Department of Water
Government of Western Australia

Seaview Park Water Reserve
Drinking Water Source Protection Plan

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Department of Water

Water Resource Protection Series

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Preface

The Department of Water has prepared this Drinking Water Source Protection Plan to report on the activities and risks to water quality within the Seaview Park Water Reserve and to recommend management strategies to minimise the identified risks.

A safe drinking water supply is critical to the wellbeing of the community and catchment protection is necessary to help avoid, minimise or manage risks to water quality. The Department is committed to protecting drinking water sources to ensure the continued supply of 'safe, good quality drinking water' to consumers.

The Australian Drinking Water Guidelines recommend a multiple barrier 'catchment to consumer' approach to protect public drinking water. The protection and management of drinking water catchments is the 'first barrier', with subsequent barriers implemented at the water storage, treatment and distribution stages of a water supply system. Catchment protection includes understanding the catchment, the hazards and hazardous events that can compromise drinking water quality, and developing and implementing preventive strategies and operational controls to ensure the safest possible raw water supply.

This plan details the location and boundary of the drinking water catchment, which provides potable water to the Seaview Park Estate. It discusses existing and future usage of the water source, describes the water supply system, identifies risks and recommends management approaches to maximise protection of the catchment.

This plan should be used to guide State and local government land use planning decisions. It should be recognised in the Shire of Gingin's Town Planning Scheme, consistent with the Western Australian Planning Commission's *Statement of Planning Policy No. 2.7 - Public Drinking Water Source Policy*. Other stakeholders should use this document as a guide for protecting the quality of drinking water in the recommended Seaview Park Water Reserve.

The stages involved in preparing a Drinking Water Source Protection Plan are:

	Stages in development of a Plan	Comment
1	Prepare Drinking Water Source Protection Assessment	Assessment document prepared following catchment survey and preliminary information gathering from government agency stakeholders.
2	Conduct stakeholder consultation	Advice sought from key stakeholders using the assessment as a tool for background information and discussion.
3	Prepare Draft Drinking Water Source Protection Plan	Draft Plan developed taking into account input from stakeholders and any additional advice received.
4	Release Draft Drinking Water Source Protection Plan for public comment	Draft Plan generally released for a six week public consultation period. In this case however, it was for eight weeks.
5	**Publish approved Drinking Water Source Protection Plan**	**Final Plan published after considering advice received in submissions. Includes recommendations on how to protect the catchment.**

Summary

Seaview Park, a rural residential estate in the Gingin Coast region of Western Australia, obtains its drinking water supply from a Water Corporation wellfield that draws groundwater from within the superficial sediments of the Perth Sedimentary Basin.

The aquifer is unconfined and recharge occurs from direct infiltration of local rainfall. This means that the quality of the groundwater source needs to be protected from land uses both within, and in close proximity to the estate. Therefore careful management is required to ensure that nearby land uses do not affect the quality of water supplied. A reasonable degree of protection is in place within the estate in that clearing of natural vegetation is discouraged and commercial activities (such as horticulture and the keeping of animals) are not permitted.

The estate is unsewered, and the majority of lots are less than two hectares in area. From a water quality protection point of view this is not ideal, as lot sizes of two hectares or greater are recommended by the Department for an unsewered subdivision on special rural zoned land, and at least four hectares for rural zoned land.

Current pastoral grazing to the east of the estate, and a considerable distance from the groundwater source, poses little risk to the quality of the water. Any potential future rural residential development located near the water source would need to be carefully planned and designed by the proponents. Additionally, issues arising would need to be dealt with by land use planning and water source protection processes running concurrently.

This Plan proposes a Water Reserve be proclaimed to protect the quality of the source. The boundary and priority classifications have been determined to provide the appropriate level of protection for the drinking water source, recognising the rights of landowners to continue established approved land use activities.

The following strategies are recommended to protect the Seaview Park drinking water source:

- The Wellhead Protection Zone for the reserve needs to be clearly identified to ensure the appropriate level of protection for the drinking water source;
- The Water Reserve, including its Wellhead Protection Zone and Priority 2 and 3 classifications, should be recognised in the Shire of Gingin's Town Planning Scheme and other applicable land use planning schemes and strategies;
- The management principles outlined in this plan should be incorporated into the Shire of Gingin's Town Planning Scheme and other applicable land use planning schemes and strategies;

- A review of the water quality monitoring program for the production bores is recommended to ensure that key parameters are being tested for; and
- Best management practices for current or approved land uses in the catchment should be implemented.

The above mentioned priority classifications areas and the Wellhead Protection Zone provide guidance on appropriate land use planning decisions to protect this drinking water resource. These priority areas and zone recognise established approved land uses but may constrain expansion of those uses, or development of alternative future land uses. Information on appropriate land uses within this Water Reserve can be found in the Department's *Water Quality Protection Note - Land Use Compatibility in Public Drinking Water Source Areas*. In order to protect water quality, best management practice at design, construction and operational stages is recommended for existing and future land use developments.

1 Drinking water supply system

1.1 Existing water supply system

Groundwater is abstracted from the Water Corporation wellfield located within the Seaview Park estate (see Figure 1).

The well field currently consists of two production bores (1/95 and 2/95) that draw water from the local shallow unconfined aquifer (refer to Figure 2). The bores operate on a duty/standby basis with annual output shared equally between the bores.

It should be noted that the historic planning approval for Seaview Park was based on water being available from either a private or community owned/operated water source. As such the higher requirements for assessment and approval that apply to public water supply sources were not required. Now that the source has been made a public water supply source these requirements will need to be achieved, including:

- establishing appropriate priority areas (P2 and P3) and a protection zone around the production bores to guide future land use planning decisions; and
- proclaiming the source under the *Country Areas Water Supply Act 1947* in order to allow By-laws to be applied to protect water quality.

A guide on the assignment of priority areas and protection zones can be viewed in the Department's *Water Quality Protection Note - Land Use Compatibility in Public Drinking Water Source Areas* at www.water.wa.gov.au click 'Water quality', then 'Publications' and then 'Water Quality Protection Notes'.

1.2 Water treatment

The water taken from the production bores is chlorinated before being supplied to the estate. Appendix A provides information on the quality of water from these production bores prior to treatment.

1.3 Catchment details

1.3.1 Physiography

The physiography of the Seaview Park area is dominated by the coastal dune system of the Perth Basin, which extends along the coast from Perth to Lancelin. The aeolian and beach lime sand found in the area is known as the Safety Bay Sand.

1.3.2 Climate

The area experiences a temperate climate with hot, dry summers and mild, wet winters. The long term average annual rainfall is about 670 millimetres. Most rain results from winter cold front systems that cross the coast between May and October.

1.3.3 Hydrogeology

Seaview Park is located in the central part of the Perth Sedimentary Basin. The Quaternary superficial sediments in the area comprise Tamala Limestone, Ascot Formation and Safety Bay Sand. The Cretaceous chalk and calcareous mudstones of the Lancelin Formation and the interbedded sandstone layers of the Leederville Formation underlie these.

The Seaview Park town water supply bores are drilled to depths of about 110 metres, where they draw groundwater from the unconfined aquifer within the superficial sediments. The water level is about 85 metres below the natural surface.

Recharge to the aquifer is widespread across the region and results from direct infiltration of rainfall. Regional groundwater flow is south westerly. The bores predominantly capture groundwater as it flows from east of the estate towards the ocean where it discharges along the shoreline above a saltwater wedge.

The unconfined nature of the aquifer makes it vulnerable to contamination from inappropriate land uses.

1.4 Future water supply requirements

The capacity of the existing bores is in excess of current demand, and likely future increases in demand.

Risk assessment work undertaken at Seaview Park has identified existing and potential incompatible land uses in the public drinking water source area and they will need to be actively managed to prevent contamination. This will require the combined efforts of the landholders, the water service provider, the Department and agencies responsible for statutory land use planning approval, to apply the principles and recommendations set out in this plan.

There may be other options that the Water Corporation could consider for supplying potable water to the estate. These options would have varying degrees of cost, and range from drilling new bores in the unconfined aquifer (away from influence of activities of the estate and possible impacts), to ultimately trunkline connection to the Perth Metropolitan Integrated Water Supply Scheme.

1.5 Water allocation

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914*. Under the Act, the right to use and control surface and groundwater is vested with the Crown. This Act requires licensing of groundwater abstraction within proclaimed groundwater areas.

Seaview Park is located within the Gingin Groundwater Area, which was proclaimed in 1975 under the *Rights in Water and Irrigation Act 1914* to allocate groundwater resources within its boundaries and to manage its sustainable use.

The Water Corporation is licensed to draw 600 Megalitres of water per year from the Seaview Park well field for the purpose of public water supply. The actual quantity of water abstracted both in 2004 and 2005 was approximately 27 Megalitres.

Recognising possible future rural residential development within the vicinity of Seaview Park, the current annual maximum limit of water that may be abstracted substantially exceeds the quantity actually abstracted. This is a licence allocation issue to be discussed at the next licence renewal meeting between the Department and Water Corporation.

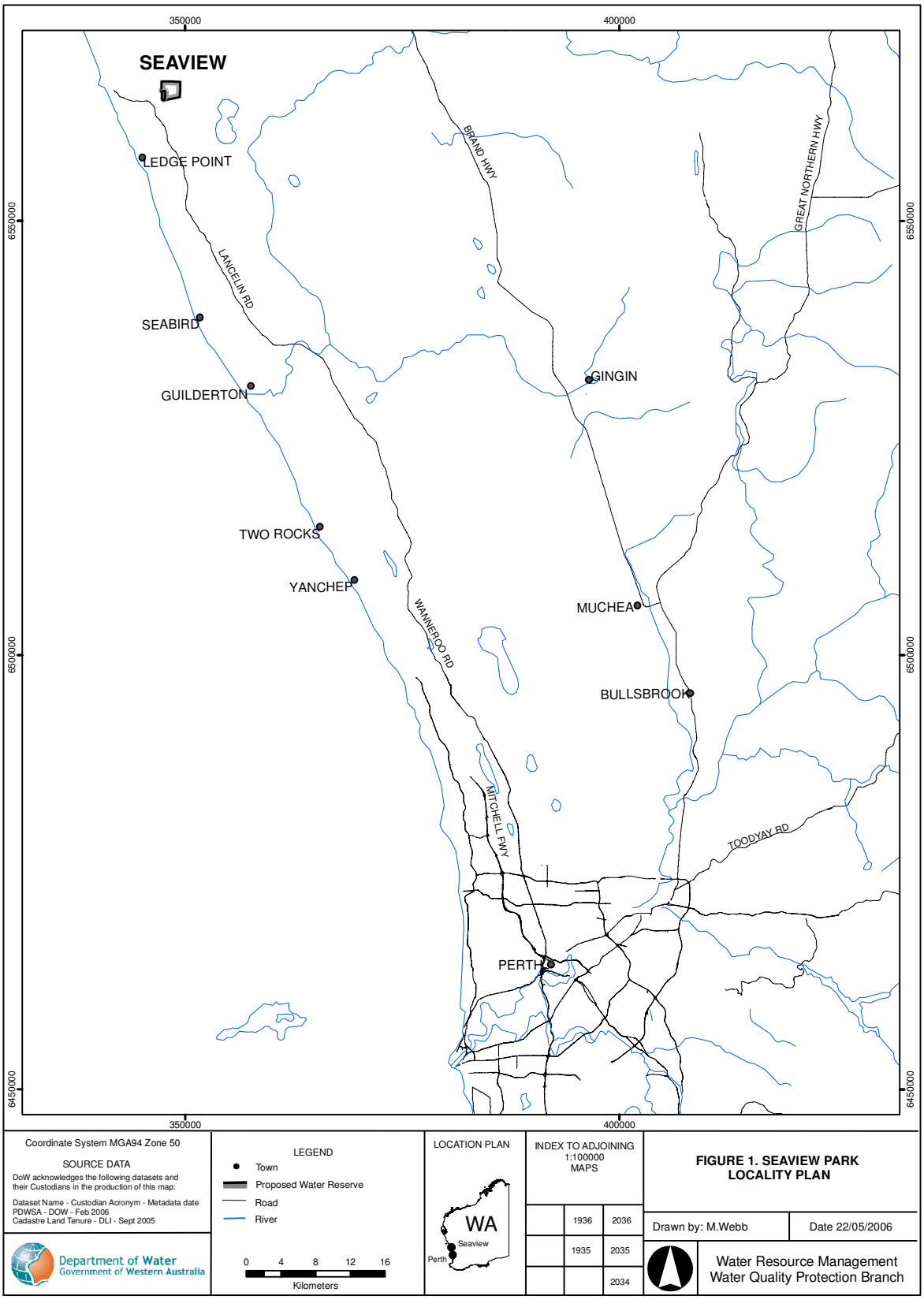

Figure 1. Seaview Park locality map

2 Water quality

The quality of raw water from the Seaview Park bores is monitored in accordance with the *Australian Drinking Water Guidelines (ADWG)* and the program set out in the Seaview Park Water Resource Management Operation Strategy (Miotti, 2003). It is regularly monitored for microbiological contamination, health related chemicals and aesthetic chemicals and parameters.

Historically, water in the area has been of good quality, generally meeting ADWG values. Salinity from the well field is approximately 450 mg/L Total Dissolved Solids (TDS). As such raw water quality, with the exception of calcium carbonate (Hardness ($CaCO_3$)), is within guideline values and there is no significant salinity trend evident.

Groundwater in the superficial aquifer in this area is naturally hard and is not a result of land use impacts. Fluoride is below the Department of Health guideline relevant to Seaview Park.

The water is chlorinated before being supplied to the estate.

Summary details of raw water quality from the well field are shown in Appendix A.

3 Land use and contamination risk

3.1 Existing land uses

Land uses and activities within close proximity of Seaview Park are shown in Figure 2.

The production bores are located on the eastern boundary of the estate where the only permitted land use is rural residential. The immediate recharge area for the bores extends eastward where the predominant land use is dryland farming (pastoral grazing).

3.2 Proposed land uses

Future development proposals near Seaview Park need to recognise drinking water source protection, with sustainable water use planning being considered concurrently with, and as a key part of, statutory land use planning processes. This means that the Shire of Gingin's Town Planning Scheme needs to both incorporate and be aligned with the management principles in this Plan. Appropriate consideration of water source protection and, where required, consultation at an early stage of proponents preparing development proposals is also to be encouraged.

It is understood that there is potential for future rural residential development to the north of Seaview Park. If a proponent initiates such a development, then a key part of the concurrent land use planning and water source protection processes will be for a new Drinking Water Source Protection Plan, or a revised version of this Plan, to be prepared.

3.3 Potential water quality risks

The potential risks to groundwater quality associated with established activities in the recharge areas include chemical or fuel spills; pesticides; and pathogen or nutrient contamination from fertilisers, septic tanks and other sources. Pathogens are the most significant risk to public health, as only very small numbers can have considerable impact. In general, when pathogens are present they are at low (and therefore difficult to detect) levels. Water can be contaminated through contact with human and animal waste. The risks are reduced however, in groundwater systems, where residence time and the filtering effects of soil help to mitigate the threat.

The main risk to the water quality of the Seaview Park well field is from development and activities within the estate. Dryland farming activities to the east pose a relatively low threat as such land uses are considered compatible with the water quality objectives of a rural environment.

Seaview Park estate is unsewered, and the majority of lots present are less than two hectares in area, with the dwellings present typically making use of conventional

septic tanks and leach drain systems. These lot sizes, in an unsewered subdivision, are not recommended current practice due to the potential risk for pathogens and high levels of nutrients entering the water source, particularly from septic tanks.

The Department recommends a minimum lot size of two hectares for special rural and four hectares for rural lots. Given the smaller than recommended lot sizes at Seaview Park estate, activities within this development have a greater potential risk to groundwater quality. This is mitigated to some extent however, by development and activities being limited under Special Provisions that the Gingin Shire has set for Rural Residential Zones. Additionally, commercial operations are not permitted and clearing of natural vegetation is discouraged.

Table 1 sets out the potential water quality risks associated with the land uses and recommends strategies for managing the risks. The strategies balance the need to protect water quality for the community in the long term, with the rights of landholders to continue to use land for permitted land uses.

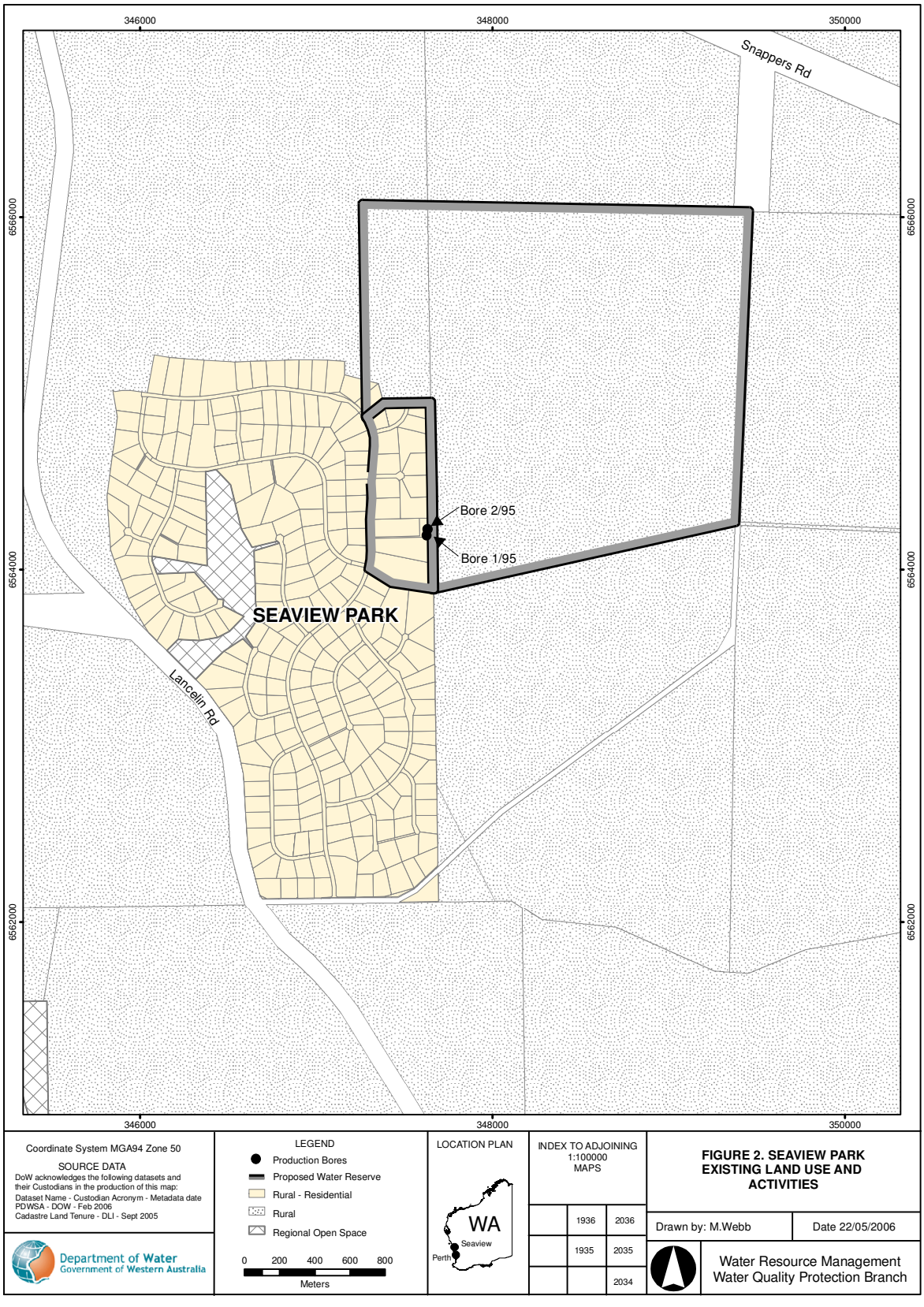

Figure 2. Land use and activities in the Seaview Park Water Reserve

4 Catchment protection strategy

4.1 Protection objectives

The objective of this Plan is to protect drinking water quality for public health, while recognising current land use rights. The measures and management practices recommended aim to avoid, minimise or manage the risk of groundwater contamination, depending on the vulnerability of the source to contamination, the strategic nature of the source and the existing land use in the area.

The priority classifications and protection zone for Seaview Park Water Reserve, have been assigned to ensure consistency with the Department's current framework for public drinking water source protection. These classifications have considered land tenure and zoning and aim to provide the appropriate level of protection for the drinking water source, while recognising the rights of landowners to continue established, approved land use/activities. The Department will encourage any approved existing non-conforming land uses to adopt best management practices to minimise the risk to water resources by means of industry based guidelines.

Groundwater quality monitoring for this source should recognise potential contamination risks from current and future land uses and ensure key characteristic parameters are included.

4.2 Proclaimed area

The proposed Seaview Park Water Reserve is shown in Figure 3. It covers the north east corner of the estate and part of the farmland located to the north east.

The Reserve includes the immediate recharge area of the unconfined aquifer and extends about two kilometres east to provide adequate cover of the upgradient capture zone for the well field. A strip of land north of the estate has been included as a future site for additional production bores, if required.

4.3 Priority classifications

Land within public drinking water source areas is assigned a Priority 1, Priority 2 and/or Priority 3 classification. The underlying aim of this is to prioritise areas to protect water quality taking into account land use information, including zoning and ownership, the importance of the water source and the vulnerability of the water body. In general, State managed (public) land and strategically important private land is identified as Priority 1, and private rural and special rural land as Priority 2. Priority 3 classification usually applies to industrial/commercial and urban zoned land that may be present. Wellhead Protection Zones of 500 metres are applied in Priority 1 areas and in Priority2/3 areas they are 300 metres from the abstraction bore.

An explanation of the priority classification system and the detail of land use compatibility within each priority classification is provided in the Department's Water Quality Protection Notes *Land Use Compatibility in Public Drinking Water Source Areas* and *Overview on Protecting our Public Drinking Water Source Areas*. These can be found at www.water.wa.gov.au click 'Water quality', 'Publications' and then 'Water Quality Protection Notes'.

It is proposed that the portion of the estate within the Reserve has Priority 3 classification and the farmland area is Priority 2 (see Figure 3). Justification for classifying the estate as a Priority 3 area is because the:

- approved land use has given rise to using management guidelines for water quality protection; and
- aquifer is vulnerable to contamination, which may lead to degradation in quality in the long term, requiring use of an alternative water source.

Priority 2 classification of the rural area is compatible with current allowable land uses and provides for a level of protection that ensures no increased risk of pollution to the aquifer. Development strategies are consistent with the principle of risk minimisation.

The Shire of Gingin's Town Planning Scheme needs to reflect the priority classifications assigned to the estate's water source, so that statutory land use planning processes are fully linked to this plan.

4.4 Protection zones

Wellhead protection zones are defined around each bore (500 metres radius in Priority 1 areas and 300 metres radius in Priority 2 and 3 areas) in which activities are to be managed to maximise protection against contamination in the immediate vicinity of the production bores. These zones do not extend outside the boundary of the proposed Water Reserve as shown in Figure 3.

4.

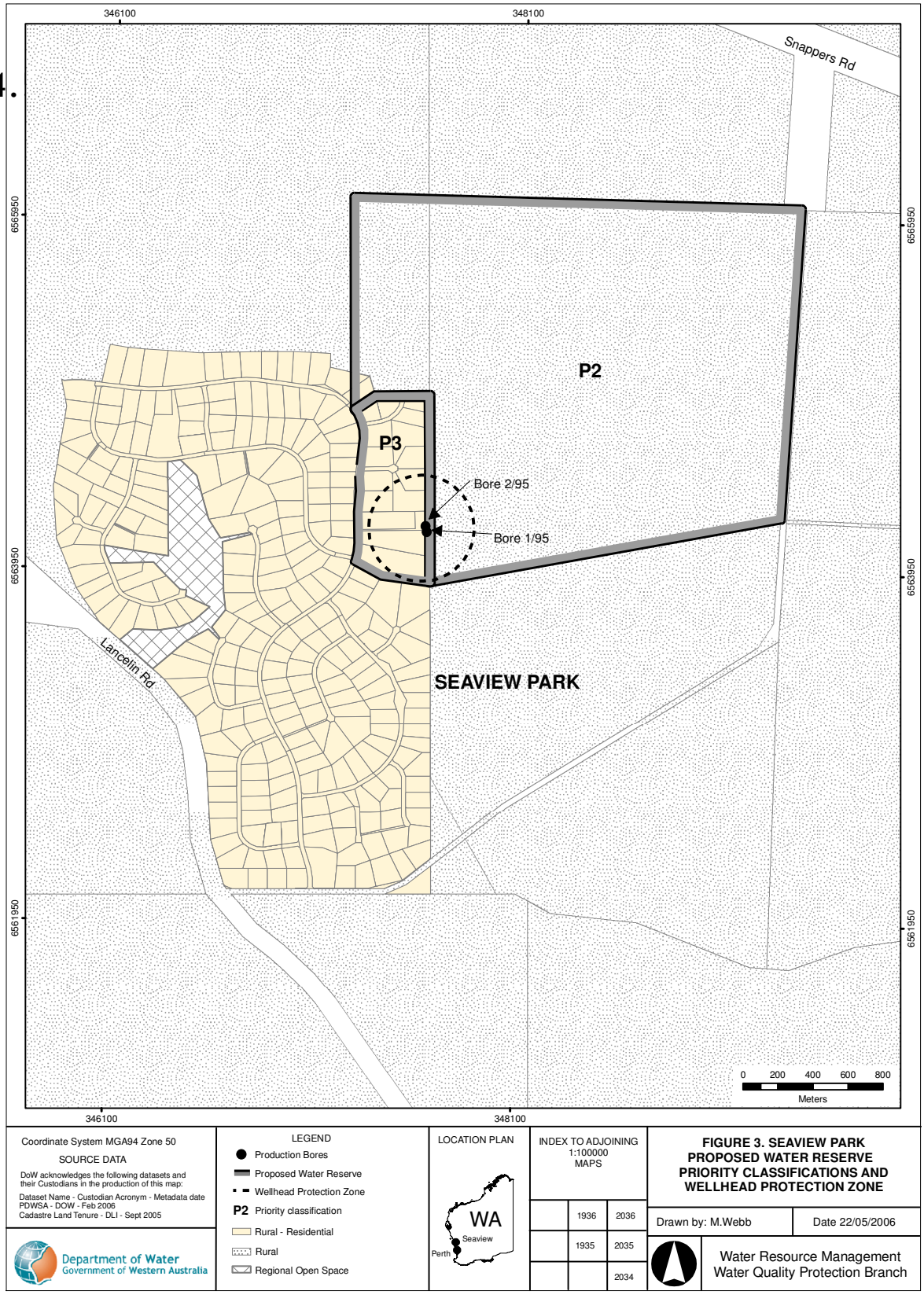

Figure 3. Seaview Park Water Reserve priority classifications and protection zones

Land use planning

Establishing appropriate protection mechanisms in statutory land use planning processes is essential to secure the long term protection of our limited drinking water sources. This means that future development proposals can be considered and based on pro-active drinking water source protection, with sustainable water use planning being considered concurrently with, and as a key part of, statutory land use planning processes.

It is recognised under the State Planning Strategy (Western Australian Planning Commission, 1997) that the establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of drinking water sources. As outlined in *Statement of Planning Policy No.2.7: Public Drinking Water Source Policy* (Western Australian Planning Commission, 2003) it is therefore appropriate that the Seaview Park Water Reserve Wellhead Protection Zone and priority classifications be recognised in the Shire of Gingin's Town Planning Scheme. Any development proposals located within this Water Reserve that are considered likely to affect the protection objectives of the Seaview Park drinking water source should be referred to the Department of Water for advice and recommendations. The Department's guidance on developments is contained in our *Water Quality Protection Note - Land Use Compatibility in Public Drinking Water Source Areas*.

4.6 Best management practices

There are opportunities to significantly reduce risks to water quality by carefully considering design and management practices. The adoption of best management practices for land uses will continue to be encouraged to help protect water quality. On freehold land, the Department of Water aims to work with landowners to achieve best management practices for water quality protection through the provision of management advice, and assistance to seek funding if required.

Guidelines are available for many land uses in the form of industry codes of practice, environmental guidelines or Water Quality Protection Notes. These documents will help managers reduce the risk of their operations causing unacceptable environmental impacts and are recommended as best practice for water quality protection. Many of these documents may be accessed at our website www.water.wa.gov.au click 'Water quality', 'Publications' and then 'Water Quality Protection Notes'.

Examples that may be relevant to land use and activities within and near the Seaview Park Water Reserve include:

- Water and Rivers Commission, 1998, Water Quality Protection Note: *Nutrient and Irrigation Management Plan,* Water and Rivers Commission.

- Water and Rivers Commission, 2000, Statewide Policy No. 2 *Pesticide Use in Public Drinking Water Source Areas,* Water and Rivers Commission.

Education and awareness (eg signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who are unfamiliar with the Seaview Park Water Reserve. A brochure will be produced for this Water Reserve, describing its location and the main threats to water quality. This brochure will be made available to the community and will serve to inform people in simple terms about the drinking water source and its protection needs.

4.7 Surveillance and By-law enforcement

The quality of public drinking water sources within country areas of the State is protected under the *Country Areas Water Supply Act 1947*. Declaration of these areas allows existing by-laws to be applied to protect water quality.

The Department of Water considers by-law enforcement, through on-ground surveillance of land use activities in Public Drinking Water Source Areas as an important water quality protection mechanism. Surveillance is also important in raising the general level of awareness of the need to protect water quality.

Signs are erected to educate the public and to advise of activities that are prohibited or regulated. This Plan recommends delegation of surveillance and by-law enforcement to the Water Corporation.

4.8 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency responses can result in water contamination. The Shire of Gingin's Local Emergency Management Advisory Committee (LEMAC) through the Northam Emergency Management District should be familiar with the location and purpose of the Seaview Park Water Reserve. A locality plan should be provided to the Fire and Rescue Services headquarters for the Hazardous Materials Emergency Advisory Team (HAZMAT). The Water Corporation should have an advisory role to any HAZMAT incident in the Seaview Park Water Reserve.

Personnel who deal with WESTPLAN – HAZMAT (Western Australian Plan for Hazardous Materials) incidents within the area should have access to a map of the Seaview Park Water Reserve. These personnel should receive training to ensure an adequate understanding of the potential impacts of spills on the water resource.

4.9 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses in the Seaview Park Water Reserve and recommends protection strategies to minimise these risks.

Table 1 Land use, potential water quality risks and recommended strategies

Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategy
	Hazard	**Management priority**			
Rural residential development and estate activities	Nutrients and pathogens from septic tanks. Fertiliser and pesticide use on gardens. Nutrients and micro-organism contamination from animal excreta.	High Medium	Unsewered lots of one to two hectares create a subdivision density that may compromise water quality. Possible future subdivisional development to the north. Bores located on eastern boundary, upgradient of estate. Land planning zoning provisions limit clearing of natural vegetation. Commercial operations including horticulture and keeping of animals, or activities that hold/discharge chemicals are not permitted.	Rural residential zoning special provisions enacted by the Shire.	*Acceptable activity – based on the following specific measures* SPECIFIC MEASURES • Ensure the Shire of Gingin's Special Provisions for the Rural Residential Zone adequately control development. • Encourage landowners to adopt best management practices for permitted activities – as per relevant Water Quality Protection Notes by the Department. • Support the use of appropriate alternative wastewater systems in order to reduce levels of nutrients and pathogens. • Oppose land use intensification through planning approval processes. • Support changes to existing planning approval protocols that reduce groundwater contamination risks. • Promote water quality protection- by establishing priority classification areas/wellhead protection zones, appropriate signage and information pitched to local residents

Activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategy
	Hazard	Management priority			
Dryland farming (pastoral grazing)	Nutrients and micro-organism contamination from animal excreta.	Medium	Low density activity at considerable distance from bores. Compatible scheme water quality objectives.	None	*Acceptable activity – based on the following specific measures* SPECIFIC MEASURES • Ensure Town Planning Scheme adequately controls development. • Limit intensification of land use through planning approval process. • Require water quality protection measures for all approved development/activities.

5 Recommendations

1 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this Plan *(Applicable stakeholders).*

2 Proclaim the Seaview Park Water Reserve under the *Country Areas Water Supply Act, 1947 (Department of Water).*

3 Prepare an implementation strategy for this Plan describing responsible stakeholders and timeframes for the recommended protection strategies *(Department of Water).*

4 The Shire of Gingin should incorporate the management principles outlined in this plan in its Town Planning Scheme (currently Number 9). In particular, the scheme should reflect the levels of drinking water source protection assigned (ie. Priority 2 and Priority 3); and the recommended Wellhead Protection Zone (*Shire of Gingin*).

5 All development proposals within the Seaview Park Water Reserve that are likely to impact on water quality and/or quantity, or are inconsistent with *Water Quality Protection Note – Land use compatibility in Public Drinking Water Source Areas* or *Statement of Planning Policy No.2.7 – Public Drinking Water Source Policy*, should be referred to the Department of Water for advice and recommendations (*Department for Planning and Infrastructure, Shire of Gingin, Developers).*

6 Incidents covered by WESTPLAN – HAZMAT in the Seaview Park Water Reserve should be addressed through the following (*Department of Water, Water Corporation)*:

- The Shire of Gingin's LEMAC are familiar with the location and purpose of the Seaview Park Water Reserve.
- The locality plan for the Seaview Park Water Reserve is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
- The Water Corporation provides an advisory role during incidents in the Seaview Park Water Reserve.
- Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Seaview Park Water Reserve and training to understand the potential impacts of spills on drinking water quality.

7 Surveillance should be undertaken to identify any incompatible land uses or potential threats within the Seaview Park Water Reserve. The Department of Water should consider delegating responsibility for the surveillance and enforcement to the Water Corporation (*Water Corporation, Department of Water*).

8 Signs should be erected along the boundary of the Seaview Park Water Reserve to define the location and promote awareness of the need to protect drinking water quality. Signs should include an emergency contact telephone number (*Water Corporation*).

9 A review of this Protection Plan should be undertaken at least every five years (*Department of Water*).

10 The water quality monitoring program for the production bores should be reviewed to ensure key characteristic parameters are included. Water quality analysis results should continue to be routinely reviewed to detect any trends of concern (*Water Corporation*).

Appendices

Appendix A - Water quality

Health parameters

Raw water from Seaview Park borefield is analysed, by Water Corporation, for health related chemicals. Health related chemicals include inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the sources up to April 2005 are summarised in the following table. All values are in milligrams per litre (mg/L). Monitoring is ongoing.

Parameter	**Range of monitored values Min-Max Median**			**AWDG Health Guideline Value ^**
	Bore 1/95	**Bore 2/95**	**Raw Bore Water (mixed)**	
Metals				
Arsenic	0.003 - 0.004 0.003	0.003*	0.002-0.004 0.003	0.007mg/L
Barium	NT	NT	0.06 - 0.075 0.06	0.7 mg/L
Boron	NT	NT	ND - 0.02 ND	4 mg/L
Inorganic				
Fluoride	ND - 0.1 0.05	ND*	-	1.5 mg/L
Nitrate + Nitrite (as N)	1.325 - 3.3 2.2	0.39 - 3.3 1.7	-	11.3 mg/L
^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.				
ND is Not Detected	NT is Not Tested	*One test result only		

The raw water from Seaview Park borefield complies with Australian Drinking Water Guidelines (ADWG) health guidelines.

Aesthetic water quality data

Aesthetic water quality analyses for raw water from Seaview Park are summarised in the following table. The values are taken from ongoing raw water monitoring by Water Corporation up to October 2005. The values are in milligrams per litre (mg/L) unless stated otherwise. Compliance with the aesthetic water quality guidelines of the Australian Drinking Water Guidelines (ADWG) is not mandatory. The only parameter that has exceeded the relevant ADWG value is Hardness ($CaCO_3$) for Bore 1/96.

Parameter	**Range of monitored values Min-Max Median**			**AWDG Health Guideline Value ^**
	Bore 1/95	**Bore 2/95**	**Raw Bore Water (mixed)**	
Salinity (TFSS less CO_2)	424 - 479 453	418 - 471 456	-	1 000 mg/L
Hardness ($CaCO_3$)	200 - **234.4** **220**	**202 - 235.7** **220**	**-**	200 mg/L
Turbidity	0.2 - 1.3 0.8	ND - 1 0.2	0.1 – 2.8 0.1	5 NTU
pH	7.36 - 7.51 7.43	6.5 - 7.55 7.35	7.3 – 7.51 7.39	6.5-8.5
Colour	ND - ND ND	ND - ND ND	ND	15 TCU
Iron (unfiltered)	ND - ND ND	ND - ND ND	-	0.3 m
Manganese (unfiltered)	ND - ND ND	ND - ND ND	-	0.1 mg/L
Aluminium (unfiltered)	ND - ND ND	ND - 0.01 ND	-	0.2 mg/L
^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.				
ND is Not Detected	NT is Not Tested	*One test result only		

The water from the Seaview Park borefield complies with ADWG aesthetic guidelines with the exception of elevated hardness levels.

Microbiological analysis

Thermotolerant coliform counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count less than 20 coliform forming units (cfu) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark (World Health Organisation, 1996).

Microbiological testing of the raw water from the Seaview Park borefield has been conducted on a monthly basis since January 2001. The raw water was sampled 63 times with no positive thermotolerant coliform counts recorded.

Appendix B - Photographs

Photo 1 Seaview Park Bores 1/95 and 2/95

Photo 2 View across estate (Showing retention of natural vegetation)

Photo 3 Dryland farming east of estate (Elevated tank in background)

Glossary

Abstraction	The pumping of groundwater from an aquifer.
ADWG	The Australian Drinking Water Guidelines, outlining guideline criteria for the quality of drinking water in Australia.
Aesthetic guideline	NHMRC guideline level ascribed to acceptable aesthetic qualities of drinking water such as taste, smell, colour and temperature.
Allocation	The quantity of water permitted to be abstracted by a licence, usually specified in kilolitres per year (kL/a).
ANZECC	Australian and New Zealand Environment Conservation Council.
Aquifer	A geological formation or group of formations able to receive, store and transmit significant quantities of water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
Bore	A narrow, lined hole, also known as a well, drilled to monitor or draw groundwater.
Borefield	A group of bores to monitor or withdraw groundwater.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
CAWS Act	Country Areas Water Supply Act 1947
CFU	Coliform forming units is a measure of pathogen contamination in water.
Diffuse source	Pollution originating from a widespread area eg urban stormwater runoff, agricultural infiltration.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
GL	Gigalitres (1000 000 000 litres)
ha	Hectares (a measure of area)
HAZMAT	Hazardous materials

Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
kL	Kilolitres (1000 litres)
Leaching / leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater. The material washed out is known as leachate. Leachate can pollute groundwater and waterways.
LEMA	Local Emergency Management Authority
m	Metres
mg/L	Milligrams per litre (0.001 grams per litre)
ML	Megalitres (1 000 000 litres)
NHRMC	National Health and Medical Research Council.
NTU	Nephelometric turbidity units are a measure of turbidity in water.
Nutrient load	The amount of nutrient reaching the waterway over a given timeframe (usually per year) from it's catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
P1	Priority 1 - priority classification for land use with respect to protecting a drinking water source
P2	Priority 2 - priority classification for land use with respect to protecting a drinking water source
P3	Priority 3 - priority classification for land use with respect to protecting a drinking water source
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
Point source pollution	Pollution originating from a specific localised source, eg sewage or effluent discharge, industrial waste discharge.

Pollution	Water pollution occurs when waste products or other substances, eg effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Public Drinking Water Source Area (PDWSA)	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.
Recharge	Water infiltrating 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 it's distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
RIWI Act	*Rights in Water Irrigation Act 1914*
Run-off	Water that flows over the surface from a catchment area, including streams.
Stormwater	Rainwater which has run off the ground surface, roads, paved areas etc. and is usually carried away by drains.
TDS	Total dissolved salts, a measurement of ions in solution, such as salts in water.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Unconfined aquifer	An aquifer in which the upper surface of water is lower than the top of the aquifer itself. The upper surface of the groundwater within the aquifer is called the watertable.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water quality	The physical, chemical and biological measures of water.

Water Reserve	An area proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply Sewerage and Drainage Act 1909* for the purposes of protecting a drinking water supply.
Watertable	The upper saturated level of the unconfined groundwater.
Well field	A group of bores to monitor or withdraw groundwater.
Wellhead	The top of a well (or bore) used to draw groundwater. A wellhead protection zone (WHPZ) is usually declared around wellheads in drinking water areas to protect the water source from contamination.
WHPZ	Wellhead Protection Zone

References

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) & Australian and New Zealand Environment and Conservation Council (ANZECC) 1996, *Draft Rural Land Uses and Water Quality – A Community Resource Document*, ARMCANZ & ANZECC, Canberra.

Department of Water Various dates, *Water Quality Protection Notes – Various titles*, Department of Water, Perth, available www.water.wa.gov.au < Water quality > Publications > Water Quality Protection Notes.

Miotti, J., 2003*, Seaview Park Water Resource Management Operation Strategy*, Draft Report, Water Corporation of Western Australia.

National Health and Medical Research Council & ARMCANZ 2004, *National Water Quality Management Strategy: Australian Drinking Water Guidelines*, NHMRC & ARMCANZ, Canberra, available <www7.health.gov.au/nhmrc/publications/synopses/eh19syn.htm>.

Scott, I., 2000*, Seaview Park Water Source Review*, Report No. A4-943, Water Corporation of Western Australia.

Western Australian Planning Commission, 2006, *Gingin Coast Structure Plan,* Western Australian Planning Commission.

World Health Organisation 1996, *Guidelines for Drinking-Water Quality – Volume 2 – Health Criteria and Other Supporting Information*, 2nd edn, World Health Organisation, Geneva, available <www.who.int/water_sanitation_health/dwq/en/2edvol2p1.pdf>.

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