



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

North Dandalup Dam Catchment Area

drinking water source protection review



Integrated water supply scheme

Water resource protection series
Report WRP187
June 2019

North Dandalup Dam Catchment Area drinking water source protection review

Integrated Water Supply System

Department of Water and Environmental Regulation

Water resource protection series

Report no. 187

June 2019

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Cover photograph: Aerial photo of North Dandalup Dam

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Summary

This drinking water source protection review considers changes that have occurred in and around the North Dandalup Dam since the *North Dandalup Pipehead Dam Catchment Area drinking water source protection plan* (Department of Environment 2005) was released. The plan still contains relevant information, so it is important that the 2005 plan and this review are read in conjunction. Both are available on our website or by contacting us.

The North Dandalup Dam is about 150 km south of Perth and stores water from the North Dandalup River catchment (see Appendix A, Figure A1, and Appendix C, figures C1 and C2). The Water Corporation takes water from the dam to supply the Integrated Water Supply System, which provides drinking water to Perth, the Goldfields and some parts of the south-west.

The catchment area was originally gazetted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* in 1982 to protect it as a source of drinking water. Although its gazetted name is 'North Dandalup Pipehead Dam Catchment Area', it is more accurately known as the 'North Dandalup Dam Catchment Area'. This report will refer to it as the latter.

The main changes since the 2005 plan are:

- Updated spatial data has shown that a small area downstream of the dam wall does not need to be part of the catchment anymore, because the water runoff from here doesn't flow into the reservoir. This will require an amendment to the catchment's boundary under legislation.
- There has been an ongoing reduction in stream flows into the reservoir due to a drying climate, however the water source continues to provide good quality, low cost drinking water.
- The reservoir receives and stores desalination water and transfers from other southern dams. This makes the dam a valuable asset for the Integrated Water Supply System.
- There has been an increase in bauxite mining activity in the catchment (see Appendix A, Figure A2). The mining risks are managed via working arrangements between the department, Water Corporation and Alcoa.

This review implements the August 2018 edition of the *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011), State planning policy no. 2.7: *Public drinking water source policy* (Western Australian Planning Commission 2003) and Strategic policy: *Protecting public drinking water source areas in Western Australia* (DoW 2016a).

The Department of Water and Environmental Regulation (DWER) prepared this document in consultation with key stakeholders, including the Shire of Murray, Water Corporation, Department of Biodiversity, Conservation and Attractions, Alcoa and Forest Products Commission (see section 2).

Important information about the North Dandalup Dam Catchment Area is in Table 1.

Table 1 Key information about the North Dandalup Dam Catchment Area

| North Dandalup Dam Catchment Area | |
|---|---|
| Local government | Shire of Murray |
| Locations supplied | This catchment is part of the Integrated Water Supply Scheme – including desalinated water, groundwater, other surface water sources and groundwater replenishment – which supplies Perth, the Goldfields and some parts of the south-west |
| Population supplied | Over 2 million people |
| Water service provider | Water Corporation |
| Capacity | 75 million kilolitres (kL) |
| Catchment size | 153 square kilometres (km ²) |
| Licence to take water | 22.2 million kL per year, issued under the <i>Rights in Water and Irrigation Act 1914</i> |
| Date of dam completion | 1994 |
| Dates of drinking water source protection reports | 2005 – <i>North Dandalup Pipehead Dam Catchment Area water source protection plan</i> (Department of Environment) 2019 – <i>North Dandalup Dam Catchment Area drinking water source protection review</i> (this document) |
| Consultation | 2003 – advertised public consultation as part of the 2005 drinking water source protection plan 2019 – consultation with key stakeholders |
| Gazettal history | Gazetted on 3 December 1982 under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> Boundary alterations gazetted on 14 November 2000 under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909</i> |
| Reference documents | <i>Australian drinking water guidelines</i> (NHMRC & NRMCC 2011, updated August 2018) State planning policy no. 2.7: <i>Public drinking water source policy</i> (WAPC 2003) <i>Managing releases from the North Dandalup Dam, North Dandalup allocation statement</i> (DWER 2017) |

1 Review of the 2005 plan

1.1 Boundary, priority areas and protection zones

The North Dandalup Dam was constructed in 1994, just upstream of the original pipehead dam (see Appendix A, Figure A1, and Appendix C, figures C1 and C2). The Water Corporation takes water from the dam to supply the Integrated Water Supply System, which provides drinking water to Perth, the Goldfields and some parts of the south-west.

The catchment was originally gazetted in 1982 under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* to protect it as a source of drinking water. Although its gazetted name is 'North Dandalup Pipehead Dam Catchment Area', this report will refer to it as the 'North Dandalup Dam Catchment Area' to reflect the correct name of the dam. The original pipehead dam is downstream of the current dam and is no longer used for drinking water supply.

There is a small area of gazetted catchment downstream of the dam wall. Now that more detailed geographic information systems are available, the Department of Water and Environmental Regulation (DWER) has determined this area doesn't form part of the catchment (see Figure A4). The department will arrange to amend the boundary under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* once this plan is published. At the same time, we will change its name to 'North Dandalup Dam Catchment Area' (see section 3.2, recommendation 1).

Through the 2005 drinking water source protection plan, the entire catchment area was assigned a Priority 1 (P1) area, and a reservoir protection zone (RPZ) was established (Figure A4). No changes to the priority area or protection zone are required because they are consistent with the department's Strategic policy: *Protecting public drinking water source areas in Western Australia* (DoW 2016a).

Please read Appendix E for more information about P1 areas, RPZs and how DWER protects drinking water sources.

1.2 Climate

The last plan stated that the average rainfall for the region was 999 mm per year (1998–2005). Since then, rainfall has reduced. The average rainfall from 2005 to 2018 was 904 mm per year for the nearby Huntly station, with the driest year being 2010, with only 630 mm (BoM 2019).

1.3 Water supply scheme

Although inflows to reservoirs in the south-west of WA (including North Dandalup) have declined under our drying climate, they still provide an important component of supply (DoW 2014).

The North Dandalup Dam remains a strategically important source for the Integrated Water Supply Scheme. Water is transferred into the dam from other IWSS dams (e.g. South Dandalup Dam to reduce water lost through evaporation) and from the Southern Seawater Desalination Plant in Binningup.

DWER licence the Water Corporation under the *Rights in Water and Irrigation Act 1914* to take water from the North Dandalup Dam to supply drinking water. This 10-year surface water licence, most recently re-issued in 2017, allows the Water Corporation to take 22.2 million kilolitres (kL) of water per year.

There have been no changes to Water Corporation's treatment regime of chlorination (to disinfect the water) and fluoridation since the 2005 plan.

Public drinking water source area (PDWSA) management is the first step in protecting water quality and ensuring a safe drinking water supply. Although treatment and disinfection are essential barriers against contamination, catchment protection is the most important, as advocated by the *Australian drinking water guidelines* (ADWG; NHMRC & NRMCC 2011, updated August 2018). The ADWG is based on preventing risks and installing multiple barriers for providing safe drinking water to consumers. This combination of catchment protection and water treatment delivers a more reliable, safer and lower cost drinking water to consumers than either approach could achieve individually.

For more information about how DWER protects PDWSAs, read Appendix E. For more information about our preventive risk management approach, read Appendix F.

1.4 Planning

Regional

The North Dandalup Dam Catchment Area is within Special control area no. 1 (SCA1) of the *Peel region scheme* (Government of Western Australia 2013). SCA1's purpose is to protect water sources that are used for high quality public water supply.

The scheme states that for planning proposals within SCA1, the Western Australian Planning Commission is to have due regard to the impact of planning proposals on the quality of the public drinking water source. It is to consult with DWER and have regard to its recommendations.

Local

The catchment area lies entirely within the Shire of Murray. It is mostly zoned state forest under the local planning scheme (*Town planning scheme no. 4*, Department of Planning, Lands and Heritage 1989), apart from a few lots zoned rural which are freehold land owned by the Crown (see section 1.9). The local scheme does not have a special control area and DWER recommends that the shire consider this for its next scheme update (see section 3.2, recommendation 2).

1.5 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, however this is at the discretion of the minister.

There are many recorded Aboriginal sites of significance within the North Dandalup Dam Catchment Area, mostly along the waterways. Not all Aboriginal sites of significance and heritage have been recorded and are on the register of Aboriginal sites, so it's important that traditional custodians are always consulted in regards to their country. This review does not propose anything that will change the way in which significant sites are affected in the North Dandalup Dam Catchment Area.

Native title is the recognition in Australian law that some Aboriginal people continue to hold native title rights and interests in lands and waters. The North Dandalup Dam Catchment Area lies within the Gnaala Karla Booja claim area (WAD6274/1998).

The State Government of Western Australia and the Noongar native title claimants have negotiated a South West Native Title Settlement. This settlement recognises the Noongar people as the traditional owners of land in the South West Settlement Area (see Appendix A, Figure A5), which includes the North Dandalup Dam Catchment Area.

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. On 8 June 2016, we amended two sets of by-laws (Metropolitan Water Supply, Sewerage and Drainage By-laws 1981 and the Country Areas Water Supply By-laws 1957) to undertake these activities. The amended metropolitan by-laws currently apply within the North Dandalup Dam Catchment Area. Once the small area downstream of the dam wall is abolished (see section 1.1 and Figure A1), the by-laws will no longer apply to that small area.

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

DWER 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.

1.6 Enforcing by-laws, surveying the area and maintenance

Since the 2005 plan, DWER has formally delegated by-law enforcement for this catchment to the Water Corporation. Water Corporation should continue its by-law enforcement activities (see section 2.2, recommendation no. 5) which include:

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

1.7 Related water resource management work

Water Corporation manages the release of water downstream of the North Dandalup Dam under instruction from DWER. These releases have been conducted since the dam's construction. In 2010, in response to increasingly low dam inflows and the need to precisely manage scheme supplies, the department began trialling reduced release volumes in consultation with downstream users.

In 2017, the department finalised the regime, via its *Managing releases from the North Dandalup Dam, North Dandalup allocation statement* (DWER 2017). The allocation statement outlines the release arrangements for the North Dandalup River below the dam.

1.8 Update on water quality risks

As part of this review, DWER has conducted an updated assessment of water quality contamination risks to the North Dandalup Dam catchment, in accordance with the ADWG. This section discusses the risks that have changed since the last plan. Please read the 2005 plan for a full explanation of the water quality risks in this catchment.

Refer to Appendix A, Figure A2 for an aerial photo showing land uses in the catchment. Refer to Appendix D for information about typical contamination risks in surface water PDWSAs. Refer to Appendix F to gain a greater understanding about the risk assessment process DWER uses in PDWSAs.

Mining

Alcoa has a mining lease – Mineral Lease number 1SA (ML1SA) granted under the *Alumina Refinery Agreement Act 1961* – that covers the entire catchment. It was granted in 1961 and expires in 2045, but provision exists in the act for Alcoa to apply for a further mineral lease. Current activities include:

- bauxite extraction
- clearing for mining
- McCoy facilities (workshop and offices).

Since the last plan, additional areas of land have been cleared for bauxite mining, increasing the risk of turbidity and hydrocarbon contamination entering the reservoir. The department's risk assessment process has identified the management priority for mining as 'high'. Risks from mining are managed via the Mining and Management Program Liaison Group, which includes members from:

- Department of Mines, Industry Regulation and Safety
- Department of Biodiversity, Conservation and Attractions
- Department of Jobs, Tourism, Science and Innovation
- DWER
- Water Corporation.

Its subcommittee (the Mining Operations Group) assesses and gives advice on vegetation clearing.

Additionally, working arrangements that include mechanisms to protect water quality have recently been endorsed by DWER, Water Corporation and Alcoa. The *Water working arrangements between Alcoa, DWER and Water Corporation covering Alcoa's mining operations in WA (2018-2023)* apply to ML1SA – which includes the North Dandalup Dam Catchment Area – and maintain a coordinated approach to managing mining operations and the protection of PDWSAs. The working arrangements cover:

- mine planning
- operational arrangements
- monitoring
- inspections
- incident management
- reporting.

The working arrangements were signed in January 2019 and are designed to cover a five-year period.

State forest

The catchment area straddles the boundary of Dwellingup State Forest and Jarrahdale State Forest, which are managed by the Department of Biodiversity, Conservation and Attractions in accordance with the *Forest management plan 2014–2023* (Conservation Commission 2013).

Department of Biodiversity, Conservation and Attraction's activities in the state forest are the same as described in the previous plan, which include prescribed burning, boundary upgrades, access road maintenance and conservation activities such as fauna monitoring and feral animal control. These activities occur at various times depending on priorities and the current level of activities that may require attention.

Forest Products Commission also conduct forestry activities in the North Dandalup Dam Catchment Area. Current harvesting plans show that Forest Products Commission's activities are confined to Alcoa clearing requirements only.

Risks to drinking water quality from these activities include high intensity unplanned fires, turbidity, hydrocarbons and pathogens, and the levels of risk are the same as in the previous plan. Risks are managed in accordance with the *Forest management plan*.

Recreation

There are no designated recreational areas in the North Dandalup catchment, except for travel along the Munda Biddi trail and public roads.

There is a picnic area downstream of the dam wall managed by the Water Corporation that provides an appropriate area for recreational access. Its location ensures that contamination in this area does not flow back into the reservoir (see Appendix A, Figure A2 and Appendix C, Figure C5).

Some unauthorised access for recreation continues to occur within the catchment. This poses risks of pathogen, hydrocarbon and nutrient contamination in the reservoir (see Appendix C, Figure C4) and the levels of risk are the same as the previous plan. Read Appendix D for general information about the risks that recreation can pose in drinking water catchments.

Water Corporation rangers conduct regular surveillance to enforce the Metropolitan Water Supply Sewerage and Drainage by-laws 1981 and the *Water Services Act 2012* and its associated 2013 regulations. Rangers issue infringements for illegal activities where required. In recent years, the highest reported activities have been four-wheel-driving, trail biking and entry into the RPZ, including swimming in the summer months. Signs show areas where access is prohibited (see Appendix C, Figure C4). Water Corporation should continue this surveillance to manage the risks of recreation in the catchment (see section 3.2, recommendation 5).

Since the last plan, the department has updated its policy on recreation in drinking water catchments. Any proposed recreation in the North Dandalup Dam Catchment Area needs to be assessed in accordance with DWER's Operational policy no. 13: *Recreation in public drinking water source areas on Crown land* (DoW 2012).

Department of Water and Environmental Regulation land

There are several parcels of land within the RPZ that are owned by the department and managed for the purposes of drinking water source protection (see Appendix A, Figure A3). Water Corporation have responsibility for managing these parcels.

1.9 Water quality information

The Water Corporation has provided updated water quality information for the North Dandalup Dam. This is shown in Appendix B.

Turbidity and pH have occasionally exceeded the ADWG aesthetic guideline levels. Turbidity makes the water appear 'cloudy' and can affect water quality treatment processes. If pH is outside of the range 6.5 -8.5, it can lead to corrosion and encrustation of pipes and fittings (NHMRC & NMMRC 2011, updated August 2018).

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

DWER provided draft copies of this review to:

- Shire of Murray
- Water Corporation
- Alcoa
- Forest Products Commission
- Department of Health
- Department Biodiversity, Conservation and Attractions.

No contentious issues were raised by any of the above stakeholders. Minor comments were able to be addressed by including additional information in this final version of the review.

DWER also wrote to the South West Aboriginal Land and Sea Council to notify them of our proposed boundary change. No response was received at the time of publishing this review.

DWER will contact all stakeholders again before we arrange constitution of the amended North Dandalup Dam Catchment Area boundary under legislation (see section 3.2, recommendation 1).

3 Implementing North Dandalup's drinking water source protection plan

3.1 Status of previous recommendations

Table 4 outlines recommendations from the 2005 plan and their current status.

Table 2 Implementation status for the North Dandalup Dam Catchment Area

| No. | 2005 recommendation | Current status |
|-----|--|--|
| 1 | The town planning scheme for the Shire of Murray should incorporate the management principles outlined in this plan, including recognition of the RPZ and P1 area assigned to land in the catchment (Shire of Murray). | The Peel Region Scheme includes the catchment area as a special control area but the local scheme doesn't. Carry forward (see section 3.2, recommendation 2). |
| 2 | Development and works proposals in the catchment area that are likely to impact on water quality or are inconsistent with the department's water quality protection notes, including <i>Land use compatibility in PDWSAs</i> (as amended from time to time) and guidelines should be referred to the department for assessment and recommendation (Shire of Murray, Department for Planning and Infrastructure ¹). | Development proposals in PDWSAs are referred to the department as part of the land use planning framework. Ongoing (see section 3.2, recommendation 3). |
| 3 | Signs should be erected and maintained along the boundaries of the catchment area and RPZ to define the areas to promote public awareness of the importance of protecting drinking water quality (Water Corporation). | Signs have been erected along the boundary and the RPZ to alert the public. Water Corporation should continue to maintain these signs. Ongoing (see section 3.2, recommendation 4). |

¹ The responsibilities of the previous Department for Planning and Infrastructure now rest with the Department of Planning, Lands and Heritage.

| No. | 2005 recommendation | Current status |
|-----|--|---|
| 4 | The Department of Conservation and Land Management ² , Forest Products Commission, Shire of Murray, Department for Planning and Infrastructure ³ and Alcoa should be supplied with a digital copy of the RPZ and priority area to facilitate their planning processes (Department of Environment ⁴). | Spatial data for all PDWSAs in Western Australia is now available via the shared land information platform and DWER's website. Completed. |
| 5 | The catchment surveillance program and associated by-law enforcement should continue to be implemented by the Water Corporation. | DWER has formally delegated responsibility for by-law enforcement to the Water Corporation. The corporation has a program of regular surveillance, inspections and by-law enforcement which includes issuing infringements where required. This program should be continued. Ongoing (see recommendation 5). |
| 6 | Investigate options for Water Corporation catchment rangers and Department of Conservation and Land Management rangers to be trained to enforce the Metropolitan Water Supply Sewerage and Drainage By-laws (Water Corporation, Department of Conservation and Land Management ⁵). | The Water Corporation has a program of regular surveillance, inspections and by-law enforcement which includes issuing infringements. Officers are trained when required. Completed. |

² The responsibilities of the Department of Conservation and Land Management now rest with the Department of Biodiversity, Conservation and Attractions.

³ The responsibilities of the previous Department for Planning and Infrastructure now rest with the Department of Planning, Lands and Heritage.

⁴ The responsibilities of the Department of Environment now rest with the Department of Water and Environmental Regulation.

⁵ The responsibilities of the Department of Conservation and Land Management now rest with the Department of Biodiversity, Conservation and Attractions.

| No. | 2005 recommendation | Current status |
|-----|---|---|
| 7 | New recreational events or activities in the catchment should only be approved if in accordance with the requirements of relevant agencies and the department's Statewide policy no. 13: <i>Policy and guidelines for recreation within PDWSAs on Crown land</i> (2003). The department will not support new activities within the RPZ (Shire of Murray, Department of Conservation and Land Management ⁵ , Water Corporation, Department of Environment ⁶). | The department has since updated this policy. Please refer to Operational policy no. 13: <i>Recreation in PDWSAs on Crown land</i> (2012), and future updates, available www.dwer.wa.gov.au . Ongoing (see recommendation 6). |
| 8 | A risk assessment of the Munda Biddi Trail should be completed and the risks assessed. Management plans covering the roles and responsibilities of the relevant agency stakeholders should be prepared and audited (Department of Conservation and Land Management ⁵ , Munda Biddi Trail Foundation). | The Munda Biddi Trail is managed by the Department of Biodiversity, Conservation and Attractions and the Munda Biddi Trail Foundation. Information for trail users states the need to stick to the trail, to only camp at designated sites, how to manage wastes and the need to protect our drinking water catchments. Completed. |
| 9 | Streamzones and other areas of the catchment in Water Corporation, Water and Rivers Commission ⁷ or other government ownership should be assessed for the need for rehabilitation. Rehabilitation with local native species should be carried out where necessary (Water Corporation, Department of Environment ⁸). | Water Corporation have delegated responsibility for management of the DWER-owned parcels of land in this catchment. Rehabilitation of streamzones within Water Corporation owned and/or managed land occurs as resources become available, with site priorities designated based on risk. Completed. |

⁶ The responsibilities of the Department of Environment now rest with the Department of Water and Environmental Regulation.

⁷ The responsibilities of the Water and Rivers Commission now rest with the Department of Water and Environmental Regulation.

⁸ The responsibilities of the Department of Environment now rest with the Department of Water and Environmental Regulation.

| No. | 2005 recommendation | Current status |
|-----|---|---|
| 10 | Personnel dealing with Westplan–HAZMAT incidents in the area should be given ready access to a locality map of the North Dandalup Pipehead Dam Catchment Area and training to understand the potential impacts of spills on the surface water resource (Department of Environment ⁹ , Fire and Emergency Services Authority of Western Australia). | Water Corporation is a member of the Shire of Murray’s Local Emergency Management Committee (Shire of Murray 2019) and Water Corporation rangers liaise with emergency response staff during such events. Complete. |
| 11 | The strategies listed in Table 1 Land use, potential water quality risks and recommended strategies should be considered for adoption by those with responsibility for the recommended protection strategy. | DWER no longer prepare implementation strategies for PDWSAs. Water Corporation is delegated with responsibility for enforcing the relevant by-laws. See section 3.2 for updated recommendations. |
| 12 | The Department of Environment ⁹ is to work with the Department of Conservation and Land Management ¹⁰ and Forest Products Commission to update the forestry manuals, codes and guidelines. | The <i>Forest management plan 2014–2023</i> , which addresses the management of water quality, was completed in 2013 with input from the Department of Water ¹¹ (Conservation Commission 2013). Complete. |
| 13 | The Department of Environment ⁹ should prepare an implementation strategy for this plan involving all relevant stakeholders. | DWER no longer prepare implementation strategies for PDWSAs. Water Corporation are delegated with responsibility for enforcing the relevant by-laws. |

⁹ The responsibilities of the Department of Environment now rest with the Department of Water and Environmental Regulation.

¹⁰ The responsibilities of the Department of Conservation and Land Management now rest with the Department of Biodiversity, Conservation and Attractions.

¹¹ The responsibilities of the Department of Water now rest with the Department of Water and Environmental Regulation.

| No. | 2005 recommendation | Current status |
|-----|--|--|
| 14 | Implementation of these recommendations should be reviewed periodically after this plan is endorsed. A full review of this plan should be undertaken after five years. | This document forms the review of the plan. It should be reviewed again in seven years or in response to changes in water quality contamination risks. Ongoing (see section 3.2, recommendation 8). |

3.2 Consolidated recommendations

Based on the findings of this review, the following recommendations will now be applied to the North Dandalup Dam Catchment Area. The stakeholders listed in brackets are responsible for, or have an interest in, implementing that recommendation.

1. Arrange for the constitution of the amended North Dandalup Dam Catchment Area boundary (as per Figure A4) under the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909*, to remove the area downstream of the dam wall and rename it to 'North Dandalup Dam Catchment Area' (i.e. remove the word 'pipehead'). (DWER)
2. Incorporate the North Dandalup Dam Catchment Area (as per Figure A4) as a special control area in the Shire of Murray's local planning scheme in accordance with the Western Australian Planning Commission's State planning policy no. 2.7: *Public drinking water source policy*. (Shire of Murray)
3. Refer development proposals within the North Dandalup Dam Catchment Area that are inconsistent with DWER's WQPN no.25: *Land use compatibility tables for public drinking water source areas* or recommendations in this review to the DWER regional office for advice. (Land use planning decision-making authorities)
4. Maintain signs along the boundary of the North Dandalup Dam Catchment Area including an emergency contact telephone number, in accordance with the Water Corporation's *S111 Source protection signage* (2013). (Water Corporation)
5. Water Corporation should continue the current regime of water quality monitoring, maintenance of fencing, inspections and by-law enforcement. (Water Corporation)
6. Recreation in the North Dandalup Dam Catchment Area will be managed in accordance with DWER's Operational policy no. 13: *Recreation in PDWSAs on Crown land* (as updated). (DWER, Water Corporation, Department of Biodiversity, Conservation and Attractions).

7. Continue to implement the *Water working arrangements* to protect drinking water quality while mining bauxite in the North Dandalup Dam Catchment Area. (Alcoa, DWER, Water Corporation)
8. Review this report in seven years or in response to changes in water quality contamination risks. (DWER)

Appendices

Appendix A – Figures

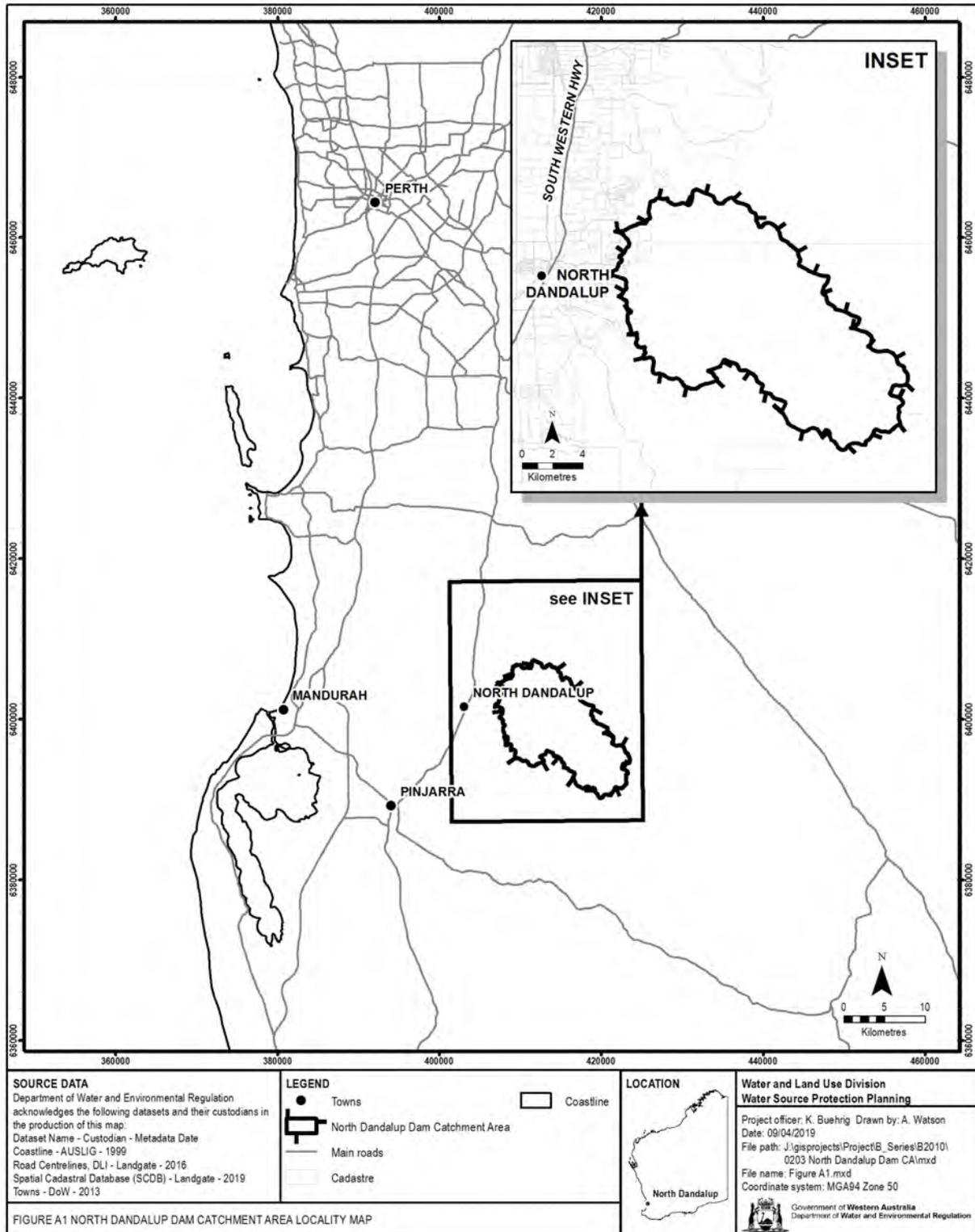


Figure A1 North Dandalup Dam Catchment Area locality map

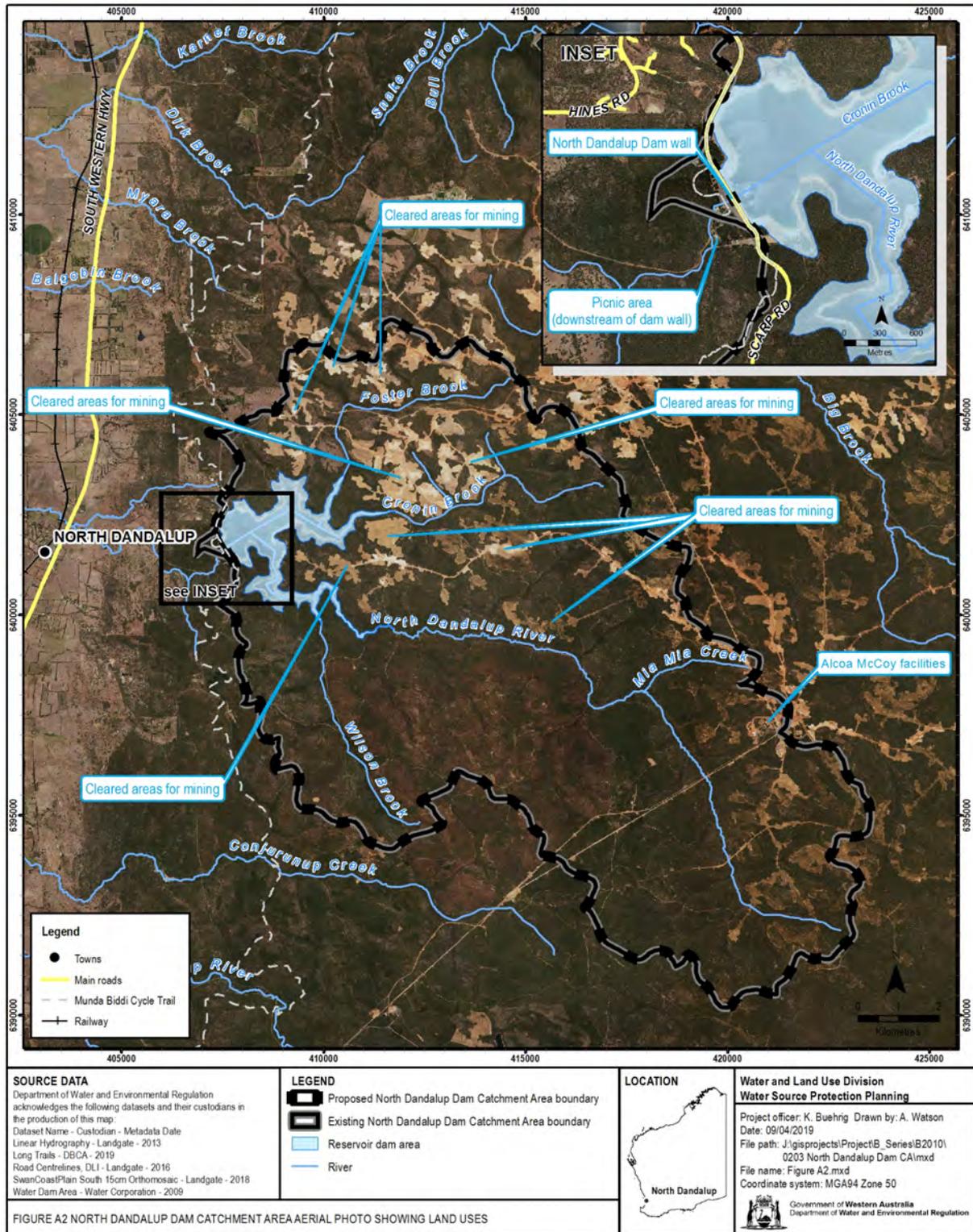


Figure A2 North Dandalup Dam Catchment Area aerial photo showing land uses

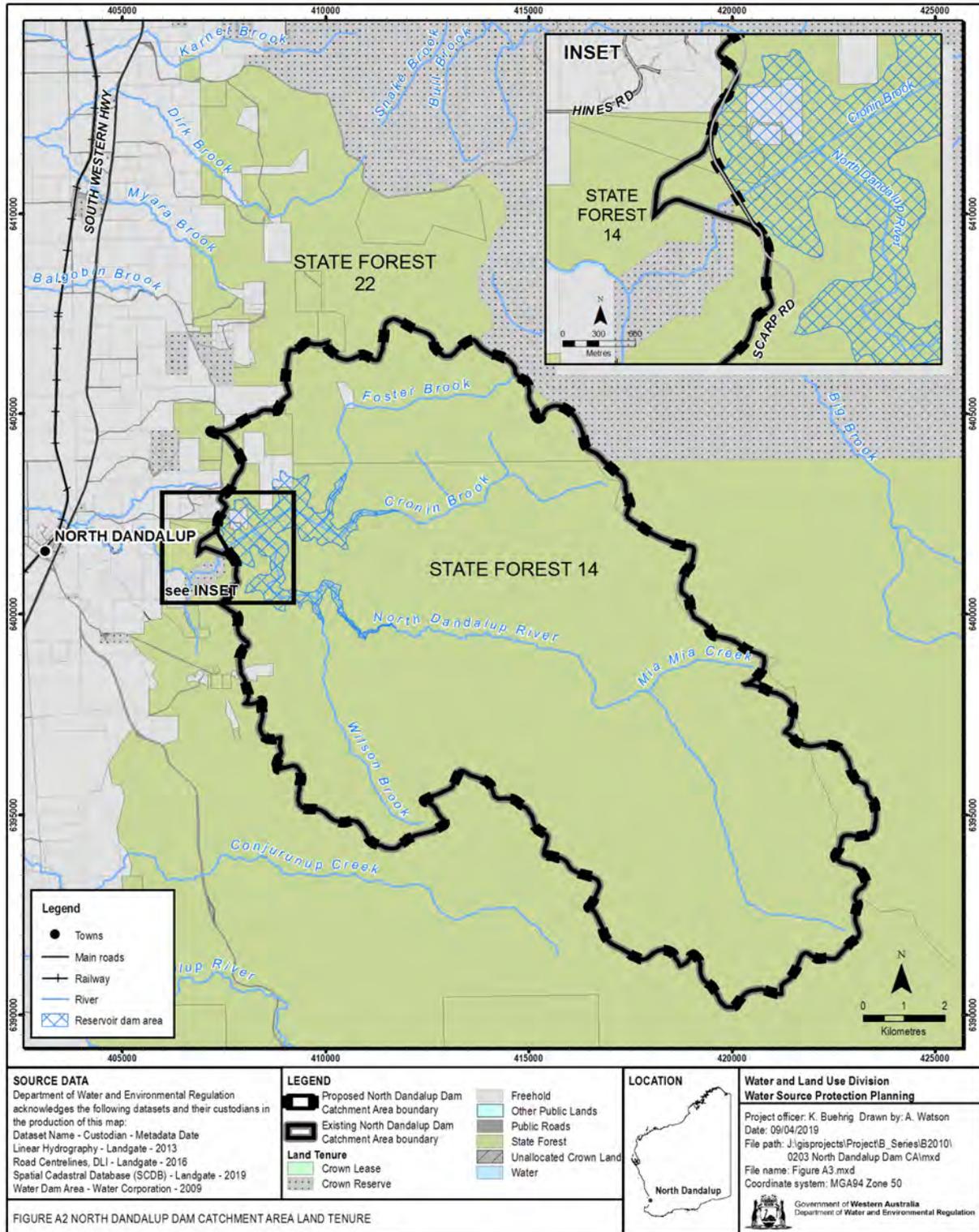


Figure A3 North Dandalup Dam Catchment Area land tenure

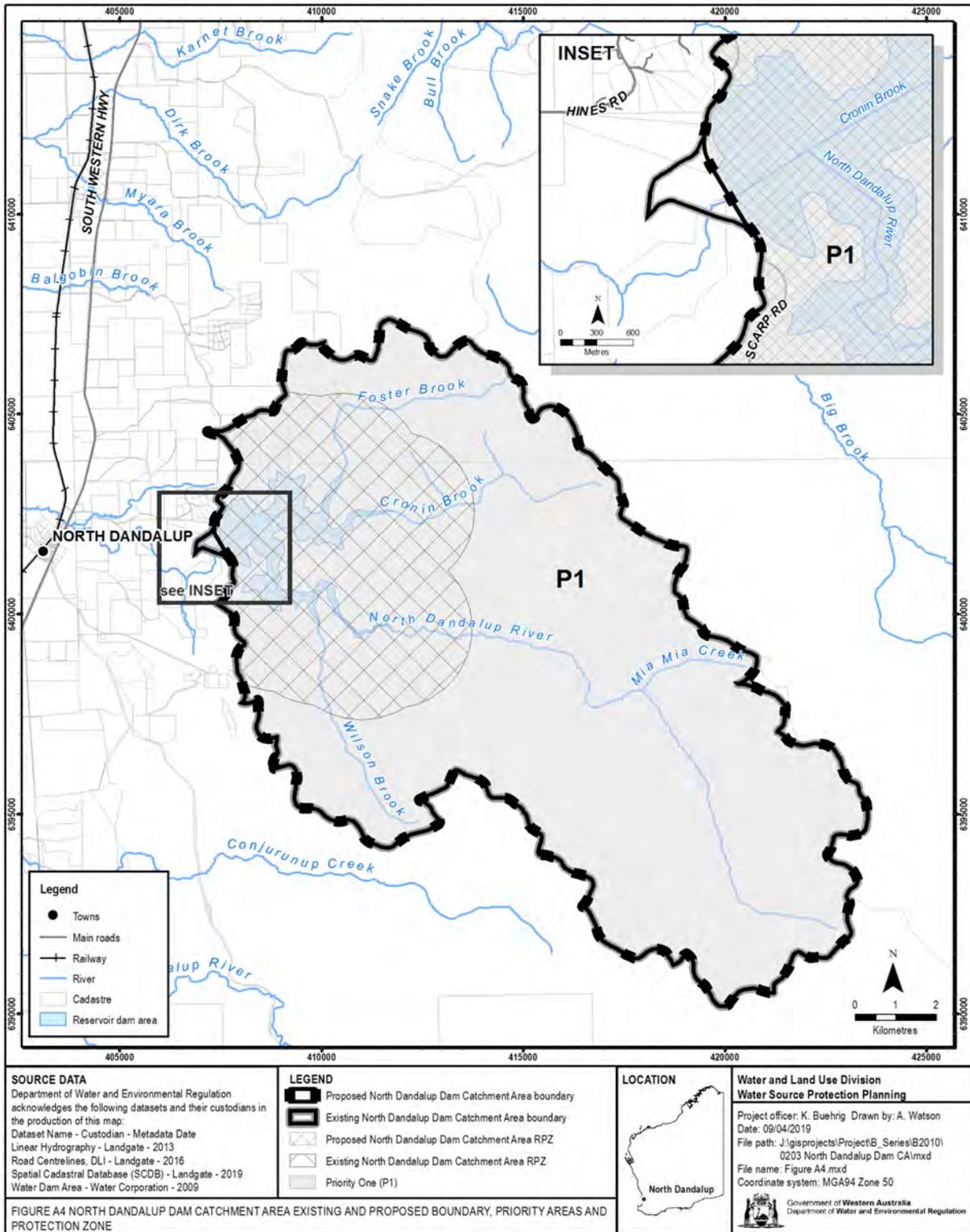


Figure A4 North Dandalup Dam Catchment Area priority areas and protection zones



Figure A5 South West Native Title Agreement area (source: National Native Title Tribunal)

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 North Dandalup 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 North Dandalup 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 November 2013 to October 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 Perth's Integrated Water Supply Scheme refer to the most recent Water Corporation drinking water quality annual report at watercorporation.com.au.

Aesthetic characteristics

The aesthetic quality analyses for raw water from North Dandalup Dam are summarised in Table B1.

Table B1 Aesthetic detections for North Dandalup Dam

| Parameter | Units | ADWG aesthetic guideline value ¹ | North Dandalup Dam | |
|--------------------------------------|----------|---|--------------------|-------|
| | | | Range | Mean |
| Chloride | mg/L | 250 | 31–80 | 66.5 |
| Colour (true) | TCU | 15 | <1–7 | 1.5 |
| Hardness as CaCO ₃ | mg/L | 200 | 30–56 | 40.7 |
| Iron unfiltered | mg/L | 0.3 | 0.008–0.180 | 0.042 |
| Manganese unfiltered | mg/L | 0.1 | <0.002–0.012 | 0.005 |
| Silicon as SiO ₂ | mg/L | 80 | 0.7–3.3 | 1.8 |
| Sodium | mg/L | 180 | 19–43 | 34.5 |
| Total filterable solids by summation | mg/L | 500 | 114–173 | 159 |
| Turbidity | NTU | 5 | <1.0– 9.2 | 1.5 |
| pH measured in laboratory | no units | 6.5–8.5 | 6.75– 8.92 | 7.59 |

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

Health-related chemicals

Raw water from North Dandalup Dam is analysed for chemicals that are potentially harmful to human health if detected at levels exceeding the health-related guideline value in the ADWG. Chemicals that have been detected in the source are summarised in Table B2, with all levels below the relevant health-related guideline value in the ADWG.

Table B2 Health-related detections for North Dandalup Dam

| Parameter | Units | ADWG health guideline value ² | North Dandalup Dam | |
|---------------------------------|-------|--|------------------------|--------|
| | | | Range | Mean |
| Barium | mg/L | 0.7 | 0.0018–0.016 | 0.0013 |
| Boron | mg/L | 4 | 0.03–0.70 | 0.199 |
| Manganese unfiltered | mg/L | 0.5 | <0.002–0.012 | 0.005 |
| Sulfate | mg/L | 500 | 1.5–12 | 7.6 |
| Fluoride laboratory measurement | mg/L | 1.5 | 0.20–0.85 | 0.46 |
| Iodide | mg/L | 0.5 | 0.05–0.05 ³ | 0.05 |

² A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHMRC & NRMCC 2011).

³ This result corresponds to the one sample taken during the reporting period.

Microbiological contaminants

Microbiological testing of raw-water samples from North Dandalup Dam is currently conducted on a weekly basis. *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 22.2 per cent of samples. However, none of the samples had *E. coli* counts greater than 20 MPN/100mL.

Appendix C – Photographs



Figure C1 North Dandalup Dam, photograph by Water Corporation



Figure C2 North Dandalup Dam wall, photograph by K. Buehrig, Department of Water and Environmental Regulation



Figure C3 Example of a sign delineating the reservoir protection zone at North Dandalup Dam, photograph by Department of Water and Environmental Regulation



Figure C4 Example of the results of unauthorised access to the North Dandalup Dam Catchment Area, photograph by Department of Water and Environmental Regulation



Figure C5 Picnic area downstream of the North Dandalup Dam wall, showing the pipehead dam, photograph by Department of Water and Environmental Regulation

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 & NRMCC 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 & NRMCC 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 (DWER) 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* (DoW 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* (DoW 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 DWER) 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 and read our Strategic policy:

Protecting public drinking water source areas in Western Australia (DoW 2016a). You can also contact DWER's Water source protection planning section on +61 8 6364 7600 or email drinkingwater@dwer.wa.gov.au.

Table E1 Drinking water source protection reports produced by DWER

| 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 | <p>Arrange for the constitution and gazettal of the source under legislation. This helps protect water quality and guides land use planning.</p> <p>All types of consulted drinking water source protection reports can recommend to constitute a source's boundary under legislation.</p> |
| 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: Gnamara 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 preventing 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, we use an assessment based on preventing risks, which considers both the maximum risk (before installing barriers) and the residual risk (after installing barriers). This means that in some cases, the maximum risks from land uses will still be considered unacceptable, even after mitigation (installing barriers) has reduced the risk. We need this more conservative approach to protect the health of consumers; those that are drinking the water.

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).

Table F1 Risk matrix: Level of risk (NHRMC & NRMMC 2011)

| Likelihood | Consequence | | | | |
|-----------------------|---------------|----------|-----------|-----------|--------------|
| | 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 |
| 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> |
| DoW | Department of Water (former) |
| DWER | Department of Water and Environmental Regulation |
| FPC | Forest Products Commission |
| HAZMAT | hazardous materials |
| 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 |
| Westplan– HAZMAT | Western Australian plan for hazardous materials |
| WQPN | water quality protection note |

Units of measurement

| | | |
|-----------------------|----------------------|--|
| km | kilometres | A measure of distance, 1 km equals 1000 m. |
| km² | square kilometres | A measure of area. |
| 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 surface water from a waterway or water body. |
| Aesthetic guideline value | The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, 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>). |
| 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. |
| Constitute | Define the boundaries of any catchment area or water reserve by Order in Council under the <i>Country Areas Water Supply Act 1947</i> or by proclamation under the <i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> . |
| 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. |
| Dissipate | To become scattered or dispersed. |
| 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. |
| 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. |
| Maximum risk | This is the level of risk in the absence of any preventive measures (barriers) 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 (NHMRC & 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. |
| Pollution | Water pollution occurs when waste products change the physical, chemical or biological properties of the water, adversely affecting water quality, the ecosystem and beneficial uses of the water. |
| 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 2 (P2) areas is <i>risk minimisation</i> and priority 3 (P3) areas is <i>risk management</i> . |
| 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 (barriers) 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 & NRMCC 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. |
| Stormwater | Rainwater that has run off the ground surface, roads, paved areas etc., and is usually carried away by drains. |
| 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. |
| Westplan–HAZMAT | State emergency management plan for hazardous materials emergencies. |

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