



Department of Water
Government of Western Australia



Canning River Catchment Area
Drinking Water Source Protection Plan
Integrated Water Supply System

Water Resource Protection Series

REPORT NO. 77
June 2007



Department of **Water**
Government of Western Australia

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Perth Integrated Water Supply Scheme

Department of Water

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Report 77

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Subject of cover photograph

Canning Dam by Des Birt

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Preface

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

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

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

This plan details the location and boundary of the Canning Reservoir catchment, which is used as a drinking water source for the Perth metropolitan drinking water supply. It discusses existing and future usage of the water source, describes the water supply system, identifies risks and recommends management approaches to maximise protection of the catchment.

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

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

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

Summary

Canning Dam is located 34 kilometres southeast of Perth on the Canning River. Its Reservoir contains high quality raw water from a largely undeveloped catchment. The Canning Reservoir is a strategic surface water source for the Perth Metropolitan water supply.

The Canning Dam catchment is contained in the gazetted Canning River Catchment Area. The Kangaroo Gully catchment and the Araluen (Lower Canning) catchment that feed the Kangaroo Gully Diversion Dam and the Araluen Pumpback Dam make up the remainder of the Canning River Catchment Area. The majority of the land in the catchment area is Crown land vested in the Conservation Commission and managed by the Department of Environment and Conservation (DEC – formerly the Departments of Environment and Conservation and Land Management). It should be managed for Priority 1 source protection to preserve and protect the high quality of the water source.

Potential risks posed to the water quality of this source have been assessed recognising the treatment for this supply is only disinfection. Based on the potential risk posed by human contact with the water and the number of people that could potentially be affected, activities that require body contact with the water are not considered acceptable in this catchment.

Outside of the Reservoir Protection Zone, some activities and land uses are considered acceptable with appropriate management conditions to ensure water quality protection objectives are met. Land use in the catchment consists principally of State Forest that may be subject to some harvesting, including the Gleneagle and Cooke Pine Plantations. Two substantial areas have recently been incorporated into the Darling Range Regional Park and the Canning National Park.

Unauthorised but popular recreational activities include fishing and marroning, ‘wild’ camping (including overnight stays) and off-road vehicle use, including riding of trail bikes (other than on designated trails). The catchment is popular for picnicking, horse riding and bushwalking, including on the Bibbulmun Track. Rubbish and vehicle dumping are particularly prevalent in the Kangaroo Gully sub-catchment. Other land uses include Western Power’s Muja Northern Terminal Line and the major transport routes of the Brookton and Albany Highways.

There are a few private land holdings close to the reservoirs in the Kangaroo Gully and Araluen sub-catchments that are used for low intensity agricultural pursuits. This plan recommends that they should be managed for Priority 2 source protection.

In order to ensure the long-term protection of the water quality of this source, it is also recommended that the Canning River Catchment Area and the priority classifications be recognised in relevant land planning strategies.

Land use activities in the catchment have the potential to contaminate this drinking water source and this plan outlines strategies that will manage these risks.

1 Drinking water supply system

1.1 Existing water supply system

The Canning Dam (see Photo 1) and Araluen Pumpback Dam are located on the Canning River approximately 34 km south east of Perth and 10 km east of the Armadale town centre. The location of the Canning Reservoir and Catchment are shown in Figure 1.

Construction of the Canning Dam was completed in 1940 with a height of 66 m and a crest length of 468 m. The reservoir has a capacity of 91 giga-litres (GL). The current annual inflow to Canning Reservoir is estimated to be 22 GL. The 730 km² Canning Reservoir catchment area was first proclaimed a Water Reserve under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act (1909)* in July 1915.

Kangaroo Gully Diversion Dam was constructed in 1951 to supplement natural flows into Canning Reservoir with flows diverted from the 59 km² Kangaroo Gully catchment. Diversion occurs by means of a flume (open concrete channel, see Photo 2), that diverts flows into Canning Reservoir a short distance upstream of the dam wall. The Kangaroo Gully Water Reserve was first proclaimed in August 1923.

The Araluen Pumpback Dam consists of a small concrete gravity structure and pump station (see Photo 3) located about 5.4 km downstream of Canning Dam. It was commissioned in 1977 to capture winter river flows sourced from the 16 km² Araluen (Lower Canning) sub-catchment area for storage in Canning Reservoir. Currently about 800 ML/year is returned to Canning Reservoir via Araluen Pumpback. The Canning River Catchment Area, comprising the catchment areas of the Araluen Pumpback, Kangaroo Gully and Canning Dam (see Figure 2), was proclaimed in November 1925.

Canning Reservoir is a water source of vital importance as it is relied on as a strategic source for the Perth Metropolitan area.

1.2 Water treatment

Raw water from the Canning Reservoir is disinfected by chlorination and fluoride is also added prior to supply to the Integrated Water Supply System (IWSS) that services Perth, Mandurah, Pinjarra, Harvey and the Goldfields and Agricultural regions. Chlorination is the final essential barrier used to ensure good quality public drinking water (NHMRC & ARMCANZ, 2004).

Disinfection by chlorination is the minimum treatment that is required for the safe supply of drinking water. Conventional water treatment often requires further

treatments such as coagulation, sedimentation and filtration, and without these treatments the Canning Reservoir is vulnerable to natural and human contamination. Although reservoir storage and disinfection by chlorination generally removes this contamination, these treatment processes alone cannot be relied upon for the provision of safe drinking water. This puts more emphasis on the importance of source protection to significantly reduce the contamination sources.

Where possible, human contamination can and should be prevented or reduced through appropriate land use or activity controls in the catchment area. This approach is endorsed by the Australian Drinking Water Guidelines (NHMRC & ARMCANZ, 2004) and reflects a 'catchment to consumer' multiple barrier approach for the provision of safe drinking water to consumers. Detention of the reservoir water for 3-4 weeks or more *without* external disturbances is important for the Canning Reservoir water source to be in the best condition for drinking water supply.

1.3 Catchment details

1.3.1 Physiography and Vegetation

The Canning catchment lies within the Darling Plateau. The Darling Range forms part of the Archaean Shield composed largely of granite which has some invaded linear belts of metamorphosed sedimentary and volcanic rocks, some isolated occurrences of which remain (Schofield, 1991). Thin sheet-like dolerite intrusions are found abundantly in the basement rock. Deep V-shaped valleys occur close to the Scarp, with shallow soils and frequent rock outcrops. In the east of the catchment valleys are broader and more U-shaped.

Soils consist of granite covered by a weathered laterite hard cap and associated clays, and include shallow sand over sheet laterite, gravelly duplex soils and grey sands. Upland laterites consist of sandy loams in a gravel matrix whilst gravels tend to become finer down slope, sometimes grading into sandy yellow earths in the lowest positions.

The majority of the catchment is covered by the Murray, Yarragil and Dwellingup vegetation complexes, and consists of open forest or woodland dominated by several *Eucalyptus* species such as jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*). Understorey species include *Banksia grandis* and *Allocasuarina fraseriana*. In the south-east of the catchment there is a significant occurrence of wandoo (*Eucalyptus wandoo*) woodland in the river valleys. There are also some areas of private land that have been cleared for agriculture and other uses.

The combined area of the catchments contributing to the Canning Reservoir is about 804 square kilometres. The catchment extends for some 55 kilometres in a south-easterly direction from the dam and pumpback located adjacent to the Scarp on the western edge of the Darling Range. The catchment is up to 16 km wide and is

bounded in the north-east by the Helena River Catchment Area and in the south by Wungong and Serpentine Catchment Areas. The Albany Highway closely follows the south-western boundary and intersects it in several locations. The Brookton Highway passes through the northern section of the catchment.

The catchment is predominantly in the City of Armadale and the Shire of Wandering, however, a small area in the north of the catchment is in the Shire of Kalamunda and a small area to the east is in the Shire of Beverley. Additionally, about 180 ha in the south-west lie in the Shire of Serpentine-Jarrahdale. The majority of the land in the catchment area is Crown land vested in the Conservation Commission and managed by the Department of Environment and Conservation (DEC – formerly the Departments of Environment and Conservation and Land Management).

1.3.2 Climate

The area has a Mediterranean climate, characterised by warm and dry summers with cool, wet winters.

The long-term average annual rainfall for the catchment is approximately 900 mm and most of this falls between May and September. There is considerable variability in rainfall across the catchment with the catchment lying between the 1300 mm rainfall isohyet in the west and 700 mm rainfall isohyet in the east. However, since 1975 the average annual rainfall at Canning Dam has decreased by almost 20% from the long-term average. This drop in rainfall is associated with a significant reduction in streamflow from 1975 to the present.

1.3.3 Hydrology

The catchment for the Canning Dam has an area of 804 km² and is located on the Darling Plateau. Elevation in the catchment is 200 m AHD at the reservoir, rising to 582 m at Mt Cooke on the southern boundary of the catchment. Elevation at the catchment boundary is generally about 400 m AHD.

Water inflow to the reservoir is mostly generated by lateral flow through the upper soil layer over the winter months. However, there is subsurface flow year round due to the slow release of groundwater recharged by winter rainfall infiltrating the gravelly soils. The average monthly flow in the winter months is significantly greater than in the summer months.

From 1948 to 1974 the average annual inflow of water into Canning Reservoir was 54 GL, however, from 1975 to 2004 the average annual streamflow into the reservoir via the Canning River was 22 GL. This decrease in streamflow of approximately 60% since the 1970s has occurred mostly as a result of reduced rainfall.

1.4 Future water supply requirements

It is intended to continue to use the Canning Reservoir and the Araluen Pumpback Dam for the IWSS drinking water supply. As Perth's population continues to increase, demand for drinking water will increase correspondingly, while rainfall may decline further. Other drinking water sources will be brought on line to supplement supply to the integrated Perth water supply system. The Canning Reservoir is being considered as a possible storage site for desalinated water from the newly commissioned desalination plant. If required, water from the Canning Reservoir may be used to supplement supply to the Goldfields and Agricultural Regions.

1.5 Protection and allocation

1.5.1 Existing water source protection

The Canning River Catchment Area covers the whole of the Canning Reservoir Water Reserve (proclaimed in 1915), the Kangaroo Gully Water Reserve (proclaimed in 1923) and the Araluen (Lower Canning) Pumpback catchment. It was proclaimed in November 1925 under the *Metropolitan Water Supply, Sewerage and Drainage (MWSSD) Act (1909)* to ensure protection of the water source from potential contamination.

1.5.2 Current allocation licence

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

The current allocation licences within the Canning River Catchment Area are Surface Water Licence No. 58580 for the Canning Reservoir, 60299 for Kangaroo Valley Diversion and 56740 for Araluen Pumpback. The total allocation for abstraction from each of these sources is 33.0 GL/year, 3.5 GL/yr and 1.2 GL/yr respectively and these licences are valid until 30 October 2007. These licences are issued for the purpose of providing water for public potable water supply and irrigation. It is expected that these licences will be renewed, although the amount of water to be abstracted may need to be reassessed in line with decisions on storage of desalinated water and climate considerations.

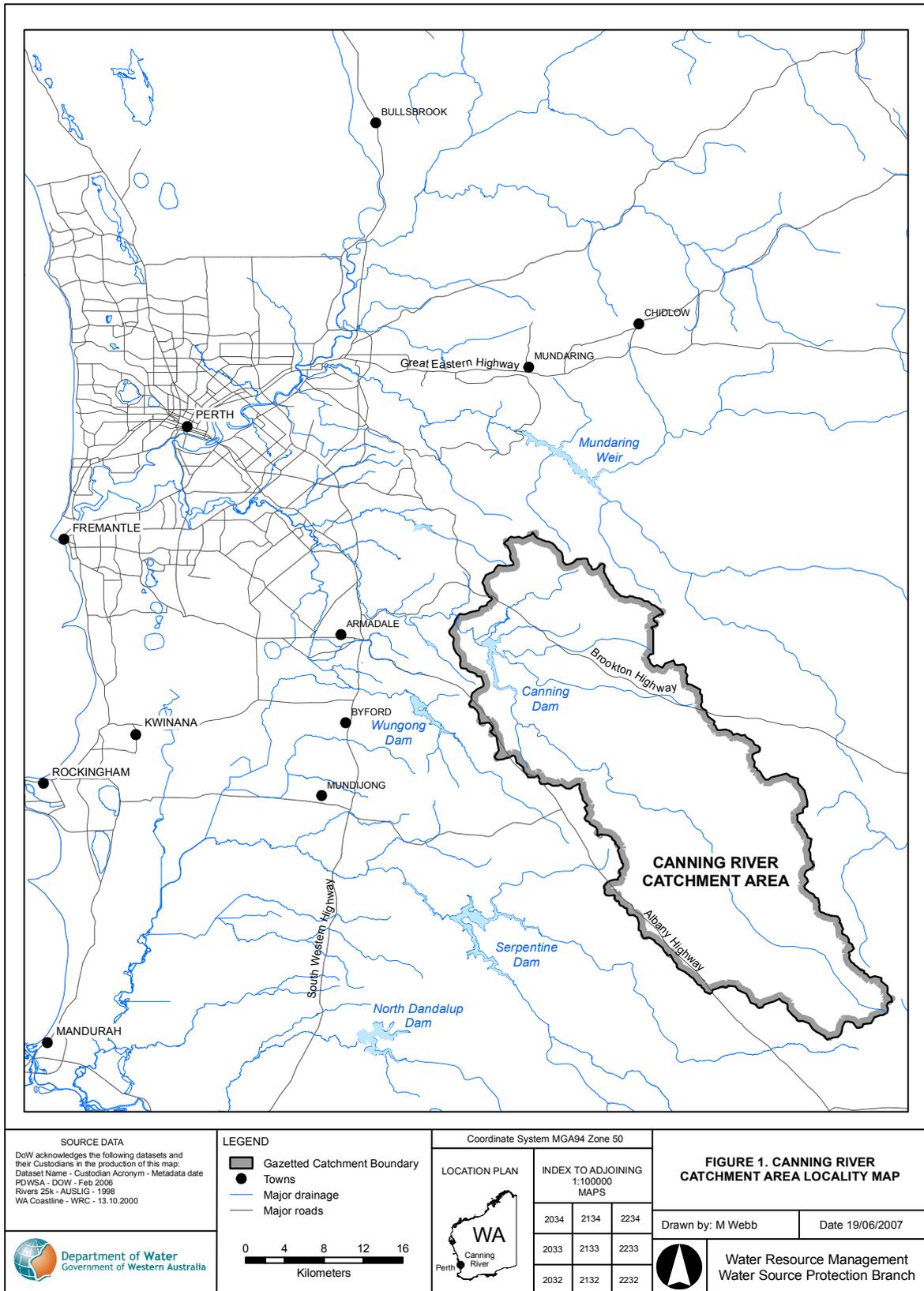


Figure 1. Canning River Catchment Area locality map

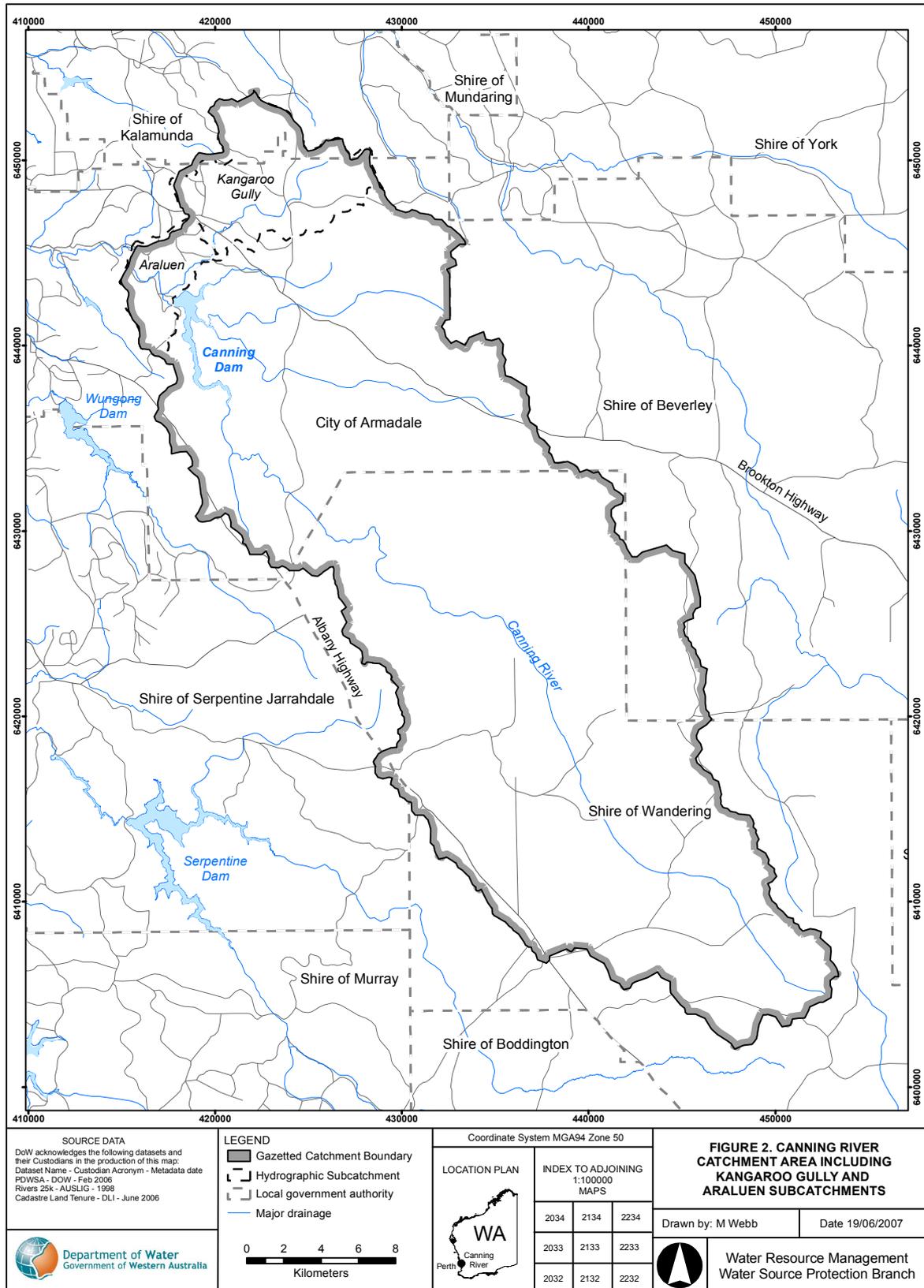


Figure 2. Canning River Catchment Area, including Kangaroo Gully and Araluen sub-catchments

2 Water quality

The potential risks to water quality associated with activities in catchments include pathogen contamination, turbidity, pesticides and nutrient contamination. Of all contaminants pathogens pose the most significant risk to public health, and human and domestic animal contact with the water represents an immediate threat of pathogen contamination.

There are three main types of pathogens that can potentially contaminate water supplies. These are bacteria (e.g. *Salmonella*, *Escherichia coli* and *Cholera*.), viruses (e.g. Rotoviruses, Hepatitis) and protozoans or parasites (e.g. *Cryptosporidium*, *Giardia*). These pathogens generally arise from faecal contamination and are commonly known to contaminate water supplies worldwide.

The viability of pathogens in surface waters will also affect the risk. For example, *Salmonella* is viable for 2-3 months and *Giardia* may still infect after one month in the natural environment (Geldreich, 1996).

The combination of human pathogen infection, the viable life of the pathogen and human contact with the water, or the presence of humans near the reservoir or feeder streams, creates a serious risk to public drinking water quality and public health. Preventing the presence of pathogens in the water source is the most effective barrier in avoiding a public health risk.

Turbidity or “cloudiness” of the water is generally due to activities in the catchment that disturb the soil, leading to erosion. Such activities are kept to a minimum in the Canning catchment area and are not allowed in the Reservoir Protection Zone (RPZ, see section 4.4 for more information). In recent years the reduction in rainfall and the associated drop of the water level in the Canning Reservoir has exposed sandy, non-vegetated banks to erosion (see Photos 4 and 5). Material eroded from unstable banks can have an effect on the reservoir water’s turbidity. The Water Corporation is currently in the process of examining various management options to address this issue.

Reservoir storage generally improves the quality of water from surface catchments. Water quality in the Canning Reservoir and tributaries to the reservoir is regularly monitored for a range of parameters, including pH, turbidity, colour, conductivity, iron, manganese and aluminium at a number of locations. Drinking water values of these parameters have to meet the Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health. A water quality summary for the Canning Reservoir’s raw water is shown in Appendix A.

2.1 Microbiological contaminants

Microbiological quality of raw water from Canning Reservoir is measured regularly both before and after treatment. Counts of *Escherichia coli* in the raw water are used

as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals, including human beings. A count of less than 20 MPN (most probable number) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark (World Health Organisation, 1996).

Between January 2001 and October 2006 positive *E. coli* counts were recorded in 42% of samples taken. None of these samples had *E. coli* counts greater than 20 MPN/100mL (see Appendix A). This is less than some other surface water catchments in the Darling Scarp that have greater human activity in their catchments.

2.2 Health related chemicals

Raw water from the Canning Reservoir is analysed for health related chemicals including inorganic substances, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters are monitored in the Canning Reservoir and its tributaries. Monitoring results from the period January 2001 to October 2006 are summarised in Appendix A.

The metals barium, boron and manganese have been detected in Canning Reservoir water, however, all levels were below ADWG values.

The pesticides Dieldrin and chloropyrifos are the only pesticides to have been measured just above the detectable limits and well below the ADWG values in the past. They have not been detected since January 2001.

2.3 Aesthetic characteristics

Aesthetic water quality analyses for raw water from the Canning Reservoir are summarised in Appendix A, Table 2.

The water quality results show the water in the Canning Reservoir to be of high quality. All parameters tested are well within the ADWG values.

3 Land use and contamination risk

3.1 Existing land uses

Land ownership, uses and activities in the Canning River Catchment Area consist of:

- privately owned land used for rural pursuits;
- Crown land (State Forests and reserves including the Gleneagle and Cooke pine plantations) used for recreation, conservation, etc; and
- State-owned and managed freehold land (Water Corporation and Water and Rivers Commission).

Land tenure and land use activities are shown in Figure 3.

3.1.1 Private land

There is some private land in the Kangaroo Gully and Araluen (Lower Canning) parts of the catchment. The area of private land is ~182 ha. Four lots in the Kangaroo Gully catchment (~92 ha) are currently used for orchards, 2 residences and some native forest, and five lots in Araluen (Lower Canning) catchment (~90 ha) are currently used for grazing, 3 residences and an orchard.

3.1.2 Crown land

Department of Water and Water Corporation owned or managed land

The Land Act Reserve No. 5913 covers most of the State Forest in the Canning catchment. This reserve is vested in the Minister for Water Resources for the purpose of water supply ('Canning reservoir watershed').

The Water and Rivers Commission has freehold ownership of several properties in the north-west of the catchment. These properties would originally have been granted to private ownership and have since been bought back by the Crown. Most of the properties consist of native vegetation. A few have previously been cleared and some have pine plantations established on them.

State Forest and reserves

The State Forest Number 22 covers most of the catchment. The land is vested in the Conservation Commission and managed by the Department of Environment and Conservation (DEC) on their behalf. A large portion of the forest in the central third of the catchment is designated as a Dieback Risk Area. The State Forest is occasionally subject to timber harvesting.

Parts of the Darling Range Regional Park, the Canning National Park and much of the Monadnocks Conservation Reserve are located within the Canning River Catchment Area (see Figure 3).

The Gleneagle and Cooke plantations are situated in State Forest adjacent to Albany Highway about 11 and 30 km from the reservoir respectively. Both plantations consist largely of pine. The Gleneagle plantation covers an area of about 105 ha (in the Canning catchment). The Cooke plantation covers an area of about 271 ha. Both plantations are harvested when required.

The Albany and Brookton Highways both pass through the Canning catchment. Brookton Highway passes within 3 km of the reservoir. Albany Highway skirts along the south-western border of the catchment, passing into and out of the Canning catchment at several points.

A major Western Power transmission line, the Muja Northern Terminal Line, also passes through the catchment.

Land and forest management

State forest is managed for multiple uses that include timber production, water production, recreation and nature conservation as well as some apiary use and wildflower and seed harvesting. There is also widespread collection of firewood for private use, which is controlled through a permit system administered by the Department of Environment and Conservation. Specific management activities include plantation timber harvesting, some native forest timber harvesting and prescribed burning.

Some parts of the Canning catchment have been included in the Darling Range Regional Park and the new Canning National Park. These areas include existing State Forest in the Araluen (Lower Canning) sub-catchment and some adjacent areas. The Monadnocks Conservation Reserve is located largely to the east of Albany Highway on the western boundary of the Canning catchment.

National Parks and Conservation Parks are not subject to timber harvesting activities, but include facilities for recreational use of the forest. Such facilities are often more numerous and of a higher standard in National Parks.

A number of gravel pits are located within the Canning River Catchment area. Gravel extraction is a land use that is considered to be *compatible with conditions* in Priority 1 management areas (see section 4.3 for more information on Priority Management Areas). However, disused gravel pits within the catchment are often used for activities such as unauthorised camping, littering and dumping and burning of cars. Public access to disused gravel pits should be prevented where possible, and disused gravel pits rehabilitated to discourage such activities.

Recreation

Recreation in the State Forest is managed by the Department of Environment and Conservation. Low impact recreational pursuits may be acceptable in some parts of the catchment (e.g. outside the RPZ). The establishment of recreational facilities in Public Drinking Water Source Areas on Crown land requires approval by the Department of Water and may be subject to conditions (Water and Rivers Commission, 2003).

A number of recreation activities occur in the catchment. Bushwalking occurs throughout the catchment, particularly along the Bibbulmun Track, which passes through the catchment about 10 km upstream of Canning Dam, to the east of the reservoir. There are four authorised campsites associated with the Bibbulmun Track that lie within the catchment: Brookton, Canning, Mt Cooke and Nerang Campsites. Each of these sites has toilet facilities and a water tank.

Mountain bike riding occurs on the Carinyah Trail that lies in State Forest and on Water and Rivers Commission-owned land near to streams in the Kangaroo Gully Catchment. The Munda Biddi long distance mountain bike trail caters for many recreational cyclists. An authorised campsite is provided in State Forest about 6 km north of the reservoir (outside the RPZ) and facilities provided include a water tank and a sealed composting toilet. Some horse-riding occurs in the north-west of the catchment.

There are two designated picnic areas along Albany Highway, Sullivan Rock and Windsor, and the upgraded Lesley picnic site on Brookton Highway (see photo 6). Boulder Rock picnic site on Brookton Highway has been closed to prevent misuse. The Carinyah picnic area on Dale Road has been removed and the site rehabilitated, although some sealed tennis courts remain. In some cases (such as at Lesley Picnic Site) loop walk trails are associated with the picnic site, increasing public access to the catchment.

There is a fully serviced day-time picnic area immediately downstream of Canning Dam that is operated by the Water Corporation. Facilities include barbecues, toilets and parking all in relatively close proximity to the Canning River. These facilities are intensively managed to minimise any potential impacts on the river.

Motor sport events may be held in catchment areas under the direction of the Confederation of Australian Motor Sport (CAMS) and Motorcycling Australia W.A. To date these events were mostly undertaken in neighbouring catchments and have so far only marginally overlapped the edge of Canning catchment.

The Canning reservoir, Canning River and tributaries are illegally fished for marron, especially during summer. Boating, fishing and swimming are prohibited in the reservoir for health and hygiene reasons. Unauthorised camping (including overnight stays and/or outside of designated areas) and unauthorised trail establishment (see Photo 7) occur more and more frequently in the Canning catchment. This may be associated with the walk and bike trails, unauthorised vehicle access, illegal fishing and pig hunting. Such activities represent a significant risk to water quality.

3.2 Proposed land uses

A Special Mining Lease, granted to Alcoa World Alumina Australia (Alcoa) in 1961, covers part of the Crown land in the catchment. Under the State Agreement Act, Alcoa has rights to extract bauxite from Crown land, with associated responsibilities to protect environmental values and rehabilitate mine sites. Areas have been mined and rehabilitated on the catchment boundary but have not extended into the catchment. Bauxite mining is unlikely to occur in the Canning catchment, and certainly not within the next 20 years.

Timber production in the Canning River Catchment area currently centres on pine plantations, but logging of native forest may occur again in the future. Timber production is considered to be *compatible with conditions* in Priority 1 source protection areas.

At present designated sites within the Canning River Catchment area are available for recreational activities such as bushwalking, trail bike riding, camping (including overnight stays) and picnicking. However, these activities are increasingly being carried out in non-designated areas. In addition, unauthorised four wheel driving and illegal hunting, fishing and marroning occur. All of these activities represent significant risks to water quality. Furthermore, as Perth's population continues to grow, demand for recreation opportunities will also increase, along with the instances of unauthorised or illegal activities.

Motorised and non-motorised competitions, such as car rallies and equestrian events, are generally considered to be incompatible with water quality protection objectives. They are not held on a regular basis in the Canning River Catchment area, but where such events have historically been approved, and cannot readily be relocated, organisers may be given conditional approval. Ideally these activities would occur outside the RPZ and Priority 1 areas (see section 4.3). Perth's continued population growth may result in higher demand for land to hold such competitions.

The Canning Dam quarry has been identified as a potential recreational rock climbing site. The quarry is located outside the Reservoir Protection Zones. Under Statewide Policy No. 13 *Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land 2003* rock climbing is considered to be an activity that is 'conditional' in a Priority 1 source protection area. Access to the quarry and the undertaking of rock climbing activities at the quarry would have to be negotiated with the Department of Water, the Water Corporation and the Department of Environment and Conversation.

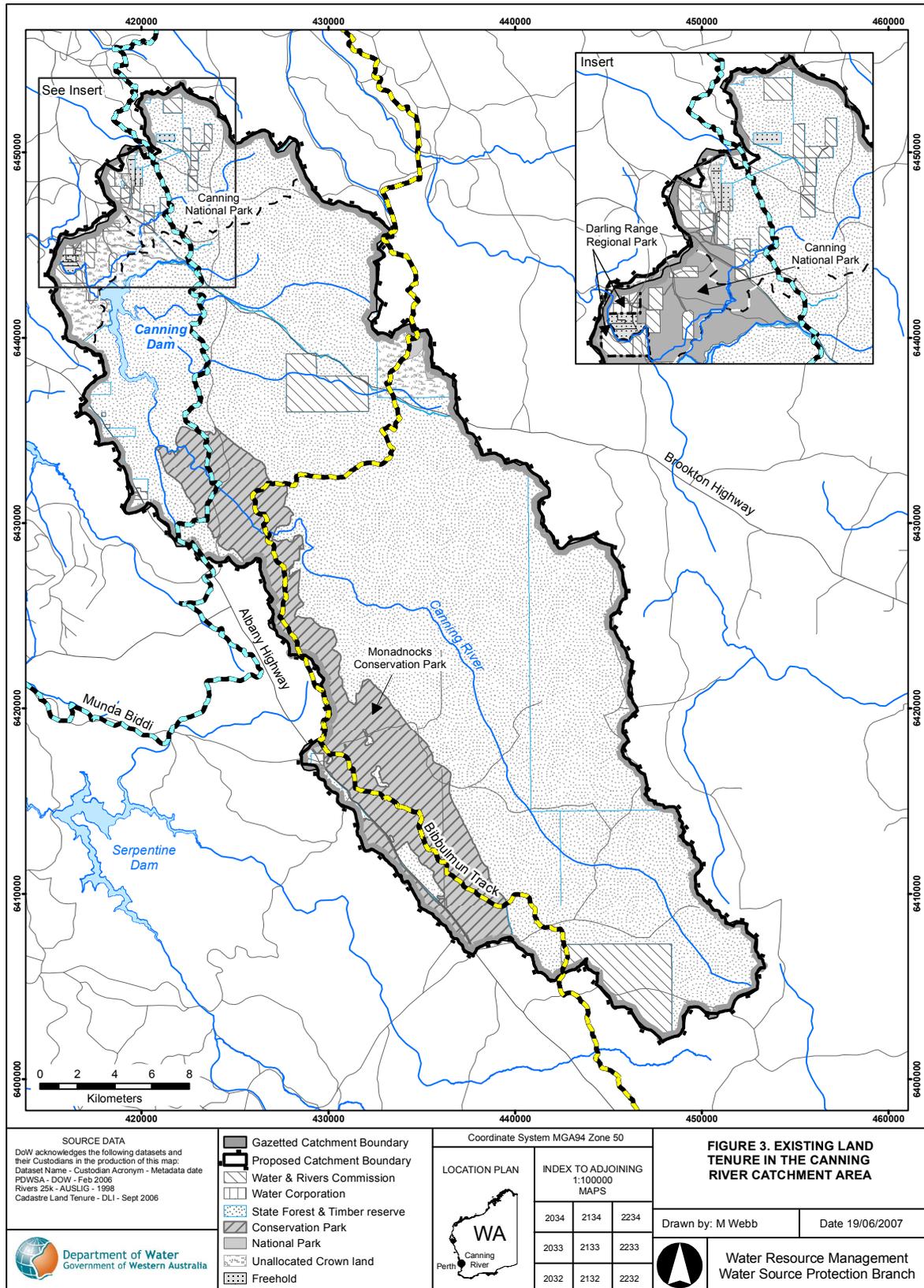


Figure 3. Existing tenure in the Canning River Catchment Area

4 Catchment protection strategy

4.1 Protection objectives

The objective of water source protection in the Canning catchment is to protect water quality by avoiding risks of contamination where possible. On private land the objective is generally to prevent any increased risk of contamination.

Canning Reservoir is a strategic source for water supply to the metropolitan area of Perth, contributing supply to more than 350,000 residences. Based on the potential risk posed by human contact with the water and the number of people that could potentially be affected, activities that require contact with the water body are considered not acceptable in this catchment.

This plan aims to balance water quality protection and social and environmental needs and aspirations. Where constraints are required, opportunities for these activities should be catered for in other more appropriate locations.

4.2 Proclaimed area

The Canning River Catchment Area was gazetted under the *Metropolitan Water Supply, Sewage and Drainage Act 1909* in 1925. In order that the gazetted catchment represents the physical catchment boundary, some minor amendments are required. It is proposed to re-gazette the catchment area to better reflect the topographic and hydrological catchment boundary and the location of the Araluen pumpback station.

The Canning River Catchment Area also forms the boundary of the Canning River Surface Water Area proclaimed under the *Rights in Water and Irrigation (RIWI) Act 1914* in 1957. The Department of Water licences the allocation of water under the *RIWI Act*.

4.3 Priority classifications

Land within Public Drinking Water Source Areas is allocated one of three priority classifications (P1, 2 or 3). These classifications attempt to prioritise areas for the protection of water quality and have been defined using present land use information, existing or approved land zoning, ownership, the importance of the water source, and the vulnerability of the waterbody. Each priority classification allows different levels of activity according to the degree of risk to the water quality of the water resource. Additional constraints may also apply in zones closest to the point where drinking water is harvested or stored (Wellhead Protection Zones or Reservoir Protection Zones).

An explanation of the priority classification and the protection approach, and details of land use compatibility with each priority classification can be obtained from the Department's Water Quality Protection Notes *Land Use Compatibility in Public*

Drinking Water Source Area and Overview on Protecting our Public Drinking Water Source Areas. They can be found on the Department's website www.water.wa.gov.au, select Water Quality > Publications: Water Quality Protection Notes.

Crown and Government owned land in the Canning River Catchment Area should be managed for Priority 1 source protection (see Figure 4). The objective is to preserve the high quality of this water by avoiding risks of contamination. This classification is justified on the following basis:

- Canning Reservoir is a strategic source of the IWSS water supply;
- The existing water quality is of a very high standard;
- Existing land uses are generally compatible with P1 or can be managed for P1 objectives with the use of best management practices; and
- The only treatment of water sourced from the reservoir is disinfection.

The privately-owned land in the catchment should be managed for Priority 2 (P2) source protection (see Figure 4). The objective of this priority classification is to ensure that there is no increased risk of pollution to the water source.

It is recognised that most current land use practices on private land are not posing an unmanageable risk to water quality, and there is therefore no urgency to convert this land to Government ownership. However, the land should be retained for low intensity agriculture or other low intensity use, and further fragmentation should not be permitted. This is reflected in the Armadale Town Planning Scheme's *Rural Living X* zoning. The Priority 2 classification for private land is appropriate as most of the private land in the catchment is used for low intensity agriculture.

The detail of general land use compatibility for the Priority 1 and Priority 2 source protection classifications can be found in the Department of Water's Water Quality Protection Note *Land use compatibility in Public Drinking Water Source Areas*.

4.4 Protection zones

To protect the reservoir from immediate risks to water quality including human contact, it is currently managed with a prohibited zone (PZ), which prohibits unauthorised access to protect the most vulnerable part of the catchment from contamination. The PZ is a key barrier in the 'catchment to consumer' multiple barrier approach for protecting the reservoir and its resultant drinking water quality (NHMRC & ARMCANZ, 2004). With the introduction of the revised *MWSSD* By-laws the PZ will be renamed the Reservoir Protection Zone (RPZ). In this plan the area is referred to as the RPZ.

The RPZ include the reservoirs as well as an area approximately 2 km around the top water level of each reservoir. The RPZ does not extend outside the catchment area. The alignment of the RPZ is shown in Figure 4, and includes protection around the Kangaroo Gully Diversion Dam and a reduced buffer around the Araluen Pumpback due to presence of private land.

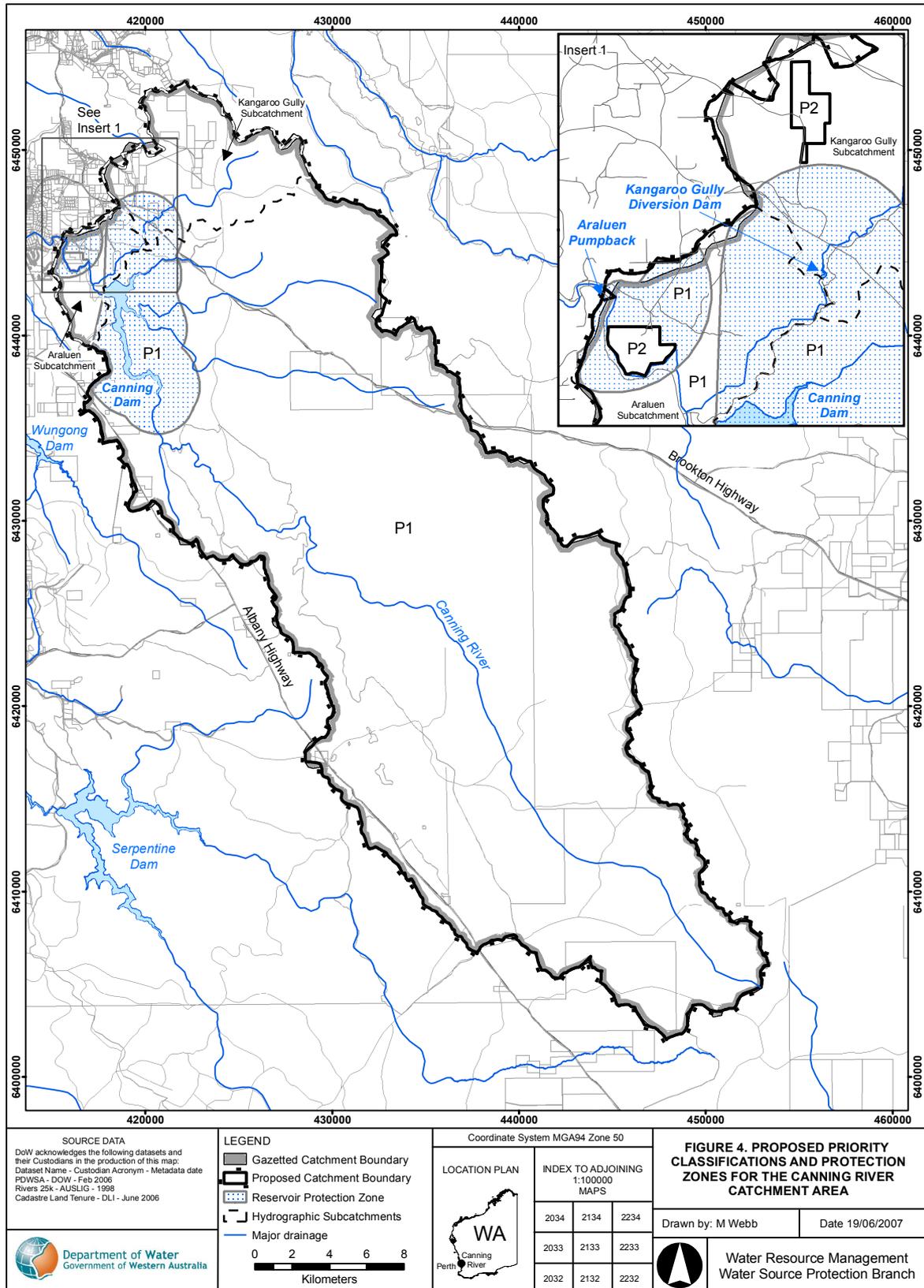


Figure 4. Proposed catchment boundary amendments, priority classifications and protection zones for the Canning River Catchment Area

4.5 Land use planning

It is recognised under the State Planning Strategy (Western Australian Planning Commission, 1997) that the establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of drinking water sources. As outlined in *Statement of Planning Policy No.2.7: Public Drinking Water Source Policy* (Western Australian Planning Commission, 2003) it is therefore appropriate that the Canning River Catchment Area, Reservoir Protection Zones and priority classifications be recognised in the relevant Planning Schemes and Strategies (Special Control Areas). Any development proposals for land located within the Canning River Catchment Area, or deemed likely to affect the protection objectives should be referred to the Department of Water for advice and recommendations, and assessment should be guided by *Draft Statement of Planning Policy No.2.9 Water Resources* (Western Australian Planning Commission, 2004).

4.6 Best management practices

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

There are guidelines available for many land uses in the form of industry codes of practice, environmental guidelines or Water Quality Protection Notes (WQPN). These have been developed in consultation with stakeholders such as industry groups, producers, state government agencies and technical advisers. Examples include

- *Guidelines for horse facilities and activities,*
- *Statewide Policy No. 13 – Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land,*
- *WQPN Extractive industries within Public Drinking Water Source Areas,*
- *WQPN Protecting Public Drinking Water Source Areas,*
- *WQPN Orchards in sensitive environments,*
- *WQPN Risk assessment of Public Drinking Water Source Areas,*
- *WQPN Roads in sensitive environments,*
- *WQPN Stockyards,*
- *WQPN Subdivision and rezoning in Public Drinking Water Source Areas,*
- *WQPN Tracks and trails near sensitive water resources,*
- *WQPN Vegetation buffers to sensitive water resources, and*
- *WQPN Wastewater treatment – onsite domestic systems.*

They are available from the Department's web site (see References section for details). The guidelines help managers reduce the risk of their operations causing unacceptable environmental impacts. They are recommended as best practice for water quality protection.

Education and awareness (e.g. signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who are unfamiliar with the Canning River Catchment area. Signage is already in the catchment to guide the public. A brochure will be produced once this Plan is endorsed, describing the Canning River Catchment area, its location and the main threats to water quality protection. This brochure will be made available to the community and will serve to inform people in simple terms about the drinking water source and its protection.

4.7 Surveillance and By-law enforcement

The quality of public drinking water sources that provide water to the metropolitan area is protected under the *Metropolitan Water Supply Sewerage and Drainage Act (1909)*. Declaration of these areas allows existing By-laws to be applied to protect water quality.

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

Signs are erected to educate the public and to advise of activities that are prohibited or regulated. Surveillance and By-law enforcement in the catchment area are currently delegated to the Water Corporation.

4.8 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency responses can result in water contamination. The City of Armadale and the Shires of Wandering, Beverley, Serpentine-Jarrahdale and Kalamunda's respective Local Emergency Management Advisory Committees (LEMAC) through the South East Metropolitan and Great Southern Emergency Management Districts should be familiar with the location and purpose of the Canning River Catchment area. A locality plan should be provided to the Fire and Rescue Services headquarters for the Hazardous Materials Emergency Advisory Team (HAZMAT). The Water Corporation should have an advisory role to any HAZMAT incident in the Canning River Catchment area.

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

For those parts of the catchment area located outside of the gazetted fire emergency response zone (FESA), the Department of Environment and Conservation is the lead agency for wildfire control and management. Water Corporation catchment rangers attend all fires and liaise closely with

4.9 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses in the Canning River Catchment area and recommends protection strategies to minimise these risks.

Following publication of the final Canning River Catchment Area Drinking Water Source Protection Plan, an Implementation Strategy will be drawn up based on the recommendations in Table 1. It will describe timeframes and funding sources for the recommended protection strategies and identify responsible stakeholders. This is reflected in the Recommendations section of this plan.

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

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
General farming - Livestock grazing - Orchard - Residences	Pathogen and nutrient contamination from septic systems, farm animals and domestic animals.	High	Use of private land for agriculture is an existing approved land use. Existing agricultural activities on private land are low intensity cropping and grazing and orchards. The risks associated with these activities can be managed through education and the adoption of Best Management Practices, however, intensification of these land uses is undesirable.	MWSSD By-laws allow the DoW to control and issue approvals for the grazing of animals and the application of any fertilisers and pesticides within a PDWSA. The Department's <i>Statewide Policy No.2 – Pesticide use in Public Drinking Water Source Areas</i> provides guidance on pesticide use and handling in the catchment. Private land in the catchment is currently zoned <i>General Rural</i> and <i>Rural Living X</i> , under the Armadale Town Planning Scheme #4. These types of zoning include restrictions on property subdivision. Water quality protection objectives of the Priority 1 and 2 classifications are recognised in the Armadale Town Planning Scheme #4.	Existing land uses are acceptable with Best Management Practices. Encourage landowners to adopt, and provide advice on, Best Management Practices (i.e. stock and runoff management, domestic on-site septic systems and chemical use and storage). Development proposals should be referred to the Department of Water for assessment and advice to ensure that water quality protection requirements are met. Oppose intensification of land use through the planning approval process. Ensure the water quality protection objectives of the Priority 1 and 2 classifications are recognised in the relevant Shire Planning Schemes, for example through a Water Catchment Zoning overlay. Should strategic lots of privately owned land become available, the Department should consider purchasing them to further reduce the risks to the water source.
	Chemical contamination from fertilisers and pesticides applied to orchards, pastures and gardens, and inadequate disposal of chemical storage containers.	Medium			
	Hydrocarbon contamination through fuel spills from fuel storage and refuelling, mechanical servicing and waste oil disposal.	Medium			
	Increased turbidity as a result of vehicle usage on unsealed roads (e.g. tractors), importing of stock feed, clearing and poor land management practices.	Low			
	Increased stream salinity from water balance changes as a result of clearing.	Low			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Plantation timber harvesting <i>Kangaroo Gully and Canning catchments</i>	Turbidity due to log handling, plantation establishment practices, the construction, use and upgrading of unsealed roads and tracks, and runoff from cleared areas.	High	The plantation management and clear-felling harvest method impacts on water quality can be reduced through application of Best Management Practices.	Timber harvesting is guided by the <i>Manual of Management Guidelines for Timber Harvesting in WA</i> (CALM, 1999) and the <i>Code of Practice for Timber Plantations in WA</i> (Forest Products Commission, 2003), including road construction and maintenance, use of sumps or drains for sediment control, appropriate retention of buffer zones along watercourses, fuel storage and handling and fertiliser and pesticide use.	<p><i>Acceptable activity with Best Management Practices.</i></p> <p>Review detailed harvesting and establishment plans during the planning phase to ensure that</p> <ul style="list-style-type: none"> contract specifications recognise water quality protection objectives including use of appropriately located chemical toilets during periods of intensive activity on the site. plantation establishment does not occur in high risk areas, such as on steep slopes or adjacent to, or across, watercourses in the catchment. vegetation buffers along watercourses in the catchment are retained; fertilisers and pesticides are used in accordance with DoH PSC-88 and Statewide Policy No.2 <i>Pesticide use in Public Drinking Water Source Areas.</i> monitoring of appropriate streams before and after harvesting and chemical application is conducted to identify any impacts. <p>Establish protocols for joint field inspections with relevant agencies prior to harvesting operations and inspect water quality protection measures on site.</p>
	Fuel spills from vehicles and machinery during harvesting and upgrading of roads.	Low	Plantations cover relatively small areas located near the catchment boundaries, which reduces the associated risks.		
	Chemical contamination from fertiliser and pesticide application during plantation establishment and maintenance.	Low	The width and quality of native vegetation buffers need to be reviewed, with the aim of restoring natural vegetation buffers adjacent to watercourses in the catchment.		
	Pathogens due to human presence, particularly as a result of increased public access via upgraded and new roads.	Medium	Increased acidity of soil and water may affect transport of other contaminants, but greater understanding of the effect of pine plantations on water quality is needed.		
	Increasing soil and water acidity due to the presence of pine trees.	Low			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Native forest timber harvesting (if undertaken)	Increased turbidity due to log handling practices, and construction, use and upgrading of unsealed roads and tracks. Of particular concern are the use of heavy log transport vehicles and poor drainage control on unsealed roads.	High	Water quality protection is a requirement of the CALM Act, which recognises the importance of water as a resource. The impact of native forest timber harvesting on water quality can be minimised through proper construction, management, and maintenance of roads, and retention of vegetation buffers along watercourses in the catchment.	Timber harvesting is guided by the <i>Manual of Management Guidelines for Timber Harvesting in WA</i> (CALM, 1999) and the <i>Code of Practice for Timber Plantations in WA</i> (Forest Products Commission, 2003), including road construction and maintenance, use of sumps or drains for sediment control, appropriate retention of buffer zones along watercourses, fuel storage and handling and fertiliser and pesticide use. Timber harvesting operations are supervised by the Forest Products Commission with surveillance by the Department of Environment and Conservation (DEC). An Interim Manual of Procedures for Management of Soils Associated with Timber Harvesting in Native Forests is being prepared by DEC.	<p><i>Acceptable activity with Best Management Practices.</i></p> <p>Continue to review road network usage and close and rehabilitate roads not essential for harvesting operations.</p> <p>Continue to review detailed (1-year and 5-year) harvesting plans during the planning phase to ensure water quality protection objectives are included.</p> <p>Require appropriately located chemical toilets to be provided for contractors working in the catchment.</p> <p>Ensure pesticide use follows the DoH PSC-88 and the Statewide Policy No.2 <i>Pesticide use in Public Drinking Water Source Areas.</i></p> <p>Establish protocols for joint inspections of water quality protection measures on site.</p> <p>Conduct baseline monitoring on a main tributary in an area for a minimum of two years prior to harvesting activities in the area. Thus, harvesting plans need to be available two years prior to harvesting.</p>
	Fuel spills from vehicles and machinery during harvesting and upgrading of roads.	Medium	Revegetation of roads and tracks following the harvesting process should be conducted to reduce public access and erosion problems.		
	Spread of forest disease by vehicle use of roads and tracks.	Low			
	Pathogens due to human presence, particularly due to increased public access from road upgrading and new roads.	Medium	Baseline water quality data is frequently not available prior to harvesting, reducing the value of post-harvesting monitoring. The issue of who should monitor, and when and how monitoring is conducted needs to be addressed to aid informed management of forestry in the catchment.		

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Fire management - Fuel reduction and biodiversity burning - Fire Access Tracks - Water points	<p>Turbidity due to increased runoff and soil exposure after fuel reduction burns and the construction and maintenance of fire access tracks and water points.</p> <p>Additional risks associated with fuel reduction burns include carbon and nutrient contamination.</p> <p>Fuel spills from vehicles and machinery, chemical contamination (pesticides and fire retardants) and potentially pathogens from direct contact of people with waterbodies.</p>	<p>Medium</p> <p>Low</p> <p>Medium</p>	<p>Fuel reduction and biodiversity burning is undertaken in accordance with the <i>Forest Management Plan 2004-2013</i>. It is an established land management practice in the catchment, and should be managed to limit the potential for turbid runoff into, and chemical contamination of, the reservoir and its tributaries.</p> <p>Fire access tracks with table drains can be constructed to minimise erosion.</p>	<p>Water Corporation rangers attend fires in the catchment.</p> <p>Regular water quality monitoring is carried out by the Water Corporation.</p>	<p><i>Acceptable activity with Best Management Practices.</i></p> <p>Establish specific guidelines related to water quality protection for consideration in the burning prescription. For example, guidelines would include the location of fire access tracks, and the construction and use of sumps and/or drains for sediment control.</p> <p>Ensure pesticide use follows the DoH PSC-88 and the Statewide Policy No.2 <i>Pesticide use in Public Drinking Water Source Areas.</i></p> <p>Liaise closely with DEC to ensure specific guidelines relating to water quality protection are incorporated into the Fire Operations Manual and that protocols are put in place for effective communication between agencies managing the catchment</p> <p>Ensure soil excavated during construction of water points is stabilised to prevent turbid runoff into watercourses.</p> <p>Ensure that post-fire water quality monitoring is carried out.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Wildfires	<p>Increased risk of turbidity associated with extensive burning by wildfire and emergency construction of fire access tracks.</p> <p>Risk of pathogen, carbon and nutrient contamination from airborne or eroded ash.</p>	<p>Medium</p> <p>High</p>	<p>Extensive burning from wildfires can be caused either naturally or following irresponsible human access.</p> <p>Intense wildfire can cause turbidity issues from the ash made airborne during the burn, or through runoff when the burn is followed by rain.</p> <p>A reduction of filtering vegetation and decomposing animal carcasses may result in an increase in nutrient and pathogen transport.</p>	<p>Water Corporation staff attend fires.</p> <p>The fuel reduction burning programs run by DEC and the Water Corporation should reduce the incidence of wildfires.</p> <p>Water quality is monitored regularly by the Water Corporation.</p>	<p>To ensure that water quality considerations are sufficiently addressed, a Water Corporation staff member should attend all fires in the catchment area.</p> <p>Sites should be inspected following fire to assess the need for turbidity mitigation works. These should be undertaken at the combined expense of the Water Corporation and the Department of Environment and Conservation.</p> <p>Ensure sites that need permanent protection from wildfire have adequate fire access tracks and/or low-vegetation buffer zones to prevent the need for extensive earthworks or clearing at short notice during a fire.</p> <p>Emergency fire access tracks should be immediately rehabilitated.</p> <p>Ensure that post-fire water quality monitoring is carried out.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Bauxite mining <i>(Does not currently occur)</i>	Turbidity from mining practices including clear-felling, ineffective site and runoff management, and use of unsealed roads and tracks. Fuel spills from vehicles and machinery. Pathogens due to presence of people in the catchment for long periods.	Low Low Low	Bauxite mining is unlikely to occur in the Canning catchment, however, Alcoa's Mining Lease does cover some of the catchment and management priorities will increase should mining commence.	Bauxite mining does not currently occur in the Canning catchment.	<i>Acceptable if operated in compliance with conditions imposed by MMPLG (Mining and Management Program Liaison Group).</i>
Firewood collection	Pathogen contamination through the presence of people (and possibly dogs) near watercourses. Rubbish dumping as a consequence of public access, including hydrocarbon waste from machinery. Increased turbidity due to use of unsealed roads and damage to vegetation through off-road driving.	Medium Medium Medium	The primary concern is the potential for people to be in close proximity to the reservoir or tributaries during public firewood collection. The collection of firewood is managed through a permit system operated by the Department of Environment and Conservation. Rubbish dumping in the form of hydrocarbon waste from machinery is particularly associated with public firewood collection points. Domestic animals often accompany people during firewood collection (see section on Animal Exercising in this Table).	Public access to the RPZ is not allowed. The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.	<i>Acceptable activity with conditions.</i> Regional plans for public firewood collection areas should give consideration to water quality protection objectives. Promote public firewood collection sites located outside the catchment. Where public firewood areas are required within the catchment, establish designated public firewood areas outside the RPZ, away from the reservoir and tributaries, and restrict activity to only these areas at the edge of the catchment. Ensure public firewood areas are regularly patrolled and that responsibility is assigned for removal of any rubbish dumped in public firewood collection areas.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
<p>Roads, tracks and trails</p> <ul style="list-style-type: none"> - Public, logging and service roads - Bibbulmun Track - Munda Biddi Trail - Infrastructure corridors 	<p>Turbidity from erosion of unsealed roads, tracks and trails.</p> <p>Fuel and chemical spills from vehicles and machinery and their loads.</p> <p>Roads, tracks or trails can provide public access to the waterbody and the catchment, which increases all associated risks of illegal activities such as rubbish dumping and camping (incl. overnight stays) in non-designated areas, and of pathogen contamination.</p>	<p>Medium</p> <p>Low</p> <p>Medium</p>	<p>Some roads and tracks are necessary for timber harvesting, fire management and general forest management. However, it is essential they are well maintained to minimise the risk of erosion, and hence the impact on water quality.</p> <p>Control of public access on roads and tracks in the State Forest is a major issue in the catchment. Uncontrolled public use of such roads and tracks is greatest in Kangaroo Gully.</p> <p>Erosion is occurring along the steeper parts of the Munda Biddi trail.</p> <p>Some drains have been installed incorrectly and channel road run-off directly into waterways.</p> <p>Drains and other sediment control measures have filled up with accumulated sediments and debris.</p>	<p>The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.</p> <p>Most roads and tracks have existing drainage and run-off control measures in place.</p> <p>A recent review of public access to forested areas identified several roads and tracks no longer required.</p> <p>Available Bibbulmun Track and Munda Biddi Trail literature advises users of the drinking water catchments, prohibited zones and camping regulations.</p> <p>Public education through this Department's Water Quality Protection Notes <i>Roads near Sensitive Water Resources</i> and <i>Tracks and trails near Sensitive Water Resources</i>.</p>	<p><i>Accepted as necessary for proper land and forest management with Best Management Practices.</i></p> <p>No further trails to be developed in the catchment without consultation with relevant agencies.</p> <p>Develop guidelines for the construction, maintenance and management of roads, tracks and trails that address water quality protection objectives, such as provision and maintenance of adequate drainage and runoff control measures.</p> <p>Ensure environmental management plans that address water quality protection objectives are developed, implemented and audited for tracks and trails in the catchment.</p> <p>Review road network, and close and rehabilitate roads and tracks not essential for forest operations and management or transport thoroughfare.</p> <p>Consider enforcement of restricted access associated with Disease Risk Areas to limit public access to areas of the catchment.</p> <p>Install appropriate drainage and runoff control measures along the steeper parts of the Munda Biddi trail or realign the route.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Gravel Pits	Increased turbidity from gravel extraction processes, poor overburden management and/or drainage control and recreational use.	Low	Gravel pits require effective site management to reduce risks to water quality, such as runoff control measures.	The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers. New pits established by DEC [CALM] are rehabilitated after use.	<p><i>Acceptable activity with best management practices.</i></p> <p>Gravel extraction to occur in accordance with this Department's Water Quality Protection Note <i>Extractive Industries near Sensitive Water Resources</i>, DEC's Policy Statements No.2 <i>Local Government Access to Basic Raw Materials from State Forest and Timber Reserves</i> and No.10 <i>Rehabilitation of Disturbed Land and Guidelines for the Management and Rehabilitation of Gravel Pits – South West Forest Areas</i> with immediate rehabilitation of sites when no longer in use.</p> <p>Inspect water quality protection measures on site.</p> <p>Close and rehabilitate gravel pits that are not required for forest management operations or road maintenance.</p> <p>Close and rehabilitate sites with evidence of illegal recreation (particularly in the Kangaroo Gully catchment) to prevent access until vegetation is deterrent enough. Signage, education and concurrent rehabilitation of access tracks may help.</p> <p>No gravel pits to be developed in the Reservoir Protection Zone.</p>
	Fuel and chemical spills from vehicles and machinery.	Low	Gravel pits are focal points for illegal and sometimes destructive recreational activities usually involving vehicles. Recreational activities may also be responsible for a failure of rehabilitation in gravel pits (Burne, 2001).		
	Pathogens from human presence, particularly as gravel pits often attract illegal recreation by some members of the public.	Medium			
	Rubbish dumping often in the form of car bodies associated with the illegal recreation in gravel pits.	Medium	It is important to rehabilitate gravel pits to help prevent illegal activities in unused pits and reduce the occurrence of rubbish dumping (e.g. car bodies). There are many gravel pits in the Canning catchment, but those in the Kangaroo Gully catchment are particularly subject to illegal recreation.		

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
SES or Police training	<p>Pathogens from human presence.</p> <p>Increased turbidity from traffic.</p> <p>Fuel and chemical spills from vehicles.</p>	<p>Medium</p> <p>Low</p> <p>Low</p>	Canning catchment was last known to be used for such training activities in 1999.	Subject to approval (with conditions) by DoW and Water Corporation.	<p><i>Acceptable activity with conditions.</i></p> <p>Ensure activity is subject to approval by DoW and the Water Corporation and appropriate water quality protection conditions are adhered to, including exclusion from RPZ and use of strict hygiene conditions.</p>
<p>Feral animals and their control</p> <ul style="list-style-type: none"> - Feral pigs - Foxes <p>(Cats and rabbits are also present but are not perceived to pose a significant risk to water quality)</p>	<p>Feral pigs create a large risk of</p> <ul style="list-style-type: none"> - turbidity and - transfer of pathogens <p>through wallowing.</p> <p>Feral pig control through hunting introduces the additional risks of</p> <ul style="list-style-type: none"> - pathogens through the presence of people near the reservoir and tributaries, and associated camping (incl. overnight stays), - pathogens from animal carcasses. <p>Fox control occurs through baiting, and involves a risk of pathogen contamination from animal carcasses and uneaten baits.</p>	<p>High</p> <p>High</p> <p>Medium</p> <p>Medium</p> <p>Medium</p>	<p>Feral pig control by hunting involves additional risks associated with pathogen contamination from feral animal carcasses, and from people remaining in the catchment for extended periods and associated camping (incl. overnight stays).</p> <p>Illegal introduction of pigs and associated diseases by hunters is known to have occurred and increases all risks associated with the animals.</p>	<p>The Water Corporation and DEC [CALM] have feral pig control programs in place. Both agencies use the trap and shoot method (refer CALM's draft <i>Feral Pig Management Strategy</i>). .</p> <p>Unless specifically authorised for management purposes, hunting is not permitted in the catchment.</p> <p>[Please note other sections in this table also apply.]</p>	<p><i>Acceptable activity with controls.</i></p> <p>Ensure pig hunting is performed by the 'trap and shoot' method only, without the use of dogs.</p> <p>Review inter-agency guidelines for the managed eradication of feral pigs to ensure water quality protection By-laws and requirements, such as the presence of hunters, dogs and camping in the catchment and the burying of feral animal carcasses, are adhered to.</p> <p>Commence detailed multi-agency data collation on rate of pig capture to monitor the success of control programs.</p> <p>Ensure DEC [CALM] protocol is followed to locate fox baits away from the reservoir or tributaries.</p> <p>Investigate use of 1080 poison to control feral pig populations as well as foxes.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Research projects	Pathogen contamination from people remaining in the catchment for extended periods, particularly close to or on the reservoir.	Medium	The risk associated with this activity is minimal, due to the low numbers of people involved, management controls and the ease of education prior to the activity occurring.	Researchers require a permit from the Water Corporation. Permit conditions include water quality protection measures.	<i>Acceptable activity with conditions.</i> Continue to ensure people involved are aware of water quality protection requirements and apply a condition of approval that requires adherence to water quality protection objectives. Site projects outside of the RPZ where possible.
Swimming	Pathogen contamination through direct contact of humans, pet dogs or horses with the waterbody.	Medium	Human or animal contact with water represents an immediate threat to water quality as all catchment protection barriers are broken. However, in the Canning reservoir and tributaries the activity is rare.	Swimming, bathing, bodily contact with water and washing clothes in the reservoir and tributaries is prohibited under MWSSD By-Laws, as they have the potential to pollute surface water supplies (NHMRC & ARMCANZ, 2004). The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.	<i>Swimming is prohibited in the reservoir and tributaries in the catchment.</i> Use signage and promotional material to ensure public awareness that swimming is prohibited in the reservoir and tributaries. Undertake surveillance with By-law enforcement.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Orienteering and rogaining	Pathogen contamination from people remaining in the catchment for extended periods, particularly close to the reservoir or tributaries. Camping (incl. overnight stays) is frequently associated with rogaining, increasing the contamination potential, although campsites are usually outside of catchment areas.	Medium	<p>There are up to two organised events held in the catchment each year, which are subject to DEC [CALM] and Water Corporation approval.</p> <p>Orienteering and rogaining run by organised groups can be managed through approval and education. However, these events may encourage later visits by individuals, with the possibility of camping (incl. overnight stays).</p>	<p>Organised events have been well managed, and the groups were very responsible and willingly promoted water quality issues.</p> <p>The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.</p>	<p><i>Acceptable activities with conditions.</i></p> <p>Ensure organised groups obtain approval for events, and proper management of the group is a condition of approval.</p> <p>Ensure approved groups use trails outside the RPZ and away from tributaries.</p> <p>Ensure approved events provide chemical toilets for participants. These should be located outside the RPZ.</p> <p>Use signage and brochures to educate on the importance of protecting drinking water quality.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Bushwalking - Bibbulmun Track	Pathogen contamination from people remaining in the catchment for extended periods, particularly close to the reservoir or tributaries. Camping (incl. overnight stays) is frequently associated with bushwalking, increasing the contamination potential, although campsites are usually outside of catchment areas.	Medium	Bushwalking through organised groups or along a designated track can be managed through approval processes and education. It is essential that a designated and promoted track be regularly inspected and maintained to minimise the risk of degradation and erosion of the area.	The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers. Available Bibbulmun Track and Munda Bidli Trail literature advises users of the drinking water catchments, prohibited zones and camping regulations. Public education through this Department's WQPN <i>Tracks and trails near Sensitive Water Resources</i> and the Department's recreation map, which shows walk trails within the region. Alternative enforcement options are available under the Environmental Protection Act 1986 (i.e. Environmental Protection Policy).	<i>Acceptable activity with conditions on designated tracks and trails only.</i> No further trails to be developed in the catchment without consultation with relevant agencies. Undertake a recreation planning exercise to identify bushwalking opportunities with the catchment. Ensure an environmental management plan is developed, implemented and audited for any bushwalking trails, which addresses water quality protection objectives, such as maintenance of the trails and associated camp sites. Ensure organised groups obtain approval for events, and proper management of the group is a condition of approval. Ensure bushwalking is restricted to designated trails outside the RPZ. Use signs and brochures to educate on the importance of protecting drinking water quality and the MWSSD By-laws. Increase surveillance in the Gibbs Rock, Geddes Rock, Boulder Rock and Lesley areas and areas east of Mounts Randall and Cooke.
	- Turbidity;	Low	Organised activities may encourage later visits to the area by individuals with the possibility of camping (incl. overnight stays).		
	- Rubbish dumping;	Low	Use of the Bibbulmun Track is increasing, and camping now occurs between designated campsites, where appropriate facilities are not available and sites chosen are generally close to the reservoir or tributaries.		
	- Spread of forest diseases, particularly if individuals do not keep to designated tracks and/or trails.	Low	Off-track bushwalking is being carried out in the Gibbs Rock, Geddes Rock, Boulder Rock and Lesley areas and areas east of Mounts Randall and Cooke.		

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Fishing and marroning	<p>Pathogen contamination from people remaining close to the reservoir for extended periods, possible associated camping (incl. overnight stays).</p> <p>The use of bait and animal carcasses for bait purposes.</p> <p>Turbidity from vehicle use close to the water body.</p> <p>Fuel and chemical spills from vehicles.</p>	<p>High</p> <p>High</p> <p>Low</p> <p>Low</p>	<p>Direct human or animal contact with the water presents a serious risk of microbiological contamination. Where direct contact occurs, the effectiveness of catchment barriers such as soil filtration or environmental decay is significantly reduced. Direct contact with the water in drinking water catchments should always be avoided.</p> <p>Marroning poses a particularly significant risk due to the large numbers of people involved that are in direct contact with the waterbody for extended periods of time. Additional risks are associated with on-site camping, picnicking and the presence of dogs close to watercourses, as well as the use of baits.</p> <p>It is considered that ceasing fishing and marroning is essential to protect water quality in such a strategic water source.</p>	<p>Fishing and marroning are prohibited under MWSSD By-Laws. The risks to water quality are currently reduced by after-hours surveillance by Water Corporation Rangers.</p>	<p><i>Fishing and marroning in the reservoir or tributaries are prohibited in the catchment.</i></p> <p>Use signage and advertising material to ensure public awareness that fishing and marroning are not permitted.</p> <p>Liaise with and advertise through Fisheries WA and fishing clubs and fishing stakeholder groups (e.g. Recfishwest) and get support from these groups for prohibition of fishing activities.</p> <p>Undertake more after-hours surveillance of the catchment with By-law enforcement with the aim of ceasing activities. (By-laws prohibiting both fishing and marroning and presence in the RPZ should be used).</p> <p>Increase the penalties associated with offences under Part 4 of the MWSSD By-laws.</p> <p>Refer people wishing to fish or marron to this Department's Recreation Map, which shows alternative locations (outside drinking water catchments) for these activities.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Camping (incl. overnight stays) <ul style="list-style-type: none"> - Bibbulmun track - Munda Biddi Mountain Bike Trail - Undesignated camping 	Pathogen contamination from people remaining in the catchment for extended periods, even if camping at designated camp sites.	Medium	Use of the Bibbulmun Track is increasing, and camping now occurs between designated campsites, where no controlled facilities are available. The risks associated with designated camping sites may decrease with installation of sealed composting toilets. Camping at undesignated sites poses a significant risk to water quality, as appropriate facilities are not available and sites chosen are generally close to the reservoir or tributaries. Camping at undesignated sites is likely to involve additional risks associated with waste disposal and illegal activities, such as camp fires, fishing and marroning.	The risks to water quality are managed at designated campsites along the Bibbulmun Track and Munda Biddi Trail, as appropriate facilities are provided and there is no direct access to the waterbody. Camping in undesignated sites in the catchment areas is prohibited under MWSSD By-laws. The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.	<i>Undesignated camping (incl. overnight stays) is prohibited in the catchment.</i> Ensure designated camping sites are established away from the reservoir and tributaries and outside the RPZ. Ensure designated camping sites adequately cater for demand (particularly the toilet facilities). Use signage, brochures and advertising material to ensure public awareness that camping is prohibited at undesignated sites, and to educate on the importance of protecting drinking water quality. Undertake surveillance to prevent camping at undesignated sites. Ensure responsibility for regular inspections, maintenance and management of camping sites is clearly assigned and agreement made on audit procedures. Refer people wishing to camp to this Department's Recreation Map, which shows designated camping sites in the region. See also section on Wildfires in this Table.
	Pathogen contamination from people remaining in the catchment for extended periods while camping at undesignated sites. There are additional risks where this activity is associated with fishing and marroning.	Medium			
	Rubbish dumping is a potential risk and difficult to control amongst such catchment users.	Low			
	Wildfires may result from camping and lighting camp fires at undesignated sites (see section on Wildfires in this Table).	High (see section on Wildfires in this Table)			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Horse riding	Pathogen contamination from people and animals remaining in the catchment for extended periods and being in contact with waterbodies (for watering horses), resulting in faecal contamination.	Medium	Horses compact ground, contributing to increased overland runoff and thus turbidity.	It is prohibited to ride horses in the catchment under <i>MWSSD</i> By-laws except on public roads or by permission of DoW and the Water Corporation.	<i>Horse riding is prohibited in the catchment except on public roads or as part of historical events that have approval and are managed as a non-conforming use.</i>
	Turbidity from the use of horses and vehicles on unsealed roads and tracks.	Medium	Horse riding events run by an organised group can be managed through approval and education.	Where permission is sought, conditions are applied to horse riding event approvals.	No further events will be approved in the catchment.
	Fuel spills from vehicles accessing the trails.	Low	The risk is reduced where horse riding occurs along roads or tracks away from the reservoir and tributaries, and camping (incl. overnight stays) occurs at designated sites, but is increased by uncontrolled riding.	Large horse riding events are not supported in Public Drinking Water Source Areas.	Restrict existing horse riding events to public roads, away from the reservoir (outside the RPZ) and tributaries.
	Rubbish dumping is a potential risk, but not generally associated with organised events.	Low		The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.	Ensure an environmental management plan is developed for any existing event being held. This should explicitly address water quality protection objectives.
	Spread of exotic plant species.	Low			Event routes should be inspected by Water Corporation Rangers before and after the event to insure water quality protection issues are addressed.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Picnicking	<p>Pathogen contamination from people and potentially their pets (dogs). The risk is greater for undesignated picnicking than picnicking in designated areas due to open access to the catchment and lack of management controls.</p> <p>Two septic systems and an Ecomax system are operated by the Water Corporation at daytime picnic sites just downstream of the Canning Dam wall. These septic systems may be a source of pathogen contamination risk in water sourced from the Araluen Pumpback.</p> <p>Rubbish dumping is a potential risk and difficult to control amongst such catchment users.</p>	<p>Medium</p> <p>Medium</p> <p>Low</p>	<p>The risk of contamination is increased by proximity to the reservoir or tributaries, this being a desirable aspect of picnic sites. However, the risk is minimised where picnic sites are provided away from watercourses and with properly maintained toilet facilities.</p> <p>Not all of the designated picnic sites in the Canning catchment have toilet facilities.</p> <p>The Canning Reservoir picnic site is in close proximity to the Canning River below the dam wall. This poses a significant risk to the quality of water sourced from the Araluen Pumpback.</p>	<p>Picnicking is not permitted in the catchment other than at designated sites.</p> <p>The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers.</p>	<p><i>Picnicking is an acceptable activity at designated sites only.</i></p> <p>Undertake a recreation planning exercise to identify regional picnicking opportunities outside the Canning catchment area.</p> <p>Ensure designated picnic areas are outside the RPZ, do not provide access to the waterbody or tributaries and include appropriate toilet facilities. If appropriate toilet facilities are not available, remove picnic sites.</p> <p>Remove any septic systems with leach drains at Canning Reservoir and replace them with lower-risk systems.</p> <p>Use signs and brochures to educate on the importance of protecting drinking water quality.</p>
Animal (dog) exercising	<p>Pathogen contamination from people and animals in the catchment, particularly close to the reservoir or tributaries.</p>	<p>Medium</p>	<p>As animal behaviour cannot always be controlled, even when on a lead, there is a risk of contamination associated with this activity, particularly close to watercourses.</p>	<p>It is prohibited to bring or allow a dog into a catchment area under MWSSD By-laws, unless on private property.</p> <p>Catchment surveillance is carried out by Water Corporation Rangers.</p>	<p><i>Presence of dogs is prohibited in the catchment.</i></p> <p>Continue to undertake surveillance with By-law enforcement.</p> <p>Use signage and advertising material to improve public awareness that dogs are not permitted in the catchment.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Motor rally events - Car events, - Motorbike events.	Turbidity from erosion of unsealed roads and tracks, particularly on the steep slopes close to the reservoir. Turbidity is also increased by the import of fill materials for reconstruction and maintenance of tracks. Fuel and oil spills from vehicles. Pathogen and litter contamination from spectators entering the catchment. Spread of forest diseases.	Medium Medium Medium Medium Low	It is recognised that rallies which may be held are national events of significance for the local area, and until such time as more appropriate locations are acceptable, approval will continue to be given to stage pre-existing events in the catchment. However, competitive motor rallying is not compatible with water quality protection objectives as specified in Water Corporation document SG097 and Statewide Policy No. 13 <i>Policy and guidelines for recreation within Public Drinking Water Source Areas on Crown land.</i>	No new events are being approved for the Canning catchment. Events organisers are not given approval to re-establish discontinued routes into the Canning catchment. Event organisers are required to have an environmental management plan in place. Water Corporation staff conduct post-event inspections to ensure water quality protection issues are addressed.	<i>Existing events are acceptable with Best Management Practices.</i> No further events to be established in the catchment. No extensions to established routes or stages and none to be held during the winter months. Ensure road restoration and repair is implemented following events. Prohibit vehicle maintenance in the catchment area. Seek to minimise spectator and support crew access to the catchment area. An environmental management plan should be developed for each event. It should address water quality protection objectives, in particular road construction and maintenance, and construction of effective runoff control measures. These need to be approved by relevant agencies. Discuss requirements for a recreation planning process including identification of where recreational rally driving is acceptable. Work with organising bodies on assessment of water quality risks with events.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Vehicle access (away from public roads or designated tracks) <ul style="list-style-type: none"> - Licensed and unlicensed cars - 4WD's - Motor cycles - Unlicensed vehicles 	Turbidity from erosion of unsealed roads and tracks, particularly on the steep slopes close to the reservoir and from damage to vegetation.	Medium	Driving in areas which are not public roads or designated tracks is an activity that occurs extensively in the Kangaroo Gully catchment, but is less extensive in the Canning catchment. The risks associated with this activity are significant, particularly with regard to turbidity caused by the erosion of unsealed roads and tracks. The Kangaroo Gully catchment near Brookton Hwy and the Lesley area of the Canning catchment are well-used off-road driving locations, and are subject to additional risks associated with the dumping of stolen cars and camping. The possibility of industry management of off-road vehicle activities could be considered with a levy on off-road vehicles sold contributing to land rehabilitation funds.	Under MWSSD By-law 4.7.2: No person shall drive a vehicle on any part of a catchment area other than a road or track which has a graded, gravelled, sealed, primed or other prepared surface without written approval of the DoW. The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers. The <i>Control of vehicles (Off-road areas) Act 1978</i> is currently under review. Once completed this legislation is expected to provide adequate penalties for illegal vehicle access.	<i>Vehicle access (away from public roads or designated tracks) is not acceptable in the catchment.</i> Discuss requirements for a recreation planning process including identification of where recreational vehicle use away from public roads or designated tracks is acceptable outside the catchment, and ensure all rangers, vehicle retailers and local Shires are aware of the catchment in order to direct users to the designated areas. Rehabilitate WRC owned land to native forest to remove the temptation provided by partially cleared property for illegal recreation. Continue to undertake surveillance to enforce MWSSD By-laws preventing vehicle access away from designated roads in the catchment. Use signage to advertise that vehicle use / driving away from designated roads is not permitted. Liaise with Western Power and DEC to consider joint signage to prohibit public vehicle access to access roads and National Parks.
	Hydrocarbon contamination from fuel spills from vehicles.	Low			
	Pathogen contamination from people remaining in the catchment for extended periods and possibly camping (incl. overnight stays), and through contact with tributary water during vehicle crossings.	Medium			
	Contamination from vehicle dumping.	Medium			
	Spread of forest disease and associated reduction in vegetation cover.	Low			

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Illegal Hunting	<p>Pathogen contamination from feral animal carcasses</p> <p>Pathogen contamination from people and dogs remaining in the catchment for extended periods and possibly camping (incl. overnight stays).</p>	<p>High</p> <p>Medium</p>	<p>DEC approve hunting in the catchment for feral animal control. The Water Corporation will only approve feral animal control by the trap-and-shoot method.</p> <p>Uncontrolled hunting and shooting introduce significant additional risks to water quality particularly due to associated camping (incl. overnight stays) and use of dogs, and decomposing animal carcasses.</p> <p>It is essential that any hunting in the catchment is by the trap-and-shoot method only and under authorisation as part of the feral animal control program, and is undertaken in an organised manner to minimise water contamination.</p>	<p>Under By-law 4.3.4: No person shall shoot, trap or hunt any game or catch, or attempt to catch, any fish or marron within a catchment area, without specific permission in writing from the Commission [DoW] to which it may attach any conditions that it deems necessary.</p> <p>Surveillance by Water Corporation Catchment Rangers currently reduces the occurrence of illegal hunting and the associated risks, but greater surveillance would further minimise this activity.</p> <p>Hunting is not permitted on land managed by DEC [CALM].</p>	<p><i>Hunting and shooting are prohibited in the catchment area.</i></p> <p>Use signage and advertising material to ensure public awareness that hunting and shooting are not permitted.</p> <p>Continue to undertake surveillance of the catchment with By-law enforcement.</p>

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Major roads - Shire roads - Main roads	Fuel and chemical spills from vehicles and their loads. There is also potential for purposeful dumping of chemicals (oils) during vehicle maintenance.	Medium	The Brookton and Albany Highways are major haulage routes, and are necessary for transportation and operations in the area.	HAZMAT emergency procedures. The application of pesticides is conducted in accordance with the Department of Health's PSC-88. Water Corporation Rangers liaise with the relevant authorities.	<i>Best Management Practices are required for all roads in the catchment.</i> Restrict development of new roads through the catchment. Oppose the development of a linkage road between Albany Hwy and Brookton Hwy that runs through the water catchment area. Assess water quality risks (including the transport of fuel and chemicals through the catchment) and develop a road maintenance and management plan that addresses these risks for Main, Shire and DEC [CALM] roads such as Albany Highway, Brookton Highway, Kinsella Road, Randall Road and Millars Log Road. This should include weed and runoff control and an emergency response process for spills. Undertake road construction and maintenance to avoid water source contamination risks (including consideration of alignment of road upgrades). Maintain signs along roads to inform people of their presence in a public drinking water supply catchment, and display the emergency contact number in the event of a spill.
	Herbicides from weed control on road verges.	Low	The risks associated with these roads are reduced by the distance from the water body. Albany Highway passes along the south-western border of the Canning catchment, intersecting it at several points. However, Brookton Highway is located in the northern part of the catchment, passing within 2.5 km of the reservoir.		
	Increased turbidity from erosion of unsealed roads.	Medium			
	Import of pathogens by motorists or their vehicle loads.	Medium			
	Import of forest diseases by motorists or their vehicle loads.	Low			
	Increased turbidity created during construction of roads and associated heavy machinery movement.	Medium	Plans to seal a linkage road between Albany Highway and Brookton Highway would result in a third major haulage road in the catchment also running reasonably close to the reservoir. This would increase all the risks associated with major roads in the catchment.		

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Infrastructure maintenance - Power lines - Pipelines - Roads	Turbidity due to clearing of vegetation, use of unsealed roads and tracks and of heavy machinery on such tracks. Herbicides from weed control. Fuel spills from vehicles and machinery. Spread of forest disease.	Low Low Low Low	Maintenance is necessary for the operation of the infrastructure. However, the risks to water quality associated with this activity need to be managed, particularly in close proximity to watercourses.	Western Power liaises with Water Corporation staff when track maintenance or upgrades occur.	<i>Best Management Practices are required for all infrastructure maintenance activities.</i> Prevent public access to roads. Ensure maintenance workers are aware of water quality protection objectives and adopt best management practices. Inspect water quality protection measures on site. Continue to liaise with Western Power to ensure their work procedures consider water quality protection objectives.
Rubbish dumping	Pathogen contamination from domestic rubbish. Nutrient, chemical, heavy metal and fuel contamination from domestic, building or industrial waste, tyres and the dumping of stolen cars.	Medium Medium	Rubbish dumping is often associated with informal or unauthorised access to, and recreation in, the catchment. As all roads and tracks in the State Forest are public roads, control of access is a major issue in the catchment. Rubbish dumping is more prevalent closer to the Perth Metropolitan area and is of considerable concern in the Kangaroo Gully and Araluen sub-catchments and near the Brookton and Albany Highways.	The risks to water quality are reduced due to catchment surveillance by Water Corporation Rangers. Where necessary the Water Corporation arranges for removal of dumped rubbish.	<i>Rubbish dumping is not acceptable in the catchment.</i> Review the road network and close roads not essential for forest operations and management or transport thoroughfare. Use signage and advertising material to ensure public awareness that rubbish dumping is not permitted. Work with community groups and local government authorities to address waste management issues and minimise illegal rubbish dumping.

Land use / activity	Potential water quality risks		Consideration for management	Current preventative measures	Recommended protection strategies
	Hazard	Management priority			
Importing water from Araluen and Kangaroo Gully sub-catchments	<p>Importing water from other sources introduces risks to Canning reservoir water, through blending with water of varying quality.</p> <p>There is also a risk of adversely affecting water quality through improper management of the inflow and outflow system, which may result in inadequate mixing of the imported water.</p>	<p>Medium</p> <p>Medium</p>	<p>The operation of the Kangaroo Gully diversion dam to import water to the Canning Reservoir is of concern to water quality, because the inflow to Canning Reservoir is very close to the Canning outlet pipe, thus sufficient detention time may not always be maintained.</p> <p>The Araluen Pumpback water also enters the dam very close to the outlet, but vertical movement through a stratified waterbody is necessary before the water reaches the Canning Reservoir outlet. This is slow and will result in dilution and detention time, minimising the associated risk.</p> <p>The presence of private land (P2) used for general farming (livestock grazing, orchards, residences) increases the risk of contaminants entering the water sources from the Diversion Dam and the Pumpback Station.</p>	<p>The Water Corporation monitors the water quality of water sourced from the Kangaroo Gully diversion dam and the Araluen Pumpback station.</p> <p>See also "General Farming" at the start of this table.</p> <p>Private property (P2) land uses are approved under applicable planning schemes, the WA Planning Commission's SPP 2.7 and this Department's WQPN <i>Land use compatibility in Public Drinking Water Source Areas</i>.</p>	<p><i>Necessary for water supply operations.</i></p> <p>Ensure imported water will not adversely affect the quality of water in the reservoir – by sampling and monitoring the sources of imported water regularly.</p> <p>Ensure management of the inflow and outflow system allows for adequate mixing of the imported water through the reservoir.</p>

5 Recommendations

- 1 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this Plan (*Applicable stakeholders*).
- 2 Amend and reproclaim the boundary of the Canning River Catchment Area as proposed in this Plan under the *Metropolitan Water Supply, Sewerage and Drainage Act (1909)* (*Department of Water*).
- 3 Prepare an implementation strategy for this Plan describing responsible stakeholders, timeframes and funding sources for the recommended protection strategies (*Department of Water*).
- 4 All relevant planning strategies and schemes, including the Planning Schemes of the Shires of Wandering, Beverley, Kalamunda and Serpentine-Jarrahdale should incorporate this Plan and reflect the identified Canning River Catchment Area boundary and the Priority 1, 2 and 3 classifications (*Department for Planning and Infrastructure, Shires of Wandering, Beverley, Kalamunda and Serpentine-Jarrahdale*).
- 5 All subdivision and development proposals within the Canning River Catchment Area that are likely to impact on water quality and/or quantity, or are inconsistent with *Water Quality Protection Note – Land use compatibility in Public Drinking Water Source Areas* or *Statement of Planning Policy No.2.7 – Public Drinking Water Source Policy* should be referred to the Department of Water for advice and recommendations (*Department for Planning and Infrastructure, City of Armadale and Shires of Wandering, Beverley, Kalamunda and Serpentine-Jarrahdale*).
- 6 Incidents covered by WESTPLAN – HAZMAT in the Canning River Catchment Area should be addressed through the following:
 - The Armadale, Wandering, Beverley, Kalamunda and Serpentine-Jarrahdale LEMAC are familiar with the location and purpose of the Canning River Catchment Area.
 - The locality plan for the Canning River Catchment Area is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
 - The Water Corporation provides an advisory role during incidents in the Canning River Catchment Area.
 - Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Canning River Catchment Area and training to understand the potential impacts of spills on drinking water quality.(*Department of Water, Water Corporation*)
- 7 A surveillance program should be implemented to identify any incompatible land uses or potential threats within the Canning River Catchment Area. Pursuant to Section 13(1) of the Water and Rivers Commission Act 1995, the Department of Water has delegated responsibility for the surveillance and enforcement to the Water Corporation (*Water Corporation*).

- 8 Signs should be erected along the boundary of the Canning River Catchment Area to define the location and promote awareness of the need to protect drinking water quality. Signs should include an emergency contact telephone number (*Water Corporation*).
- 9 A review of this Plan should be undertaken after five years (*Department of Water*).
- 10 Discussions should be held with relevant agencies and other stakeholders to improve recreation management in drinking water catchments, ensure appropriate recreational facilities are provided outside of these catchments wherever possible, and only permit low risk recreation activities in low risk areas (*Applicable stakeholders*).
- 11 Work with Main Roads WA to ensure that any linkage road between Brookton Highway and Albany Highway is as distant from Canning Reservoir as possible, and preferably outside the catchment. Should the construction occur within the catchment, ensure it is planned, designed and constructed to mitigate water quality risks (*Department of Water, Water Corporation*).
- 12 Stream zones and other areas of the catchment in Water Corporation, Water and Rivers Commission [Department of Water] or other government ownership should be assessed for the need for rehabilitation, and rehabilitation with native species (preferably of local provenance) carried out where necessary (*Applicable agencies*).
- 13 Review the surface water quality monitoring program of the reservoir and tributaries to ensure key characteristic parameters are included. Routinely review water quality analysis results to detect any increasing trends (*Water Corporation*).
- 14 Liaise with relevant agencies and stakeholder groups to develop individual guidelines for the construction, maintenance and management of roads, tracks and trails to ensure water quality protection objectives are addressed (*Department of Water, applicable stakeholders*).

Appendices

Appendix A – Water Quality

The Water Corporation has monitored the raw (source) water quality from Canning Dam in accordance with the Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health. The raw water is regularly monitored for:

a. Aesthetic related characteristics– (Non-Health Related)

b. Health related characteristics

- Health Related Chemicals
- Microbiological Contaminants

Following is data representative of the quality of raw water in Canning Dam. In the absence of specific guidelines for raw water quality, the results have been compared with ADWG values set for drinking water. Results that exceed ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. For more information on the quality of drinking water supplied to the Perth region refer to the most recent Water Corporation Drinking Water Quality Annual Report at www.watercorporation.com.au, select > Water, > Water Quality, > [2005-2006] Annual Report.

Aesthetic Related Characteristics

Aesthetic water quality analyses for raw water from Canning Dam are summarised in Table 2.

The values are taken from ongoing monitoring for the period January 2001 to October 2006. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

Table 2 Aesthetic related detections for Canning Dam

Parameter	Units	ADWG Aesthetic Guideline Value*	Canning Dam	
			Range	Median
Aluminium acid soluble	mg/L	0.2	0.02 – 0.022	0.021
Colour – True	TCU	15	2 – 7	4
Conductivity at 25°C	mS/m	-	29 – 34	31
Iron unfiltered	mg/L	0.3	0.028 – 0.24	0.103
Manganese unfiltered	mg/L	0.1	<0.002 – 0.055	0.012
Turbidity	NTU	5	0.4 – 1.8	0.9
pH measured in laboratory	-	6.5 – 8.5	6.87 – 7.4	7.19

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

Health Related Characteristics

Health Parameters

Raw water from Canning Dam is analysed for health related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the source between January 2001 and October 2006 are summarised in Table 3. Any parameters that have on occasion exceeded the ADWG are shaded.

Table 3 Health related detections for Canning Dam

Parameter	Units	ADWG Health Guideline Value*	Canning Dam	
			Range	Median
Metals				
Barium	mg/L	0.7	0.0095 – 0.011	0.0105
Boron	mg/L	4	0.02 – 0.04	0.024
Manganese	mg/L	0.5	<0.002 – 0.055	0.012

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

Microbiological Contaminants

Microbiological testing of raw water samples from Canning Dam is currently conducted on a weekly basis. *Escherichia coli* counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count less than 20 most probable number (MPN) per 100 mL is typically associated with low levels of faecal contamination and is used as a microbiological contamination benchmark (World Health Organisation, 1996).

During the reviewed period of January 2001 to October 2006, positive *Escherichia coli* counts were recorded in 42% of samples. None of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

Appendix B - Photographs



Photo 1: Canning Dam



Photo 2: Kangaroo Gully diversion flume



Photo 3: Araluen pumpback dam and station



Photo 4: Erosion of exposed bank at Canning Reservoir (October 2006)



Photo 5: Erosion of exposed bank at Canning Reservoir (October 2006)



Photo 6: Rehabilitation work at Lesley Picnic Site



Photo 7: Unauthorised trail through feeder stream

Glossary

Abstraction	The pumping of water from a water source.
ADWG	The Australian Drinking Water Guidelines, outlining guideline criteria for the quality of drinking water in Australia.
Aesthetic guideline	NHMRC guideline level ascribed to acceptable aesthetic qualities of drinking water such as taste, smell, colour and temperature.
AHD	Australian Height Datum is the height of land in metres above mean sea level. For example this is +0.026 m at Fremantle.
Allocation	The quantity of water permitted to be abstracted by a licence, usually specified in kilolitres per year (kL/a).
ANZECC	Australian and New Zealand Environment Conservation Council.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
DEC	Department of Environment and Conservation [formerly Departments of Environment and Conservation and Land Management]
DoW	Department of Water
GL	Gigalitre(s) (1 GL = 1,000,000 litres)
ha	Hectare(s) (1 ha = 10,000 square metres)
IWSS	The Integrated Water Supply System that services Perth, Mandurah, Pinjarra, Harvey and the Goldfields and Agricultural regions.
km	Kilometres (1,000 metres)
km²	Square kilometres (a measure of area)
m	Metres
mg/L	Milligrams per litre (0.001 grams per litre)

mm	Millimetres
NHMRC	National Health and Medical Research Council.
NTU	Nephelometric turbidity units are a measure of turbidity in water.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
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 or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Public Drinking Water Source Area (PDWSA)	Includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply Sewerage and Drainage Act 1909</i> and the <i>Country Areas Water Supply Act 1947</i> .
Recharge	Water infiltrating to replenish an aquifer.
Reservoir	A reservoir, dam, tank, pond or lake that forms part of any public water supply works
RPZ	Reservoir Protection Zone, a 2 km wide buffer area around the top water level of storage reservoirs and including the reservoir waterbody.
Run-off	Water that flows over the surface from a catchment area, including streams.
TDS	Total dissolved salts, a measurement of ions in solution, such as salts in water.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Wastewater	Water that has been used for some purpose and would normally

be treated and discarded. Wastewater usually contains significant quantities of pollutant.

Water quality The physical, chemical and biological measures of water.

Water Reserve An area proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply Sewerage and Drainage Act 1909* for the purposes of protecting a drinking water supply.

WRC Water and Rivers Commission

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