



Government of **Western Australia**
Department of **Water and Environmental Regulation**

Samson Brook Catchment Area

drinking water source protection review



Waroona and Hamel town water supply
Integrated water supply scheme

Water resource protection series
Report WRP189
June 2019

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Cover photograph: Aerial photo of Samson Brook Catchment Area

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Summary

This drinking water source protection review considers changes that have occurred in and around the Samson Brook Catchment Area since the *Samson Brook Catchment Area water source protection plan* (Water and Rivers Commission 2002) was released. The plan still contains relevant information, so it is important that these documents are read in conjunction. Both are available on our website or by contacting us.

We prepared this document in consultation with key stakeholders, including Department of Biodiversity, Conservation and Attractions, Department of Mines, Industry Regulation and Safety, Forest Products Commission, Alcoa, the Water Corporation and the shires of Harvey and Waroona.

The main changes since the 2002 plan are:

- The revised Samson Brook Catchment Area boundary was proclaimed under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* in 2008.
- The Samson Brook dam was upgraded.
- The Samson Brook pipehead dam was constructed and now supplies drinking water to the Waroona and Hamel town water supply scheme and the Integrated water supply scheme (IWSS).
- The Samson Brook Catchment Area is now closed to recreational marroning and fishing.
- Public access to the reservoirs has been restricted via boom gates, signs and fencing on tracks.
- The completed Waterous Loop bike trail avoids reservoir protection zones.
- The Waroona-Yarloop wildfire caused widespread damage to fencing and vegetation within the catchment area. Turbidity from ash and soil erosion caused the reservoirs to be taken offline for a year.
- Unauthorised access and recreation has increased within the catchment area.
- Pathogens have frequently been detected in raw water samples. The raw water is treated to a higher level before distribution to consumers to ensure it meets the requirements of the *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011).

This review helps implement the ADWG, State planning policy no. 2.7: *Public drinking water source policy* (Western Australian Planning Commission 2003) and our Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a).

Important information about the Samson Brook Catchment Area is in Table 1.

Table 1 Key information about the Samson Brook Catchment Area

Samson Brook Catchment Area	
Local government authorities	Shire of Waroona Shire of Harvey
Location supplied	Integrated water supply scheme Waroona and Hamel water supply scheme
Population supplied	Over 2 million people in Waroona and Hamel, Perth, the Goldfields, the Wheatbelt and some parts of the South West
Water service provider	Water Corporation
Dam capacity	Samson Brook dam: 8 GL Samson Brook pipehead dam: 300 ML
Licensed abstraction	16 300 000 kL per year (Department of Water and Environmental Regulation surface water licence 152691)
Dates of drinking water source protection reports	2002 – <i>Samson Brook Catchment Area water source protection plan</i> (Water and Rivers Commission) 2018 – <i>Samson Brook Catchment Area drinking water source protection review</i> published (this document)
Consultation	2002 – advertised for public consultation as part of the water source protection plan 2018 – local government, government and water service provider consultation
Gazettal history	Gazetted as the Waroona Water Supply Catchment Area on 3 October 1952 under the <i>Country Areas Water Supply Act 1947</i> Abolished and re-gazetted as the Samson Brook Catchment Area on 14 November 2000 under the <i>Country Areas Water Supply Act 1947</i> Abolished and re-gazetted on 19 August 2008 as the Samson Brook Catchment Area under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i>
Reference documents	<i>Australian drinking water guidelines</i> (NHMRC & NRMCC 2011)

Samson Brook Catchment Area	
	State planning policy no. 2.7: <i>Public drinking water source policy</i> (Western Australian Planning Commission 2003)

1 Review of Samson Brook's drinking water source protection plan

1.1 Boundary, priority areas and protection zones

The 2002 *Samson Brook Catchment Area drinking water source protection plan* (Water and Rivers Commission 2002) recommended that the catchment boundary be amended to incorporate the new pipehead dam, which was under construction at the time.

The new pipehead dam was completed in 2003 and the amended Samson Brook Catchment Area was gazetted in 2008 under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*. The entire catchment area was assigned a priority 1 (P1) area and included two reservoir protection zones – one for the Samson Brook dam and the other for the Samson Brook pipehead dam (Figure A2).

No further changes to the catchment area boundary, priority areas or reservoir protection zones are required, because they are consistent with our current Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a).

The Samson Brook Catchment Area is reflected as a special control area in both the Peel and Greater Bunbury regional planning schemes.

Please read Appendix E for more information about how we protect drinking water sources.

1.2 Update on water supply scheme

1.2.1 Water licence

The Department of Water and Environmental Regulation has issued licence 152691 to the Water Corporation to draw 16 300 000 kL of water per year from the Samson Brook dam and Samson Brook pipehead dam (Figure A2) for the IWSS and the Waroona and Hamel water supply scheme.

1.2.2 Samson Brook dam

In the early 2000s, the Samson Brook dam was used for irrigation. The 2002 plan identified that it could be used for public drinking water. In the mid-2000s, the Water Corporation negotiated water allocation transfers with irrigation supplier Harvey Water and began supplying drinking water from the Samson Brook dam. The dam continued supplying both irrigation and public drinking water until 2012, when Harvey Water transferred the remaining irrigation allocation to the Water Corporation. Since then, the Samson Brook dam has been used solely for public drinking water supply via the Samson Brook pipehead dam (see section 1.2.3).

The Samson Brook dam has undergone significant upgrades since 2002, including a new spillway. The dam's maximum capacity has remained at 8 GL.

1.2.3 Samson Brook pipehead dam

The Samson Brook pipehead dam is located about 7 km downstream of the Samson Brook dam. It is 22 m high, 189 m wide and holds up to 312 ML. The pipehead dam receives water from releases from the Samson Brook Dam, and a natural catchment area of about 11 km². It provides the supply point for the Waroona and Hamel water supply scheme and the IWSS.

1.2.4 Treatment system

Drinking water supplied from the Samson Brook pipehead dam is treated to a high level to help reduce the water quality risks posed by activities within the catchment area. To ensure aesthetic and microbiological quality for consumers, the water is screened and filtered to reduce metals and turbidity and chlorinated to disinfect the water.

It should be recognised that although treatment and disinfection are essential barriers against contamination, public drinking water source area (PDWSA) 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 (ADWG; NHMRC & NRMMC 2011)* and is based on preventive risk and multiple barriers 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, and the Department of Water and Environmental Regulation's approach based on preventive risk, read Appendix E.

1.3 Aboriginal sites of significance and native title claims

Aboriginal sites of significance are important places with special cultural connections to Aboriginal people. They are important because they link Aboriginal cultural tradition to place, land and people over time. These sites are integral to the lives of Aboriginal people, and are found in urban, rural and remote areas. They are most common near rivers, lakes, swamps, hills and the coast. The *Aboriginal Heritage Act 1972* protects all Aboriginal places and objects that are culturally important to Aboriginal people. It is against the law to disturb a site or to remove artefacts.

There are five Aboriginal sites of significance within the Samson Brook Catchment Area (Figure A5). These are S05-11, S05-12, Willowdate North (S02987), Willowdale North Isolated Finds and Orion Road Log Dump.

Native title is the recognition in Australian law that some Aboriginal people continue to hold native title rights to lands and water arising from their traditional laws and customs. There is one native title claim within the Samson Brook Catchment Area – Gnaala Karla Booja (WAD6274/1998) (Figure A5).

The State Government of Western Australia and the Noongar native title claimants have negotiated a South West Native Title Settlement. The Settlement recognises the Noongar people as the traditional owners of land in the South West Settlement Area, which extends from a point south of Dongara on the west coast, approximately east to a point north of Moora and then south-easterly to a point midway between Albany and Esperance (see Figure A7).

The settlement includes six identical Indigenous Land Use Agreements (ILUAs). The agreements enable some types of land-based customary activities to be undertaken by Noongar people in PDWSAs within the South West Settlement Area. The Department of Water (now the Department of Water and Environmental Regulation) amended two sets of by-laws (Metropolitan Water Supply, Sewerage and Drainage By-laws 1981 and the Country Areas Water Supply By-laws 1957) on 8 June 2016 to enable Noongar people to undertake these land-based activities.

Some of the land-based activities include:

- entry to registered Aboriginal sites in reservoir protection zones for customary purposes
- designation of camping sites for Noongar people (outside reservoir protection zones and wellhead protection zones)
- gathering invertebrates and eggs, lighting fires and gathering flora for customary purposes.

The ILUA is available via the Department of Premier and Cabinet, see www.dpc.wa.gov.au/lantu/Claims/Pages/SouthWestSettlement.aspx. Refer to Water quality information sheet 39: *Aboriginal customary activities in public drinking water source areas in the South West Native Title Settlement Area* (Department of Water 2017).

The Department of Water and Environmental Regulation is committed to working with Aboriginal people in its planning and management activities. The department recognises that native title is an important framework for water management.

1.4 Enforcing by-laws, surveying the area and maintenance

This review recommends that the Water Corporation continue by-law enforcement under the existing delegation arrangement (see section 3.2, recommendation no. 5). This also includes:

- erecting and maintaining signs in accordance with *S111 Source protection signage* (Water Corporation 2013)
- maintaining security and fencing around the dam and within the catchment area
- ongoing regular surveillance and inspections.

The Water Corporation undertakes frequent surveillance, inspections and site visits to help manage the water quality risks from activities within the Samson Brook Catchment Area.

1.5 Update on water quality risks

As part of this review, the Department of Water and Environmental Regulation has conducted an updated assessment of water quality contamination risks to the Samson Brook drinking water source, in accordance with the ADWG. Table 2 shows the risks that are new or changed since the 2002 plan, and also includes risks that are still considered high.

Refer to Appendix D for information about typical contamination risks in PDWSAs. Refer to Appendix F to gain a greater understanding about the risk assessment process we use.

The Samson Brook Catchment Area is predominantly covered by native vegetation (Figure A3). Land uses and activities within the catchment area include bauxite mining and associated forestry, managed recreation in the Lane Poole Reserve, Munda Bididi and Waterous Loop bike trails and a small area of land owned by the Water Corporation (figures A3 and A4).

1.5.1 Private land

In 2002, the Water Corporation purchased the only privately owned lot within the Samson Brook Catchment Area (Figure A4) to enable the pipehead dam to be constructed. The rest of the lot within the catchment area remains undeveloped and covered by native vegetation.

The property is fenced and boom gates restrict vehicle access (Figure C2). Signs advise that public access is restricted on the Water Corporation property (Figure C1). However, some people continue to gain unauthorised vehicle access by damaging property fencing (see section 1.5.7).

1.5.2 Dam construction and upgrades

Since the 2002 plan, works have been carried out on the Samson Brook dam and pipehead dam. The Water Corporation implemented best management practices during the works to reduce water quality risks, but despite best efforts, turbidity and metals have been detected in the reservoirs (see section 1.6 for more information). As the pipehead dam is complete and the upgrades to Samson Brook dam are finished, further such risks to water quality are not expected.

1.5.3 Bauxite mining and forestry (state forest)

Bauxite mining occurs within the Samson Brook Catchment Area and the Samson Brook reservoir protection zone (figures A3 and A6). The water quality risks and recommended management strategies for bauxite mining activities are described in Table 1 of the 2002 plan.

Alcoa's mining operations are overseen by the Mining and Management Planning Liaison Group (MMPLG), comprising representatives from state government agencies with responsibilities or interests in mining operations. This group will

continue to review mining plans and manage issues relating to mining operations, as per Ministerial Statement 728, within the Samson Brook Catchment Area.

Water Corporation officers conduct weekly visits of mine sites to identify water quality risks, inspect mitigation measures such as sumps and bunding to ensure they are functioning correctly and to collect water quality samples for testing.

Alcoa reports any incidents with the potential to contaminate the water source to the MMPLG for investigation and remediation.

1.5.4 Forestry (state forest)

Forestry is associated with mining activities in the Samson Brook Catchment Area (Figure A3), with approximately 180 ha of land being cleared annually. Typically, cleared areas are rehabilitated within 18 months. The water quality risks and recommended management strategies for forestry activities are described in Table 1 of the 2002 plan.

1.5.5 Lane Poole Reserve

The Lane Poole Reserve covers part of the outer catchment and reservoir protection zone of the Samson Brook dam (Figure A4) and is managed by the Department of Biodiversity, Conservation and Attractions.

The *Lane Poole Reserve and proposed reserve additions management plan* (Department of Environment and Conservation 2011) identifies the 'visitor management setting' for land in the catchment area. The reservoir protection zone is identified as 'natural' and public access is restricted. The outer catchment is predominantly 'natural – recreation', with some areas along Nanga Road identified as 'recreation' and 'highly modified'.

Existing recreational opportunities are low level, with more intensive activities such as campsites and off-road driving opportunities located outside the Samson Brook Catchment Area.

1.5.6 Munda Bididi and Waterous Loop bike trails

The Munda Bididi bike trail runs through the lower half of the Samson Brook Catchment Area (Figure A3). To reduce water quality risks, the trail was designed to avoid the Samson Brook dam reservoir protection zone and provide overnight camp sites outside the catchment area.

The Waterous Loop bike trail was finalised after publication of the 2002 plan. The trail runs from the Munda Bididi at Nanga, through Waroona and rejoins the Munda Bididi in the southern extent of the catchment area (Figure A3). It was designed to avoid the Samson Brook pipehead dam reservoir protection zone, but crosses the small stream that connects the Samson Brook dam with the pipehead dam.

A small bridge provides access over the stream and deters direct access to the water body (Figure C2). However, there are no signs to advise trail users of the importance of this stream or that body contact with the water is prohibited. The trail leading down

to and from the bridge poses a turbidity risk because the entry and exit points are steep and have been heavily eroded by bikes and rain, with no sediment controls in place.

Cyclists have been observed accessing the reservoir protection zones, either leaving the designated trail or using alternative tracks to reach the Waterous Loop trail from outside the catchment area. Rubbish has been observed where cycling groups stop to eat, particularly in a small clearing adjacent to the stream. These types of activities pose a risk to drinking water quality and public health.

1.5.7 Unauthorised access and recreation

Unauthorised access and recreation pose considerable risks to water quality in the Samson Brook Catchment Area. Direct body contact with the reservoirs and shallow pit latrines dug on the reservoir banks pose extremely high pathogen risks.

Unauthorised recreation is of particular concern around the pipehead dam due to the relatively small size of the waterbody, low residence time for water in the dam and short distance to the off-take for drinking water supply.

Off-road access

All unsealed roads within the Samson Brook dam and pipehead dam reservoir protection zones are obstructed with boom gates and fenced shoulders. Signs advise visitors of the location and importance of the drinking water source and that access is prohibited (Figure C4).

However, fencing is regularly cut or flattened, the gates, boom gates and locks are often damaged or broken and vegetation is removed to gain access via cars and trail bikes. Off-road vehicle use poses a risk of hydrocarbons and turbidity contamination, particularly when vehicles are close to the reservoirs (figures C5 and C6).

Water Corporation undertakes frequent surveillance, issues infringements and maintains fencing and gates in the aim to deter unauthorised access (see section 1.4).

Fishing and marroning

The 2002 plan proposed to close the Samson Brook Catchment Area to recreational fishing and marroning to prevent unacceptable pathogen risks to drinking water quality from direct body contact with the water.

The Samson Brook dam and pipehead dam are now permanently closed to fishing and marroning. However, these are the most common unauthorised activities in the catchment area. Evidence of marroning and fishing, such as campfires, discarded fishing equipment, baits, marron shells, animal carcasses, rubbish and shallow pit latrines dug near the water's edge, are frequently found at both dams (figures C7, C8 and C9). Surveillance, education, infringements, fencing and boom gates have deterred but not prevented these activities.

Feral pigs and unauthorised hunting

Feral pig control is no longer undertaken in the Samson Brook Catchment Area. However, anecdotal evidence indicates that feral pigs have returned to the area following the 2016 Waroona-Yarloop wildfire (see section 1.5.8). Pigs pose a risk of pathogen contamination from their excreta due to their behaviour and proximity to water bodies. Unauthorised hunting also occurs in the catchment area and poses additional pathogen risks to water quality from human access, dogs and pig carcasses.

Vandalism and rubbish dumping

Unauthorised access has led to vandalism of infrastructure and signs and rubbish dumping within the catchment area (Figure C10). Signs, gates and fencing are frequently damaged. In 2015, vandals accessed the Samson Brook pipehead dam and tampered with a dam valve, releasing 89 million litres of drinking water into the Samson Brook that would otherwise have been supplied to the IWSS.

1.5.8 Wildfire and fire management

In January 2016, the Waroona-Yarloop bushfire burnt over 69 000 ha of land, including substantial areas of the catchments for the Samson Brook dam and Samson Brook pipehead dam. The Water Corporation kept the dams offline for over a year to mitigate the water quality impacts from ash, turbidity and pathogens (figures C11 and C12). Mitigation measures included physical removal of debris and eroded soils, erosion control using coir logs, extra water quality monitoring and replacing damaged infrastructure including fences.

The Samson Brook pipehead dam was brought back online in February 2017.

The water quality risks and recommended management strategies for fire management activities are detailed in Table 1 of the 2002 plan.

Table 2 Summary of potential water quality risks, land use compatibility and best management practices

Land use/activity	Hazard	Management priority	Comments	Best management practice guidance ¹
<p><i>Recreation – unauthorised</i></p> <p>Direct human contact with reservoirs</p> <p>Shallow pit latrines</p> <p>Off-road vehicle use</p> <p>Marroning and fishing</p> <p>Camping</p> <p>Hunting</p>	<p>Pathogens</p> <p>Turbidity</p> <p>Nutrients</p> <p>Hydrocarbons</p>	<p>High</p> <p>Medium</p>	<p>Unauthorised recreation poses high pathogen risks from direct human contact with the reservoirs, shallow toilets dug in erosion-prone areas and carcasses left near the water's edge.</p> <p>Ongoing education, surveillance and enforcement strategies help deter unauthorised activities.</p> <p>These activities are illegal – penalties may apply.</p>	<p>n/a</p>
<p><i>Bauxite mining and forestry</i></p> <p>Human presence</p> <p>Vehicle use and fuel storage</p> <p>Rehabilitation</p>	<p>Pathogens</p> <p>Turbidity</p> <p>Hydrocarbons</p> <p>Nutrients</p> <p>Pesticides</p>	<p>High</p> <p>Medium</p>	<p>Bauxite mining and forestry are compatible with conditions in priority 1 areas</p>	<p>WQPN no. 44: <i>Roads near sensitive water resources</i></p> <p>WQPN no. 60: <i>Tanks for mobile fuel storage in PDWSAs</i></p> <p>WQPN no. 84: <i>Rehabilitation of disturbed land in PDWSAs</i></p> <p>WQPN no. 96: <i>Pest animal management in PDWSAs</i></p>

Land use/activity	Hazard	Management priority	Comments	Best management practice guidance ¹
				<p>WQPN no. 104: <i>Aerial spraying of crops with pesticides</i></p> <p><i>Working Arrangements between Alcoa World Alumina Australia and the Water and Rivers Commission and the Water Corporation covering Alcoa's Mining Operations in the Darling Range.</i></p> <p><i>Forest management plan 2014-2023</i></p> <p><i>Code of Practice for Timber Harvesting</i></p> <p><i>Manual of Management Guidelines for Timber Harvesting</i></p> <p>Public service circular 88: <i>Use of herbicides in water catchment areas</i></p>
<p><i>Feral animals</i></p> <p>Pigs</p>	<p>Pathogens</p> <p>Turbidity</p>	<p>High</p> <p>Medium</p>	<p>Feral pig control is not undertaken at Samson Brook Catchment Area. While pig numbers were substantially reduced after the Waroona-Yarloop fire, pigs have been sighted again in the catchment and will continue to pose risks to water quality.</p>	<p>WQPN no. 96: <i>Pest animal management in PDWSAs</i></p>
<p><i>Wildfires</i></p> <p>Human presence</p>	<p>Turbidity</p> <p>Pathogens</p>	<p>High</p>	<p>Occasional wildfire events such as the Waroona-Yarloop fire can have</p>	

Land use/activity	Hazard	Management priority	Comments	Best management practice guidance ¹
Carcasses Vehicle use Fire-fighting foam Ash and erosion	Nutrients Hydrocarbons	Medium	considerable impacts on water quality for a prolonged period of time.	
<i>Recreation – authorised</i> Munda Bididi Trail Lane Poole Reserve Waterous Loop Trail	Pathogens Turbidity	Medium	The Munda Bididi Trail and Lane Poole Reserve activities are located outside the RPZs and are considered medium management priorities. The Waterous Loop Trail is outside RPZs but erosion management is required near the stream crossing. Direct human contact with the water body is possible at the stream crossing.	Operational policy no. 13: <i>Recreation in PDWSAs on Crown land</i>

¹ Water quality protection notes (WQPNs) are available at www.dwer.wa.gov.au or see *Further reading*.

1.6 Water quality information

The Water Corporation has provided updated water quality information for the Samson Brook dam and Samson Brook pipehead dam. This is shown in Appendix B.

Health-related guideline values were not exceeded for any parameters during the review period (2013 to 2018). Occasional exceedances of the aesthetic ADWG values for aluminium, iron and turbidity have been attributed to construction works at the Samson Brook dam and pipehead dam.

The 2002 plan noted regular pathogen detections at Samson Brook Dam. During the review period, pathogens were detected in all samples from Samson Brook Dam. Water Corporation investigations into the pathogen detections have not identified a specific source in the catchment area but the detections are related to significant rainfall events. There are multiple sources of pathogens in the catchment area including humans.

It is important to appreciate that this raw-water data does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment exist downstream of the raw water to ensure it meets the requirements of the ADWG.

2 Consultation

We consulted the shires Harvey and Waroona, Water Corporation, Department of Biodiversity, Conservation and Attractions, Department of Mines, Industry Regulation and Safety, Department of Health, Alcoa and South West Aboriginal Land and Sea Council during the preparation of this review. Information provided by stakeholders was incorporated into this document. No contentious issues were raised.

3 Implementing Samson Brook Catchment Area drinking water source protection plan

3.1 Status of previous recommendations

Table 3 outlines recommendations from the 2002 plan and their current status.

Table 3 Implementation status for Samson Brook Catchment Area

No.	Recommendation	Comments
1	Gazettal of amended catchment area.	Gazetted in 2008 under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> .
2	Incorporation into land planning strategies.	<p>The Samson Brook Catchment Area is reflected in the <i>Peel region scheme</i> and the <i>Greater Bunbury regional scheme</i> as special control areas.</p> <p>The catchment area is not reflected in the Shire of Waroona and Shire of Harvey local planning schemes. This has been continued as a recommendation of this review (section 3.2, recommendation no. 1).</p>
3	<p>Referral of development proposals:</p> <ul style="list-style-type: none"> • Department of Water and Environmental Regulation (formerly Water and Rivers Commission) to provide the shires of Harvey and Waroona with guidelines for referral of development proposals. • Referral of development proposals. 	<p>Guidelines have been provided through the Department of Water and Environmental Regulation WQPNS series.</p> <p>Development proposals within all PDWSAs are referred to the Kwinana-Peel Region office of the Department of Water and Environmental Regulation. This has been continued as a recommendation of this review (section 3.2, recommendation no. 2).</p>

No.	Recommendation	Comments
4	Erection of signs: <ul style="list-style-type: none"> • Development of guidelines for signage. • Determine number and location of signs required. • Erect signs. 	Signs advising on the location of the Samson Brook Catchment Area have been erected throughout the catchment. Installing additional signs along the Waterous Loop Trail is a new recommendation of this review (section 3.2, recommendation no. 4).
5	Emergency response: <ul style="list-style-type: none"> • Develop response plan. • Inform WAHMEMS personnel of special requirements for the Samson Brook Catchment Area. 	Emergency response protocols have since changed to Westplan-HAZMAT and the local emergency management committee (LEMC). This has been continued as a new recommendation of this review (section 3.2, recommendation no. 3).
6	Surveillance program: <ul style="list-style-type: none"> • Develop guidelines for the surveillance of water reserves. • Implement the surveillance program. 	Water Corporation undertakes surveillance within the water reserve. This has been continued as a new recommendation of this review (section 3.2, recommendation no. 5).
7	Water quality monitoring program: <ul style="list-style-type: none"> • Review the program 	Water Corporation reviewed the water quality monitoring program and conducts quarterly monitoring of major components and weekly microbiological monitoring.
8	Access roads: <ul style="list-style-type: none"> • Ensure road maintenance programs address water quality risks • Control runoff at major stream crossing 	Unsealed roads throughout the catchment area are fenced and restrict access via boom gates. Turbidity control measures including coir logs are used where erosion concerns area identified. This has been continued as a recommendation of this review (section 3.2, recommendation no. 6).

No.	Recommendation	Comments
9	Recreation: <ul style="list-style-type: none"> • Prohibit swimming, fishing, marroning and uncontrolled hunting under by-laws • Develop recreation plan to consider recreation opportunities outside the catchment area • Develop recreation facilities recommended in the recreation plan • Implement fishing and marroning offsets 	<p>The Samson Brook Catchment Area was gazetted under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i>. Swimming, fishing, marroning and hunting are prohibited under the Metropolitan Water Supply, Sewerage, and Drainage Act By-laws 1981.</p> <p>Water-based recreational opportunities in the south-west were reviewed through the Public Administration Committee's inquiry <i>Recreation Activities within Public Drinking Water Source Areas</i> and report (Standing Committee on Public Administration 2010).</p> <p>In response to the report, the Department of Water and Environmental Regulation abolished or removed by-laws from more than 15 public drinking water source areas in the south west, allowing for increased recreational opportunities.</p> <p>Drakesbrook Dam was re-developed between 2009 and 2012, with enhanced recreational and fishing opportunities.</p> <p>Waroona Dam and Drakesbrook Dam are included in the Department of Primary Industries and Regional Development marron and trout stocking programs. Visitors are encouraged to use these facilities instead.</p>
10	Review of the plan and recommendations.	Undertaken through the preparation of this review document.

3.2 Consolidated recommendations

Based on the findings of this review, the following recommendations will now be applied to the Samson Brook Catchment Area. The bracketed stakeholders are those expected to have a responsibility for, or an interest in, the implementation of that recommendation.

1. Incorporate the findings of this review and the location of the Samson Brook Catchment Area (including its priority area and protection zones) in the Shire of Waroona local planning scheme and Shire of Harvey local planning scheme in accordance with the WAPC's State planning policy no. 2.7: *Public drinking water source policy*. (shires of Waroona and Harvey)

2. Refer development proposals within the Samson Brook Catchment Area that are inconsistent with the Department of Water and Environmental Regulation's WQPN no. 25: *Land use compatibility tables for public drinking water source areas* or recommendations in this review to the Department of Water and Environmental Regulation regional office for advice. (Department of Planning, shires of Waroona and Harvey, proponents of proposals)
3. Ensure incidents covered by Westplan–HAZMAT in the Samson Brook Catchment Area are addressed by ensuring that:
 - the shire of Harvey and Waroona local emergency management committees are aware of the location and purpose of the Samson Brook Catchment Area
 - the locality plan for the Samson Brook Catchment Area is provided to the Department of Fire and Emergency Services headquarters for the HAZMAT emergency advisory team
 - the Water Corporation acts in an advisory role during incidents in the Samson Brook Catchment Area
 - personnel dealing with Westplan–HAZMAT incidents in the area have ready access to a locality map of the Samson Brook Catchment Area and information to help them recognise the potential impacts of spills on drinking water quality.

(Water Corporation)

4. Maintain signs along the boundary of the Samson Brook Catchment Area including an emergency contact telephone number, in accordance with the Water Corporation's *S111 Source protection signage (2013)*. Erect additional signs along the Waterous Loop Trail advising of the location of the Samson Brook Catchment Area (Water Corporation)
5. Water Corporation should continue the current regime of water quality monitoring, surveillance, maintenance of fencing, inspections and by-law enforcement. (Water Corporation)
6. Continue to identify and manage erosion risks along roads and tracks, especially within the Samson Brook dam and pipehead dam reservoir protection zones and near water bodies. (Water Corporation)
7. Continue a range of surveillance, education and enforcement strategies to deter unauthorised recreational activities within the Samson Brook Catchment Area. (Water Corporation)
8. This report is planned to be reviewed in seven years or in response to changes in water quality contamination risks. (Department of Water and Environmental Regulation)

Appendices

Appendix A – Figures

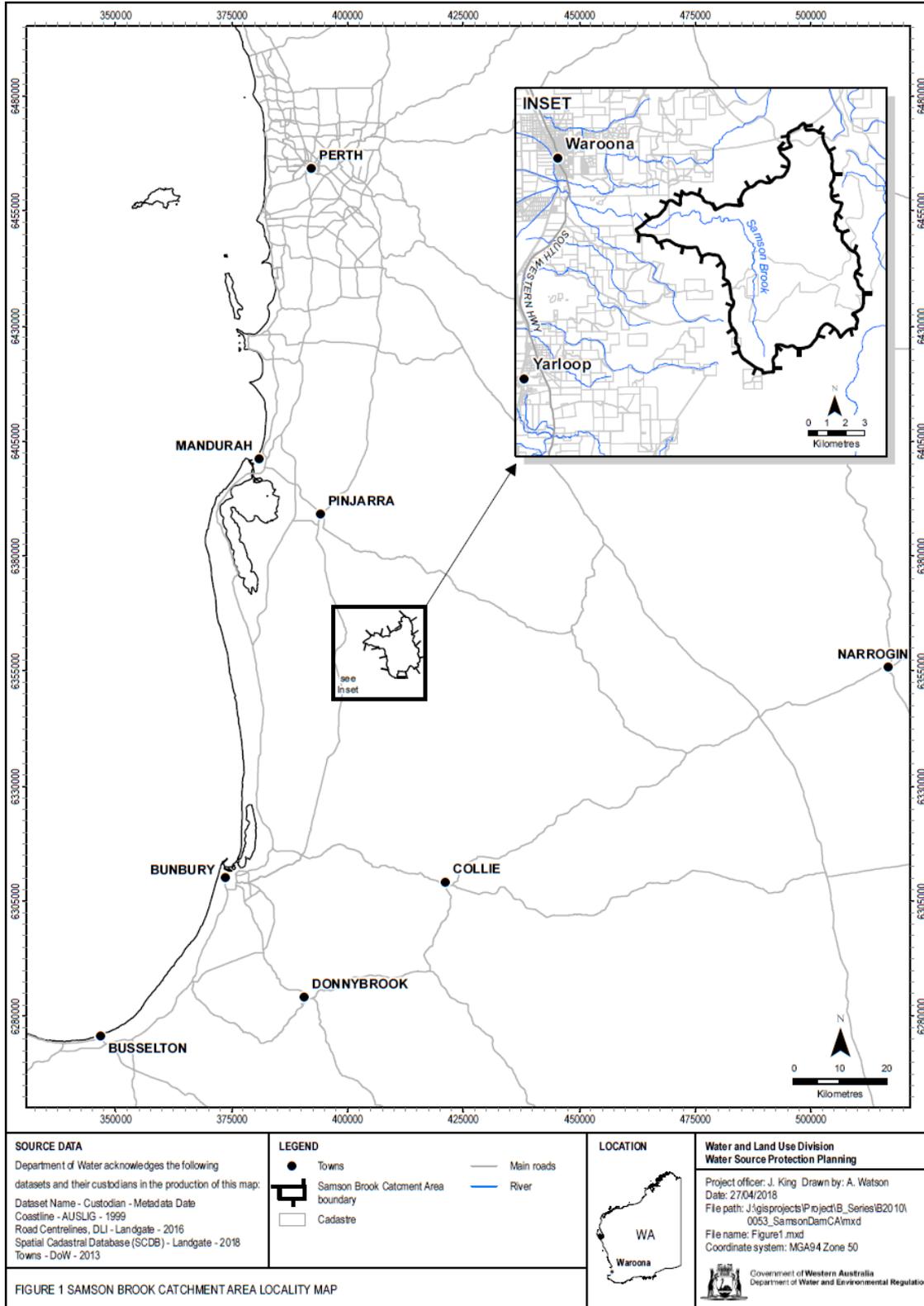


Figure A1 Samson Brook Catchment Area locality map

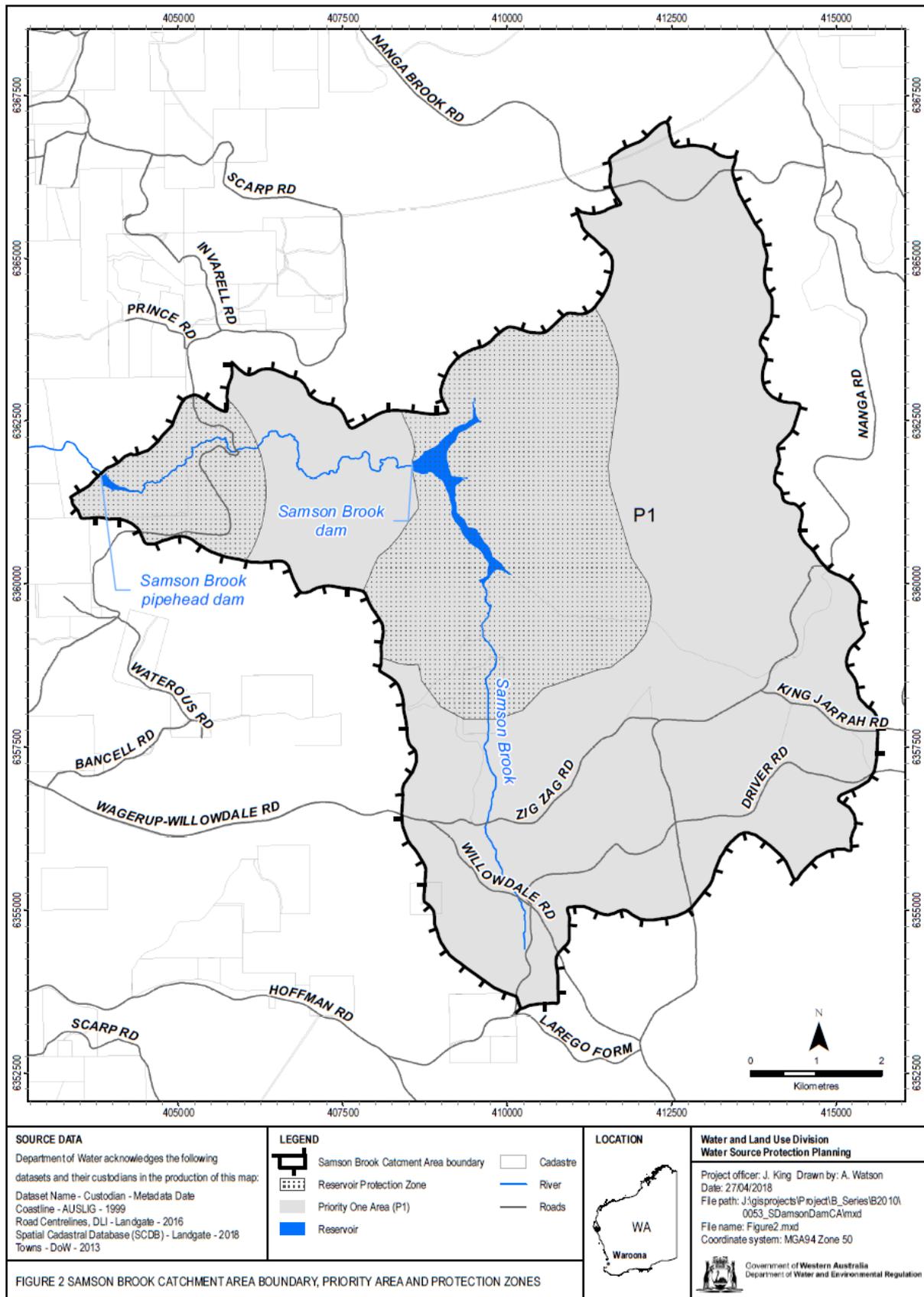


Figure A2 Samson Brook Catchment Area boundary, priority areas and protection zones

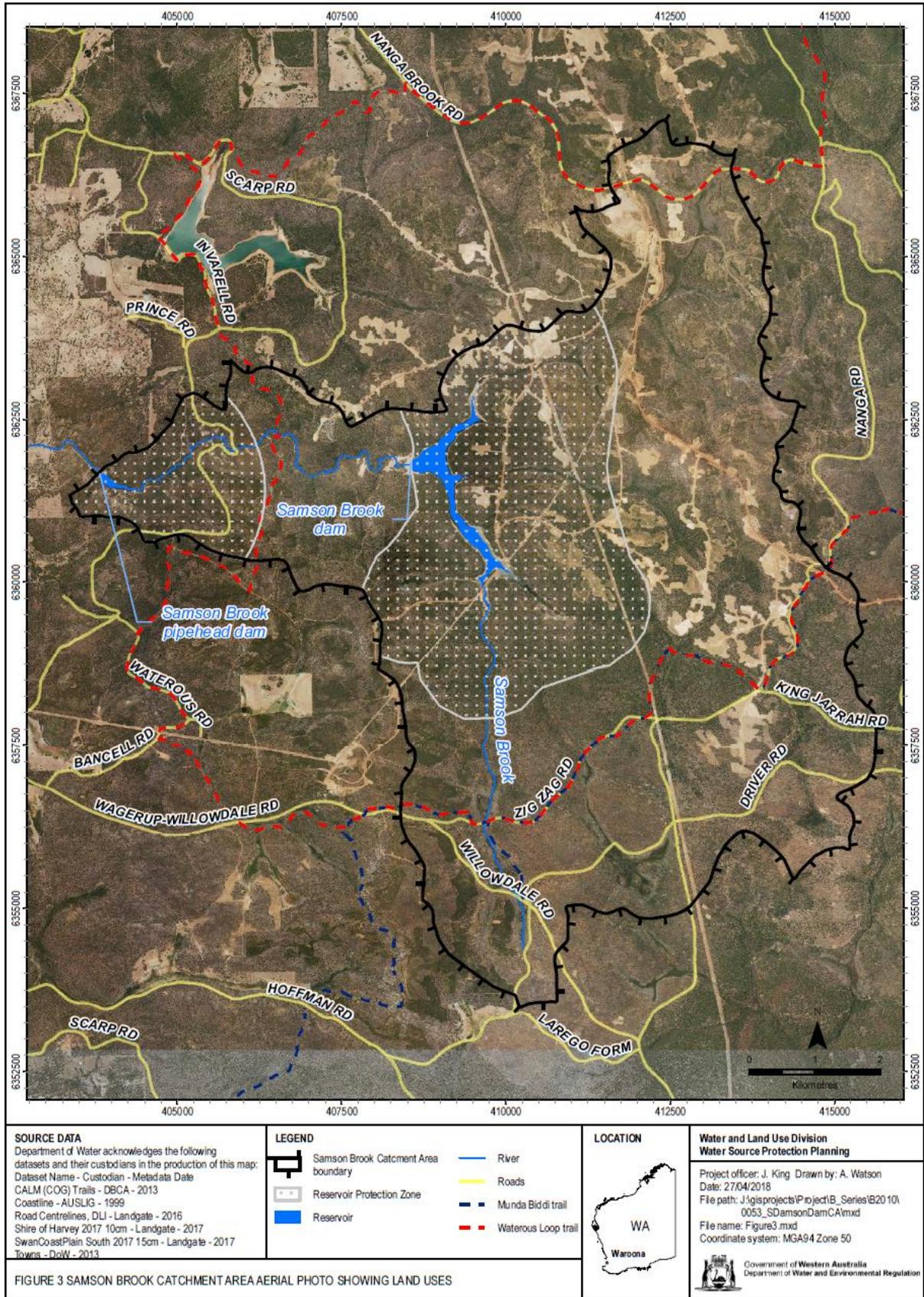


Figure A3 Samson Brook Catchment Area aerial photo showing land uses

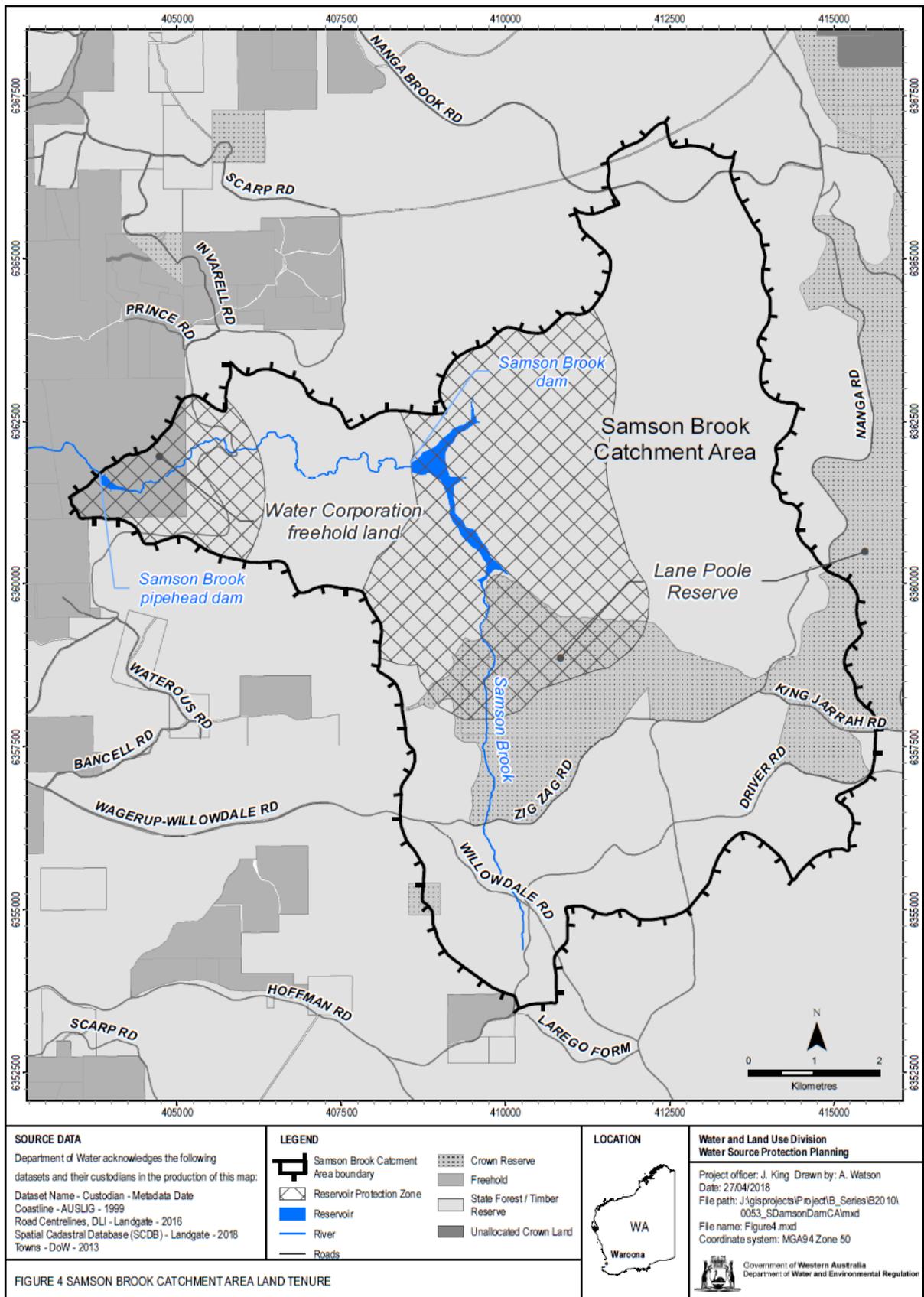


Figure A4 Samson Brook Catchment Area land tenure

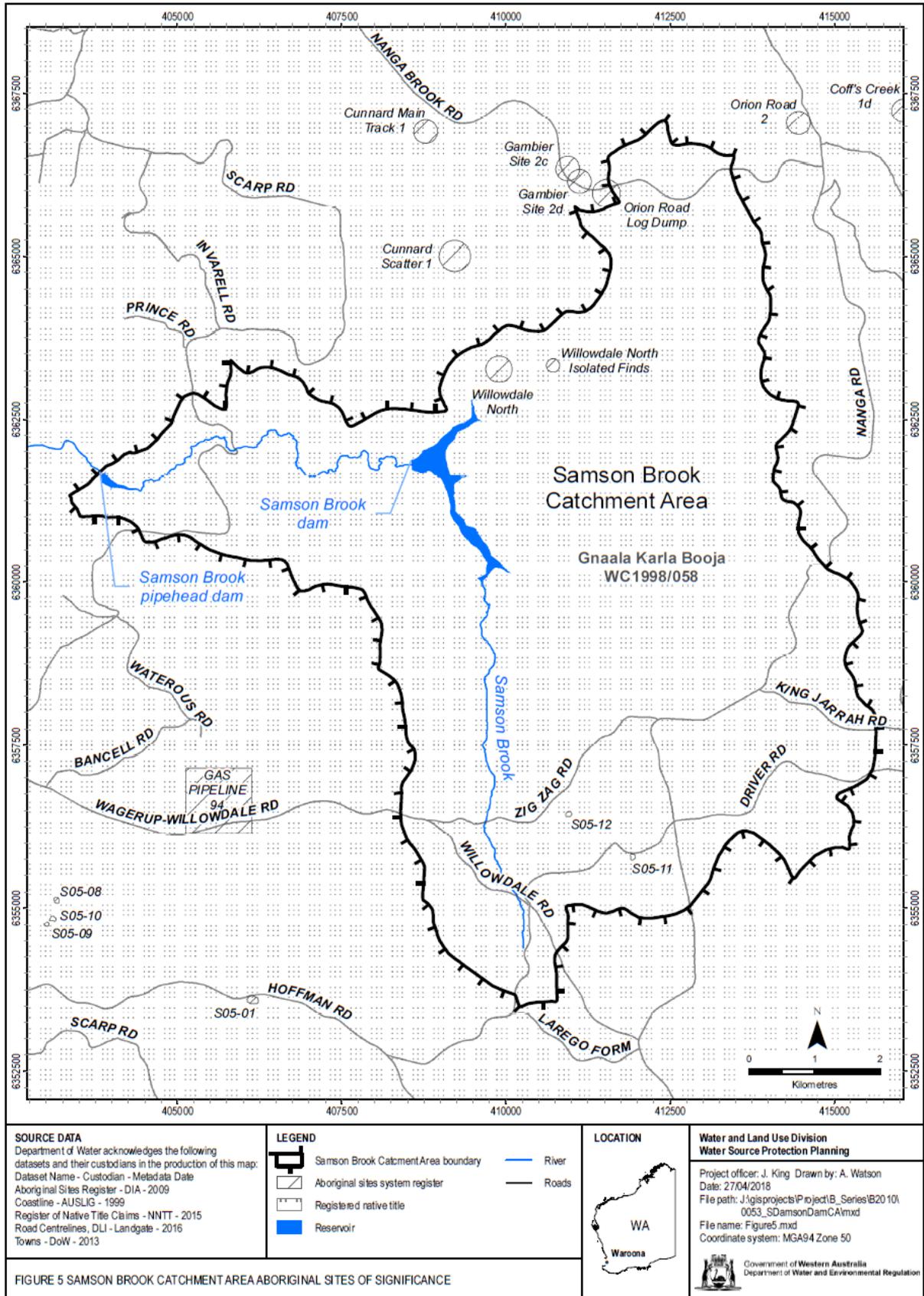


Figure A5 Samson Brook Catchment Area Aboriginal sites of significance

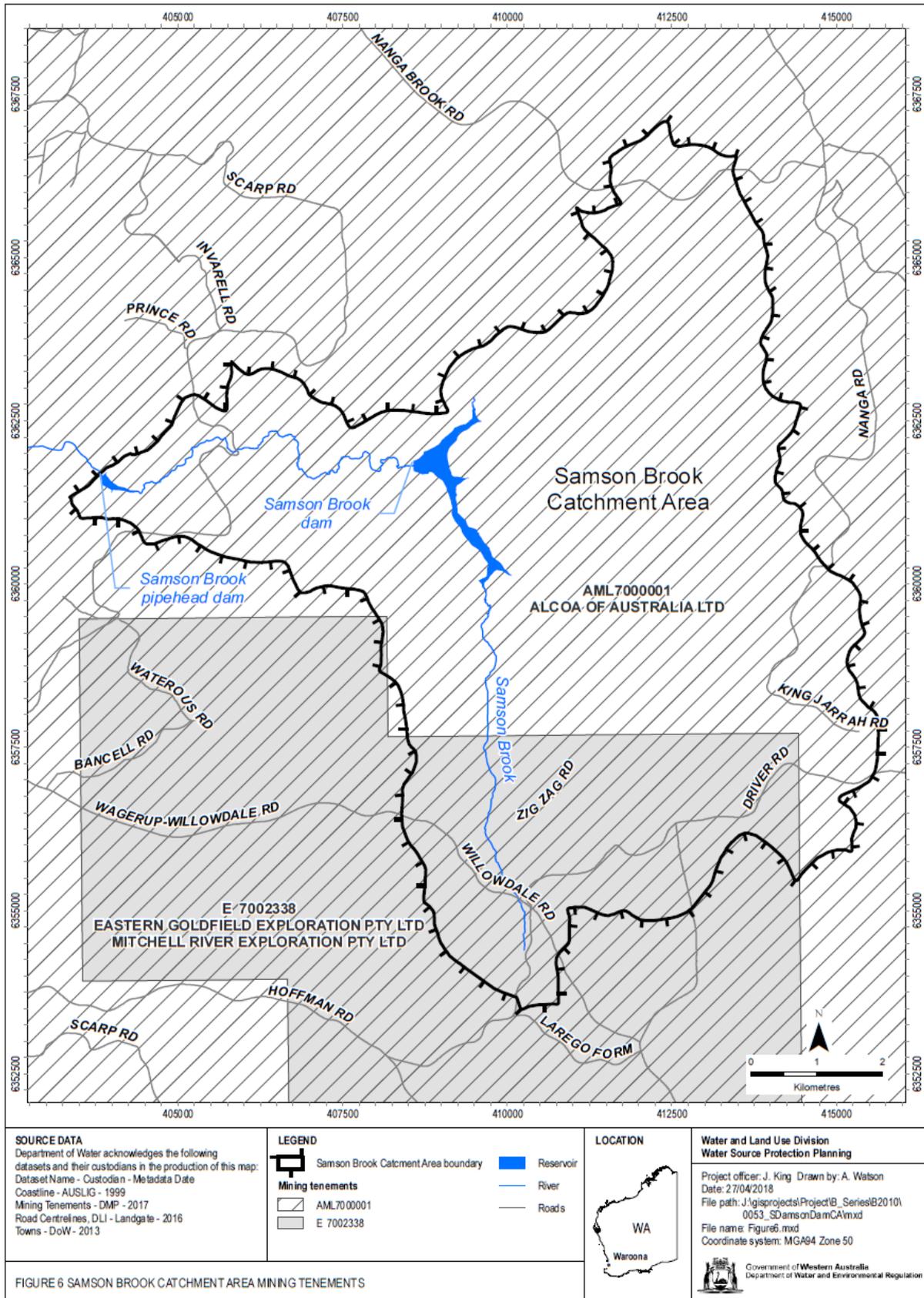


Figure A6 Samson Brook Catchment Area mining tenements

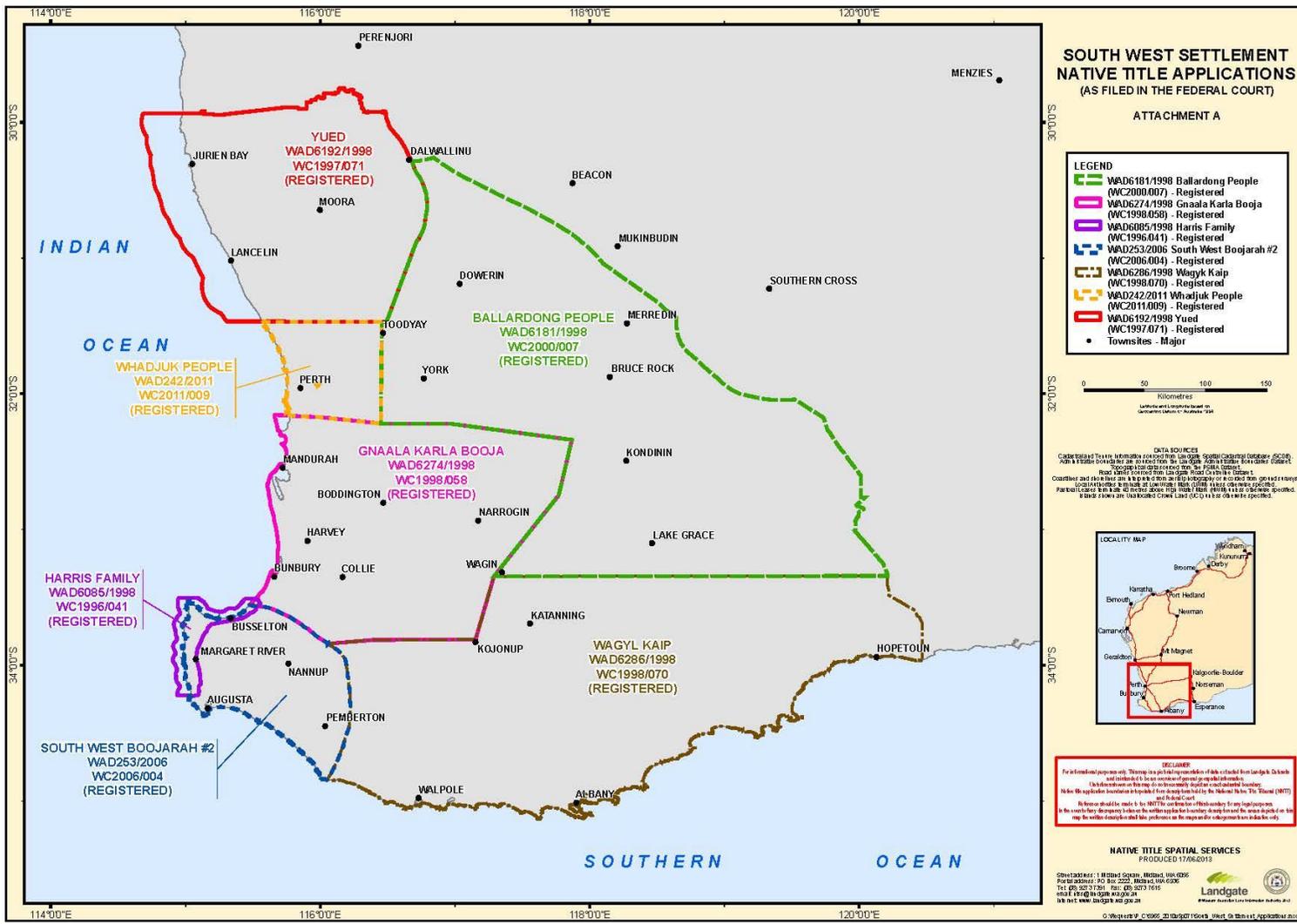


Figure A7 South West Native Title Agreement area (source: Department of Premier and Cabinet)

Appendix B – Water quality data

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

The Water Corporation has monitored the raw (source) water quality from Samson Brook Dam in accordance with the requirements of the *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011) and interpretations agreed to with the Department of Health. This data shows the quality of water in the public drinking water source area (PDWSA). The raw water is monitored regularly for:

- aesthetic characteristics (non-health-related)
- health-related characteristics including:
 - health-related chemicals
 - microbiological contaminants.

The following data represents the quality of raw water from Samson Brook Dam. 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. Any water quality parameters that have been detected are reported; those that on occasion have exceeded the ADWG are in bold and italics to give an indication of potential raw-water quality issues associated with this source. The values are taken from ongoing monitoring for the period May 2013 to April 2018.

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 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 Waroona scheme and Perth metropolitan area, refer to the most recent Water Corporation drinking water quality annual report at watercorporation.com.au What we do > Water quality > Water quality publications > Most recent *Water quality annual report*.

Aesthetic characteristics

The aesthetic quality analyses for raw water from Samson Brook Dam are summarised in the following table.

Aesthetic detections for Samson Brook Dam

Parameter	Units	ADWG aesthetic guideline value ¹	Samson Brook Dam	
			Range	Mean
Aluminium (acid soluble)	mg/L	0.2	0.045– 0.42	0.181
Ammonia as nitrogen ²	mg/L	0.41	0.008–0.055	0.032
Chloride	mg/L	250	40–60	49.2
Colour (true)	TCU	15	2–11	5.05
Conductivity	mS/m	–	16–24	19.15
Hardness as CaCO ₃	mg/L	200	14–22	18.25
Iron unfiltered	mg/L	0.3	0.045– 0.38	0.198
Manganese unfiltered	mg/L	0.1	0.004–0.06	0.012
Sodium	mg/L	180	23–30	26.5
Sulfate	mg/L	250	6–7.5	6.75
Total filterable solids by summation	mg/L	600	89–115	101.5
Turbidity	NTU	5	0.7– 20	3.66
pH measured in laboratory	no units	6.5–8.5	6.53–7.71	6.98

¹ An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water

² This is reported as ammonia as nitrogen, whereas the ADWG uses ammonia as ammonia, with a health guideline value of 0.5 mg/L. This has been converted to 0.41 mg/L so as to compare with the ammonia as Nitrogen values that were sampled.

Health-related chemicals

Raw water from Samson Brook Dam is analysed for chemicals that are potentially harmful to human health, including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related parameters that have been detected in the source are summarised in the following table.

Health-related detections for Samson Brook Dam

Parameter	Units	ADWG health guideline value ³	Samson Brook Dam	
			Range	Mean
Barium	mg/L	0.7	0.011–0.011	0.011
Boron	mg/L	4	0.04–0.04	0.04
Manganese unfiltered	mg/L	0.5	0.004–0.06	0.012
Nitrate plus nitrogen as N ⁴	mg/L	11.29 ⁵	<0.05–0.22	<0.05
Sulfate	mg/L	500	6–7.5	6.75

³ 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 (NHMRC & NRMCC 2011).

⁴ This is reported as nitrate as nitrogen, whereas the ADWG uses nitrate as nitrate, with a health guideline value of 50 mg/L. This has been converted to 11.29 mg/L so as to compare with the nitrate as nitrogen values that were sampled.

⁵ A 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.

Microbiological contaminants

Microbiological testing of raw-water samples from Samson Brook Dam is currently conducted on a weekly basis (when the source is online). *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals.

A detection of *E. coli* in raw water may indicate contamination of faecal material.

During the reviewed period, positive *E. coli* counts were recorded in all samples, of which 66 per cent had counts greater than 20 MPN/100mL.

Appendix C – Photographs

Photographs by J. King, Department of Water and Environmental Regulation, unless otherwise stated



Figure C1 Signs on Water Corporation property



Figure C2 Typical boom gate and fencing



Figure C3 Waterous Loop trail stream crossing



Figure C4 Signs near Samson Brook dam



Figure C5 *Unauthorised off-road vehicle use, photograph by T. Jones, Water Corporation, reproduced with permission*



Figure C6 *Off-road vehicle use along the Samson Brook reservoir, photograph by D. Hetherington, Water Corporation, reproduced with permission*



Figure C7 Evidence of marron fishing at the Samson Brook dam, photograph by D. Hetherington, Water Corporation, reproduced with permission



Figure C8 Evidence of unauthorised camping at Samson Brook dam



Figure C9 Rubbish from unauthorised camping, photograph by D. Hetherington, Water Corporation, reproduced with permission



Figure C10 Rubbish dumping, photograph by D. Hetherington, Water Corporation, reproduced with permission



Figure C11 Erosion and turbidity after the Waroona-Yarloop wildfire, photograph by D. Hetherington, Water Corporation, reproduced with permission



Figure C12 Turbidity in the Samson Brook pipehead dam after the Waroona-Yarloop wildfire, photograph by D. Hetherington, Water Corporation, reproduced with permission

Appendix D – Typical contamination risks in surface water sources

Land development and land- or water-based activities within a catchment area can directly affect the quality of drinking water and its treatment. Contaminants can reach drinking water sources through runoff over the ground and infiltration through soil. 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 resulting in illness, hospitalisation or even death. 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 2011). Contaminants can also interfere with water treatment processes, and damage water supply infrastructure (such as iron corroding pipes).

The *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011) outline criteria for acceptable drinking water quality to protect human health, manage aesthetics and maintain water supply infrastructure.

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

Microbiological risks

Pathogens are types of microorganisms that are capable of causing illness and include bacteria, protozoa and viruses. When people consume drinking water that is contaminated with pathogens, the consequences vary considerably, ranging from mild illness (such as stomach upset or diarrhoea) to hospitalisation and in some cases even death. For example, seven people died and about 2500 became ill in Walkerton, Canada, during 2000, because the town's water supply was contaminated by a pathogenic strain of *Escherichia coli* and *Campylobacter* (NHMRC & NRMCC 2011).

The types of pathogens that are likely to cause harm to people are commonly found in the faeces of humans and domestic animals (such as dogs and cattle). These pathogens can enter drinking water supplies from faecal contamination in the catchment area, either directly or indirectly.

Directly: When people or domestic animals come into contact with a body of water, pathogens may enter that water source. This occurs through the direct transfer of faecal material into the water such as while fishing, marroning or swimming.

Indirectly: Pathogens can wash over or infiltrate into the soil, and find their way into water supplies, such as from septic tanks or animal manure deposited in paddocks.

A number of pathogens are commonly known to contaminate water supplies worldwide. These include bacteria (for example *Salmonella*, *Escherichia coli* and cholera), protozoa (such as *Cryptosporidium* and *Giardia*) and viruses. Monitoring for the presence of *E. coli* in water supplies provides an indication of the level of recent faecal contamination.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (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 ability of pathogens to survive in surface water differs between species. *Salmonella* may be viable for two to three months, *Giardia* may still infect after a month in the natural environment (Geldrich 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) may survive weeks to months in fresh water (NHMRC & NRMCC 2011).

Unlike chemicals, which dissipate and dilute when they enter a water source, pathogens can multiply under the right conditions, increasing the likelihood of contamination. Therefore it is important to understand both the groundwater and surface water systems to be able to protect the drinking water source from pathogens.

Given the wide variety of pathogens, their behaviour in the environment and the potential consequences of consuming contaminated water, the most effective way to protect public health and reduce water treatment costs is to avoid the introduction of pathogens into a water source.

Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water (cloudiness). Erosion from activities such as off-road driving and clearing of vegetation can cause turbidity in surface water sources. Increased turbidity can result in cloudy or muddy-looking water, which is not aesthetically appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens and chemicals can attach onto soil particles and become more difficult to remove during disinfection and treatment processes. High levels of turbidity in a water body can also affect the environment. Suspended particles smother riparian vegetation and reduce the ability of light to penetrate the water column. This affects plant growth which in turn can affect water quality.

Other physical properties of water can affect water supply infrastructure, or the aesthetics of the drinking water. For example, pH can contribute to the corrosion and encrustation of pipes; iron and dissolved organic matter can affect the colour and smell of water; and salinity levels can affect its taste. Although not necessarily

harmful to human health, water with properties like this will be less appealing to customers.

Chemical risks

Chemicals can occur in drinking water as a result of natural leaching from mineral deposits or from different land uses (NHMRC & NRMMC 2011). A number of these chemicals (organic and inorganic) are potentially toxic to humans.

Pesticides include agricultural chemicals used to control weeds (herbicides) and pests (insecticides, rodenticides, nematicides (for worms) and miticides (for 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 such as fuels and oils are potentially toxic to humans. Harmful chemical by-products may be formed when hydrocarbons are combined with chlorine during the water treatment process. Hydrocarbons can occur in water supplies as a result of spills and leaks from vehicles and machinery.

Drinking water sources can also be contaminated by nutrients such as nitrogen and phosphorus. Nutrients can be introduced into a catchment via the application of fertiliser, from septic systems, and from animal faecal matter deposited in the catchment that washes over soil and down waterways and into the water supply. Nitrate and nitrite are two forms of nitrogen that can be toxic to humans at high levels, with infants younger than three months being most susceptible (NHMRC & NRMMC 2011).

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

Appendix E – How do we protect public drinking water source areas?

The *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011) outline how we should protect drinking water in Australia. The ADWG recommends a 'catchment to consumer' framework that uses an approach based on preventive risk and multiple barriers. 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 the taps in your home. It ensures a holistic assessment of water quality risks and solutions to ensure the delivery of a reliable and safe drinking water to supply your home.

An approach based on preventive risk means that we look at all the different risks to water quality. We determine what risks can reasonably be avoided and what risks need to be minimised or managed to protect public health. This approach means that the inherent risks to water quality are as low as possible. A risk-based approach is often suggested as a way to address risks to water quality in a public drinking water source area (PDWSA; the area from which water is captured to supply drinking water). However, a risk-based approach is not the same as an approach based on preventive risk. A risk-based approach is inadequate for addressing risks to public health, and is not recommended by the ADWG.

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 PDWSA. 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 (for example chlorination to inactivate pathogens), maintenance of pipes and testing of water quality.

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 report is important. We should not forget that ultimately it's about safeguarding your health by protecting water quality now and for the future.

An additional benefit from PDWSA protection is that it complements the state's conservation initiatives.

In Western Australia, the Department of Water and Environmental Regulation protects PDWSAs by implementing the ADWG, writing reports, policies and guidelines, and providing input into land use planning.

This drinking water protection report achieves elements 2 and 3 of the 12 elements in the ADWG recommended for protecting drinking water. It shows the PDWSA's location, its characteristics, existing and potential water quality contamination risks, and makes recommendations to deal with those risks.

The *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* and the *Country Areas Water Supply Act 1947* provide us with legislative tools to protect water quality for PDWSAs. These Acts and the associated by-laws allow us to assess and manage the water quality contamination risks from different land uses and activities. The department works cooperatively with other agencies and the community to implement this legislation and develop drinking water source protection reports. For example, the Western Australian Planning Commission has developed a number of state planning policies to help guide development in PDWSAs.

An important step in maximising the protection of water quality in PDWSAs is to define their boundaries, priority areas and protection zones to help guide land use planning and to identify where legislation applies. Our Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a) describes how we do this. It is available www.dwer.wa.gov.au.

There are three different priority areas. The objective of priority 1 (P1) areas is risk avoidance – ensuring there is no degradation of the water quality (for example over Crown land). The objective of priority 2 (P2) areas is risk minimisation – maintaining or improving water quality (for example over rural-zoned land). The objective of priority 3 (P3) areas is risk management – maintaining the water quality for as long as possible (for example, urban- or commercial-zoned land). Protection zones surround drinking water abstraction bores and surface water reservoirs so that the most vulnerable areas are protected from contamination.

Our Water quality protection note (WQPN) no. 25: *Land use compatibility tables for public drinking water source areas* (Department of Water 2016b) outlines appropriate development and activities within each of the priority areas (P1, P2 and P3).

With more than 120 constituted PDWSAs across Western Australia, the department prioritises the update of drinking water source protection reports (such as this document). Our aim is to update each report every seven years. In some locations, more frequent updates may be required to address changing water quality risks and land uses. These updates allow us to make changes to the PDWSA boundary, priority areas and protection zones if required. They also allow solutions to new water quality risks to be considered.

There are three different types of drinking water source protection report – each providing for different needs. The following table shows the differences between the types of reports.

There is a fourth type of report – Land use and water management strategy – that performs the same functions as a drinking water source protection report. However, these strategies are prepared by the Western Australian Planning Commission (with input from the Department of Water and Environmental Regulation) and are strategic documents that integrate land use planning with water management. There are currently land use and water management strategies for Gnangara, Jandakot and Middle Helena.

If you would like more information about the ADWG and how we protect drinking water in Western Australia, visit www.dwer.wa.gov.au > what we do > water > urban water > drinking water, or read our Strategic policy: *Protecting public drinking water source areas in Western Australia* (Department of Water 2016a). You can also contact the Department of Water and Environmental Regulation's Water source protection planning branch on +61 8 6364 7600 or email drinkingwater@dwer.wa.gov.au.

Drinking water source protection reports produced by the Department of Water and Environmental Regulation

Drinking water source protection report	Scope and outcome	Consultation	Time to prepare	Implementation table	Gazettal
Drinking water source protection assessment (DWSPA)	Desktop assessment of readily available information	Preliminary	Up to 3 months	No	Arrange for the constitution and gazettal of the source under legislation. This helps protect water quality and guides land use planning. All types of consulted drinking water source protection reports can recommend to constitute a source's boundary under legislation.
Drinking water source protection plan (DWSPP)	Full investigation of risks to water quality building on information in the DWSPA	Public	6–12 months	Prepared from recommendations in the DWSPA and/or information from public consultation	
Drinking water source protection review (DWSPR)	Review changes in land and water factors and implementation of previous recommendations. Sometimes prepared to consider specific issues in a PDWSA	Key stakeholders	3–6 months	Prepared from recommendations in the DWSPA or DWSPP	

Appendix F – Understanding risks to drinking water quality

The existing integrated land use planning and public drinking water source area (PDWSA) protection program is based on the findings of three parliamentary committee reports in 1994, 2000 and 2010 (see *Further reading*). Since 1995, this program has resulted in the development of four Western Australian Planning Commission state planning policies (SPPs), recognising the importance of PDWSAs for the protection of water quality and public health:

- SPP no. 2.2: *Gnangara groundwater protection*
- SPP no. 2.3: *Jandakot groundwater protection*
- SPP no. 2.7: *Public drinking water source policy*
- SPP no. 2.9: *Water resources*.

This integrated program relies upon a risk assessment process based on preventive risk in each PDWSA through the development of drinking water source protection reports. It is important to understand how risks are assessed to appreciate the impact of development within PDWSAs.

Risk-based assessments normally focus on the acceptability of risks after mitigation (residual risks). For drinking water sources, an assessment based on preventive risk that considers both the maximum and residual risks is required. This means that in some cases, the maximum risks from land uses will still be considered unacceptable, even after mitigation has reduced the risk. This is a more conservative approach needed to protect the health of consumers.

Water quality risks are evaluated by considering the type and scale of a potential contamination event (consequence), together with the probability/frequency of that event occurring (likelihood). An understanding of this relationship will prevent the common misunderstanding that probability equals risk (see risk matrix below).

Risk matrix: Level of risk (from the Australian drinking water guidelines 2011)

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Moderate	High	Very high	Very high	Very high
Likely	Moderate	High	High	Very high	Very high
Possible	Low	Moderate	High	Very high	Very high
Unlikely	Low	Low	Moderate	High	Very high

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Rare	Low	Low	Moderate	High	High

For example, just because a drinking water contamination incident has not occurred for many years (low likelihood) does not mean that the risk is low. This is because we also need to consider the consequence of that contamination when determining risk. Furthermore, no previous detection of contamination is not proof that the risk is acceptable.

Shortened forms

List of shortened forms

ADWG	<i>Australian drinking water guidelines</i>
ANZECC	Australian and New Zealand Environment Conservation Council
HAZMAT	hazardous materials
ILUA	Indigenous land use agreement
IWSS	integrated water supply scheme
LEMC	local emergency management committee
MMPLG	Mine management planning liaison group
NHMRC	National Health and Medical Research Council
NRMMC	Natural Resource Management Ministerial Council
P1, P2, P3	priority 1, priority 2, priority 3
PDWSA	public drinking water source area
RPZ	reservoir protection zone
WAHMEMS	Western Australian hazardous materials emergency management scheme (previous name for Westplan–HAZMAT)
WAPC	Western Australian Planning Commission
Westplan–HAZMAT	Western Australian plan for hazardous materials
WQPN	water quality protection note

Units of measurement

ha	hectares	A measure of area, 1 ha equals 10 000 m ² .
km	kilometres	A measure of distance, 1 km equals 1000 m.
km²	square kilometres	A measure of area.
mS/m	millisiemens per metre	Electrical conductivity of a solution or soil and water mix that provides a measurement of salinity.
m	metres	A measure of distance.

mg/L	milligrams per litre	A measure of concentration of a substance in a solution.
mm	millimetres	A measure of length.
MPN	most probable number	A method used to measure the occurrence of microbes in a sample of water. The procedure uses tubes or microtitre plates and presence/absence tests (WHO 2011).
NTU	nephelometric turbidity units	A measure of turbidity in water.
pH		A logarithmic scale for expressing the acidity or alkalinity of a solution; a pH below 7 indicates an acidic solution and above 7 indicates an alkaline solution.
TCU	true colour units	A measure of degree of colour in water.

Volumes of water

One millilitre	0.001 litre	1 millilitre	(mL)
One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 gigalitre	(GL)

Glossary

Abstraction	The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.
Advisory Committee for the Purity of Water	A non-statutory interdepartmental committee chaired by the Department of Health providing advice to the Ministers for Health and Water on drinking water quality.
Aesthetic guideline value	The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, for example appearance, taste and odour (NHMRC & NRMCC 2011).
Allocation	The volume of water that a licensee is permitted to abstract, usually specified in kilolitres per year (kL/y).
Australian drinking water guidelines	The <i>National water quality management strategy: Australian drinking water guidelines 6</i> (ADWG; NHMRC & NRMCC 2011) outlines acceptable criteria for the quality of drinking water in Australia (see <i>References</i>).
Bore	A narrow, lined hole drilled into the ground to monitor or draw groundwater (also called a well).
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Catchment area	An area constituted under the <i>Country Areas Water Supply Act 1947</i> or the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> for the purposes of protecting a drinking water supply.
Contamination	A substance present at concentrations exceeding background levels that presents – or has the potential to present – a risk of harm to human health, the environment, water resources or any environmental value.
Drinking water source protection report	A report on water quality hazards and risk levels within a public drinking water source area; includes recommendations to avoid, minimise, or manage those risks for the protection of the water supply in the provision of safe drinking water supply.
Gazette	Publication within the Government Gazette of Western Australia of the Order in Council or Proclamation defining the boundaries of any catchment area or water reserve.

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 & NRMCC 2011).
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.
Integrated water supply scheme	The Water Corporation's Integrated water supply scheme which supplies drinking water to over 2 million people in Perth, the Goldfields and Agricultural region and some parts of the South West.
Maximum risk	This is the level of risk in the absence of any preventive measures being installed in the system, or assuming that preventive measures have failed. Assessing maximum risk is useful for identifying high priority risks, determining where attention should be focused and preparing for emergencies (NHRMC & NRMCC 2011).
Microbe	A microorganism, usually one of vegetable nature, a germ. Also known as a bacterium, especially one causing illness.
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.
Proclamation	Made under the Governor of Executive Council and published in the Government Gazette to constitute or abolish a water reserve, catchment area or underground water pollution control area under section 13 and 57A of the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> .
Public drinking water source area	The area from which water is captured to supply drinking water. It 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> or the <i>Country Areas Water Supply Act 1947</i> .

Priority 1, 2 and 3	Three different priority areas are assigned within PDWSAs to guide land use decisions. The objective of priority 1 (P1) areas is <i>risk avoidance</i> , priority 1 (P2) areas is <i>risk minimisation</i> and priority 3 (P3) areas is <i>risk management</i> .
Public sector circular number 88	A state government circular produced by the Department of Health providing guidance on appropriate herbicide use within water catchment areas.
Reservoir	A dam, tank, pond or lake that captures water from a surface catchment to create a water supply source.
Reservoir protection zone	A buffer measured from the high water mark of a drinking water reservoir, and inclusive of the reservoir (usually 2 km). This is referred to as a prohibited zone under the Metropolitan Water Supply, Sewerage, and Drainage Act By-laws 1981.
Residual risk	This is the level of risk after considering preventive measures that are applied in the drinking water supply system, such as fencing to keep cattle away from drinking water bores, or surveillance to identify people accessing protected areas. Residual risk provides an indication of how effective preventive strategies are or the need for additional preventive measures (NHRMC & NRMMC 2011).
Runoff	Water that flows over the surface from a catchment area, including streams.
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.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
Turbidity	The cloudiness or haziness of water caused by the presence of fine suspended matter.
Water quality	Collective term for the physical, aesthetic, chemical and biological properties of water.
Water reserve	An area constituted under the <i>Country Areas Water Supply Act 1947</i> or the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> for the purposes of protecting a drinking water supply.
Wellhead	The top of a well (or bore) used to draw groundwater.

Wellhead protection zone	Usually declared around wellheads in public drinking water source areas to protect the groundwater from immediate contamination risks.
Westplan–HAZMAT	State emergency management plan for hazardous materials emergencies.

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