# APPENDIX 7

# GROUNDWATER REPLENISHMENT TRIAL FINAL REPORT

# Groundwater Replenishment Trial

## Final Report

May 2013

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Australian Government
Water for the Future

WATER CORPORATION

## Endorsement

This report was prepared by Vanessa Moscovis.

Appreciation is extended to Natasha Glass and Nick Turner for their contribution and members of the Groundwater Replenishment Project Team for their review.

This report is endorsed as complete.

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- State Government of Western Australia.
- Inter Agency Working Group – Department of Water, Department of Health and Department of Environment and Conservation.
- Technical Reference Group for the Advanced Water Treatment Process – MWH, IBL Solutions (review of design, construction and operation).
- W2W Alliance: Black and Veatch/Thiess/Water Corporation JV (AWRP design, construction).
- Technical Reference Group for Groundwater– CSIRO, Curtin University, Rockwater Hydrogeology Consultants, Department of Water.
- CH2MHill (design of Visitor Facilities).
- Water Supply and Demand Advisory Panel.
- Consulted stakeholders.
- Community of Perth.
- Groundwater Replenishment Project Team.

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## Acronyms and Definitions

| | | |
|---|---|---|
| AWRP | Advanced Water Recycling Plant | A multiple treatment process consisting of ultrafiltration, reverse osmosis, ultraviolet disinfection for the *Groundwater Replenishment Trial*. |
| CCP | Critical Control Point | An activity, procedure or process where control can be applied that is essential for operating the treatment process to ensure recycled water meets guidelines set by the DoH and DEC. |
| DEC | Department of Environment and Conservation | Responsible for the protection of the environment. |
| DoH | Department of Health | Responsible for the protection of human health. |
| DoW | Department of Water | Responsible for the protection of water resources, including public drinking water sources. |
| EC | Electrical Conductivity | A measure of how well a material accommodates an electrical charge. It provides an estimate of total dissolved salts in the water. |
| EPA | Environmental Protection Authority | Established by the Western Australian government as an independent authority with the broad objective of protecting the State's environment. |
| EVs | Environmental Values | Applies to particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health. |
| GW-TRG | Groundwater Technical Reference Group | Team of experts from the CSIRO, DoW, Curtin University, Rockwater Pty Ltd and Water Corporation formed to progress the groundwater objectives of the Trial. |
| GWR | Groundwater Replenishment | The process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for drinking water prior to being recharged to an aquifer for later use as a drinking water source. |
| GWRT or "Trial" | Groundwater Replenishment Trial | Refers to all activities carried out to meet the stated objectives of the Groundwater Replenishment Trial. It includes, but is not limited to the AWRP, recharge bore, monitoring borefield. |
| IAWG | Inter-agency Working Group | Consisting of representatives from DoW, DoH, DEC and Water Corporation, was formed to oversee the Trial with the intention of developing policy and regulation for groundwater replenishment. |
| IWSS | Integrated Water Supply Scheme | The system of pipes and pumps which supplies drinking water to the Perth Metropolitan area, Mandurah and the Goldfields pipeline. |
| MoU | Memorandum of Understanding | In the context of groundwater replenishment it refers to the agreement between the DoH and Water Corporation outlining the requirements for a groundwater replenishment scheme; including water quality guidelines, operational performance and reporting requirements and communications protocols. |
| NDMA | *N*-Nitrosodimethylamine | A disinfection by-product produced in the *Advanced Water Recycling Plant* and a *Recycled Water Quality Indicator* as set by the DoH. |

| | | |
|---|---|---|
| RMZ | Recharge Management Zone | Defines the minimum distance between recharge of recycled water and abstraction of groundwater for public drinking water supplies. |
| RWQI | Recycled Water Quality Indicator | Chemicals or pathogens that best represent a larger group of chemicals or microbiological hazards identified by the *Recycled Water Quality Parameters*. They have been specified by the DoH and documented in the *GWRT MoU* Schedule 1. |
| RWQMP | Recycled Water Quality Management Plan | Describes the management systems and processes required to effectively govern a groundwater replenishment system. |
| RWQP | Recycled Water Quality Parameter | Refers to the water quality parameters to be measured in recycled water, as defined by the DoH and set out in the *GWRT MoU* Schedule 1. Analysis of these parameters will allow assessment of the recycled water against the *Water Quality Guidelines.* |
| RO | Reverse Osmosis | Second treatment step in the advanced water recycling process. |
| TOC | Total organic carbon | Is derived from natural organic matter (plants, animals) and many man made materials, and is considered a good indication of contamination. |
| UV | Ultraviolet Disinfection | Third treatment step in the advanced water recycling process. |
| | Water Quality Guidelines | Compliance with the water quality guidelines set by the DoH and DEC will represent protection of human health and the *Environmental Values*.<br>Water quality guidelines that are relevant to protecting human health and the health-related EVs are set out in the *GWRT MoU* Schedule 1. |
| WRMOS | Water Resource Management Operation Strategy | A requirement from DoW whereby a licensee commits to a management strategy for a given water resource. |
| WWTP | Wastewater Treatment Plant | A treatment process which immediately precedes the AWRP, providing secondary treatment to raw wastewater. In the context of the Trial it referred to the Beenyup WWTP, located in Craigie, Perth. |

## Units of Measure

| | | |
|---|---|---|
| kL | Kilolitre | One thousand litres. |
| ML | Megalitres | One million litres. |
| GL | Gigalitres | One billion litres. |
| mg/L | Milligrams per litre | One thousandth of a gram or $10^{-3}$ grams. |
| ug/L | Micrograms per litre | One millionth of a gram or $10^{-6}$ grams. |
| ng/L | nanograms per litre | One billionth of a gram or $10^{-9}$ grams. |
| pg/L | picograms per litre | One trillionth of a gram or $10^{-12}$ grams. |
| pfu/L | Plague forming units | Measure of virus |
| mBq/L | Millibequerel | Measure of radioactivity |

# 1 Executive Summary

This report is the final project report for the Groundwater Replenishment Trial.

It describes outcomes of the Trial's three principal objectives: Policy and Regulation, Technical Feasibility, Community Engagement and concludes that groundwater replenishment is a sustainable water source for Perth, Western Australia.

The south-west of Western Australia is experiencing the effects of a drying climate, which has resulted in a review of the long term feasibility of traditional water sources, such as dams (surface water) and groundwater.

Water Corporation's 50 year plan *Water Forever: Towards Climate Resilience* identified increasing water efficiency and water recycling and a portfolio of new water source options, including groundwater replenishment, as the mechanisms to achieve water security for Perth (Water Corporation, 2009b).

A $500 million strategy for securing Perth's groundwater supplies was released in 2011. The strategy, *Water Forever: Whatever the Weather,* involves the transfer of groundwater abstraction to the deeper Leederville and Yarragadee aquifers, the implementation of groundwater replenishment and the development of sustainable coastal superficial groundwater reserves (Water Corporation, 2011).

Groundwater replenishment is the process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for drinking water prior to being recharged to an aquifer where it is stored for later use as a drinking water source.

Similar schemes operate successfully internationally, however policy and regulation required to support groundwater replenishment did not exist in Western Australia.

The Environmental Protection Authority (EPA) provided strategic advice on groundwater replenishment in 2005 (EPA, 2005) recommending that a trial be undertaken in an area of low risk to human health and the environment. Based on this advice, Water Corporation commenced the planning for a trial at its Beenyup Wastewater Treatment Plant (WWTP) site at Craigie, in Perth's northern suburbs, in 2006.

The Water Corporation undertook the Groundwater Replenishment Trial with three principal objectives:

- To provide a context for the States' regulatory agencies to develop health and environmental regulation and water allocation policy for groundwater replenishment.
- To demonstrate the technical feasibility of the treatment process and aquifer response to reliably meet health and environmental water quality guidelines.
- To raise awareness and encourage community discussion about groundwater replenishment and its potential as a future water source.

The Trial involved an Advanced Water Recycling Plant (AWRP) further treating secondary treated wastewater using ultrafiltration (UF), reverse osmosis (RO) and ultraviolet (UV) disinfection to produce water that met Australian guidelines for drinking water. The water was then recharged into the confined Leederville aquifer at a depth of 120 to 220m at a location remote from existing drinking water abstraction bores.

Water quality was monitored throughout the treatment process and via an extensive network of 22 groundwater monitoring bores located at the Beenyup site.

Key milestones for the Groundwater Replenishment Trial are presented in Table 1 below.

**Table 1: Groundwater Replenishment Trial key milestones**

| Milestone | Start | Finish |
|---|---|---|
| Undertake regulator, stakeholder and community engagement | 2004 | December 2012(1) |
| Undertake baseline groundwater monitoring | January 2009 | November 2010 |
| Design and construct the AWRP, recharge bore and monitoring borefield | May 2008 | December 2009 |
| Commission the AWRP | December 2009 | November 2010 |
| Commence recharge to the Leederville aquifer | November 2010 | |
| Operate the AWRP and recharge the aquifer | November 2010 | December 2012 |
| Complete the Groundwater Replenishment Trial | December 2012 | |

(1) Stakeholder and Community consultation will continue after completion of the Trial.

The Trial was overseen by the State's regulatory agencies; the Department of Health (DoH), Department of Water (DoW) and Department of Environment and Conservation (DEC) and also by independent technical experts. There was also on-going engagement with key health and environment stakeholders and the community.

The Groundwater Replenishment Trial has delivered successful results achieving the project objectives as outlined below.

## Policy and Regulation

The agencies responsible for the development of policy and regulation required for groundwater replenishment in Western Australia are the DoH for public health, DoW for protecting water resources, including public drinking water sources, and DEC for protecting the environment.

Whilst there were standard processes for the DEC and DoH to approve construction and operation of a wastewater treatment plant and recycling scheme, current Western Australian health, environment and water legislation defines water produced from an AWRP as wastewater, regardless of the level of treatment. This prevented the establishment of groundwater replenishment within the existing regulatory framework.

An Inter-Agency Agreement between Water Corporation and the DoW, DoH and DEC was executed in March 2007 to develop policy and regulation for groundwater replenishment and to assess its feasibility as a sustainable water source. An Interagency Working Group (IAWG) was established to progress these requirements.

The IAWG developed the GWR Regulatory Framework which defined the requirements for the approval and ongoing regulation of a GWR scheme, using existing statutory processes where possible, and following national guidelines to assess aspects that were unique to groundwater replenishment.

The DoH led a three-year research project prior to commencing the Trial which identified 254 water quality guidelines that the recycled water must meet to protect human health. These guidelines must be met at the point of recharge (Buynder et al, 2009).

The research also identified 292 Recycled Water Quality Parameters (RWQP), which must be measured to assess the recycled water against the 254 water quality guidelines and a subset of 18 Recycled Water Quality Indicators (RWQI) which demonstrate the safety of the recycled

water for a much larger suite of chemicals, microorganisms and radiological parameters. This two-part approach allows more frequent monitoring of a small number of parameters (RWQI) to verify that the treatment system is operating correctly and that hazardous chemicals are being consistently removed. The DoH confirmed that the RWQI are representative of the RWQP.

The Trial also addressed all other policy and regulatory gaps, including:

- Defining the process for identifying the environmental values (EVs) of the receiving aquifer and the quality guidelines required to protect the EVs.
- Developing a process for determining the minimum distance between recharge of recycled water and abstraction for drinking (known as the Recharge Management Zones), and setting this distance at 250m for future GWR schemes at the Beenyup site recharging to the Leederville and Yarragadee aquifers.

In undertaking their assessment of groundwater replenishment as a sustainable water source, DoH, DEC and Dow have advised that:

- The Groundwater Replenishment Trial delivered adequate information to develop policy and regulation for groundwater replenishment.
- Subject to undergoing the approval process outlined in the GWR Regulatory Framework, groundwater replenishment from Beenyup can be regulated effectively to provide a safe sustainable water source option for Perth.

Therefore policy and regulation is in place to assess, and if acceptable implement, future groundwater replenishment schemes.

## Technical Feasibility

The technical feasibility of the Trial assessed three aspects; the management systems and processes, the treatment process and the aquifer response.

The Trial successfully demonstrated that the treatment process (WWTP and AWRP) can be consistently and reliably operated in accordance with the management systems and processes using identified critical control points (CCPs) to always meet the water quality guidelines, protecting human health and the environmental values of the Leederville aquifer. This was confirmed by independent reviews and audit.

The treatment process operated within the CCPs 99.93% of the time. There were three instances where the CCPs did not meet specifications whilst recharge continued. These events did not pose a risk to the environment or human health and the regulators accepted Water Corporation's approach to continue recharge on each occasion.

A total of 2,533 megalitres (ML) of recycled water has been recharged over the Trial period of 10 November 2010 to 31 December 2012. The daily average of 3.22 ML/d was sufficient to fulfil the technical objectives.
Twenty two monitoring bores across five sites allow collection of water samples and continuous monitoring of pressure and parameters such as conductivity and temperature. A comprehensive groundwater research program provided information to allow assessment of potential risks such as clogging and geochemical reactions as well as providing data to determine recharged water travel times and aquifer pressure response.

The Trial concluded that the aquifer has responded very well to recharge. Every one of the 58,224 groundwater samples collected during the Trial met the water quality guidelines, with the exception of some naturally occurring metals and major ions (e.g., iron and chloride) which was above guideline levels in the ambient groundwater.

Aquifer monitoring has confirmed the validity of groundwater models developed for the Trial and that these models can be used to understand and monitor the aquifer response to recharge from GWR schemes.

## Stakeholder and Community Engagement

Australian and international research and case studies have demonstrated that traditional public relations activities do not increase consumer confidence in drinking recycled water. The literature highlights trust in scheme providers and regulators as one of the deciding factors in whether a recycled water scheme will be implemented (Kinnear, 2007).

The Groundwater Replenishment Trial's community and stakeholder engagement strategy employed the "two-step" communication theory of informing opinion leaders first and then continuing to inform the broader community. In order to build trust, the strategy was primarily based on a "face to face" approach, rather than relying solely on mass communication methods. These activities were supported by advertising, media relations and other traditional public relations tools where appropriate.

Presentations and briefings to over 160 health, environment and local government stakeholder groups, including the local councils and other decision making authorities, local Aboriginal groups and community groups occurred throughout the Trial.

Groundwater replenishment was positively received and publicly supported by all sides of politics.

Mechanisms for community engagement included, but were not limited to:

- Showing over 7,400 adults and school children through the Trial's Visitors facilities.
- A website for Groundwater Replenishment and use of other social media.
- Advertising in community newspapers and providing media releases.
- Presenting at community forums.
- Quarterly water quality reporting to the community via the GWR Website.

Water Corporation consistently received positive feedback to this approach, with community members engaging in discussion and actively seeking more information.

Regular research using a number of methods was undertaken to monitor community support for groundwater replenishment. Support for groundwater replenishment has remained steady at between 70 and 76 per cent.

Support for groundwater replenishment also increased significantly when people were given sufficient information and allowed to learn through enquiry. This was demonstrated by the survey results from the Visitors Centre where support increased from 74 per cent before a tour to 93 per cent at the end of a tour.

The Trial was completed in December 2012 and the State's regulatory agencies; DEC, DoH and DoW have determined that groundwater replenishment is a safe and sustainable water source option for the future. Water Corporation has recommended to State Government a transition from the Trial to a large scale groundwater replenishment scheme.

## 2 Purpose

This is the final project report for the Groundwater Replenishment Trial.

It describes outcomes of the Trial's three principal objectives: Policy and Regulation, Technical Feasibility, Community Engagement and concludes that groundwater replenishment is a sustainable water source for Perth, Western Australia.

## 3 Context

Climate change has resulted in a reduction of rainfall in the South-West of Western Australia since the mid 1970s and more severely since 2001. Further decline in rainfall is expected over the next 50 years in the South-West of Western Australia (CSIRO & BOM, 2007), with 2010 experiencing the lowest inflow to Water Corporation dams on record. This has a serious impact on potential yields from dams and groundwater sources, which historically have been Perth's two largest sources of drinking water.

Water Corporation's *"Water Forever: Towards Climate Resilience"* (Water Corporation, 2009b) is the 50 year strategy describing how Water Corporation will achieve water security for Perth. It outlines increasing water efficiency and water recycling and identifies a portfolio of new water source options, including groundwater replenishment.

*"Water Forever – Whatever the Weather"* (Water Corporation, 2011) includes a $500 million groundwater security strategy commencing in 2013. The groundwater security strategy involves the transfer of groundwater abstraction to the deeper Leederville and Yarragadee aquifers, the implementation of groundwater replenishment and the development of sustainable coastal superficial groundwater reserves.

Groundwater replenishment is the process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for drinking water prior to being recharged to an aquifer where it mixes with groundwater and is stored for later use as a drinking water source. It is illustrated in Figure 1.

Indirect potable reuse; using recycled water for drinking after first storing in the environment (i.e., river, dam or aquifer) is undertaken in other parts of the world, such as California, Namibia and Singapore. A summary of schemes is provided at the Trial's webpage.

Water Corporation identified groundwater replenishment as a potential water source in 2004 and commenced engagement with regulators and the community. In 2005 the EPA assessed the potential for groundwater replenishment (also referred to as Managed Aquifer Recharge) on the Swan Coastal Plain. The assessment identified potential issues with groundwater replenishment and outlined the approvals required to progress a scheme. In summarising its assessment, the EPA provided support for the concept and recommended that Water Corporation progress a staged approach, starting with a trial undertaken in an area of low risk to human health and the environment (EPA, 2005).

Based on this advice, Water Corporation commenced planning the Groundwater Replenishment Trial in 2006 to build knowledge of the technical, health, environmental and social issues and to collect sufficient information to build community and regulator confidence that groundwater replenishment is a safe, viable and sustainable water source option for Perth.

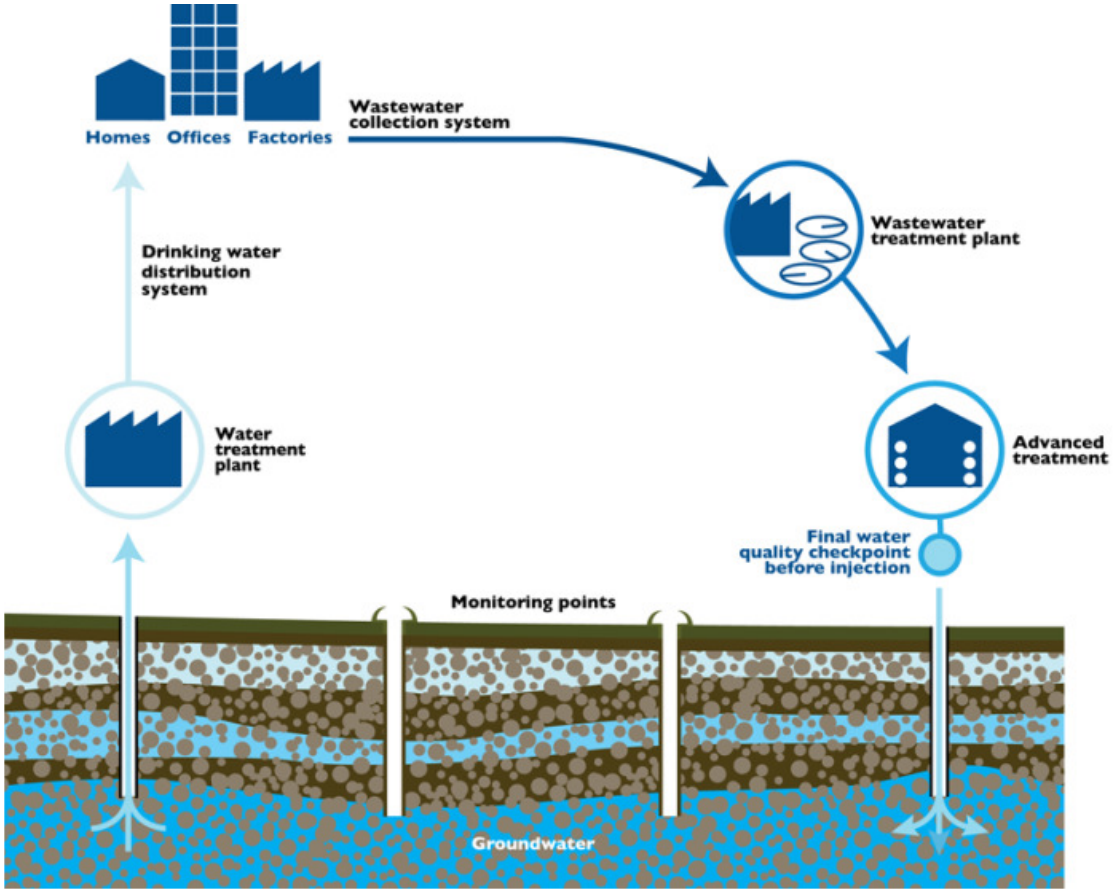



**Figure 1: A conceptual Groundwater Replenishment Scheme**

# 4 Introduction

Water Corporation undertook the Groundwater Replenishment Trial with three principal objectives:

- To provide a context for the State's regulatory agencies to develop health and environmental regulation and water allocation policy for groundwater replenishment.
- To demonstrate the technical feasibility of the management systems and processes, treatment process and aquifer response to reliably meet health and environmental water quality guidelines.
- To raise awareness and encourage community discussion about groundwater replenishment and its potential as a future water source.

The Trial is located adjacent to the Beenyup Wastewater Treatment Plant (WWTP) at Craigie, in Perth's northern suburbs, as shown in Figure 2.


**Figure 2: Groundwater Replenishment Trial site location**

The Trial involved an Advanced Water Recycling Plant (AWRP) further treating secondary treated wastewater from the Beenyup Wastewater Treatment Plant (WWTP), using ultrafiltration (UF), reverse osmosis (RO) and ultraviolet (UV) disinfection to produce water that met Australian guidelines for drinking water. These two treatment plants together were required to provide the appropriate level of treatment.

The water was then recharged into the confined Leederville aquifer at a depth of 120 to 220m at a location remote from existing drinking water abstraction bores. Water quality was monitored throughout the treatment process and via an extensive network of 22 groundwater monitoring bores located at the Beenyup site.

A detailed description of the scheme is provided in Section 5.

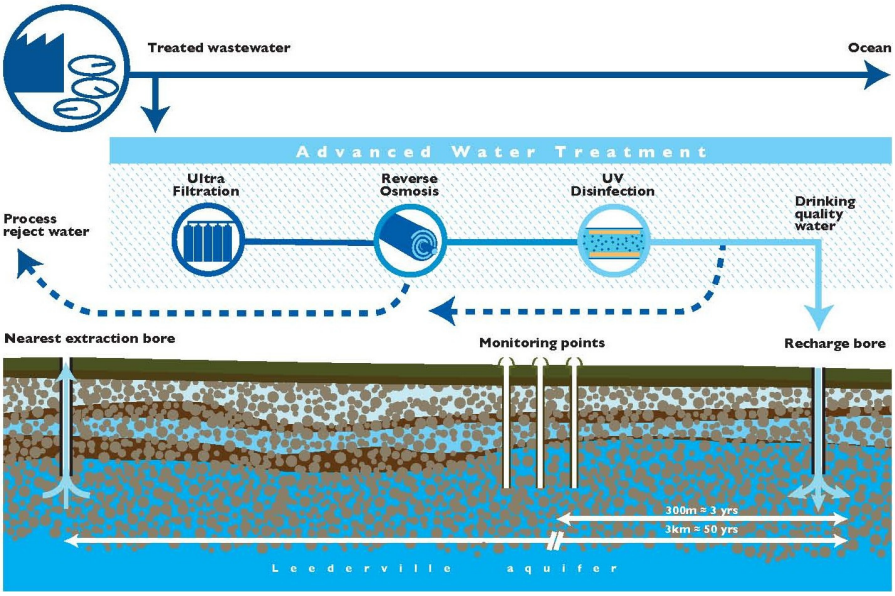



**Figure 3: Groundwater Replenishment Trial Process Diagram**

Planning for the Trial commenced in 2006. Key milestones are presented in Table 2.

**Table 2: Groundwater Replenishment Trial key milestones**

| Milestone | Start | Finish |
|---|---|---|
| Undertake regulator, stakeholder and community engagement | 2004 | December 2012(1) |
| Undertake baseline groundwater monitoring | January 2009 | November 2010 |
| Design and construct the AWRP, recharge bore and monitoring borefield | May 2008 | December 2009 |
| Commission the AWRP | December 2009 | November 2010 |
| Commence recharge to the Leederville aquifer | November 2010 | |
| Operate the AWRP and recharge the aquifer | November 2010 | December 2012 |
| Complete the Groundwater Replenishment Trial | December 2012 | |

(1) Stakeholder and Community consultation will continue after completion of the Trial.

The Groundwater Replenishment Trial was overseen by the relevant regulators; the Department of Health (DoH), Department of Water (DoW) and Department of Environment and Conservation (DEC) and by independent technical experts. There was also on-going engagement with key health and environment stakeholders and the community.

# 5 Scheme Description

The Groundwater Replenishment Scheme has four components:

1. Beenyup wastewater catchment.
2. Beenyup Wastewater Treatment Plant.
3. GWRT Advanced Water Recycling Plant.
4. Leederville aquifer.

## 5.1 Beenyup Wastewater Catchment

Managing wastewater discharged to sewers is important to protect the collection system, treatment process, end uses such as groundwater replenishment and ocean discharge, health and the safety of Water Corporation staff.

The Beenyup wastewater catchment extends from Burns Beach in the north, Scarborough in the south and Ellenbrook and Midland in the east.

The majority of wastewater collected in the Beenyup wastewater catchment is from households, with just 2% of the wastewater coming from commercial and industrial premises. The largest commercial and industrial customers in the catchment are food producers, which contribute high biodegradable organic loads and commercial laundries which contribute high volumes of water.

All discharges to the wastewater collection system from commercial and industrial businesses must meet Water Corporations' industrial waste acceptance criteria. These customers are issued with an Industrial Waste Permit outlining the conditions of discharge. Customers with high load discharges or with waste streams of concern are included in on-going surveillance programs. All new industrial or commercial business customers who connect to the wastewater collection system undergo a rigorous assessment.

Wastewater derived from hospitals can be perceived as presenting a high risk to recycled water quality due to the discharge of pharmaceuticals and other medical wastes. A thorough investigation has confirmed that this is a low risk due to the following reasons:

- There is only one large hospital and a number of small hospitals in the Beenyup wastewater catchment, contributing approximately 0.02% of the total wastewater to the catchment.
- Of this only 0.011% is considered to be "medical waste", with the rest coming from non-medical sources such as kitchens and laundries.
- Waste generated by hospitals is adequately managed by the DoH via the Clinical and Related Waste Management Policy. The Policy, which is based on Australian and New Zealand Standard AS/NZS 3816:1998, specifies that with the exception of free-flowing blood and body fluids (coming from incidental waste from cleaning etc), clinical and related chemical waste must be disposed of by means other than via discharge to sewer.
- This condition is also a requirement of the Industrial Waste Permit of each hospital, which is issued by Water Corporation.
- Water Corporation conducts periodic audits of each hospital's waste management practices, including adherence to the Policy. The most recent audits indicated acceptable performance.

- The groundwater replenishment treatment process (WWTP and AWRP) is very effective in removing all chemicals, including pharmaceuticals, to well below water quality guidelines set by the DoH.

Table 3 provides an analysis of the source of wastewater in the Beenyup wastewater catchment.

**Table 3: Breakdown of wastewater collected in the Beenyup wastewater catchment**

| Component | Volume Kilolitres per day | % of Beenyup WWTP inflow |
|---|---|---|
| Households | 124,000 | 98% |
| Total trade waste of all types (including hospitals) | 3,000 | 2% |
| Total hospital wastewater | 73 | 0.06% |
| Non-medical hospital wastewater (kitchens and laundries) | 60 | 0.05% |
| Medical hospital wastewater | 13 | 0.01% |

## 5.2 Beenyup Wastewater Treatment Plant

The Beenyup WWTP has a capacity of 135ML (135,000 kilolitres) per day. In 2011/12 Beenyup WWTP treated an average of 127ML per day utilising an activated sludge treatment process.

Recycled water quality at the point of recharge is assured by operating the treatment processes within the critical limits of each Critical Control Point (CCP) or undertaking the required corrective action when a limit is exceeded. When a CCP was exceeded at Beenyup WWTP and the corrective action did not occur, flow to the AWRP was stopped. Figure 4 illustrates the locations of the CCPs at Beenyup WWTP.

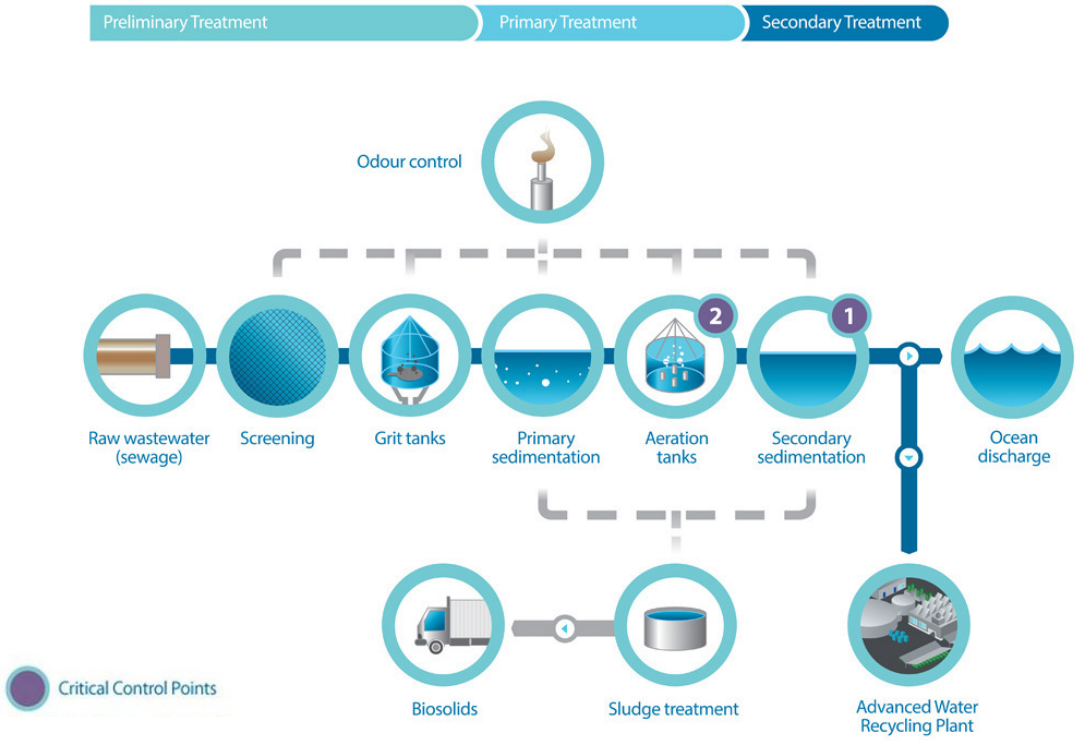



**Figure 4: Beenyup WWTP Critical Control Points**

## 5.3 Advanced Water Recycling Plant

The AWRP produced up to 5 ML/day using UF, RO and UV treatment processes. The treatment process was designed specifically to remove pathogenic micro-organisms and chemicals to below water quality guidelines set by the DoH.

Water that did not meet any of the three CCPs in the WWTP or the first CCP in the AWRP was not accepted to the AWRP storage tank. One of two corrective actions occurred during a breach of a CCP in the AWRP; water was diverted out of the treatment process at the point of exceedance or the treatment process was shut down. Figure 5 illustrates the CCPs for the AWRP.

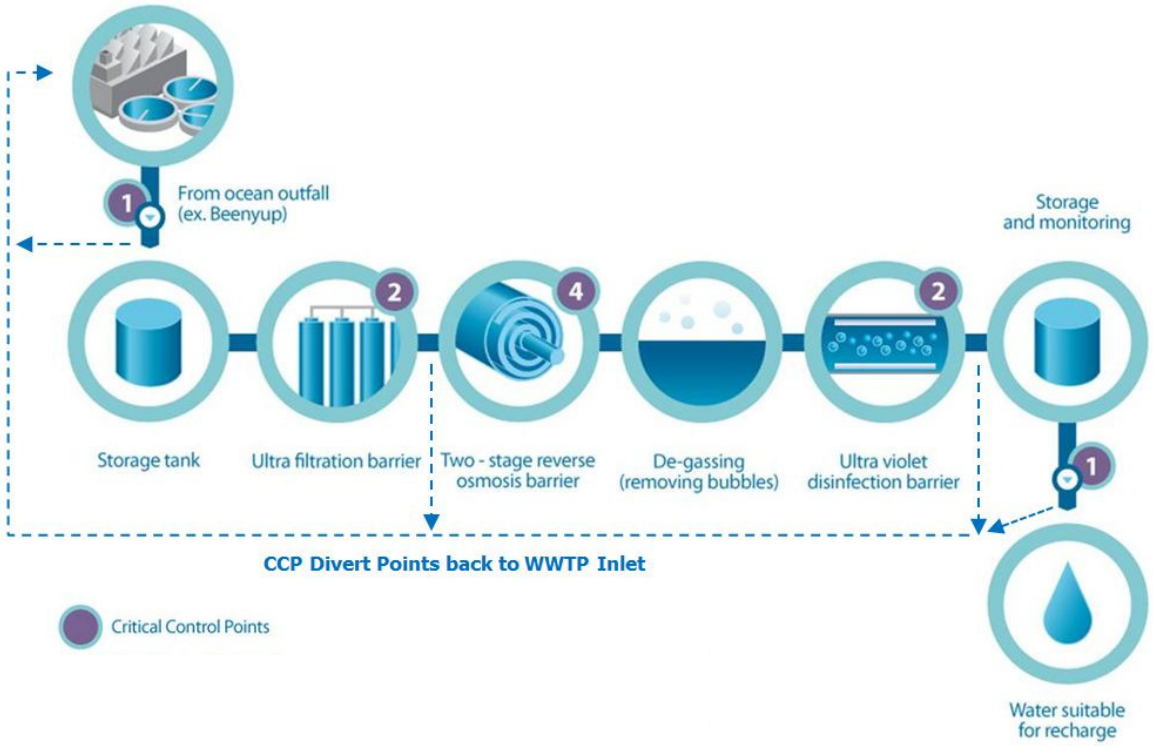



**Figure 5: AWRP Critical Control Points**

## 5.4 Leederville aquifer

The final component of the GWR scheme associated with the Trial was the receiving environment; the Leederville aquifer.

Extensive aquifer investigations were carried out to gain a detailed understanding of the characteristics of the aquifers at the Beenyup site. A summary of the stratigraphy, or aquifer composition, is provided in Table 4.

Water is recharged to the Leederville aquifer between 120m and 200m, denoted by green shading in the table below. The Leederville aquifer is confined at the recharge location and is remote from existing drinking water abstraction bores.

**Table 4: Hydro-stratigraphic summary for the Beenyup site.**

| Summary Depth (m) | | Description | Geological Unit | Hydrogeology |
|---|---|---|---|---|
| From | To | | | |
| 0 | 20 | Sand, medium to coarse grained quartz and limestone grains | Tamala Limestone | Superficial aquifer |
| 20 | 50 | Limestone | Tamala Limestone | Superficial aquifer |
| Unconformity | | | | |
| 50 | 65 | Sandstone, silty, medium to coarse grained quartz and glauconite with silt and shale beds. | Osborne Formation | Mirrabooka aquifer |
| | | | | Kardinya Shale aquitard |
| Unconformity | | | | |
| 65 | 95 | Sandstone, fine to coarse grained, moderately sorted, sub-rounded quartz with thin dark grey siltstone beds | Leederville Formation (undifferentiated) | Leederville aquifer |
| 95 | 125 | Siltstone and shale | Leederville Formation | aquitard |
| 125 | 175 | Sandstone, fine to coarse grained quartz with thin siltstone and mudstone beds | Leederville Formation: Wanneroo Member | Leederville aquifer |
| 175 | 190 | Siltstone, mudstone and poorly sorted sandstone. | Leederville Formation: Wanneroo Member | Intra-formational siltstone |
| 190 | 225 | Sandstone, fine to coarse grained quartz with thin siltstone and mudstone beds | Leederville Formation: Wanneroo Member | Leederville aquifer |
| 225 | 260 | Siltstone and mudstone | Leederville Formation: Mariginiup Member | aquitard |
| 260 | 320 | Siltstone and mudstone | South Perth Shale | aquitard |
| Unconformity | | | | |
| 320 | 390 | Sandstone and siltstone | Gage Formation | Yarragadee aquifer |
| 390 | >750 | Sandstone and siltstone | Yarragadee Formation | Yarragadee aquifer |

Note: green shading highlights the recharge zone for the Leederville recharge bore.

# 6 Policy and Regulation

The first objective of the Trial was to provide context to develop and regulation for health, environment and water in order to facilitate groundwater replenishment.

Whilst using groundwater replenishment to supplement drinking water supplies is well established in other parts of the world, there was a lack of national and state guidelines in 2006 to guide the regulation and operation of groundwater replenishment schemes in Western Australia. Therefore an objective of the Trial was to engage with the relevant regulators to develop policy and regulation.

The relevant regulators in Western Australia are:

- DoH for protection of public health.
- DoW for protection and management of water resources, including public drinking water sources.
- DEC for protection of the environment.

An Inter-Agency Agreement between Water Corporation and the DoW, DoH and DEC was executed in March 2007. This agreement defined the roles and responsibilities for each of the signatories before, during and after the Trial and established an Interagency Working Group (IAWG) to progress the two main requirements of the Agreement based on information provided by the Trial; viz:

- Develop policy and regulation for groundwater replenishment.
- Assess the feasibility of groundwater replenishment as a sustainable water source.

The IAWG met regularly throughout the Trial, successfully achieving these requirements, which is described in detailed in the following section.

**Trial Outcome – Developing Policy and Regulation:**

The DoH, DoW and DEC oversaw the performance of the Trial and used information provided by the Water Corporation to develop policy and regulation.

## 6.1 Develop policy and regulation for groundwater replenishment

While there were standard processes for the DEC and DoH to approve construction and operation of a wastewater treatment plant, relevant health[1], environment[2] and water[3] legislation defines water produced from an AWRP as wastewater or waste, which prevented groundwater replenishment within the existing regulatory framework.

There was also uncertainty regarding the water quality guidelines that should be applied to recycled water in order to protect human health and the Leederville aquifer, as well as the role of each agency in regulating these guidelines. Therefore the purpose of this component of the requirement was to:

1. Develop a regulatory framework required to assess and approve a groundwater replenishment scheme.
2. Identify and address the gaps in the policy landscape, including the definition of water produced by an AWRP for groundwater replenishment.
3. Define the specific requirements for regulation, including water quality guidelines that the recycled water must meet and rules for abstracting the groundwater replenishment allocation entitlement.

### 6.1.1 Developing the GWR Regulatory Framework

The IAWG developed the GWR Regulatory Framework for the Trial. It provides initial assessment of the scheme and defines the requirements for on-going regulation after approval to commence recharge is granted. It used existing statutory processes wherever possible and followed national guidelines to assess aspects that were unique to groundwater replenishment. A summary of the GWR Regulatory Framework is provided in Figure 6.

The IAWG reviewed the effectiveness of the GWR Regulatory Framework in governing the Trial and confirmed it was appropriate for future groundwater replenishment schemes. The GWR Regulatory Framework was documented and signed by the Directors General of DoW and DEC, DoH's Executive Director for Public Health and Water Corporation's Chief Executive Officer in December 2012. This document is provided in Appendix A.

1 Health Act 1911
2 Environmental Protection Act 1986
3 Metropolitan Water Supply, Sewerage, Drainage Act 1909

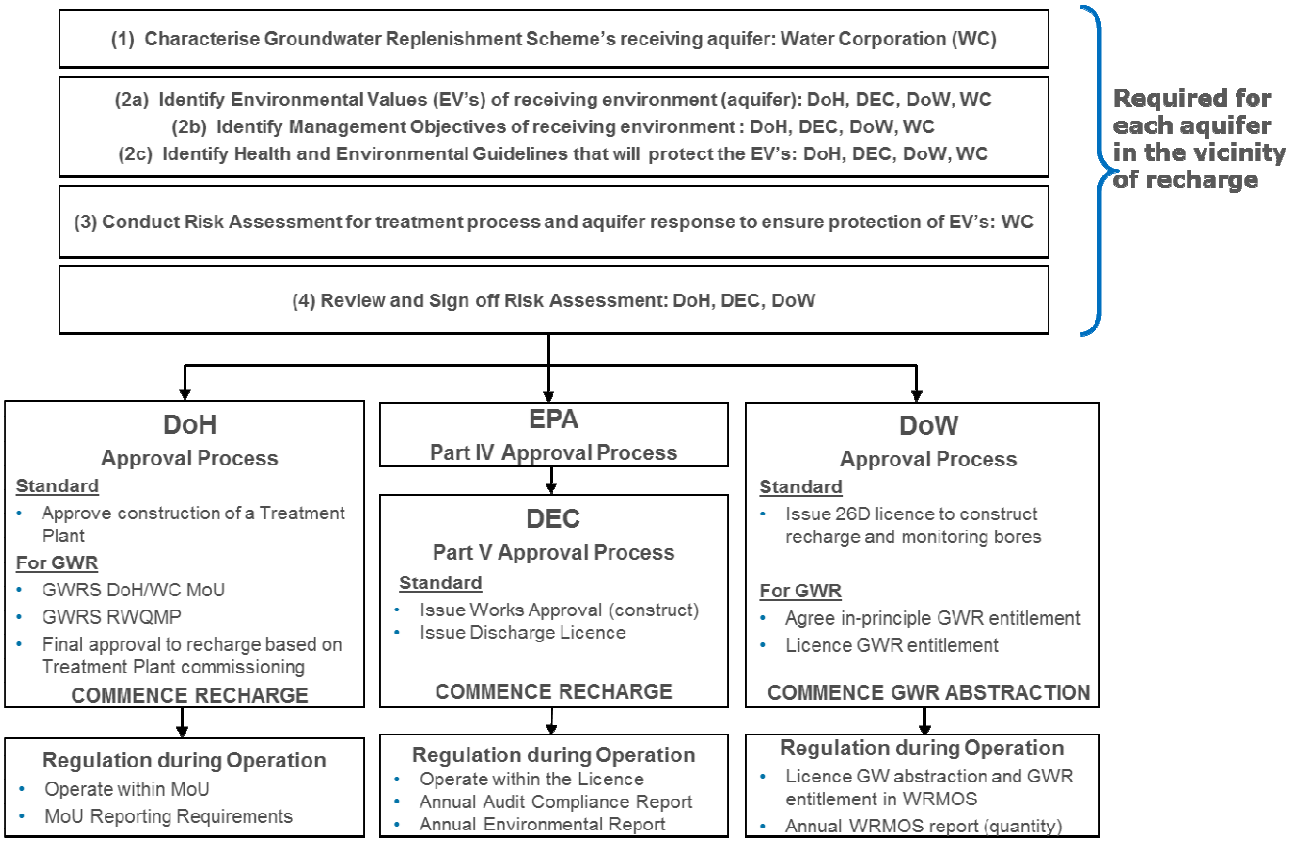



**Figure 6: Groundwater Replenishment Regulatory Framework**

**Trial Outcome – GWR Regulatory Framework:**

The IAWG developed the GWR Regulatory Framework, describing how a groundwater replenishment scheme will be assessed, regulated and operated.

### 6.1.2 Identify and address the gaps in the policy landscape

There were a number of gaps in the policy landscape, including an absence of appropriate water quality guidelines and policies to ensure protection of human health and the aquifer as a drinking water resource.

The IAWG worked progressively throughout the Trial to address these gaps, summarising the outcomes in the report *Addressing Gaps in Policy and Regulation for Groundwater Replenishment (December 2012)*. The report is included as Appendix B and the key issues have been described in Sections 6.1.3 to 6.1.6 below.

### 6.1.3 Definition of "recycled water" and "waste"

Recycled water is usually treated wastewater which is further treated to varying qualities that is "fit for purpose" for its intended use. In the case of groundwater replenishment, recycled water is produced by treating secondary treated wastewater with advanced water treatment processes to meet drinking water quality standards before being recharged into an aquifer.

Current legislation does not adequately define recycled water for the purposes of groundwater replenishment. Therefore DoH and DoW have provided clarification of their Agency's definition of "*recycled water*" and DEC their definition of "*waste*" produced by an AWRP for the purposes of groundwater replenishment. These definitions have been provided in Appendix B.

Revising the definition of recycled water enabled DoW to review the compatibility of a groundwater replenishment scheme in Public Drinking Water Source Areas. This included the review of the application of by-laws under the *Metropolitan Water Supply, Sewerage and Drainage Act (1909)* (complete) and DoW's Land Use Compatibility Tables documented in the Water Quality Protection Note #25 (position agreed, documentation update due by mid-2013).

In reviewing the definition of "*waste*" in conjunction with the water quality produced by the AWRP, DEC has concluded that water which is produced by the AWRP and meets the water quality guidelines set by DoH for the protection of human health and the drinking water Resource EV ceases to be defined as "waste".

The outcomes of DoH, DoW and DEC review are documented in Appendix B.

### 6.1.4 Defining the water quality guidelines for GWR

The key element to the approvals process is to characterise the receiving environment such that appropriate water quality guidelines can be defined.

In February 2008 the IAWG agreed four Environmental Values (EVs) as relevant to the Leederville aquifer in the vicinity of the recharge site. They also agreed the:

- Management objectives of the identified Environmental Values (to maintain the value of the groundwater for its intended purpose);
- Water Quality Guidelines required to protect the Environmental Values (to be met at the point of recharge); and
- Agency who would regulate in order to protect each environmental value.

A summary of this is provided in Table 5. Detailed description of how DoH, DEC and DoH regulated the Trial is provided in Section 6.1.7.

**Table 5: Environmental Values for the Trial**

| Environmental Value [1] | Agency Responsible for Management (Mechanism) | Water Quality Guideline that will protect the Environmental Value |
|---|---|---|
| Drinking Water Resource | Department of Health (Memorandum of Understanding) | **18 Recycled Water Quality Indicators (RWQI)** and<br>292 Recycled Water Quality Parameters (RWQP) analysed to assess **254 Water Quality Guidelines**<br><br>Defined by DoH, these guidelines are based on:<br>• Australian Drinking Water Guidelines (2004) Australian NHMRC and ARMCANZ.<br>• Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) – Augmentation of Drinking Water Supplies Natural Resource Management Ministerial Council, Environment Protection and Heritage Council and Australia Health Ministers Conference. May 2008.<br>• Premier's Collaborative Research Project – *Characterising treated wastewater for drinking purposes following reverse osmosis treatment project*. June 2009. |
| Industrial Water | Department of Health (Memorandum of Understanding) | **As per Drinking Water Resource.**<br>Given the wide nature of industrial process requirements, lack of standard national guidelines and that industry has direct and unrestricted access to potable (drinking) water for the purpose of process water, Drinking Water EV water quality guidelines will be applied for the Industrial Use EV. |
| Primary Industry | Department of Environment and Conservation (Licence for Prescribed Premise) | **6 physical and chemical parameters (targets and limits set)**<br>Identified by DEC, these guidelines are based on:<br>• *Department of Health Guidelines for the Non-potable Uses of Recycled Water in Western Australia (August, 2011)*<br>• *Maximum concentrations of nitrogen and phosphorus on the Swan Coastal Plain:* Table 2 - Water Quality Protection Note 22 – Irrigation with nutrient rich treated wastewater July 2004 WA Department of Water<br>• *Metal and metalloids concentrations for Primary Industry purposes*: Table 3.4.1 Primary Industry Trigger values – Australian and New Zealand Guidelines for Fresh and Marine Water Quality #4 (2000) ANZECC/ARMCANZ<br>• *Water Reuse. Issues, Technologies and Applications (2007). Asano T, Burton FL, Laeverenz HL, Tsuchihashi R, Tchobanoglous G (17:20)* |
| Cultural and Spiritual | This value cannot be protected by assigning water quality guidelines. Water Corporation has consulted with representatives from local the indigenous community. | |

(1) All environment al values identified must be protected for current and future use.

DoH and DEC requires that the water meets the water quality guidelines defined in Table 5 at the point of recharge. This is a more stringent requirement than provided in the *Australian Guidelines for Water Recycling, Managing Health and Environmental Risks (Phase 2): Augmenting Public Drinking Water Supplies* which recommends that the guidelines are met at the consumers tap. This more stringent approach is required by DoH because the recycled water is being recharged into an aquifer which is currently used as a source of public drinking water supplies.

DoH also confirmed the sampling programme, including frequency, based on risks that the parameters presented to human health.

### 6.1.5 Recharge Management Zone

The IAWG sought technical advice from the Groundwater Replenishment Trial's Groundwater Technical Reference Group (GW TRG) to understand the groundwater system and aquifer response to recharge in order to define the minimum distance between abstraction and recharge.

The IAWG established that the distance between all Groundwater Replenishment Scheme recharge bores and drinking water abstraction bores will be defined by a Recharge Management Zone (RMZ) and resolved that it would be regulated by the DoH. Groundwater monitoring must occur within the zone to ensure that the groundwater meets the water quality guidelines at the boundary of the zone. There are some parameters whose concentration in groundwater is already above guidelines, e.g. iron. In these situations the water is not required to meet the water quality guideline at the RMZ boundary. Note the requirement to meet water quality guidelines at the RMZ boundary is in addition to meeting at the point of recharge and is intended to account for any changes to water quality which may occur in the aquifer.

Outside of the boundary, the water is considered to become part of the groundwater environment and is able to be abstracted for drinking. The distance of the RMZ from the recharge bore will be determined for each recharge bore based on knowledge of the local aquifer characteristics and response to recharge.

Based on technical data obtained from the Beenyup site, the IAWG established that the RMZ boundary for the confined aquifers at the Beenyup site should be located at a radial distance of 250m from the recharge bore. This minimum distance is applicable to future groundwater replenishment schemes at the Beenyup site recharging the Leederville and Yarragadee aquifers.

### 6.1.6 DoW Policy Position for Managed Aquifer Recharge

DoW developed a state-wide policy *Operational Policy 1.01 - Managed Aquifer Recharge in Western Australia* in 2011 to aid the approval of socially and environmentally acceptable Managed Aquifer Recharge (MAR) proposals under the RIWI Act 1914 (DoW, 2011). This policy is referred to hereafter as the MAR Policy.

**Trial Outcome – Addressing Gaps in Policy and Regulation:**

The Trial provided information required for the DoH, DEC and DoW to successfully address all gaps in existing policy and regulatory to enable groundwater replenishment to occur.

This included:

- Defining "recycled water" produced by an AWRP for GWR.
- Defining the process for identifying the EVs of the receiving aquifer and the water quality guidelines required to protect the EVs.
- Developing a process for determining the minimum distance between recharge of recycled water and abstraction for drinking (known as the Recharge Management Zone).
- DoW developing a MAR Policy which describes approval requirements for a Managed Aquifer Recharge scheme.

It also included regulation specific to future GWR schemes recharging at the Beenyup site:

- Defining a minimum distance of 250m between recharge of recycled water and abstraction for drinking water applicable to Leederville aquifer and Yarragadee aquifer recharge bores at the Beenyup site.

### 6.1.7 Requirements of Regulation

Defining the EVs, management objectives and water quality guidelines enabled the DoH, DoW and DEC to provide clear regulation without encroaching on the jurisdiction of another agency. Table 6 summarises the requirements of each agency and the mechanism for management.

**Table 6: Requirements for regulating the Trial**

| Agency | Relevant Legislation | Requirement | Demonstrated by | Mechanism |
|---|---|---|---|---|
| **Managing Recharge** | | | | |
| DoH | Health Act (1911) | • Compliance with:<br>○ RWQI and 254 water quality guidelines at the point of recharge<br>○ Treatment performance targets for reduction of pathogenic microorganisms<br>○ Surrogates of operational performance (CCPs)<br>○ Robust management systems and processes<br>• Monitoring and assessment of RWQP and RWQI within the Trial's 22 monitoring bores | • Recycled water quality monitoring<br>• Treatment process monitoring<br>• Groundwater quality monitoring<br>Information provided at Monthly Health Advisory Committee meetings | Memorandum of Understanding between the Department of Health and Water Corporation for the Groundwater Replenishment Trial. July 2010. |
| DEC | Environmental Protection Act (1986) | • Compliance with recycled water targets and limits at the point of recharge<br>• Groundwater monitoring program | • Recycled water quality monitoring<br>• Groundwater quality monitoring<br>• Annual Licence Compliance Reports | Licence for Prescribed Premise |
| DoW | Rights in Water and Irrigation Act (1914) | • Obtain a 26D licence to construct the recharge and monitoring bores. | • Compliance with 26D Licence conditions | Licencing Procedures |

| Agency | Relevant Legislation | Requirement | Demonstrated by | Mechanism |
|---|---|---|---|---|
| **Managing Abstraction** | | | | |
| DoW | Rights in Water and Irrigation Act (1914) | • Obtain a 26D licence to construct abstraction bores (if required)<br>• Obtain a 5C licence to abstract water equivalent to volume recharged via groundwater replenishment. | • Documented monthly production and abstraction volumes. | Licencing procedures<br>*and*<br>Water Resource Management Operation Strategy for the Integrated Water Supply Scheme |

The following sections describe the specific requirements of the DoH, DEC and DoW.

### 6.1.8 Department of Health

DoH led a three year research project *Characterising treated wastewater for drinking purposes following reverse osmosis treatment* completed in 2009 as part of the Premier's Collaborative Research Program (Buynder, et al., 2009) to determine the requirements for safe replenishment of drinking water aquifers with highly treated secondary treated wastewater.

The project assessed potential public health risks from pathogenic micro-organisms, chemical contaminants and radioactive compounds in order to define water quality guidelines required to protect human health and identify operating and monitoring requirements for the Groundwater Replenishment Trial.

Key outcomes from the research project defined DoH's regulatory requirements for the Trial. They were:

- Definition of water quality guidelines which will protect human health. These were in the form of 292 Recycled Water Quality Parameters (RWQP) and corresponding 254 water quality guidelines which must be met at the point of recharge.
- Definition of a subset of 18 parameters termed Recycled Water Quality Indicators (RWQI), which are chemicals or pathogens that best represent a larger group of chemicals or microbiological hazards identified by the RWQP.
- The requirement for Water Corporation to identify appropriate surrogates of operational performance and corresponding critical limits for performance, referred to as the Critical Control Points (CCPs), which will ensure the recycled water continuously meets the water quality guidelines at the point of recharge. The AWRP was required to divert water from the treatment process or shut down when the critical limits were breached.
- Identification of MS2 Coliphage as a valid indicator of the removal of viruses and other pathogenic microorganisms (including bacteria and protozoa) to achieve the health-based performance targets in the UF and RO treatment process.
- Requirement for Water Corporation to develop and demonstrate management systems and processes to effectively govern a groundwater replenishment scheme.

The management systems and processes required to govern are documented in the *Recycled Water Quality Management Plan* (Water Corporation, 2010) and discussed in further detail in Section 7.1.

Two research outcomes required further assessment and confirmation by the DoH, based on information provided by the Trial. They were to confirm:

- RWQI are representative of the RWQP.
- Management systems and processes outlined in the Recycled Water Quality Management Plan provide effective governance of the groundwater replenishment scheme.

## Further assessment and confirmation by DoH

The Trial provided adequate data for the DoH to undertake further the assessment required.

An extensive monitoring program allowed the DoH to confirm that the RWQI adequately represented the RWQP in the Beenyup wastewater catchment (presented in Table 7).

**Table 7: RWQI for groundwater replenishment in the Beenyup wastewater catchment**

| RWQI | Unit | Guideline Value(1) | Limit of reporting | Chemical Group that they represent |
|---|---|---|---|---|
| Boron | mg/L | 4 | 0.02 | Inorganic chemicals |
| N-nitrosodimethylamine (NDMA) | ng/L | 100 | 1 | Nitrosamines |
| Nitrate as nitrogen | mg/L | 11 | 0.01 | Inorganic chemicals |
| Chlorate | mg/L | 0.7 | 0.01 | Inorganic disinfection by-products |
| 1,4-Dioxane | ug/L | 50 | 0.1 | Organic chemicals |
| Chloroform | ug/L | 200 | 0.05 | Other disinfection by-products |
| Fluorene | ug/L | 140 | 0.1 | Organic chemicals |
| 1,4-dichlorobenzene | ug/L | 40 | 0.05 | Organic chemicals |
| 2,4,6-trichlorophenol | ug/L | 20 | 1 | Phenols |
| Carbamazepine | ug/L | 100 | 0.05 | Pharmaceuticals and personal care products |
| Estrone | ng/L | 30 | 1 | Hormones |
| EDTA | ug/L | 250 | 10 | Organic chemicals |
| Trifluralin | ng/L | 50000 | 1 | Pesticides and herbicides |
| Diclofenac | ug/L | 1.8 | 0.05 | Pharmaceuticals and personal care products |
| Octadioxin | pg/L | 9000 | 2 | Organic chemicals |
| MS2 Coliphage | pfu/L | <1 | 0.6 | Microorganisms / Pathogens |
| Alpha particle activity | mBq/L | 500 | 10 | Radioactive compounds |
| Beta particle activity (-K40) | mBq/L | 500 | 10 | Radioactive compounds |

(1) Sampled results should be equal to or less than the guideline value.

*The Memorandum of Understanding Between the Department of Health and the Water Corporation for the Groundwater Replenishment Trial* (GWRT MoU) formalises the relationship between the DoH and Water Corporation and describes the regulatory approval and operational requirements of the Trial.

The MoU defines water quality requirements, describes the reporting requirements, defines the water quality events and sets the communications protocols. DoH scrutinise the treatment process performance, including water quality, monthly. DoH has used the Trial period to refine this process, ensuring a robust management system is in place.

The DoH required an independent audit of these management systems and processes. The outcomes of this audit are provided in Section 7.1.3.

The GWRT MoU is currently being revised to include findings from the Trial so that it is applicable to future groundwater replenishment schemes at the Beenyup site. The DoH has provided proposed amendments to the MoU in their regulator assessment letter for groundwater replenishment (Appendix C). It is expected that the revised MoU will also include the minimum distance to apply between recharge and abstraction.

**Trial Outcome – DoH Requirement of Regulation:**

The DoH has confirmed that the:

- RWQI adequately represent the RWQP.
- GWRT MoU forms an effective mechanism for DoH to manage groundwater replenishment.

DoH also required that Water Corporation demonstrate that the groundwater replenishment process (WWTP and AWRP) can be reliably and continuously operated:

- To consistently achieve the water quality guidelines and RWQI in recycled water.
- To achieve the health-based treatment performance targets for the reduction of pathogenic microorganisms across the treatment process, in particular UF and RO.
- Within the critical limits of each CCP or undertake the required corrective action, i.e. divert water from the treatment process or shut down.

The Trial successfully achieved each of these requirements. Details are provided in Section 7.2.

### 6.1.9 Department of Environment and Conservation

DEC formally regulated the Trial activities under Part V of the Environmental Protection Act (1986) through a Works Approval to manage construction activities and a Licence for Prescribed Premises (Category 54) to manage the 'discharge to water' (or recharge of recycled water) to the Leederville aquifer during operation of the Trial.

Through these licensing mechanisms DEC ensured protection of the Primary Industry EV. This EV recognised the use of groundwater for a variety of purposes, including the production of food crops, irrigation of parks and gardens and aquaculture, with potential environmental endpoints of humans, soils, plants, groundwater and surface water.

The Trial has demonstrated that licencing the AWRP as a Prescribed Premise (Category 54) is a successful mechanism for regulating groundwater replenishment.

**Trial Outcome – DEC Requirement of Regulation:**

Managing the operation of the AWRP through a *Licence for Prescribed Premise* is an effective way for the DEC to regulate GWR and ensure the environment is protected.

### 6.1.10 Department of Water

DoW manages the annual groundwater abstraction via a five yearly Water Resource Management Operation Strategy (WRMOS) for the Integrated Water Supply Scheme (IWSS) (Water Corporation, 2012c). The process by which water recharged via groundwater replenishment is recouped aligns with established operating procedures detailed in the IWSS WRMOS. The groundwater allocation attributable to groundwater replenishment is to be managed annually in addition to the baseline groundwater allocation.

DoW provided an allocation of additional groundwater abstraction equal to that recharged via groundwater replenishment during the Trial. Locations for abstracting the groundwater replenishment entitlement were determined by Water Corporation in consultation with DoW.

For water accounting purposes, Water Corporation included the monthly volume recharged as part of groundwater replenishment to standard reporting processes. The overall "banked" volume was also reported. This is the cumulative difference between recharge and abstraction calculated over the life of the scheme. 1900 ML was banked at 30 June 2012.

This approach aligns with the policy direction provided in the DOW's MAR Policy.

**Trial Outcome – DoW Requirement of Regulation:**

- The WRMOS provides an effective mechanism for DoW to apply the MAR Policy to effectively manage the water recharged via groundwater replenishment.
- The Trial provided an allocation of additional groundwater abstraction equal to that recharged, providing a model for future management of recharged water.

## 6.2 Assess the Feasibility of Groundwater Replenishment as a sustainable water source

DoH, DoW and DEC had full oversight of the operation and performance of the Groundwater Replenishment Trial. This included regular updates at IAWG meetings of recycled water and groundwater quality, AWRP performance, aquifer response, water quality events and outcomes of investigations, activities planned for stakeholder and community engagement, media activity and the community response determined by surveys and other feedback mechanisms.

Water Corporation has also provided presentations to regulators on particular aspects of the Trial, including the communications strategy, groundwater research findings and a detailed look at the management systems and processes. These presentations were provided by Water Corporation staff and supported by technical specialists where relevant, including CSIRO, Curtin University and Rockwater hydrogeological consultants collaborating to deliver the groundwater objectives and IPSOS, a market research company responsible for communications surveys.

These briefings together with regular updates of water quality and treatment performance have provided DoH, DoW and DEC with the information that they require to assess the feasibility of groundwater replenishment.

### 6.2.1 DoH Assessment of Groundwater Replenishment

In its evaluation of the Trial (provided in Appendix C), the DoH noted that the Trial more than adequately protected human health and the environment. The DoH also:

- Agreed that the Trial was successful in its aim to demonstrate that advanced water treatment processes are technically feasible, and manageable from a public health viewpoint.
- Noted that Water Corporation has implemented the three minor improvements identified in the independent audit report (see Section 7.1.3.2).
- Noted that the Trial demonstrated the highest standards of risk management throughout, including extremely intensive monitoring of water quality, with relevant water quality standards being met.

### 6.2.2 DoW Assessment of Groundwater Replenishment

In its evaluation of the Trial (provided in Appendix C), DoW has advised that:

- The advanced water recycling process adequately protects the environmental values of the Leederville aquifer.
- The DoW can successfully administer abstraction of groundwater that has been replenished as part of a GWR scheme.
- Future GWR schemes operated in accordance with existing management systems and procedures established for the Trial can adequately protect the identified environmental values of the receiving aquifer.
- The DoW will assess future GWR Scheme proposals in accordance with the GWR Regulatory Framework.

### 6.2.3 DEC Assessment of Groundwater Replenishment

In its evaluation of the Trial (provided in Appendix C), DEC has advised that:

- The AWRP has produced water that has met all licence limits and targets.
- The AWRP treatment process and associated management systems and procedures successfully protect the environmental values of the Leederville aquifer. This was evidenced by an extensive monitoring program which confirmed compliance with the required water quality guidelines at the point of recharge and throughout a series of 20 monitoring bores within the Leederville aquifer.
- DEC is confident that a GWR scheme operated in accordance with the AWRP process, management systems and procedures defined in the Trial can adequately protect the identified environmental values of the receiving aquifer.
- DEC will assess any future GWR scheme proposals submitted by Water Corporation in accordance with the GWR Regulatory Framework.

**Trial Outcome – Agency Assessment of GWR:**

DoH, DEC and DoW has confirmed that:

- The Groundwater Replenishment Trial delivered adequate information to develop policy and regulation for groundwater replenishment
- Subject to undergoing the approval process outlined in the GWR Regulatory Framework, a groundwater replenishment scheme at the Beenyup site can be regulated effectively to provide a sustainable water source.

# 7 Technical Feasibility

The second objective of the Trial was to demonstrate technical feasibility of the following:

1. Management Systems and Processes – Determine the effectiveness of the Wastewater Quality Framework, i.e., systems and procedures in place to assure the water quality continuously meets the required standards.
2. Treatment Process – Demonstrate that the treatment process (including the WWTP and AWRP) treats the source wastewater sufficiently to produce water that consistently and reliably meets the water quality guidelines.
3. Aquifer Response – Determine how the aquifer responds to recharge, including water quality, pressure response and movement of recycled water throughout the groundwater system.

## 7.1 Management Systems and Processes

Management systems and processes guide the operations and maintenance of the treatment process to ensure that water quality guidelines and treatment performance requirements are consistently and reliably met.

The Groundwater Replenishment Trial is managed by a Wastewater Quality Framework, adapted from the successful model used for assuring drinking water quality in Australia.

The Framework, presented in Figure 7, covers fundamental requirements such as:

- Characterising the source water to ensure that treatment is adequate.
- Understanding the potential risks to the operation and maintenance of the treatment processes and having adequate operation and maintenance procedures to minimise those risks.
- Monitoring treatment performance and water quality.
- Incident and emergency management procedures.

It also recognises that supporting processes such as guidance and governance by senior managers and regulators, employee training, community involvement and research and development are equally important in assuring water quality.

This information is captured in the *GWRT Recycled Water Quality Management Plan.* The Plan is a live document in a process of continual refinement and improvement.

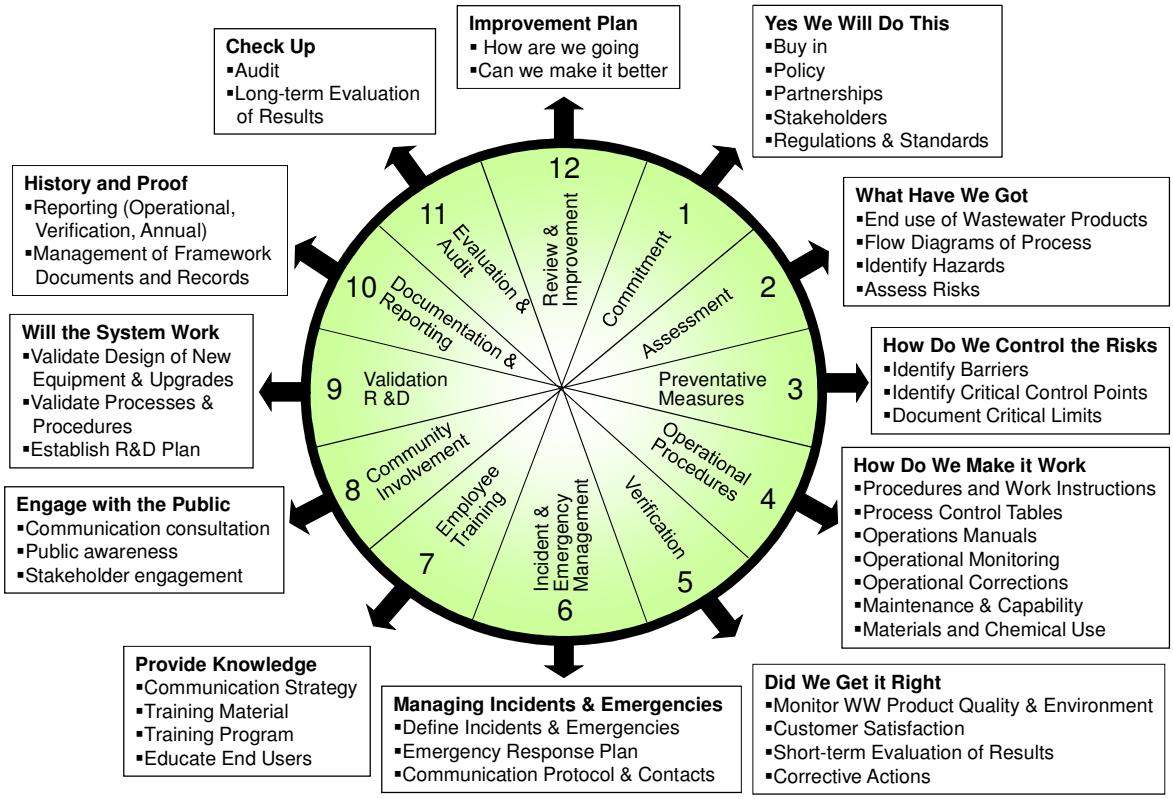



**Figure 7: Groundwater Replenishment Wastewater Quality Framework**

A rigorous Health and Environmental Risk Assessment process underpins the framework and is used to develop and provide annual review of the following key processes:

- Beenyup wastewater catchment source control measures.
- WWTP and AWRP treatment performance, particularly of CCPs.
- WWTP and AWRP verification sampling program.
- Location and depth of monitoring bores and the groundwater sampling and monitoring plan.
- Areas for further research (AWRP and groundwater) to be conducted over the Trial.
- Incident management process.
- Environment scan process (which identifies and provides review of newly identified hazards).

The management systems and processes are reviewed in a number of ways:

1. Annual Risk Assessment
2. Technical Peer Review
3. Audit of the Management System

These are discussed in detail in Sections 7.1.1 to 7.1.3.

### 7.1.1 Annual Risk Review

Risk assessments for the Trial's groundwater replenishment scheme (Beenyup wastewater catchment, wastewater treatment process, advanced water treatment process and aquifer response) were carried out at key milestones; as an input to design (March 2008), confirmation of design prior to construction (March 2009), at completion of the commissioning phase (November 2010) and then annually during operation.

Each risk assessment was conducted via a workshop with specialists from each area and considered relevant water quality data, treatment performance (CCP) data and new information sourced from research, experiences of other schemes or as part of the environment scan.

The risk reviews confirmed that the operational protocols and monitoring programs remained effective or identified areas for improvement.

### 7.1.2 Independent Peer Review

Water Corporation used the services of a number of technical experts during the Trial to provide a review of the advanced water treatment processes, hydrogeological and community engagement aspects of the Trial. Outcomes of the review were used to improve processes.

The scope of review of the technical aspects and service providers are provided in Table 8. The Peer reviewers for the Communications component are provided in Table 14.

**Table 8: Technical Peer Reviewers and scope of review**

| Panel Member | Scope of Review |
|---|---|
| **Treatment Process and Monitoring** | |
| MWH Australia | • Development of treatment process design, sampling and testing regimes and operational protocols<br>• Monthly reviews of the AWRP performance<br>• Six monthly detailed reviews of treatment performance, operational procedures and management systems<br>• Annual treatment process risk assessment review |
| IBL Solutions (Ian Law) | • Development of treatment process design, sampling and testing regimes and operational protocols<br>• Annual treatment process risk assessment review |
| Colorado School of Mines (Dr Jörg Drewes) | • Process control, sampling, analysis and water quality<br>• Chemical indicators of reverse osmosis treatment |
| University of NSW (Professor Greg Leslie) | • Process design and membrane technology |
| University of NSW (Dr Stuart Khan) | • Chemical indicators of reverse osmosis treatment |
| **Aquifer Response** | |
| KIWA Water Research (Pieter Stuyfzand) | • Development of Monitoring Borefield design, groundwater monitoring regime<br>• Monitoring, hydrogeology, geochemistry during recharge |

### 7.1.3 Audit of the Management Systems and Processes

#### 7.1.3.1 ReQuality

A review of the effectiveness of all 12 elements of the *GWRT Recycled Water Quality Management Plan* was undertaken annually by Water Corporation using the Water Services Association of Australia auditing tool, *ReQuality*. The review demonstrates compliance of management systems and processes against the *National Water Quality Management Strategy, Australian Guidelines for Recycled Water: Managing Health and Environmental Risks (Phase 1)*, identifies gaps and sets priorities for improvement.

The results of the review were excellent, with all elements ranked above 90% compliance with the requirements of the Framework. This score is representative of the high level of planning and governance that has been committed to the Trial.

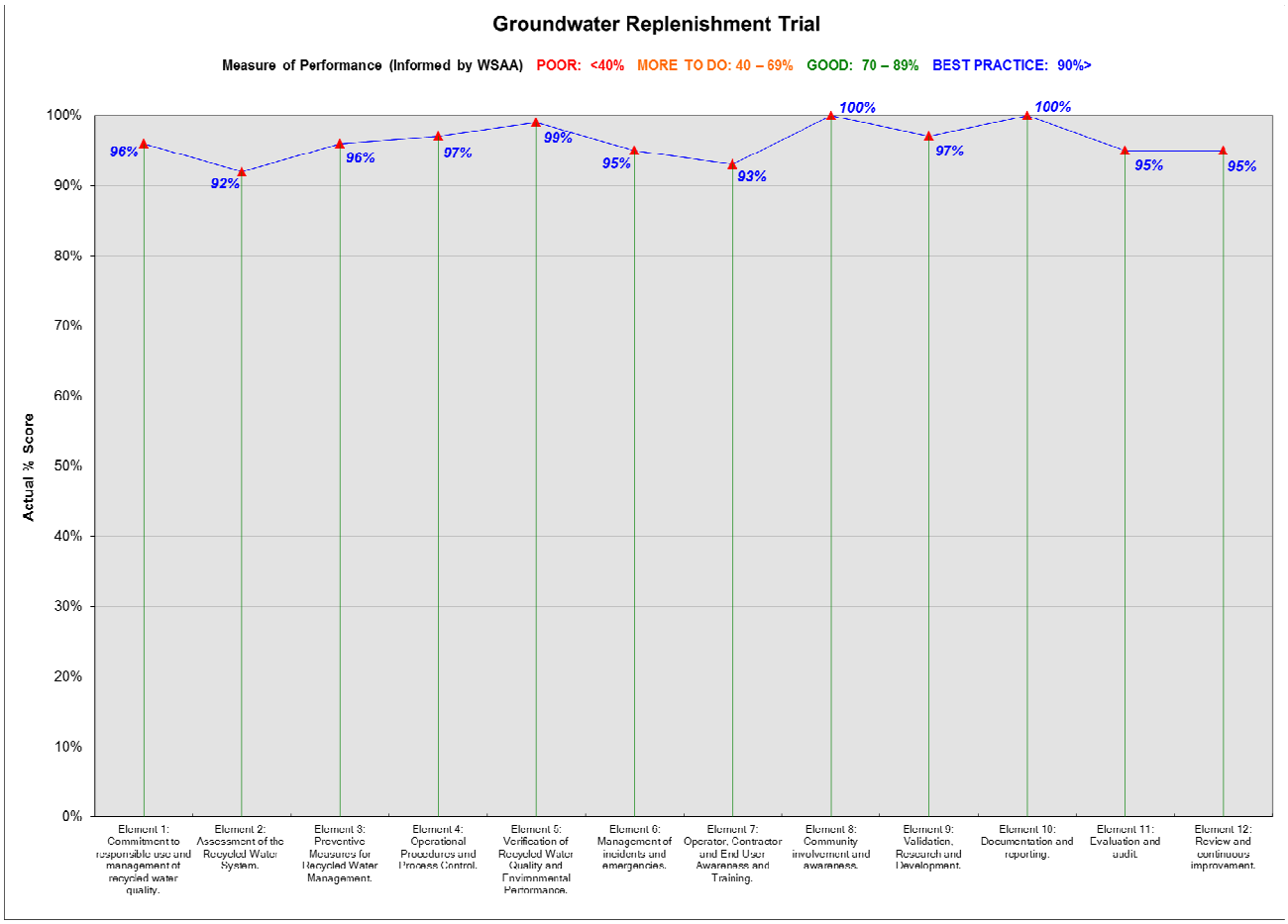



**Figure 8: Outcomes of the GWRT Management Plan Review**

#### 7.1.3.2 Independent Audit – Deloittes, Touche Tohmatsu

As part of the final assessment of the Trial, DoH required third-party assurance that the systems and processes used to manage the Trial can deliver a safe, reliable and sustainable drinking water source option that adequately protects human health and the environment.

An audit was completed by Deloitte Touche Tohmatsu covering the Trial period; 10th November 2010 to 31st December 2012.

Three objectives of the audit were identified in consultation with the DoH. They were:

1. Compliance with the GWRT MoU (see section 6.1.8) and monitoring aquifer after recharge.
2. Adequacy and effectiveness of the Corporation's wastewater quality monitoring and reporting system.
3. Adequacy and effectiveness of the Wastewater Quality Framework for the Trial.

The audit scope included the GWRT MoU and the principal recycled water quality management operating manuals used by Water Corporation during the recharge period, including:

- S100 - Standards for Wastewater Monitoring, which described the sampling and monitoring requirements.
- S218 – Wastewater Process Control Tables, which described the methods for monitoring the CCPs
- S342 – GWRT Wastewater Sampling Guidelines, which described the sampling methods and work instructions required for sampling the AWRP and monitoring borefield.
- Waste Water Quality Management System (WWQMS), the computerised database which scheduled sampling, stored all water quality results and produced water quality reports.
- Supervisory Control and Data Acquisition (SCADA), which provided automated process control for many of the treatment units within the AWRP. SCADA raises alarms when the set warnings are reached.

Three minor improvement opportunities were identified by the Audit. These three recommendations related only to minor administrative issues and did not impact the ability of the AWRP to reliably produce recycled water which met the water quality guidelines or prevent sampling to the correct procedures or required frequency. All three improvement opportunities were immediately addressed by Water Corporation.

The Audit concluded that:

> Based on the procedures performed, in all material respects, nothing has come to our attention that causes us to believe that the [Water] Corporation's procedures for the groundwater replenishment trial have not been performed in accordance with the Criteria, for the period 10 November 2010 to 31 December 2012.

A full copy of the Audit conducted by Deloitte Touche Tohmatsu is provided in Appendix D.

**Trial Outcome – Management Systems and Processes:**

The Trial has successfully demonstrated that the management systems and processes which guide the operations and maintenance of the treatment process ensure water quality guidelines and treatment performance requirements are consistently and reliably met.

## 7.2 Treatment Process Performance

The objective was to:

- Demonstrate to the regulators and the community that the groundwater replenishment treatment process (WWTP and AWRP) could reliably and consistently produce recycled water that met the water quality guidelines set to protect public health and the receiving aquifer.
- Identify the requirements for the design and operation of a large scale GWR AWRP.

Therefore the four aspects of treatment process performance assessed during the Trial were the ability to consistently and reliably:

- Comply with water quality guidelines regulated by DoH and DEC.
- Achieve the health-based performance targets for reduction of pathogenic micro-organisms across the treatment process, in particular UF and RO.
- Operate within the CCPs.
- Confirm the appropriate design and operational protocols for a groundwater replenishment scheme with similar treated wastewater characteristics to Beenyup WWTP.

### 7.2.1 Compliance with Water Quality Guidelines

The recycled water produced by the AWRP is required to comply with 254 water quality guidelines (which require analysis of 292 RWQP) and a subset of 18 RWQI defined by DoH and six chemical and physical parameters defined by the DEC (see 6.1.4) at the point of recharge. Water Corporation was also required to monitor and report on groundwater quality from 22 GWRT monitoring bores.

An extensive sampling program carried out during the Trial has demonstrated that the AWRP has performed extremely well, consistently meeting all water quality guidelines. Groundwater monitoring also demonstrated 100 per cent compliance with the water quality guidelines. A summary of the AWRP and groundwater results is provided in Table 9.

**Table 9: Recycled water and groundwater water quality results**

| Recharge Period | Number of recycled water quality results | Number of groundwater results | % of Recycled Water results that met: | | % of Recycled Water results that met: | |
|---|---|---|---|---|---|---|
| | | | DoH Guideline | DEC Guideline | DoH Guideline | DEC Guideline |
| Nov 10 – April 11 | 825 | 17,154 | 100 | 100 | 100 | 100 |
| May 11 – Jan 12 | 1,859 | 21,795 | 100 | 100 | 100 | 100 |
| Feb 12 – Jul 12 | 918 | 11,888 | 100 | 100 | 100 | 100 |
| Aug 12 – Oct 12 | 187 | 4,321 | 100 | 100 | 100 | 100 |
| Nov 12 – Dec 12 | 315 | 4,124 | 100 | 100 | 100 | 100 |
| TOTAL | 4,104 (11,974)(1) | 58,224 | | | | |

(1) Indicates the total number of samples collected throughout the treatment process – not all were required for compliance purposes.

The RWQI are defined as chemicals or pathogens that best represent a larger group of chemicals or microbiological hazards identified by the RWQP. The PCRP research project (see Section 6.1.8) determined that monitoring a smaller number of RWQI frequently is more effective than monitoring the entire suite of RWQP. DoH also confirmed the sampling frequency, based on risks that the parameters presented to human health. The results of the RWQI monitoring during the Trial, including during the AWRP commissioning process are provided in Table 10.

**Table 10: RWQI summary results to 31 December 2012 (includes commissioning data)**

| Parameter | Units | Guideline Value | Limit of Reporting | Total # of data points | # Data Points Collected during recharge | Maximum | Median | Mean | Std Dev |
|---|---|---|---|---|---|---|---|---|---|
| Boron | mg/L | 4 | 0.02 | 76 | 31 | 0.13 | 0.09 | 0.09 | 0.02 |
| N-nitrosodimethylamine(1) | ng/L | 10(1) | 1 | 76 | 30 | 17.00 | 2.45 | 3.09 | 2.47 |
| Nitrate as nitrogen | mg/L | 11 | 0.01 | 75 | 30 | 3.60 | 1.40 | 1.57 | 0.65 |
| Chlorate | mg/L | 0.7 | 0.01 | 28 | 10 | 0.02 | 0.01 | 0.01 | 0.00 |
| 1,4-Dioxane | ug/L | 50 | 0.1 | 74 | 29 | 0.12 | 0.10 | 0.10 | 0.00 |
| Chloroform | ug/L | 200 | 0.05 | 80 | 31 | 1.30 | 0.27 | 0.32 | 0.20 |
| Fluorene | ug/L | 140 | 0.1 | 9 | 7 | 0.10 | 0.10 | 0.10 | 0.00 |
| 1,4-dichlorobenzene | ug/L | 40 | 0.05 | 71 | 31 | 0.57 | 0.10 | 0.14 | 0.10 |
| 2,4,6-trichlorophenol | ug/L | 20 | 1 | 9 | 7 | 1.00 | 1.00 | 1.00 | 0.00 |
| Carbamazepine | ug/L | 100 | 0.05 | 74 | 29 | 0.050 | 0.050 | 0.050 | 0.00 |
| Estrone | ng/L | 30 | 1 | 28 | 10 | 1.00 | 1.00 | 1.00 | 0.00 |
| EDTA | ug/L | 250 | 10 | 80 | 31 | 10.0 | 10.0 | 10.0 | 0.0 |
| Trifluralin | ng/L | 50,000 | 1 | 29 | 11 | 1.00 | 1.00 | 1.00 | 0.00 |
| Diclofenac | ug/L | 1.8 | 0.05 | 74 | 29 | 0.050 | 0.050 | 0.050 | 0.00 |
| Octadioxin | pg/L | 9,000 | 2 | 10 | 8 | 10.00 | 3.00 | 4.60 | 3.06 |
| MS2 Coliphage | pfu/L | <1 | 0.6 | 86 | 33 | 1.00 | 0.60 | 0.60 | 0.04 |
| Alpha particle activity | mBq/L | 500 | 10 | 12 | 10 | 40 | 15.5 | 17.5 | 8.94 |
| Beta particle activity (-K40) | mBq/L | 500 | 10 | 12 | 10 | 90 | 70 | 60.4 | 25.95 |

(1) The water quality guideline for NDMA was increased to 100 ng/L from 1 January 2013 to align with the Australian Drinking Water Guidelines.

All RWQI results were well below the water quality guidelines during recharge.

There were two RWQI, N-nitrosodimethylamine (NDMA) and MS2 Coliphage, where a result did not meet the water quality guidelines. In both instances, this occurred during commissioning, prior to commencing recharge. Further details are provided below.

## N-nitrosodimethylamine (NDMA)

There were a small number of NDMA results which occurred during the commissioning process (prior to commencement of recharge) which did not meet the water quality guideline. These are shown in Figure 9.

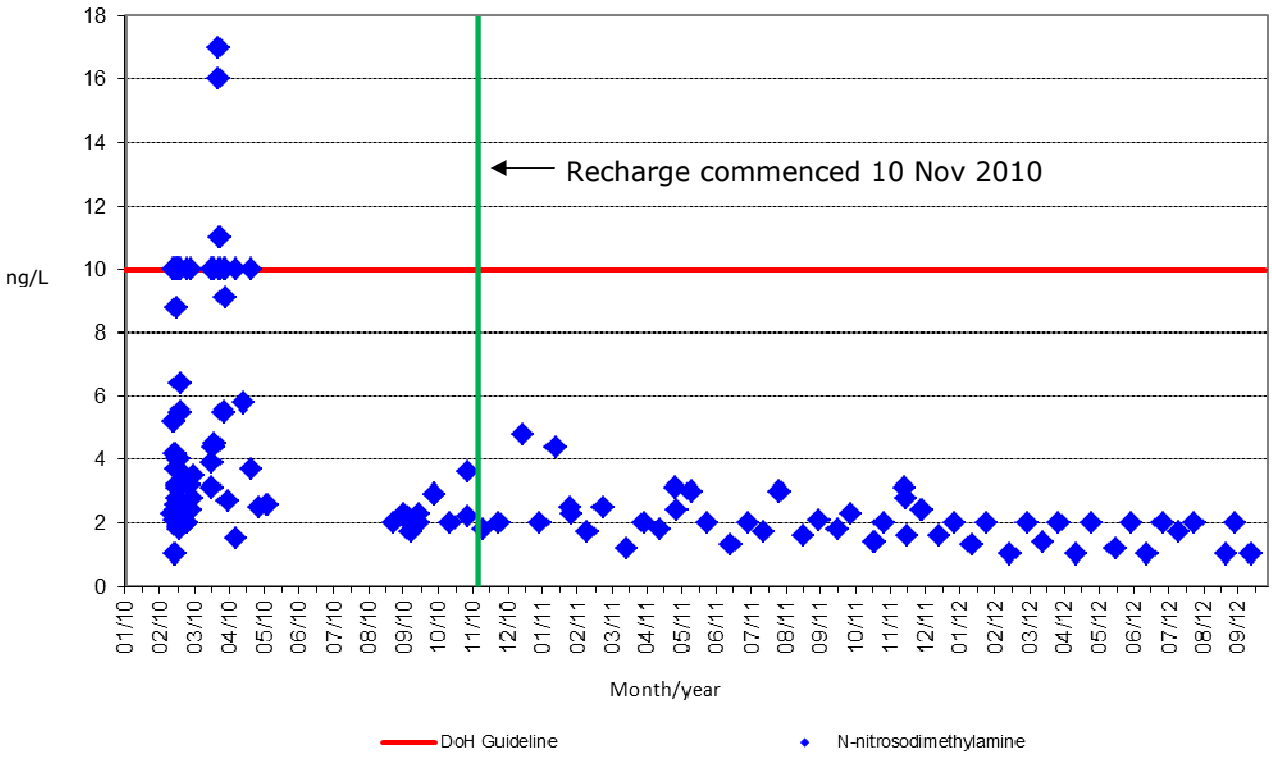



**Figure 9: N-nitrosodimethylamine results during the Trial**

NDMA is a chemical which may be formed during the AWRP treatment process as a result of sub-optimal chloramination (chlorine and ammonia) dosing. Chloramination is a necessary part of the treatment process, required to maintain the ultrafiltration and reverse osmosis membranes. The potential for NDMA formation was recognised and accounted for early in the AWRP design process and action was required during commissioning process to optimise the chloramination dose to minimise NDMA formation. Analysis of the NDMA results (Figure 9) shows that was achieved. NDMA remained well below the water quality guideline during the recharge period. It should also be noted that the DoH have increased the guideline limit for NDMA from 10 nanograms per litre (ng/L) to 100 ng/L to align with the Australian Drinking Water Guidelines.

## MS2 Coliphage

A recycled water sample collected on 28/9/10 (prior to commencement of recharge) returned a result for MS2 Coliphage of 1pfu/L. The water quality guideline is <1pfu/L and the Limit of Reporting for MS2 Coliphage at the time of sampling was 0.6pfu/L (see Figure 10).

A detailed investigation was immediately initiated within the AWRP and at the external laboratory which conducted the analysis. The investigation concluded that it was not an accurate result due to the following reasons:

- The UF, RO and UV treatment process were functioning correctly at the time.

- Sampling before and after the UF units to determine the health-based performance targets (see Section 7.2.2), indicated a post UF sample result of < 0.6pfu/L. Note, these samples are collected at the same time.
- There is no opportunity for reintroduction of pathogens between the UF and recycled water quality sampling point.
- The laboratory advised that there was potential for environmental contamination at the laboratory during analysis.

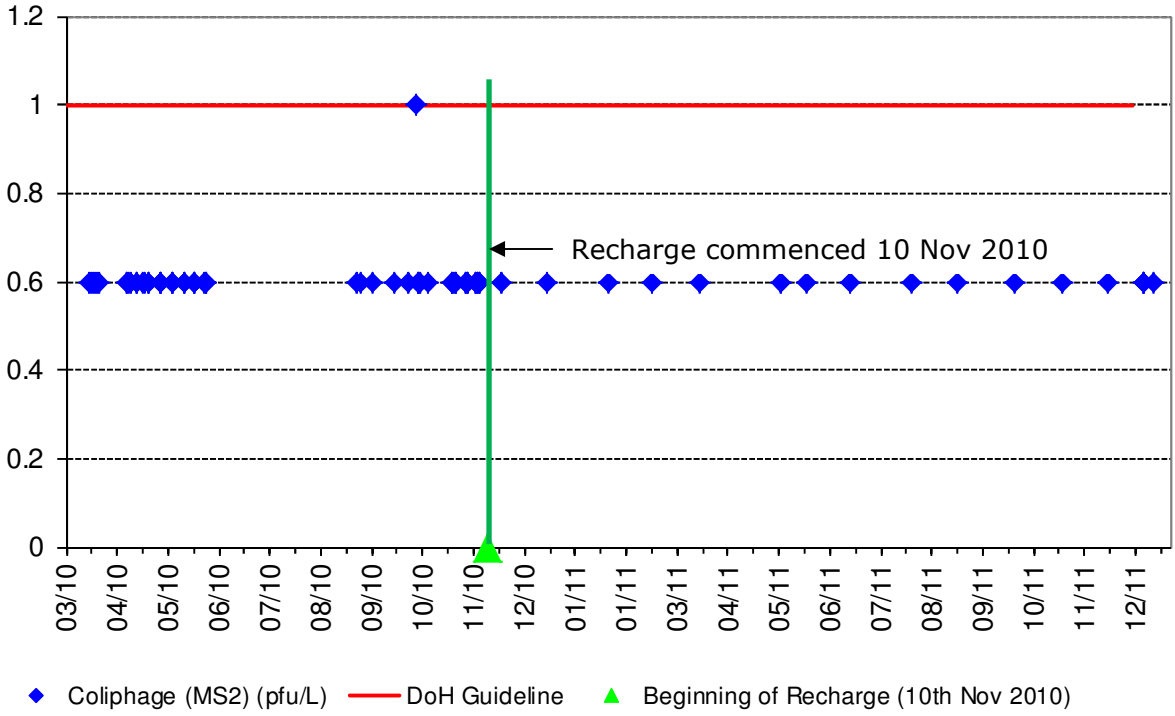



**Figure 10: MS2 Coliphage results during the Trial**

A number of additional measures were initiated by the laboratory to prevent contamination of samples.

In addition, six (6) resampling events where scheduled in October 2010. All samples passed, returning results of <0.6pfu/L.

**Trial Outcome – Recycled Water Quality**

Consistent and reliable performance of the AWRP has been demonstrated by 100% compliance of 4,104 recycled water quality and 58,224 groundwater quality results with all water quality guidelines.

### 7.2.2 Health-Based Performance Targets – Pathogen Removal

The AWRP was required to demonstrate that the UF and RO processes could achieve the health-based performance targets, expressed as "log reduction", for removal of pathogenic microorganisms (bacteria, protozoa and virus).

#### Ultrafiltration

The performance target required for UF is a reduction by a minimum of 3log (or a 1000-fold) of pathogenic microorganisms across the UF treatment process.

The DoH stipulated that M2S Coliphage was a valid indicator of the removal of pathogenic microorganisms.

Demonstrating 3log reduction of MS2 coliphage across the UF treatment process required a concentration of at least 1001 plaque forming units (pfu – a unit used to measure viruses) to be present in the feed water to allow for limitations in laboratory reporting.

M2S Coliphage is naturally present in treated wastewater (AWRP source water) in high enough concentrations to demonstrate the required 3 log, therefore Water Corporation was not required to artificially add MS2 coliphage.

Sampling occurred monthly throughout the Trial period. All samples which had sufficient concentration of MS2 coliphage present in the feedwater demonstrated a minimum of 3 log reduction. This successfully demonstrated the AWRP requirement to meet the health-based performance target for UF.

#### Reverse Osmosis

The performance target required for RO is also a reduction by a minimum of 3log (or a 1000 - fold) of pathogenic microorganisms across the across the RO treatment process.

The DoH stipulated that M2S Coliphage or a synthetic dye, Rhodamine WT were valid indicators of the removal of pathogenic microorganisms.

Due to a lack of naturally occurring MS2 Coliphage (having been removed previously by UF), an artificial indicator was required to be added to the RO feed water in order to demonstrate removal. Due to ease of operation and a generally more conservative removal, Rhodamine WT was the indicator chosen for the challenge test.

The treatment process discharged water to waste during the RO challenge testing.

Three successful challenge tests occurred during the Trial. Each test successfully demonstrated a minimum of 3 log reduction across RO. This successfully demonstrated the AWRP requirement to meet the health-based performance target for RO.

**Trial Outcome – Health-based Performance Targets:**

Testing of the UF and RO treatment process demonstrated that the health-based performance targets for pathogenic micro-organisms were met.

### 7.2.3 Operate within the Critical Control Points (CCPs)

Meeting this requirement involved:

- Confirming the CCPs and their critical limits.
- Monitoring performance of the CCPs.

### 7.2.4 Confirmation of Critical Control Points and Critical Limits

Recycled water quality and treatment performance data collected and assessed over the course of the Trial has indicated that the CCPs selected for the treatment process are appropriate. This has been proven by the verification monitoring for the Trial, where 4104 recycled water quality results have met the 254 water quality guidelines defined in the GWRT MoU.

In addition, the validity of the CCPs was confirmed by a formal review conducted by technical peer reviewers MWH Global and IBL Solutions in conjunction with Water Corporation's operations and process expertise groups.

### 7.2.5 Performance of Critical Control Points

The treatment process performed to specification 99.93% of the time. There were three events during the Trial recharge period when the treatment process CCPs did not meet specifications whilst recharge continued. Two events occurred in March 2012 and the third in August 2012. This information is presented in Table 11 and described in detail in Section 7.2.6. These events did not pose a risk to the environment or public health. The Trial's regulators determined that it was acceptable for recharge to continue on each occasion.

**Table 11: Treatment performance against operational criteria**

| Month | Portion of time that water entering the next process step was in compliance with all operational criteria | Proportion of time that recycled water met all operational criteria at the point of recharge |
|---|---|---|
| November 2010 – December 2010 | 100% | 100% |
| January 2011 – December 2011 | 100% | 100% |
| January 2012 | 100% | 100% |
| February 2012 | 100% | 100% |
| March 2012 | <100% (1) | <100%(1) |
| April 2012 | 100% | 100% |
| May 2012 | 100% | 100% |
| June 2012 | 100% | 100% |
| July 2012 | 100% | 100% |
| August 2012 | < 100%(2) | < 100%(2) |
| September 2012 | 100% | 100% |
| October 2012 | 100% | 100% |
| November 212 | 100% | 100% |
| December 2012 | 100% | 100% |

Notes:

(1) The process was not in compliance for a total of 4 hours and 22 mins during 2 events which occurred in March 2012. Total operating time during Trial was approximately 18,700 hours.

(2) The process was not in compliance for a total of 9 hours and 24 mins during 1 event which occurred in August 2012. Total operating time during Trial was approximately 18,700 hours.

### 7.2.6 Water Quality Events

The three water quality events experienced during the operational period of the Trial are described below.

**1. Low Dissolved Oxygen Levels - March 2012**

The dissolved oxygen concentration required to maintain healthy populations of micro-organisms in the wastewater treatment process is >0.5mg/L. Micro-organisms digest (remove) organic and inorganic material from the wastewater and reduce the pathogenic micro-organisms in the treated wastewater.

On 5 March 2012, a failure of the power supply to Beenyup WWTP aeration tanks resulted in oxygen concentrations dropping below 0.5mg/L in the aeration tanks. During this time approximately 700kL of secondary treated wastewater from the Beenyup WWTP passed through to the AWRP.

Continuous monitoring of the WWTP and the AWRP was able to determine that the remaining 12 CCPs were working correctly at the time of the event, therefore the recycled water that was recharged to the confined Leederville aquifer was within water quality guidelines.

A full investigation has since been undertaken and numerous resulting recommendations have been actioned to ensure this cannot happen again.

DoH, DEC and DoW were notified of the event. They advised that the event did not pose a risk to human health or the environment and were comfortable with the response and subsequent corrective actions.

**2. Elevated pH - March 2012**

The AWRP is designed to recharge water with a pH between 6.5 and 8.5. This pH range is similar to the naturally occurring water in the aquifer.

On 29 March 2012, a series of events resulted in about 300 kL of water with a pH value between 8.5 and 9.0 being recharged for 1 hour and 35 minutes. When the pH of the recycled water reached a level of 9.0, the final pH control set point, the plant automatically shut down as designed and recharge ceased. This final pH control set point had been incorrectly set at 9.0 rather than 8.5.

The Australian Drinking Water Guidelines recommend that drinking water should be supplied with a pH between 6.5 and 8.5 to ensure aesthetic water quality. Under some circumstances a pH exceeding 8.5 is acceptable. There is unlikely to be an impact on taste in drinking water at a pH of 9.0.

The Groundwater Technical Reference Group has confirmed via ongoing monitoring that this event has not had a detrimental effect on the aquifer or the environment.

A full investigation was carried out in response to the event identifying a number of areas for improvement during commissioning and while undertaking maintenance on equipment. These improvements have been implemented.

DoH, DEC and DoW were notified of the event. They advised that the event did not pose a risk to human health or the environment and were comfortable with the response and subsequent corrective actions.

### 3. Total Organic Carbon analyser not operational - August 2012

Total organic carbon (TOC) is derived from natural organic matter (plants, animals) and many man made materials, and is considered a good indication of contamination. The treatment process is very effective at removing TOC. Hence the change in amount of TOC across the plant is a very good measure of overall system performance.

On 16 August 2013, the reverse osmosis process and TOC analyser were turned off for maintenance. When the RO was returned to service, the TOC analyser was not turned back on. This should not have been possible but there was an error in the control system.

As a result 882kL of water was recharged to the confined Leederville aquifer while the CCP TOC analyser was off. The other twelve CCPs were all operating correctly during this period. In addition, TOC continued to be measured by two other analysers. A different form of TOC analyser (referred to as an "s::can"), which was located in the same position as the CCP TOC analyser and another TOC analyser located before the RO treatment unit. All monitoring indicated stable operation throughout the period. Hence, it was possible to demonstrate that the recycled water recharged was within the water quality guidelines. The control system has been upgraded so that the RO unit cannot operate without the TOC analyser being turned on.

DoH, DEC and DoW were notified of the event. They advised that the event did not pose a risk to human health or the environment and were comfortable with the response and subsequent corrective actions.

While it was unfortunate to have experienced these water quality events, they each provided an opportunity to test the management systems and processes, in particular the incident management system and escalation and reporting mechanisms ultimately resulting in a more robust treatment process and management system.

The total duration of all water quality events and volume of water recharged during these events was extremely small in comparison to total operating times and recharge volumes. This is shown in Table 12.

**Table 12: Summary of water quality events**

| Event | Date | Duration (HH:MM) | Volume (kL) |
|---|---|---|---|
| **AWRP run time since recharge commenced** | **10 Nov 2010 – 31 Dec 2012** | **~18,770:00** | **2,533,000** |
| Dissolved Oxygen | 5 March 2012 | 2:47 | 700 |
| pH | 29 March 2012 | 1:35 | 300 |
| Total Organic Carbon Analyser | 16 August 2012 | 9:24 | 882 |
| **Total for Events** | | **13:46** | **1,882** |

Note: Although the TOC analyser event occurred for almost 7.5 hours longer than the low dissolved oxygen event, it only recharged approximately 100 kL more recycled water to the Leederville aquifer. This is because the treatment process was running at half capacity, i.e., only one RO train, halving the production volume, thus recharge rate.

**Trial Outcome –Treatment Plant Performance:**

Consistent and reliable performance of the AWRP has been demonstrated by:

- The treatment process operated within the CCPs, or correctly diverted for more than 99.93% of the time.
- Monitoring of the other 12 CCPs during each of the three water quality events indicated stable operation throughout the period. Hence, it was possible to demonstrate that the recycled water recharged was within DoH and DEC specifications.
- Water Corporation response to the water quality events demonstrated that the management system was robust.
- DoH, DEC and DoW advised none of the three events posed a risk to human health or the environment and that they were satisfied with the response and subsequent corrective actions.

### 7.2.7 Identify the design and operational requirements for a full scale AWRP

An objective of the Trial was to test the process design and operational protocols to ensure that water quality guidelines and production targets could be consistently and reliably met for a full scale AWRP. This was achieved by:

- Operating within water quality guidelines and CCPs (see Sections 7.2.1 and 7.2.2).
- Operating to target production volumes.
- Identifying and addressing technical issues and managing hazards to an acceptable level.

#### Production Volumes

The AWRP was designed to produce up to 5 ML/d. Allowing for process water and maintenance requirements, the recharge target was 4 ML/d.

Reduced production volumes during 2011 triggered a review of the target recharge rate required to meet the groundwater objectives. The Groundwater TRG reset the target to a daily average of 3 ML/d over the period of the Trial.

2,533 ML of recycled water was recharged over the Trial period from 10 November 2010 to 31 December 2012 (see Figure 11). This is a daily average of 3.22 ML/d.

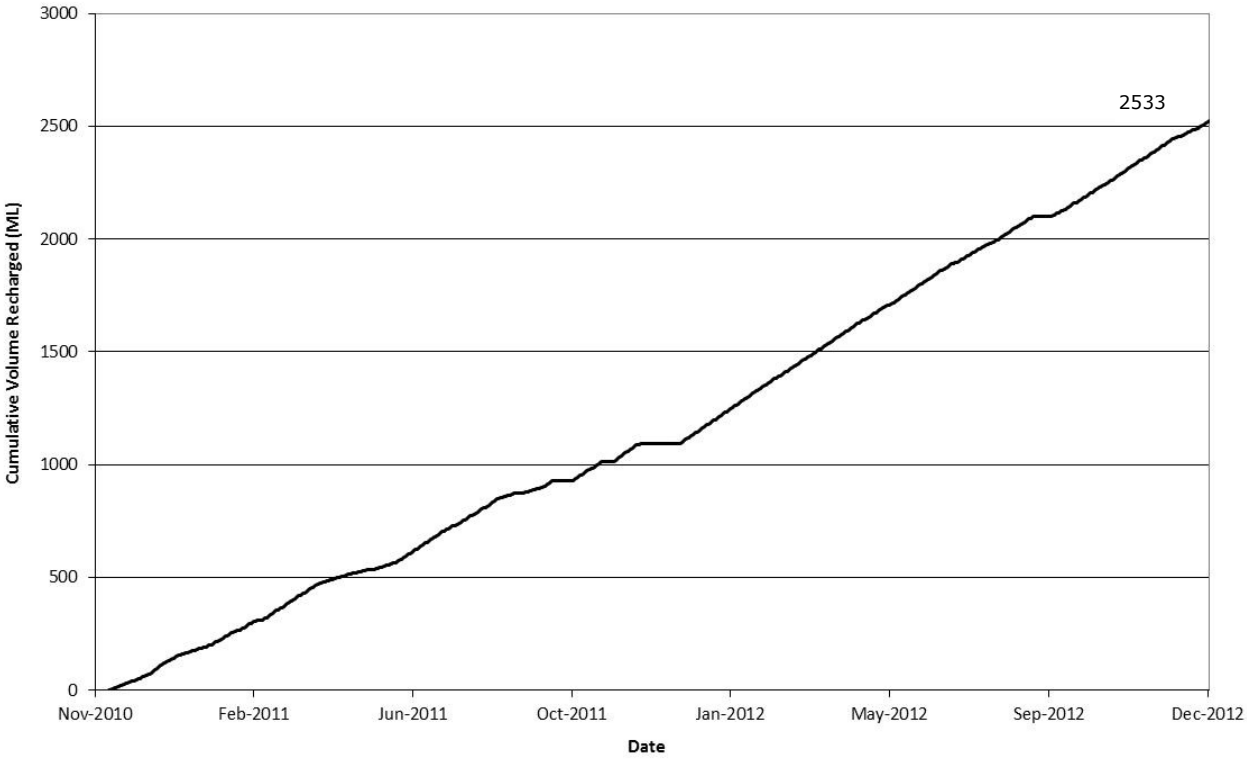



**Figure 11: Cumulative volume recharged**

Figure 12 provides the daily average recharge rates calculated for each month of the Trial period (represented by the bar chart) and the average daily recharge calculated over the entire Trial period (represented by the line graph).

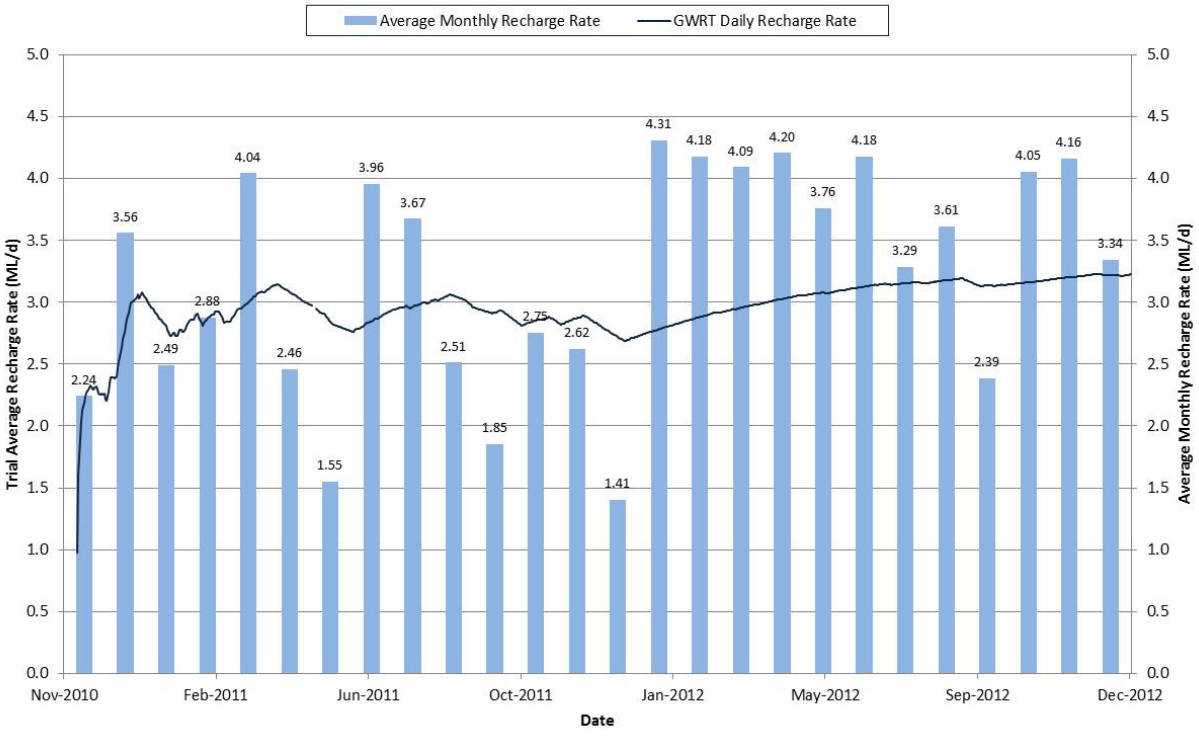



**Figure 12: Average AWRP recharge volumes**

### Confirmation of Design and Operational Protocols

All technical issues identified during the design, construction, and operation phases have been comprehensively documented for development of future AWRPs.

The most significant technical issues identified were the:

- Formation of disinfection byproducts.
- Biofouling of the reverse osmosis membranes.

Formation of disinfection by-products was successfully managed by AWRP design (see Section 7.2.1). Prevention of biofouling took longer to resolve and was the primary cause of reduced production volumes.

**Trial Outcome – Design and Operational Requirements:**
All technical issues identified during the design, construction, and operation phases have been comprehensively documented for development of future AWRPs.

## 7.3 Recharge Bore and Monitoring Borefield

There were four broad groundwater objectives:

- Confirm that Environmental Values of the Leederville aquifer continue to be protected after recycled water is mixed with groundwater.
- Understand the aquifer response to recharge.
- Identify sustainable recharge rates and pressures and assess potential for clogging of the recharge bore.
- Determine the transferability to a large GWR Scheme.

22 monitoring bores at located at five different sites across the Beenyup site, each at different distances and directions from the point of recharge (20m north, 60m north, 120m east, 180m south west and 240m north) provided information to address the objectives.

The monitoring bores at each site are located at varying depths within the Leederville aquifer to monitor physical and chemical parameters, pressure and water level to assess changes in groundwater chemistry and pressures during recharge. Figure 13 provides the location of the monitoring bores.

The *Site Evaluation Report,* (Rockwater, 2008) and the *Site Characterisation Report,* (Water Corporation, 2009) describe the composition and characteristics of the Leederville aquifer in the vicinity of the Trial site. This, in conjunction with an extensive background groundwater sampling program, allowed a detailed understanding of the aquifer prior to recharge and was an input to the risk assessment which resulted in the development of the groundwater sampling and monitoring regime. This sampling and monitoring regime was reviewed and approved by the DoH and DEC. A review of the risks associated with the aquifer was also undertaken annually (see Section 7.1.1).

Although the AWRP production has been less than expected, the Groundwater TRG has advised that the average daily recharge rate of 3.22 ML/d was sufficient to meet all of the groundwater objectives.

Progress against each of the groundwater objectives is described below.


**Figure 13: GWRT monitoring borefield**

### 7.3.1 Confirm that Environmental Values of the Leederville aquifer continue to be protected

Confirmation that the EVs of the Leederville aquifer are protected after recycled water is mixed with groundwater is demonstrated by compliance of all 58,224 groundwater quality results with the water quality guidelines, with the exception of some naturally occurring metals and major ions (e.g., iron and chloride) which was above guideline levels in the ambient groundwater.

### 7.3.2 Understand the aquifer response to recharge

Aquifer response is measured in terms of pressure and water movement.

#### Vertical movement

Monitoring of the pressure response between the Leederville and Superficial aquifers has demonstrated a generally downward hydraulic gradient with no upward movement of water possible. Groundwater monitoring has also shown no change in water quality in the Superficial aquifer since recharge commenced. This has confirmed that the Leederville aquifer is confined in the vicinity of recharge. It has also confirmed the risk to the integrity of the Pinjar Seal due to recharge is extremely low.

#### Horizontal movement

A groundwater model to predict the rate recycled water travels through the aquifer was developed as part of the Trial. The accuracy of this solute transport model was checked by monitoring electrical conductivity (EC) at the monitoring bores. EC is an effective tracer of recycled water in groundwater because the EC concentration in recycled water is much lower than natural groundwater.

Initial breakthrough describes the condition when EC begins to decrease, indicating the recycled water has reached the monitoring bore. Full breakthrough describes the condition when the EC concentration has stabilised at a value considerably lower than background (determined by the Groundwater Technical Reference Group), indicating conclusively that recycled water has reached the monitoring bore.

Full breakthrough appears to be complete at the 20m north and 60m north sites, and in two of the four monitoring sites at 120m east site. Partial breakthrough has occurred in all monitoring bores at the 180 m West site and in the deepest monitoring bore at the 240m North site. This demonstrates that the location of the monitoring bores was appropriate and monitoring of these points provides a suitable representation of recycled water quality in the aquifer. Table 13 details when recycled water was seen at the monitoring bore sites, while Figure 14 shows the distance travelled in 782 days of recharge (to 31 December 2012).

**Table 13: Movement of recycled water through the aquifer at December 2012**

| Monitoring Bore | Initial Breakthrough | Full Breakthrough |
|---|---|---|
| 20 m North (5 bores) | Mid November 2010 | All bores by early December 2010 |
| 60 m North (5 bores) | Early December 2010 | All bores by early March 2011 |
| 240 m North (3 bores) | 1 of 3 bores in mid - August 2011 | Not yet seen |
| 120 m East (4 bores) | Early February 2011 | Not yet seen |
| 180 m South West (3 bores) | Decrease in bore monitoring fastest layer – July 2011<br>Decrease in other two bores – January 2012 | Not yet seen |

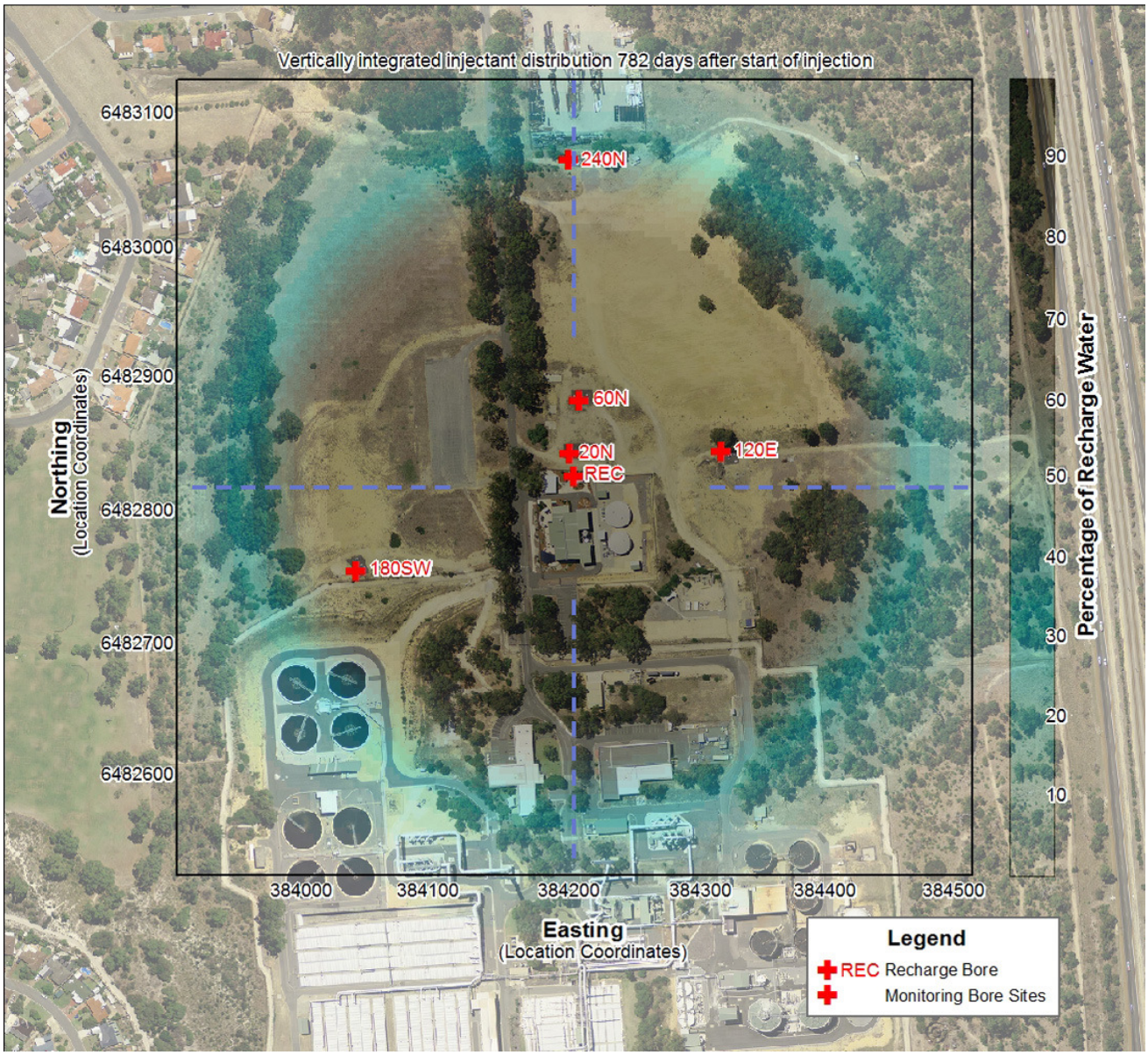



**Figure 14: Recharged water – distance travelled in 782 days of recharge (to 31/12/12)**

### 7.3.3 Identify sustainable recharge rates and pressures and assess potential for clogging of the recharge bore

Recharge operated very well, with limited clogging of either the recharge bore or aquifer being detected. The ongoing performance of recharge confirms the low risk of clogging at this site, and indicates that infrequent operational maintenance of the recharge bore is likely to be adequate to sustain efficient operation of recharge.

The information collected to date allows reliable prediction of aquifer head response to recharge under full scheme conditions.

### 7.3.4 Determine transferability to a large GWR scheme

The Trial has consolidated the understanding of local and regional hydrogeological conditions within the Leederville aquifer.

A regional scale solute transport model based on the Perth Region Aquifer Modelling System (PRAMS 3.4) has been developed. The model incorporates a refined grid around the Trial site and has been found to be valid and suitable as a basis for modelling large scale groundwater replenishment schemes.

In summary, all of these research findings indicate a positive response of the aquifer to recharge of recycled water and demonstrate protection of the EVs of the Leederville aquifer.

The research findings were collated in the *2011 Groundwater Report (*Water Corporation, 2012a*)* and the *2012 Groundwater Report (*Water Corporation, 2012b*)* and presented to the Regulators in February 2012. The report, including a synopsis, was made available on the GWRT webpage.

**Trial Outcome – Aquifer response:**

- The groundwater objectives of the Trial were met.
- The environmental values of the Leederville aquifer were protected, demonstrated by compliance of over 58,244 groundwater results with all water quality guidelines.
- The Leederville aquifer was confirmed to be confined in the vicinity of recharge.
- Sustainable recharge rates and practices were established.
- The solute transport model, developed to predict travel times of recharge water, was demonstrated to be accurate and will provide a useful tool to plan and monitor future groundwater replenishment schemes.

# 8 Stakeholder and Community Engagement

## 8.1 Communications Strategy

The third objective of the Groundwater Replenishment Trial was to raise awareness and encourage community discussion about groundwater replenishment as a future water source.

A potential barrier to acceptance of groundwater replenishment was a negative emotional response to the concept of drinking recycled water, the "yuck factor", even with an environmental buffer such as the aquifer. Critical to a successful communications strategy was acknowledging that many people are not comfortable with the concept even though it was demonstrated to be safe.

Research indicated that traditional public relations and marketing activities would not increase community confidence in relation to indirectly drinking recycled water (Po et al., 2005). This is due to the highly emotive nature of the concept and the inability to communicate technical information through a mass media campaign (i.e. television and press). Experience of other water utilities had also demonstrated that the community often reacted negatively when they felt they had not been consulted in the decision making process.

Research also identified organisational trust as one of the deciding factors in the successful introduction of non-traditional water sources such as groundwater replenishment (Hurlimann and McKay 2004).

Water Corporation was guided by this research and the experiences of unsuccessful recycling schemes for drinking, both internationally and in Australia and the highly successful groundwater replenishment scheme in Orange County, California, to develop a communications strategy which employed a two-step approach:

- One - engage with experts/opinion leaders.
- Two - engage with the broader community.

This communication method is based on the Multi-step Flow Theory (Katz and Lazarsfeld, 1955), stating that the majority of people form their own opinions based on the views of experts or opinion leaders who influence the media.

The strategy focused heavily on face-to-face engagement, including personal briefings and tours of the Groundwater Replenishment Trial. This was supported by a range of communications materials including brochures, newsletters and information available online. These materials provided information which was simple to understand but with enough technical information for those interested in more detail.

Face-to-face engagement was also supported with social media including Facebook, Twitter and independently run community engagement forums which allowed another method for the community to seek information and discuss concepts and ideas with other members of the community.

This resulted in an engagement program which:

- Provided balanced and objective information about groundwater replenishment, the Trial and why it was being trialled in Perth.
- Generated awareness and understanding of groundwater replenishment.
- Provided clear and simple information about the treatment process and regular updates of water quality results and treatment performance.

- Provided transparency in reporting.
- Sought community feedback on using groundwater replenishment to supplement drinking water supplies.

This approach encouraged the community to learn more about groundwater replenishment and engage in robust discussions and in doing so built trust and ultimately support.

The communications strategy, the implementation plan and the communications materials were regularly reviewed to ensure that the communication was effective and the information delivered was in the most suitable format for the community. The review was undertaken by project members in conjunction with peer reviewers with a wide range of skills including community engagement, market research and media monitoring. The scope of review and service provider is provided in Table 14.

**Table 14: Communications peer reviewers and scope of review**

| Panel Member | Scope of Review |
|---|---|
| • Twyford Consulting<br>• Strategen<br>• Ipsos (formerly branded as Synovate) | Development and review of Communications Strategy and Implementation Plan |
| • Phillips Group<br>• 306m (formerly branded as Media Monitors) | Quarterly monitoring of media response |
| • Data Analysis Australia<br>• Ipsos (formerly branded as Synovate) | Market research and external studies of community attitudes and behaviour in relation to recycling |

Aspects of the communications strategy which informed the revision included:

- Feedback from key stakeholders, community groups, focus groups, GWRT Community Advisory Panel and social media.
- Data from community attitudes surveys.
- Review of media articles and media monitoring.

Examples of where the strategy was revised taking account of these factors are described in the relevant sections below.

The communications approach proved successful with the 2012 Annual Community Survey indicating that community support for a full scale groundwater replenishment scheme remained steady at around 76 per cent (Ipsos, 2012).

The sections below outline the community engagement activities and supporting communication methods used throughout the Trial, which are summarised in Table 15.

**Table 15: Summary of engagement techniques**

| **Methods of Engagement** |
|---|
| Stakeholder Briefings (Health, Environment, Community, Government) |
| Community Advisory Panel |
| Community Events |
| Tours of the Trial to schools, community and technical audiences |
| Community Open Days |
| In-Schools Program |
| Social Media |
| - Facebook |
| - Twitter |
| - YouTube |
| **Supporting Materials** |
| Frog Packs |
| Quarterly Newsletters |
| Quarterly Trial Performance Reports |
| Trial internet webpage |
| Reports – Technical and Annual |
| **Methods of Seeking Feedback** |
| Survey |
| - Annual Community Support survey |
| - Pre and post tour surveys |
| - Email surveys |
| Online Forum |
| Focus Groups |
| Media monitoring – National and local |
| Community Advisory Panel |

**Trial Outcome – Communications Strategy:**

The Trial successfully employed a "two-step" Communications Strategy of stakeholder and community engagement, with regular assessment and community feedback loops.

## 8.2 Stakeholder Engagement

In the early stages of the Trial local, national and international experts and opinion leaders with an interest in water recycling, public health or environmental protection were identified. They included but were not limited to members of state and local government, academics and technical experts, regulating agencies and representatives from health, environmental and special interest groups.

Regular briefings with over 160 stakeholders were provided throughout the Trial period ensuring they were kept informed and enabling questions or concerns to be addressed by Water Corporation and DoH where relevant. The briefings also identified items of interest that could be incorporated into future communication material and briefings. These stakeholders were then able to provide current and correct information to the community or media if required.

This approach was highly successful with a number of instances during the Trial where the key stakeholders were consulted and quoted by the media. The majority of the people who were briefed were supportive of groundwater replenishment.

Details of the stakeholder engagement activities carried out during the Trial are provided in Appendix F.

### 8.2.1 State Government - Members of Parliament

The Groundwater Replenishment Trial was developed and initial approvals received during a Labour Government. Final approvals and operation of the Trial were conducted under a Liberal Government following the State election in 2008.

Water Corporation provided regular briefings during the development of the Trial and throughout the Trial period to the Minister for Water and State Government MLAs and MLCs, including Shadow Minister for Water.

Groundwater replenishment has been positively received and publicly supported by all sides of politics.

During the Trial the then Minister for Water, the Honourable Bill Marmion:

- Announced a $2.5 million investment in the preliminary design and investigation works for a large groundwater replenishment scheme as part of the Liberal-National Government's 2012/13 State Budget.
- Endorsed and launched Water Forever: Whatever the Weather, the ten year water source plan for Perth which includes progressive expansion of GWR.

Notably, both these announcements were also supported by the Shadow Minister for Water, Mr Fran Logan.

During the most recent round of briefings in mid-late 2012, support for the expansion of a large groundwater replenishment scheme was favourable.

### 8.2.2 Local Government

Throughout the duration of the Trial, regular briefings were conducted to:

- City of Joondalup – the Trial site is within their boundary;
- City of Stirling – neighbouring council; and

- City of Wanneroo – future recharge bores will be within their boundary.

City of Joondalup Mayor Troy Pickard has advised that:

> The City has been impressed with the preliminary results of the Water Corporation's Groundwater Replenishment Trial at Craigie and supports innovative initiatives that strive to improve water resources in Perth's drying climate.

The City of Wanneroo, while generally supportive of the concept of groundwater replenishment, would generally like to see the recycled water used to offset water allocations in their council instead of used for drinking water.

### 8.2.3 Key Health Stakeholders

Water Corporation worked with the DoH to identify and brief key health stakeholders including the Australian Medical Association, Public Health Association, Health Consumers Council, the Royal College of Surgeons and College of General Practitioners and Professor Peter Collignon, an Infectious Diseases Physician and Microbiologist from the Australian National University who has opposed proposals for indirectly drinking recycled water in other parts of Australia. Briefings occurred over a three year period with the latest round of briefings to health stakeholders completed in May 2012.

Health stakeholders were neutral to supportive of GWR once they had gained an appreciation of the very low risk of the approach. Water being treated to drinking water standards, recycled water spending years in the aquifer prior to abstraction and a high level of scrutiny from the DoH contributed to their confidence and level of support.

Water Corporation provided regular updates of the Trial performance to Professor Collignon. Professor Collignon believes that recycled water should only be used for drinking as a last resort, due to high concentrations of microorganisms and chemicals in wastewater, however in a submission to the Productivity Commissions Review of the Australian Urban Water Sector written by Professor Collignon dated May 23rd 2011 he stated:

> In most other areas of the world where water is recycled from sewage —indirectly into potable water supplies, it is usually done by replenishing aquifers and often because of the previous over-extraction of this underground water which has then resulted in the risk that salt water would enter the aquifer (e.g. Orange County and Oxnard). When recycled water is put into aquifers, there are usually also very long retention times before any recycled water is used. This means the many natural processes we have to help protect us against pathogens can still operate (e.g. major dilutions of the added water and prolonged storage or retention times). These natural processes result in viruses, bacteria etc dying off with time – often a 10 fold reduction in numbers every few weeks.

### 8.2.4 Key Environment Stakeholders

Water Corporation also engaged regularly with key environmental stakeholders such as the WA Centre for Water Research (University of Western Australia), Conservation Council and community interest groups.

Professor Jorg Imberger, WA Centre for Water Research, is supportive of groundwater replenishment.

The Conservation Council were also supportive of the approach initially, but a member group had some concerns regarding water quality and regulatory issues after which they adopted a more neutral position. This member group have been updated a number of times during the Trial, and remain cautious but not strongly opposed to the approach.

### 8.2.5 Community Advisory Panel

The Groundwater Replenishment Trial Community Advisory Panel was established in 2008.

Comprising of members from a range of sectors including the community, public health and environment, the Panel met quarterly and played a pivotal role in providing detailed comment on all aspects of the Trial.

The Panel developed the 'traffic light' public reporting method for the Quarterly Water Quality Reports (see Figure 15). They also provided valuable suggestions and feedback on Water Corporation's response to water quality events.


**Figure 15: GWRT Performance Report – Level 1**

Following a review of their function in November 2010, the scope of the group was expanded to incorporate water supply considerations for the Perth area, as well as groundwater replenishment. As a result, the Panel is now referred to as the "Water Supply and Demand Advisory Panel".

**Trial Outcome – Stakeholder Engagement:**

- Regular briefings to key stakeholders in the area of public health, environment, local and State Government ensured that opinion leaders and decision makers had current information.
- The approach proved successful with a number identified key stakeholders quoted by the media.
- The majority of the people who were briefed were supportive of groundwater replenishment.

## 8.3 Community Engagement

The engagement strategy also involved engaging directly with community members in small groups or individually in order to increase awareness and enable informed discussion and debate.

This approach allowed Water Corporation to tailor information to suit individual's needs, gain detailed feedback and address any concerns. It also allowed community members to engage on a personal level with the project team, simplifying technical information and allowing self-discovery. This evoked trust and confidence in the treatment process, water quality and Water Corporation as the service provider.

A number of engagement methods were used to ensure that as many different sectors of the community as possible were engaged. These methods are detailed below.

### 8.3.1 Visitors Centre

The AWRP, recharge bore and monitoring borefield were designed to allow visitors to tour the site. These facilities were augmented with a theatrette and educational walk providing information about the water cycle, groundwater replenishment, and the other initiatives outlined in Water Forever (Water Corporation, 2009b); water recycling and water efficiency.

Tours were offered to the general community, technical groups, stakeholders and school groups. Tours commenced at the official launch of the Trial on 30 November 2010.

In addition to tours held throughout the year, Community Open Days were held bi-annually throughout the Trial. They were promoted as educational family events, with the primary objective of providing tours of the AWRP.


Almost 400 tours were conducted during the Trial resulting in more than 7,400 visitors. This includes approximately 1,200 community members who attended the four Open Days.

Visitors were surveyed before and after the tours to provide an understanding of their views and concerns and determine how these attitudes changed after gaining further information.

Community feedback indicated that Open Days and tours were an important mechanism for providing the community with further information, with support for groundwater replenishment increasing significantly after community members had seen the Trial facility. Detailed survey results are provided in Section 8.5.

### 8.3.2 Community Outreach Program


Information booths, held at markets and festivals around Perth were designed to engage more broadly with the community, reaching people who were not aware of groundwater replenishment.

Water Corporation attended 18 community events, all generating a high level of community interest, with more than 500 people completing the groundwater replenishment support surveys.

Detailed survey results are provided in Section 8.5.

### 8.3.3 Schools Program

Educating children about water is recognised as an integral part of Water Corporation's community engagement process. Teaching students about the water cycle and how water is provided to homes and how wastewater is removed results in greater overall awareness for students, and their parents, and encourages adoption of water efficient behaviours.

The Water Education Program was broadened to include groundwater replenishment. School students in Years 5-12, TAFE and tertiary institutions, were encouraged to tour the Visitors Centre with Water Corporation's Education Officers. This program was extremely successful with more than 4,600 students touring the Visitor Centre.

Students were given a modified tour which was suitable for their age and knowledge. As with community and stakeholder groups, students completed surveys before and after their tour. This feedback was used to ensure school children were getting information that was appropriate to their learning requirements, but did not form part of the overall community support rate. This is because in the absence of their parents, school children could be construed as being influenced by Water Corporation's Education Officers may provide an artificially inflated rate of community support.

However, their feedback was consistent with surveys completed by adults, which is discussed in more detail in Section 8.5.2. This information was valuable in understanding how to tailor communication to children and understanding their attitudes towards groundwater replenishment and other water initiatives.

The specialist education team also visited more than 34 schools, presenting in school classrooms on groundwater replenishment.

**Trial Outcome – Community Engagement:**

A number of different methods were used to engage directly with community members. This allowed self-discovery as community members received technical information tailored to individual requirements.

This increased awareness and enable informed discussion and debate.

## 8.4 Supporting communications

Community engagement activities were supported by a range of communications materials which provided information to the community that could be accessed and read at a later date, or shared with friends and family.

### 8.4.1 Frog Information Packs

A specially developed information kit, referred to as 'Frog Packs' were a valuable information tool for the community and students. The packs provided comprehensive and detailed information on groundwater replenishment including:

- What is groundwater replenishment and why trial it.
- How the secondary wastewater is treated to drinking water standards.
- How water quality is ensured.
- The perceived impact on the groundwater environment.
- How community members can book tours.
- What happens when the Trial is completed.

The frog packs were well received by the community and feedback indicated that the information provided in the frog packs was comprehensive yet simple enough to understand.

### 8.4.2 Social Media

The evolution and popularity of social media allowed alternative platforms for consultation and interaction with the public.

A successful social media communication strategy was implemented and included the use of:

- Facebook and Twitter for informal dialogue.
- YouTube as a medium for posting short updates, interviews and information clips.
- Online forum – 'Have Your Say' to allow informed discussion completely independently of Water Corporation (the site is administered by a third party). Further information is provided in Section 8.5.2.

A Groundwater Replenishment Trial Facebook page was developed in May 2011 and maintained a steady following of 762 Facebook users (Likes).

The Trial utilised the Water Corporation's existing Twitter account, accessing more than 3,000 followers and existing YouTube account, accessing 57 subscribers to provide regular updates of Trial progress.

These mediums provided an opportunity to promote other engagement initiatives such as the online forum and community open days and share media coverage, news on the water industry trends in general and also present informative videos. The viral nature of social media (meaning a story spreads quickly) meant a considerable amount of interaction whether it be commenting, re-tweeting or sharing of videos was seen throughout the Trial.

Sentiment across those engaging with Water Corporation through social media used was generally positive.

### 8.4.3 Groundwater Replenishment Webpage

The dedicated GWRT webpage, active since December 2009, contained:

- An overview of groundwater replenishment and frequently asked questions.
- Detailed information on the treatment process and water quality guidelines.
- Weekly updates of the volume of recycled water recharged to the aquifer.
- Quarterly Performance Reports.
- Key reports and publications such as annual reports, groundwater reports.
- Links to related sites, including DoH's GWRT page, similar recycling schemes.
- Facility to book a community or school tour of the Trial facility.

### 8.4.4 E-newsletters

A quarterly newsletter has been distributed electronically since February 2010. The newsletter provided stakeholders and the community with general information on groundwater replenishment, updates on progress and developments of the Trial including links to *Groundwater Replenishment Performance Reports* or other Water Corporation initiatives including the Target60 campaign.

The newsletters provided another mechanism for addressing community concerns which had been highlighted via community feedback during tours or on social media. The regularity of the newsletters ensured the topics were relevant and information provided was current.

Readership of the newsletter grew to almost 1,400 subscribers in the final year of the Trial.

All editions of the e-newsletters were made available on the GWRT webpage for the benefit of new subscribers and as a historical record.

### 8.4.5 Groundwater Replenishment Trial Performance Reports

Water Quality Reports were released every quarter providing summarised data relating to water quality, treatment process performance and the distance that the recharged water had travelled during the period.

These reports were publically available on the GWRT webpage and a link was also included in the quarterly Trial newsletter which was distributed electronically.

Water Corporation committed to notifying the community when the treatment process did not perform to specification, referred to as "water quality events". Water quality events which impacted on recycled water quality were reported immediately, while exceptions to treatment process performance which do not impact recycled water quality were reported at the next quarterly Water Quality Report.

Three water quality events occurred during the Trial's recharge period, see Section 7.2.2 for more information. On one occasion, recycled water quality exceeded the water quality guidelines for pH and was immediately reported to the community via a media statement and on the GWRT webpage. On the other two occasions, recycled water quality remained within water quality guidelines, therefore were reported via the next quarterly Water Quality Report. On all three occasions, there was no reported media coverage.

Positive feedback was received from the community demonstrating that the GWRT Performance Reports provided a high level of transparency and addressed community concerns regarding water quality.

### 8.4.6 Groundwater Reports

Reporting against groundwater research objectives commenced in 2007. Reports were published at key points during initial background investigations and then annually after recharge commenced in November 2010.

Reports contain technical information, including aquifers response to recharging recycled water, the movement of this water throughout the aquifer and groundwater quality data. Groundwater Reports were available on the GWRT webpage throughout the Trial.

### 8.4.7 Annual Reports

Water Corporation published annual reports throughout the Trial, providing an overview of the Trial activities and research findings during the year. These reports were available on the GWRT webpage.

### 8.4.8 Proactive Media

When dealing with such a sensitive subject, media plays a pivotal role in community perception. From the development of the Trial, Water Corporation maintained a cooperative relationship with the media and sought proactive media opportunities where possible to ensure accurate information was reported and community awareness was increased.

The table below outlines the media statements released over the duration of the Trial by Water Corporation or the Government Media Office.

**Table 16: Key Media Statements provided during the Trial**

| Title | Date | Released by | Key topics |
|---|---|---|---|
| Groundwater Replenishment Trial completed | 05/01/2013 | Government Media Office | GWRT completed, excellent preliminary results achieved, regulators to assess Trial and provide advice to Government. |
| Last chance for community to have their say on groundwater replenishment | 18/10/2012 | Water Corporation | Advertising the October 2012 Community Open Day – the last to be held during the Trial period. |
| Water recycling trial has drawn 6,000 visitors | 20/09/2012 | Government Media Office | More than 6,000 visitors have toured GWRT, invitation to tour before completion of Trial. |
| Sharing water industry knowledge in Singapore | 01/07/2012 | Government Media Office | Singapore International Water Week – Minister for Water, the Hon. Marmion in Singapore to discuss with world water industry leaders urban water supply solutions, including indirectly drinking recycled water. He also visited Singapore NEWater plants, where recycled water is used for drinking. |
| State Budget 2012-13: Building the State - Boost for groundwater replenishment trial | 11/06/2012 | Government Media Office | State budget hand down - $2.5m investment to undertake preliminary design and investigation works for an expansion of the groundwater replenishment scheme. |
| Water Corporation warns of misleading information on water quality | 23/05/2012 | Water Corporation | Water Corporation warn residents of door-to-door sales people making false claims about drinking water quality, including statements about sewerage being put into the water supply. Media statement noted GWRT in progress. |
| Advanced Water Recycling Plant – Groundwater Replenishment Trial | 30/03/12 | Water Corporation | Water Corporation notifies community of Water Quality Event which occurred at the AWRP. |
| Three out of four support full water recycling | 23/03/2012 | Government Media Office | New survey results for GWRT show three out of four people support moving to full recycling scheme, promotion of the March 2012 Community Open Day. |
| Fun and informative Groundwater Replenishment Trial open day | 11/10/2011 | Water Corporation | Community invited to find out more about how recycling could help meet our future demand for drinking water at the October 2011 Community Open Day. |

| Title | Date | Released by | Key topics |
|---|---|---|---|
| Perth's new major water supply secured (referencing Southern Seawater Desalination Plant) | 01/08/2011 | Government Media Office | Minister announces an expansion of the Southern Seawater Desalination Plant. Statement also noted the Government was investigating other supply solutions for future major water sources, including groundwater replenishment. |
| Groundwater Replenishment Trial shows early success | 13/04/2011 | Government Media Office | Results from first three months of GWRT show positive results, all water samples met health and environmental guidelines |
| Groundwater Replenishment Trial - Open Day | 08/03/2011 | Water Corporation | Community invited to March 2011 Community Open Day |
| Letter to the Editor - Wanneroo Times - Groundwater Replenishment | 11/01/2011 | Water Corporation | GWRT was the result of many years of research and collaboration, WA gave approval to recharge into groundwater, community consultation started in 2005. |
| Australia's first Groundwater Replenishment Trial starts | 30/11/2010 | Government Media Office | GWRT officially launched by then Water Minister Graham Jacobs |
| Perth Trial of Recharging Recycled Water into Groundwater begins | 30/11/2010 | Federal Government Media Office | GWRT Officially launched. Attended by Parliamentary Secretary for Sustainability and Urban Water, Senator Don Farrell. |
| Groundwater Replenishment Trial Update | 11/06/2010 | Water Corporation | Initial operation and testing of GWRT completed successfully. |
| Water Forever Options Paper released for comment | 09/06/2008 | Water Corporation | GWR named as favoured future water source option by Dr Jim Gill, then Water Corporation CEO. |

All media statements received a degree of coverage via various media outlets. Detailed information on media trends and non-proactive articles can be found in Section 8.6.

**Trial Outcome – Supporting Communications:**

A number of different methods were used to support communications.

These were very well received with positive feedback regularly provided on all supporting materials.

## 8.5 Seeking Community Feedback

Water Corporation has actively monitored community attitudes towards groundwater replenishment. Information gathered from the community can provide commentary and statistical data identifying levels of support (referred to as quantitative data), or purely provide commentary (referred to as qualitative data). Both types of information are important in understanding community attitudes toward groundwater replenishment and allowing Water Corporation to provide information that meets the community's information requirements.

The following surveys methods used during the Trial have provided quantitative data:

- **Annual Community Surveys** – telephone interviews with over 400 randomly selected Perth residents to survey their attitude towards groundwater replenishment.
- **Visitors Centre Surveys** - taken before and after people have toured the Trial's Visitors Centre.
- **Community and Stakeholder Event surveys** - taken during community outreach events, stakeholder and community workshops and presentations.
- **Pulse Surveys** - a short, quick, email survey sent to more than 40,000 community members.

The following survey methods used during the Trial have provided qualitative data:

- **Focus Groups** – a form research in which a group of people are asked about their perceptions, opinions, beliefs and attitudes towards a product, service, concept etc.
- **Online Forum: 'Have your say on recycling'** – an online website to share, listen and learn from the community.

Water Corporation uses this information to understand any shifts in community attitudes and then in conjunction with a panel of community engagement experts, undertakes an annual review of the Communication Strategy to ensure that the Trial continues to deliver information in the format that best suits the community.

### 8.5.1 Quantitative Survey Outcomes

#### 8.5.1.1 Annual Community Surveys

An independent market research organisation, Ipsos (formerly branded as Synovate), have tracked community attitudes towards groundwater replenishment since 2007. This included data collected, collation and interpretation.

The primary research method was an annual survey undertaken by approximately 400 residents within metropolitan Western Australia via a computer aided telephone interview. To ensure validity of the results the survey is carried out in July-August each year and a representative sample size of 400 people is obtained. Where necessary, data is weighted by age and gender to ensure the data represents demographics provided by the Australian Bureau of Statistics.

These surveys were more detailed than other survey methods, monitoring levels of awareness, knowledge, trust in Water Corporation, key regulators and stakeholders, and support for a full-scale groundwater replenishment scheme.

**Awareness**

Awareness of groundwater replenishment has been measured since 2007.

Unprompted awareness has fluctuated between 3 and 14 per cent during the survey period.

The 2012 Annual Community Survey period, while low, was typical of previous years; measuring 5 per cent initially, awareness increased to 44 per cent when prompted.

Significant fluctuations observed in unprompted awareness of groundwater replenishment indicate that it may be impacted by external factors which complete for mind share within the community. For example, the 2012 Annual Community Survey was conducted during the Olympics Games, which may have impacted the ability for survey participants to recall groundwater replenishment without prompting.

Prompted awareness levels were between 43 and 49 per cent during the survey period. This indicates that whilst nearly half of the population has heard of groundwater replenishment, it is not top-of-mind for many, indicating that the community is comfortable with the concept.

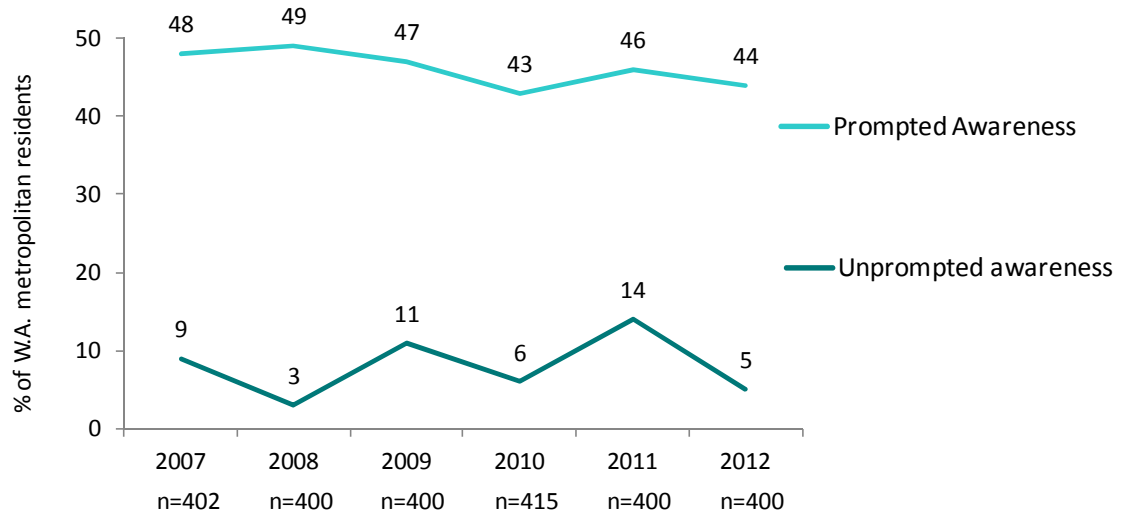



**Figure 16: Awareness of groundwater replenishment.**

## Trust

Trust in the Water Corporation and key stakeholders to regulate groundwater replenishment has been measured since 2009.

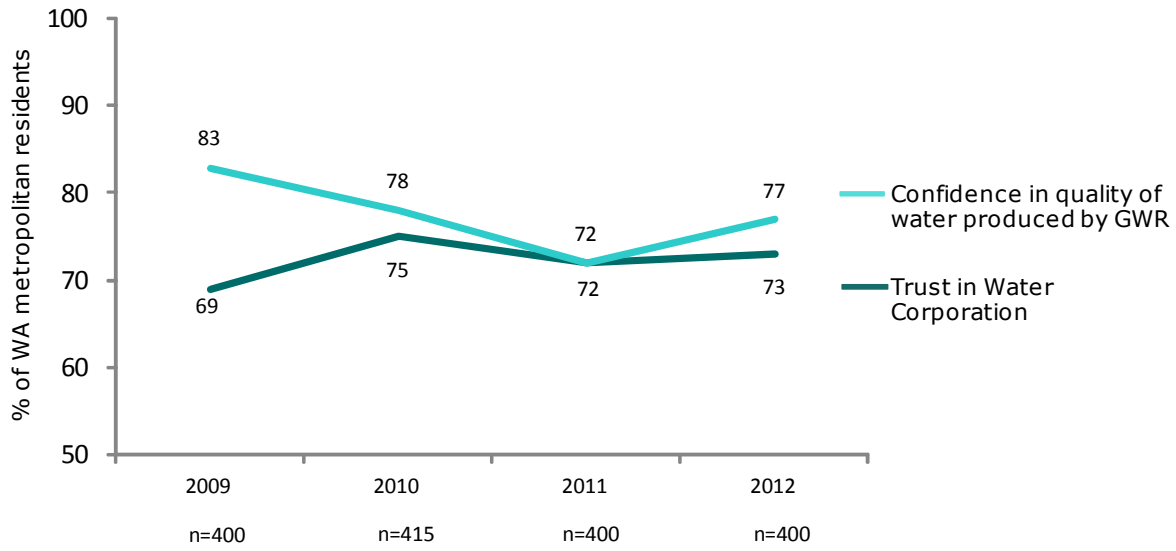



**Figure 17: Trust in Water Corporation to make decisions about the use of water from groundwater replenishment.**

Trust in Water Corporation having the institutional capability to deliver a groundwater replenishment scheme remained steady at between 69 and 75 per cent over the research period, with 73 per cent in the 2012 annual survey (Ipsos, 2012) – representing nearly three quarters of the Western Australian metropolitan population.

Community trust in the quality of water produced by the Trial's treatment process was also steady between 72 and 83 per cent during the research period, with 77 per cent in the 2012 annual survey (Ipsos, 2012).

Trust in the DoH, DoW and DEC to regulate also remained steady. DoH had the highest levels of trust fluctuating between 80 and 82 per cent in the survey period.

## Support

The Annual Community Survey has measured support since 2007. After a short introduction to groundwater replenishment, survey participants were asked *"Based on what you know, would you say you support, oppose or need more information about groundwater replenishment as an additional drinking water source for Perth?".*

The response is referred to as unconditional support and is strongly linked to levels of trust in Water Corporation to safely deliver a groundwater replenishment scheme.

Levels of support, opposition or the number of survey participants who required additional information remained steady from 2008. There was a significant increase in support from 2007 to 2008. Responses have been provided in Table 17.

A supplementary question was introduced in 2009 which was designed to understand how survey participants that would like more information would respond if they assumed the trial was successful. Survey participants were asked *"if the Trial was successful, and recycled water was added to Perth's groundwater, how would you feel about this becoming part of your drinking water supply?".*

In 2009 a supplementary question was introduced *"if the Trial was successful, and recycled water was added to Perth's groundwater, how would you feel about this becoming part of your drinking water supply?".* This question was designed to understand preferences of survey participants who had previously advised that they would like more information. Survey participants were requested to answer yes or no to this question. The response was referred to as conditional support.

In 2012 support increased from 53 per cent to 76 per cent, while opposition increased from 9 per cent to 15 per cent. 9 per cent of participants continued to required more information before making a decision. These trends were representative of previous years. Responses have been provided in Table 17.

**Table 17: Support for Groundwater Replenishment**

| Issue | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| **Unconditional support for groundwater replenishment** | | | | | | |
| Support | 46% | 55% | 55% | 52% | 49% | 53% |
| Opposition | 13% | 12% | 11% | 6% | 11% | 9% |
| Require more information | 41% | 31% | 33% | 42% | 39% | 38% |
| **Conditional support for groundwater replenishment** | | | | | | |
| Support | n/a | n/a | 73% | 70% | 67% | 76% |
| Opposition | n/a | n/a | 19% | 21% | 21% | 15% |
| Require more information | n/a | n/a | 12% | 9% | 8% | 9% |

Note: Data sourced from Ipsos Annual Community Surveys.

Summaries of conditional and unconditional support have been provided in Figure 18.

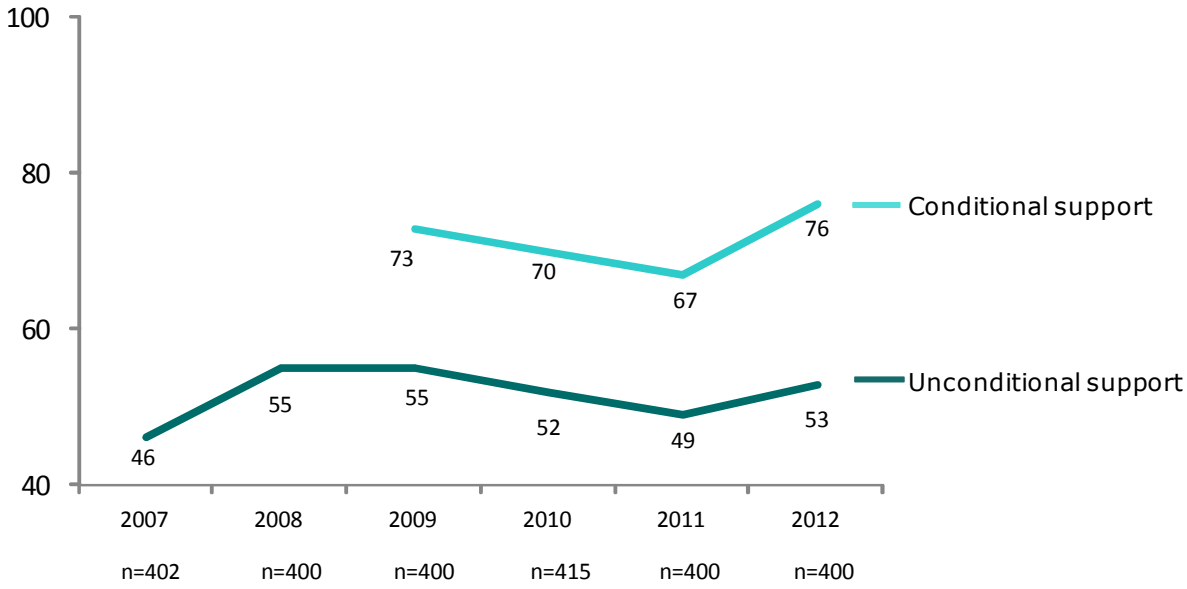



**Figure 18: Community support for groundwater replenishment.**

**Trial Outcome – Annual Community Survey Results:**

Ipsos have advised that results across the survey period (2007 – 2012) were consistent, indicating:

- Prompted awareness of groundwater replenishment has remained steady,44 per cent in the 2012 Annual Community Survey.
- Unprompted awareness is low, 5 per cent in 2012, indicating that it is not 'top of mind' for the community.
- Trust in Water Corporation to deliver a groundwater replenishment scheme remained stable and high.
- Support for a full scale groundwater replenishment scheme also remained stable and unconditional support remained high, 76 per cent in 2012.

#### 8.5.1.2 Visitors Centre Surveys

To track how effective the Visitor Centre was, visitors were asked a series of questions both before they went on a tour and when they had completed the tour to gauge support for groundwater replenishment, trust in Water Corporation and highlight any concerns.

Water Corporation conducted the Visitors Centre Surveys before and after each tour between January 2011 and December 2012, and results were collated quarterly by Ipsos.

Tours enabled community members to see the rigorous treatment process and understand the monitoring in place to ensure that the recycled water consistently and reliably achieved water quality guidelines.

When asked *"How do you feel about the idea adding recycled water to our drinking water supply?"* both before and after the tour, support levels rose significantly (Figure 19).

These results were consistent with previous survey periods and the average of the 2012 Visitors Centre Survey period (93 per cent support after the tour).

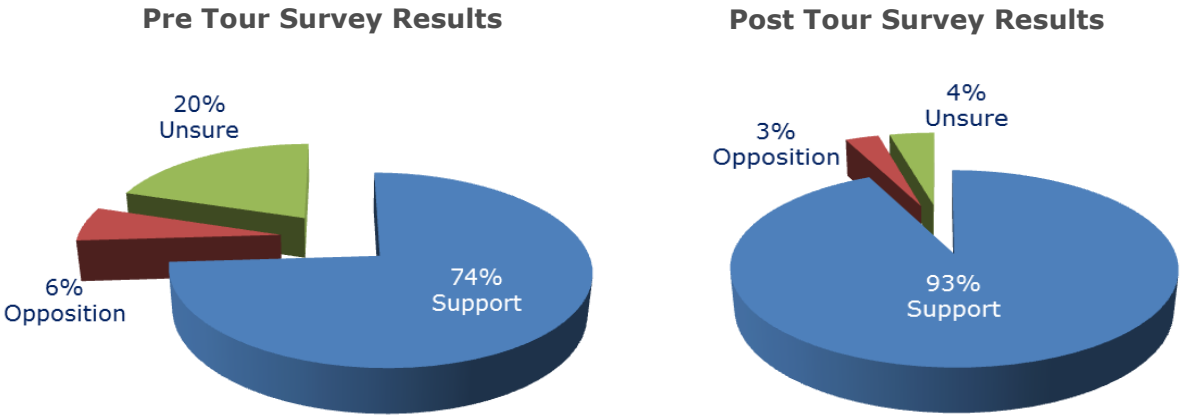



**Figure 19: Visitors centre survey results: October – December 2012.**

The results were extremely positive and supported previous research which indicated that the process of self-exploration based on information, significantly contributed to the positive shift in community support.

#### 8.5.1.3 Community Event Surveys

Community events allowed an exchange of information and discussion between Water Corporation and community members about groundwater replenishment. Following each conversation community members were asked to complete a survey.

Water Corporation conducted the surveys between May 2011 and December 2012, and results were collated by Ipsos.

Figures from these surveys were also very positive with support for groundwater replenishment at over 89 per cent.

#### 8.5.1.4 Pulse Surveys

Three Pulse Surveys were undertaken during the Trial and were moderated by an external market research and data collection company, *Research Panel.* They were short, online surveys which were sent to a panel of more than 40,000 people.

All three Pulse Surveys undertaken indicated community support for a full scale scheme of around 79 per cent.

**Trial Outcome – Quantitative Survey Results:**

- Consistent results were achieved across all quantitative surveying methods AND across the research period (2007 – 2012).
- Support for groundwater replenishment remained steady and high.

### 8.5.2 Qualitative Surveys Outcomes

#### 8.5.2.1 Focus groups

A focus group is a form of qualitative research during which researchers facilitate a robust discussion with a group of people seeking their perceptions, opinions, beliefs and attitudes towards an area of interest – in this case identifying community support or concerns about groundwater replenishment.

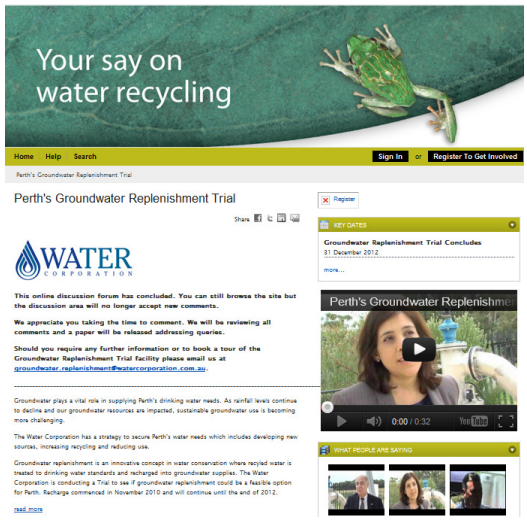
Ipsos ran Focus Groups in 2009 and 2012. The 2009 research primarily tested key messaging, identified rational and emotional barriers to community acceptance and assisted in the development of the overarching communications strategy.

In 2012, the same criteria was applied to identify community concerns and help refine the key messages for the final stage of the Trial and to test community response to the transition to future groundwater replenishment schemes. The outcomes provided recommendations to refine the content, tone and mediums of Water Corporation's communications, in order to maximise a positive response from the general community.

Comments made in the 2012 Focus Groups provided confidence that the potential risk for community outrage when transitioning to operation of groundwater replenishment was low.

#### 8.5.2.2 Online Engagement: Forum – "Your say on water recycling"

Water Corporation engaged consultants *Bang the Table*, to moderate two online forums in 2011 and 2012. The forum titled, *"Your Say on Water Recycling"* provided another mechanism for the community to learn about groundwater replenishment and engage in discussion with others in the community.




Information provided on the forum included general information about the Trial, videos of the treatment process and interview technical experts, frequent asked questions and a library of key project reports.

This style of third party-moderated forum allowed the community to drive the conversation and self-regulate discussion without the direct presence of Water Corporation.

The forum was widely advertised using local newspapers, social media, the Trials' website and flyers. Both forum periods saw a significant amount of traffic to the site as illustrated in the table below.

**Table 18: Number of participants in the online engagement forums**

| | Forum 1 (Oct 2011 – Jan 2012) | Forum 2 (Jul 2012 – Sep 2012) | Period from October 2011 to September 2012(1) |
|---|---|---|---|
| Visitors(2) | 2,220 | 2,450 | 5,807 |
| Site Visits(3) | 7,109 | 4,336 | 18,280 |
| Registered(4) | 66 | 68 | 141 |
| Comments(5) | 43 (22) | 33 (19) | 76 (41) |
| Doc. downloads | 552 | 142 | 1,460 |

(1) Refers to the period from the start of the Forum 1 to the conclusion of the Forum 2. The difference in numbers between Forum 1 and 2 indicates activity on site between forums.
(2) *Visitors* represents the total number of unique visitors to the site
(3) *Site Visits* is the total number of hits on the site, an individual may have viewed the page more than once.
(4) *Registered* are those who signed up and are able to comment and receive alerts when there was new activity on the forum.
(5) Number in brackets indicates the number of individuals who commented. E.g., 43 comments were made by 22 individuals in Forum 1.

Figures for Forum 1 and Forum 2 do not equal those in the final column. This indicates that information was still being accessed after Forums had closed, providing another mechanism for providing information to the community.

Although the forums saw a high volume of visitors to the site, only a relatively small portion commented. This suggests that the majority of people did not feel strongly enough to voice an opinion and were therefore generally comfortable with groundwater replenishment.

Independent administration of the online forum and lack of Water Corporation presence allowed participants to self-regulate the discussion. This enabled Water Corporation to gauge the recurring concerns and provided another mechanism to qualitatively assess support in the community.

Across both the forum periods, the majority of comments raised related to recycled water quality and consideration of other uses of recycled water.

The key comments throughout both forum periods allowed Water Corporation to re-evaluate messaging and ensured communications addressed comments raised.

**Trial Outcome – Qualitative Survey Results:**

- A number of different methods were successfully used to seek people's opinion on groundwater replenishment and identify any issues of concern.
- This information was used to tailor future communications.
- Comments provided in these forums were consistent with comments provided in quantitative surveying methods.

## 8.6 Media Articles and Responses

Media reporting and community response to proposals for recycled drinking water schemes such as groundwater replenishment in South East Queensland was considered in development of the Trial's communication strategy.

Providing regular media statements (see Section 8.4.8) and engaging opinion leaders and decision makers was part of Water Corporation's communications strategy.

To better understand community and media sentiment, Water Corporation engaged *Phillips Group* in 2009 to monitor national media reporting of water recycling schemes, including indirectly drinking recycled water. The analysis of the trends and community response was considered in the review of the Communications Strategy.

Following on, in 2010 when recharge began, 360m (formerly branded as Media Monitor) provided more local media monitoring.

Groundwater replenishment and the Trial maintained a steady presence within the media with 430 media articles during the assessment period. Of these, approximately 60 per cent were of a positive nature. The others were neutral with a small amount being unfavourable. Overall, media response towards groundwater replenishment was favourable or neutral.

Water Corporation's consistent and positive presence within the community was another element contributing to community support and trust.

For a full analysis of media trends throughout the Trial, refer to Appendix E.

**Trial Outcome – Media Articles and Response:**

- Media reporting of Groundwater replenishment was positive (60 per cent) or neutral.
- Water Corporation's consistent and positive presence within the community contributed towards achieving community support and trust.

## 8.7 Responding to Community Feedback

A key component of the Communications Strategy was to involve the community in the discussion about groundwater replenishment, including seeking feedback and actively addressing questions raised.

Through surveying Water Corporation identified the most common questions, therefore barriers to acceptance as:

- Water quality (particularly the risk of harmful chemicals remaining after treatment).
- Alternate uses for recycled water, such as industry and irrigation should be considered first.

Water quality concerns were routinely addressed during tours of the AWRP (Section 8.3.1), in quarterly GWRT Performance Reports (Section 8.4.5) and at a more high level in the Frog Information Packs (Section 8.4.1).

Explaining that the volume of scheme water used in homes was considerably greater than scheme use by industry and irrigation (due to private access to groundwater by industry and irrigators) enabled the community to conclude that groundwater replenishment represented

the best option for water recycling. This information was also provided during tours and in Frog Information Packs.

Often after hearing the level of treatment and scrutiny involved with groundwater replenishment, the question was "Why don't we drink it directly, rather than recharge to the aquifer".

This demonstrated that Water Corporation's active and transparent presence within the community and valuable supporting communications (such as the webpage, information packs, etc.) were effective in alleviating concerns and achieving support for groundwater replenishment.

The flexible nature of the communications strategy employed ensured that messages could be tailored to address key concerns identified through the various feedback mechanisms along the way.

## 8.8 Post-Trial Media Coverage

This Report describes Trial progress and outcomes until 31 December 2012. However, on 17 March 2013, a Western Australian weekly newspaper, *The Sunday Times* published a front page article which generated a substantial amount of interest in the media and social media.

In order to provide a balanced assessment of the Trial, including community response to the coverage, Water Corporation has included this media and the follow on activities in this Report.

*The Sunday Times* article, headlined 'Potty Perth', claimed to have revealed a plan to pump treated wastewater into Perth's water supply and suggested that a Trial had taken place 'quietly'. The newspaper article was supported by articles in their on-line edition *Perth Now*.

A substantial amount of interest was generated following the article including:

- TV coverage via news bulletins on Channel 7, Channel 9 and Channel 10 that evening.
- Social media commentary resulting in more than 300 comments.
- Radio broadcast coverage on 6PR 882, 92.9, MIX 94.5, 96FM, 93.7 Nova.
- Letters to The West Australian editor and Community News the following week.

The provocatively titled article and follow on media was useful to Water Corporation as it resulted in an increased level of awareness within the community (see Section 8.4.8), and a review of the social media commentary and Letter's to the Editor provided Water Corporation with a qualitative assessment of community sentiment.

Water Corporation took the opportunity to survey community attitudes as a result of media coverage. This was achieved in two ways:

1. Leverage off recent market research and conducted a small scale qualitative survey to understand how levels of trust - one of the main barriers to supporting the introduction of a non-traditional water source such as groundwater replenishment – may have been impacted.
2. Undertake a telephone survey asking the same questions as the Annual Community Survey.

The outcomes of these surveys are provided below.

### 8.8.1 Market Research

An independent market research company 'Metrix' is engaged to measure Water Corporation's Customer Performance Index quarterly, assessing customer perceptions of performance as a provider of water and wastewater services.

The CPI is calculated by averaging the mean performance scores (out of 10) across eight pillars; brand, product quality, customer experience, community and customer engagement, environmental responsibility, long term planning, communications, and value for money.

Coincidently the 2013's first quarter Customer Performance Index was conducted in the week before *The Sunday Time* article, providing an opportunity to undertake another unscheduled survey in the week following the media coverage to measure the reach and impact of the new coverage.

Based on a sample size of 108 people, 86 per cent of survey participants were aware of recent media coverage about the State Government considering the use of recycled water in Perth's water supply, indicating a significant penetration. (Note: while this sample size (n=100) is statistically valid, it has maximum error margin of 9.8 per cent. For this reason, the below data was used only to give an indicative representation.)

Table 19 provides a summary of the performance against the key indicators before and after the news coverage.

**Table 19: Key Customer Performance Indicators before and after the March 2013 media coverage**

| Customer Performance Pillars | Before the new release | After the news release |
|---|---|---|
| Brand | 6.9 | 7.1 |
| Product Quality | 7.0 | 7.1 |
| Customer Experience | 6.7 | 7.1 |
| Community & Customer Engagement | 6.5 | 6.6 |
| Environmental Responsibility | 6.5 | 6.5 |
| Long Term Planning | 6.6 | 6.4 |
| Communications | 6.2 | 6.1 |
| Value for Money | 5.8 | 5.8 |
| **Average** | **6.5** | **6.6** |

Metrix advised prior to the survey that the negative news coverage may potentially impact on four pillars – Brand, Communications, Customer/Community Engagement and Long Term Planning.

This survey confirms that although there was wide spread awareness of the coverage across the sample group (86%), there was no change to Water Corporation's performance rating.

### 8.8.2 Additional Community Survey

Ipsos were engaged to undertake an additional Community Survey to gauge changes in awareness, trust and support following the recent media coverage.

The survey was undertaken between 9th and 16th April 2013, approximately three weeks after the main media coverage. The same principles for data collection were followed allowing comparison with previous Annual Community Survey results.

Key measures of awareness, trust and support can be seen in Figure 20 to Figure 22.

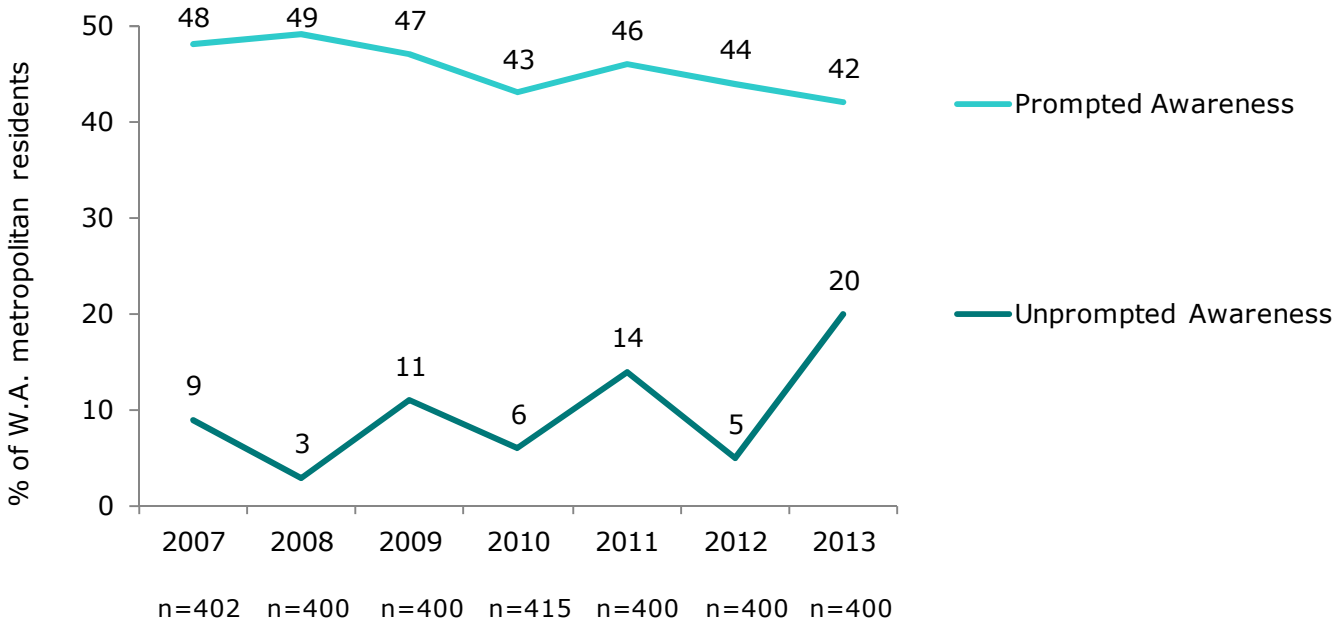



**Figure 20: Awareness of groundwater replenishment after March 2013 media.**

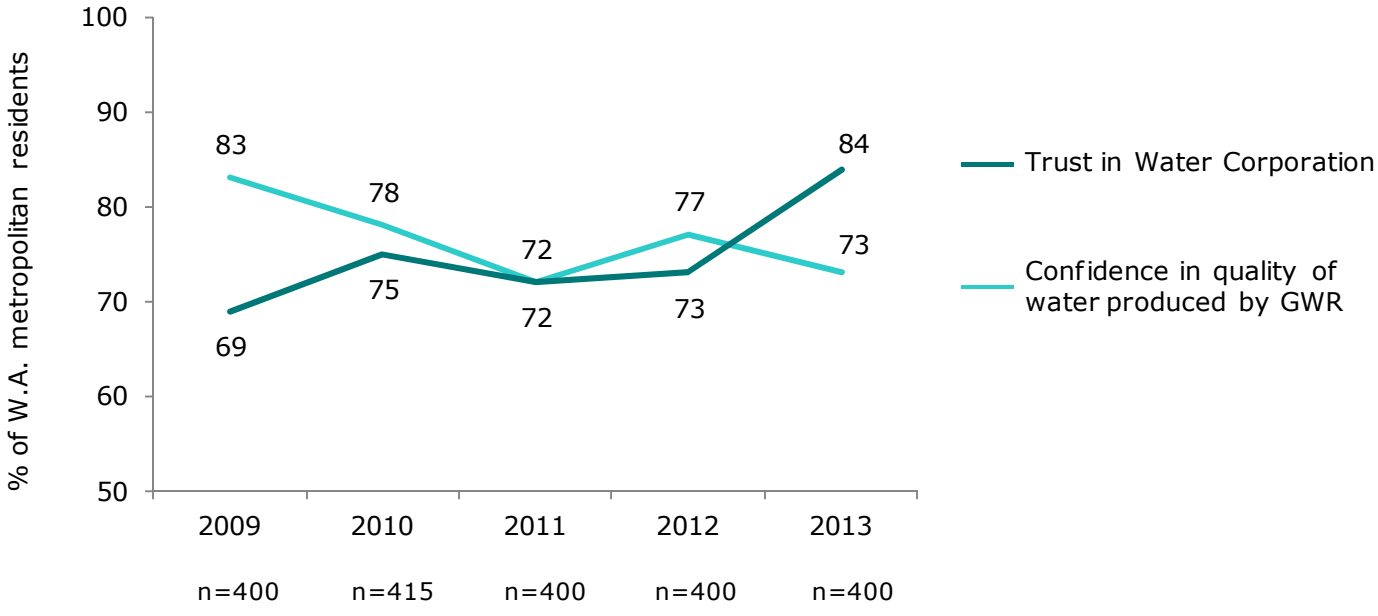



**Figure 21: Trust in Water Corporation after March 2013 media.**

## Support

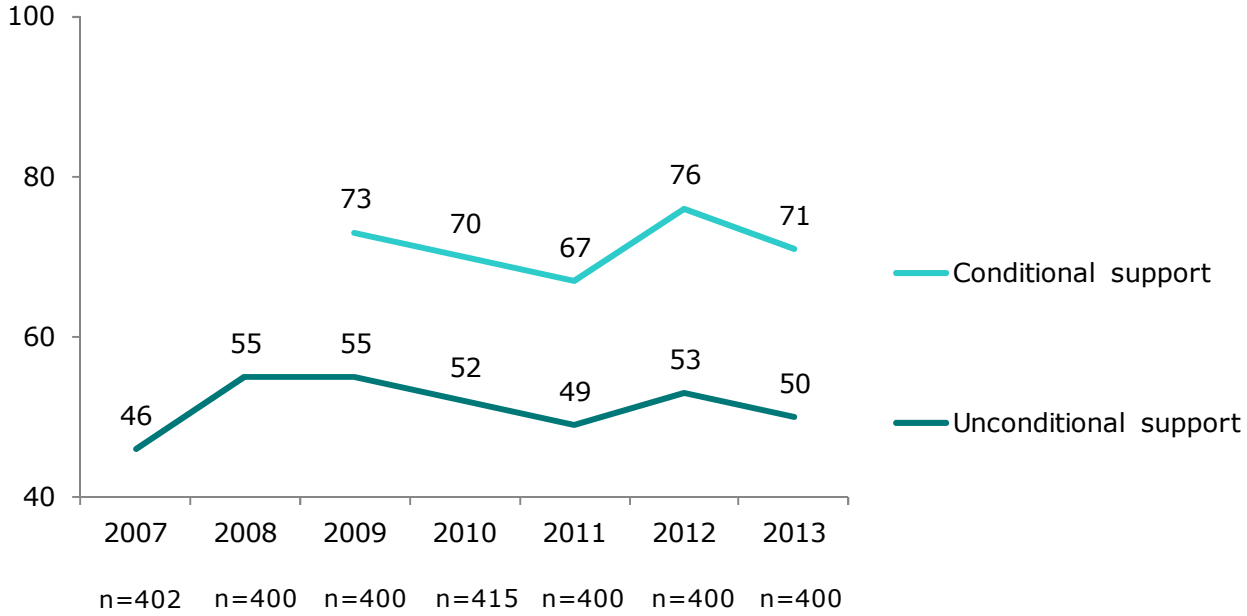



**Figure 22: Support for groundwater replenishment after March 2013 media.**

There were two statistically relevant changes:

- Unprompted awareness, which increased by 15 per cent from 2012, indicating the media coverage had significant and long lasting penetration into the community.
- Trust, which increased 11 per cent from 2012.

Both conditional and unconditional support remaining steady.

# 9 Conclusion and Recommendations

The Groundwater Replenishment Trial was completed on 31 December 2012.

The Trial's Regulators, DoH, DoW and DEC have developed policy and regulation necessary to undertake groundwater replenishment in Western Australia and have determined that groundwater replenishment is a safe and sustainable water source option for the future.

The Trial successfully demonstrated that the treatment process (WWTP and AWRP) can be consistently and reliably operated, in accordance with the management systems and processes, to reliably meet the water quality guidelines, protecting human health and the environmental values of the Leederville aquifer.

The Trial has concluded that the aquifer has responded very well to recharge. Every one of the 58,244 groundwater results collected during the Trial has met the water quality guidelines.

Community support for groundwater replenishment has remained steady, with the most recent survey indicating 76 per cent and continues to be positively received and publicly supported by all sides of politics.

**Water Corporation will be recommending to State Government a transition from the Trial to a large scale groundwater replenishment scheme.**

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# Appendix A:

# Groundwater Replenishment Regulatory Framework

# Groundwater Replenishment Regulatory Framework

December 2012

Prepared by the Groundwater Replenishment Trial Interagency Working Group:

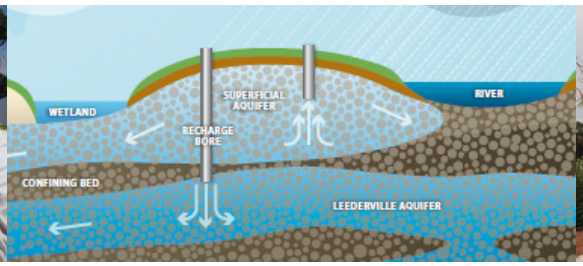
Government of Western Australia Department of Health

Department of Environment and Conservation Our environment, our future

Government of Western Australia Department of Water

and

WATER CORPORATION




# Revision History

| Version | Prepared By | Date Issued | Issued to | Comments Received |
|---|---|---|---|---|
| Final Draft v1 | Adrian Parker, Ruth Dowd, Richard Theobald, Clemencia Rodriguez, Nick Turner, Vanessa Moscovis and Tran Huynh | 05/12/12 | GWRT IAWG | Comments received from Alan Sands, Director Environmental Regulation. |
| Final Draft v1A | Tran Huynh | 10/12/12 | GWRT IAWG and Signatories for endorsement. | |
| | | | | |
| | | | | |

## Status

The Groundwater Replenishment Framework is "Draft" untill all signatories have signed it off for final release.

A "Draft" document should not be used for any purpose other than to be reviewed with the intention of generating a "Final" version

# Table of Contents

# Endorsement

**This document was developed by the Groundwater Replenishment Trial Interagency Working Group which consisted of:**

1. **Department of Health** of 189 Royal Street, East Perth, Western Australia

2. **Department of Environment and Conservation**, of 168 St Georges Terrace, Perth, Western Australia

3. **Department of Water**, of 168 St Georges Terrace, Perth, Western Australia

4. **Water Corporation**, a statutory body corporate established under the Water Corporation Act 1995, of 629 Newcastle Street, Leederville, Western Australia

In endorsing this document, the Department of Health (DoH), Department of Environment and Conservation (DEC), Department of Water (DoW) and the Water Corporation agree to comply with the Groundwater Replenishment Regulatory Framework.

This document will be reviewed by the DoH, DEC, DoW and Water Corporation, five (5) yearly from the commencement date.

**Signed for**
**Department of Health**

Dr Tarun Weeramanthri
Executive Director
Public Health and Clinical Services Division

19th December, 2012
Date

**Signed for**
**Department of Environment and Conservation**

Mr Keiran McNamara
Director General

13 December 2012
Date

**Signed for**
**Department of Water**

Ms Maree De Lacey
Director General

17 December 2012
Date

**Signed for**
**Water Corporation**

Ms Sue Murphy
Chief Executive Officer

17 December 2012
Date

## Definitions

**Advance Water Recycling Plant (AWRP)** is a multi-step treatment process which produces recycled water for the purpose of Groundwater Replenishment.

**ANZECC Guidelines** means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000a).

**Australian Guidelines for Water Recycling (AGWR) Guidelines** means the Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1) (2006), the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Augmentation of Drinking Water Supplies (2008) and the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge (2009) published by the National Health and Medical Research Council.

**Commencement Date** means the date on which the last party signs the GWR Regulatory Framework.

**Drinking Water** means water intended primarily for human consumption, which also has other domestic uses.

**Environmental Values** is the term applied to particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health.

**Groundwater Replenishment** process by which secondary treated wastewater undergoes advanced treatment to produce water which meets Australian guidelines for Drinking Water prior to being recharged to an aquifer for later use as a Drinking Water source.

**Groundwater Replenishment Regulatory Framework** defines the approvals pathway required to develop, approve and provide ongoing regulation for a Groundwater Replenishment Scheme.

**GWR MoU** means the Groundwater Replenishment Memorandum of Understanding between the DoH and the Water Corporation.

**GWRT MoU** means the Groundwater Replenishment Trial Memorandum of Understanding between the Department of Health and the Water Corporation. *The GWRT MoU will be superseded by the GWR MoU*.

**Interagency Working Group (IAWG)** comprising of Departments of Health, Environment and Conservation and Water and the Water Corporation to oversee the Groundwater Replenishment Trial.

**Point of recharge** is where recycled water has met all the critical control points i.e., a step or procedure at which controls can be applied and a hazard can be prevented, eliminated or reduced to acceptable (critical) levels and is ready to be recharged to the aquifer.

**Public Drinking Water Source Areas (PDWSA's)** are underground pollution control areas, water reserves and catchment areas that have been identified as current or future sources of Drinking Water.

**Recharge Management Zone (RMZ)** defines the minimum distance between recharge of recycled water and abstraction of groundwater for public Drinking Water supplies.

**Recycled Water** in the case of GWR is produced by further treatment of secondary treated wastewater by the Advanced Water Recycling Plant (AWRP) to meet Drinking Water quality standards before being recharged into an aquifer.

**Wastewater Catchment** means the wastewater collection system that delivers inflows to wastewater treatment plants.

# 1 Introduction

Groundwater replenishment (GWR) is the process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for Drinking Water prior to being recharged to an aquifer for later use as a Drinking Water source.

The Water Corporation intends on implementing Groundwater Replenishment to provide a public Drinking Water source for Perth, Western Australia.

The Water Corporation has been working with the Department of Health (DoH), Department of Environment and Conservation (DEC), Department of Water (DoW) to assess the viability of Groundwater Replenishment.

# 2 Background

Groundwater Replenishment was initially considered as a viable recycled water option for Western Australia in 2005. Successful GWR Schemes for Drinking Water sources (indirect potable reuse) occurred internationally, however, there was a lack of National and State guidance for the planning, design, commissioning, operation, use and regulation of these schemes.

Under Section 16(e) of the *Environmental Protection Act (1986)*, the Environmental Protection Authority (EPA) advises the Minister for the Environment on strategic environmental matters. Advice provided under Section 16(e) also guides the proponent on the type and extent of further work that will be required for environmental approval.

In 2005 the EPA assessed the potential for Groundwater Replenishment to be conducted in the Perth metropolitan area. The EPA supported further investigation of the approach on a staged basis "*starting with trials and projects of low risk*" (EPA, 2005).

Based on this advice, the Water Corporation developed the Groundwater Replenishment Trial. The DoH, DEC, DoW and the Water Corporation entered into a Groundwater Replenishment Trial Interagency Agreement in March 2007 (IAWG, 2007) and formed the Interagency Working Group (IAWG). The Objectives of this Agreement were to allow:

1. The Water Corporation to conduct the Groundwater Replenishment Trial to assess technical feasibility and gauge community support for Groundwater Replenishment; and
2. The DoH, DEC and DoW to review information from the Water Corporation's Groundwater Replenishment Trial in order to:
    a) Develop a GWR Regulatory Framework.
    b) Inform government policy relating to Groundwater Replenishment, specifically by addressing issues identified by the IAWG in April 2008 (IAWG, 2008).
    c) Assess Groundwater Replenishment as a Drinking Water source for Perth, Western Australia.

By December 2012 the IAWG will have successfully achieved objectives 2a and 2b through the delivery of the GWR Regulatory Framework document and addressed the gaps in Policy and Regulation, which will have informed the GWR Regulatory Framework.

Assessment of Groundwater Replenishment as a Drinking Water source for Perth (Objectives 1 and 2c) will be complete in early 2013.

# 3 Scope of the Document

This document outlines the GWR Regulatory Framework.

It is important to note that Groundwater Replenishment will be used as a Drinking Water source. Therefore this document only addresses the indirect potable reuse of water and does not address any other use for recycled water.

This document is not intended and does not affect any of the statutory responsibilities of the DoH, DEC, DoW or the Water Corporation.

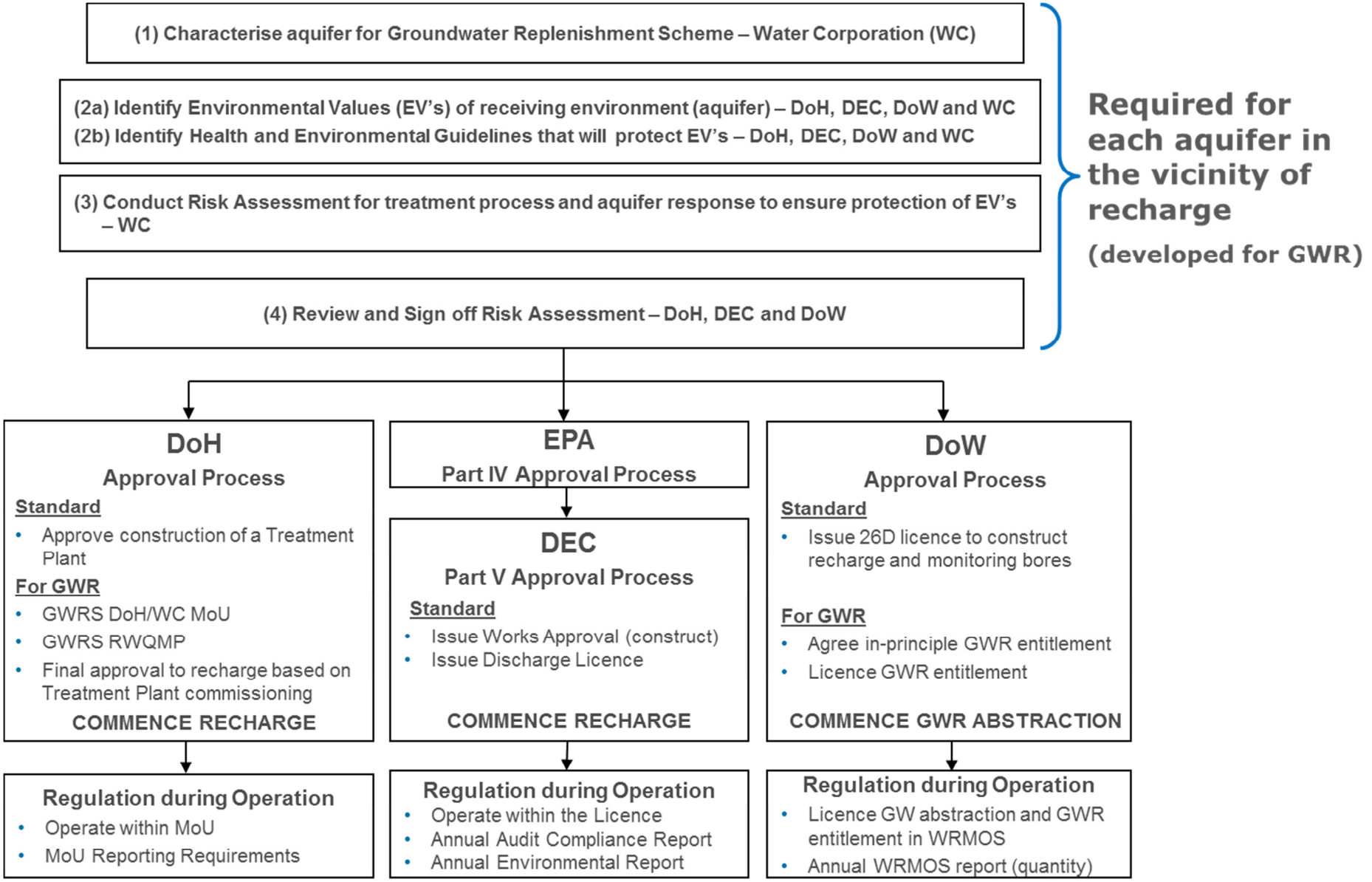
# 4 Purpose of the Regulatory Framework

The GWR Regulatory Framework defines the approvals pathway required to develop, approve commencement of recharge and provide ongoing regulation for a Groundwater Replenishment Scheme.

The GWR Regulatory Framework was developed utilising existing legislation, AGWR Guidelines and ANZECC Guidelines and a directive from the Western Australian Environmental Protection Authority (EPA) to implement a risk-based approach.

Figure 4-1 illustrates the GWR Regulatory Framework.

**Figure 4-1: Groundwater Replenishment Framework**



# 5 Roles and responsibilities

The government agencies that have a role in providing initial assessment, approval and ongoing regulation of a GWR Scheme are as follows:

## 5.1 Department of Health

The DoH is responsible for administering the legislation concerning health regulation in Western Australia under the *Health Act 1911*.

The DoH's role is to:

i. Minimise human exposure to environmental health hazards that pose or have the potential to pose a health risk.
ii. Reduce the incidence and impact of communicable disease.
iii. Guide, assess and approve all water recycling schemes to safeguard public health.

## 5.2 Department of Environment and Conservation

DEC is responsible for administering the legislation concerning environmental regulation in Western Australia under the *Environmental Protection Act 1986* (the EP Act). Under Part V of the EP Act*,* DEC regulates emissions and discharges from prescribed premises.

DEC will consider Groundwater Replenishment under Part V of the *EP Act.*

## 5.3 Department of Water

The DoW manages water quality issues by using powers provided through the *Metropolitan Water Supply, Sewerage and Drainage Act 1909 (WA)* and the *Country Areas Water Supply Act 1947 (WA)* and associated By-laws under these Acts.

The DoW also manages abstraction of groundwater under the *Rights in Water and Irrigation Act (RIWI Act) 1914.*

## 5.4 Water Corporation

The Water Corporation provides water services across Western Australia, under the *Water Corporation Act 1995* and administers the *Water Agencies (Powers) Act 1984.*

The Water Corporation will seek approval for construction and operation of future Groundwater Replenishment Schemes in accordance with this Groundwater Replenishment Regulatory Framework.

# 6 Definition of Recycled Water and Waste

Recycled water is usually treated wastewater which is further treated to varying qualities that is "fit for purpose" for its intended use. In the case of GWR, recycled water is produced by further treatment of secondary treated wastewater by an Advanced Water Recycling Plant (AWRP) to meet Drinking Water quality standards before being recharged into an aquifer.

Current legislation does not adequately define recycled water for the purposes of Groundwater Replenishment. The DoH, DEC, and DoW were required to consider the definition of recycled water produced by an AWRP for the purposes of Groundwater Replenishment as part of the Trial. The definitions are as follows:

**Department of Health**
The DoH considers *recycled water as "sewage" until it is appropriately treated to a level considered to be Drinking Water quality or above. The water passing through the AWRP is sewage up until the point of recharge*.

**Department of Environment and Conservation**
For the purposes of DEC's regulation of the AWRP and Groundwater Replenishment as a prescribed premises category 54, recycled water from the AWRP will always be considered to be treated sewage irrespective of the recycled water quality achieved.

The Trial has demonstrated that DEC is able to effectively manage the recharge of treated sewage from the Beenyup AWRP into the Leederville aquifer, by regulating the AWRP and confirming the specification of recycled water quality prior to it entering the recharge bore, so as to achieve the objectives and purposes of the EP Act.

In relation to the above circumstances, DEC has considered the extent to which 'matter', as referred to in the definition of 'waste' under section 3(1) of the EP Act - being in this case treated sewage (recycled water) arising from the Beenyup AWRP - ought to be regulated under the EP Act. DEC has concluded that recycled water meeting the Drinking Water specification ceases to be 'waste'.

An 'emission' under section 3(1) of the EP Act is defined to include a discharge of waste. Under section 56(1) of the EP Act, an occupier of prescribed premises who, among other things, causes an emission from the premises commits an offence unless having done so in accordance with a licence issued in relation to the premises. In view of DEC's conclusion above, the recharge of recycled water meeting the Drinking Water specification to groundwater does not meet the definition of an emission under the EP Act.

**Department of Water**
The DoW has taken advice from the DoH and consider *recycled water as "sewage" until it is appropriately treated to a level considered to be Drinking Water quality or above. The water passing through the AWRP is*

*sewage up until the point of recharge*. DoW will adopt this definition in the administration of their relevant acts, regulation and by-laws.

# 7 Purpose of the Recharge Management Zone

A Recharge Management Zone (RMZ) defines the minimum distance between recharge of recycled water and abstraction of groundwater for public Drinking Water supplies. It also defines the boundary at which groundwater must meet the water quality guidelines required to protect the identified environmental values. Environmental values are always preserved and the recharged water becomes part of the environment beyond the RMZ boundary.

The IAWG have agreed that a RMZ is a requirement of any GWR Scheme. They have defined that:

- A RMZ should be applied to all Groundwater Replenishment Schemes recharging into the confined aquifers in Perth.
- The RMZ boundary is a radial distance of 250m from the recharge bore for all confined aquifers at the Beenyup site, subject to final assessment of the Yarragadee aquifer.
- The principles for a groundwater monitoring plan within the RMZ. A groundwater monitoring plan should demonstrate protection of the environmental values of the receiving groundwater environment and be derived from the groundwater risk assessment (section 8.1.3).

In addition to defining the RMZ, the DoH, DEC, and DoW were required to consider their Agency's ongoing role in regulating the RMZ as an output of the Trial. This is summarised as follows:

**Department of Health**
DoH will regulate the RMZ within the GWR MoU. The DoH requires that the groundwater quality meets the Recycled Water Quality Parameters and Recycled Water Quality Indicators as defined in the GWR MoU at the RMZ boundary.

**Department of Environment and Conservation**
DEC has an interest in the RMZ in so far as it is the receiving environment for the discharge of treated sewage (recycled water) from the prescribed premises (AWRP).

DEC may require the on-going monitoring of groundwater quality within the RMZ, as part of licencing conditions. This is to ensure that the regulatory controls applied to the prescribed premises are effectively preventing pollution and environmental harm occurring as a result of the discharge of treated sewage (recycled water) and that the environmental values of the groundwater are being protected.

**Department of Water**

DoW have advised that the appropriate mechanism to manage groundwater quality is through the GWR MoU which is administered by the DoH.

The DoW's Operational Policy 1.01 – Managed aquifer recharge in Western Australia (DoW, 2011) makes reference to the establishment of "managed aquifer recharge management zones" (MAR management zones) to facilitate the management of groundwater quality and quantity in the vicinity of MAR schemes. These zones are used as an internal management tool by the DoW to ensure the location of MAR schemes is considered in the processing of other groundwater abstraction licence applications in the area.

The RMZ meets the DoW requirement for this internal management tool and will be mapped on the DoW's geographical information system (GIS) for internal use.

# 8 Groundwater Replenishment Regulatory Framework

The purpose of the GWR Regulatory framework is defined in section 3.

## 8.1 Initial Assessment of a Groundwater Replenishment Scheme

The first four steps of the GWR Regulatory Framework involve collaboration between the DoH, DEC, DoW and Water Corporation to conduct an initial assessment of the GWR scheme prior to entering into each Agency's formal approval process.

This approach was developed for Groundwater Replenishment utilising a risk management approach recommended by the AGWR Guidelines ( (NRMMC-EPHC-AHMC, 2006) (NRMMC-EPHC-NHRMC, 2008) (NRMMC-EPHC- NHRMC, 2009) and the ANZECC Guidelines (ANZECC and ARMCANZ, 2000a). This approach recognises and protects water quality to maintain or enhance an environment which will support an ecosystem or use for public benefit, welfare, safety or health.

The benefits of applying this approach are:

- To gain agreement between the three regulating agencies and the Water Corporation of the values of the receiving groundwater environment.
- To gain agreement between the three regulating agencies and the Water Corporation of the water quality guidelines that will protect the values of the receiving groundwater environment early in the development of the GWR scheme.

- Support the EPA's environmental impact assessment of the proposed GWR Scheme under Part IV for the EP Act 1986[1].

Prior to commencing the Initial Assessment of a Groundwater Replenishment Scheme, the Water Corporation must undertake Planning of a GWR scheme. Planning must consider the scale and location of the scheme and suitability of source water quality and the receiving groundwater environment.

This information can then be used to undertake the initial assessment.

### 8.1.1 Step One: Aquifer Characterisation

This step requires the Water Corporation to characterise the receiving groundwater environment such that appropriate environmental values can be defined.

Information used to characterise the aquifer can be derived from, but is not limited to, existing knowledge of groundwater systems and models that can predict pressure, fate and solute transport. Site investigations may also be carried out to inform this step. The extent of the investigations will depend on the amount of background knowledge that is available to the receiving groundwater environment at the vicinity of recharge.

The Water Corporation will obtain all approvals necessary to undertake site investigations.

Previous experience with the Groundwater Replenishment Trial, subsequent schemes and Table 4.2 in chapter 4 of the Australian Guidelines for Water Recycling: Managed Aquifer Recharge (Phase 2) (NRMMC-EPHC- NHRMC, 2009) will define the key issues to consider at this stage of project development.

### 8.1.2 Step Two: Environmental Values, Management Objectives and Water Quality Guidelines

This step involves:

1. Defining the Environmental Values (EV) for the receiving groundwater environment in the vicinity of recharge.
2. Establishing a set of broad management objectives for the relevant environmental values.
3. Determining appropriate water quality guidelines or criteria.

[1] The Water Corporation will refer all GWR Schemes to the EPA for assessment under Part IV of the EP Act.

**Environmental Values**
'Environmental values' is the term applied to particular values or uses of the environment that are important for a healthy ecosystem or for public benefit, welfare, safety or health. The ANZECC Guidelines recognise six environmental values:

- Aquatic ecosystems
- Primary industries (irrigation and general water uses, stock Drinking Water, aquaculture and human consumers of aquatic foods)
- Recreation and aesthetics
- Drinking water resource
- Industrial water
- Cultural and spiritual value

The DoH, DEC, DoW and Water Corporation will convene to identify the EVs relevant to the receiving groundwater environment.

**Management Objectives**
The environmental management objectives reflect the desired state for EV's identified as relevant to the receiving groundwater environment, such as "maintain for current and future use".

The DoH, DEC, DoW and Water Corporation will convene to identify the management objectives for the relevant EV's.

**Water Quality Guidelines**
Associated with each environmental value are 'guidelines' or 'trigger values' for substances that might potentially impair water quality (e.g. pesticides, metals or nutrients). If these values are exceeded, they may be used to trigger an investigation or initiate a management response. Where two or more agreed environmental values apply to a water body, the more conservative, or stringent, of the associated guidelines should be selected as the water quality guideline.

Determining the EV's and associated water quality guidelines provides a clear pathway for assigning Agency responsibilities where multiple agencies can regulate a GWR Scheme. Water quality guidelines appropriate for the protection of EVs are described in Table 9.1.

**Table 8-1: Water quality guidelines appropriate for the protection of EVs**

| Environmental Value | Water Quality Guideline that will protect the Environmental Value |
|---|---|
| Aquatic Ecosystems | DEC to establish water quality criteria[2] which will be applied with assistance from DoW and DoH. |
| Primary Industries | Given the unrestricted access to potable (drinking) water for the purpose of primary industry, the Drinking Water Resource EV water quality guidelines will be applied. |
| Recreation and Aesthetics | DoH and DEC to establish water quality criteria[2] with assistance from DoW. |
| Drinking Water Resource | *Recycled Water Quality Parameters* and *Recycled Water Quality Indicators* identified by the DoH and defined in the GWR MoU. |
| Industrial Water | Given the unrestricted access to potable (drinking) water for the use in industrial processes, the Drinking Water Resource EV water quality guidelines will be applied. |
| Cultural and spiritual values | No water quality guidelines are provided for this environmental value. Water Corporation to continue to engage with Indigenous stakeholders. |

Representatives from the DoH, DEC, DoW and Water Corporation will convene to identify the water quality guidelines required to protect the relevant EV's.

### 8.1.3 Step Three: Risk Assessment

The Water Corporation will undertake a risk assessment from the wastewater catchment to the boundary of the Recharge Management Zone by applying the process described in the AGWR Guidelines to evaluate whether the GWR Scheme is able to protect the EVs. The risk assessment will consider whether the:

1. Management approaches in wastewater catchments are adequate to mitigate risks to feed quality for the treatment process.
2. Recycled water produced by the treatment process meets the required water quality guidelines at the point of recharge.
3. Potential aquifer risks to ensure that water quality continues to meet the water quality guidelines at the boundary of the Recharge Management Zone.

[2] Water quality guidelines may be derived from existing guidelines where appropriate.

### 8.1.4 Step Four: Agency Evaluation

The Water Corporation will present the GWR Scheme risk assessment to the Agencies, including risk mitigation strategies.

The DoH, DEC and DoW will evaluate and provide written advice regarding the acceptability of the risk assessment process and resultants risks.

## 8.2 Approvals Process

### 8.2.1 Environment Protection Authority

The Environment Protection Authority (EPA) undertakes the environmental impact assessment (EIA) of proposals and schemes referred to it under Part IV of the Environmental Protection Act 1986 (EP Act). EIA is a systematic and orderly evaluation of a proposal and its impact on the environment. This evaluation includes considering ways in which the proposal, if implemented, could avoid or reduce any impact on the environment.

Further details on submitting a proposal can be found on the EPA website.

The Water Corporation will refer a proposal under Part IV of the EP Act for a GWR scheme to the EPA.

The EPA will make its decision on whether or not to assess a GWR Scheme based on the potential impact(s) to the environment. It will advise the Water Corporation and relevant Decision Making Authority (DMA) of its decision on whether or not to assess the GWR Scheme, once all requests for information have been met to the EPA's satisfaction.

If the EPA determines a formal level of assessment, the GWR Scheme project proposal will then be assessed by the EPA under Part IV of the EP Act and managed according to the Ministerial Conditions applied to it. Further approvals will also be required under Part V of the EP Act. If the EPA finds the proposal does not require assessment, the Part V approvals will still be required. Approvals under Part V are administered by the Department of Environment and Conservation.

### 8.2.2 Department of Environment and Conservation

#### 8.2.2.1 Works Approval

To meet the requirements of Part V of the EP Act, Water Corporation is required to undertake any work or construction in relation to an AWRP and GWR scheme (that will cause the premises to become or capable of being a prescribed premises) in accordance with a works approval issued by DEC.

Water Corporation will be required to make an application for a works approval to DEC and provide supporting information to allow DEC to determine whether all necessary measures to protect the environment will be taken to ensure emissions and discharges from the prescribed premises do not present an unacceptable risk.

A key area of interest for DEC will be the treatment processes and process controls including measurement, critical control and feedback systems that will be used to manage the performance of the AWRP and GWR process, to the extent that they impact on recycled water quality and emissions and discharges from the Premises.

DEC assesses works approval applications in accordance with all relevant principles and objectives of the EP Act and will, where a decision is made to issue a works approval, impose conditions on the works approval in accordance with Section 62A of the EP Act, to prevent, control, abate or mitigate pollution or environmental harm.

Following completion of the works authorised by the works approval, Water Corporation will be required to submit a compliance document to DEC. This compliance document is required to verify that the works have been completed in accordance with the conditions of works approval and that commissioning has demonstrated that the AWRP is operating to its design specification. Section 57 (3)(b) of the EP Act, prevents DEC issuing a licence where works have not been completed as per the conditions of a works approval.

#### 8.2.2.2 Licence

Water Corporation will require a licence under Part V of the EP Act to operate an AWRP and GWR scheme. DEC will impose conditions on any licence issued in accordance with Section 62A of the EP Act, to prevent, control, abate or mitigate pollution or environmental harm.

The extent to which DEC may impose conditions on Part V licences for GWR Schemes will depend on the circumstances and facts of each GWR proposal. For most schemes, conditions relating to the specification of the treated sewage (recycled water quality) and monitoring of the receiving groundwater are likely to be appropriate.

### 8.2.3 Department of Health

The following requirements must be addressed by the Water Corporation in gaining approval for a GWR Scheme.

#### 8.2.3.1 Approve construction of a Treatment Plant

According to the *Health Act* 1911, recycled water is considered to be sewage, until such time it appropriately treated to a level considered to be Drinking Water quality or above. Therefore, an Advanced Water Recycling Plant (AWRP) is considered to be an infrastructure

which treats sewage and *requires an application to construct or install an apparatus for the treatment of sewage* in accordance with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*.

#### 8.2.3.2 Memorandum of Understanding

The DoH will enter into a Memorandum of Understanding (MoU) with the Water Corporation to describe requirements for water quality, monitoring, review, notification, compliance and audit. A MoU enables the DoH to assess and scrutinise recycled water quality to ensure protection of public health and the Drinking Water resource.

#### 8.2.3.3 Recycled Water Quality Management Plan

The Recycled Water Quality Management Plan is designed to manage recycled water quality from catchment to tap by incorporating an integrated quality assurance framework. A 12 element risk management framework for the management of recycled water quality describes a process for developing and implementing preventative risk management systems for recycled water use. This management framework is referenced in the AGWR Guidelines.

A GWR Scheme will be managed through the implementation of a Recycled Water Quality Management Plan. The Plan together with details of a monitoring plan for the Scheme must be endorsed by the DoH prior to commencing recharge.

#### 8.2.3.4 Treatment Plant Commissioning

The DoH will review AWRP commissioning data prior to providing final approval to commence recharge.

### 8.2.4 Department of Water

The DoW have developed a new policy, *Operational Policy 1.01 – Managed aquifer recharge in Western Australia* (DoW, 2011) to aid the approval of socially and environmentally acceptable managed Aquifer Recharge (MAR) proposals under the *RIWI Act 1914*. Policy 1.01 was utilised to provide guidance in the development of the following DoW approvals required for a GWR Scheme:

#### 8.2.4.1 26D licence to construct recharge and monitoring bores

Construction of recharge bores will need to be licensed under Section 26D of the *RIWI Act 1914*. The license when issued will contain terms and conditions specific to the construction requirements of the bore. The Water Corporation must apply for a 26D licence prior to commencing construction.

#### 8.2.4.2 In-principle GWR entitlement

As noted in Section 6.2 of the DoW Operational Policy 1.01, *water that is recharged into the natural groundwater system is vested in the Crown (i.e. when the recharge water enters the groundwater*

*system, the proponent does not retain ownership of that water).* Therefore the proponent of a GWR Scheme has the same rights as other licence holders and must apply for a licence to recover the recharge water. Typically, DoW will grant licence entitlement to abstract water to the proponent undertaking recharge operations.

The DoW have granted the Water Corporation a 1:1 recharge and recovery ratio of a GWR Scheme (i.e., 7 GL/yr, Stage 1). An annual licence to recoup GWR recharged water is outlined below.

#### 8.2.4.3 Licence GWR entitlement

The DoW manages annual groundwater abstraction via a five (5) yearly Water Resource Management Operating Strategy (WRMOS) for the Integrated Water Supply Scheme (IWSS) (Water Corporation, 2012). The process by which GWR water is recouped aligns with established operating procedures detailed in the IWSS WRMOS.

Prior to the commencement of each water year, the Water Corporation will submit a 5C application to abstract water that will specify the anticipated groundwater abstraction and proposed location (including GWR water). As the licence will be issued for a limited tenure, an addendum to the IWSS WRMOS will be prepared.

The GWR entitlement of the 5C licence will be based on the forecast recharge for that year. The location of abstraction will be determined in accordance with the operating rules for groundwater abstraction that include the environmental sensitivity principles described in the IWSS WRMOS.

Matters relating to water quality can be submitted as an addendum to the IWSS WRMOS, once the results of the Trial have been analysed against the identified environmental values within the defined management zone and the level of protection achieved.

#### 8.2.4.4 Permission and exemption of By-Laws under the EP Act

The DoW is responsible for protecting Public Drinking Water Source Areas (PDWSA's) under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act 1909.* There is currently no differentiation with regards to recharging into an unconfined or confined PDWSA and therefore, all associated By-laws under the *MWSSD Act 1909* apply.

Specifically, there are two By-laws under *MWSSD Act 1909* that relate to the approval of a GWR Scheme proposal. These By-laws are administered by the DoW, and are as follows;

**By-law 5.4.6**
*In a pollution area or a part of a pollution area, a person shall not dispose of or discharge onto or into the ground, or into any lake, swamp or drain industrial wastes, chemicals, radioactive material, petroleum or petroleum products, polluted water, or refuse unless that person has been granted permission in writing by the Commission to do so.*

**By-law 5.4.7**
*A person shall not discharge into any well or observation well any chemical, industrial waste, treated or untreated sewage, effluent or other matter which in the opinion of the Commission may pollute the underground water.*

Based on the definition of recycled water (section 6), GWR recycled water is not considered to be *polluted water, or refuse* or *untreated sewage, effluent or other matter* pertaining to the above By-laws. The DoW will not require the administration of these Bylaws for the approval of a GWR Scheme. Therefore, the Water Corporation will not be required to seek permission or exemption from these By-laws for a GWR Scheme.

## 8.3 Regulating an Operational Scheme

### 8.3.1 Department of Health

The DoH provides protection of public and the Drinking Water resource by regulating the recycled water quality in a GWR Scheme. This is managed via a GWR MoU (section 8.2.3.2).

The Health Advisory Committee, consisting of the DoH and Water Corporation was established for the GWR Trial and will remain in place after the Trial. The Committee, chaired by the Water Corporation, meets monthly to review treatment performance and recycled water quality to ensure protection of public health and the Drinking Water resource. Both organisations are committed to the ongoing work of this Committee to ensure safe Recycled Water.

### 8.3.2 Department of Environment and Conservation

Water Corporation must manage, operate, monitor, report and undertake any relevant actions in relation to an operational GWR scheme in accordance with the conditions of the EP Act licence. The licence will require Water Corporation to produce an Annual Audit Compliance Report (AACR) that sets out the extent to which licence conditions have been complied with over the previous year and an Annual Environmental Report (AER). The licence will require the AER to include information relating to any complaints and/or incidents at the premises together with a summary of relevant process/operational data, monitoring data and an assessment of monitoring results against any targets or limits in the licence.

DEC will regulate operational GWR Schemes through a series of inspections and audits and by the review and assessment of AACRs, AERs and other submissions that may be required by the licence.

### 8.3.3 Department of Water

The DoW will manage the annual groundwater recharge and abstraction quantities via the IWSS WRMOS. The GWR abstraction will be negotiated annually in addition to a baseline groundwater allocation.

For water accounting purposes, the Water Corporation will add water replenishment volumes to standard monthly and annual reporting. The overall "banked" volume will also be reported. This is the cumulative difference between recharge and abstraction calculated over the life of the scheme.

# 9 Conclusion

The IAWG have developed the GWR Regulatory Framework which defines the initial assessments pathway required to develop, approve commencement of recharge and provide ongoing regulation for a Groundwater Replenishment Scheme.

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# Appendix B:

# Addressing Gaps in Policy and Regulation for Groundwater Replenishment

# Addressing Gaps in Policy and Regulation for Groundwater Replenishment

December 2012

Prepared by the Groundwater Replenishment Trial Interagency Working Group:

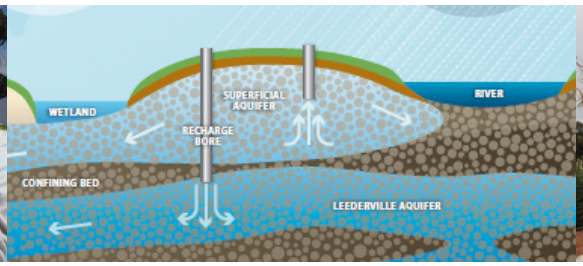
Government of Western Australia Department of Health

Department of Environment and Conservation Our environment, our future

Government of Western Australia Department of Water

and

WATER CORPORATION

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## Revision History

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# Table of Contents

## Definitions

**AWRP** is the Advance Water Recycling Plant that is a multi-step treatment process which produces recycled water for the purpose of Groundwater Replenishment.

**Australian Guidelines for Water Recycling (AGWR) Guidelines** means the Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1) (2006), the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Augmentation of Drinking Water Supplies (2008) and the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge (2009) published by the National Health and Medical Research Council.

**Drinking Water** means water intended primarily for human consumption, which also has other domestic uses.

**Groundwater Replenishment** process by which secondary treated wastewater undergoes advanced treatment to produce water which meets Australian guidelines for Drinking Water prior to being recharged to an aquifer for later use as a Drinking Water source.

**Groundwater Replenishment Regulatory Framework** defines the approvals pathway required to develop, approve and provide ongoing regulation for a Groundwater Replenishment Scheme.

**GWR MoU** means the Groundwater Replenishment Memorandum of Understanding between the DoH and the Water Corporation.

**GWRT MoU** means the Groundwater Replenishment Trial Memorandum of Understanding between the Department of Health and the Water Corporation. *The GWRT MoU will be superseded by the GWR MoU*.

**IAWG** is the Interagency Working Group comprising of Departments of Health, Environment and Conservation and Water and the Water Corporation to oversee the Groundwater Replenishment Trial.

**Point of recharge** is where recycled water has met all the critical control points i.e., a step or procedure at which controls can be applied and a hazard can be prevented, eliminated or reduced to acceptable (critical) levels and is ready to be recharged to the aquifer.

**Public Drinking Water Source Areas** are underground pollution control areas, water reserves and catchment areas that have been identified as current or future sources of Drinking Water.

**RMZ** is the Recharge Management Zone defining the minimum distance between recharge of recycled water and abstraction of groundwater for public Drinking Water supplies.

**Recycled Water** in the case of GWR is produced by further treatment of secondary treated wastewater by the Advanced Water Recycling Plant (AWRP) to meet Drinking Water quality standards before being recharged into an aquifer.

**Wastewater Catchment** means the wastewater collection system that delivers inflows to wastewater treatment plants.

# 1 Introduction

Groundwater replenishment (GWR) is the process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for Drinking Water prior to being recharged to an aquifer for later use as a Drinking Water source.

GWR was initially considered as a viable recycled water option for Western Australia in 2005. Successful GWR Schemes for Drinking Water sources (indirect potable reuse) occurred internationally, however, there was a lack of National and State guidance for the planning, design, commissioning, operation, use and regulation of these schemes.

In 2005 the Environmental Protection Authority (EPA) assessed the potential for Groundwater Replenishment to be conducted in the Perth metropolitan area. The EPA supported further investigation of the approach on a staged basis "*starting with trials and projects of low risk*" (EPA, 2005).

Based on this advice, the Water Corporation developed the Groundwater Replenishment Trial.

The Department of Health (DoH), Department of Environment and Conservation (DEC), Department of Water (DoW) and the Water Corporation entered into a Groundwater Replenishment Trial Interagency Agreement in March 2007 (IAWG, 2007) and formed the Interagency Working Group (IAWG). One of the objectives of the IAWG was for the DoH, DEC and DoW to review information from the Water Corporation's Groundwater Replenishment Trial in order to:

a) Develop a GWR Regulatory Framework.
b) Inform government policy relating to Groundwater Replenishment, specifically by addressing issues identified by the IAWG in April 2008 (IAWG, 2008).
c) Assess Groundwater Replenishment as a Drinking Water source for Perth, Western Australia.

By the end of 2012, the IAWG will have developed the GWR Regulatory Framework which defines the approvals pathway required to develop, approve commencement of recharge and provide ongoing regulation for a GWR Scheme. Appendix 1 illustrates these requirements and further details can be found in the GWR Regulatory Framework document.

The IAWG identified a number of gaps in policy and regulation specific to GWR to be addressed by the GWR Trial. These issues were documented in *"Specific Issues that the Groundwater Replenishment Trial Must Address"* (IAWG, 2008). After development and implementation of an approvals framework for the Trial these gaps were assessed and remaining gaps were identified for progression by the IAWG in *Outputs from "Lessons Learned Workshop"* (IAWG, 2011). A summary of how the identified gaps in policy

specific to GWR have been addressed are described in this report. The outcomes of which has informed the GWR Regulatory Framework.

The DoH, DEC and DoW will provide an assessment of Groundwater Replenishment as a Drinking Water source for Perth in early 2013.

# 2 Department of Health

The DoH identified four main gaps in policy for Groundwater Replenishment:

i. What guidelines should be applied to protect human health and where should they be applied.
ii. What is the approvals process required for a Groundwater Replenishment scheme.
iii. What is the minimum distance and or time between recharge and abstraction.
iv. How will the DoH provide management to the operation of a Groundwater Replenishment scheme?

## 2.1 Health Related Guidelines for Recycled Water Quality

The DoH led a three year research project "Characterising treated wastewater for drinking purposes following reverse osmosis treatment" as part of the Premiers Collaborative Research Program (Buynder, et al., 2009)

The project assessed potential public health risks from pathogenic micro-organisms, chemical contaminants and radioactive compounds in order to define health-related guidelines for recycled water and identify operating and monitoring requirements for the Groundwater Replenishment Trial.

The Recycled Water Quality Parameters (RWQP), Recycled Water Quality Indicators (RWQI) and surrogates that were identified by the research project were further assessed for suitability by the GWR Trial. The DoH advised that all health-related guidelines must be met at the point of recharge.

RWQP are the final water quality parameters and RWQI are chemicals or pathogens that (best) represent a larger group of chemical or microbiological hazards that share similar properties and characteristics and that exist as RWQPs. The RWQP and RWQI are listed in Schedule 1 of the GWR MoU.

The DoH will finalise the RWQP and RWQI for use in Groundwater Replenishment on the Beenyup wastewater catchment upon completion of the Groundwater Replenishment Trial.

## 2.2 Approval of a GWR Scheme

The approvals process developed for the Groundwater Replenishment Trial included providing approval to construct a treatment facility in accordance with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*, establishment of the GWRT MoU (DoH & Water Corporation, 2010), the submission of a Recycled Water Quality Management Plan (Water Corporation, 2010) and staged commissioning for the Advanced Water Recycling Plant (AWRP) in order to demonstrate Drinking Water quality could be achieved at the point of recharge. With these documents in place and commissioning data provided, DoH provided permission to commence recharge.

The DoH approval process developed was found to be effective and will be implemented for future GWR Schemes.

## 2.3 Minimum separation between recharge and abstraction

The DoH required a recharge management zone (RMZ) to define the minimum distance between recharge and abstraction of recycled water to ensure that the groundwater meets the health and environment related guidelines at the boundary of the zone.

The IAWG defined the requirements for a RMZ based on technical advice from the Trial's Groundwater Technical Reference Group. The IAWG agreed that a RMZ is a requirement of any GWR Scheme and defined the following:

- A RMZ should be applied to all Groundwater Replenishment Schemes recharging into the confined aquifers in Perth.
- The RMZ boundary is a radial distance of 250m from the recharge bore for all confined aquifers at the Beenyup site, subject to final assessment of the Yarragadee aquifer.
- The principles for a groundwater monitoring plan within an RMZ. A groundwater monitoring plan should demonstrate protection of the environmental values of the receiving groundwater environment and be derived from the groundwater risk assessment.

The principles of the RMZ will be applied to operational monitoring requirements for a 1.5GL Groundwater Replenishment scheme into the Leederville aquifer at the Beenyup site after the Trial and will be confirmed as part of the approvals process for future proposed GWR Schemes.

## 2.4 Management of GWR

The DoH provides protection of public health and the Drinking Water resource by regulating recycled water quality. This was managed for the Trial via *The Memorandum of Understanding between the Department of Health and the Water Corporation for the Groundwater Replenishment Trial* (DoH & Water Corporation, 2010)

which formalised the relationship between the DoH and the Water Corporation. It described the regulatory approval and operational requirements of the Trial, including the reporting requirements, defined the recycled water quality events and set the communications and audit protocols. Regular communication occurs between Water Corporation and the DoH via a monthly Health Advisory Committee meeting.

The MoU provided an effective mechanism for managing Groundwater Replenishment during the Trial and will be extended to provide management of future Groundwater Replenishment Schemes.

# 3 Department Environment and Conservation

Under the Environmental Protection regulations, a registration or a licence is required for particular prescribed premises such as wastewater treatment plants. Currently no category exists for an AWRP and a specific category for an AWRP needed to be considered for approving a GWR Scheme.

## 3.1 Prescribed Premise

Under Part V of the Environmental Protection Act 1986 (EP Act 1986), DEC regulates industrial facilities that are prescribed in Schedule 1 of the Environmental Protection Regulations 1987 (EP Regulations).

For the purposes of the GWR trial the AWRP was considered to fall within the description of prescribed premises category 54, being premises on which sewage is treated, or from which treated sewage is discharged onto land or into waters.

During the Trial, concerns were raised by the IAWG regarding potential public perception and public acceptability issues for GWR if the AWRP was regulated as a sewage facility.

DEC therefore considered whether to develop a specific prescribed premises category for AWRP and GWR as part of their on-going prescribed premises review.

DEC concluded that as category 54 adequately describes the activities of the AWRP and any change in the prescribed premises category description would not change the scope and content of a works approval or licence conditions, there was insufficient justification for creating an additional prescribed premises category.

All AWRPs and GWR Schemes will therefore be regulated by DEC under prescribed premise category 54.

### 3.2 Definition of Waste

To date, DEC has considered the groundwater recharge of water that meets Drinking Water quality standards to be a discharge of treated sewage and as an emission of waste that should be controlled through the Part V licensing process.

DEC has reviewed its position regarding the status of the recycled water produced by the Beenyup AWRP and recharged to the Leederville aquifer.

The Trial has demonstrated that DEC is able to effectively manage the recharge of treated sewage from the Beenyup AWRP into the Leederville aquifer, by regulating the AWRP and confirming the specification of recycled water quality prior to it entering the recharge bore, so as to achieve the objectives and purposes of the EP Act.

In relation to the above circumstances, DEC has considered the extent to which 'matter', as referred to in the definition of 'waste' under section 3(1) of the EP Act - being in this case treated sewage (recycled water) arising from the Beenyup AWRP - ought to be regulated under the EP Act. DEC has concluded that recycled water meeting the Drinking Water specification ceases to be 'waste'.

## 4 Department of Water

The DoW was required to assess Groundwater Replenishment in order to develop:

i. Policy position for Managed Aquifer Recharge (MAR).
ii. Policy position on recharging recycled water in Public Drinking Water Source Areas.
iii. Recharge entitlements and a licencing process for Groundwater Replenishment.

### 4.1 Policy position for Managed Aquifer Recharge

A new statewide policy was developed by the DoW in 2011 to aid the approval of socially and environmentally acceptable managed Aquifer Recharge (MAR) proposals under the *RIWI Act 1914* (DoW, 2011).

### 4.2 Recharging recycled water in Public Drinking Water Supply Areas

#### 4.2.1 Land Use Compatibility

The *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (MWSSD Act 1909) allows for gazettal of Public Drinking Water Supply Areas (PDWSA). For all gazetted PDWSA's a water source protection plan is developed which identifies source protection areas

(Priority 1, 2 or 3). Acceptable activities within these priority zones are guided by the DoW's Water Quality Protection Note (WQPN) #25 (DoW, 2004).

The *WQPN #25: Land Use Compatibility Table* (DoW, 2004) states that "wastewater injection into the ground" is incompatible in P3 areas of a PDWSA.

However, it also states:

*"there may be special circumstances which may occasionally result in an 'incompatible' land use receiving approval. Where planning decisions result in this outcome it is important for project proponents to have demonstrated an overriding community benefit and that the land use will not increase the risk of contamination to the PDWSA. The DoE[1] expects to have significant, early involvement ...".*

For the purpose of conducting Managed Aquifer Recharge (MAR) for the augmentation of Drinking Water supplies (such as in the case of the GWR Trial) there must be a clear demonstration that the project represents an overriding community benefit, and furthermore that the recharge water is treated to such a high standard that it meets the recycled water quality criteria set within the GWRT MoU. Accordingly, this issue is not considered an impediment to MAR projects and can be readily managed by licensed water service providers, in consultation with the DoW. This has been successfully demonstrated by the Water Corporation in their delivery of the GWR Trial.

Notwithstanding the above, the DoW is currently updating WQPN # 25. This review will include re-considering the compatibility of this land use through the inclusion of appropriate footnotes, expanded definitions and references.

### 4.2.2 MWSSD Act & By-Laws

There are two relevant By-laws under this Act that relate to the approval of GWR Trial proposed in Public Drinking Water Source Areas (PDWSA's). These By-laws are administered by the DoW, and are as follows;

**By-law 5.4.6**
*In a pollution area or a part of a pollution area, a person shall not dispose of or discharge onto or into the ground, or into any lake, swamp or drain industrial wastes, chemicals, radioactive material, petroleum or petroleum products, polluted water, or refuse unless*

[1] At the time of developing WQPN#25, DoE (Department of Environment) were the lead agency responsible for managing Environment and Water Resources in Western Australia.

*that person has been granted permission in writing by the Commission to do so.*

**By-law 5.4.7**
*A person shall not discharge into any well or observation well any chemical, industrial waste, treated or untreated sewage, effluent or other matter which in the opinion of the Commission may pollute the underground water.*

The key issue for proponents to address is water quality as both Bylaws aim to protect the Drinking Water quality of aquifers that are used by public water supply. DoW have the ability to provide permission and exemption of these two bylaws , contingent on the proponent demonstrating their proposal can achieve Drinking Water quality objectives.

The terminology for recycled water produced by the AWRP for GWR had yet to be recognised and therefore considered a by-product of sewage. With recycled water yet to be defined, the Corporation instead committed to conducting the GWR Trial using a risk management approach as outlined in the AGWR Guidelines and sought permission and exemption for By-laws 5.4.6 and 5.4.7 under MWSSD Act 1909 in order to progress the GWR Trial.

DoH have since provided advice on the definition of recycled water (Appendix 2), in which GWR recycled water is not considered to be *polluted water, or refuse* or *untreated sewage, effluent or other matter* pertaining to the above By-laws. The DoW will not require the administration of these Bylaws for the approval of a GWR Scheme.

### 4.2.3 Recharge entitlements and licencing process

The DoW in consultation with the Water Corporation has established a set of operating procedures to manage groundwater allocation and abstraction for the Water Corporations' Integrated Water Supply Scheme (IWSS) utilising the Water Resource Management Operating Strategy (WRMOS) (Water Corporation, 2012).

Prior to the commencement of the 12/13 water year, the DoW and the Corporation negotiated a baseline 120 GL bore abstraction plan for the IWSS. The baseline 5C licence issued will have a tenure of five (5) years. In accordance with the DoW's requirements, the Corporation will aim to achieve a sustainable average baseline abstraction over the five-year 5C licence period that does not exceed 120 GL/yr.

The DoW requires that the Corporation apply the same established operating procedures to recoup allocation from GWR recharged water in addition to the baseline 120GL/yr. Each year, the

Corporation will apply to the DoW for a licence to take water under Section 5C of the RIWI Act 1914. The application will be subject to the standard assessment and approval process of the DoW. The licenced water entitlement will be equivalent to the anticipated recharge for the coming year. To support the application, the Water Corporation must prepare, in consultation with the DoW a proposed bore abstraction plan to recover GWR in keeping with environmental principles described in the IWSS WRMOS.

In a letter from the DoW to the Water Corporation (Appendix 3), the DoW will grant a 1:1 allocation ratio between water recharged and that recovered for the proposed 7GL/yr, 'Stage 1' expansion of GWR at Beenyup subject to approval of the Corporation's hydrogeological investigations. However, as specified in Operational Policy 1.01, the DoW may also allow additional groundwater to be abstracted in the future, where the Corporation can demonstrate the sustainability of such abstraction.

For the GWR Trial, the DoW issued the Corporation with an annual 1.3 GL GWR 5C licence authorising the abstraction of water from existing Leederville aquifer production bores within the Mirrabooka and Gwelup borefields for the 2012/13 water year.

# 5 Interagency Working Group

There were a number of issues which the GWRT IAWG were to answer collectively. These issues are detailed below.

## 5.1 Develop a Regulatory Framework

The GWR Regulatory Framework defines the approvals pathway required to develop, approve commencement of recharge and provide ongoing regulation for a Groundwater Replenishment Scheme.

The GWR Regulatory Framework was developed utilising existing legislation and addressing policy gaps specific to GWR, using AGWR Guidelines and ANZECC Guidelines and a directive from the Western Australian Environmental Protection Authority (EPA) to implement a risk-based approach.

## 5.2 Ongoing interactions of IAWG

The IAWG was developed to progress the objectives of the Groundwater Replenishment Trial Inter Agency Agreement. The IAWG will disband when these objectives have been achieved.

The DoH, DEC, DoW and Water Corporation will reconvene in order to progress the Initial Assessment of a GWR Scheme as outlined in the GWR Regulatory Framework.

### 5.2.1 ERA involvement

The Economic Regulatory Authority (ERA) are responsible for the licensing of water service providers to ensure the delivery of safe water and sets out the conditions by which water and wastewater services operate.

The Water Corporation is increasingly using alliance contracting arrangements (consisting of Water Corporation and private enterprise) to design and construct and in some cases operate the new water source infrastructure. Responsibility for the Operating Licence of such a facility will depend on the type of contract delivered. Discussions between the ERA, Corporation and Alliance contractor (if applicable) will occur to ensure appropriate Operating Licences are in place.

### 5.2.2 Wastewater Catchment Protection

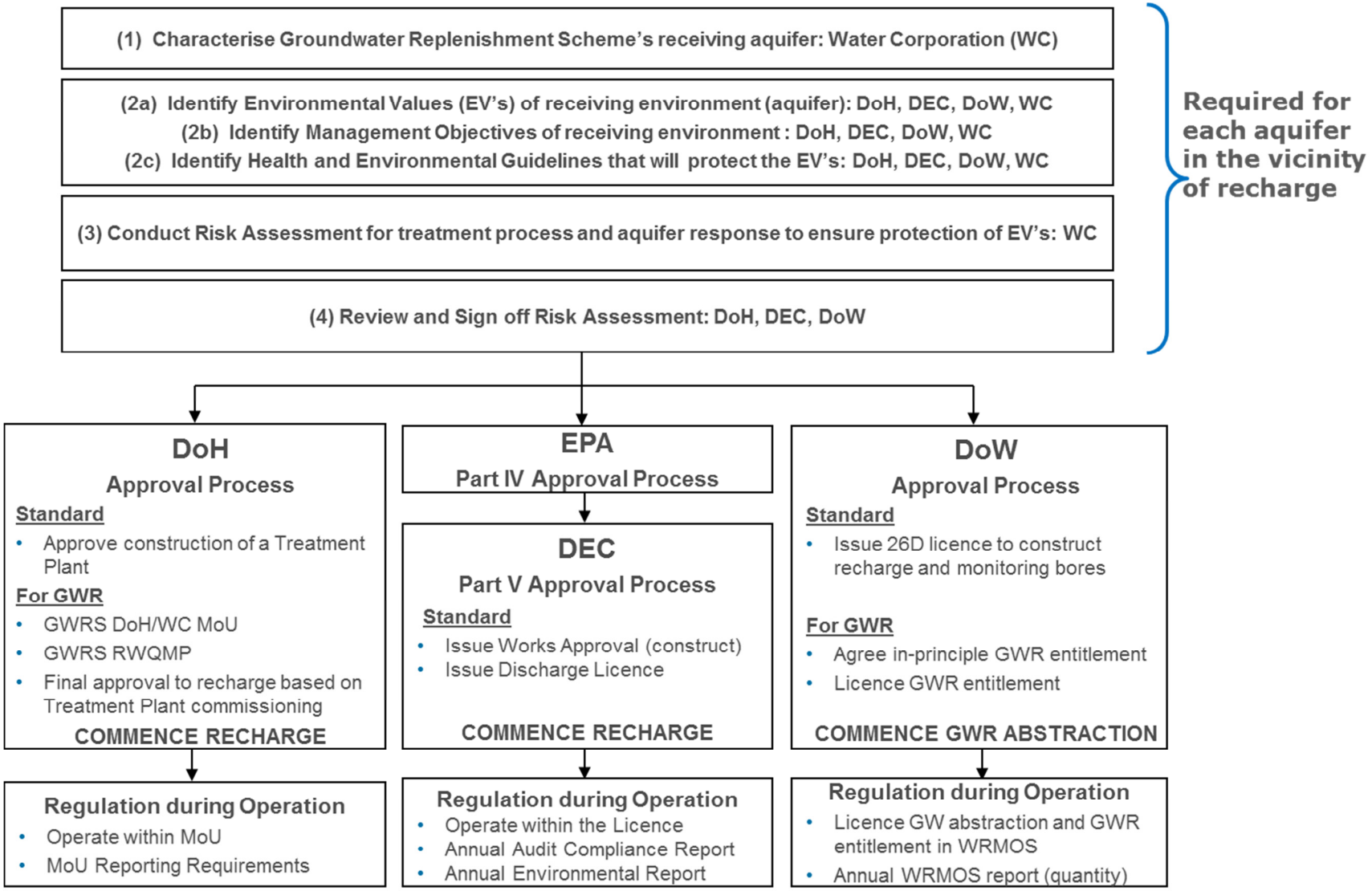
The Water Corporation has systems and procedures in place to manage discharges from commercial and industrial properties. These activities are in place to mitigate risks to the wastewater collection, treatment infrastructure, treatment processes, recycling options, environmental discharges and health and safety of staff and the community.

The Corporation has an appropriate mechanism, via the regular Health Advisory Committee meetings, for raising wastewater catchment issues for discussion with the DoH.

# 6 Conclusion

The IAWG have addressed all the identified gaps in policy specific to GWR. The outcomes of which have been used to inform the GWR Regulatory Framework.

## Appendix 1: Groundwater Replenishment Framework



## Appendix 2: Letter from DoH to DoW defining recycled water from Groundwater Replenishment.

Government of **Western Australia**
Department of **Health**

Your Ref:
Our Ref: EHB-01916
Enquiries: Clemencia Rodriguez (9388 4812)

Mr Adrian Parker
A/Program Manager Recycling and Efficiency
Department of Water
PO Box K822
Perth WA 6842

Dear Mr Parker

**Re: Groundwater Replenishment Trial Water Quality**

I refer to the Inter Agency Working Group Framework Action log dated 27 July 2012. The Department of Water sought advice from the Department of Health (DOH) concerning the quality of water produced by the Beenyup Groundwater Replenishment Trial (GWRT), "at the point of injection".

The DOH is the health regulator for recycled water for the GWRT. Water quality of the GWRT is regulated through a memorandum of understanding for recycled water between the DOH and the Water Corporation.

In accordance with the Health Act 1911 recycled water is considered to be "sewage", until such time as it is appropriately treated to a level considered be drinking water quality or above. As part of the terms and conditions of the trial, recycled water produced by the Beenyup Groundwater Replenishment Trial advanced water treatment plant is required to meet or exceed the quality criteria set for drinking water quality (2004 Australian Drinking Water Quality Guidelines) before being recharged to the Leederville Aquifer. Thus the DOH considers that water passing through the Beenyup advanced water treatment plant is sewage up until the point of injection.

Please note that the advice provided by this Department in correspondence dated 29 November 2011 was in relation to the reuse of secondary treated wastewater in Public Drinking Water Source Areas (surface and unconfined aquifer sources). Recycled water produced in compliance with the Phase 1 Australian Guidelines for Water Recycling: Management Health and Environmental Risks 2006 bears no resemblance to that produced by the Beenyup advanced water treatment plan. Notwithstanding any treatment process Phase 1 compliant recycled water is considered by the DOH to be sewage and shall be treated as such in accordance with the Health Act 1911.

**Environmental Health**
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Grace Vaughan House 227 Stubbs Terrace Shenton Park WA 6008
Telephone (08) 9388 4999 Fax (08) 9388 4955
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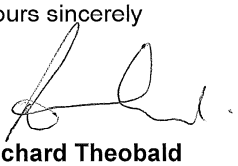
ABN 28 684 750 332

XDHEL024

I trust this information is of assistance to you. If you would like to discuss this matter further please do not hesitate to contact me on 9388 4967.

Yours sincerely



**Richard Theobald**
**MANAGER WATER UNIT**
**PUBLIC HEALTH DIVISION**
9 August 2012

cc Water Corporation

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## Appendix 3: Letter from DoW to Water Corporation providing GWR entitlement

Government of **Western Australia**
Department of **Water**

Your ref: PM#6895829
Our ref: CEOW 297/12
Enquiries: Adrian Parker (6364 7139)

*looking after all our water needs*

Sue Murphy
Chief Executive Officer
Water Corporation
PO Box 100
LEEDERVILLE WA 6100

Dear Sue,

***RECOVERY OF ALLOCATION BENEFIT FOR GROUNDWATER REPLENISHMENT***

Thank you for your letter dated 17 May 2012 advising us of progress on the expansion of the groundwater replenishment (GWR) trial at Beenyup to a full scale operational facility.

The Department of Water (DoW) acknowledges the significance of this key milestone and the importance of confirming the administrative water licensing procedure and the amount of banked water that can be recovered by the project.

As you are aware, this process is guided by the DoW's Operational Policy 1.01 – *Managed aquifer recharge in Western Australia*. The policy establishes broad water quantity and quality considerations, which in response to your request, are clarified below.

The Department has an established set of operating procedures to manage groundwater allocation and abstraction for the integrated water supply system (IWSS). The Department and the Corporation are currently finalising the baseline abstraction plan for the IWSS, and the Department will issue a five year licence for this abstraction. In accordance with the Departments' requirements, the Water Corporation will aim to achieve a sustainable average baseline abstraction over the five year licence period that does not exceed 120GL/yr.

The Department requires that the Corporation apply the same established operating procedures to recoup allocation from GWR recharged water above the baseline 120GL/yr. Each year, and upon application by the Corporation, the Department will issue an annual short term licence for additional allocation delivered by GWR on the anticipated recharge for the coming year. The assessment of this application will require the Department and the Corporation to agree on confined aquifer subareas to be targeted for recoup of 'banked' water each year. Short term groundwater licences will then be issued to reflect the additional allocation made available by GWR.

Subject to the Corporation committing to the above requirements, the Department will grant a 1:1 allocation ratio between water recharged and that recovered for the proposed 7GL/yr, 'Stage 1' expansion of GWR at Beenyup. However, as specified in Operational Policy 1.01, the Department may also allow additional groundwater to be abstracted in the future, where the Corporation can demonstrate the sustainability of such abstraction.

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wa.gov.au

Similarly, we acknowledge that the Water Corporation will be applying for a 1.3GL/yr increase above the 120GL/yr baseline as part of the submission for the 2012/2013 Water Resource and Management Operating Strategy (WRMOS), and that this increase will be granted subject to the Corporation meeting the above requirements.

Matters relating to water quality can be submitted as an addendum to the WRMOS, once the results of the 'trial' phase have been analysed against the identified environmental values within the defined management zone and the level of protection achieved.

The DoW looks forward to working in partnership with the Corporation to progress the expansion of this priority project. Should you require any further assistance in this regard, then please contact Mr Adrian Parker on 6364 7139.

Yours sincerely

Greg Davis
**A/DIRECTOR GENERAL**

14 June 2012

## References


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# Appendix C:

# Regulator Assessment of Groundwater Replenishment

**i: DoH**

**ii: DEC**

**iii: DoW**

Government of **Western Australia**
Department of **Health**

Your ref: CEO462013
Our ref: EHB-01081
Enquiries: Clemencia Rodriguez (9388 4812)

Ms Sue Murphy
Chief Executive Officer
Water Corporation
PO Box 100
LEEDERVILLE 6902 WA

Sue
Dear Ms Murphy

**Approval to continue operation of the 1.5 GL/year – Beenyup Groundwater Replenishment (GWR) scheme**

Thank you for submitting the Beenyup Groundwater Replenishment Trial (GWRT) final report and the independent audit of the GWRT recycled water quality, management and reporting systems conducted by Deloitte Touche Tohmatsu as requested by this Department in January 2013.

The Department of Health (DOH) is satisfied with the operational performance of the treatment process and system management implemented by the Water Corporation for the operation of the GWRT, as formalised through the Memorandum of Understanding (MoU) between the Water Corporation and the DOH in September 2010.

I note that the Water Corporation has implemented the three minor improvement opportunities identified by the independent audit report.

I agree that both the Trial report and the independent audit confirm that the Trial was successful in its aim - to demonstrate that advanced water treatment processes are technically feasible, and manageable from a public health viewpoint. The Trial demonstrated the highest standards of risk management throughout, including extremely intensive monitoring of water quality, with relevant water quality standards being met. The Trial more than adequately protected human health and the environment.

I am pleased to endorse the continued operation of the Beenyup Groundwater Replenishment (GWR) scheme in accordance with the management systems and procedures defined in the GWRT.
I propose that we review and amend the current Memorandum of Understanding. In so doing, I would request the following:

- That regular monitoring using Recycled Water Quality Indicators (RWQI) be conducted for compliance purposes;

- The Water Corporation ensures that nanomaterials research is reviewed as part of the annual risk assessment review for GWRS;

- When validated analytical methods for nanomaterials are available, feed water concentrations to the Advanced Water Recycling Plant and after reverse osmosis treatment are measured, in order to characterise nanomaterial occurrence and removal in the Perth context;

- Section 7.3 "Additional Management and Quality Criteria" of the MoU for Ground Water Replenishment is reviewed to enable the Department of Health to request to the Corporation to include any additional quality criteria based on environmental scan reports, catchment assessment reports, or community perceived risk;

- Chemical parameters for which further method development is required in accordance with Appendix F of the Water Corporation's final report is included in the annual risk assessment review for GWR;

- The above mentioned chemical parameters are reflected in Schedule 1 of an amended MoU; and

- Virus challenge testing is conducted in compliance with the National Recycled Water Guidelines (Phase 2 Augmentation of Drinking Water Supplies) for any replacement ultrafiltration membranes at the current 1.5 GL Advanced Water Recycling Plant (AWRP) or any new /upgraded AWRP.

If the State Government determines that recycled water is a safe, sustainable and reliable drinking water source option for Perth, the DOH will assess any future Groundwater Replenishment (GWR) scheme proposals in accordance with the Interagency Working Group "Groundwater Replenishment Regulatory Framework" document signed by this Department on 19 December 2012.

If you have any questions, please do not hesitate to contact the Water Unit of the Department of Health on (08) 9388 4999.

Yours sincerely

Tarun Weeramanthri

Dr Tarun Weeramanthri
**EXECUTIVE DIRECTOR**
**PUBLIC HEALTH AND CLINICAL SERVICES DIVISION**

20th May 2013

**Cc:** **Department of Water**
**Department of Environment and Conservation**

Government of **Western Australia**
Department of **Environment and Conservation**

Your ref:
Our ref:
Enquiries: Tony Wynne
Phone: 6467 5233
Email: tony.wynne@dec.wa.gov.au

RECEIVED
DATE 28/2/13 BY

Ms Sue Murphy
Chief Executive Officer
Water Corporation
629 Newcastle Street
LEEDERVILLE WA 6007

Dear Ms Murphy

**ASSESSMENT OF THE GROUNDWATER REPLENISHMENT TRIAL**

The Department of Environment and Conservation (DEC) has participated in the Inter Agency Working Group (IAWG) set up to provide oversight of the Water Corporation's Groundwater Replenishment Trial (GWRT).

To fulfill the commitments made by the IAWG, DEC has undertaken an assessment of groundwater replenishment (GWR). As a result of this assessment I can confirm:

- DEC regulated the GWRT through a licence issued under Part V of the *Environmental Protection Act 1986.* This licence set conditions relating to the operation of the Advanced Water Recycling Plant (AWRP) and set limits and targets on the quality of recycled water recharged to the Leederville aquifer.

- Throughout the GWRT and to date, the AWRP has produced recycled water that has met all licence limits and targets.

- The GWRT demonstrated that the Water Corporation's AWRP treatment process and associated management systems and procedures successfully protect the environmental values of the Leederville aquifer. This was evidenced by an extensive monitoring program which confirmed compliance with required water quality guidelines at the point of recharge and throughout a series of 20 monitoring bores within the Leederville aquifer.

- As part of the IAWG DEC committed to producing an approvals framework. This has been successfully achieved with the issue of the Groundwater Replenishment Regulatory Framework which defines the approvals pathway for developing a GWR scheme, approving the commencement of recharge and providing on-going regulation of a GWR scheme.

- DEC is confident that a GWR scheme operated in accordance with the AWRP process, management systems and procedures defined in the GWRT, can adequately protect the identified environmental values of the receiving aquifer.

- DEC will assess any future GWR scheme proposal submitted by the Water Corporation in accordance with the issued Groundwater Replenishment Regulatory Framework.

DEC's assessment of the trial has considered all information provided throughout the GWRT including presentations by the Water Corporation and its consultants, groundwater research and monitoring outcomes, quality management systems and IAWG progress reports together with information received by DEC as a result of our regulation of the AWRP and recharge of recycled water.

A summary report that supports DEC's assessment of the GWRT is being prepared and once approved will be provided to the Water Corporation.

Yours sincerely

Jim Sharp
ACTING DIRECTOR GENERAL

26 February 2013

Government of **Western Australia**
Department of **Water**

*looking after all our water needs*

Your ref:
Our ref: WT2419-04
Enquiries: Adrian Parker 6364 7139

Mark Leathersich
Manager Infrastructure Planning
Water Corporation
PO Box 100
LEEDERVILLE WA 6100

Dear Mr Leathersich,

***EVALUATION OF THE GROUNDWATER REPLENISHMENT TRIAL (GWRT)***

The Department of Water (DoW) chairs the Interagency Working Group (IAWG) and works collaboratively with the Department of Environment and Conservation (DEC), the Department of Health (DoH) and the Water Corporation to provide oversight to the Corporations' Groundwater Replenishment Trial (GWRT).

In December 2012, the IAWG achieved a major milestone with the finalisation of the Groundwater Replenishment (GWR) Regulatory Framework. This framework defines the regulatory approval pathway to develop a GWR scheme, commence recharge and administer its ongoing operation. The Regulatory Framework has been signed and supported by the regulatory agencies, including the DoW Director General.

The DoW's assessment of the trial has considered all information provided throughout the GWRT. To date, the Water Corporation has demonstrated that the advanced water recycling process and associated management systems adequately protect the agreed environmental values of the Leederville aquifer. In accordance with the GWR Regulatory Framework, the licensed abstraction of the recharged water entitlement in the 2012/13 water year has been successfully administered via the water resource management operating strategy (WRMOS) process.

The future staged expansion of the GWRT into a larger scheme, operated in accordance with the existing management systems and procedures established for the GWRT can adequately protect the identified environmental values of the receiving aquifer. The DoW can also advise that it will assess any future scheme expansion proposals for GWR submitted by the Water Corporation in accordance with the procedures specified in the GWR regulatory framework.

Should you require any additional clarification then please contact Adrian Parker on 6364 7139.

Yours sincerely

Paul Brown
**EXECUTIVE DIRECTOR**
**REGIONAL DELIVERY AND REGULATION**

25 March 2013

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## Appendix D:

## GWRT Audit of Management Systems
## By Deloitte, Touche, Tohmatsu.

PM-# 8852665

# Water Corporation

## 2013 Groundwater Replenishment Trial Audit

**March 2013 Report**

Deloitte Touche Tohmatsu
ABN 74 490 121 060

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Mr Rino Trolio
Manager
Wastewater Quality Branch
Water Corporation
37 Lemnos Street
Shenton Park WA 6008

26 March 2013

Dear Rino

**2013 Groundwater Replenishment Trial audit**

We have completed the 2013 Groundwater Replenishment Trial Audit for the Water Corporation for the period 10 November 2010 to 31 December 2012 and are pleased to submit our report to you.

I confirm that this report is an accurate presentation of findings and conclusions from our audit procedures.

If you have any questions or wish to discuss anything raised in the report, please contact Andrew Baldwin on 9365 7236 or me on 9365 7024.

Yours sincerely

Richard Thomas

Richard Thomas
Partner

# Contents

# Executive summary

## Purpose

On 30 September 2010, the Department of Health (**the Department**) and Water Corporation (**the Corporation**) entered into a Memorandum of Understanding (**MoU**) for the Groundwater Replenishment Trial (**GWRT**).

Section 6.4 of the MoU provides for the Department to conduct a performance audit of the Corporation's systems and databases used to manage and report recycled water quality. The report should include recommendations for improvements where appropriate.

The Department commissioned this project to cover the period from 10 November 2010 to 31 December 2012, in line with the period of GWRT.

In accordance with the Audit Objective and Scope Statement[1] accepted by the Director Environmental Health, Department of Health and the Manager, Wastewater Quality Branch (**WWQB**), Water Corporation, this report presents the results and conclusions of the assignment performed by Deloitte on behalf of the Department and the Corporation.

## Terms of reference

The engagement was conducted in accordance with the requirements of the Objective and Scope Statement signed by representatives of the Corporation and the Department on 4 February 2013 as set out below.

Our procedures to address Objective 1 were designed to provide limited assurance as defined in the Australian Standard on Assurance Engagements ASAE 3500 "Performance Engagements", issued by the Australian Auditing and Assurance Standards Board (**the Standard**).

This report sets out the results of our procedures undertaken, including methodology, detailed findings and observations. Our limited assurance report related to Objective 1 is set out in the Independence Assurance Report section of this report.

The procedures conducted to address Objectives 2 and 3 do not provide assurance in accordance with the Standard.

## Context

The Corporation is undertaking GWRT to demonstrate that the use of advanced water treatment processes can deliver a safe, reliable and sustainable water source option that adequately protects human health and the environment.

As part of GWRT, a proportion of treated wastewater from the Corporation's Beenyup Wastewater Treatment Plant (**WWTP**) is diverted to an Advanced Water Recycling Plant (**AWRP**) for an advanced treatment process aimed at purifying the water to drinking water quality. The treated water is then recharged into the groundwater in the Leederville Aquifer at a depth of 120 – 220 metres.

A contamination of groundwater by recharging treated wastewater has the potential to have a significant detrimental impact on the community's confidence in the Corporation's ability to competently manage groundwater replenishment. WWQB's approach is to implement measures that reduce the likelihood of such an event.

[1] Refer to Appendix A

Schedule 1 of the MoU sets out the recycled water quality requirements that the Corporation is required to meet.

Binding Protocols 2, 3 and 4 of the MoU set out the recycled water quality management Protocols and operating manuals that enable the Corporation to demonstrate compliance with Schedule 1 and any additional direction given by the Department.

The principal recycled water quality management operating manuals used by the Corporation during the period subject to audit were:

- *S100 – Standards for Wastewater Monitoring* (latest version dated 2012), which includes standards and guidelines used by the Corporation and reflects the requirements of the MoU
- *S218 – Wastewater Process Control Tables (**PCT**)* (latest version dated 2012), which contains methods of monitoring the Critical Control Points (**CCP**) in the treatment process and their critical operating limits
- *S342 – GWRT Wastewater Sampling Guidelines* (latest version dated 20 December 2010), which includes work guidelines and work instructions used by the Corporation and reflects the requirements of the MoU.

A computerised Wastewater Quality Management System (**WWQMS**) is used by the Corporation to apply the requirements prescribed by S100. WWQMS automates many aspects of recycled water quality management and acts as the central database for all information on recycled water quality including sampling program design, sampling analysis, monitoring and reporting.

The real time information system Supervisory Control and Data Acquisition (**SCADA**) is used to provide automated process control for many process elements within the AWRP. The SCADA system raises alarms when set warning values are exceeded.

# Overall results and observations

For a detailed description of the following scope objectives, please refer to the Objective and Scope Statement at Appendix A of this report. For our conclusion on Objective 1, please refer to the Independence Assurance Report on page 24 of this report.

## Objective 1

**Compliance with MoU and monitoring aquifer after recharge**

Through our examination of key documents, discussions with key stakeholders, examination of WWQMS and SCADA, observations of related processes, procedures and operations, and sample testing (refer to 'Methodology' and 'Detailed findings' sections of this report), we observed that during the period 10 November 2010 to 31 December 2012, the Corporation had established and maintained:

- A RWQ Management Plan, which is designed to interpret and apply the combined requirements of relevant elements of the MoU, Australian Guidelines for Water Recycling, recommendations from the Premiers Collaborative Research Program and any directions by the Department
- Its S100 manual, which is designed to implement the requirements of the MoU and the RWQ Management Plan for establishing and managing sampling programs, sampling activity, monitoring of sampling results and any related remedial activity
- RWQ control systems within the ARWP, including CCPs and their respective operating limits for each treatment train
- Mechanisms for identifying, reporting and managing exceptions to defined operating limits, in accordance with the requirements of the MoU

- Mechanisms for determining:
    - Predicted residence and travel times of groundwater after recharge
    - Characterisation of recharged water for disinfection by-products (DBPs).

Two improvement opportunities are detailed at item 1 (relating to completeness of S100 Standards) and item 3 (related to CCP performance reporting) of the 'Observations and Recommendations' section of this report.

## Objective 2

**Adequacy and effectiveness of WWQMS**

Through our examination and testing of WWQMS and the key components of the Corporation's RWQ management processes, we observed that during the period 10 November 2010 to 31 December 2012, the Corporation appeared to manage and report, as appropriate, on the requirements within:

- S100 (Appendixes C, D and E)
- S342 GWRT Water Sampling Guidelines
- Schedule 2, 3, 4 and 5 of the MOU.

Improvement opportunities identified during our observations in relation to Objective 2 are listed at item 2 of the 'Observations and Recommendations' section of this report.

## Objective 3

**Adequacy and effectiveness of the management framework employed by WWQB**

Through our examination of key documents, discussions with key stakeholders, examination of WWQMS and SCADA, observations of related processes, procedures and operations, and sample testing in relation to the Wastewater Quality Framework, we observed that the Corporation appears to have incorporated effective mechanisms for managing its wastewater quality obligations, including:

- Maintaining a resourced management structure and assigning responsibilities to staff for managing wastewater quality
- Establishing and maintaining processes and procedures that are designed to facilitate its compliance with the requirements of the MoU in relation to recycled water
- A supported WWQMS which is designed to assist the Corporation in meeting its RWQ objectives.

# Methodology

## Phase 1: Consideration of relevant risks

This engagement took into consideration those risks relevant to the Corporation's RWQ management obligations, then focussed on and assessed those activities and management control systems in proportion to the perceived risk relating to the requirements of the MoU and Departmental requirements.

We gained further understanding of the Corporation's compliance requirements for RWQ management via:

- Discussions with key stakeholders, including the Department's Manager, the Corporation's WWQB Manager and relevant staff from WWQB
- A high level assessment of major features and activities of WWQMS, particularly changes to results obtained from laboratory analysis
- Observation of related processes, procedures and operations
- Examination of key documents.

A list of risk events identified, consultation and documents examined is provided at Appendix B.

## Phase 2: Testing and analysis

In conducting our assignment, we:

- Examined relevant documents
- Conducted a site visit to Beenyup AWRP
- Tested the reliability and integrity of BP3 of the MoU
- Examined WWQMS including:
    - Scheduling and conduct of sampling activity
    - Appropriateness of sampling locations
    - Completeness and accuracy of reporting
- Considered the Wastewater Quality Framework, including:
    - Communication between the Corporation and the Department
    - Review of management performance
    - Adequacy of identification and evaluation of RWQ exceptions
    - Timeliness of remedial actions.

For Objective 1 of the Objective and Scope Statement where we are required to reach a conclusion, we performed additional testing and analysis of relevant transactions and activity to examine the appropriateness of systems and procedures in place, plus the level of compliance achieved by the Corporation in relation to RWQ requirements.

## Objective 1

**Compliance with MoU and monitoring aquifer after recharge**

In conducting our work for Objective 1, our procedures were designed to provide limited assurance as defined by ASAE 3500.

To determine the performance of the Corporation against the criteria listed in Objective 1, we:

- Confirmed our understanding of and documented the RWQ management process as it is designed to comply with S100 (Appendixes C, D and E) and Schedule 1 of the MoU
- Examined how this process flows through into performance reporting, particularly in relation to notifiable events
- Performed walk-through and sample testing of key RWQ management activities and control systems
- Established an understanding of the management process involved in determining predicted residence and travel times of recharged water and the process of characterisation of groundwater for DBPs.

## Objective 2

**Adequacy and effectiveness of WWQMS**

We examined the adequacy and effectiveness of the WWQMS to:

- Manage and report on the requirements within S100 (Appendixes C, D and E), S342 and Schedules 2, 3, 4, and 5 of the MoU as appropriate
- Enable the Corporation to monitor compliance with Table 1 of the MoU, as appropriate

Our examination included a consideration of all changes made to sample analysis data within WWQMS during the audit period 10 November 2010 and 31 December 2012.

## Objective 3

**Adequacy and effectiveness of the management framework employed by WWQB**

In examining the adequacy and effectiveness of the Wastewater Quality Framework employed by WWQB, we considered the relevance of the WWQB's structure, plans, operations and protocols to the expectations and requirements of the MoU.

We primarily focussed on the level of competence and understanding of MoU's requirements as displayed by the management and key personnel of the WWQB.

We also specifically examined whether:

- The GWRT management performance has been subjected to continual review
- RWQ exceptions are accurately identified and adequately evaluated
- Remedial action plans are appropriate and timely
- Communication between the Corporation and the Department is adequate.

## Acceptance of scope and methodology

The scope and methodology of this performance audit was agreed in advance by the Director Environmental Health, Department of Health, and the Manager, WWQB, Water Corporation.

## Inherent Limitations

This report has been prepared subject to the following limitations:

- Because of the inherent limitations of any internal control structure, it is possible that errors or irregularities may occur and not be detected. The matters raised in this report are only those which came to our attention during the course of performing our procedures and are not necessarily a comprehensive statement of all the weaknesses that exist or improvements that might be made
- Our work is performed on a sample basis; we cannot, in practice, examine every activity and procedure, nor can we be a substitute for management's responsibility to maintain adequate controls over all levels of operations and their responsibility to prevent and detect irregularities, including fraud
- Any projection of the evaluation of the control procedures to future periods is subject to the risk that the systems may become inadequate because of changes in conditions, or that the degree of compliance with them may deteriorate
- Recommendations and suggestions for improvement should be assessed by management for their full commercial impact before they are implemented
- We believe that the statements made in this report are accurate, but no warranty of completeness, accuracy, or reliability is given in relation to the statements and representations made by, and the information and documentation provided by Water Corporation personnel. We have not attempted to verify these sources independently unless otherwise noted within the report.

# Detailed findings

## Objective 1

**(a) Determine whether RWQ Parameters in Table 1, Schedule 1 of the MoU accurately reflect the requirements specified by the:**

- **S100 Standards for Wastewater Monitoring (Appendixes C, D and E)**
- **Additional directions by the Department.**

S100 Standards define the minimum requirements for monitoring of wastewater quality to enable reporting of plant performance. Appendices C, D & E of the standards relate specifically to GWRT and contain monitoring and sampling requirements for the AWRP and the groundwater monitoring bore field consisting of 22 monitoring bores around the injection bore.

The S100 standards have been reviewed and endorsed by the Department and designed to concur with the RWQ parameters contained in Table 1 of the MoU that also contains guideline values from the Department for each of the listed parameters in recycled water.

Appendix E of S100 contains a listing of RWQ parameters along with prescribed sampling frequencies of those parameters, whilst Appendix D of S100 lists the sampling groups in which the various parameters are grouped for sampling.

Based on our examination of Table 1 of the MoU and Appendix E (GWRT AWRP Operational Sample Suite Parameters) of S100, we determined that with the exception of the following two parameters in Table 1 that could not be located within Appendix E, the RWQ parameters are consistent across the two documents:

- Monobromoacetonitrile
- Chrysene.

Following discussions with the Wastewater Quality Framework Coordinator, we were informed that Monobromoacetonitrile and Chrysene, although monitored for compliance with the Department's guideline values, are not specifically stated in Appendix E. We found these parameters listed in Appendix D (WWQMS Additional Sample Groups for the GWRT) of S100.

The missing parameters in Appendix E are highlighted as an improvement opportunity at item 1 of the 'Observations and recommendations' section of this report.

We note that no additional directions have been issued by the Department during the audit period.

**(b) Determine whether RWQ Management Plan GWRT – October 2010 accurately interprets and applies the requirements of the:**

- **Framework of the Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase1) as published in 2006 (AGWR)**
- **RWQ Parameters in Table 1, Schedule 1 of the MoU**
- **Health recommendations from the PCRP report**

The Corporation's RWQ Management Plan – October 2010 identifies and addresses the requirements for management of the GWRT in order to provide recycled water for recharge that meets all health and environmental water quality requirements.

In assessing the appropriateness and effectiveness of the plan, we considered the criteria provided by the Department within the scope of this performance audit.

*AGWR Framework*

We observed that the Corporation's RWQ Management Plan has incorporated the 12 element framework contained within the AGWR. The 12 elements of the framework are:

1. Commitment
2. Assessment
3. Preventative measures
4. Operational procedures
5. Verification
6. Incident and emergency management
7. Employee training
8. Community involvement
9. Validation R&D
10. Documentation and reporting
11. Evaluation and audit
12. Review and improvement.

The framework in the Phase 1 guidelines also recommends a set of actions within each element. Our testing indicates that the Corporation appears to have accurately interpreted and applied those action plans that are applicable to GWRT.

*RWQ Parameters in Table 1, Schedule 1 of the MoU*

Table 1 of the MoU contains an extensive list of RWQ parameters derived from an elaborate research on recycled water. The table also contains guideline values for each of those parameters to ensure that the recycled water meets the quality requirements for health and environment.

We determined that the requirements of RWQ parameters, as contained in Table 1 of MoU, appear to have been accurately interpreted and applied by the RWQ Management Plan by means of the 12 element framework. In particular, the Plan provides for:

- Regular risk and hazard identification and assessment
- Preventative measures and multiple barriers approach to treating wastewater
- Operational procedures such as S100 Standards, S342 Sampling guidelines and PCTs
- Verification monitoring by sampling at various locations at the plant as well as the bore fields
- An Incident Management System (**IMS**) to identify and respond to incidents early to minimise impact on water quality
- Documentation and regular reporting on performance with respect to RWQ Parameters and RWQ Indicators.

*Health recommendations from the PCRP report*

The PCRP is a comprehensive research project undertaken over a period of three years to determine the feasibility of augmenting drinking water supplies through groundwater replenishment using Membrane Filtration /Reverse Osmosis treatment of wastewater.

The health recommendations from PCRP relate to the validation and verification monitoring program of the GWRT and contain a set of recommendations on achieving those monitoring requirements.

Through our examination of the RWQ Management Plan and discussion with staff, we determined that the Plan appears to accurately interpret and apply the PCRP's health recommendations within one or more elements of the 12 element framework. Specifically, the Plan provides for:

- Monitoring of Treatment Performance Indicators (TPI) and radioactive material during the commissioning verification and validation
- Ongoing research projects to refine the methods of assessment of chemicals
- Documentation and implementation of a comprehensive risk management framework
- Online monitoring of operational performance of GWRT treatment trains using surrogate parameters with appropriate critical and operational limits
- Water sample analysis to be conducted by NATA accredited laboratories in accordance with Australian Standards
- Scheduled reviewing and reporting of performance to the Department
- Community and stakeholder engagement in communication and consultation strategy.

**(c) Determine whether the Beenyup AWRP PCT has identified CCPs for each treatment train, with operating limits specified and endorsed by the Department and where monitoring exceeds specified limits, appropriate response actions have been undertaken and exceptions appropriately documented and reported in accordance with BP 4 of the MoU**

In examining the AWRP CCPs and their operating limits, the appropriateness of response actions and reporting of incidents, we considered the AWRP's structure, operations, monitoring process and the reporting and communication requirements of BP4 of the MoU.

*CCPs and their operating limits*

Through discussions with relevant staff and performing a walkthrough of the AWRP treatment process we determined that the AWRP is comprised of the following three main treatment trains:

1. Ultra-Filtration
2. Reverse Osmosis
3. Ultra-violet Disinfection Unit.

Activities or processes to prevent or reduce the risk of hazards, being the CCPs, are embedded within each treatment barrier. Performance of a CCP is measured by a surrogate that indicates the integrity of each treatment barrier, for instance, conductivity monitoring of RO permeate is a surrogate for RO membrane integrity.

We identified a total of 13 CCPs incorporated within the GWRT treatment process that are supported by 56 sub-processes referred to as Process Control Points (PCP).

The PCT contains the operating criteria (Target Criteria, Alert limit and Violation limit) for each CCP and PCP for the GWRT scheme.

To assess the appropriateness of the CCPs and their operating limits, we queried the source or relevant authority underlying the decision to incorporate those CCPs and operating limits.

We noted that CCPs and their operating limits have been:

- Endorsed by the Department in the PCT
- Prescribed by the manufacturers of the AWRP equipment to keep the plant functioning at an efficient level without abnormal wear and tear that may cause the equipment to malfunction or underperform.

In addition, we were informed that:

- The design of AWRP's CCP structure is based on an internationally recognised design of similar wastewater treatment plants, especially the New Water Plant at Singapore and the Queensland Wastewater Plant
- The Water 2 Water Alliance (**W2WA**) was selected for the delivery of the detail design, construction and commissioning of the GWRT Plant
- Inter Agency Working Group (**IAWG**) has confirmed the capability of the detail design to be adequate to address the risks to human health and GWRT's Environmental Values as identified in the associated Risk Assessment Report
- Validity of the CCPs and their operating limits was confirmed by a formal review conducted by MWH Global with input from technical experts from the Corporation and GWRT technical peer reviewer, Ian Law (IBL Solutions)
- The approach taken to develop the treatment train aligns with both the Australian Drinking Water Guidelines (**ADWG**) and the AGWR
- Treatment trains and CCPs have been designed and constructed in accordance with the Hazard Analysis and Critical Control Points (**HACCP**) philosophy, which we understand has been a leading platform for international legislation and good manufacturing processes for the food industry.

*Incidents and Reporting*

Through our observations and discussions with relevant staff, we determined that:

- All AWRP CCPs are continuously monitored on-line via SCADA system
- If the operating limits of any CCP is exceeded, an automated corrective action is initiated and the treatment train shuts down to prevent recycled water proceeding to the next treatment barrier. The process shutdown is referred to as an incident.

To assess the appropriateness of response actions to incidents and the consequent documentation and reporting of incidents, we:

- Examined the Corporation's IMS and the BP4 of the MoU that specifies the requirements for reporting an incident as Level 1 (significant) or Level 2 (minor)
- Considered the Monthly Governance Reports, prepared by the WWQB's Scientific Officer, and the Monthly AWRP Performance Reports, prepared by the AWRP's Process Technical Officer (**PTO**), to identify the number of incidents that had occurred during the audit period
- Compared the two sets of reports to determine the degree of accuracy in the number of incidents reported during the audit period.

We observed that Daily and Weekly AWRP Performance Reports are generated by the PTO and emailed to the Scientific Officer and other relevant staff at WWQB. These reports are used by the Scientific Officer to compile the monthly Governance reports for presentation to the Department in the monthly Health Advisory Committee (HAC) meetings.

The Monthly AWRP Performance Reports contain the same data from relevant Daily and Weekly reports and are presented to internal managers at the Monthly AWRP Performance Review meetings. We observed, however, minor variances between the AWRP Performance Reports and the Governance Reports for four months. The inconsistency between the two reports is detailed as an improvement opportunity at item 3 of the 'Observations and Recommendations' section of this report.

Based on our testing and analysis, we noted a total of 10 incidents relating to CCP performance during the audit period. Of these, two incidents were reported as Level 1 events and eight as Level 2 events.

We tracked each of the incidents to the Corporation's IMS and determined that the incidents appear to have been documented and reported in accordance with BP4 of the MoU.

**(d) Determine whether there are procedures in place to confirm that water injected into the groundwater aquifer has complied with the RWQ parameters specified in Table 1, Schedule 1 of the MoU and that any exception has been appropriately documented and reported in accordance with the MoU**

In assessing compliance of the Corporation's injected recycled water with the RWQ parameters in Table 1 of the MoU, and the appropriateness of documentation and reporting of exceptions, we examined the Corporation's Wastewater Quality Framework incorporating the 12 elements (mentioned earlier in this report). In particular, we considered the Corporation's:

- Operational procedures and processes to manage recycled water quality
- Preventative measures comprising treatment barriers, source protection and CCPs
- Verification monitoring and reporting
- IMS
- Overall documentation and reporting.

Our observations and testing indicate that the Wastewater Quality Framework appears to be working effectively in monitoring RWQ parameters, identifying violations and reporting them as required by the MoU.

Specifically, we observed that:

- All RWQ parameters contained in Table 1 of MoU have been organised into two separate sampling groups for the Plant and the Groundwater bores via WWQMS. The sampling programs are renewed on a quarterly basis by the Corporation's Scientific Officer
- Sampling activity is undertaken at seven stages within the AWRP treatment process. Most importantly, sampling is undertaken for:
    - Treated water prior to being injected into the aquifer
    - Groundwater subsequent to recharging treated water into the aquifer.
- Missed samples are tracked via WWQMS and reported via the monthly governance reports that are presented to the Department in the monthly HAC meetings along with the more detailed Water Quality Reports

- Violations are tracked and identified as Level 1 or Level 2 as per the Corporation's IMS and reported according to BP4 of the MoU
- During the audit period, two Level 1 events occurred that were identified by the sampling monitoring process and reported according to BP4 of the MoU
- All the parameters are tested for both the Plant as well as the Groundwater bores at least once a year, in addition to the regular sampling activity scheduled as per the sampling programs
- Parallel to monitoring by sampling activity, monitoring also occurs by means of CCPs (such as turbidity and conductivity) and PCPs built within the three treatment trains in the plant. The operating limits of CCPs and PCPs have been endorsed by the Department and specified within the PCT tables. The CCPs work to ensure that the equipment and treatment processes are functioning effectively in maintaining the quality of recycled water per the requirements of RWQ parameters in Table 1 of the MoU:
    - Any exceedances in CCP values beyond the specified operating limits initiates an automated corrective action that shuts down the treatment train to prevent recycled water proceeding to the next treatment barrier
    - Any exceedances in PCP values beyond the specified operating limits create an alert on the SCADA monitoring screen to notify the plant operators of a potential issue that may require remedial action
    - During the audit period, two Level 1 events and one Level 2 event occurred which were identified by CCP monitoring process and reported according to BP4 of the MoU
    - One of the reported Level 1 events related to a breach of the pH parameter levels prescribed in Table 1 of the MoU, where around 300 kilolitres of recycled water with a higher than prescribed pH value was recharged into the aquifer on 29 March 2012. The breach was reported to the Department within 24 hours in accordance with BP4 of the MoU. At the 31 May 2012 HAC meeting, the Department concluded that the event was a minor event, with no significant drinking water health impacts. The Department also accepted a continuance of the recharge after control systems were modified to the Department's satisfaction to prevent a recurrence of the breach.

**(e) Determine whether mechanisms have been established and documented to accurately determine and document predicted residence and travel times in the aquifer**

To assess the accuracy of the predicted residence and travel times of recharged water within the aquifer, as determined and documented by the Corporation, we:

- Examined the relevant documentation prepared by the Corporation, in particular, the:
    - Annual Groundwater Reports
    - Technical Reference Group (**TRG**) reports
- Held discussions with the Corporation's Water Source Strategy Officer to understand the approach and techniques used in predictions.

Based on our discussions and examination of documentation, we observed that:

- Predictions of residence and travel times have been established by **TRG** consisting of groundwater experts from CSIRO, Curtin University, Department of Water, Rockwater Hydrogeological Consultants and the Corporation

- Members of the TRG are recognised as experts in their fields and appear to be suitably qualified to address travel and residence times in groundwater systems
- The distance and travel times are determined by testing the temperature and conductivity of groundwater through 22 monitoring bores drilled at five different sites at a range of distances and depths from the recharge bore
- A hydrogeological model was constructed, namely the Perth Region Aquifer Modelling System (PRAMSOL3.4R), to investigate the residence and travel times of recharged groundwater. The model has been further improved into a solute transport version maintaining all the flow characteristics of the original model version to accurately measure flow characteristics, while providing water transport capability
- The TRG meets on a frequent basis to review and provide continuing technical assistance in assessing the predicted residence and travel times. Any recommendations raised during the meeting are discussed and implemented by the Corporation.

**(f) Determine whether mechanisms have been established and documented to characterise the groundwater after recharge to identify any formation of DBPs**

Characterisation of groundwater for DBP involves monitoring the aquifer environment, which includes not only groundwater but also salts, clay and other materials in the aquifer.

To determine the adequacy of characterisation of groundwater for DBPs, we:

- Examined relevant documentation prepared by the Corporation, including the:
    - Baseline Report, which contains baseline values of DBPs in groundwater
    - Annual Groundwater Reports for 2011 and 2012
    - TRG reports.
- Held discussions with the Corporation's Water Source Strategy Officer to understand the characterisation process.

Based on our discussions and analysis, we understand that:

- Prior to the GWRT's commissioning exercise, a study was undertaken to determine the baseline values of DBPs in the aquifer, which are contained in Table 14 of the Appendix in Baseline Groundwater Quality Results Report
- From the start of GWRT, the Water Source Strategy Officer has maintained a detailed tracking spreadsheet that is continually updated for DBP values obtained from sampling of groundwater bores. The data forms the basis of a trend analysis for review
- The trend analysis incorporating the latest DBP values is reviewed in the monthly TRG meetings attended by recognised groundwater experts from CSIRO, Curtin University, Department of Water, Rockwater Hydrogeological Consultants and the Corporation
- Following the TRG meeting, a report is prepared and presented to the IAWG
- Any unusual findings are flagged within the monthly operational meetings to ensure a prompt remedial action, if required.

Based on our testing and analysis, we observed that DBPs are included in the sampling groups for groundwater bores, contained in Table B29 of S100 Standards.

Additionally, DBPs are also included in sampling groups for treated water prior to recharge. Violations and missed samples are investigated and reported in the monthly Governance reports that are discussed at the monthly HAC meetings with the Department.

# Objective 2

**Assess the adequacy and effectiveness of the WWQMS to manage and report on the requirements within S100 (Appendices C, D and E), S342 GWRT Wastewater Sampling Guidelines and Schedule 2, 3, 4 and 5 of the MoU, as appropriate.**

WWQMS is the management system used by WWQB to apply and manage the requirements prescribed by S100 Standards and S342 Sampling Guidelines.

WWQMS automates many aspects of recycled water quality management as prescribed by S100 and acts as the central database for all information on recycled water quality including sampling program design, sampling analysis, monitoring and reporting.

A number of controls and exception reports generated by WWQMS serve to further strengthen the Corporation's recycled water quality management processes. No change can be made without authorisation by means of Change Request forms.

In assessing the adequacy and effectiveness of WWQMS, we:

- Conducted tests of lab results entered in WWQMS
- Examined Missed Samples Report to determine compliance with sampling frequency requirements and noted the reasons for any missed samples
- Examined Violations Report for the audit period to determine the identification and reporting of incidents
- Viewed email correspondence for alerts and violations between WWQB staff and with the laboratory.

To determine the appropriateness of sampling locations, programs and frequencies incorporated within WWQMS, we queried the underlying source or authority for selecting those specific locations, programs and frequencies. Acceptable explanations were given for all issues we raised.

**Key results and observations:**

Through our examination and testing of WWQMS as above and the key components of the Corporation's GWRT management processes as described at Objective 1 above, we observed that during the period 10 November 2010 to 31 December 2012, the Corporation appears to have managed and reported on the requirements within S100 Standards, S342 GWRT Wastewater Sampling Guidelines and Schedule 2, 3, 4 and 5 of the MoU, as appropriate.

Our observations indicated that the Corporation appears to have:

- Selected appropriate sampling locations and frequencies, based on extensive research and testing in collaboration with CSIRO and PCRP
- Developed appropriate sampling programs in WWQMS in accordance with Appendix D of S100 Standards that incorporate all RWQ parameters contained in Table 1 of the MoU
- Established appropriate violation and alert limits in WWQMS for RWQ parameters and indicators
- Conducted sampling in accordance with the sampling programs and frequencies and investigated and documented the reasons for missed samples within WWQMS
- Appropriately identified and reported violation incidents to the Department in accordance with BP4 of the MoU

- Engaged NATA accredited laboratories for analysing all regulatory samples
- Established appropriate accreditation requirements for all staff involved in sampling.

We note that presently no requirements have been specified within Schedule 2, 3, 4 and 5 of the MoU.

During our observations, we identified improvement opportunities in relation to:

- Violation limit in WWQMS for *Chloroacetic acid*
- Review of violation reports.

The improvement opportunities together with recommendations are listed at item 2 in the 'Observations and Recommendations' section of this report.

# Objective 3

**Assess the adequacy and effectiveness of the management framework -'Wastewater Quality Framework' employed by the Corporation's WWQB.**

In examining the adequacy and effectiveness of the management framework employed by WWQB, we considered the relevance of the WWQB's structure, plans, operations, communication and protocols to the expectations and requirements of the Department as contained in the MoU.

We also focussed on the level of competence displayed by the management and key personnel of the WWQB and the technical staff at the AWRP.

**Key results and observations:**

Through observation and discussion with key staff, we observed that:

- The Corporation's Wastewater Quality Framework as contained in the RWQ Management Plan provides:
    - Key information on how the Corporation implements the AGWR Framework, using the 12 elements of the Wastewater Quality Framework as the foundation
    - Guiding principles for the Corporation's management of Recycled Water Quality, including the manner in which the Corporation:
        - Applies a risk prevention approach to recycled water quality management
        - Works with the Department to achieve the quality standards for treated recycled water on a continuing basis
- Recycled water quality exception results requiring notification to the Department are also notified to responsible line managers, including General Managers, via email notifications and monthly Governance reports, facilitating their evaluation and timely resolution
- The Corporation and the Department communicate on a regular basis.

We also observed a number of initiatives in place to continue to enhance the Corporation's recycled water quality management efforts, including:

- Ongoing commitment to the responsible use of recycled water and management of the GWRT, which is demonstrated by the Corporation's Wastewater Quality Policy, signed by the Corporation's CEO. The level of signatory on the policy is indicative of the level of profile accorded to management of wastewater quality within the Corporation
- Use of the Requality review tool to ensure compliance with the 12 elements of the AGWR Framework. We note that the most recent Requality audit reported that GWRT has achieved "best practice" for all 12 elements of the Framework as outlined in the RWQ Management Plan.

  The achieved level of compliance is reflective of the level of planning and governance committed to the GWRT
- Commissioning an external assessment of treatment process performance and effectiveness of the management systems by MWH throughout the operational period of GWRT. We note that monthly treatment performance and bi-annual system reviews generated a number of useful recommendations that have contributed to strengthening the recycled water quality management framework

- Assembling a qualified team to manage the requirements of GWRT and the Wastewater Quality Framework. The number and competence level of staff appears to have been designed to match the commensurate risks involved in the extensive operational requirements of GWRT
- Continuing to support the laboratory and other research organisations in developing improved analytical methods for wastewater samples and further refining the methods currently used
- Implementing a plant maintenance schedule to ensure efficient functioning of the equipment at AWRP
- Establishing a comprehensive forum for engaging external stakeholders and the community to acknowledge and manage their perception and opinions
- Use of “lessons learnt” briefing notes from incidents
- Use of monthly governance reports to monitor compliance, supported by water quality reports and groundwater reports
- Regular meetings of senior managers as well as TRG to monitor compliance on a continual basis.

# Observations and recommendations

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| **1. Completeness of S100 Standards' Appendix E listing** | **Criteria**<br>Appendices C, D & E of the S100 Standards contain monitoring and sampling requirements for the AWRP and the groundwater bores in relation to the RWQ parameters contained in Table 1, Schedule 1 of the MoU. The Department expects the Corporation to monitor and achieve each of those parameters in recycled water. Appendix E contains a listing of all parameters that are monitored, including research and regulatory parameters along with their prescribed sampling frequencies.<br>**Finding**<br>Based on our comparison of RWQ parameters in Table 1of the MoU with the list of monitored parameters in Appendix E of S100, we observed that the following two RWQ parameters from Table 1 are currently not listed in Appendix E:<br>• *Monobromoacetonitrile*<br>• *Chrysene.*<br>However, both parameters are included in sampling groups listed in Appendix D of S100 and have been subjected to the required sampling activity managed by WWQMS.<br>**Cause**<br>S100 has not been updated to ensure the Appendix E listing contains all of the regulatory RWQ parameters specified in Table 1 of the MoU.<br>**Effect**<br>The requirements specified by S100 Standards relating to the parameters *Monobromoacetonitrile* and *Chrysene* are not accurately reflected in Table 1 of the MoU. | To ensure that RWQ parameters in Table 1 of the MoU accurately reflect the requirements specified by the S100 Standards, Appendix E of S100 be updated to include the parameters *Monobromoacetonitrile* and *Chrysene*. | * |

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| **Management Comment/Action:**<br>Following review of S100 against the requirement of the GWRT MoU (Table 1), the parameters *Monobromoacetonitrile* and *Chrysene* were added to Appendix E. | | | |

| **Responsibility for Action:** | **Accountable Manager:** | **Target Date:** |
|---|---|---|
| Manager Wastewater Quality Branch | General Manager Regional Customer Services | Complete (25 March 2013) |

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| **2. Review of violations in WWQMS** | **Criteria**<br>Alert and violation limits for RWQ parameters have been set-up within WWQMS to facilitate monitoring and reporting. Results of water sample analysis are communicated directly into WWQMS by means of a text file from the laboratory.<br>Any exceedances of guideline values of parameters (contained in Table 1 of MoU) are flagged as a violation by WWQMS. Accordingly, the violation limits in WWQMS have been set to match Table 1 guideline values.<br>Any changes to data within WWQMS can only be made after a Change Request Form is completed and authorised.<br>**Finding**<br>1. Based on our comparison of RWQ parameter guideline values in Table 1 with the list of alert and violation limits setup in WWQMS, we identified that one of the parameters (*Chloroacetic acid*) does not have a violation or alert limit setup within the WWQMS. As a result, the parameter is unable to be monitored via WWQMS.<br>We were informed that the above parameter has been alternatively monitored via the Water Quality Report that is presented at monthly GWRT HAC meetings with the Department<br>2. In our examination of the WWQMS violation report for the audit period, we identified that historical data for one parameter (*Trifluralin*) was changed within WWQMS. The change was duly authorised by the Department. However, an error was made while changing the data, which caused the above parameter to be flagged within the violation report even though the actual value was much below the guideline value.<br>As the violation report is reviewed by the Corporation on a progressive monthly basis only, the above error was not recognised until the time of this audit when violation report was printed and viewed for the entire audit period. | To ensure that WWQMS continues to effectively manage the requirements prescribed by S100 Standards and S342 Sampling Guidelines:<br>1. A violation limit be setup within WWQMS for *Chloroacetic acid* concurrent to the guidelines value specified in Table 1 of the MoU<br>2. Where a change is made to historical data, a violation report be reviewed for the relevant period to identify and rectify any potential anomalies in a timely manner. | ** |

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| | **Cause**<br>1. WWQMS does not have a violation/alert limit setup for *Chloroacetic acid*<br>2. For any changes made to historical data in WWQMS, the violation report is not reviewed retrospectively to identify any errors.<br>**Effect**<br>These matters increase the risk that:<br>1. For *Chloroacetic acid*, WWQMS may not effectively manage the requirements prescribed by S100 Standards and S342 Sampling Guidelines<br>2. Without a due diligence check, the Corporation is unable to identify and rectify any errors arising from changing historical data within WWQMS. | | |

**Management Comment/Action:**

**1.** *Chloroacetic acid* was added to the alerts and violations monitoring list in WWQMS to enable automated monitoring of this parameter.

**2.** To ensure that potential database errors in WWQMS are prevented when authorised changes of GWRT data take place, an additional step in the GWRT Change Management Process has been added. The additional step describes that when a change to historical data in WWQMS is made then a GWRT Violation Report for the entire operating history of the AWRP is to be undertaken to ensure that these types of issues are prevented.

| **Responsibility for Action:** | **Accountable Manager:** | **Target Date:** |
|---|---|---|
| Manager Wastewater Quality Branch | General Manager Regional Customer Services | Complete (25 March 2013) |

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| **3. Review of AWRP monthly performance reports** | **Criteria**<br>Daily and Weekly AWRP Performance Reports are generated by the PTO at AWRP and emailed to the Scientific Officer and other relevant staff at WWQB. These reports are used by the Scientific Officer to compile the monthly Governance reports for presentation to the Department in the monthly HAC meetings.<br>The Monthly AWRP Performance Reports contain the same data from Daily and Weekly reports and are used for internal review of monthly CCP performance at the Monthly AWRP Performance Review meetings.<br>**Finding**<br>Based on our comparison of monthly AWRP reports with the monthly governance reports for the audit period, we observed four occasions of inconsistency between the two sets of reports even though they are expected to contain the same data.<br>We were informed that the inconsistency was largely due to the confusion over reporting of CCP operational exceedances (where corrective action did occur) against the actual CCP violations (where intended corrective action did not occur). With the finalisation of CCP Business Rules document by the Department in July 2012, we understand that the confusion has now been eliminated.<br>We understand that the Corporation and the Department place their primary reliance on the monthly Governance reports, which are thoroughly scrutinised by the Department at the HAC meetings.<br>We were informed that all discrepancies have now been rectified to ensure that the AWRP Monthly Reports match the Governance Reports.<br>**Cause**<br>An additional due diligence check to ensure the monthly AWRP reports match the final and formal Governance reports is not considered to be a priority for the Corporation in producing complete and accurate Governance reports. | As a further due diligence measure, the monthly AWRP reports be checked for alignment with the monthly Governance reports to ensure the same information is reflected in the internal, supporting reports. | * |

| Reference/Subject | Observations | Recommendations | Risk Rating |
|---|---|---|---|
| | **Effect**<br>There has been some minor misalignment between the final governance reports and the internal, supporting reports. | | |

**Management Comment/Action:**

1. The identified discrepancies between the AWRP Monthly Reports and the GWRT Governance Reports have been rectified and approved by the GWRT HAC.
2. To ensure that information presented in the both the AWRP Monthly Report and the GWRT Governance Reports is aligned, a standing agenda item has been added to the GWRT Monthly Performance Meeting to ensure that this occurs.

| **Responsibility for Action:** | **Accountable Manager:** | **Target Date:** |
|---|---|---|
| Manager Wastewater Quality Branch | General Manager Regional Customer Services | Complete (25 March 2013) |

# Independence Assurance Report

We have been engaged by the Corporation to conduct a limited assurance engagement relating to specific aspects of the MoU between the Corporation and the Department for the period 10 November 2010 to 31 December 2012.

Specifically we have been asked to express a conclusion on the Corporation's performance under the following criteria (**the Criteria**):

(a) RWQ Parameters in Table 1, Schedule 1 of the MoU accurately reflect the requirements specified by the:

- S100 Standards for Wastewater Monitoring (Appendixes C, D and E)
- Additional directions by the Department

(b) RWQ Management Plan – October 2010 accurately interprets and applies the requirements of the:

- AGWR Framework
- RWQ Parameters in Table 1, Schedule 1 of the MoU
- Health recommendations from the PCRP report

(c) The Beenyup AWRP PCT has identified CCPs for each treatment train, with operating limits specified and endorsed by the Department and where monitoring exceeds specified limits, response actions have been undertaken and exceptions documented and reported in accordance with BP 4 of the MoU

(d) There are procedures in place to confirm that water injected into the groundwater aquifer has complied with the RWQ parameters specified in Table 1, Schedule 1 of the MoU and that any exception has been appropriately documented and reported in accordance with the MoU

(e) Mechanisms have been established and documented to accurately determine and document predicted residence and travel times in the aquifer

(f) Mechanisms have been established and documented to characterise the groundwater after recharge to identify any formation of DBPs.

**The Corporation's responsibility for the performance of procedures to meet the requirements in the MoU**

The Corporation is responsible for designing and performing procedures to meet the requirements of the MoU.

**Our Responsibility**

Our responsibility is to express a conclusion on the performance of the Corporation's procedures against the Criteria, based on our procedures. We conducted our engagement in accordance with Australian Standard on Assurance Engagements ASAE 3500 *Performance Engagements*, issued by the Australian Auditing and Assurance Standards Board, in order to state whether, in all material respects, anything has come to our attention that causes us to believe that the Corporation's procedures for the groundwater replenishment trial have not been performed in accordance with the Criteria, for the period 10 November 2010 to 31 December 2012.

Our procedures are described in Methodology and Detailed Findings sections above.

Our engagement provides limited assurance as defined in ASAE 3500. A limited assurance engagement is substantially less in scope than a reasonable assurance engagement conducted in accordance with ASAE 3500 and consequently does not enable us to obtain assurance that we would become aware of all significant matters that might be identified in a reasonable assurance engagement. Accordingly, we will not express an opinion providing reasonable assurance.

ASAE 3500 also requires us to comply with the relevant ethical requirements of the Australian professional accounting bodies.

**Limitations of use**

This report is made solely to the Corporation for the purpose of the reporting requirements of its MoU with the Department, in accordance with the accepted Audit and Scope Statement dated 4 February 2013, and is not intended to be and should not be used by any other person or entity. We understand that a copy of our report may be given to the Department for its information however we accept no responsibility to the Department or to anyone (apart from you) who is provided with or obtains a copy of our work without our written agreement. No other person or entity is entitled to rely, in any manner, or for any purpose, on this report. We do not accept or assume responsibility to anyone other than the Corporation for our work, for this report, or for any reliance which may be placed on this report by any party other than the Corporation.

**Inherent Limitations**

- Because of the inherent limitations of any internal control structure, it is possible that errors or irregularities may occur and not be detected. The matters raised in this report are only those which came to our attention during the course of performing our procedures and are not necessarily a comprehensive statement of all the weaknesses that exist or improvements that might be made
- Our work is performed on a sample basis; we cannot, in practice, examine every activity and procedure, nor can we be a substitute for management's responsibility to maintain adequate controls over all levels of operations and their responsibility to prevent and detect irregularities, including fraud
- Any projection of the evaluation of the control procedures to future periods is subject to the risk that the systems may become inadequate because of changes in conditions, or that the degree of compliance with them may deteriorate
- We believe that the statements made in this report are accurate, but no warranty of completeness, accuracy, or reliability is given in relation to the statements and representations made by, and the information and documentation provided by Corporation personnel. We have not attempted to verify these sources independently unless otherwise noted within the report.

**Independence**

In conducting our engagement, we have complied with the independence requirements of the Australian professional accounting bodies.

**Conclusion**

Based on the procedures performed, in all material respects, nothing has come to our attention that causes us to believe that the Corporation's procedures for the groundwater replenishment trial have not been performed in accordance with the Criteria, for the period 10 November 2010 to 31 December 2012.

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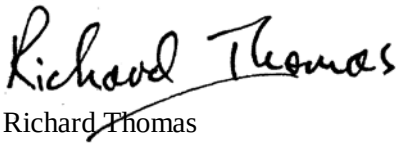


Richard Thomas

Partner

Perth, 26 March 2013

# Appendix A

## Terms of reference (Objective and scope statement)

Government of Western Australia
Department of Health
Public Health

# WATER CORPORATION

# Groundwater Replenishment Trial

# Audit 2013

# OBJECTIVE AND SCOPE STATEMENT

# Background

On 30th September 2010 the Department of Health and Water Corporation entered into a Memorandum of Understanding for the Groundwater Replenishment Trial (MoU).

Section 6.4 of the MoU states that the Department may conduct an audit of the Corporation's systems and data bases used to manage and report recycled water quality as required.

The audit report should include recommendations for improvements where appropriate.

The recycled water quality requirements that the Water Corporation must achieve during the trial are set out in Schedule 1 of the MOU. In addition Schedule 1 defines the Recycled Water Quality Parameters and Recycled Water Quality Indicators that are to be used during the trial to verify operational performance.

Binding Protocol 2 of the MoU lists the Water Quality Management Processes and Procedures that enable the Water Corporation to demonstrate compliance with Schedule 1 and any additional direction given by the Department of Health.

The principle recycled water quality management operating manuals used by the Water Corporation are:

- Advanced Water Recycling plant Process Control Table (updated) (S218 Wastewater Process Control Tables)
- GWRT Critical Control Table
- S100 Standards for Wastewater Monitoring, Appendixes C,D, and E
- S342 Groundwater Replenishment Trial Wastewater Sampling Guidelines; and
- GWRT Incident Management Plan

A computerised Wastewater Quality Management System (WWQMS) is used by the Water Corporation to apply the requirements prescribed by S100 Standards for Wastewater Monitoring, Appendixes C,D and E.

The Chief Executive Officers shall endorse the audit report and timetable for improvements. The responsible officers (Director Environmental Health, Department of Health and Manager Wastewater Quality Branch, Water Corporation) shall provide regular progress reports.

# Objectives

1. To determine whether:
   - Recycled Water Quality Parameters in Table 1 Schedule 1 of the MoU accurately reflect the requirements specified by the :
     - S100 Standards for Wastewater Monitoring, Appendixes C,D, and E as endorsed by the Department of Health 9th November 2010, and
     - any additional directions given by the Department of Health
   - Recycled Water Quality Management Plan Groundwater Replenishment Trial – October 2010 accurately interprets and applies the combined requirements of the:
     - Framework of the Australian Guidelines for Recycled Water: Managing Health and Environmental Risk (Phase 1) as published in 2006;
     - Recycled Water Quality Parameters in Table 1 Schedule 1 of the MoU
     - Health recommendations from the Premiers Collaborative Research Project report – "Characterising treated wastewater for drinking purposes following reverse osmosis treatment" 2009; and
     - any additional directions given by the Department of Health
   - The Beenyup Advanced Water Recycling Plant Process Control Table has identified critical control points:
     - that have been identified for each treatment train,
     - with appropriate operating limits; and where
     - monitoring exceeds specified limits:
       - appropriate response actions have been undertaken; and
       - exceptions are appropriately documented and reported in accordance with Binding Protocol 4 of the MoU.
   - Water injected into the groundwater aquifer has complied with:
     - The recycled water parameters specified in Table 1 for Schedule 1 of the MoU; and that
     - Any exception has been appropriately documented and reported in accordance with the MoU.
   - Established predicted residence and travel times in the aquifer have been accurately determined and documented.
   - The groundwater after recharge has been adequately characterised to identify any formation of disinfection by-products.

2. To assess the adequacy and effectiveness of the Wastewater Quality Management System (WWQMS) to;
   - manage and report on the requirements within S100(Appendixes C,D and E),
   - S342 Groundwater Replenishment Trial Wastewater Sampling Guidelines; and
   - Schedule 2,3,4 and 5 of the MoU as appropriate.

3. To assess the adequacy and effectiveness of the 'Wastewater Quality Framework', management framework employed by the Water Corporation's Wastewater Quality Branch.

## Scope and Focus

The scope of the audit covers:

- Recycled Water Quality Management Plan Groundwater Replenishment Trial – October 2010
- Advanced Water Recycling Plant Critical Control Points as documented within the Process Control Table (updated)
- Appendixes C,D and E, "Standards for Wastewater Monitoring", S100 manual,
- "Groundwater replenishment Trial Wastewater Sampling Guidelines", S342;
- visits to the Beenyup Advanced Water Recycling Plant (AWRP),
- testing transactions over the period 10 November 2010 to 31 December 2012,
- testing the reliability and integrity of Binding Protocol 3 reporting over the period 10 November 2010 to 31 December 2012,
- the computerised Wastewater Quality Management System (WWQMS),
- the management framework (Wastewater Quality Framework) administering;
    - S100 "Standards for Wastewater Monitoring", Appendixes C.D and E,
    - the Wastewater Quality Management System (WWQMS); and
    - Groundwater Replenishment Trial Wastewater Sampling Guidelines S342,

  within the Water Corporation's Wastewater Quality Branch,

The audit will test whether:

- Under the Recycled Water Quality Management Plan, S100 and Binding Protocol 2:
    - sampling programs are consistent with the Recycled Water Quality Management Plan,
    - samples are taken in accordance with the sampling programs,
    - remedial actions are taken when samples exceed guidelines,
    - sampling locations are appropriate,
    - sampling results are within guidelines,
    - samples are handled correctly; and
    - reporting is complete and accurate.
- Under Binding Protocol 3:
    - exception protocols are followed
- The management framework administering:
    - recycled water quality management performance is subjected to continual review,

- recycled water quality exceptions are adequately identified and evaluated,
- remedial plans are appropriate and timely; and
- communication between the Wastewater Quality Branch and Department of Health is adequate.

Rino Trolio
Water Corporation

04/02/2013

Richard Theobald
Department of Health

4/2/13

RICHARD THOMAS
~~Andrew Baldwin~~
Deloitte Touche Tohmatsu
(PARTNER)

4/2/13

# Appendix B

## Risk events, consultation & documents examined

### Risk events considered

- Inadequately treated wastewater recharged into groundwater aquifer resulting in pollution of groundwater, posing a risk to the environment and cultural heritage
- Process risks such as sampling and scheduling activities
- Incompetence of employees, suppliers, contractors
- Failure of reporting systems (risk to completeness, accuracy, validity, relevance of information reported)
- Failure of CCPs and treatment process
- Failure of staff to apply prescribed procedures
- Corruption/failure of monitoring system (SCADA)
- Corruption/failure of management system (WWQMS)
- Manipulation/fraudulent statement of water sample test results
- Failure of catchment monitoring.

### Consultation – key Corporation personnel

**Wastewater Quality Branch**

- Rino Trolio, Manager Wastewater Quality Branch
- Rod Holme, Wastewater Quality Manager
- Stacey Hamilton, Scientific Officer - GWRT
- Scott Garbin, Wastewater Quality Framework Coordinator.

**Infrastructure Planning Branch**

- Michael Martin, Principal Hydro geologist
- Simon Higginson, Water Source Strategy Officer.

**Advanced Water Recycling Plant**

- Sheena Clark, Process Technical Officer
- Glen McGregor, Plant Manager
- Daniel Bisgrove, GWRT Process Coordinator
- Adam Henderson, GWRT Process Coordinator
- Andrew Fogg, Beenyup WWTP Process Coordinator
- Mark Cocks, GWRT Operations Coordinator.

## Key documents examined

- Memorandum of Understanding for GWRT
- S100 Standards for Wastewater Monitoring
- S342: GWRT AWRP Water Sampling Guidelines
- S218: Wastewater Process Control Tables
- RWQ Management Plan
- GWRT Incident Management Plan
- GWRT Critical Control Point Table
- *Re*quality Report
- MWH Biannual Review Reports
- PCY220: Recycled Water Policy
- PCY327: Wastewater Quality Policy
- Risk Assessment Report (March 2008)
- Risk Assessment Review 1 (April 2009)
- GWRT Treatment Validation Report
- AWRP Work Instruction Register
- AWRP PCT
- GWRT Commissioning Verification Report and Letter of Endorsement
- AGWR
- PCRP Appendix 5 – Health Recommendations
- GWRT Basis of Design Memo Document.

Regular/operational reports

- Missed samples report
- Violations Report
- WWQMS Listing of Alerts and Violations
- Monthly Governance Reports
- Water Quality Reports
- Groundwater Annual Reports
- AWRP Daily Reports
- AWRP Weekly Reports
- AWRP Monthly Reports.

Meeting Minutes

- HAC meetings
- IAWG meetings
- Wastewater Governance Committee meetings

- Wastewater Management Committee meetings
- AWRP Monthly Performance Review meetings
- Catchment Integration meetings
- GWRT Executive Committee meetings.

# Appendix C

## Table - Importance of recommendations based on risk and opportunity to improve

**(Sourced from Water Corporation Management Review & Audit's reporting framework)**

| CATEGORY | IMPORTANCE | ACTION |
|---|---|---|
| * * * * *<br><br>CRITICAL | Critical issue.<br><br>Critical strategic importance. | CEO to initiate immediate action.<br><br>Immediate advice to Chairman, Audit & Compliance Committee.<br><br>Follow up briefings to Audit & Compliance Committee and the Board. |
| * * * *<br><br>MAJOR | Major issue.<br><br>Major strategic importance or opportunity to improve business. | CEO to ensure process in place to initiate immediate action.<br><br>CEO to monitor action plan.<br><br>Regular progress reports to Audit & Compliance Committee and the Board. |
| * * *<br><br>SIGNIFICANT | Significant issue.<br><br>Significant strategic importance. | CEO/Custodian to ensure immediate action initiated.<br><br>CEO/Custodian to monitor action plan.<br><br>Regular progress reports to CEO with progress report to Audit & Compliance Committee meetings. |
| * *<br><br>MODERATE | Moderate issue.<br><br>Minimal strategic importance or opportunity to improve. | Branch/Regional Business Manager to ensure priority is set for action according to resource and other constraints. Where priority of action is affected by constraints appropriate General Manager must agree.<br><br>Branch/Regional Business Manager to monitor action plan.<br><br>Regular reporting to appropriate General Manager/Custodian with exception reporting to Audit &Compliance Committee. |
| *<br><br>MINOR | No strategic importance.<br><br>Minor opportunity to improve. | Line management to ensure a priority is set for action according to resource & other constraints.<br><br>Line management to monitor action plan.<br><br>Exception reporting to Branch/Regional Business Manager. |

# Appendix E:

# Media Review

360m MEDIA INSIGHT. STRATEGIC COUNSEL.

A Sentia Media Company

# MEDIA ANALYSIS REPORT

- **Groundwater Replenishment Trial: December 2009 – November 2012**
- **Water Corporation**

WATER CORPORATION

# Introduction

This document presents an analytical overview of Australian press, internet and broadcast* coverage of the Water Corporation's Groundwater Replenishment Trial (GWRT) between **1 December 2009 to 30 November 2012**.

**NOTE**

**MEDIA ANALYSIS REPORTS BY 360$^{m}$ USE THE CARMA® METHODOLOGY – FOR MORE INFORMATION, SEE PAGE 2.**

This report aims to provide:

- An identification and explanation of trends in volume in press, internet and broadcast media during the three-year analysis period.
- An overview of the leading topics mentioned in media coverage of the Groundwater Replenishment Trial, with a focus on which spokespeople and which media outlets influenced the discussion.
- A summary of the leading messages conveyed in the media coverage, with a focus on the key spokespeople.
- Conclusions drawn from the analysis of the media pertaining to the points above.

DISCLAIMER: *Since only summaries of broadcast coverage were available for analysis, these reports were not analysed for messages or favourability.

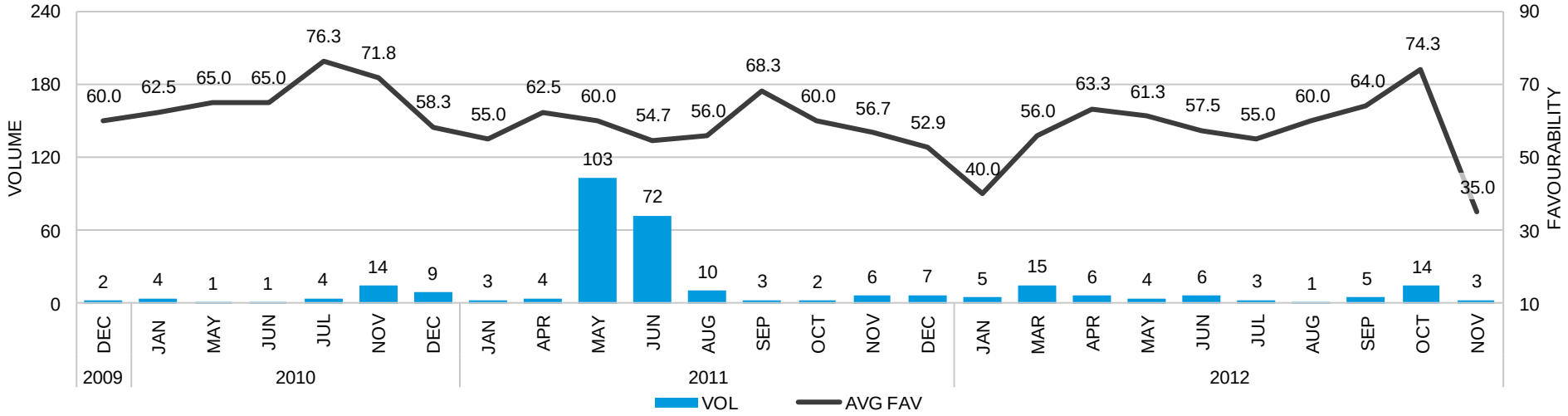
## Key Findings

### Table 1 GWRT Only

| KEY METRICS | | DECEMBER 2009 – NOVEMBER 2012 |
|---|---|---|
| TOTAL VOLUME | OVERALL | 430 |
| | PRESS | 120 |
| | BROADCAST | 123 |
| | INTERNET | 187 |
| AVERAGE FAVOURABILITY | PRESS & INTERNET | 59.2 |
| LEADING MESSAGE | PRESS & INTERNET | GWRT WATER IS SAFE TO DRINK (197) |

- As the key metrics suggest, press and internet coverage of the GWRT during the period 1 December 2009 to 30 November 2012 was quite favourable on average. The average favourability rating of 59.2 is a positive result for the Water Corporation and demonstrates that discussion of the trial in the press and internet coverage was consistently and favourably influenced by the Water Minister and the Water Corporation, and to a lesser extent Regional Development Minister Brendon Grylls, Shadow Water Minister Fran Logan, and the University of Western Australia's Jorg Imberger.
- These spokespeople frequently conveyed the five leading favourable messages in their support of the trial (see chart 2). The leading message in the press and internet coverage – *GWRT water is safe to drink* – was conveyed in 197 of 307 press and internet articles; to put it another way, almost 65% of all press and internet reports cited some reassurance that there was no risk in drinking GWRT water. The leading messages illustrate the successful communication of the main talking points in promoting the trial: that the safety and regulation of the trial was paramount.
- By contrast, the leading topics illustrate what was mentioned most frequently in the press and internet coverage of the trial (chart 3), and how favourably these topics were discussed. Accordingly, it is a clearer indication of which topics were the focus of press and internet reporting. In another positive finding, the data shows that safety and the GWRT methodology were frequently discussed, and this favourably correlates with messaging on the trial, discussed above. Significantly, community support was not only the most frequently mentioned topic (over 75% of all of press and internet articles mentioned the topic) – it was also primarily raised in favourable reports on the GWRT, as the 60.8 average favourability rating attests. Consequently, the importance of community support was a dominant theme in the coverage, and this was frequently conveyed by the Minister and Water Corporation spokespeople, and included an emphasis on public information initiatives, such as tours of the Beenyup facility.
- Overall, media outlets were generally supportive of the trial. One of the most encouraging examples was the highly favourable feature written article by Greg Thomson, editor of the Community Newspaper Group, in October 2012, which appeared in many of the group's community newspapers across the Perth metropolitan region. Coverage of the trial in *The West Australian*, the most influential media outlet in the state, was also generally quite favourable, and included editorials that were supportive of groundwater replenishment in future water planning. However, the newspaper also displayed a tendency to play on public anxiety over recycled water through consistent and prominent use of the term "sewage" (including in lead paragraphs and headlines).
- This contrasted markedly with discussion of the trial in *The Australian*, which although less frequent, and less influential, was a source of rational discussion on recycled water for human consumption during the entire analysis period, and rarely made references to "sewage" or appealed to community anxiety.
- There were also some problematic discussions of the trial in the broadcast coverage, most notably on radio station 6PR. The most revealing example of this was that Australia's most notable critic of groundwater replenishment – the Australian National University's Peter Collignon – was interviewed on the station on a number of occasions during the trial period.
- The media trend charts below unsurprisingly reveal that discussions of the GWRT were most prominent following state government announcements; the official launch in November 2010, and the consideration of "fast-tracking" the trial in May 2011. The latter issue was particularly significant as media discussion was heightened by a high-profile public debate over future water planning, brought on by a prolonged dry period in Perth and surrounds.

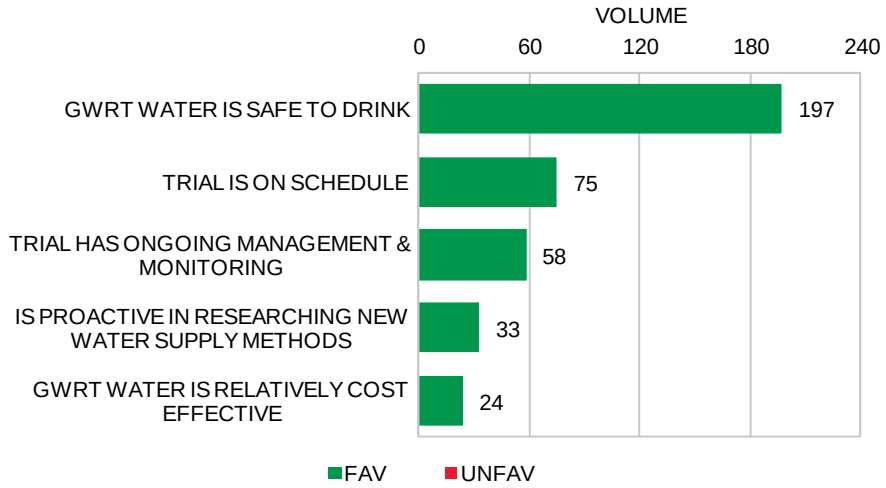
## Chart 1 Press & Internet (GWRT)




- Press and internet reporting on the GWRT was particularly favourable in **July 2010**, and included reports on a study by the University of Western Australia into community attitudes towards drinking recycled water. These online reports emphasised the encouraging results of the research, and cited comment from Water Corporation spokesperson Ben Jarvis, who said: "There seems to be growing support for it [drinking recycled water] and we hope that will continue with the trial that we're putting in place now" ("Perth leans towards recycled water", *ABC Online*, 1 July 2010).
- Coverage of the GWRT increased notably in late **November 2010**, with former Water Minister Graham Jacobs, Premier Colin Barnett and the Water Corporation's Nick Turner quoted prominently in most reports that discussed the official launch of the trial. Significantly, all three offered assurances that safety was of utmost importance, and that public support was crucial. For example, Turner explained the methodology and emphasised that "the water is checked all the way through that system and the treatment system itself is checked online 24/7" (*news.com.au*, 29 November 2010). Elsewhere, Jacobs pointed to an informed and engaged public: "Community support will be essential to the success of the groundwater replenishment trial. The [Water] corporation is committed to keeping the community informed throughout the trial and the visitor centre has been built to help achieve this goal" (*SBS Online*, 30 November 2010). Accordingly, the favourable messages *GWRT water is safe to drink* and *trial has ongoing management and monitoring* were frequently conveyed in these reports.
- Coverage of the GWRT heightened markedly during **May–June 2011**, and this was the most significant period in which the trial was discussed. This can be primarily attributed to the high-profile media debate in the Western Australian media about Perth's future water supply, with reports of low dam levels, warnings of future water restrictions, and a revived discussion of the Kimberley pipeline water plan. Western Australia's Shadow Minister for Water, Fran Logan, featured prominently in this debate, and coverage included his opinion article in favour of the trial and future recharging of aquifers with treated wastewater (*The West Australian*, 16 May 2011). This bipartisan support for the GWRT – most frequently conveyed by Logan – was a critical, positive influence on the overall favourability of media coverage during the trial period.
- In **late May 2011**, media coverage again intensified, with reporting on Water Minister Bill Marmion's decision to explore the "fast-tracking" of the GWRT, including a front page report in *The West Australian* (27 May 2011). However, despite the focus on favourable comments from Marmion, and qualified comments of support from the Department of Health, and Logan, the article demonstrated the problematic nature of media reporting on recycled water for drinking: the use of the term "sewage". In this front page report it appeared in

the headline ("Recycled sewage may be on tap in 18 months"), and influenced the subsequent broadcast coverage on 27 May, when "sewage" was mentioned in the majority of broadcast reports. *The West Australian* again employed this unfortunate term in the headline of an editorial the following day, which was otherwise supportive of the trial, and included the assertion that escalating the GWRT "is an example of the sort of action that is needed" ("Treated sewage can be part of our water mix", *The Weekend West*, 28 May 2011).

### Chart 2 Leading Messages – All GWRT Press & Internet coverage (December 2009–November 2012)




- Two other spokespeople that were frequently cited in **late May 2011** were Regional Development Minister Brendon Grylls and the University of Western Australia's Jorg Imberger. The report on Grylls was syndicated nationwide on Fairfax online news sites, and was notable as it "cut through" some of the technological jargon, as in Grylls's observation: "Direct recycled water into the grid is probably tricky [to convince the public to support] but water reinjected into the aquifer, shandied with existing ground water sources, filtered through the same sand-water filter that many of you have on your pool filter at home would be a step that I think the community is willing to take" ("'Get over it': Grylls urges acceptance of recycled water", *watoday.com.au*, 31 May 2011). Imberger's response to the "fast-track" proposal were also widely syndicated on Fairfax online news sites, and included his authoritative declaration that "in terms of health it's as safe as you can get. They're [the Water Corporation] not going to take any risks at all; they'll treat it until there's absolutely nothing wrong with it at all" (*watoday.com.au*, 27 May 2011). Grylls's and Imberger's statements in late May were the most prominent displays of support for the trial outside those made by the Water Minister and Water Corporation spokespeople, and consequently, the favourable message *GWRT water is safe to drink* was most frequently apparent during the May 2012 press and internet coverage.

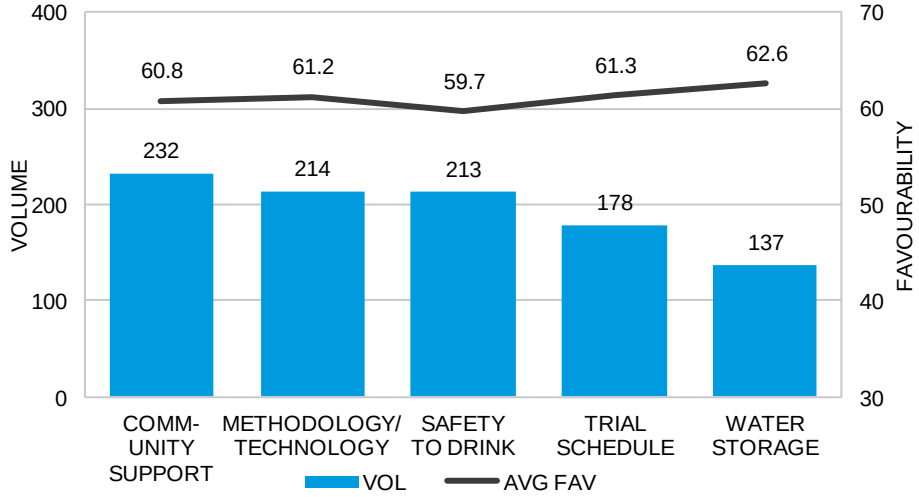
- Reporting on the Western Australian Government's allocation of additional money to the trial in the state budget was particularly favourable during **March 2012**, despite the continued use of the term "sewage" by *The West Australian* ("$100m to make sewage drinkable", 18 May 2012). This prominent article described the GWRT as a "landmark" trial and noted that future staged upgrades would "be expected to cost significantly less" than the upgrade due to start in 2014, conveying the favourable message that *GWRT water is relatively cost-effective*. Press coverage of the Water Corporation's GWRT survey results, which showed that "three out of four people support a full water-recycling scheme" was also very favourable (*Joondalup Times*, 27 March 2012), as was the favourable article syndicated in 13 publications from the Community Newspaper Group, which cited comments by Murdoch College student Jacob McGrath, who said: "The groundwater replenishment page on Facebook puts out a monthly newsletter and I think everyone should access that. It is knowledge we should all understand. The more people that know, the more people will take action" (*Stirling Times*, 20 March 2012). The spike in favourable coverage during April can be primarily attributed to the front page reports in the *Joondalup Times* and the *Wanneroo Times*, which focused on comments by the Urban Development Institute of Australia's Debra Goostrey, who said it was "vital we embrace this [groundwater replenishment] technology" (17 April 2012).

- There was one final spike in favourable coverage during **October 2012**, with Greg Thomson's highly favourable feature article on the GWRT syndicated across nine of the Community Newspaper Group's Perth metropolitan newspapers. Thompson's article was one of the most favourable reports on the trial across the entire period, and one of the more strategically important given his editorial position in the Community Newspaper Group. Thomson favourably described the "revolution" underway at Beenyup that "could ultimately 'drought-proof' Perth", and extensively quoted the Water Corporation's Nick Turner and Clare Lugar. Significantly, there were no mentions of the term "sewage" in the Thomson articles, with references instead to "recycled wastewater" and "refined wastewater". The report also conveyed numerous favourable messages, including that the Water Corporation *is proactive in researching new water*

*supply methods*, that the *trial has ongoing management and monitoring,* and that *GWRT water is safe to drink*.

- The other significant report on the GWRT during **September–October 2012** was the article titled "Recycled water bid stepped up", which covered the "upbeat comments" in the Water Corporation's annual report about future groundwater replenishment schemes ahead of the completion of the "landmark trial" (*The West Australian*, 19 September 2012; and online). Although this article cited favourable comments from Marmion and Logan, and conveyed favourable messages on the trial, the term "sewage" appeared in the opening paragraph. The second version of the article (or the "edition change", which is available more widely in metropolitan Perth), included a cartoon of two elderly people straining toilet water.

### Chart 3 Leading Topics – All GWRT Press & Internet coverage (December 2009–November 2012)



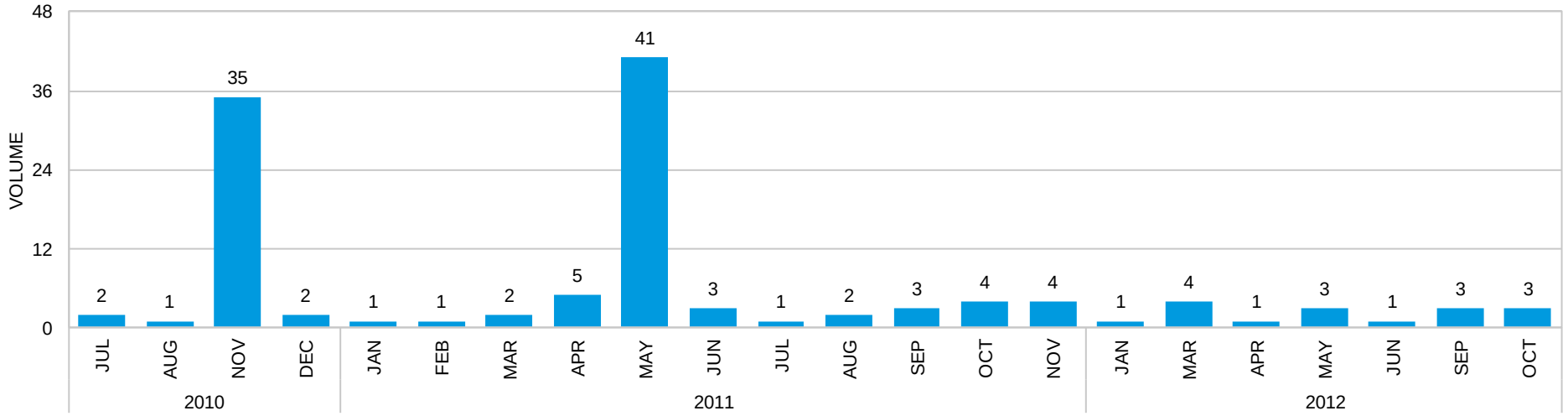

- The other unfavourable finding was that letter-to-the-editors from the community were responsible for the two periods when unfavourable press coverage was negative on average (**January and November 2012**). In **January 2012**, a letter written by Patricia Malone of Scarborough responded to reports on the plan to drought-proof Perth, in particular the commitment to a "full-blown recycling water project". Malone unfavourably suggested "there is always the risk of human error in treating sewage so that it is suitable for human consumption. Can the Government take the risk with our drinking water?" (*The Mandurah Coastal Times*, 4 January 2012; *Hills Gazette*, 7 January 2012). Another unfavourable letter followed up Malone's assertions, and argued: "The Government is always talking about a shortage of fresh water and it is always spending taxpayers' money where it is not required. Now it is talking about treating sewage water for us all to drink" (*Mandurah Coastal Times*, 11 January 2012). These letters communicated the message *GWRT water is not safe to drink*. During **November 2012**, in the wake of Thomson's article, one anonymous letter-to-the-editor unfavourably questioned the Water Corporation's advanced water treatment technology. The letter argued that "the one important factor missing" in the technology was consideration of the increased quantity of pharmaceuticals in wastewater. The letter unfavourably suggested: "We will not be 'recharging the aquifers' but polluting our underground water supply", and conveyed the unfavourable messages *GWRT water does environmental damage* and *GWRT water is not safe to drink* (*Southern Gazette*; *Stirling Times*, 13 November 2012 and online).

**WHAT MEDIA SAYS**

THE STATE-OWNED UTILITY'S ANNUAL REPORT HAS GIVEN THE CLEAREST INDICATION YET OF THE EXTENT TO WHICH AUTHORITIES HOPE WATER RECYCLING WILL SOLVE PERTH'S WATER PROBLEMS AS THE CLIMATE DRIES … THE UPBEAT COMMENTS BY THE WATER CORPORATION COME AHEAD OF THE DECEMBER COMPLETION OF A LANDMARK TRIAL

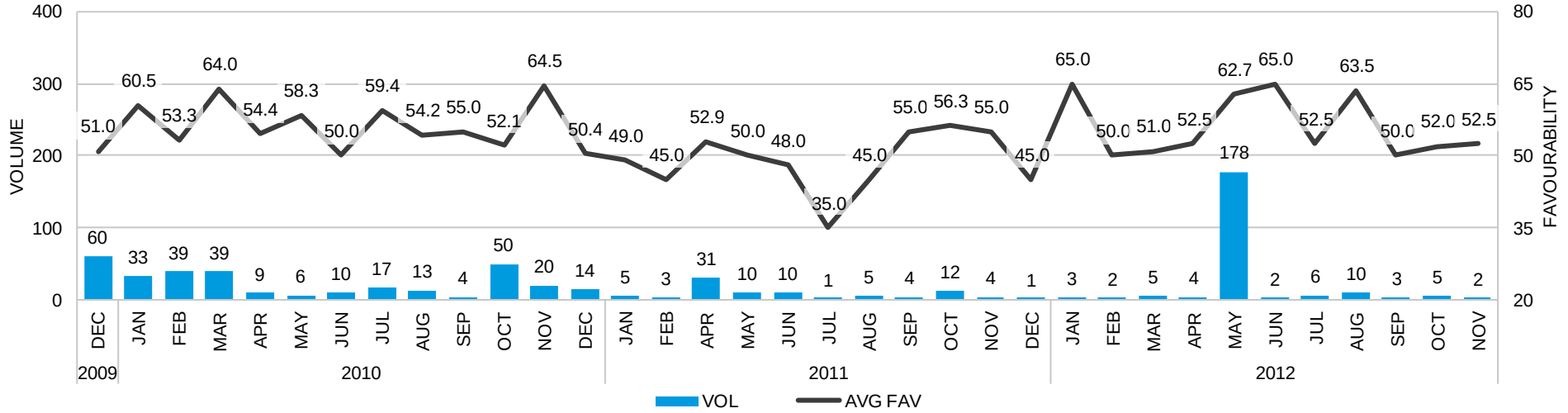
*The West Australian, 19 September 2012*

## Chart 4 Broadcast Summaries (GWRT)




- As the trend chart above also illustrates, the two major announcements by the state government – the official launch in **November 2010** and the consideration to "fast-track" the GWRT in **May 2011** – almost single-handedly determined the profile of the trial in the GWRT broadcast reports. However, broadcast discussions of the GWRT primarily followed the lead of press reporting, and were often shaped by the coverage in *The West Australian*.
- The first prominent discussions of the GWRT in the broadcast coverage appeared on **30 November 2010**, when the trial was officially launched. Former Water Minister Graham Jacobs appeared in the bulk of the reports, with a small proportion of coverage also quoting Premier Colin Barnett and the Water Corporation's Nick Turner. During an interview with Simon Beaumont on the *Mornings* show, Turner discussed the process involved in the water treatment, and stated that he would "be happy to drink the water once it was fully treated" (6PR Perth, 30 November 2010). Turner also noted that the corporation was organising tours of the Craigie visitors' centre at the Beenyup Wastewater Treatment Plant, to educate people about the water cycle and the recycling method.
- Broadcast reporting on the GWRT again spiked in **May 2011** with discussion of the state government decision to look at "fast-tracking" the trial. Marmion and Imberger were most frequently cited in this coverage, and the latter's support of the plan and authoritative assurance regarding the safety of drinking GWRT water was an important positive influence. However, of the 41 broadcast reports on the fast-track proposal, over half mentioned sewage, demonstrating the impact on broadcast coverage of the front page article titled "Recycled sewage may be on tap in 18 months" that appeared in *The West Australian* (27 May 2011).

## Chart 5 Press & Internet (General Recycled Water/Other Recycled Water Projects)




- The above chart illustrates the gradual decline in discussions of recycled water for drinking during the period of the GWRT. This decline closely correlated with an end to drought conditions on the eastern seaboard, which was all but confirmed when Australia recorded its wettest spring on record in 2010. Aside from a renewal of discussion in May 2012 (discussed below), coverage during 2011 and 2012 tapered off quite considerably.
- In **December 2009 and January 2010**, reporting on faults at the Gold Coast Pimpama wastewater treatment plant – which saw recycled water pumped to homes – was often unfavourable, and community criticism centred on the issue of trust in government. Many reports also discussed the previous rejection by the Toowoomba community of a recycled drinking water proposal in 2006. This coverage expressed the sentiment that the community was wise to reject the proposal because the government could not ensure that the quality of the water would be safe.
- The failed Toowoomba plebiscite was a consistent reference point in press coverage of recycled water for human consumption, primarily in Queensland, but also nationally. This was apparent in **February 2010** in coverage of a pre-election proposal by South Australian Opposition Leader Isobel Redmond to recycle storm water for drinking. Many reports suggested that the experience at Toowoomba was proof of the community's aversion to drinking recycled water. As one article noted, this had significant political ramifications: "Ever since Labor was trounced over its plans to introduce recycled sewage as drinking water in some constituencies interstate it has shown a Pavlovian response to anything to do with recycled water" (*The Advertiser*, 3 February 2010).
- In Queensland's coverage, the politics of recycled water were often emphasised: the mothballing of Queensland's Western Corridor Recycled Water Scheme became synonymous with poor governance and the unpopular Bligh Labor government, and was often raised in the wake of the December 2010 and January 2011 Queensland floods – with Wivenhoe Dam management under scrutiny – and during the state election in early 2012.
- Favourable coverage of recycled water for drinking was most often apparent in coverage of advocacy work by national water associations and commissions. For example, coverage of the **OzWater 2010 water conference** frequently cited the Australian Water Association's Tom Mollenkopf, who said: "Governments should be examining other alternatives now and that includes adding purified water to our drinking water supply"("Planner calls for recycled sewage in water", *The Sydney Morning Herald*, 8 March 2010). Elsewhere, the University of Wollongong's Professor Sara Dolnicar referenced the Toowoomba plebiscite and suggested "attitudes to recycled water are hampering the community's response to Australia's water shortage" (*Illawarra Mercury*, 1 March 2010).

- In **late 2011**, press coverage of the Productivity Commission report on water often focused on its recommendations to lift bans on drinking recycled water; as one article suggested, the report "criticise[d] the way the planned potable use of recycled water was ruled out after a community backlash" ("PM told recycled water fit to drink", *The Australian*, 13 October). *The Australian* emerged as an important media outlet in the discussion of recycled water, as evidenced by its editorial that observed: "The commission made a good case why consumers should be free to exercise choice in their water consumption through a more efficient price mechanism, why water restrictions should be limited to emergencies and why high-quality recycled water for drinking should not be ruled out" (13 October 2011).
- The trend chart above shows that from mid-2011, press reporting on recycled water for drinking declined quite notably, aside from a spike in **May 2012**. This coverage was driven by a favourable front page article in *The Sydney Morning Herald* (which was widely syndicated online) which reported that the New South Wales state government would "consider introducing treated sewage into Sydney's drinking water supply as a means of meeting the city's future water needs" (7 May 2012). This influential article – and the majority of other articles – cited Chris Davis, Commissioner at the National Water Commission and the chairman of the independent panel advising the state government review. Davis emphasised that: "I think people need to be convinced that it's safe and reliable … They need to get over the hang-up of thinking about where the water came from, and being offended by that".
- Unsurprisingly, the article also mentioned that Toowoomba residents had "voted down a plan to drink their own purified sewage, even in the face of a critical water shortage". However, the article also referred to the GWRT, and contrasted the mention of Toowoomba by reporting: "But, the notion has gained momentum in Perth, where a pilot plan is under way to replenish groundwater supplies with treated effluent" (*The Sydney Morning Herald*, 7 May 2012).
- The following day, the newspaper favourably reported on research by the WateReuse Research Foundation that suggested "the 'yuck factor' associated with recycled sewage can be overcome once people learn they already drink it" (*The Sydney Morning Herald*, 8 May 2012). In the following days, there were also several letters-to-the-editor in favour of recycled water, and significantly, there were no unfavourable reports on the proposal, and no overtly unfavourable comments from opponents. Accordingly, the press and internet coverage in May 2012 was overwhelmingly favourable, and provided some evidence that the debate on recycled water for drinking had matured.

**WHAT MEDIA SAYS**

A MAJOR REASON WHY 'THE COMMUNITY PERCEPTIONS REMAIN A STICKING POINT' TO THIS REFORM IS THAT THE PRESS REPEATEDLY REFERS TO 'TREATED EFFLUENT … FOR WATER SUPPLY' AND WRITES THINGS LIKE: 'THE GOVERNMENT WILL CONSIDER INTRODUCING TREATED SEWAGE INTO SYDNEY'S DRINKING WATER'. THIS LANGUAGE IS HIGHLY EMOTIVE AND MISLEADING. IT WOULD HELP THE COMMUNITY … IF THE DISCUSSION WAS ABOUT 'PURE WATER DERIVED FROM TREATED WASTEWATER'

*Letter to The Sydney Morning Herald, 7 May 2012*

# Your 360m & Sentia Media Team

**KHALI CHALLIS**
**Media Analysis Consultant**

Khali is the Media Analysis Consultant for 360m, specialising in tailoring media analysis to meet a business' needs. She has been with Sentia Media for over nine years, and has worked as both a Senior Portfolio Analyst and an Account Director.

A graduate in Communications, in 2008 Khali won the company's global "best of the best" award.

**PAUL CHAPMAN**
**Account Director**

Paul is Account Director for the WA, SA and NT markets. He has been in the media intelligence industry for over 10 years, holding senior sales, business development and customer service roles in Perth, Canberra and London, across a range of sectors including State and Federal government along with oil, gas and resources.

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Sarah Green joined Sentia Media over seven years ago and is the Account Manager for the WA Government portfolio, as well as the local Western Australian Office Manager. Sarah has a degree in Media and Marketing from Murdoch University and has over seven years' industry experience working in both Western Australia and China.

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**SCOTT SMITH**
**Media Analyst**

Scott joined Sentia Media in 2006. He started in account management for the West Australian Government team before becoming a Media Analyst in 2010, where he specialises in analysis for the primary, resource and utility sectors.

Prior to working at Sentia Media, Scott worked as a tutor and lecturer in Media Studies at Edith Cowan University. Scott holds a Bachelor of Arts (Honours) in Media Studies from Edith Cowan University.

## Best Practice Media Analysis

The media analysis methodology used by 360m has a systematic approach to turn media content into meaningful data. This approach analyses media content both quantitatively and qualitatively.

360m uses the CARMA® media content analysis methodology, which is internationally recognised as one of the leading commercial systems available. CARMA® (Computer Aided Research and Media Analysis) uses advanced technology to quantify media content, and human intelligence to provide qualitative insight and analysis.

360m uses the CARMA® methodology to qualitatively analyse media coverage by taking into account multiple variables. These include the:

- Placement of media reports (front page or lead item in broadcast media and websites);
- Positioning of organisation discussion (headline, prominent mentions, passing mentions);
- Image (photos, illustrations, charts, cartoons, or the image content of video);
- Topics discussed in the media and their relative importance to the client organisation;
- Messages, both favourable and unfavourable, communicated in media reports;
- Sources quoted (both organisation representatives and other individuals who make relevant comments in the media); and
- Tone of content (extreme language, adjectives and adverbs, metaphors or similes and other figures of speech).

An aggregate score is calculated based on these multiple variables and presented on a 0–100 scale where 50 is neutral. This is an overall rating of the favourability of each media report towards the client organisation (and, if relevant, other organisations or competitors). This aggregate score is called the CARMA® Favourability Rating.

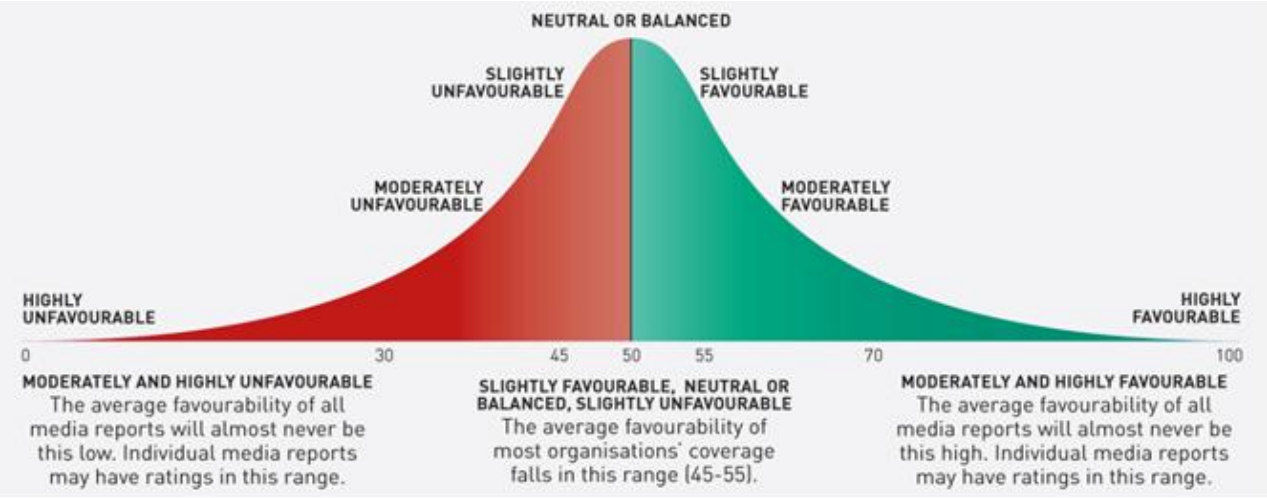
The average favourability is the aggregated rating of the media coverage analysed. This can identify the potential impact of media reporting, and can be used to identify trends and establish benchmarks for future data.

The criteria for analysis (such as topics and specific key messages) are set up uniquely for each individual client by a team of media analysis experts. These experts bring their industry knowledge to identify key issues and attitudes that appear in the media, answer clients' key questions, and, where relevant, provide recommendations for further action.

The consistency of analysis is ensured in three key ways:

- Most of the variables analysed are objective criteria (such as media name, positioning, sources' names);
- The somewhat more subjective topics and messages are identified by either exact phrasing or acceptable alternatives, provided to researchers before analysis begins; and
- 360m uses multiple researchers on projects to minimise individual subjectivity.

## Average Favourability Explained



## AMEC Membership

360$^{m}$ is a member of the International Association for Measurement and Evaluation of Communication (AMEC), the leading organisation for media analysis and measurement globally with 104 members in 50 countries.

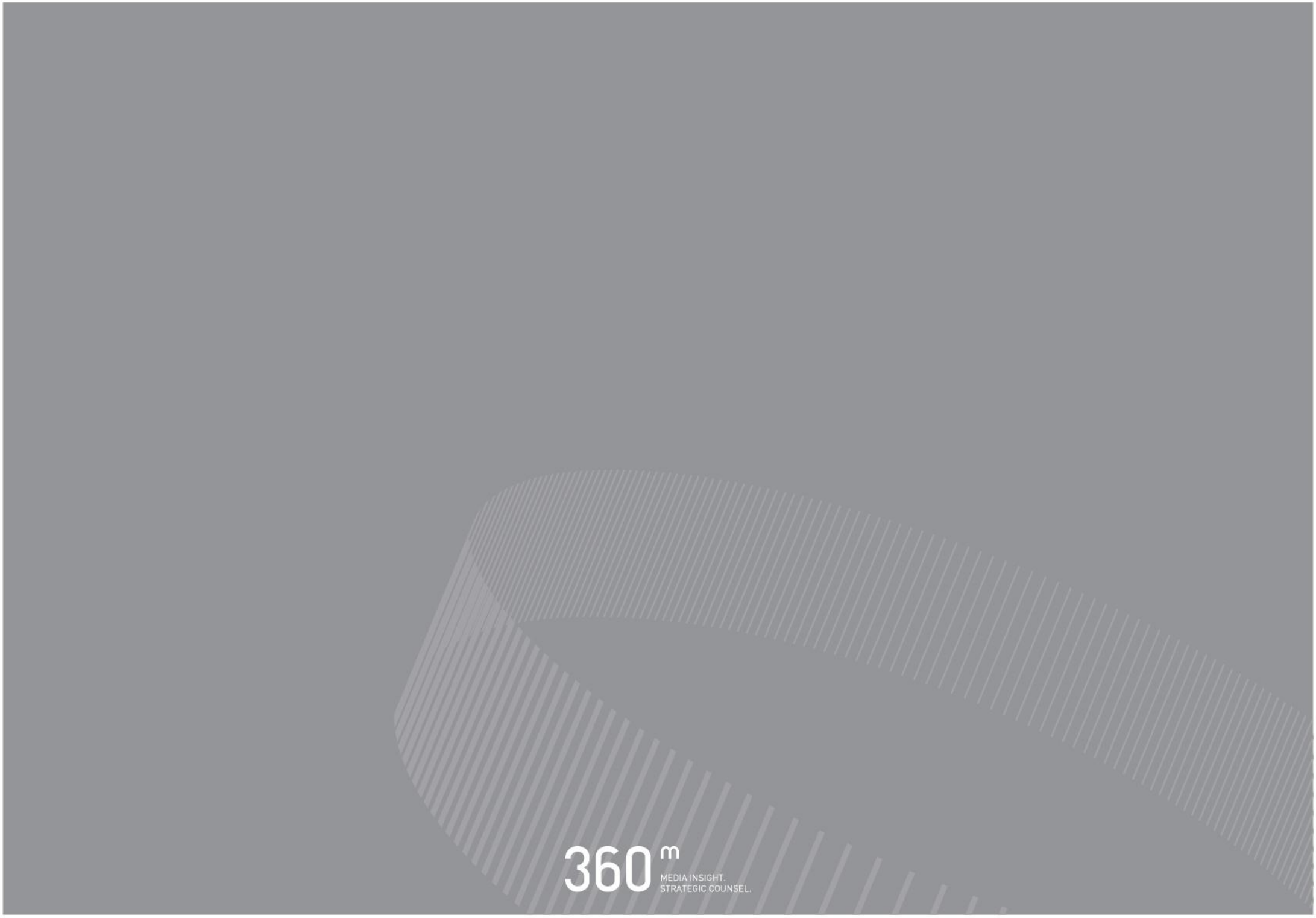
AMEC's purpose is to define and develop the industry on an international scale with better professional standards for both companies and individuals. To give you confidence that you have received the best reports and insights, having this membership means that 360$^{m}$ complies with AMEC's strict standards (see www.amecorg.com).

## AMEC Global Communication Effectiveness Awards 2012

In 2012, reports produced by 360$^{m}$ won a total of five AMEC Awards:

- **Gold** – Best Use of Communication Management: Business-to-Business
- **Silver** – Best Use of Communication Management: Not-for-Profit
- **Silver** – Best Use of Measurement for a Single Event
- **Bronze** – Best Use of Measurement for a Single Event
- **Bronze** – Best Use of Communication Management: Public Sector

→ 360$^{m}$ IS THE WORLD'S MOST AWARDED MEDIA ANALYSIS AND MEASUREMENT COMPANY 2010–2012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# Appendix F:

# Stakeholder Engagement Log

## List of Stakeholder Activities for Groundwater Replenishment

| STAKEHOLDER | NO. | BRIEFING METHOD(S) | DATE(S) |
|---|---|---|---|
| **WA State Regulating Agencies** | | | |
| Department of Health (General staff) | 12 | Briefing, presentation, tour | 2007 - 2012 |
| Department of Water (General staff) | 17 | Briefing, presentation, tour | 2007 - 2012 |
| Department of Environment and Conservation (General staff) | 9 | Briefing, presentation, tour | 2007 - 2012 |
| Environmental Protection Authority (including Board) | 7 | Briefing, presentation, tour | 2007, 2008, 2011, 2012 |
| GWRT Inter Agency Working Group | 31 | Meeting to progress development of policy and regulation | 2007 - 2012 |
| Department of Health (Health Advisory Committee Meeting) | 25 | Monthly meeting to review water quality data and AWRP performance | 2010, 2011, 2012 |
| **WA State Government and Members of Parliament** | | | |
| State Parliament | 2 | Science and Parliament Day | 2007, 2008 |
| Government Media Office | 1 | Briefing | 2009 |
| Terry Redman MLA<br>Minister for Water | * | Briefings<br>1 Tour | 2013 |
| Bill Marmion MLA<br>Former Minister for Environment; Water | * | Regular briefings, tours | 2010 - 2013 |
| Graham Jacobs MLA<br>Former Minister for Water | * | Regular briefings, tours | 2009, 2010 |
| Liz Behjat MLC<br>Member for North Metropolitan Region | 1 | Briefing | 2010 |
| Ian Britza MLA<br>Member for Morley | 1 | Tour | 2011 |
| Liza Harvey MLA<br>Member for Scarborough | 2 | Briefing | 2010, 2012 |
| Albert Jacob<br>Member for Ocean Reef | 2 | Briefing, tour | 2011, 2012 |
| John Kobelke MLA<br>Former Member for Balcatta and<br>Former Minister for Water Resources | * | 2 Briefings as Member for Balcatta<br>Regular briefings as former Minister for Water | 2010, 2012<br>2006 - 2008 |
| Francis Logan MLA<br>Former Shadow Minister for Water and<br>Member for Cockburn | * | 1 Briefing as Shadow Miniser for Water<br>Regular briefings as Member for Cockburn and member of Woodman Point Wastewater Treatment Plant Community Reference Group | 2012<br>2007 - 2012 |
| Paul Miles MLA<br>Member for Wanneroo | 1 | Meeting | 2012 |
| Michael Mischin, MLC<br>Member for North Metropolitan Region | 2 | Briefing, tour | 2010, 2011 |
| Andrea Mitchell MLA<br>Member for Kingsley | 3 | Briefing, tour | 2011 |
| Anthony O'Gorman<br>former Member for Joondalup | 2 | Briefing | 2010, 2012 |
| Margaret Quirk MLA<br>Member for Girrawheen | 1 | Briefing | 2012 |
| Michael Sutherland MLA<br>Member for Mount Lawley | 1 | Tour | 2011 |
| Ken Travers MLC<br>Member for North Metropolitan Region | 2 | Briefing | 2010, 2012 |

| STAKEHOLDER | NO. | BRIEFING METHOD(S) | DATE(S) |
|---|---|---|---|
| Alison Xamon<br>Former Member for East Metropolitan Region | 2 | Briefing | 2010, 2012 |
| **Federal Government** | | | |
| Senator Don Farrell MP<br>Office of Minister for Environment; Water | 1 | Tour | 2010 |
| National Water Commission | 3 | Tour | 2011, 2012 |
| Department of Sustainability, Environment, Water, Population and Communities | 22 | Tour (2)<br>Regular updates of Trial Progress (20) | 2007 - 2013 |
| CSIRO | 7 | Forum, briefing, presentation, tour | 2006, 2011, 2012 |
| National Centre for Marine Conservation and Resource Sustainability | 1 | Tour | 2011 |
| **WA Local Government - (Close to the Groundwater Replenishment Trial)** | | | |
| City of Joondalup - Councillors and officers | 6 | Briefing, meeting, tour | 2009, 2011, 2012, 2013 |
| City of Stirling - Officers | 2 | Briefing | 2011, 2012 |
| City of Wanneroo - Councillors and officers | 4 | Briefing, presentation | 2008, 2010, 2011, 2012 |
| **Western Austalian State Government Agencies** | | | |
| Dept of Agriculture and Food | 2 | Presentation, tour | 2011, 2012 |
| Dept of Further Education, Employment, Science and Technology | 1 | Briefing | 2012 |
| Dept of Planning | 2 | Tour | 2011, 2012 |
| Dept of Transport | 1 | Tour | 2012 |
| Dept of Treasury | 1 | Briefing | 2012 |
| Economic Regulation Authority - Governing body | 1 | Meeting | 2011 |
| Fremantle Ports | 1 | Tour | 2012 |
| Public Administration Committee | 1 | Briefing | 2008 |
| **Health** | | | |
| Australian Medical Association (WA) | 1 | Presentation | 2008 |
| Australian National University - Director Infectious Diseases Unit and Microbiology Department | 9 | Briefing | 2009 |
| Cancer Council | 1 | Presentation | 2012 |
| Environmental Health Officers Association | 2 | Briefing | 2006, 2007 |
| Health Consumers Council | 3 | Briefing, presentation | 2007, 2008, 2011 |
| Public Health Association | 1 | Briefing | 2007 |
| Royal Perth Hospital | 2 | Meeting, presentation | 2009, 2011 |
| University of WA - School of Pathology and Laboratory Medicine | 1 | Briefing | 2012 |

| STAKEHOLDER | NO. | BRIEFING METHOD(S) | DATE(S) |
|---|---|---|---|
| University of WA - School of Population Health | 2 | Briefing | 2011 |
| University of Notre Dame - School of Medicine | 1 | Presentation | 2007 |
| Sir Charles Gairdner Hospital | 1 | Tour | 2012 |
| St John of God - Murdoch | 1 | Tour | 2012 |
| Telethon Institute of Child Health | 1 | Presentation | 2012 |
| **Environment** | | | |
| Alliance for a Clean Environment (ACE) | 2 | Briefing | 2009, 2012 |
| Conservation Council of Western Australia | 3 | Briefing and presentation | 2007, 2009, 2011 |
| Pollution Action Network | 1 | Meeting | 2009 |
| Yallagonga Regional Park Community Advisory Committee | 2 | Presentation and tour | 2011 |
| **Community and Professional Bodies** | | | |
| Australian Water Association (AWA) | 3 | Briefing and tour | 2008, 2011, 2012 |
| Water Services Association of Australia | 5 | Briefing, presentation, tour | 2008 - 2012 |
| Beenyup Community Reference Group | 25 | Presentation, tour<br>Quarterly meetings since 2006 | 2006 - 2012 |
| GWRT Community Advisory Panel and<br>Water Supply & Demand Advisory Panel | 17 | Briefing, meeting, tour | 2008 - 2012 |
| South West Aboriginal Land and Sea Council | 4 | Briefing, meeting, tour | 2008 - 2010 |
| **Academic** | | | |
| Curtin University, including:<br>Water Quality Research Centre<br>Facilities Management/Sustainability | 11 | Meeting and tour | 2011, 2012 |
| Edith Cowan University | 1 | Tour | 2011 |
| Murdoch University | 4 | Tour | 2009, 2011, 2012 |
| Notre Dame University | 1 | Briefing | 2007 |
| Polytechnic West | 2 | Tour | 2011, 2012 |
| University of Western Australia - Population Health | 1 | Briefing, tour | 2011 |
| University of Western Australia - Centre for Water Research | 3 | Briefing, presentation | 2010, 2011, 2012 |
| Prof Don Bursill, Co-Chair, Premier's Science and Research Council, and Chief Scientist for SA | 1 | Briefing | 2012 |
| **Media** | | | |
| 16 media releases were issued over the course of the trial.<br>Tours were provided to various media outlets including: | | | |
| ABC News | | The West Australian | |

| STAKEHOLDER | NO. | BRIEFING METHOD(S) | DATE(S) |
|---|---|---|---|
| Channels 7, 9 and 10 News | | The Weekend West - West Cadets | |
| Community News Group | | The Sunday Times | |
| **Internal** | | | |
| Water Corporation Customer Advisory Council | 5 | Briefing, presentation, tour | 2008, 2009, 2011, 2012 |
| Water Corporation Staff | 32 | Briefing, presentation, tour | 2010 - 2012 |
| **Other interested organisations and groups** | | | |
| WA Local government shires (other than the Cities of Joondalup, Stirling and Wanneroo) | 8 | Presentations and/or tours | 2010 - 2012 |
| Community interest groups | 5 | Presentations and/or tours | 2010 - 2012 |
| Engineering consultancies | 24 | Presentations and/or tours | 2010 - 2012 |
| Engineering professional bodies | 14 | Presentations and/or tours | 2010 - 2012 |
| General interest groups | 13 | Presentations and/or tours | 2010 - 2012 |
| Interstate regulating agencies | 9 | Presentations and/or tours | 2010 - 2012 |
| Interstate and international water utilities | 11 | Presentations and/or tours | 2010 - 2012 |
| Interstate and International Academic Organisations | 5 | Presentations and/or tours | 2010 - 2012 |
| **TOTAL STAKEHOLDER BRIEFINGS** | **418** | | |

| **Tour groups** | | |
|---|---|---|
| General community tours | 92 groups | |
| Schools Tours | 250 groups | |