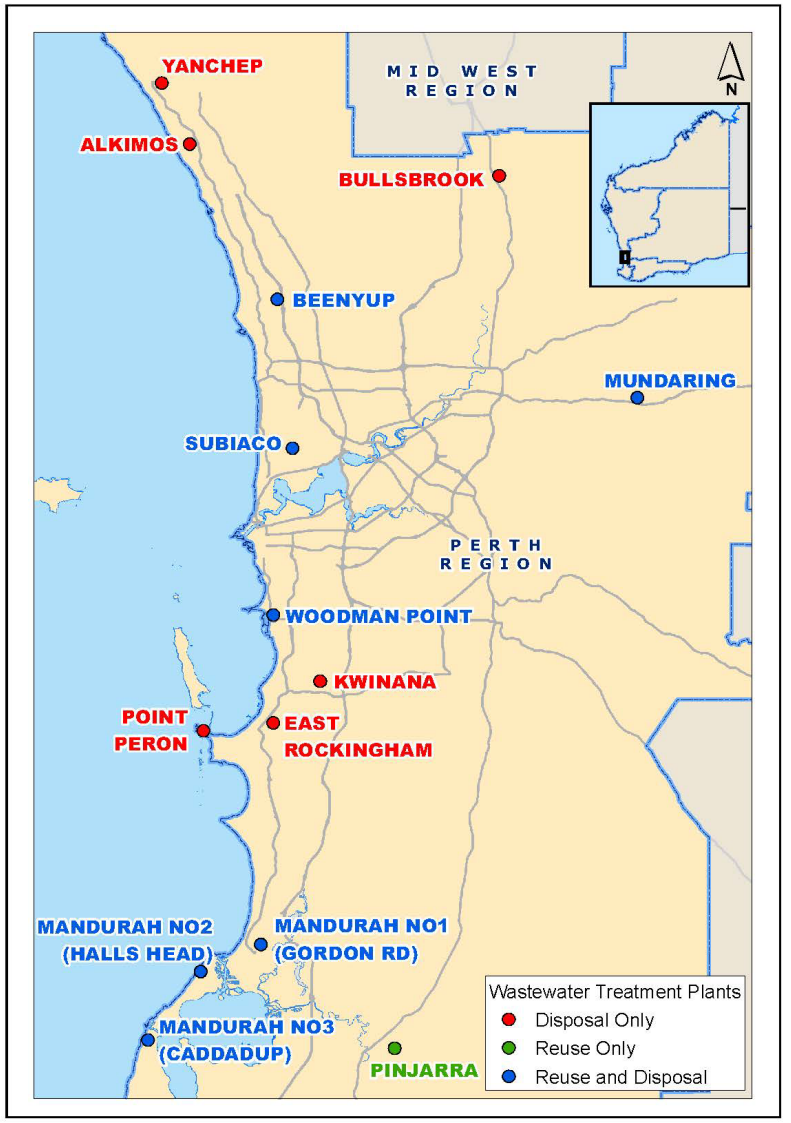

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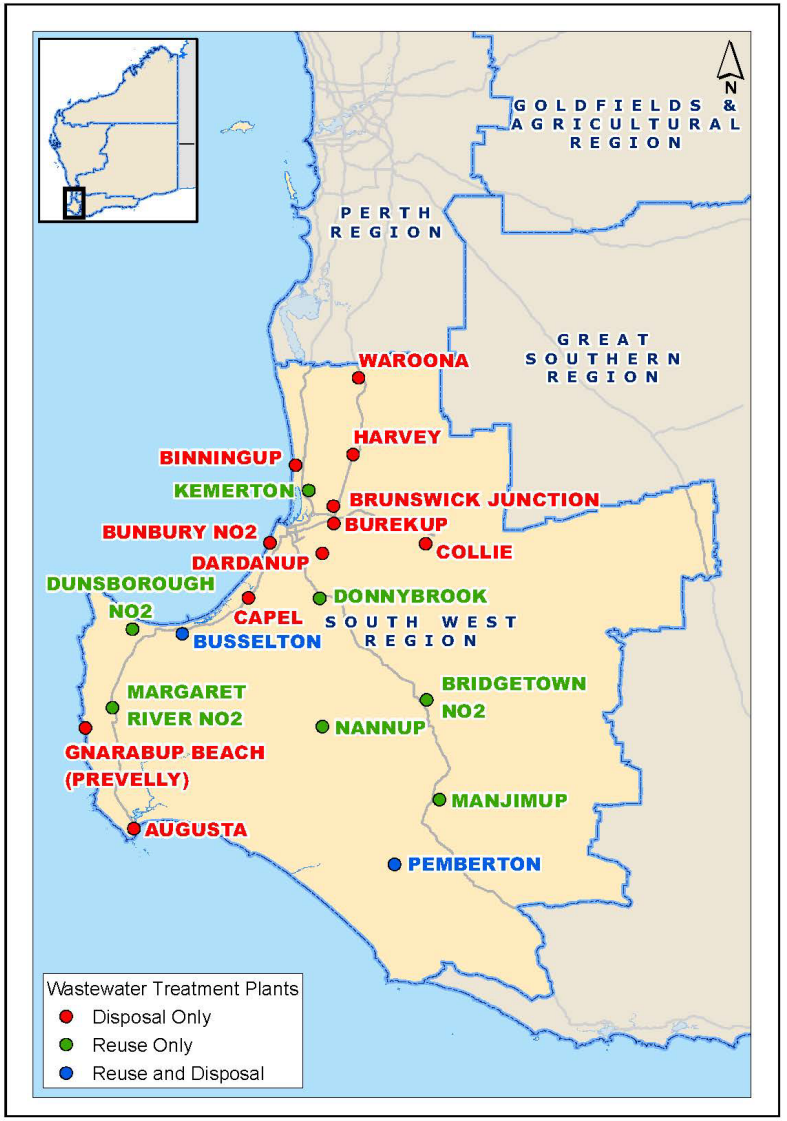
Table 9: South West Region

Region	Location	Treatment type	Recycling
SWR	AUGUSTA	Pond	
	BINNINGUP	Pond	
	BRIDGETOWN	Activated sludge	Private scheme
	BRUNSWICK	Pond	
	BUNBURY	Activated sludge	
	BUREKUP	Pond	
	BUSSELTON (YUNDERUP)	Activated sludge	2 Private schemes
	CAPEL	Pond	
	COLLIE	Activated sludge	
	DARDANUP	Pond	
	DONNYBROOK (BOYANUP)	Pond	Water Corporation
	DUNSBOROUGH 2	Activated sludge	Water Corporation
	GNARABUP BEACH (PREVELLY)	Activated sludge	
	HARVEY	Pond	
	KEMERTON (AUSTRALIND)	Activated sludge	Water Corporation
	MANJIMUP	Pond	Water Corporation Private scheme
	MARGARET RIVER 2 (COWARAMUP)	Activated sludge	Water Corporation Shire of Augusta and Margaret River 2 Private schemes
	NANNUP	Pond	Water Corporation
	PEMBERTON	Activated sludge	Shire of Manjimup
	WAROONA	Pond	



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Appendix B

Appendix B - Groundwater replenishment – all recycled water quality parameters (RWQP)

Table 10: Annual recycled water quality parameter results

Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
1,4-Dichlorobenzene	µg/L	40	1	<1.0	<1.0	✓
1,4-Dioxane	µg/L	50	0.1	<0.1	<0.1	✓
17alpha-estradiol	ng/L	175	1	<1.0	<1.0	✓
17beta-estradiol	ng/L	175	1	<1.0	<1.0	✓
1-methylnaphthalene	µg/L	0	1	<0.1	<0.1	✓
2,4,6-trichlorophenol	µg/L	20	1	<1.0	<1.0	✓
2,4-dichlorophenol	µg/L	200	1	<1.0	<1.0	✓
2,4-dichlorophenoxyacetic acid	µg/L	30	0.5	<0.5	<0.5	✓
2,6-dichlorophenol	µg/L	10	1	<1.0	<1.0	✓
2,6-di-tert-butylphenol	µg/L	2	0.05	<0.05	<0.05	✓
2-chlorophenol	µg/L	300	1	<1.0	<1.0	✓
2-methyl-naphthalene	µg/L	-	0.1	<0.1	<0.1	✓
2-nitrophenol	µg/L	0.7	0.5	<0.5	<0.5	✓
2-phenylphenol	µg/L	20	1	<1.0	<1.0	✓
2-propyltoluene	µg/L	0.7	0.5	<0.5	<0.5	✓
4-chloro-2-methylphenoxy acetic acid (MCPA)	µg/L	35	1	<1.0	<1.0	✓
4-chlorophenol	µg/L	10	1	<1.0	<1.0	✓
4-cumylphenol	µg/L	0.35	0.05	<0.05	<0.05	✓
4-nitrophenol	µg/L	30	1	<1.0	<1.0	✓
4-nonylphenol	µg/L	500	10	<10	<10	✓
4-tert-octylphenol	µg/L	50	10	<10	<10	✓
Acenaphthene	µg/L	-	0.001	<0.001	<0.001	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
Acenaphthylene	µg/L	-	0.001	<0.001	<0.001	✓
Aluminium	mg/L	0.2	0.005	<0.005	<0.005	✓
Ammonia as nitrogen	mg/L	0.5	0.01	0.53	0.41	✓
Androstenedione	ng/L	9	2	<2.0	<2.0	✓
Anthracene	µg/L	150	0.001	<0.001	<0.001	✓
Antimony	mg/L	0.003	0.0001	<0.0001	<0.0001	✓
Arsenic Unfiltered	mg/L	0.01	0.001	<0.001	<0.001	✓
Atrazine	µg/L	40	0.1	<0.1	<0.1	✓
Barium	mg/L	2	0.002	<0.002	<0.002	✓
Benzidine	ng/L	0.2	20	<20	<20	✓
Benzo(a)anthracene	µg/L	-	0.001	<0.001	<0.001	✓
Benzo(a)pyrene	µg/L	0.01	0.001	<0.001	<0.001	✓
Benzo(b)fluoranthene	µg/L	-	0.001	<0.001	<0.001	✓
Benzo(g,h,i)perylene	µg/L	-	0.001	<0.001	<0.001	✓
Benzo(k)fluoranthene	µg/L	-	0.001	<0.001	<0.001	✓
Benzotriazole	µg/L	20	1	<1.0	<1.0	✓
Beryllium	mg/L	0.004	0.0001	<0.0001	<0.0001	✓
Bisphenol A	µg/L	200	1	<10	<10	✓
Boron	mg/L	4	0.02	0.1	0.09	✓
Bromochloroacetic acid	µg/L	0.7	0.7	<0.7	<0.7	✓
Bromochloromethane (LOR - 1 µg/L)	µg/L	40	1	<1.0	<1.0	✓
Bromodichloromethane	µg/L	6	1	<1.0	<1.0	✓
Bromoform	µg/L	100	1	<1.0	<1.0	✓
Cadmium	mg/L	0.002	0.0001	<0.0001	<0.0001	✓
Carbamazepine (LOR - 0.1 µg/L)	µg/L	100	0.1	<0.1	<0.1	✓
Carbon disulfide	µg/L	700	1	<1.0	<1.0	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
Chlorate	mg/L	0.7	0.01	<0.01	<0.01	✓
Chloride	mg/L	250	1	5	4	✓
Chloroacetic acid	µg/L	150	2	<2.0	<2.0	✓
Chloroform	µg/L	200	1	<1.0	<1.0	✓
Chlorophene	µg/L	0.35	0.05	<0.05	<0.05	✓
Chromium	mg/L	0.05	0.0005	<0.0005	<0.0005	✓
Chrysene	µg/L	-	0.001	<0.001	<0.001	✓
Clostridium perfringens spores	cfu/100mL	<1	1	<1.0	<1.0	✓
Cobalt	mg/L	0.001	0.0001	<0.0001	<0.0001	✓
Coliphage (MS2)	pfu/100mL	<1	1	<1.0	<1.0	✓
Coliphage (somatic)	pfu/100mL	<1	1	<1.0	<1.0	✓
Copper	mg/L	2	0.0001	<0.0001	<0.0002	✓
Dibenzo(a,h)anthracene	µg/L	-	0.001	<0.001	<0.001	✓
Dibromochloroacetic acid	µg/L	0.7	<0.7	<0.7	<0.7	✓
Dibromomonochloromethane	µg/L	100	1	<1.0	<1.0	✓
Dichloroacetic acid	µg/L	100	2	<2.0	<2.0	✓
Dichloromethane	µg/L	4	1	1.3	<1.0	✓
Diclofenac (LOR - 0.1 µg/L)	µg/L	1.8	0.1	<0.1	<0.1	✓
DTPA	µg/L	20	10	<10	<10	✓
Equilenin	ng/L	30	2	<2.0	<2.0	✓
Equilin	ng/L	30	2	<2.0	<2.0	✓
Estriol	ng/L	50	1	<1.0	<1.0	✓
Estrone	ng/L	30	1	<1.0	<1.0	✓
Ethinyl Estradiol	ng/L	1.5	1	<1.0	<1.0	✓
Ethylenediamine tetraacetic acid	µg/L	250	10	<10	<10	✓
Etiocholanolone	ng/L	7	2	<2.0	<2.0	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
Fluoranthene	µg/L	-	0.001	<0.001	<0.001	✓
Fluorene	µg/L	140	0.001	<0.001	<0.001	✓
Fluoride	mg/L	1.5	0.05	0.09	0.05	✓
Flupropanate	ug/L	9	0.5	<0.5	<0.5	✓
Galaxolide	µg/L	1800	1	<1.0	<1.0	✓
Glyphosate	µg/L	1000	100	<100	<100	✓
Gross alpha activity	mBq/L	500	0.01	<33	<34	✓
Gross beta activity minus K40	mBq/L	500	0.01	<70	62	✓
HeptaCDD (1,2,3,4,6,7,8-HpCDD)	pg/L	-	2	<1.0	<1.0	✓
HeptaCDF (1,2,3,4,6,7,8-HpCDF)	pg/L	-	1	<1.0	<1.0	✓
HeptaCDF (1,2,3,4,7,8,9-HpCDF)	pg/L	-	1	<1.0	<1.0	✓
HexaCDD (1,2,3,4,7,8-HxCDD)	pg/L	-	1	<1.0	<1.0	✓
HexaCDD (1,2,3,6,7,8-HxCDD)	pg/L	-	1	<1.0	<1.0	✓
HexaCDD (1,2,3,7,8,9-HxCDD)	pg/L	-	1	<1.0	<1.0	✓
HexaCDF (1,2,3,4,7,8-HxCDF)	pg/L	-	1	<1.0	<1.0	✓
HexaCDF (1,2,3,6,7,8-HxCDF)	pg/L	-	1	<1.0	<1.0	✓
HexaCDF (1,2,3,7,8,9-HxCDF)	pg/L	-	1	<1.0	<1.0	✓
HexaCDF (2,3,4,6,7,8-HxCDF)	pg/L	-	1	<1.0	<1.0	✓
Indeno(1,2,3-c,d)pyrene	µg/L	-	0.001	<0.001	<0.001	✓
Iodide	mg/L	0.1	0.02	<0.02	<0.02	✓
Iron	mg/L	0.3	0.005	<0.005	<0.005	✓
Iron unfiltered	mg/L	0.3	0.01	<0.01	<0.01	✓
Lead	mg/L	0.1	0.0001	<0.0001	<0.0001	✓
Lithium	mg/L	0.15	0.0001	0.0003	0.0002	✓
Magnesium	mg/L	800	0.1	<0.1	<0.1	✓
Manganese	mg/L	0.5	0.001	<0.001	<0.001	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
Mercury	mg/L	0.001	0.0001	<0.0001	<0.0001	✓
Mestranol	ng/L	2.5	2	<2.0	<2.0	✓
Methyl-tert-butyl ether	µg/L	13	1	<1.0	<1.0	✓
Metolachlor	µg/L	300	0.1	<0.1	<0.1	✓
Molybdenum	mg/L	0.5	0.001	<0.001	<0.001	✓
N,N-diethyl-m-toluamide	µg/L	2500	0.1	<0.1	<0.1	✓
Nickel	mg/L	0.02	0.001	<0.001	<0.001	✓
Nitrate as nitrogen	mg/L	11	0.01	1.4	1.1	✓
Nitrite as nitrogen	mg/L	1	0.01	<0.01	<0.01	✓
N-nitrosodiethylamine (NDEA)	ng/L	10	2	<0.2	<0.2	✓
N-nitrosodimethylamine (NDMA)	ng/L	100	2	<2.0	<2.0	✓
N-nitrosodi-n-butylamine (NDBA)	ng/L	6	2	<2.0	<2.0	✓
N-nitrosodi-n-propylamine (NDPA)	ng/L	5	2	<2.0	<2.0	✓
N-nitroso-diphenylamine (NDPhA)	ng/L	7000	10	<10	<10	✓
N-nitrosoethylmethylamine (NEMA)	ng/L	2	2	<2.0	<2.0	✓
N-nitrosomorpholine (NMOR)	ng/L	5	2	<2.0	<2.0	✓
N-nitrosopiperidine (NPIP)	ng/L	4	2	<2.0	<2.0	✓
N-nitrosopyrrolidine (NPYR)	ng/L	20	2	<2.0	<2.0	✓
Norethindrone	ng/L	250	100	<100	<100	✓
Octadioxin	pg/L	9000	2	<2	<2	✓
Octafuran	pg/L	-	4	<1.0	<1.0	✓
PCB 105	pg/L	-	20	<20	<20	✓
PCB 114	pg/L	-	4	<4	<4	✓
PCB 118	pg/L	-	100	<100	<100	✓
PCB 123	pg/L	-	2	<2	<2	✓
PCB 126	pg/L	-	1	<1	<1	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
PCB 156	pg/L	-	10	<10	<10	✓
PCB 157	pg/L	-	1	<1.0	<1.0	✓
PCB 167	pg/L	-	10	<10	<10	✓
PCB 169	pg/L	-	1	<1.0	<1.0	✓
PCB 189	pg/L	-	2	<2	<2	✓
PCB 77	pg/L	-	1	<1	<1	✓
PCB 81	pg/L	-	1	<1	<1	✓
PentaCDD (1,2,3,7,8-PeCDD)	pg/L	-	1	<1	<1	✓
PentaCDF (1,2,3,7,8-PeCDF)	pg/L	-	1	<1	<1	✓
PentaCDF (2,3,4,7,8-PeCDF)	pg/L	-	1	<1	<1	✓
Pentachlorophenol	µg/L	10	1	<1.0	<1.0	✓
Perchlorate	µg/L	6	0.5	<0.5	<0.5	✓
Perfluorooctane sulfonate (PFOS)	µg/L	0.07	0.05	<0.05	<0.05	✓
Perfluorooctanoic acid (PFOA)	µg/L	0.56	0.05	<0.05	<0.05	✓
pH measured in laboratory	No unit	6.0-8.5	0.1	7	6.9	✓
Phenanthrene	µg/L	150	0.001	<0.001	<0.001	✓
Progesterone	ng/L	105	100	<100	<100	✓
Propiconazole	µg/L	100	0.1	<0.05	<0.05	✓
Pyrene	µg/L	150	0.001	<0.001	<0.001	✓
Selenium	mg/L	0.01	0.001	<0.001	<0.001	✓
Silver	mg/L	0.1	0.0001	<0.0001	<0.0001	✓
Simazine	µg/L	20	0.1	<0.1	<0.1	✓
Sodium	mg/L	180	0.1	7.3	5.2	✓
Strontium	mg/L	4	0.0001	<0.002	<0.002	✓
Sulphate	mg/L	500	0.01	<0.1	<0.1	✓
Testosterone	ng/L	7	2	<2.0	<2.0	✓

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Parameter	Units	Guideline	LOR	Value Reported		Requirement Met
				Stage 1	Stage 2	
TetraCDD(2,3,7,8-TCDD)	pg/L	-	1	<1.0	<1.0	✓
TetraCDF (2,3,7,8-tetraCDF)	pg/L	-	1	<1.0	<1.0	✓
Thallium	mg/L	0.002	0.0001	<0.0001	<0.0001	✓
Thermotolerant coliforms	cfu/100 mL	<1	1	<1.0	<1.0	✓
Tin	mg/L	14	0.0001	<0.0001	<0.0001	✓
Tolyltriazole	µg/L	20	1	<1.0	<1.0	✓
Total cyanide	mg/L	0.08	0.01	<0.01	<0.01	✓
Total dissolved solids by evaporation	mg/L	500	10	30	22	✓
Total trihalomethanes	µg/L	250	4	<4.0	<4.0	✓
Tribromoacetic acid	µg/L	0.7	0.7	<0.7	<0.7	✓
Trichloroacetic acid	µg/L	100	1	<1.0	<1.0	✓
Trifluralin	µg/L	90	0.1	<0.1	<0.1	✓
Turbidity	NTU	5	0.5	<0.5	<0.5	✓
Uranium	mg/L	0.02	0.0001	<0.0001	<0.0001	✓
Vanadium	mg/L	0.015	0.005	<0.0001	<0.0001	✓
Zinc	mg/L	3	0.005	0.006	<0.005	✓

Note: All data statistics are calculated assuming <limit of reporting (LOR) data are equal to LOR (e.g. <0.1 µg/L is 0.1 µg/L for calculation purposes).

Table 11: Description of units

Abbreviation	Full name	Relative to grams per litre (g/L)
mg/L	Milligrams per litre	10^{-3} or 0.001
µg/L	Micrograms per litre	10^{-6} or 0.000001
ng/L	Nanograms per litre	10^{-9} or 0.000000001
pg/L	Picograms per litre	10^{-12} or 0.000000000001
cfu/100 mL	Colony forming units per 100ml	Not applicable
NTU	Nephelometric Turbidity Units	Not applicable

Appendix C

Appendix C – Recycled Water Quality Data - sampling undertaken by Water Corporation as per MoU

Data shown in the tables below is based on the following assumptions drawn from the MoU and the notes on page 53.

- MAR schemes are not shown.
- Schemes where disinfection is owned and operated by another party are not shown.
- Residual TCL monthly, pH and E.coli samples are shown for Water Corporation end use schemes only.
- Suspended solids is shown for activated sludge plants only.

Table 12: Low and medium exposure risk recycling schemes

Region	WWTP	Primary Recipient	Residual TCl mnthly compliance (# samples)	Samples <0.2 mg/L	Requirement met	Residual Cl wkly check (# samples)	Samples <0.2 mg residual	Requirement met	Suspended Solids (# samples)	Samples >30 mg/L	Requirement met	pH (# samples)	samples outside 6.5-9	Requirement met	*E. coli* (# samples)	samples >1000cfu/ 100mL (for low risk)	Requirement met
GAR	Beverley	Shire of Beverley	-	-	(2)	21	7	(5)	-	-	(3)	-	-	(2)	-	-	(2)
GAR	Corrigin	Shire of Corrigin	-	-	(2)	-	-	(2)	-	-	(3)	-	-	(2)	-	-	(2)
GAR	Kambalda	Private Scheme	-	-	(2)	12	1	(5)	24	0	✓	-	-	(2)	-	-	(2)
GAR	Leonora	Shire of Leonora	-	-	(2)	32	6	(7)	-	-	(3)	-	-	(2)	-	-	(2)
GAR	Mukinbudin	Shire of Mukinbudin	-	-	(2)	39	7	(5)	-	-	(2)	-	-	(2)	-	-	(2)
GAR	Narembeen	Shire or Narembeen	-	-	(2)	5	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
GSR	Boddington	Private Scheme	-	-	(2)	50	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
GSR	Katanning	Private Scheme 1	-	-	(2)	58	31	(5)	-	-	(3)	9	0	✓	-	-	(2)
GSR	Katanning	Private Scheme 2	-	-	(2)	58	31	(5)	-	-	(3)	9	0	✓	-	-	(2)
GSR	Katanning	Shire of Katanning	-	-	(2)	58	31	(5)	-	-	(3)	9	0	✓	-	-	(2)
GSR	Kojonup	Shire of Kojonup	-	-	(2)	26	0	✓	-	-	(3)	6	0	✓	-	-	(2)
GSR	Kulin	Shire of Kulin	-	-	(2)	7	0	(5)	-	-	(3)	-	-	(2)	-	-	(2)
GSR	Narrogin	Shire of Narrogin	-	-	(2)	36	1	(5)	-	-	(3)	-	-	(2)	-	-	(2)
GSR	Tambellup	Shire of Tambellup-Broomehill	-	-	(2)	63	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
GSR	Williams	Shire of Williams	-	-	(2)	52	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
MWR	Dongara	Shire of Irwin	-	-	(2)	52	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
MWR	Kalbarri	Shire of Northampton	-	-	(2)	49	0	✓	-	-	(3)	-	-	(2)	-	-	(2)
NWR	Broome North	Water Corporation	9	0	✓	44	1	(5)	-	-	(3)	8	0	✓	9	1	(6)
NWR	Broome South	Shire of Broome	13	0	✓	58	0	✓	-	-	(3)	12	0	✓	13	1	(6)
NWR	Broome South	Private scheme 1	13	0	✓	58	0	✓	-	-	(3)	12	0	✓	13	1	(6)
NWR	Broome South	Private scheme 2	13	0	✓	58	0	✓	-	-	(3)	12	0	✓	13	1	(6)
NWR	Derby	Private Scheme	12	3	(5)	47	5	(5)	-	-	(3)	11	0	✓	11	1	(6)
NWR	Port Hedland	Private Scheme	-	-	(2)	52	1	(5)	-	-	(3)	-	-	(2)	-	-	(2)
Perth	Mundaring	Shire of Mundaring	-	-	(2)	43	0	✓	12	0	✓	-	-	(2)	-	-	(2)
Perth	Mundaring	Private scheme	4	0	(5)	43	0	✓	12	0	✓	-	-	(2)	10	0	✓
SWR	Bridgetown	Private Scheme	8	0	✓	28	0	✓	-	-	(3)	8	0	✓	8	0	✓
SWR	Busselton	Private Scheme	-	-	(1)	-	-	(1)	12	0	✓	-	-	(2)	-	-	(2)
SWR	Busselton	Private Scheme	-	-	(1)	-	-	(1)	12	0	✓	-	-	(2)	-	-	(2)
SWR	Manjimup	Private Scheme	-	-	(2)	19	2	(5)	-	-	(3)	-	-	(2)	-	-	(2)
SWR	Margaret River	Shire of Margaret River	-	-	(2)	61	0	✓	12	0	✓	-	-	(2)	-	-	(2)
SWR	Margaret River	Private Scheme	-	-	(2)	61	0	✓	12	0	✓	-	-	(2)	-	-	(2)
SWR	Margaret River	Water Corporation	11	0	✓	66	0	✓	12	0	✓	24	5	(5)	12	0	✓

ISSN 2653-2034

Appendix C

Notes:

(1) UV disinfection
(2) This sampling is not the responsibility of Water Corporation
(3) Suspended Solids not applicable to these schemes
(4) This sampling is not required in the DoH approval
(5) Operational exception – health compliance still achieved
(6) Review of asset and adjustment of disinfection setpoint, follow up resample in spec
(7) See Recycling Incidents

Table 13: Low and medium exposure risk recycling schemes with continuous online analysis of chlorine residual.

Region	WWTP	Primary Recipient	Residual TCl mnthly compliance (#samples)	Samples <0.2 mg/L	Requirement met	Residual TCl wkly check (# samples)	Samples <0.2 mg residual	Requirement met	Suspended Solids (#samples)	Samples >30 mg/L	Requirement met	pH (samples taken)	samples outside 6.5-9	Requirement met	*E. coli* (#samples)	samples >1000cfu/ 100mL (for low risk)	Requirement met
NWR	Karratha 1	City of Karratha	-	-	(6)	-	-	(6)	12	0	✓	24	0	✓	64	0	✓
NWR	Wickham	Private Scheme	-	-	(2)	-	-	(2)	-	-	(2)	-	-	(2)	-	-	(2)
Perth	Subiaco	Water Corporation	-	-	(6)	-	-	(6)	11	0	✓	15	0	✓	7	0	✓
Perth		Private Scheme															
Perth		Private Scheme															
Perth		Private Scheme															
SWR	Pemberton	Shire of Manjimup	-	-	(6)	-	-	(6)	8	0	✓	16	0	✓	8	0	✓

Table 14: Extra low exposure risk recycling schemes (all schemes wholly operated and maintained by the Water Corporation)

Region	WWTP	Primary Recipient	Residual TCl mnthly compliance (#samples)	Samples <0.2 mg/L	Requirement met	Residual TCl wkly check (# samples)	Samples <0.2 mg residual	Requirement met	Suspended Solids (#samples)	Samples >30 mg/L	Requirement met	pH (samples taken)	samples outside 6.5-9	Requirement met	*E. coli* (#samples)	samples >10000cfu/100mL (for low risk)	Requirement met
GAR	Toodyay	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	4	1	(8)	5	0	✓
GAR	York	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	14	1	(8)	14	0	✓
GSR	Albany 2	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	24	4	(8)	24	0	✓
GSR	Mt Barker	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	9	0	✓	9	0	✓
GSR	Walpole	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	8	3	(8)	9	0	✓
SWR	Donnybrook	Water Corporation	9	0	✓	-	-	(5)	-	-	(5)	3	0	(8)	3	0	✓
SWR	Dunsborough	Water Corporation	12	0	✓	-	-	(5)	-	-	(5)	8	2	(8)	8	0	✓
SWR	Kemerton	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	51	2	(8)	36	2	(8)
SWR	Manjimup	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	24	2	(8)	24	1	(8)
SWR	Nannup	Water Corporation	-	-	(5)	-	-	(5)	-	-	(5)	24	11	(8)	12	0	✓

Notes:

(2) This sampling is not the responsibility of Water Corporation
(5) This sampling is not required in the DoH approval
(6) Continuous online sampling of chlorine residual, therefore no requirement to undertake monthly compliance or weekly check samples
(8) Sample exceedance; review of barriers showed no elevated public health risk.

ISSN 2653-2034