



Government of Western Australia
Department of Water

Australind, Eaton and Picton Water Reserves

Drinking water source protection plan
Australind regional water supply scheme



Looking after all our water needs

Water resource protection series
Report WRP 128
June 2011

Australind, Eaton and Picton Water Reserves drinking water source protection plan

Australind Regional Water Supply Scheme
(Australind, Brunswick Junction, Burekup, Eaton,
Pelican Point, Picton and Roelands town water
supplies)

Looking after all our water needs

Department of Water

Water Resource Protection series

Report no. WRP 128

June 2011

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Cover photograph: Aerial photograph of Australind and Eaton

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Summary

Australind, Eaton and Picton are located approximately 150 km south of Perth and 5 km north-east of Bunbury (see Figure A1). Australind is in the Shire of Harvey and Eaton and Picton are in the Shire of Dardanup. The Australind Regional Water Supply Scheme, operated by the Water Corporation, supplies drinking water to at least 20 000 people in the towns of Australind, Eaton, Burekup, Brunswick Junction, Pelican Point, Picton and Roelands (Australian Bureau of Statistics 2006).

Drinking water for the Australind Regional Water Supply Scheme is sourced from seven production bores; five production bores in Australind and two production bores in Eaton. An additional production bore is expected to be brought online in Picton during 2011–2012.

The Water Corporation's production bores abstract water from the Leederville and Yarragadee aquifers (see *Summary of key information* below). Both of these aquifers are considered to be locally confined and therefore there is negligible risk from contamination that may occur at the surface.

This plan recommends:

- proclaiming the Australind, Eaton and Picton bore fields as public drinking water source areas under the *Country Areas Water Supply Act 1947* (WA)
- managing the land in these water reserves for priority 1 (P1) water source protection
- recognising these water reserves in the Shire of Harvey and Shire of Dardanup local planning schemes and other applicable schemes and strategies
- using best management practices for existing or future bore construction and maintenance in an around these water reserves.

Summary of key information

Australind, Eaton and Picton Water Reserves	
Local government authority	Shire of Dardanup (Eaton and Picton) and Shire of Harvey (Australind)
Locations supplied	Australind Regional Water Supply Scheme (Australind, Brunswick Junction, Burekup, Eaton, Pelican Point, Picton and Roelands)
Aquifer type	Locally confined (therefore negligible risks from contamination at the surface)

Volume of water abstracted	3 447 653 kL (2009-10) Australind (Leederville aquifer) 98 854 kL (2009-10) Australind (Yarragadee aquifer) 1 289 916 kL (2009-10) Eaton (Yarragadee aquifer)												
Number of production bores	5 – Australind water reserve 2 – Eaton water reserve 1 – Picton water reserve (yet to be commissioned)												
Bore name, GPS coordinates and aquifer	Australind 1/77 (E 380 447, N 6 318 403) – Yarragadee aquifer 1/82 (E 381 207, N 6 319 131) – Leederville aquifer 3/92 (E 381 214, N 6 320 321) – Leederville aquifer 1/97 (E 380 451, N 6 318 421) – Leederville aquifer 1/06 (E 381 166, N 6 319 347) – Leederville aquifer Eaton 4/72 (E 379 673, N 6 313 021) – Yarragadee aquifer 1/75 (E 379 690, N 6 313 035) – Yarragadee aquifer Picton 4/83 (E 379 793, N 6 311 115) – Yarragadee aquifer												
Date of bore completion	<table> <tr> <td>Australind</td><td>Eaton</td></tr> <tr> <td>1/77 – 1977 (standby bore)</td><td>4/72 – 1972</td></tr> <tr> <td>1/82 – 1982</td><td>1/75 – 1975</td></tr> <tr> <td>3/92 – 1992</td><td></td></tr> <tr> <td>1/97 – 1997</td><td>Picton</td></tr> <tr> <td>1/06 – 2006</td><td>4/83 – 1983</td></tr> </table>	Australind	Eaton	1/77 – 1977 (standby bore)	4/72 – 1972	1/82 – 1982	1/75 – 1975	3/92 – 1992		1/97 – 1997	Picton	1/06 – 2006	4/83 – 1983
Australind	Eaton												
1/77 – 1977 (standby bore)	4/72 – 1972												
1/82 – 1982	1/75 – 1975												
3/92 – 1992													
1/97 – 1997	Picton												
1/06 – 2006	4/83 – 1983												
Proclamation status	Proclamation will need to be progressed under the <i>Country Areas Water Supply Act 1947</i> (WA) when this plan is finalised.												

1 Overview of the Australind Regional Water Supply Scheme

1.1 The drinking water supply system

The Australind Regional Water Supply Scheme supplies drinking water to seven towns including Australind, Eaton, Brunswick Junction, Roelands, Burekup, Pelican Point and Picton.

It should be recognised that although filtration and disinfection are essential barriers against water quality contamination, catchment management is the first step in protecting water quality and ensuring a safe drinking water supply. This approach is endorsed by the *Australian drinking water guidelines, 2004* (ADWG) (NHMRC & NRMCC 2004a) and reflects a risk-based, multiple-barrier approach for providing safe drinking water to consumers. This combination of catchment protection and water treatment will deliver a more reliable, safer and lower-cost drinking water to consumers than either approach could achieve individually.

For more information on why it is so important to protect our catchments, please refer to Appendix D.

1.1.1 Australind bore field

The Australind bore field consists of five production bores and two monitoring bores (Figure A2 and Figures C1 to C5). Four of these production bores (1/82, 3/92, 1/97 and 1/06) abstract water from the Leederville aquifer, while one standby production bore (1/77) abstracts water from the Yarragadee aquifer. The two monitoring bores (1/92 and 2/92), located west of the Leschenault Inlet, monitor any adverse pumping impacts on the position of the saline interface in the Leederville aquifer.

Water abstracted from the Leederville aquifer is pumped to the Australind water treatment plant where it is filtered to reduce iron and manganese, pH-corrected using sodium hydroxide and chlorinated for disinfection. Treated water is then pumped to water supply tanks before entering the reticulated supply. Water from the Australind bore field augments the Eaton supply when necessary.

The Yarragadee aquifer bore (1/77) is only used to supplement the Leederville aquifer bores during times of high demand. Water abstracted from this bore is chlorinated at the bore site and pumped to storage tanks where it is mixed with treated water from the Australind water treatment plant.

1.1.2 Eaton bore field

The Eaton bore field consists of two production bores (4/72 and 1/75) that abstract water from the Yarragadee aquifer (Figure A2 and Figure C6). These bores pump water to the Eaton water treatment plant where it undergoes filtration for iron and manganese removal and chlorination for disinfection. It is then pumped to holding tanks before being gravity-fed or pumped into Eaton's reticulated supply.

1.1.3 Picton bore field

The Picton bore field consists of one production bore (4/83) screened in the Yarragadee aquifer (Figure A2). This bore is scheduled to come online during 2011/12 when the new Picton drinking water treatment plant is completed (Figure C7).

1.2 Water management

1.2.1 Licence to take water

Water resource use and conservation in Western Australia (WA) is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914*. Under this Act, the right to use and control water is vested with the Crown. This means that a licence is required for drilling bores and abstracting groundwater (pumping water from a bore, spring or soak) within proclaimed groundwater areas throughout the state. Some exemptions may apply such as abstracting water for domestic or stock-watering purposes.

The Water Corporation holds two licences to take water for the Australind Regional Water Supply Scheme. These licences are for a ten year term. GWL108048(8) allows abstraction of 3 340 000 kL per annum from the Perth-Yarragadee South aquifer within the Bunbury Groundwater Area, Bunbury-Yarragadee subarea. GWL107987(6) allows abstraction of 3 260 000 kL per annum from the Perth-Leederville aquifer within the Bunbury Groundwater Area, Kemerton South subarea. These groundwater areas and subareas are proclaimed under the *Rights in Water and Irrigation Act 1914*.

1.2.2 Water planning

South West Regional Water Plan 2010 – 2030

The *South West Regional Water Plan 2010 – 2030* (Department of Water 2010a) outlines our strategic actions to achieve integrated sustainable water resource management in the region. The plan introduces seven water resource management themes that cover all the major issues facing the region.

The plan recognises the importance of protecting public drinking water source areas (PDWSA) under theme 5: *Provide integrated water services for urban communities*. The development and implementation of drinking water source protection plans are strategic actions put forward to achieve the objective: *Government and water utilities provide an integrated approach to water service management and delivery for viable and healthy communities*.

The plan's supporting detail (Department of Water 2010b) contains the relevant information underlying the plan and provides a deeper understanding of the issues and proposed solutions.

South West groundwater areas allocation plan

The South West groundwater areas allocation plan (Department of Water 2009) provides our direction for the allocation of groundwater in the south-west area. The plan also provides the department's policies on licensing and allocating water, objectives for the water resource and objectives for managing water allocation.

The plan describes available water resources and groundwater allocation within the area. The Yarragadee aquifer in the Bunbury-Yarragadee subarea is fully allocated while the Leederville aquifer in the Kemerton South subarea has limited availability.

1.2.3 Future water needs

The Water Corporation predict abstraction will reach the allocated limit in 2021. An additional 1 000 000 kL is expected to be required for the future development of land in the area consistent with existing local planning schemes.

1.3 Characteristics of the catchments

1.3.1 Physical environment

The Australind region is located on the Swan Coastal Plain; a flat to gently undulating sand plain with sandy hills generally lower than 30 m AHD. Numerous shallow drainage lines cross the plain, draining to wetlands and the sea. The Swan Coastal Plain terminates at the Darling Scarp to the east and the Whicher Scarp to the south.

1.3.2 Climate

The Australind region has a Mediterranean-type climate with warm, dry summers and cool, wet winters. Average temperatures range from 15–30°C in January to 7–17°C in July (BoM 2011a). Average rainfall for the region is 774 mm per annum (BoM 2011b), with the majority of rainfall occurring between June and August.

1.3.3 Hydrogeology

Eaton and Australind are situated at the northern margin of the Bunbury trough, a structural division of the Perth Basin. The Bunbury trough is a deep graben, bounded to the east by the Darling Scarp and to the west by the Busselton Fault.

The upper formations in which fresh groundwater may occur comprise the superficial, Leederville, Yarragadee and Cockleshell Gully Formations.

The superficial formations are considered unconfined and comprise a relatively thin cover (up to 30 m) of sand, silt, clay and limestone. Groundwater from the superficial formations is generally brackish and bore yields are low, making it unsuitable for town water supply purposes.

The Leederville formation consists of interbedded sandstone, siltstone and shale with an average thickness of 150 m. Recharge to the aquifer mainly occurs in the south over the Blackwood Plateau where the formation outcrops. Groundwater flows radially between north-east and north-west from the recharge area. The Leederville

aquifer is considered locally confined in the Australind area where the production bores are situated. A saline interface occurs along the south-east shore of the Leschenault Inlet. This interface has not affected the Australind water supply bores. In the Eaton area, groundwater from the Leederville is not considered suitable due to high iron content, the potential for saltwater intrusion and conflict with private water users.

The Yarragadee formation comprises sandstone interbedded with minor siltstone, shale and mudstone. Locally, the Yarragadee formation is overlain by the Bunbury basalt and is considered confined. Recharge to the Yarragadee formation is predominantly via vertical leakage from the overlying Leederville formation in the recharge areas on the Blackwood Plateau to the south and east. The Yarragadee aquifer is of higher quality in the Eaton area than the Australind area. Groundwater flows in a north to north-westerly direction in this region of the Yarragadee formation.

The Cockleshell Gully formation underlies the Yarragadee formation. In the vicinity of Australind, groundwater salinity is generally brackish to saline. This aquifer is not used for public water supply purposes in the region.

1.4 How is the drinking water protected?

The Australind, Eaton and Picton sources are not yet proclaimed under the *Country Areas Water Supply Act 1947*.

The confining layers of rock above the Leederville and Yarragadee aquifers act as natural barriers to contamination from surface land uses and activities.

The production bores are sealed and capped to prevent the inflow of potentially contaminated surface waters directly into the aquifer through the production bores. The Water Corporation ensures the integrity of the seals and capping through regular inspections and maintenance.

The Water Corporation employs best management practices for operating and managing the production bores, water treatment plants and compounds (Water Corporation 2011). The production bores and water treatment plants are contained in fenced, locked compounds to deter unauthorised access and vandalism (Figure C8). The compounds are regularly inspected by Water Corporation staff.

1.5 Other useful information

1.5.1 Other groundwater bores in the area

The Water Corporation operates drinking water bores in the Australind, Eaton and Picton water reserves. If bores for other purposes (e.g. irrigation, private household use) are drilled near a public drinking water supply bore, they can cause contamination of the drinking water source. For example, a poorly constructed private bore may introduce contaminants from surface leakage down the outside of the bore casing into an otherwise uncontaminated aquifer.

Poorly constructed bores in a confined aquifer may also create a connection with a superficial aquifer, across the protective confining layer. Contaminants in the superficial aquifer may then be introduced into the confined aquifer along this potential pathway.

It is therefore important to ensure that any bores are appropriately located and constructed to prevent contamination of the public drinking water source. This will be assessed through the Department of Water's water licensing process where applicable under the *Rights in Water and Irrigation Act 1914*. All bores should be constructed in accordance with *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003).

2 Common contamination risks

A wide range of microbiological, chemical and physical contamination risks can impact on water quality and therefore affect the provision of safe, good quality drinking water to consumers.

Some contaminants in drinking water can affect human health. Other impurities can affect the water's aesthetic qualities, including its appearance, taste, smell and 'feel' but are not necessarily hazardous to human health. For example, cloudy water with a distinctive odour or strong taste may not be harmful to health, but clear, pleasant-tasting water may contain harmful, undetectable microorganisms (NHMRC & NRMCC 2004b). Contaminants can also interfere with water treatment processes, and destroy water supply infrastructure (such as pipes).

The ADWG outlines criteria for acceptable drinking water quality to protect human health, aesthetics and water supply infrastructure.

For more information about water quality in this drinking water source, see section 3.

Some commonly-seen contamination risks relevant to groundwater drinking water sources are described below.

2.1 Microbiological

Pathogens are types of microorganisms that are capable of causing illness. These include bacteria, protozoa and viruses. In drinking-water supplies, pathogens that can cause illness are commonly found in the faeces of humans and domestic animals (such as dogs and cattle).

Pathogens can enter drinking water supplies from faecal contamination in the water reserve. In groundwater sources, this occurs indirectly – faecal material can infiltrate through the soil and into the groundwater. For example, contamination can occur from septic tanks or grazing animals.

A number of pathogens are commonly known to contaminate water supplies worldwide. These include bacteria (e.g. salmonella, *Escherichia coli* and cholera), protozoa (e.g. *Cryptosporidium*, *Giardia*) and viruses. *E. coli* counts provide an indication of the level of faecal contamination.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (e.g. humans and domestic animals), the transfer to and movement of the pathogen in the water source and its ability to survive in the water. The percentage of humans in the world that carry pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich 1996).

The survival and movement of pathogens in groundwater is influenced by the characteristics of the pathogen (such as its size and the length of time it normally takes to decay) and the groundwater properties (including flow rate, porosity, amount

of carbon in the soil, temperature, and pH). Inactivation rate (the time it normally takes a pathogen to decay) is one of the most important factors governing how far pathogens may migrate. Typical half-lives of pathogens range from a few hours to a few weeks. For example, reported migration distances of bacteria in groundwater are:

- 600 m in a sandy aquifer
- 1000–1600 m in channelled limestone
- 250–408 m in glacial silt-sand aquifers (Robertson & Edbery 1997).

Therefore it is important to understand the groundwater system to be able to protect the drinking water source from pathogens.

When people consume drinking water contaminated with pathogens the effects may vary considerably, ranging from mild illness (such as stomach upset or diarrhoea) to hospitalisation and sometimes even death. During 2000, seven people died in Walkerton, Canada, because the town's water supply was contaminated by a pathogenic strain of *E. coli* and campylobacter (NHMRC & NRMMC 2004b). Where possible, avoiding the introduction of pathogens into a water source is the most effective way to protect public health.

2.2 Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water (cloudiness). Increased turbidity can result in cloudy or muddy-looking water, which is not very appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens can adsorb onto soil particles and may be shielded from the effects of disinfection. Chemicals can also attach to suspended soil particles.

Some physical properties of water such as pH (a measure of acidity or alkalinity) can contribute to the corrosion and encrustation of pipes. Other properties such as iron and dissolved organic matter can affect the colour and smell of water. Although not necessarily harmful to human health, coloured or 'hard' water will not be as appealing to consumers. Salinity can affect the taste of drinking water.

2.3 Chemical risks

Chemicals can occur in drinking water as a result of natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC 2004a). A number of these chemicals (organic and inorganic) are potentially toxic to humans.

Pesticides include agricultural chemicals such as insecticides, herbicides, nematicides (used to control worms), rodenticides and miticides (used to control mites). Contamination of a drinking water source by pesticides (and other chemicals) may occur as a result of accidental spills, incorrect use or leakage from storage areas. In these cases, the relevant authorities should be notified promptly and the spill cleaned up to prevent contamination of the drinking water source.

Hydrocarbons (e.g. fuels, oils) are potentially toxic to humans, and harmful chemical by-products may be formed when they are combined with chlorine during the water-treatment process. Hydrocarbons can occur in water supplies as a result of spills and leakage from vehicles.

Drinking-water sources can also be contaminated by nutrients (such as nitrogen) from fertiliser applications, faulty septic systems, leach drains and from domestic and feral animal faecal matter that washes through or over soil and into a water source. Nitrate and nitrite (forms of nitrogen) can be toxic to humans at high levels, with infants younger than three months being most susceptible (NHMRC & NRMCC 2004a).

Other chemicals and heavy metals can be associated with land uses such as industry and landfill. These may enter drinking water sources and could be harmful to human health.

3 Contamination risks to these drinking water sources

3.1 Water quality

The Water Corporation regularly monitors the quality of raw water from the Australind and Eaton bore fields for microbiological, health-related and aesthetic (non-health-related) characteristics. An assessment of the drinking water quality once treated is also made against the ADWG. This assessment is made by an intergovernmental committee called the Advisory Committee for the Purity of Water that is chaired by the Department of Health.

A water quality summary for the Australind and Eaton bore fields, between December 2005 and November 2010, is presented in Appendix B. For more information on water quality, see the Water Corporation's most recent drinking water quality annual report at <www.watercorporation.com.au> What we do > Water quality > Water quality publications > Click on the most recent *Water quality annual report*.

3.1.1 Australind bore field

Raw water from the Leederville aquifer at Australind is characterised by naturally occurring levels of iron, turbidity and occasionally colour above the ADWG aesthetic guidelines. The pH is typically below the aesthetic guidelines, while naturally occurring manganese levels are above the ADWG health guidelines. Treatment of the raw water ensures levels of manganese, iron, colour, turbidity and pH in the reticulated water meet the ADWG guidelines.

Raw water from the Yarragadee aquifer at Australind is of lower quality, with naturally occurring levels of chloride, iron, sodium, suspended solids and pH above the ADWG aesthetic guidelines. The Yarragadee aquifer at Australind is used as an emergency source only. Water from this bore is mixed with treated water from the Australind water treatment plant to ensure levels of chloride, iron, colour, turbidity and pH in the reticulated water meet the ADWG guidelines.

3.1.2 Eaton bore field

Raw water from the Yarragadee aquifer at Eaton is characterised by naturally occurring levels of iron and turbidity above the ADWG aesthetic guidelines. Treatment of the raw water ensures levels of iron and turbidity in the reticulated water meet the ADWG guidelines.

3.2 Land uses and activities

The Australind, Eaton and Picton Water Reserves are located over crown land vested in the Water Corporation or freehold land owned by the Water Corporation.

The water quality contamination risks to the Australind, Eaton and Picton drinking water sources were assessed in accordance with the ADWG. As the drinking water is

drawn from confined groundwater sources and the bores are appropriately constructed and sealed, there is negligible potential for contamination from surrounding land uses. This is because confining layers of rock sit above the groundwater resources, acting as barriers to contamination from surface land uses and activities.

4 Protecting your drinking water sources

This plan's objective is to protect water quality in the Australind, Eaton and Picton Water Reserves to ensure safe drinking water for the Australind Regional Water Supply Scheme.

4.1 Proclaiming the public drinking water source areas

This plan recommends proclamation of the proposed Australind, Eaton and Picton Water Reserves under *Country Areas Water Supply Act 1947* (WA) (Figure A3).

Small water reserves (approximately 20 m² each) are proposed around each production bore within the Water Corporation compounds in Australind, Eaton and Picton. These water reserves will not extend outside the Water Corporation compounds. This will ensure the locations of these drinking water supply bores are identified, and can therefore be protected.

At the time of proclamation, the department will consider defining the boundaries of the water reserves to reflect the entire compounds or lots managed by the Water Corporation, depending on the advice of the Water Corporation.

Once the water reserves are proclaimed, the local government authorities should incorporate them into their planning schemes consistent with State planning policy no. 2.7: *Public drinking water source policy*. PDWSAs are commonly shown in planning schemes as special control areas. This provides guidance for state and local government planning decision makers and developers. In the case of these small water reserves, the intention is to ensure any other confined aquifer bores are constructed to meet the *Minimum construction requirements for water bores in Australia* (National Minimum Bore Specifications Committee 2003) to protect the drinking water supply.

4.2 Defining priority areas

The protection of PDWSAs relies on statutory and non-statutory measures for water resource management and land-use planning. The Department of Water's policy for the protection of PDWSAs includes a system that defines three specific priority areas:

- priority 1 (P1) areas have the fundamental water quality objective of risk avoidance (e.g. state forest and other crown land)
- priority 2 (P2) areas have the fundamental water quality objective of risk minimisation (e.g. land that is zoned rural)
- priority 3 (P3) areas have the fundamental water quality objective of risk management (e.g. areas zoned urban or light/general industrial).

The determination of priority areas is based on the strategic importance of the land or water source including risks to water quality and quantity, the local planning-scheme

zoning, the form of land tenure and existing approved land uses or activities. For further detail, please refer to our water quality protection note (WQPN) no. 25: *Land use compatibility in public drinking water source areas*.

For an explanation of the background and support for protection of PDWSAs, please refer to WQPN no. 36: *Protecting public drinking water source areas*.

We propose to assign the all the land in the Australind, Eaton and Picton Water Reserves as P1 because:

- water from these sources constitutes a strategic supply to the Australind Regional Water Supply Scheme
- all the freehold land in the water reserves is owned by the Water Corporation
- all the crown land in the water reserves is vested in the Water Corporation.

4.3 Defining protection zones

In addition to priority areas, protection zones are normally defined to protect drinking-water sources from contamination in the immediate vicinity of water extraction facilities. Specific conditions may apply within these zones such as restrictions on the storage of chemicals or public access.

Wellhead protection zones (WHPZs) are generally circular (unless information is available to determine a different shape or size), with a 500 m radius around each production bore in a P1 area and a 300 m radius around each production bore in P2 and P3 areas. WHPZs do not extend outside the boundary of the water reserve.

WHPZs are not considered necessary for these water reserves due to the confined nature of the water sources at Australind, Eaton and Picton and the fenced compounds around the production bores located on land managed by the Water Corporation.

4.4 Education and awareness-raising

Education and awareness-raising (such as through providing information on signs and in publications) are key mechanisms for protecting water quality, especially for people visiting the area. We will produce a brochure once this plan is finalised, describing the Australind, Eaton and Picton Water Reserves and their location. The brochure will inform people in simple terms about the drinking water sources and why it is important to protect them.

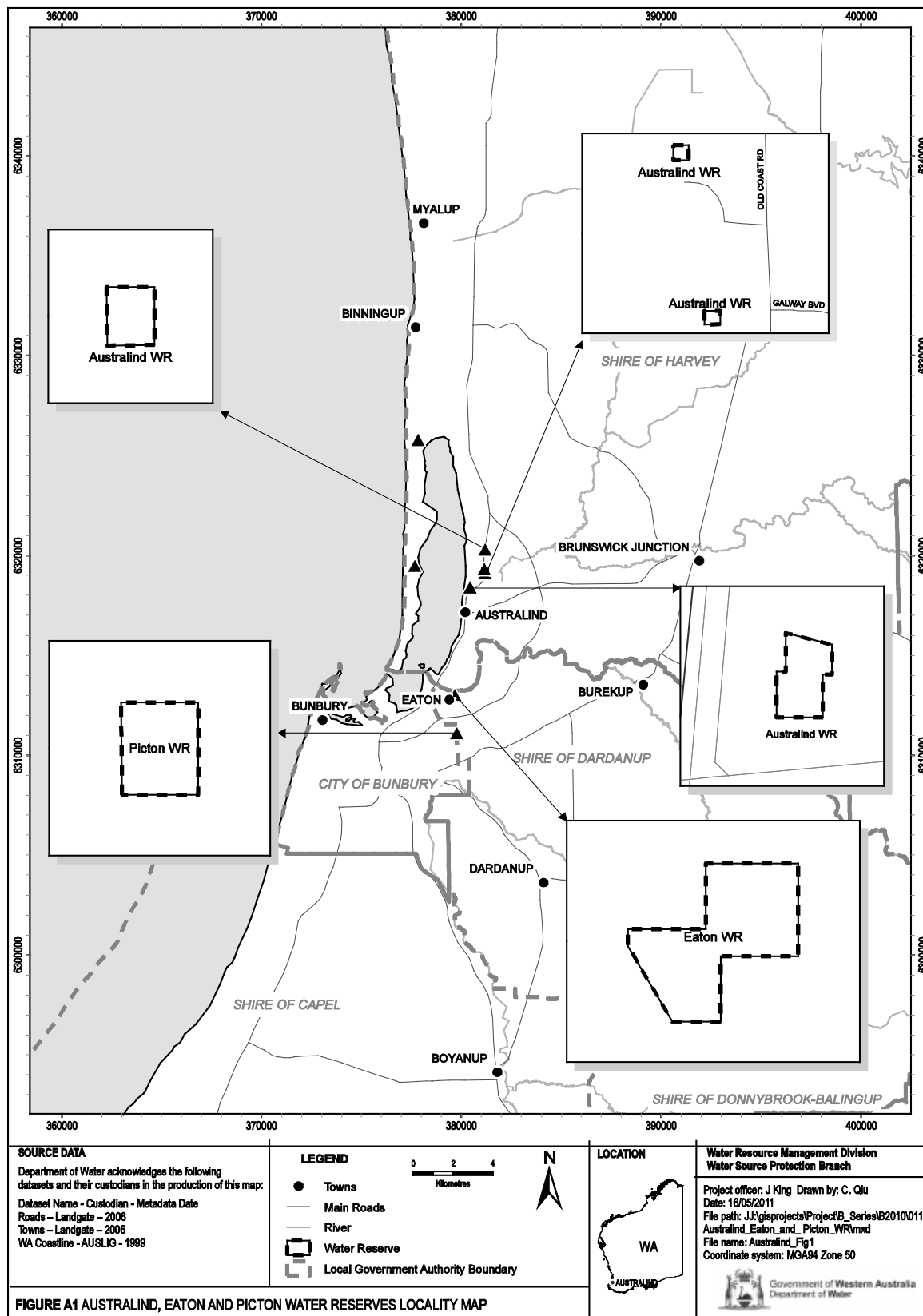
5 Recommendations

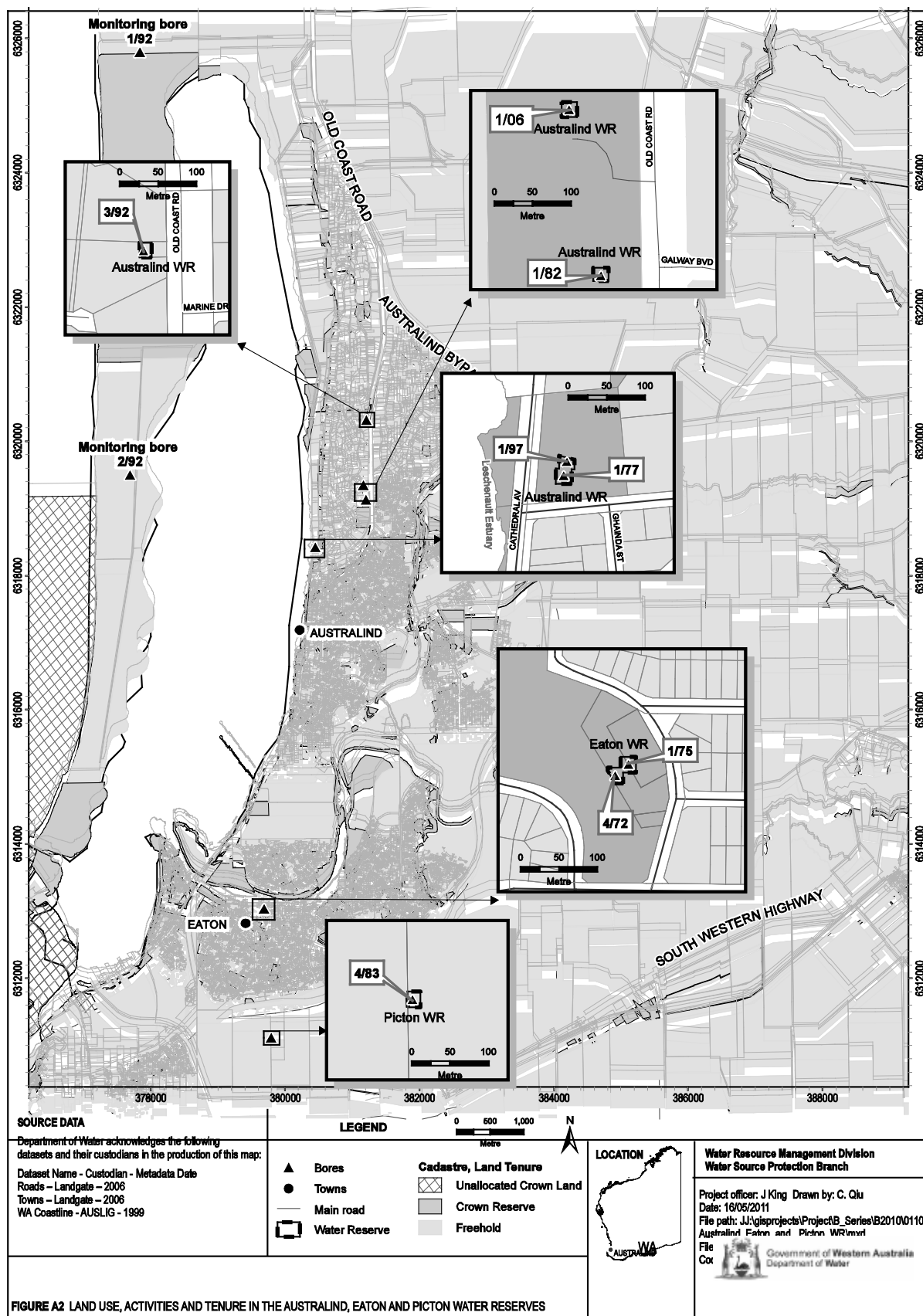
The following recommendations apply to the Australind, Eaton and Picton Water Reserves. The bracketed stakeholders are those expected to have a responsibility for, or an interest in the relevant recommendation being implemented.

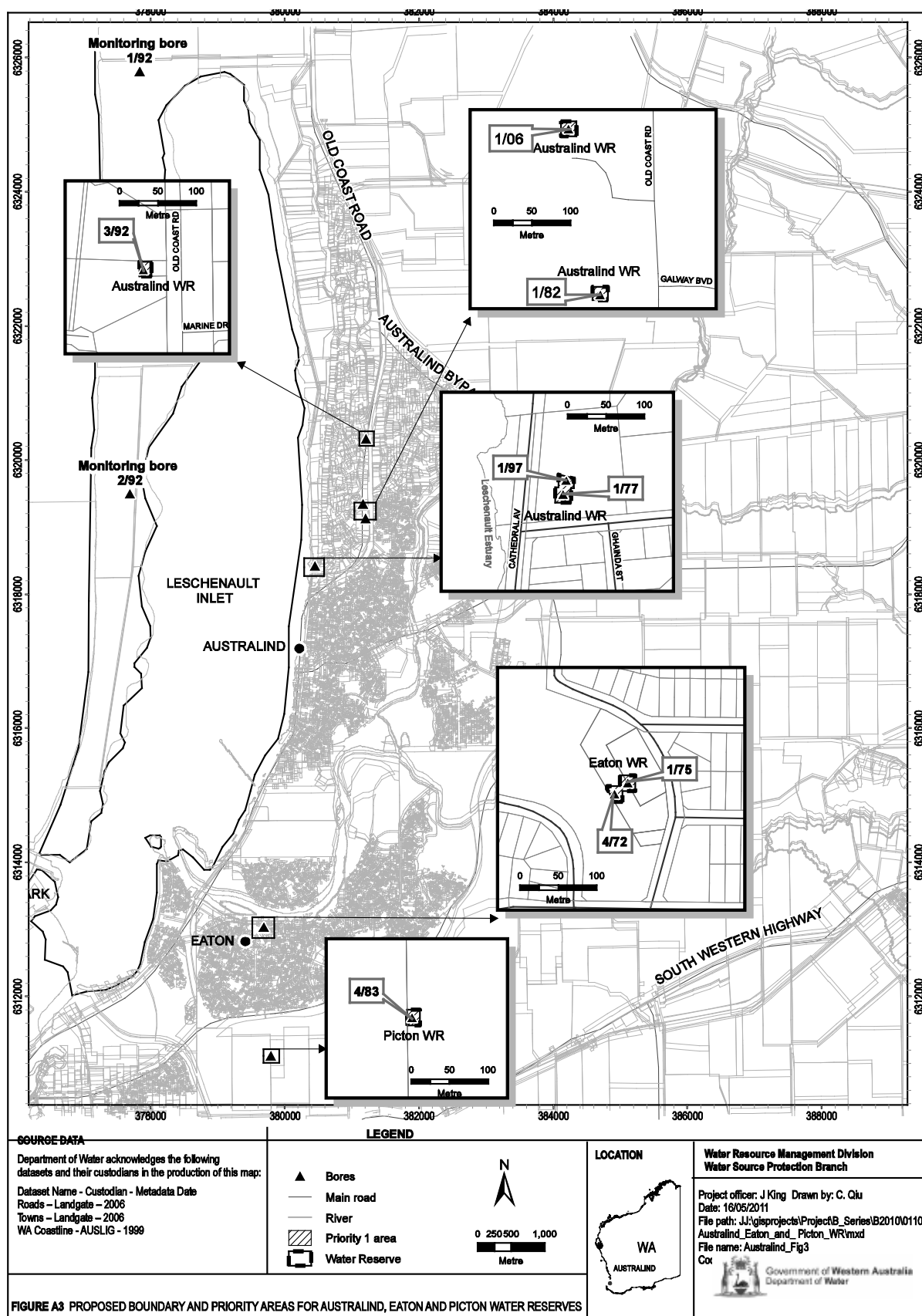
1. Proclaim the Australind, Eaton and Picton Water Reserves under the *Country Areas Water Supply Act 1947* (WA). (Department of Water)
2. Reflect the Australind, Eaton and Picton Water Reserves in the Shire of Dardanup and Shire of Harvey local planning schemes in accordance with the WAPC's Statement of planning policy no. 2.7: *Public drinking water source policy*. (Shire of Dardanup, Shire of Harvey)
3. Incidents covered by WESTPLAN–HAZMAT in the Australind, Eaton and Picton Water Reserves should be addressed by ensuring that:
 - the South West LEMC is aware of the location and purpose of the Australind, Eaton and Picton Water Reserves
 - the locality plan for the Australind, Eaton and Picton Water Reserves is provided to the FESA headquarters for the HAZMAT emergency advisory team
 - the Water Corporation acts in an advisory role during incidents in the Australind, Eaton and Picton Water Reserves
 - personnel dealing with WESTPLAN–HAZMAT incidents in the area have ready access to a locality map of the Australind, Eaton and Picton Water Reserves and information to help them recognise the potential impacts of spills on drinking water quality. (Water Corporation)
4. Erect signs on the boundary of the Australind, Eaton and Picton Water Reserves. (Water Corporation)
5. Review this plan after five years. (Department of Water)

Appendices

Appendix A – Figures







Appendix B — Water quality data

The information provided in this appendix has been prepared by the Water Corporation.

The Water Corporation has monitored the raw (source) water quality from the Australind and Eaton bore fields in accordance with the *Australian Drinking Water Guidelines* (ADWG) and interpretations agreed to with the Department of Health. Water quality data for Picton is not available at this time. The raw water is regularly monitored for:

a. aesthetic-related characteristics (non-health related)

b. health-related characteristics

- health-related chemicals
- microbiological contaminants.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment, to name a few, exist downstream of the raw water to ensure it meets the requirements of the ADWG. For more information on the quality of drinking water supplied to the Australind refer to the most recent Water Corporation Drinking Water Quality Annual Report at www.watercorporation.com.au/W/waterquality_annualreport.cfm.

B1 Australind bore field

Following is data representative of the quality of raw water in the Leederville and Yarragadee aquifers at Australind. In the absence of specific guidelines for raw water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Results that exceed the ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

Aesthetic-related characteristics

Aesthetic water quality analyses for raw water from the Leederville and Yarragadee aquifers at Australind are summarised in Table 1.

The values are taken from ongoing monitoring for the period December 2005 to November 2010. All values are in milligrams per litre (mg/L) unless stated otherwise. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

Table 1 Aesthetic-related detections for the Australind bore field (Leederville and Yarragadee aquifers)

Parameter	Units	ADWG aesthetic guideline value*	Australind (Leederville)		Australind bore 1/77 (Yarragadee) [†]	
			Range	Median	Range	Median
Chloride	mg/L	250	135 - 150	142.5	410 - 480	442.5
Colour – true		15	<1 - >200	3	<1 - 8	<1
Hardness as CaCO ₃	mg/L	200	78 - 88	80	79 - 111	97
Iron unfiltered	mg/L	0.3	15 - 21	18	0.116 - 2.6	0.4
Sodium	mg/L	180	72 - 81	73	330 - 340	335
Total filterable solids by summation	mg/L	500	398 - 413	401.5	1000 - 1120	1067
Turbidity	NTU	5	1.5 - 220	55	0.5 - 8	1.45
pH measured in laboratory	No Unit	6.5 – 8.5	6.05 – 6.57	6.24	7.6 – 9.09	8.65
Zinc [^]	mg/L	3	0.02	0.02	-	-

* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

[^] Based on three or less samples.

[†] Australind bore 1/77 is used only as an emergency source due to water quality issues.

Health-related characteristics

Health parameters

Raw water from the Leederville and Yarragadee aquifers at Australind is analysed for health-related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related water quality parameters that have been measured at detectable levels in the source between December 2005 and November 2010 are summarised in Table 2. Any parameters that have on occasion exceeded the ADWG are shaded. Manganese is removed during treatment processes.

Table 2 Health-related detections for the Australind bore field (Leederville and Yarragadee aquifers)

Parameter	Units	ADWG health guideline value*	Australind (Leederville)		Australind bore 1/77 (Yarragadee)	
			Range	Median	Range	Median
Manganese unfiltered	mg/L	0.5	0.42 – 0.74	0.57	0.014 – 0.07	0.0325
Mercury	mg/L	0.001	<0.0005 – 0.0006	<0.0005	<0.0005 – <0.0005	<0.0005
Nitrite plus Nitrate as N	mg/L	11.29	<0.002 – 0.01	<0.03	<0.05 – <0.05	<0.05
Sulphate	mg/L	500	11 – 16	12	0.44 – 59	34.5
Barium	mg/L	0.7	0.3 – 0.4	0.35	0.08 – 0.1	0.09
Boron	mg/L	4	0.05 – 0.08	0.06	0.75 – 0.76	0.755
Molybdenum	mg/L	0.05	<0.0005 – <0.0005	<0.0005	0.0016 – 0.002	0.0018
Selenium	mg/L	0.01	<0.003 – <0.003	<0.003	<0.003 – 0.003	<0.003
Copper [^]	mg/L	2	0.03 – 0.03	0.03	-	-
Radon – 222	Bq/L	100	5.7 – 12.6	9.925	-	-
Fluoride laboratory measurement	mg/L	1.5	0.15 – 0.25	0.2	-	-

* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & NRMCC 2004a).

[†] The guideline value of 11.29 mg/L (as nitrogen) has been set to protect bottle fed infants less than three months of age. Up to 22.58 mg/L (as nitrogen) can be safely consumed by adults and children over three months of age.

[^] Based on three or less samples.

Microbiological contaminants

Microbiological testing of raw water samples from the Leederville and Yarragadee aquifers at Australind is currently conducted on a monthly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water.

A detection of *Escherichia coli* in raw water abstracted from any bore may indicate contamination of faecal material through ingress in the bore, or recharge through to the aquifer (depending on aquifer type).

During the review period of December 2005 to November 2010, *Escherichia coli* was not detected in any samples.

B2 Eaton bore field

Following is data representative of the quality of raw water in the Eaton bore field. In the absence of specific guidelines for raw water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customers tap. Results that exceed the ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

Eaton bore water supply is also supplemented with Australind supply water during periods of high demand.

Aesthetic-related characteristics

Aesthetic water quality analyses for raw water from the Eaton bore field are summarised in Table 3.

The values are taken from ongoing monitoring for the period December 2005 to November 2010. All values are in milligrams per litre (mg/L) unless stated otherwise. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

Table 3 Aesthetic-related detections for the Eaton bore field (Yarragadee aquifer)

Parameter	Units	ADWG aesthetic guideline value*	Eaton (Yarragadee)	
			Range	Median
Chloride	mg/L	250	110 - 125	115
Colour - true	TCU	15	<1 - 20	<1
Hardness as CaCO ₂	mg/L	200	110 - 120	118
Iron unfiltered	mg/L	0.3	0.133 - 6	4.8
Sodium	mg/L	180	61 - 64	62.5
Total filterable solids by summation	mg/L	500	389 - 412	399
Turbidity	NTU	5	3 - 80	48
pH measured in laboratory	No unit	6.5 – 8.5	6.45 – 7.01	6.63

* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

Health-related characteristics

Health parameters

Raw water from the Eaton bore field is analysed for health related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related water quality parameters that have been measured at detectable levels in the

source between December 2005 and November 2010 are summarised in Table 4. No health parameters exceeded the ADWG.

Table 4 Health-related detections for the Eaton bore field (Yarragadee aquifer)

Parameter	Units	ADWG health guideline value*	Eaton (Yarragadee)	
			Range	Median
Nitrate as nitrogen	mg/L	11.29	<0.002 – 0.014	0.003
Nitrite as nitrogen	mg/L	0.91	<0.002 – 0.004	<0.002
Nitrite plus nitrate as N	mg/L	11.29	<0.002 – 0.014	<0.032
1,4 - Dichlorobenzene	ug/L	40	<1 - 1	1
Tributyltin oxide as tin	ug/L	1	<0.002 – 0.002	<0.002
Manganese unfiltered	mg/L	0.5	0.006 – 0.2	0.13
Sulphate	mg/L	500	14 - 15	14
Boron	mg/L	4	0.1 – 0.1	0.1
Copper	mg/L	2	0.01 – 0.014	0.012
Radon – 222	Bq/L	100	1.5 – 2.68	2.07
Fluoride laboratory measurement	mg/L	1.5	0.15 – 0.15	0.15

* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & NRMCC 2004a).

† The nitrate and nitrite plus nitrate guideline value of 11.29 mg/L (as nitrogen) has been set to protect bottle fed infants under three months of age. Up to 22.58 mg/L as nitrogen can be safely consumed by adults and children over three months of age.

Microbiological contaminants

Microbiological testing of raw water samples from the Eaton bore field is currently conducted on a monthly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water.

A detection of *Escherichia coli* in raw water abstracted from any bore may indicate contamination of faecal material through ingress in the bore, or recharge through to the aquifer (depending on aquifer type).

During the review period of December 2005 to November 2010, *Escherichia coli* was not detected in any samples.

Appendix C — Photographs



Figure C1 *Australind Water Reserve production bore 1/77*



Figure C2 *Australind Water Reserve production bore 1/97*



Figure C3 Australind Water Reserve production bore 3/92



Figure C4 Australind Water Reserve production bore 1/06



Figure C5 Australind Water Reserve production bore 1/82



Figure C6 Eaton Water Reserve production bores 1/75 (foreground) and 4/72 (background)



Figure C7 Picton Water Reserve drinking water treatment plant and compound under construction



Figure C8 Fenced and locked compound around production bore 1/77 in the Australind Water Reserve

Appendix D — How do we protect public drinking water source areas?

The *Australian drinking water guidelines* (ADWG) (NHMRC & NRMCC 2004a) outline how we should protect drinking water in Australia. The ADWG recommends a 'catchment to consumer' framework that uses a preventive risk-based and multiple-barrier approach. A similar approach is recommended by the World Health Organization.

The 'catchment to consumer' framework applies across the entire drinking water supply system – from the water source to your tap. It ensures a holistic assessment of water quality risks and solutions to ensure the delivery of a reliable and safe drinking water to your home.

A preventive risk-based approach means that we look at all the different risks to water quality, in order to determine what risks can reasonably be avoided and what risks need to be minimised or managed. This approach means that the inherent risks to water quality are as low as possible. A multiple-barrier approach means that we use different barriers against contamination at different stages of a drinking water supply system.

The first and most important barrier is protecting the catchment. If we get this barrier right, it has a 'flow-on effect' that can result in a lower cost, safer drinking water supply. Other barriers against contamination include storage of water to help reduce contaminant levels, disinfecting the water (e.g. chlorination to inactivate pathogens), maintenance of pipes and testing of water quality. Another community benefit of catchment protection is its complimentary nature to conservation initiatives.

Research and experience shows that a combination of catchment protection and water treatment is safer than relying on either barrier on its own. That's why this drinking water source protection review is important. We should not forget that ultimately it is about protecting your health, and about protecting the catchment's water quality now and for the future.

In Western Australia, the Department of Water protects public drinking water source areas (PDWSAs) by putting the ADWG into practice, writing plans, policies and guidelines, and providing input into land-use planning.

The *Metropolitan Water Supply, Sewerage and Drainage Act 1909* (WA) and the *Country Areas Water Supply Act 1947* (WA) provide us with the tools we need to protect water quality in PDWSAs. These tools allow us to assess and manage the water quality contamination risks from different land uses and activities. We work cooperatively with other agencies in the implementation of this legislation.

An important step in maximising the protection of water quality in PDWSAs is to define priority areas and protection zones to help guide land use planning and to identify where legislation applies. There are three different priority areas. Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality

of the drinking water source using the principle of risk avoidance. Priority 2 (P2) areas are defined and managed to maintain or improve the quality of the drinking water source using the principle of risk minimisation. Priority 3 (P3) areas are defined and managed to maintain the quality of the drinking water source for as long as possible using the principle of risk management. Protection zones surround drinking water extraction points (such as bores and reservoirs), so that the most vulnerable areas may be protected from contamination.

If you would like more information about the ADWG and how we protect drinking water in Western Australia, go to <<http://drinkingwater.water.wa.gov.au>> or email drinkingwater@water.wa.gov.au.

The following table outlines the stages involved in the preparation of this drinking water source protection plan:

Stages in development of a plan		Comment
1	Prepare drinking water source protection plan. February 2011	Draft protection plan prepared and released only to the Shire of Harvey, Shire of Dardanup and Water Corporation given the water sources are confined aquifers and not subject to contamination from surface land uses or activities.
2	Publish approved drinking water source protection plan. June 2011	Final protection plan published after considering submissions. Includes recommendations on how to protect water quality. Proclamation of this public drinking water source area can now be progressed.

List of shortened forms

ADWG	<i>Australian drinking water guidelines</i>
AHD	Australian height datum
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
Bq/L	Becquerel per litre
BoM	Bureau of Meteorology
HAZMAT	hazardous materials
kL	kilolitre
km	kilometre
LEMC	local emergency management committee
m	metres
mg/L	milligram per litre
mm	millimetre
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
NTU	nephelometric turbidity units
PDWSA	public drinking water source area
TCU	true colour units
TDS	total dissolved solids
WR	water reserve
WHPZ	wellhead protection zone
WESTPLAN–HAZMAT	Western Australian plan for hazardous materials

Glossary

Abstraction	The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.
Aesthetic guideline value	The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, e.g. appearance, taste and odour (NHMRC & NRMMC 2004a).
Allocation	The quantity of water that a licensee is permitted to abstract is their allocation, usually specified in kilolitres per annum (kL/a).
Augment	Augment means to increase the available water supply. For example, pumping back water from a secondary storage/reservoir dam.
Australian drinking water guidelines	The <i>National water quality management strategy: Australian drinking water guidelines</i> 6, 2004 (NHMRC & NRMMC 2004a) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's Bibliography).
Bore field	A group of bores to monitor or withdraw groundwater is referred to as a bore field.
Catchment	The physical area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Electrical conductivity	This estimates the volume of TDS or the total volume of dissolved ions in a solution (water) corrected to 25°C. Measurement units include millisiemens per metre and microsiemens per centimetre.
Graben	An elongated depression of rock between two geological faults.
Health guideline value	The concentration or measure of a water quality characteristic that, based on current knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHMRC & NRMMC 2004a).
Hydrocarbons	A class of compounds containing only hydrogen and carbon, such as methane, ethylene, acetylene and benzene. Fossil fuels such as oil, petroleum and natural gas all contain hydrocarbons.
mg/L	A milligram per litre (0.001 grams per litre) is a measurement of a total dissolved solid in a solution.
Nephelometric turbidity units	Nephelometric turbidity units are a measure of turbidity in water.

Nutrients	Minerals, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate), dissolved in water which provide nutrition (food) for plant growth.
Pathogen	A disease-producing organism that can cause sickness and sometimes death through the consumption of water, including bacteria (such as <i>Escherichia coli</i>), protozoa (such as <i>Cryptosporidium</i> and <i>Giardia</i>) and viruses.
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
pH	A logarithmic scale for expressing the acidity or alkalinity of a solution. A pH below seven indicates an acidic solution and above seven indicates an alkaline solution.
Pollution	Water pollution occurs when waste products or other substances (effluent, litter, refuse, sewage or contaminated runoff) change the physical, chemical or biological properties of the water, adversely affecting water quality, living species and beneficial uses.
Public drinking water source area	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> (WA) and the <i>Country Areas Water Supply Act 1947</i> (WA).
Recharge	Recharge is the action of water infiltrating through the soil/ground to replenish an aquifer.
Recharge area	An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
Scheme supply	Water diverted from a source or sources by a water authority or private company and supplied via a distribution network to customers for urban and industrial use or for irrigation.
Total dissolved solids	Total dissolved solids consist of inorganic salts and small amounts of organic matter that are dissolved in water. Clay particles, colloidal iron and manganese oxides, and silica fine enough to pass through a 0.45 micrometer filter membrane can also contribute to total dissolved solids. Total dissolved solids comprise sodium, potassium, calcium, magnesium, chloride, sulfate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate (and nitrite) and phosphate (NHMRC & NRMCC 2004a).

Total filterable solids by summation	Total filterable solids by summation is a water quality test which is a total of the following ions: Na (sodium), K (potassium), Ca (calcium), Mg (magnesium), Cl equivalent (chloride), alkalinity equivalent, SO ₄ equivalent (sulfate) or S (sulfur) in grams, Fe (iron), Mn (manganese), and SiO ₂ (silicon oxide). It is used as a more accurate measure than total dissolved solids (TDS). The higher the value, the more solids that are present and generally the saltier the taste.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
True colour units	True colour units are a measure of degree of colour in water.
Turbidity	The cloudiness or haziness of water caused by the presence of fine suspended matter.
Water quality	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.

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