



Government of Western Australia  
Department of Water

# Manjimup Dam and Phillips Creek Dam Catchment Areas

Drinking water source protection plan

*Manjimup town water supply*



*Looking after all our water needs*

Water resource protection series  
Report WRP 126  
June 2011



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Cover photograph: Aerial photograph of Manjimup Dam and Phillips Creek Dam Catchment Areas

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# Contents

Contents .....	iii
Preface .....	v
Summary .....	vii
1 Overview of Manjimup’s drinking water source .....	1
1.1 The drinking water supply system .....	1
1.2 Water management and planning .....	2
1.2.1 Licence to take water .....	2
1.2.2 Future water needs .....	2
1.2.3 Water planning .....	3
1.3 Characteristics of the catchment .....	4
1.3.1 Physical environment .....	4
1.3.2 Climate .....	4
1.3.3 Hydrology .....	5
1.4 How is this drinking water protected? .....	5
2 Common contamination risks .....	6
2.1 Microbiological .....	6
2.2 Physical risks .....	7
2.3 Chemical risks .....	7
3 Contamination risks in this drinking water source .....	9
3.1 Water quality .....	9
3.2 Land uses and activities .....	9
3.2.1 Manjimup Dam Catchment Area land tenure .....	9
3.2.2 Phillips Creek Dam Catchment Area land tenure .....	9
3.2.3 State forest, timber reserve, and crown land .....	10
3.2.4 Recreation .....	13
3.2.5 Private land .....	15
3.2.6 Aboriginal sites of significance and Native title claims .....	16
3.3 Possible future contamination risks .....	16
4 Protecting your drinking water source .....	21
4.1 Proclaiming the public drinking water source area .....	21
4.2 Defining priority areas .....	21
4.3 Defining protection zones .....	23
4.4 Planning for future land uses .....	23
4.5 Using best management practices .....	24
4.6 Enforcing by-laws and surveying the area .....	24
4.7 Responding to emergencies .....	25
4.8 Putting this plan into action .....	25
5 Recommendations .....	26
Appendices .....	29
List of shortened forms .....	49
Glossary .....	51
References .....	54

## Appendices

Appendix A — Figures.....	29
Appendix B — Water quality data.....	34
Appendix C — Land use, potential water quality risks and recommended protection strategies.....	37
Appendix D — Photographs .....	46

## Tables

Table 1            Land use and potential water quality risks in the Manjimup Dam and Phillips Creek Dam Catchment Areas .....	18
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# Preface

## ***How do we protect public drinking water source areas?***

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

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

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

The first and most important barrier is protecting the catchment. If we get this barrier right, it has a flow-on effect that can result in a lower cost, safer drinking water supply. Other barriers against contamination include storage of water to help reduce contaminant levels, treating the water (e.g. chlorination to remove pathogens), maintenance of pipes and testing of water quality. It is also recognised that catchment protection supports environmental conservation initiatives.

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

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

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

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

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

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

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

Stages in development of a plan		Comment
1	Water Corporation prepared a drinking water source protection assessment document.  (June 2004)	Prepared after initial catchment survey and preliminary information gathering.
2	Conduct stakeholder consultation.  (December 2010)	Advice sought from key stakeholders using the assessment document as a tool for information and discussion. Draft protection plan is prepared.
3	Consult draft drinking water source protection plan.  (18 May – 15 June 2011)	Draft protection plan released for a public consultation period.
4	Publish approved drinking water source protection plan.  (June 2011)	Final protection plan published after considering submissions. Includes recommendations on how to protect water quality. Proclamation of the changes to these public drinking water source areas can now be progressed.



# Summary

Manjimup is located 307 km south of Perth in the south-west corner of Western Australia (Figure 1). The Manjimup town water supply (TWS), operated by the Water Corporation, is sourced from Manjimup Dam and Phillips Creek Dam.

Manjimup Dam is located in Scabby Gully approximately 9.5 km south-west of Manjimup. It is currently proclaimed as *Manjimup Dam Catchment Area*. Manjimup Dam is sometimes known as Scabby Gully Dam but in this plan it will be referred to as Manjimup Dam.

Phillips Creek Dam is located on Jarnadup Creek approximately 6 km west of Manjimup. Phillips Creek Dam is currently proclaimed as *Manjimup Water Reserve and Catchment Area*, however in this plan it will be referred to as Phillips Creek Dam Catchment Area.

The catchment areas are both within the Warren River basin and located in the Shire of Manjimup. They are surface water catchments with predominantly native vegetation. The catchments are predominately crown land and vested reserves, and have therefore are proposed to be priority 1 (P1) areas. There are also three small areas of private land within the catchments, these are proposed to be priority 2 (P2) areas. Reservoir protection zones (RPZs) have been defined around each reservoir and exclude the privately owned land. Please see Figure 5 for the proposed priority areas and RPZs.

Manjimup has a population of 10,162 people (ABS, 2010) and is the major commercial centre of the lower south-west, serving both the Warren and Blackwood regions. The economy of the town is based on agriculture, horticulture, forestry, timber processing and tourism.

The Department of Water has prepared this drinking water source protection plan to help protect the quality of water in Manjimup Dam and Phillips Creek Dam to ensure it is safe for drinking. This plan:

- shows the location, size and significance of the drinking water sources
- identifies the risks to water quality from surrounding land uses and activities
- outlines the catchment boundaries that need protecting
- determines priority areas and RPZs (special areas that need protecting)
- notes the current use of an emergency source from Four Mile Brook Dam
- recommends strategies to address the risks to water quality
- guides future land-use planning decisions in the Manjimup Dam and Phillips Creek Dam Catchment Areas.

This plan is consistent with the *Australian drinking water guidelines* (ADWG) (NHMRC & NRMCC 2004a) and State planning policy no. 2.7: *Public drinking water source policy* (WAPC, 2003).

We prepared this document in consultation with key stakeholders and it was released for a month with an invitation to make submissions. Stakeholders we worked with included government agencies, the Water Corporation and the community. Private

landowners in the catchment were consulted about what it means to their properties. This plan replaces the *Manjimup Dam and Phillips Creek Dam Catchment Areas water source protection assessment* produced in 2004 by the Water Corporation.

The most important recommendations in this plan are to:

- proclaim the changes recommended to the catchment area boundaries to more accurately reflect the catchment areas, significantly reducing the amount of private land affected by the catchment areas
- implement management of private land as P2 areas and crown land and reserves as P1 areas
- implement RPZs and their management in both catchments
- include the amended boundary, priority areas and protection zones in the Shire of Manjimup's local and town planning schemes
- require referral of any subdivision and development applications in the Manjimup Dam and Phillips Creek Dam Catchment Areas that are inconsistent with our Water quality protection note no. 25: *Land use compatibility in public drinking water source areas* or State planning policy no. 2.7: *Public drinking water source policy*
- formally delegate the surveillance and by-law enforcement for the Manjimup Dam Catchment Area to the Water Corporation (Phillips Creek Dam Catchment Area is already delegated to the Water Corporation).

The following table is a summary of information about the Manjimup Dam and Phillips Creek Dam Catchment Areas.

*Table 1 Key information about Manjimup and Phillips Creek dams*

	Manjimup Dam	Phillips Creek Dam
Local government authority	Shire of Manjimup	
Locations supplies	Manjimup	
Volume of water held/pumped	Storage capacity of 1 607 ML.	Storage capacity of 269 ML.
Date of dam completion	Constructed in 1967, dam wall was raised to its current height of 17 m in 1995.	Constructed in 1936, dam wall was raised to its current height of 11 m in 1956.
Date of drinking water source protection assessment	June 2004.	
Proclamation status	The current catchment area was proclaimed in 1968, under the <i>Country Areas Water Supply Act 1947</i> .	The current catchment area was proclaimed in 1959, under the <i>Country Areas Water Supply Act 1947</i> .
Current Water Corporation Licence	The Water Corporation is currently licensed to take 894 000 kL from Manjimup and Phillips Creek dams.	

# 1 Overview of Manjimup's drinking water source

## 1.1 The drinking water supply system

Manjimup Dam, the main supply dam for Manjimup, was initially constructed in 1967. In 1995 the dam wall was raised to 17 m. It is an earth-fill dam wall. The reservoir covers an area of 26.4 hectares (ha) and has a storage capacity of 1 607 ML.

Phillips Creek Dam was initially constructed in 1936 then raised in 1956 to 11 m. It is also an earth-fill dam wall. The reservoir covers an area of 7.4 ha has a storage capacity of 269 ML.

The raw water from Manjimup Dam and Phillips Creek Dam is disinfected with chlorine then fluoridated at treatment plants located at the dam sites. Water from Manjimup Dam is corrected for pH using caustic soda. Water from Phillips Creek Dam is treated with UV technology (disinfection using ultra violet light).

Once the raw water is treated at the dam sites, it is then pumped to a 9000 kL ground level tank located at Mottram Street in the Manjimup town site. From there, water is pumped into a 1 000 kL elevated tank which maintains pressure in the town's distribution network.

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

For more information on why it is so important to protect our catchments, please read the preface at the front of this plan.

Due to lower than average runoff in recent winters, the current sources could not reliably supply the annual Manjimup town water demand without supplementation from a separate source. A pumpback from a soak on Four Mile Brook has been used as an emergency source to supplement water levels in Manjimup Dam. The soak is located approximately 2.5 km south-west of Manjimup Dam.

During particularly dry years, the Water Corporation may also source water from private farm dams in the area with suitable water quality.

Manjimup Dam did not provide water to the town water supply (TWS) while receiving water from Four Mile Brook. At these times water was sourced solely from Phillips Creek Dam. The TWS resumed sourcing water from Manjimup Dam after sanitation through a minimum detention time in the reservoir of 30 days followed by disinfection.

Four Mile Brook soak and any private farm dams are emergency sources only and not a permanent part of the Manjimup scheme. The catchment area for Four Mile Brook soak is on crown land and in state forest in the upper portion of the Big Brook Dam catchment area, a sub-catchment of the proclaimed Lefroy Brook Weir public drinking water source area (PDWSA). It has similar water quality risks to those identified for the crown land in the Manjimup Dam catchment. As the catchment for the Four Mile Brook soak is within the Lefroy Brook PDWSA, it will not be covered by this drinking water source protection plan.

## 1.2 Water management and planning

### 1.2.1 Licence to take water

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914*. Under this Act, the right to use and control water is vested with the Crown. This means that a licence is required for altering the beds and banks of waterways and abstracting water (pumping water from a river or creek) within proclaimed surface water areas throughout the state. Some exemptions may apply such as abstracting water for domestic purposes only.

The Manjimup Dam and Phillips Creek Dam Catchment Areas are located within the Warren River Surface Water Area and the upper Lefroy Brook subarea which are proclaimed under the *Rights in Water and Irrigation Act 1914*.

The Water Corporation is currently licensed by the Department of Water under the *Rights in Water and Irrigation Act 1914* to take 450 000 kL from Four Mile Brook and 894 000 kL from a combination of Manjimup Dam and Phillips Creek Dam annually.

From 1 October 2008 until 30 September 2009, 605 444 kL was taken from Manjimup Dam, 119 280 kL from Phillips Creek Dam and 142 250 kL of pumpback was taken from Four Mile Brook to supplement the Manjimup Dam water supply. The pumpback supplied from Four Mile Brook occurred in the period between 1 July and the 17 September 2009.

Overall production was approximately 81 per cent of the licensed allocation during the 2008-2009 financial year. In June 2009 there were 2 289 services supplied by the Manjimup Dam and Phillips Creek Dam.

The current operating strategy for the Manjimup town water supply does not require any downstream release from the Manjimup and Phillips Creek dams. It is noted that leakage from the dams provides a small continuous flow downstream. Also there is generally some overflow from the pumping pool on Four Mile Brook.

### 1.2.2 Future water needs

The existing drinking water sources cannot currently supply Manjimup's annual water demand without interim supplementation from a separate source. A number of options have been considered by the Water Corporation to increase supply.

Catchment thinning has been conducted previously in Manjimup Dam and Phillips Creek Dam Catchment Areas to increase water yield, as prescribed in *Forest Management - recommendations to the Water Corporation for increasing streamflow from the Manjimup water supply catchments* (Bradshaw 2003). Thinning operations were conducted by the Forest Products Commission in accordance with the *Contractors' timber harvesting manual* (FPC 2003) and the *Code of practice for timber harvesting* (CALM 1999), which include provision for protection of water resources. Thinning of the forested catchments was expected to increase streamflow to Manjimup and Phillips Creek dams, however this has not been thoroughly investigated. The program for further catchment thinning has been put on hold until the results of Wungong catchment trials are released.

Consideration was also given to increasing the storage capacity of Phillips Creek Dam by raising the dam wall by 2 m. This would increase the storage capacity in the reservoir from 269 ML to 440 ML. However, the value of this option is diminished with the current low rainfall, as the dam captures the available runoff.

Current supplementary water supply arrangements are only intended as a contingency, short term plan until a permanent new source can be provided for Manjimup. Ideally, the Water Corporation seeks to utilise the highest quality source water it can practically access. Groundwater and surface water sources are being considered. Drilling and environmental investigations will need to be undertaken as part of a source planning study, to determine the long term water supply arrangement for Manjimup.

The investigations are currently planned to commence in 2015, with the performance of the existing dams and contingency supply having some bearing on this priority. After the investigations are complete, analysis of the data and source options leading to a confirmed source plan, may take up to two years. Then any proposed infrastructure would need to be planned and developed, so it may be around 2020 before a new source could supply Manjimup. This timeline is dependent on supply meeting demand for Manjimup, and so if a further deterioration of rainfall and runoff into the dams occurs in Manjimup, the investigation and planning work may commence earlier.

### 1.2.3 Water planning

#### Salinity situation statement - Warren River

*Salinity Situation Statement: Warren River* (Department of Water 2006) presents a revised set of salinity management options based on recent land use in the Warren River Catchment. This report analyses where and why the catchment became saline, describes its salinity in the intervening years and suggests the scales of intervention needed to reduce the river salinity.

#### Warren-Donnelly surface water allocation plan

The *Warren-Donnelly surface water allocation plan: for public comment* (Department of Water 2010c) provides our direction for the allocation of surface water in the

Warren-Donnelly area. The plan provides new allocation limits, resulting from modelling the ecologically sustainable yield of Warren-Donnelly surface water resources and accounting for risks to the environment and future water supply from the Warren catchment. The plan also provides our policies on licensing and allocating water, objectives for the water resource, how we will manage water allocation and implement the final plan.

This plan was released for public comment in June 2010. See our website for current information on the plan < [www.water.wa.gov.au](http://www.water.wa.gov.au) > Select *Managing our water* > *Allocation planning* > *Warren-Donnelly plan area*. We expect the plan to be finalised by the end of 2011.

### South west regional water plan

The *South west regional water plan 2010 – 2030* (Department of Water 2010a) outlines our strategic actions to support water resource management themes for all the major issues facing the region. The plan's supporting detail document (Department of Water, 2010b) contains all the relevant information underlying the plan and provides a deeper understanding of the issues and proposed solutions. The plan includes the Manjimup Dam and Phillips Creek Dam Catchment Areas.

The plan states that, "*when compared with design capacity, the region's reduced rainfall pattern is already resulting in the under-performance of most surface water supply dams. Public water supply dams have become less reliable due to reduced streamflow. For instance, a series of low rainfall years (2001, 2002 and 2004) in the Manjimup area resulted in insufficient runoff to fill the Manjimup and Phillips Creek public water supply dams. Stage 4 water restrictions in Manjimup were the result.*"

## 1.3 Characteristics of the catchment

### 1.3.1 Physical environment

The landforms of the Manjimup area are characteristic of the Darling Range Plateau with a combination of undulating and hilly dissected plateaus. Soils are typically bauxitic laterite soils over Archean granitic and metamorphic rocks. Sands and ironstone gravels over mottled clays (gravely duplex soils) are found in the uplands and yellow mottled soils and some gravel in the hilly dissected country. In the deeper valleys, the soils are heavier alluvials (red-brown earths, karri loams) which are of significant horticultural value (WAPC 1997b).

### 1.3.2 Climate

The area has a temperate climate, characterised by warm, dry summers with cool, wet winters. The long-term average annual rainfall for Manjimup is 1007.1 millimetres (mm), calculated from 1915 to 2010. The annual rainfall for Manjimup is declining, with an average of 924 mm from 1981 to 2010 (Bureau of Meteorology 2010). Roughly 80 per cent of the annual rainfall occurs between May and October.

### 1.3.3 Hydrology

Manjimup Dam catchment has an area of 7.72 kilometres squared (km<sup>2</sup>) with an elevation of 221 m AHD at the reservoir, rising to 312 m AHD at the head of the catchment. At full supply the reservoir has a storage capacity of 1 607 ML and a surface water area of 26.4 ha. The average annual streamflow entering Manjimup Dam since 1975 is 771 ML.

Phillips Creek Dam catchment has an area of 1.84 km<sup>2</sup> with an elevation of 270 m AHD at the reservoir, rising to 322 m AHD at the head of the catchment. At full supply the reservoir has a storage capacity of 269 ML and a surface area of 7.4 ha. The average annual streamflow entering Phillips Creek Dam since 1975 is 231 ML (Water Corporation, 2004).

## 1.4 How is this drinking water protected?

The Manjimup Dam and Phillips Creek Dam Catchment Areas were proclaimed in 1959 and 1968 respectively under the *Country Areas Water Supply Act 1947*. Proclamation identifies the location of the catchment area and ensures that its drinking water value is considered in land use planning decisions. It also allows by-laws to be applied for the protection of water quality.

The Water Corporation regularly patrols and surveys the catchment areas to identify risks to water quality and enforce the by-laws where required. To find out more about by-laws, please see section 4.6: *Enforcing by-laws and surveying the area*. We have already delegated powers of by-law enforcement to the Water Corporation for the Phillips Creek Dam Catchment Area and will also do this for the Manjimup Dam Catchment Area, as this plan recommends.

In 2004 the Water Corporation prepared the *Manjimup Dam and Phillips Creek Dam Catchment Areas drinking water source protection assessment*. It has information about these catchments, identifies risks to water quality and recommends strategies to manage the risks. This drinking water source protection plan replaces that assessment, as it provides more up-to-date information, and recommends strategies to address the water quality risks.

The *Shire of Manjimup local planning scheme no. 4* (Department of Planning 2010) recognises the existing proclaimed Manjimup Dam and Phillips Creek Dam Catchment Areas as special control areas, to help guide land use planning and decision making. This is in accordance with the Western Australian Planning Commission's Statement of Planning Policy no. 2.7: *Public drinking water source policy*. The types of development supported in the catchment areas are described in our Water quality protection note (WQPN) no. 25: *Land use compatibility in public drinking water source areas*.

## 2 Common contamination risks

Land development and land- and water-based activities within a catchment can directly affect the quality of the drinking water and its treatment. Contaminants can reach drinking-water sources through run-off over the ground and infiltration through soil. A wide range of microbiological, chemical and physical contamination risks can impact on water quality and therefore affect the provision of a reliable, safe, good quality drinking water to consumers.

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

The Australian drinking water guidelines (ADWG) outline water quality criteria for drinking water to protect human health, manage aesthetics and maintain water supply infrastructure.

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

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

### 2.1 Microbiological

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

Pathogens can enter drinking water supplies from faecal contamination in the catchment. When people (while fishing, marroning, swimming or the like) or domestic animals come into contact with a body of water, pathogens may enter that water source. This occurs through the direct transfer of faecal material (even a very small amount can cause contamination) into the water. Contamination can also occur indirectly through surface runoff moving faecal material into the water, or infiltrating through the soil, such as from septic tanks or animal manure in paddocks.

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

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (e.g. humans and domestic animals), the



transfer to and movement of the pathogen in the water source and its ability to survive in the water. The percentage of humans in the world that carry pathogens varies. For example, it is estimated that between 0.6 to 4.3 per cent of people are infected with *Cryptosporidium* worldwide, and 7.4 per cent with *Giardia* (Geldreich 1996).

The ability of pathogens to survive in surface water also differs between species. Salmonella may be viable for two to three months, *Giardia* may still infect after one month in the natural environment (Geldreich 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) may survive weeks to months in fresh water (NHMRC & NRMCC 2004a).

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

## 2.2 Physical risks

Erosion is the mobilisation of soil particles that are released into the air and water. Activities like off-road driving and uprooting vegetation can cause erosion. Erosion increases the turbidity ('cloudiness') of a water body. This increased turbidity can result in cloudy or muddy-looking water, which is not aesthetically appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). Pathogens can adsorb onto soil particles and may be shielded from the effects of disinfection. Chemicals can also attach to suspended soil particles. Increased turbidity also impacts on other environmental constituents. It smothers riparian vegetation and reduces the transfer of light within the water column which affects plant growth.

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

## 2.3 Chemical risks

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

Pesticides include agricultural chemicals such as insecticides, herbicides, nematicides (used to control worms), rodenticides and miticides (used to control mites). Contamination of a drinking water source by pesticides (and other chemicals)

may occur as a result of accidental spills, incorrect use or leakage from storage areas. In these cases, the relevant authorities should be notified promptly and the spill cleaned up to prevent contamination of the drinking water source.

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

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

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

## 3 Contamination risks in this drinking water source

### 3.1 Water quality

The Water Corporation regularly monitors the quality of raw water from the Manjimup Dam and Phillips Creek Dam for microbiological, health-related and aesthetic (non-health-related) characteristics. This data shows the quality of water in the catchment. An assessment of the drinking water quality once treated is also made against the ADWG. This assessment is made by an intergovernmental committee called the Advisory Committee for the Purity of Water that is chaired by the Department of Health.

A water quality summary for the Manjimup Dam and Phillips Creek Dam from October 2005 to September 2010 is presented in Appendix B. For more information on water quality, see the Water Corporation's most recent drinking water quality annual report at <[www.watercorporation.com.au](http://www.watercorporation.com.au)> What we do > Water quality > Water quality publications > click on the most recent *Water quality annual report*.

### 3.2 Land uses and activities

The Manjimup Dam and Phillips Creek Dam Catchment Areas are predominantly government-owned and -managed land with only three small areas of privately owned land. Current land uses and activities and their risks to the drinking water sources are described below. Table 1, at the end of this section, summarises the key contamination risks. Appendix C displays a more detailed risk assessment and includes recommended protection strategies to address the water quality risks. Please see Figure 3 for a map of existing land uses within the catchments.

#### 3.2.1 Manjimup Dam Catchment Area land tenure

99.78 per cent (770 ha) of the Manjimup Dam Catchment Area is state forest combined with a small section of unallocated crown land (including the reservoir). The remaining 0.22 per cent (1.72 ha) is privately owned land.

The state forest is vested in the Conservation Commission of Western Australia and managed by the Department of Environment and Conservation (DEC) on their behalf. Managed uses can include conservation, timber production, water catchment protection and other regulated purposes.

#### 3.2.2 Phillips Creek Dam Catchment Area land tenure

Phillips Creek Dam Catchment Area contains two reserves representing the majority of the catchment. The larger one, Reserve 33217, is vested with the Minister for Water and managed by the Water Corporation with the objective of production of water and the protection of water quality. The smaller one, Reserve 15974, is not vested but comes under the authority of the Department of Land Information. The

catchment area also contains a small section of state forest near the dam wall and a small area of timber reserve at the back of the catchment. There are three areas of privately owned land within the catchment. This private land is 7 per cent (12.9 ha) of the whole catchment area.

A timber processing plant is located near the western border of the Phillips Creek Dam Catchment Area (east of Appadene Road) and the potential for runoff into the catchment has been considered. See Figure 4 for the location of the timber processing plant. More detailed investigations into localised water flow patterns are required to confirm if runoff from the timber mill could flow into the catchment area, however initial investigations show that this is not the case.

### 3.2.3 State forest, timber reserve, and crown land

The Manjimup Dam and Phillips Creek Dam Catchment Areas are partly located in state forest which is vested in the Conservation Commission of Western Australia and managed by the DEC under the *Conservation and Land Management Act 1984*. DEC is obligated under the Act to prepare its management plans in consultation with the Department of Water and Water Corporation and submit them to the Minister for Water.

DEC manages indigenous state forest and timber reserves according to the *Forest management plan 2004–2013* (FMP). The purpose of state forest and timber reserves as outlined in the FMP includes conservation, recreation, timber production on a sustainable yield basis, water catchment protection and other purposes prescribed by the Conservation and Land Management Regulations 2002 (e.g. beekeeping).

The Conservation Commission of WA has developed the *Forest management plan 2004–2013*. This covers the majority of all the areas of indigenous state forest and timber reserves within the Swan, south west and Warren Regions. The plan covers; principles of ecologically sustainable forest management, scales of management, purposes for reservation of indigenous state forest and timber reserves, operation of the plan and the scope of various key performance indicators.

#### *Unsealed roads and tracks*

##### Manjimup Dam Catchment Area

All roads and tracks in the catchment are open to the public. Traffic volumes are low, with roads used primarily by local and forestry vehicles. Rock Bar Road crosses immediately behind the reservoir and is a source of turbidity in its current condition. Roads in the state forest are managed by DEC. Littering and pollution of the water supply are prohibited and pesticide use is regulated. Road verge weed control is not generally conducted in the catchment. Roads are a risk to the water source posed through turbidity, presence of people (pathogens) and potential accidents resulting in fuel or chemical spills.

## Phillips Creek Dam Catchment Area

Deanmill Log Road, a main access road to Deanmill town and mill, runs within part of the catchment. There are several other roads in the catchment such as Appadene Road. Traffic volumes are low. The Water Corporation is responsible for maintaining the roads in Reserve 33217 under delegation from Department of Water. A track crosses Jarnadup Brook at the back of the reservoir, providing direct access for contamination. Road verge weed control is not generally conducted in the catchment. Roads are a risk to the water source posed through turbidity, presence of people (pathogens) and potential accidents resulting in fuel or chemical spills.

### *Timber management*

## Manjimup Dam Catchment Area

The Forest Products Commission (FPC) operates in accordance with the *Contractors' Timber Harvesting Manual* (FPC, 2003) and the *Code of Practice for Timber Harvesting* (CALM, 1999) under an environmental management system (EMS), which includes guidelines for protection of water – best practice environmental management. FPC operations and activities in the catchment are regulated by DEC and monitored by the Water Corporation with respect to water quality. Timber harvesting can cause erosion which poses a turbidity risk for the water source.

## Phillips Creek Dam Catchment Area

Timber production is not an objective in this catchment area, however, timber management may facilitate water production. FPC, on behalf of the Water Corporation, has conducted thinning and harvesting operations in the catchment in accordance with the *Contractors' Timber Harvesting Manual* (FPC 2003) and using best practice environmental management. Timber harvesting can cause erosion which poses a turbidity risk for the water source.

### *Resource harvesting (apiarists, wildflower picking, seed collection)*

## Manjimup Dam Catchment Area

Very low levels of these activities are reported in the catchment. There are no active licensed apiary sites in the catchment. There is the potential for people to access tributaries or the water body. These activities are managed by DEC through the issuing of licences. Access to the reservoir protection zone (RPZ) of this dam is not supported so that water quality is protected. The presence of people in the catchment poses a pathogen and turbidity risk to the water source.

## Phillips Creek Dam Catchment Area

These activities are not authorised in the catchment.

### *Fire management (fire breaks and controlled burns)*

The main risk to water quality is an increase in turbidity from fuel reduction burning and the construction and maintenance of fire breaks. This is particularly true in areas

close to the reservoir. Undertaking good management practices during prescribed burning (such as maintaining vegetation buffers along watercourses) can reduce turbidity levels.

#### Manjimup Dam Catchment Area

Fire management in the state forest is the responsibility of DEC. Water quality issues are considered in fire management plans. Water Corporation staff attend all major fires with post event inspections conducted.

#### Phillips Creek Dam Catchment Area

The Water Corporation is required to meet obligations defined under the *Bush Fires Act 1954* with regard to fire management and fire breaks and to conduct fuel reduction burns in the land under its delegation. The Water Corporation supports fire-fighting units of other agencies, and advises on water quality issues to be considered in fire management operations.

#### *Wildfire*

Human access increases the likelihood of wildfire. Wildfire potentially removes streamline and reservoir vegetation buffers which leads to an increased risk of turbidity, pathogens impacts and decreases water quality.

Streamline and reservoir buffers are considered before application of chemical fire suppressors to avoid contamination of waterways. Turbidity can be caused by the use of unsealed roads in the construction of, and access to, water points for wildfires. Wildfires are a significant risk to water quality.

#### Manjimup Dam Catchment Area

Fire management in the state forest is the responsibility of DEC. Water quality issues are considered in fire management plans. A number of water points (excluding the reservoir) exist in the catchment for potential use during fires. Water Corporation staff attend all major fires and post event inspections are conducted.

#### Phillips Creek Dam Catchment Area

The Water Corporation supports fire-fighting units of other agencies and advises on water quality issues to be considered in fire management operations. There are no fire-fighting water points in this catchment.

#### *Firewood collection*

Signage is required to inform firewood collectors that public access to RPZs is not supported, to protect drinking water quality. Hydrocarbon contamination from spills from vehicles or machinery may be associated with public firewood collection. Firewood collection also poses a turbidity risk to the water source from vehicle access and vegetation removal.

#### Manjimup Dam Catchment Area

Unauthorised firewood collection occurs with the potential for people to be close to the reservoir or tributaries. There are tracks bordering the north and west of the

catchment area providing access, with the closest point being within 100 m of the reservoir.

#### Phillips Creek Dam Catchment Area

It is an offence to remove firewood from vested Reserves. Some unauthorised firewood removal does occur as the catchment is close to Deanmill.

#### *Feral animals and their control*

There is the potential for pathogen contamination of tributaries and the reservoir from animal carcasses, uneaten baits, faeces and wallowing. Native animals pose a lower risk than domestic and pest animals such as pigs and dogs that carry human pathogens. Feral pigs are not currently considered a significant risk in the catchment areas.

#### Manjimup Dam Catchment Area

DEC is responsible for feral animal control programs in the catchment. Currently feral animal control is not conducted because it is not deemed necessary in this catchment.

#### Phillips Creek Dam Catchment Area

Feral animal control in this catchment is not currently deemed necessary, but if required in the future, it would be conducted by the Water Corporation.

#### *Illegal rubbish dumping*

#### Manjimup Dam Catchment Area

Moderate levels of rubbish dumping are reported in the state forest. Road access in the catchment increases the likelihood of dumping. Identified dumped rubbish is removed by DEC and the Water Corporation. In the eastern section of the unallocated crown land, moderate levels of rubbish dumping are reported. Rubbish dumping poses a contamination risk to the water source due to the leaching of nutrients, pathogens (from manure, carcasses and other waste) and chemicals.

#### Phillips Creek Dam Catchment Area

Some illegal rubbish dumping occurs at the head of the catchment. Deanmill has a domestic rubbish collection service, which should be utilised instead. The Water Corporation conducts rubbish removal when identified. Rubbish dumping poses a contamination risk to the water source due to the leaching of nutrients, pathogens (from manure, carcasses and other waste) and chemicals.

### 3.2.4 Recreation

Statewide Policy no. 13: *Policy and guidelines for recreation within public drinking water source areas on crown land* allows for some limited land based recreational activities in the outer catchments of PDWSAs. Recreational activities such as bush walking, bird watching, bike riding and orienteering are supported in the outer catchments of PDWSAs, under this policy.

The recent Standing Committee on Public Administration, Report 11, September 2010: *Recreation Activities within Public Drinking Water Source Areas* states that it does not support the use of public drinking water source areas for both recreation and drinking water supply and supported the existing Statewide Policy 13.

### *Fishing/marroning*

Human contact with water involves an immediate threat to water quality with the potential for pathogen contamination. Direct contact with the water reduces the effectiveness of detention time as a barrier.

Fishing and marroning activity is known to occur in the reservoirs throughout the year. The reservoirs are both accessible from around the front fence, and from the rear. Vehicle access to the reservoir banks increases the risk of turbidity. Increased surveillance and enforcement is required to address this matter. Fishing and marroning are prohibited activities in the reservoirs.

### *Horse riding*

Direct contact of animals with waterways and water bodies, poses a high risk of pathogen and nutrient contamination. Horse riding on established public roads and designated trails (outside the defined RPZ) poses a reduced risk and is an acceptable activity in state forest and the outer catchment of PDWSAs. Minimal activity levels are reported with no organised groups regularly operating in the catchments.

### *Munda Bididi*

#### Manjimup Dam Catchment Area

The new alignment of the Munda Bididi cycle trail (opening as this plan is published) passes through the north-eastern section of the Manjimup Catchment Area, following Denata Road (see Figure 3). There are no associated camp sites within the catchment. As the trail follows an existing public road, and is some distance from the reservoir, the trail does not pose a significant risk to drinking water quality.

### *Off-road vehicle use*

Off-road driving poses a water quality risk through increases in turbidity, presence of people (pathogens) and potential accidents resulting in fuel or chemical spills. Vehicle access to the reservoir banks increases the potential for turbidity and hydrocarbon contamination. Public access to the RPZ is also proposed to be prohibited whether by car, bike, or on foot, to protect water quality.

#### Manjimup Dam Catchment Area

Low levels of off-road vehicle use are reported in the catchment, with numerous established roads available for use. Vehicles can access the reservoir bank from Rock Bar Road at the rear of the reservoir. Off-road vehicle access is prohibited in the catchment area.



## Phillips Creek Dam Catchment Area

Off-road vehicle use in the catchment is limited with refuelling in the catchment unlikely due to its proximity to Deanmill. Most vehicle activity is confined to established tracks, however direct access to the reservoir banks is possible with activity usually associated with fishing or marroning.

### *Picnicking and camping*

There are no designated picnic or camping sites in the catchments. Most activity is associated with fishing or marroning. There is the potential for camping with direct vehicle access to both Manjimup Dam and Phillips Creek Dam reservoir banks.

Unauthorised picnicking and camping are prohibited activities on DEC controlled land and within PDWSAs. Picnicking and camping increases the risk of pathogen contamination to the reservoirs, via human contact or transfer of pathogens from surface water runoff to the water bodies.

### *Swimming*

There have been reports of people swimming in the reservoirs, particularly during the summer season. Swimming is a prohibited activity in PDWSAs and penalties apply.

Body-contact with the water can result in pathogen contamination. Human or animal contact with water involves an immediate threat to water quality with the potential for pathogen contamination. Chlorination alone does not provide sufficient protection against all human pathogens. Direct contact with the water significantly reduces the effectiveness of detention time in the reservoir as a barrier. In addition, human activity in and around the reservoir increases turbidity and fire risk.

## 3.2.5 Private land

### *Residences*

#### Phillips Creek Dam Catchment Area

The amount of private land in the catchments will be significantly reduced through the proclamation of the new, reduced catchment area boundaries. There are only two residences at the back of Phillips Creek Dam Catchment Area.

Septic systems, general household waste, the use of pesticides and herbicides, and the keeping of domestic pets and farm animals can pose contamination risks to water quality. There is approximately a 1 km vegetation buffer between the residences and the reservoir.

### *Agriculture (intensive and extensive)*

#### Manjimup Dam Catchment Area

One small section of rural land is within the catchment. The area is used for cropping and/or grazing but only low level activity occurs. The use of pesticides, herbicides and manure application can pose a risk to the water source.

## Phillips Creek Dam Catchment Area

A small area of rural land in the north-west corner of the catchment is currently used for cropping and/or grazing. This land is zoned Priority Agriculture under the *Shire of Manjimup local planning scheme no. 4*, therefore there is the potential for intensification. The risk to water quality increases with intensification. The distance from the reservoir (over 1 km) assists in reducing the risk of contamination to the reservoir associated with these activities. There is also a small section of rural land along the eastern edge of the catchment which is used for cropping and/or grazing. The use of pesticides, herbicides and manure can pose a risk to the water source. Best management practice for rural activities is recommended to protect water quality.

### 3.2.6 Aboriginal sites of significance and Native title claims

Aboriginal sites of significance are those areas that Aboriginal people value as important and significant to their cultural heritage. The sites are significant because they link Aboriginal culture and tradition to place, land and people over time. These areas form an integral part of Aboriginal identity and the heritage of Western Australia. The *Aboriginal Heritage Act 1972* protects all Aboriginal sites in the state. There is one Aboriginal site of significance within the Phillips Creek Dam Catchment Area. This site is called Phillips Creek.

Native title is the recognition in Australian law that some Aboriginal people continue to hold Native title rights to lands and water arising from their traditional laws and customs. There is one native title claim within the Manjimup Dam and Phillips Creek Dam Catchment Areas. This is the South West Bojarah claim (WAD 253/06).

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

## 3.3 Possible future contamination risks

Existing authorised land uses within the catchments are expected to remain unchanged. Any future land uses should be conducted in accordance with the Department of Water's, WQPN no. 25: *Land use compatibility in public drinking water source areas* and consistent with the Western Australian Planning Commission's Statement of planning policy no. 2.7: *Public drinking water source policy*.

The Shire of Manjimup's *Local planning scheme no. 4* (Department of Planning, 2010), has classified the areas of private land within the proposed Manjimup Dam and Phillips Creek Dam Catchment Areas as 'priority agriculture'.

The purpose of the 'priority agriculture' zone is to provide for the sustainable use of high quality agricultural land, particularly where water resources exist, preserving existing agricultural production and allowing for new agricultural production by securing suitable land and water resources, to provide for intensive agricultural and

horticultural production; including market gardens, orchards and vineyard enterprises.

Some types of intensive agricultural activities are compatible with conditions in P2 areas, based on the Department of Water, WQPN no. 25: *Land use compatibility in Public Drinking Water Source Areas*. The Shire of Manjimup should refer to us any subdivision and development applications in the catchment areas that are inconsistent this document or State planning policy no. 2.7: *Public drinking water source policy*.

Any transient or recreational activities should be conducted in accordance with our Statewide policy no.13: *Policy and guidelines for recreation within public drinking water source areas on crown land* and the DEC's requirements.

**Table 1** Land use and potential water quality risks in the Manjimup Dam and Phillips Creek Dam Catchment Areas

This table summarises key contamination risks. See Appendix C for more land uses.

Land use/activity	Hazard	Management priority	Compatibility of land use/activity	Best management practice guidance								
Swimming, fishing and marroning in the reservoirs	Pathogens from body contact with the water.	High	Swimming, fishing and marroning are illegal – penalties may apply under by-laws of the <i>Country Areas Water Supply Act 1947</i> or DEC and Department of Fisheries regulations.	<p>Statewide policy no. 13: <i>Policy and guidelines for recreation in PDWSA on crown land</i></p> <p>Standing Committee on Public Administration (SCPA) Report 11, September 2010: <i>Recreation activities within PDWSA</i></p> <p>DEC's Policy statement no.18: <i>Recreation, tourism and visitor services.</i></p>								
	Turbidity from reservoir access.	Medium			Agriculture-extensive (stock grazing and broad hectare cropping)	Chemicals from pesticides.	Medium	Extensive agriculture (stock grazing and broad hectare cropping) is compatible with conditions in Priority 2 (P2) areas.	<p>WQPN no. 1: <i>Agriculture-dryland crops near sensitive water resources</i></p> <p>Statewide policy no. 2: <i>Pesticide use in public drinking water source areas</i></p> <p>WQPN no. 65: <i>Toxic and hazardous substances – storage and use</i></p> <p><i>Stocking rate guidelines for small rural holdings</i> (Department of Agriculture</p>	Nutrients from fertiliser.	Medium	Hydrocarbons and chemicals from spills.
Agriculture-extensive (stock grazing and broad hectare cropping)	Chemicals from pesticides.	Medium	Extensive agriculture (stock grazing and broad hectare cropping) is compatible with conditions in Priority 2 (P2) areas.	<p>WQPN no. 1: <i>Agriculture-dryland crops near sensitive water resources</i></p> <p>Statewide policy no. 2: <i>Pesticide use in public drinking water source areas</i></p> <p>WQPN no. 65: <i>Toxic and hazardous substances – storage and use</i></p> <p><i>Stocking rate guidelines for small rural holdings</i> (Department of Agriculture</p>								
	Nutrients from fertiliser.	Medium										
	Hydrocarbons and chemicals from spills.	Medium										
	Turbidity from erosion and runoff.	Low										

Land use/activity	Hazard	Management priority	Compatibility of land use/activity	Best management practice guidance
	Pathogens from stock grazing.	Low / Medium		2000).
Roads and tracks	Hydrocarbons and chemicals from spills.	Medium	Existing public and designated roads are acceptable.	WQPN no. 44: <i>Roads near sensitive water resources</i>
	Turbidity from erosion and runoff.	Medium	Public access via unauthorised roads and tracks is not supported.  Closure of some roads and gating of access roads is recommended.	WQPN no. 10: <i>Contaminant spills emergency response.</i>
Rubbish dumping	Leaching of pathogens, nutrients and chemicals.	High	Rubbish dumping is illegal – penalties may apply under by-laws of the <i>Country Areas Water Supply Act 1947</i> and DEC's regulations.	Keep Australia Beautiful website < <a href="http://www.kabc.wa.gov.au">www.kabc.wa.gov.au</a> > has information on littering and litter reporting.
Fire management	Turbidity from erosion and runoff.	Medium	Compatible in PDWSAs.	Public sector circular number 88 (PSC:88)  DEC's fire management plans  <i>Bushfires Act 1954.</i>
	Nutrients and chemicals from fire management.	Low		

Land use/activity	Hazard	Management priority	Compatibility of land use/activity	Best management practice guidance
Horse riding	Pathogens from humans and horses.	Medium	Horse riding on public roads and designated trails only is acceptable within the outer catchments of PDWSAs.	Statewide Policy no. 13: <i>Policy and guidelines for recreation within PDWSAs on crown land.</i>
	Turbidity from erosion.	Low		

## 4 Protecting your drinking water source

The management objective for the Manjimup Dam and Phillips Creek Dam Catchment Areas is to preserve and protect the high quality of raw water by avoiding the risk of contamination from inappropriate land uses and activities. This will help to ensure the availability of reliable, safe drinking water to consumers in the Manjimup area.

This plan recognises the right of existing approved land uses to continue to operate in the catchments. The prevention, minimisation and management (in that order) of risks to water quality is imperative for the protection of public health.

### 4.1 Proclaiming the public drinking water source area

The proclamation process considers the public consultation undertaken as part of the development of the drinking water source protection plan. This plan recommends proclamation of the proposed amendments to the Manjimup Dam and Phillips Creek Dam Catchment Areas under the *Country Areas Water Supply Act 1947*.

The Manjimup Dam and Phillips Creek Dam Catchment Areas were originally proclaimed under the *Country Areas Water Supply Act 1947* in 1968 and 1959 respectively. Figure 2 shows the existing proclaimed catchment areas. Recent hydrological investigations show the physical catchment areas vary from those previously gazetted. The proposed boundaries will more accurately reflect the catchment areas of the reservoirs.

Once the catchment areas are amended the local government authority should incorporate the PDWSAs into the next update of their planning schemes consistent with State planning policy no. 2.7: *Public drinking water source policy*. PDWSAs are commonly shown in planning schemes as special control areas. This provides guidance for state and local government planning decision makers and developers.

Proclamation of a PDWSA will not change the zoning of land. There is no requirement to obtain a licence or approval to operate within a proclaimed PDWSA.

All existing and approved land uses and activities in a proclaimed area can continue. However, we recommend that best management practices are employed in PDWSAs to protect the quality of the drinking water source. New developments or expansion of existing land uses or activities need to consider the recommendations in this plan.

For more guidance on appropriate land uses and activities please refer to our WQPN no. 25: *Land use compatibility in public drinking water source areas*.

### 4.2 Defining priority areas

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

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

The determination of priority areas is based on the strategic importance of the land or water source including risks to water quality and quantity, the local planning-scheme zoning, the form of land tenure and existing approved land uses or activities. For further detail, please refer to our WQPN no. 25: *Land use compatibility in public drinking water source areas*.

The proposed priority areas for the Manjimup Dam and Phillips Creek Dam Catchment Areas have been determined in accordance with current Department of Water policy. These areas are described below and displayed in Figure 5. Our WQPN no. 25: *Land use compatibility in public drinking water source areas* outlines activities that are *acceptable*, *compatible with conditions* or *incompatible* within the different priority areas. For an explanation of the background and support for protection of PDWSAs, please refer to WQPN no. 36: *Protecting public drinking water source areas* and the Standing Committee on Public Administration (SCPA), Report 11, September 2010: *Recreation Activities within Public Drinking Water Source Areas (PDWSA)*.

We propose to assign the land vested in Water Corporation, state forest, timber reserve and all crown land in the Manjimup Dam and Phillips Creek Dam Catchment Areas as P1 because:

- These vestings meet criteria for the management of P1 areas and Department of Water and Planning current policy.
- Water supply sources in the south-west of WA are decreasing and need to be protected.
- Current permitted land uses in these areas are considered *acceptable* in P1.

We propose to assign the remaining private land as P2 because:

- Current land use is considered *compatible with conditions* provided best management practices are applied.
- The land is privately owned and zoned rural, so the development rights are recognised.

Within the Manjimup Dam Catchment Area there is only one very small area of P2 land approximately covering 1.72 ha in the north eastern tip of the catchment. Refer to Figure 5 for the location of this P2 area.

Within the Phillips Creek Dam Catchment Area, there are two P2 areas. One small section runs along the eastern edge of the catchment area and the other section is in the north-west corner of the catchment area. In total, these P2 areas approximately cover 12.9 ha. Refer to Figure 5 for the location of these P2 areas.



### 4.3 Defining protection zones

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

Reservoir protection zones (RPZs) are assigned over the most vulnerable part of the catchment. They include the water storage body but do not extend outside the catchment (e.g. downstream of the dam wall). The RPZs that occur in the *Metropolitan Water Supply Sewerage and Drainage Act 1909* are legislatively set at a distance of 2 km from the high water level of a reservoir. For consistency, and where reasonable, we also apply RPZs to country sources. In proposed water resource management legislation, the Department of Water has recommended that a 2 km RPZ, or other distance approved by the Minister for Water following development of a drinking water source protection plan, should apply across the whole state.

The proposed RPZ for the Manjimup Dam Catchment Area extends from the high water level 2 km back into the catchment. The RPZ for Phillips Creek Dam Catchment Area covers the whole catchment, except for the two P2 areas previously discussed. This is because the catchment itself is too small to allow for a 2 km RPZ. Refer to Figure 5 for further information on where the RPZs are within each catchment area.

Public access to the RPZ (other than what is specified in our Statewide Policy no. 13: *Policy and guidelines for recreation within PDWSA on crown land*) is not supported due to the significance of the resource for the provision of safe, good quality, reasonable cost drinking water.

### 4.4 Planning for future land uses

It is recognised under the Western Australian Planning Commission's (WAPC) *State planning strategy* (1997) that appropriate protection mechanisms in statutory land-use planning processes are necessary to secure the long-term protection of drinking water sources. As outlined in the WAPC's Statement of planning policy no. 2.7: *Public drinking water source policy* (2003) it is appropriate that the Manjimup Dam and Phillips Creek Dam Catchment Areas, their priority areas and protection zones be recognised in the Manjimup's Shire local planning scheme. Any development proposals within the Manjimup Dam and Phillips Creek Dam Catchment Areas that are inconsistent with advice in WQPN no. 25: *Land use compatibility in public drinking water source areas* or recommendations in this plan, need to be referred to the Department of Water for advice.

For further information on the integration of land-use planning and water source protection, please refer to our WQPN no. 36: *Protecting public drinking water source areas*. This note describes the findings of Parliamentary Committee reviews instrumental in the integration of water quality protection and land use planning in Western Australia.

The department's protection strategy for PDWSAs provides for approved developments to continue even if those facilities would not be supported under current water quality protection policies. In these instances, the department can provide advice to landowners or operators on measures they can use to improve their facilities and reduce water quality contamination risks (see section 4.5: *Using best management practices*).

## 4.5 Using best management practices

There are opportunities to reduce water contamination risks by carefully considering design and management practices. To help protect water sources, the Department of Water will continue to encourage the adoption of best management practices.

Guidelines on best management practices for many land uses are available in the form of industry codes of practice, environmental guidelines and water quality protection notes. They outline the recommended practices to ensure the protection of water quality and can thus help managers reduce any detrimental effects of their operations. These guidelines are developed in consultation with stakeholders such as industry groups, agricultural producers, state government agencies and technical advisers. Examples include WQPN no. 1: *Agriculture - dryland crops near sensitive water resources*, WQPN no. 44: *Roads near sensitive water resources* and WQPN no. 96: *Pest animal management in public drinking water source areas*, which are listed in this plan's *References* section.

Education and awareness-raising (such as providing information on signs and in brochures) are key mechanisms for protecting water quality, especially for people visiting the area. We will produce a brochure, once this plan is finalised, describing the Manjimup Dam and Phillips Creek Dam Catchment Areas, their locations and the main threats to water quality. The brochure will inform people in simple terms about the drinking water source and why it is important to protect it. It will be available to the community and other stakeholders.

## 4.6 Enforcing by-laws and surveying the area

The quality of water in PDWSAs within country areas of the state is protected under the *Country Areas Water Supply Act 1947*. Proclamation of PDWSAs allows by-laws to be applied to protect water quality.

The Department of Water considers by-law enforcement, through surveillance of land-uses and activities in PDWSAs, to be an important mechanism to protect water quality.

There are currently limited signs at access points and around the catchments to educate and advise the public about the importance of these catchment areas to the Manjimup water supply. More will be erected soon, as recommended in this plan.

This plan recommends that Water Corporation continue to undertake surveillance and by-law enforcement in both catchments, and that surveillance and by-law

enforcement for the Manjimup Dam Catchment Area be formally delegated to the Water Corporation.

## 4.7 Responding to emergencies

The escape of contaminants during unforeseen incidents and the use of chemicals during emergency responses can result in water contamination. The Manjimup Shire's local emergency management committee (LEMC), through the South West emergency management district, should be familiar with the location and importance of the Manjimup Dam and Phillips Creek Dam Catchment Areas.

A locality plan will be provided to the fire and rescue services headquarters for the hazardous materials (HAZMAT) emergency advisory team. DEC is the lead agency for wildfire control management for most of the catchment area outside of the gazetted fire emergency response zone within the Manjimup Dam Catchment Area. Within the Phillips Creek Catchment Area the Water Corporation is the lead agency for wildfire control management outside of the gazetted fire emergency response zone. The Water Corporation should have an advisory role to the HAZMAT team for incidents in the Phillips Creek Dam 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 Manjimup Dam and Phillips Creek Dam Catchment Areas. These personnel should have an adequate understanding of the potential impacts of chemical spills or other incidents on these drinking water sources.

## 4.8 Putting this plan into action

Table 1 (found at the end of section 3) identifies the potential water quality risks associated with existing land uses in the Manjimup Dam and Phillips Creek Dam Catchment Areas. Further information and the recommended protection strategies to deal with those risks are outlined in Appendix C.

When this plan is complete, an implementation strategy will be drawn up based on the recommendations in Appendix C.

## 5 Recommendations

The following recommendations apply to the Manjimup Dam and Phillips Creek Dam Catchment Areas. The bracketed stakeholders are those expected to have a responsibility for, or an interest in, the relevant recommendation being implemented.

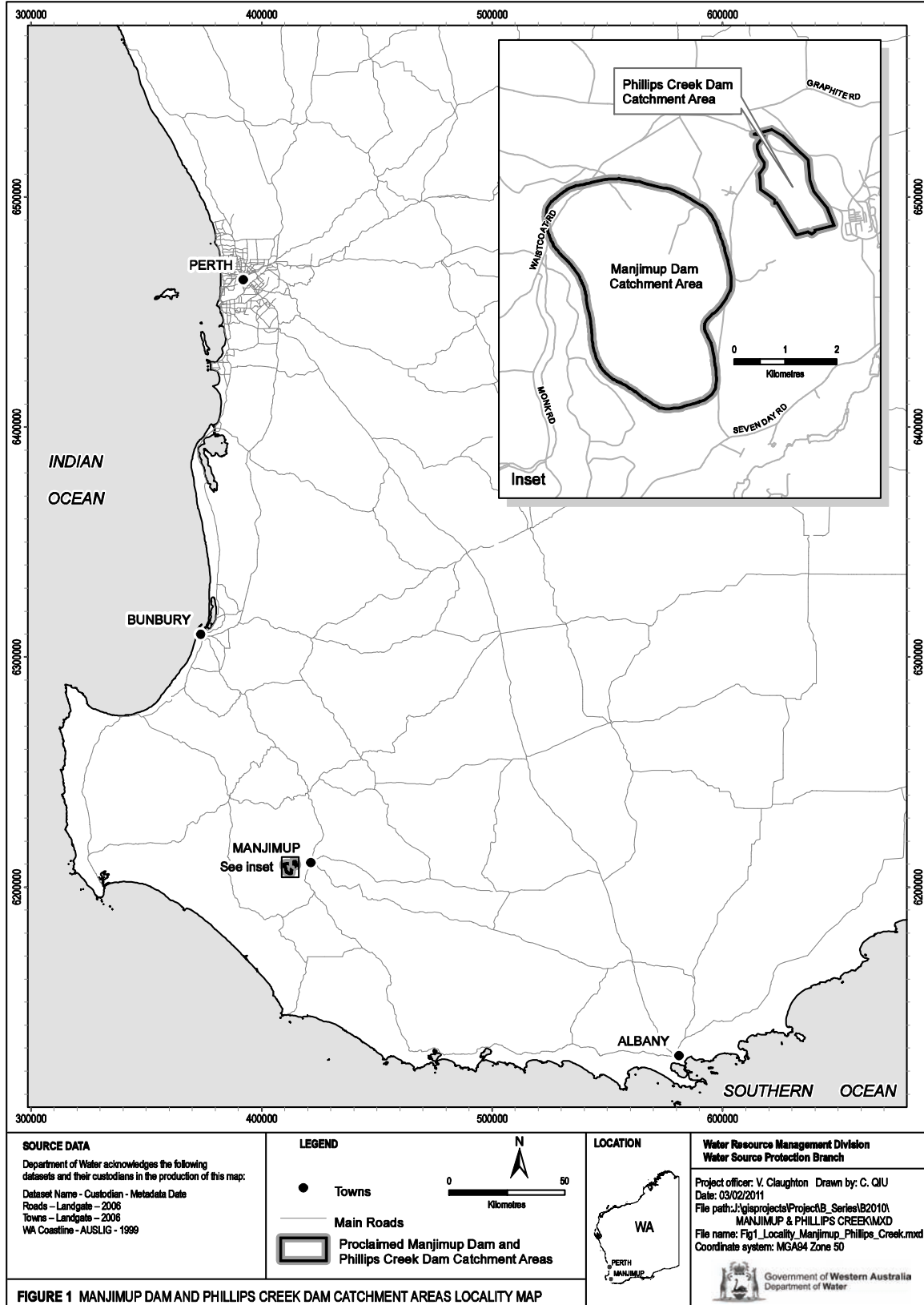
1. Amend the boundary of the Manjimup Dam and Phillips Creek Dam Catchment Areas under the *Country Areas Water Supply Act 1947*. (Department of Water)
2. Develop an implementation strategy for this plan's recommendations (including the recommended protection strategies as detailed in Appendix C) showing responsible stakeholders and planned timeframes. (Department of Water, applicable stakeholders)
3. Incorporate this plan and reflect the Manjimup Dam and Phillips Creek Dam Catchment Area boundaries, P1 and P2 areas and reservoir protection zones in the Manjimup Shire's local planning scheme in accordance with the WAPC's Statement of planning policy no. 2.7: *Public drinking water source policy*. (Shire of Manjimup)
4. All development proposals within the Manjimup Dam and Phillips Creek Dam Catchment Areas that are inconsistent with the Department of Water's WQPN no. 25: *Land use compatibility in public drinking water source areas* or recommendations in this plan should be referred to the Department of Water for advice and recommendations. (Department of Planning, Shire of Manjimup, proponents of proposals)
5. Incidents covered by WESTPLAN–HAZMAT in the Manjimup Dam and Phillips Creek Dam Catchment Areas should be addressed by ensuring that:
  - the Shire of Manjimup LEMC is aware of the location and purpose of the Manjimup Dam and Phillips Creek Dam Catchment Areas
  - the locality plan for the Manjimup Dam and Phillips Creek Dam Catchment Areas is provided to the FESA headquarters for the HAZMAT emergency advisory team
  - the Water Corporation or Department of Water acts in an advisory role during incidents in the Manjimup Dam and Phillips Creek Dam Catchment Areas
  - personnel dealing with WESTPLAN–HAZMAT incidents in the area have ready access to a locality map of the Manjimup Dam and Phillips Creek Dam Catchment Areas and information to help them recognise the potential impacts of spills on drinking water quality. (Department of Water or Water Corporation)
6. Delegate by-law enforcement and surveillance of the Manjimup Dam Catchment Area to the Water Corporation. (Department of Water)

7. Erect signs along the boundary of the Manjimup Dam and Phillips Creek Dam Catchment Areas including an emergency contact telephone number. (Water Corporation)
8. Install gates on appropriate roads and tracks to prevent unauthorised access to the Manjimup Dam and Phillips Creek Dam Catchment Areas (Water Corporation, Department of Environment and Conservation)
9. Review this plan after five years. (Department of Water)



# Appendices

## Appendix A – Figures



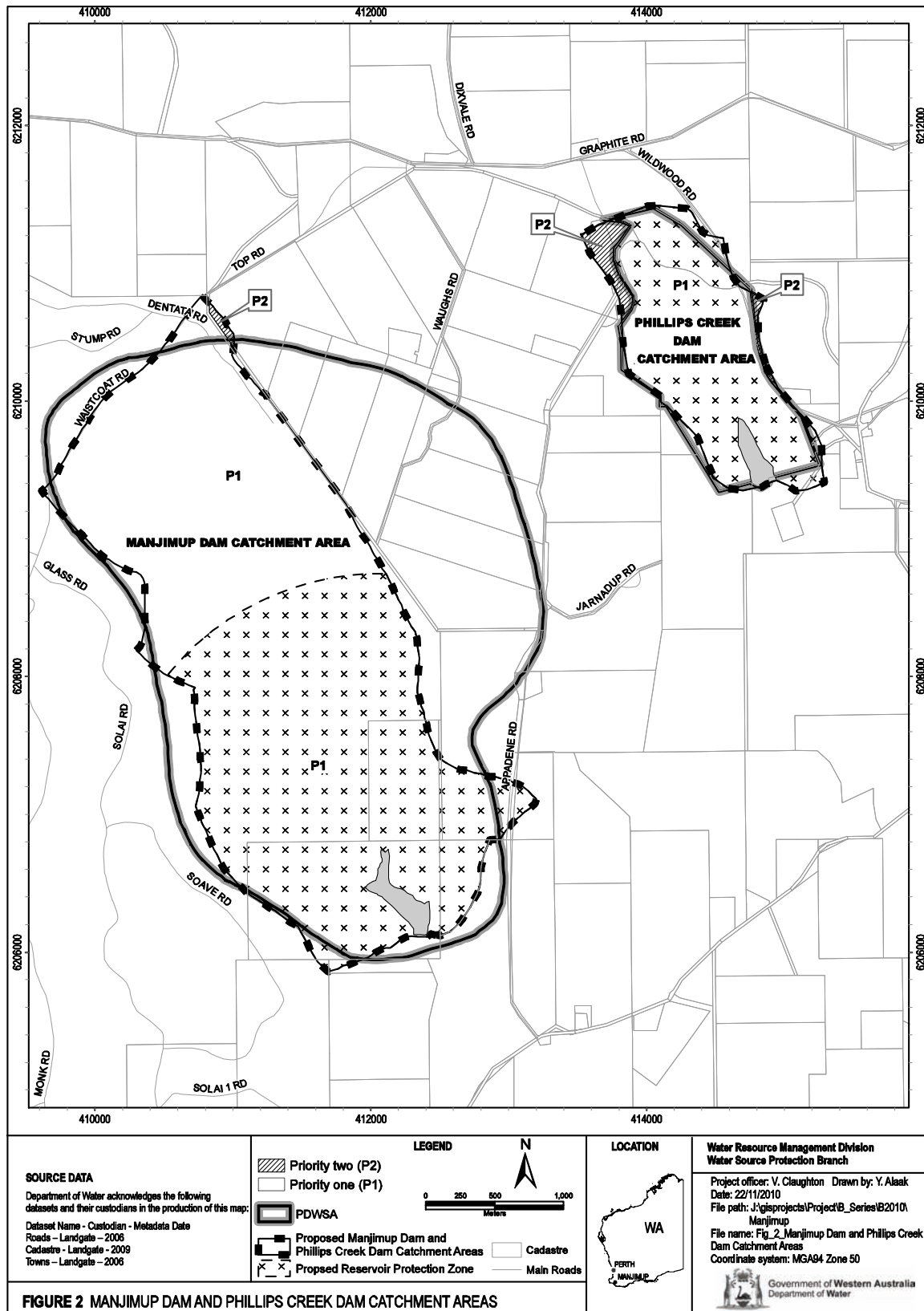
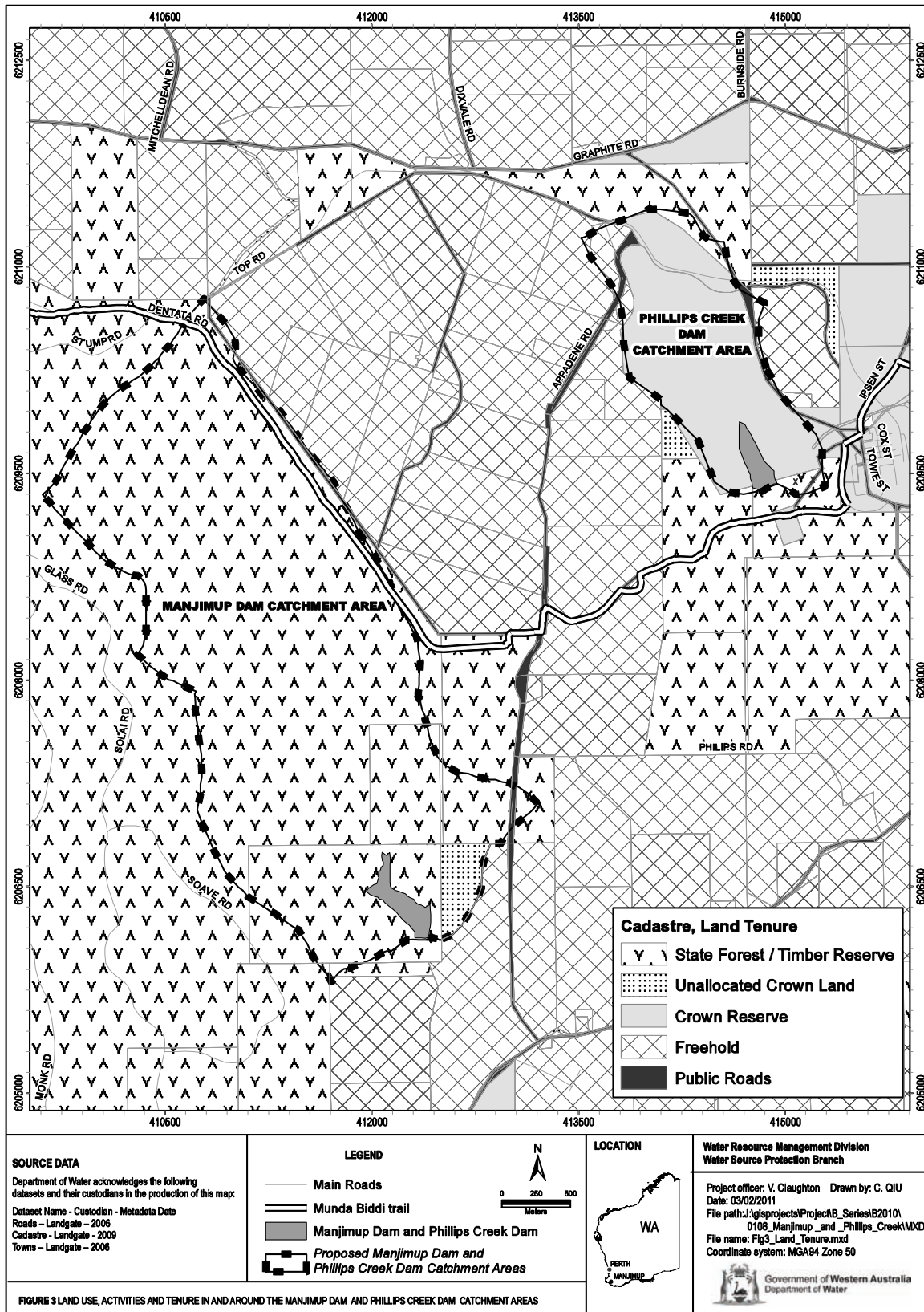
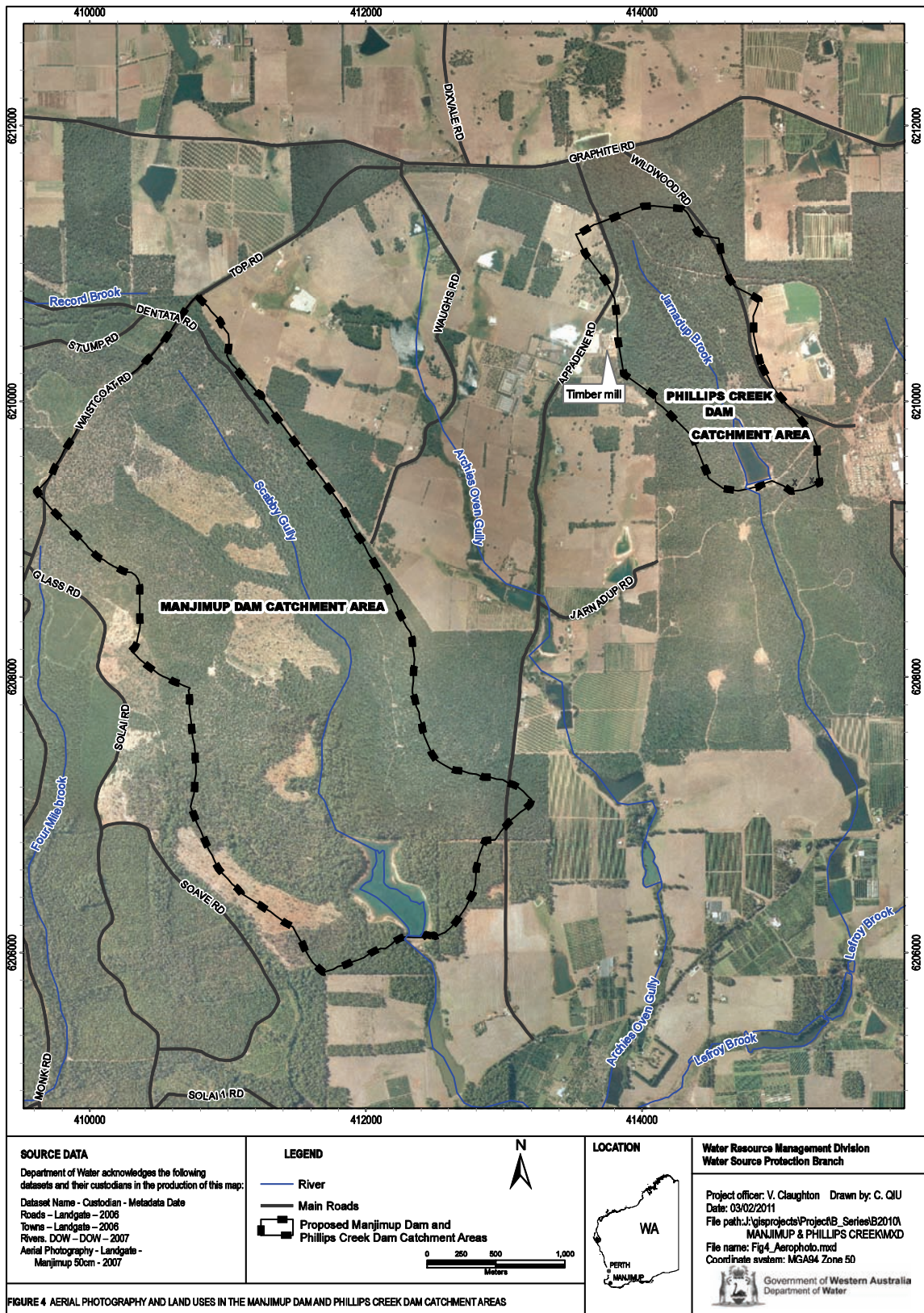
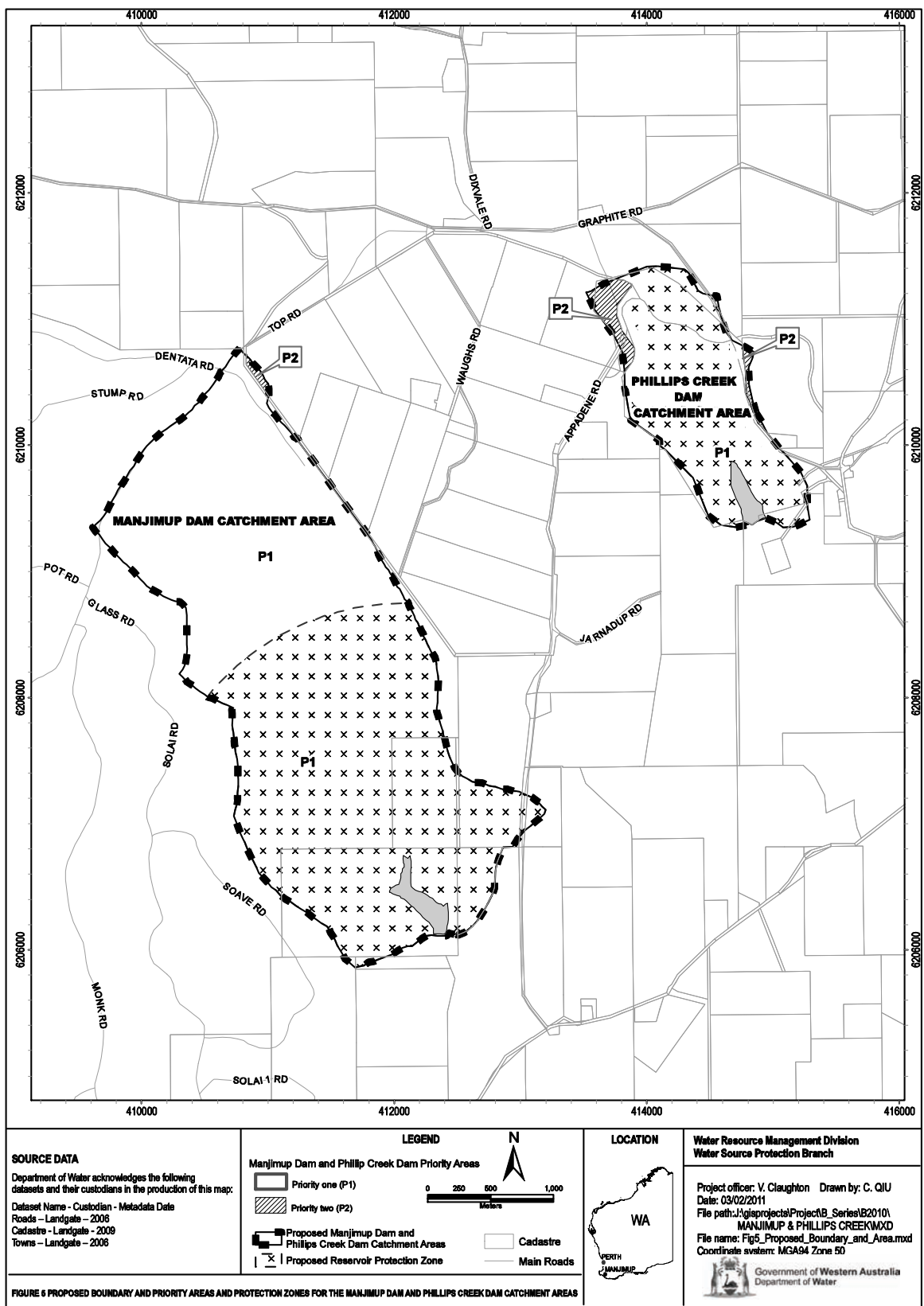


FIGURE 2 MANJIMUP DAM AND PHILLIPS CREEK DAM CATCHMENT AREAS









## Appendix B – Water quality data

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

The Water Corporation has monitored the raw (source) water quality from Manjimup Dam and Phillips Creek Dam. This data shows the quality of water in the catchments. An assessment of the drinking water quality is also made in accordance with the *Australian drinking water guidelines, 2004 (ADWG)* (NHMRC & NRMCC 2004a) and interpretations agreed to with the Department of Health. The raw water is monitored regularly for:

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

The following data represents the quality of raw water in Manjimup Dam and Phillips Creek Dam. In the absence of specific guidelines for raw-water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Results that exceed the 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. Barriers such as storage and water treatment exist downstream of the raw water to ensure it meets the requirements of the ADWG.

For more information on the quality of drinking water supplied to Manjimup refer to the most recent Water Corporation Drinking Water Quality Annual Report at < [www.watercorporation.com.au](http://www.watercorporation.com.au) > What we do > Water quality > Water quality publications > Most recent *Water quality annual report*.

### *Aesthetic*

The aesthetic quality analyses for raw water from Manjimup Dam and Phillips Creek Dam are summarised in the following table.

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

*Aesthetic detections for Manjimup's raw water*

Parameter	Units	ADWG aesthetic guideline value*	Phillips Creek Dam raw water		Manjimup Dam raw water	
			Range	Median	Range	Median
Chloride	mg/L	250	75 - 140	110	58 - 80	70
Colour – true	TCU	15	<1 - 19	6	<1 - 12	3
Hardness as CaCO <sub>3</sub>	mg/L	200	25 - 65	45	25 - 39	34
Iron unfiltered	mg/L	0.3	0.03 – 1.6	0.12	<0.003 – 0.78	0.14
Sodium	mg/L	180	43 - 73	59	35 - 46	40
Total filterable solids by summation	mg/L	500	169 - 260	222.5	139 - 172	157
Turbidity	NTU	5	0.3 - 32	0.9	0.2 – 6.8	0.7
pH measured in laboratory	NO UNIT	6.5 - 8.5	6.45 – 9.89	7.16	6.29 – 7.59	7.01

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

*Health related**Health-related chemicals*

Raw water from Manjimup Dam and Phillips Creek Dam is analysed for chemicals that are harmful to human health, including categories of chemicals such as inorganics, heavy metals, industrial hydrocarbons and pesticides. Health-related water-quality parameters that have been measured at detectable levels in the source between October 2005 and September 2010 are summarised in the following table. Any parameters that have on occasion exceeded the ADWG are shaded.

*Health-related detections for Manjimup's raw water*

Parameter	Units	ADWG health guideline value*	Phillips Creek Dam raw water		Manjimup Dam raw water	
			Range	Median	Range	Median
Nitrate as Nitrogen	mg/L	11.29	<0.002 – 0.005	0.014	<0.002 – 0.07	0.02
Nitrite as Nitrogen	mg/L	0.91	<0.002 – 0.005	0.003	<0.002 – 0.003	<0.002
Nitrite plus Nitrate as N	mg/L	11.29	<0.002 – 0.68	<0.05	<0.002 – 0.13	<0.05
Manganese unfiltered	mg/L	0.5	<0.002 – 0.28	0.005	<0.002 – 0.14	0.018

Parameter	Units	ADWG health guideline value*	Phillips Creek Dam raw water		Manjimup Dam raw water	
			Range	Median	Range	Median
Sulphate	mg/L	500	7.5 - 11	9	12 - 21	18
Boron <sup>†</sup>	mg/L	4	0.02 – 0.02	0.02	-	-
Fluoride laboratory measurement	mg/L	1.5	<0.10 – 0.95	<0.10	<0.10 – 0.6	<0.1
Iodide	mg/L	0.1	<0.02 – 0.08	<0.02	<0.02 – 0.03	<0.02

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

<sup>†</sup> Results from three or less samples

### *Microbiological contaminants*

Microbiological testing of raw-water samples from Manjimup Dam and Phillips Creek Dam is currently conducted on a weekly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water. 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 of the raw water (WHO 2004). As such, counts less than 20 MPN are seen as being an indication of raw water that has not been recently contaminated with faecal material.

During the reviewed period of October 2005 to September 2010, positive *Escherichia coli* counts were recorded in 53 per cent of samples taken from Phillips Creek Dam raw water. Approximately 10 per cent of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

During the same review period, positive *Escherichia coli* counts were recorded in 46 per cent of samples from Manjimup Dam raw water. Approximately 5 per cent of these samples had *Escherichia coli* counts greater than 20 MPN/100mL.

Raw water from Phillips Creek Dam undergoes chlorine and ultraviolet disinfection and raw water from Manjimup Dam undergoes chlorine disinfection prior to distribution to treat for microbiological contaminants.

## Appendix C – Land use, potential water quality risks and recommended protection strategies

Land use/activity applies to both Manjimup Dam and Phillips Creek Catchment Areas unless otherwise specified

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Roads and tracks	Hydrocarbon contamination from fuel and chemical spills	Medium	<p>Traffic volumes within the catchment areas (CA) are low.</p> <p>Rock Bar Rd crosses immediately behind Manjimup Dam. This is a possible source of turbidity.</p>	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• HAZMAT emergency response</li> </ul>	<ul style="list-style-type: none"> <li>• Increase signage to inform people that they are within the catchment areas and need to protect water quality. Signage should include an emergency contact number.</li> <li>• Use fencing and gates to restrict access to reservoirs and close and rehabilitate unnecessary roads within the catchment areas.</li> </ul>
	Turbidity from erosion and runoff	Medium	<p>Parts of Appadene Rd and Deanmill Log Rd are within the Phillips Creek Dam CA.</p> <p>A track that crosses Jardanup Brook at the back of the Phillips Creek Dam CA provides direct access to the reservoir.</p>	<ul style="list-style-type: none"> <li>• signage at entrance of dams</li> <li>• DEC / Water Corporation road management</li> <li>• existing regulations</li> <li>• road construction and maintenance.</li> </ul>	<ul style="list-style-type: none"> <li>• Adhere to WQPN no. 44: <i>Roads near sensitive water resources</i> and WQPN no. 10: <i>Contaminant spills – emergency response</i>.</li> <li>• Incident management procedures in place with Main Roads and local shires.</li> </ul>

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Illegal crop growing	Pathogens from human access	High	Occasionally illegal crop growing occurs in the catchment areas.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• detention time</li> <li>• regulations.</li> </ul>	<ul style="list-style-type: none"> <li>• Use fencing and gates to restrict access to unnecessary roads within the catchment areas.</li> <li>• Increase surveillance.</li> </ul>
	Nutrients from fertilisers and pesticide contamination	Medium			
Rubbish dumping	Leaching of pathogens	High	Road access to the catchments encourages rubbish dumping.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• detention time</li> <li>• rubbish removal.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase signage to inform people that they are within the catchment areas and need to protect water quality.</li> <li>• Use fencing and gates to restrict access to unnecessary roads within the catchment areas.</li> </ul>
	Leaching of nutrients	High	Bulk rubbish dumping often occurs at the top of the Phillips Creek Dam Catchment Area.		
	Leaching of chemicals	High			
Timber production	Turbidity from erosion and runoff	Low	Thinning has occurred in both catchment areas. Trial thinning occurred in the Manjimup Dam Catchment Area to try increase runoff.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• detention time</li> <li>• best practice by FPC and DEC</li> <li>• regulations.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure pesticides are only applied as outlined in PSC:88 (see references).</li> <li>• Ensure contractors working within the catchment areas are aware of the PDWSA and the need to protect water quality.</li> </ul>
	Contamination from pesticide/herbicide use	Low			



Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Fire management	Turbidity from erosion and runoff	Low	Controlled burns have not occurred in recent years.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• detention time.</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that fire breaks are maintained.</li> <li>• Ensure pesticides are only applied as outlined in PSC:88.</li> <li>• Adhere to DEC's fire management plans and the <i>Bushfires Act 1954</i>.</li> </ul>
	Contamination from herbicide use	Low	The back of Phillips Creek Dam Catchment Area has a large build up of organic material.		
Wildfire	Turbidity from erosion and runoff	Medium	Fires can result in a rapid increase of decomposed and eroded material entering the reservoirs. Wildfires are a significant risk to water quality.	<ul style="list-style-type: none"> <li>• Water Corporation surveillance</li> <li>• detention time</li> <li>• fire management and prevention activities.</li> </ul>	<ul style="list-style-type: none"> <li>• Streamline and reservoir buffers are considered before applying chemical fire retardants.</li> <li>• Ensure local HAZMAT emergency response team are aware of the location and purpose of the PDWSAs.</li> <li>• DEC undertake fire management to reduce fuel load in the catchment areas.</li> </ul>
	Hydrocarbon contamination from vehicles	Low			
	Nutrients from fire fighting foam	Low			
Feral pigs and introduced animals	Pathogens from carcasses and faeces	High	DEC manages pests in the Manjimup Dam Catchment Area and	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure removal of feral animal carcasses as soon as practical.</li> <li>• Continue monitoring feral pig</li> </ul>

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
	Turbidity from wallowing and rooting	Medium	Water Corporation manages pests in the Phillips Creek Dam Catchment Area.	Corporation surveillance <ul style="list-style-type: none"> <li>Water Corporation /DEC feral animal management programs.</li> </ul>	population and increase management as required. <ul style="list-style-type: none"> <li>Ensure feral animal management does not include the use of poisons that pose a water quality contamination risk.</li> <li>Adhere to our WQPN no. 96: <i>Pest animal management in PDWSAs.</i></li> </ul>
	Nutrients from faeces	Medium	Feral pigs levels are currently low both catchments.		
Recreation: - hunting - bush walking - cycling (Munda Biddi) - camping - picnicking - firewood collection - resource harvesting	Pathogens from human access	High	Tracks bordering the north and west of the Manjimup Dam Catchment Area provide access to within 100 m of the reservoir.	<ul style="list-style-type: none"> <li>water quality monitoring</li> <li>Water Corporation surveillance</li> <li>detention time</li> <li>regulations/policy (e.g. no public access to the RPZ)</li> <li>signage at entrance of dams.</li> </ul>	<ul style="list-style-type: none"> <li>Increase signage to inform people that they are within a catchment area and need to protect water quality, also that access to RPZ is prohibited.</li> <li>Future access to RPZ of the dams is not supported to protect water quality.</li> <li>Increase surveillance.</li> <li>Use fencing and gates to restrict access to unnecessary roads within the catchment areas.</li> </ul>
	Turbidity from erosion and runoff	Medium	Close locality of Phillips Creek Dam Catchment Area to the town of Deanmill encourages unauthorised recreational activity.		

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
	Nutrients from faeces and waste materials	Medium	Public access along established public roads and trails (such as cycling on the Munda Biddi) is permitted.		<ul style="list-style-type: none"> <li>• Adhere to DEC's Policy statement no.18: <i>Recreation, tourism and visitor services</i>.</li> <li>• Apply Statewide Policy 13: <i>Policy and Guidelines for Recreation within PDWSAs on crown land</i>.</li> <li>• Consider advice in SCPA Report 11, September 2010: <i>Recreation Activities within PDWSA</i>.</li> </ul>
Horse riding	Pathogens from human and horse access and horse faeces	Medium/High	Horse riding on established public roads is acceptable within the outer catchment of PDWSA.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• detention time</li> <li>• regulations.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase signage to inform people that they are within the catchment areas and need to protect water quality.</li> <li>• Use fencing and gates to restrict access to unnecessary roads.</li> <li>• Apply Statewide Policy 13: <i>Policy and guidelines for recreation within PDWSAs on crown land</i>.</li> </ul>
	Soil compaction and turbidity from erosion	Low	A group occasionally ride through the Manjimup Dam Catchment Area.		

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies		
	Hazard	Management priority					
Off-road vehicles	Turbidity from erosion and runoff	Medium	<p>Numerous established roads within the catchments mean that off-road vehicle use is reduced.</p> <p>Most off-road activity is associated with reservoir access.</p> <p>Off-road driving on reservoir banks occurs in both catchments.</p>	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation surveillance</li> <li>• detention time</li> <li>• regulations.</li> </ul>	<ul style="list-style-type: none"> <li>• Increase signage to inform people that they are within the catchment areas and need to protect water quality.</li> <li>• Use fencing and gates to restrict access to unnecessary roads within the catchment areas.</li> <li>• Water Corporation to increase surveillance where possible and appropriate.</li> <li>• Adhere to DEC's regulations and Policy statement no.18: <i>Recreation, tourism and visitor services.</i></li> </ul>		
	Hydrocarbon contamination from vehicles	Medium				Fishing/marroning	Pathogens from human access and contact with the water body
Fishing/marroning	Pathogens from human access and contact with the water body	High	<p>Fishing/marroning regularly occurs in the reservoirs.</p> <p>Access occurs from</p>	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• Water Corporation</li> </ul>	<ul style="list-style-type: none"> <li>• Increase signage to inform people that they are within the catchment areas and need to protect water quality.</li> </ul>		

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
	Turbidity from access to reservoir banks	Medium	over the front fence and rear of catchment area to Phillips Creek Dam.	<ul style="list-style-type: none"> <li>surveillance</li> <li>detention time</li> <li>regulations.</li> </ul>	<ul style="list-style-type: none"> <li>Use fencing and gates to restrict access to unnecessary roads within the catchment area.</li> <li>Increase surveillance.</li> <li>Statewide Policy 13: <i>Policy and guidelines for recreation within public drinking water source areas on crown land.</i></li> </ul>
	Nutrients from baits and carcasses	Low	Access occurs from over the front fence and rear of the catchment area to Manjimup Dam.		
Swimming	Pathogens from human access and contact	High	Access occurs from over the front fence and rear of catchment area to Phillips Creek Dam and Manjimup Dam.	<ul style="list-style-type: none"> <li>Water Corporation surveillance</li> <li>regulations.</li> </ul>	<ul style="list-style-type: none"> <li>Increase signage to inform people that they are within the catchment areas and need to protect water quality.</li> <li>Use fencing and gates to restrict access to unnecessary roads within the catchment areas.</li> <li>Increase surveillance.</li> <li>Statewide Policy 13: <i>Policy and guidelines for recreation within public drinking water source areas on crown land.</i></li> </ul>
	Turbidity from access to reservoir banks	Medium	Swimming regularly occurs in reservoirs.		

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Agriculture	Contamination from pesticide and herbicide application	Medium	Only a very small area of private land will remain in the amended catchment area. Some agricultural land use occurs at the head of the Manjimup Dam Catchment Area.	<ul style="list-style-type: none"> <li>• water quality monitoring</li> <li>• detention time</li> <li>• regulations</li> <li>• vegetation buffers.</li> </ul>	<ul style="list-style-type: none"> <li>• Large areas of private land to be removed from the catchment areas based on the new boundaries.</li> <li>• Follow best management practices of chemical use, stocking rates and waste management as outlined in these guidance documents:  <i>Statewide policy no. 2: Pesticide use in public drinking water source areas</i>  <i>Stocking rate guidelines for small rural holdings</i> (Department of Agriculture 2000)  <i>WQPN no. 1: Agriculture-dryland crops near sensitive water resources</i>  <i>WQPN no. 65: Toxic and hazardous substances – storage and use.</i></li> </ul>
	Nutrients from fertiliser use	Medium			
	Hydrocarbons from fuels and chemical spills	Medium	Phillips Creek Dam has two areas of agricultural land use, however there is roughly a 1 km vegetation buffer to the reservoir.		
	Turbidity from erosion and runoff	Low			
	Pathogens from stock grazing	Low / Medium			

Land use/activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Weeds	Chemicals from herbicides	Medium	Blackberries impeding water flow in tributaries in the catchments	<ul style="list-style-type: none"> <li>• water quality monitoring.</li> </ul>	<ul style="list-style-type: none"> <li>• Land owners and managers to manage weeds, particularly blackberry, as appropriate, in accordance with Statewide policy no. 2: <i>Pesticide use in public drinking water source areas.</i></li> </ul>

## Appendix D – Photographs



*Figure D1 Manjimup Dam Reservoir*



*Figure D2 Phillips Creek Dam Reservoir*





Figure D3 Rubbish dumping in the Manjimup Dam Catchment Area



Figure D4 Unsealed road within the Phillips Creek Dam Catchment Area



Figure D5 Chain gate limiting access to the Manjimup Dam



Figure D6 Fence limiting access to the Phillips Creek Dam

## List of shortened forms

<b>ADWG</b>	<i>Australian drinking water guidelines</i>
<b>ANZECC</b>	Australian and New Zealand Environment Conservation Council
<b>ARMCANZ</b>	Agriculture and Resource Management Council of Australia and New Zealand
<b>CA</b>	catchment area
<b>DEC</b>	Department of Environment and Conservation
<b>ha</b>	hectare
<b>HAZMAT</b>	hazardous materials
<b>kL</b>	kilolitre
<b>km</b>	kilometre
<b>km<sup>2</sup></b>	square kilometre
<b>LEMC</b>	local emergency management committee
<b>m</b>	metre
<b>m<sup>2</sup></b>	square metre
<b>mg/L</b>	milligram per litre
<b>mL</b>	millilitre
<b>ML</b>	megalitre
<b>mm</b>	millimetre
<b>MPN</b>	most probable number
<b>NHMRC</b>	National Health and Medical Research Council
<b>NRMMC</b>	Natural Resource Management Ministerial Council
<b>NTU</b>	nephelometric turbidity units
<b>PSC 88</b>	public sector circular number 88
<b>PDWSA</b>	public drinking water source area
<b>RPZ</b>	reservoir protection zone
<b>WESTPLAN–HAZMAT</b>	Western Australian plan for hazardous materials



# Glossary

<b>Abstraction</b>	The pumping of groundwater from an aquifer, or the removal of water from a waterway or water body.
<b>Adsorb</b>	Adsorb means to accumulate on the surface of something.
<b>Aesthetic guideline value</b>	The concentration or measure of a water quality characteristic that is associated with acceptability of water to the consumer, e.g. appearance, taste and odour (NHMRC & NRMCC 2004a).
<b>Allocation</b>	The quantity of water that a licensee is permitted to abstract is their allocation, usually specified in kilolitres per annum (kL/a).
<b>Australian drinking water guidelines</b>	The <i>National water quality management strategy: Australian drinking water guidelines 6, 2004</i> (NHMRC & NRMCC 2004a) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's Bibliography).
<b>Catchment</b>	The physical area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
<b>Department of Environment and Conservation</b>	The Department of Environment and Conservation was established on 1 July 2006, bringing together the Department of Environment and the Department of Conservation and Land Management.
<b>Effluent</b>	Effluent is treated or untreated liquid, solid or gaseous waste discharged by a process such as through a septic tank and leach drain system.
<b>Health guideline value</b>	The concentration or measure of a water quality characteristic that, based on current knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHMRC & NRMCC 2004a).
<b>Hectare</b>	A measurement of area, equivalent to 10 000 square metres.
<b>Hydrocarbons</b>	A class of compounds containing only hydrogen and carbon, such as methane, ethylene, acetylene and benzene. Fossil fuels such as oil, petroleum and natural gas all contain hydrocarbons.
<b>Hydrology</b>	The science dealing with water on the land, its properties, laws, geographical distribution, etc.
<b>Leaching/ leachate</b>	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater. The material washed

out is known as leachate. Leachate can pollute groundwater and waterways.

<b>mg/L</b>	A milligram per litre (0.001 grams per litre) is a measurement of a total dissolved solid in a solution.
<b>Most probable number</b>	Most probable number is a measure of microbiological contamination.
<b>Nutrients</b>	Minerals, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) dissolved in water which provide nutrition (food) for plant growth.
<b>Pathogen</b>	A disease-producing organism that can cause sickness and sometimes death through the consumption of water, including bacteria (such as <i>Escherichia coli</i> ), protozoa (such as <i>Cryptosporidium</i> and <i>Giardia</i> ) and viruses.
<b>Pesticides</b>	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
<b>pH</b>	A logarithmic scale for expressing the acidity or alkalinity of a solution. A pH below seven indicates an acidic solution and above seven indicates an alkaline solution.
<b>Pollution</b>	Water pollution occurs when waste products or other substances (effluent, litter, refuse, sewage or contaminated runoff) change the physical, chemical or biological properties of the water, adversely affecting water quality, living species and beneficial uses.
<b>Public drinking water source area</b>	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> .
<b>Public sector circular number 88</b>	A state government circular produced by the Department of Health providing guidance on appropriate herbicide use within water catchment areas.
<b>Reservoir</b>	A reservoir, dam, tank, pond or lake that forms part of any public water-supply works.
<b>Reservoir protection zone</b>	A buffer measured from the high water mark of a drinking water reservoir, and inclusive of the reservoir (usually 2 km). This is referred to as a prohibited zone under the <i>Metropolitan Water Supply Sewerage and Drainage Act By-laws 1981</i> .
<b>Runoff</b>	Water that flows over the surface from a catchment area, including streams.

<b>Scheme supply</b>	Water diverted from a source or sources by a water authority or private company and supplied via a distribution network to customers for urban and industrial use or for irrigation.
<b>Storage reservoir</b>	A major reservoir of water created in a river valley by building a dam.
<b>Total dissolved solids</b>	Total dissolved solids consist of inorganic salts and small amounts of organic matter that are dissolved in water. Clay particles, colloidal iron and manganese oxides, and silica fine enough to pass through a 0.45 micrometer filter membrane can also contribute to total dissolved solids. Total dissolved solids comprise sodium, potassium, calcium, magnesium, chloride, sulfate, bicarbonate, carbonate, silica, organic matter, fluoride, iron, manganese, nitrate (and nitrite) and phosphate (NHMRC & NRMCC 2004a).
<b>Total filterable solids by summation</b>	Total filterable solids by summation is a water quality test which is a total of the following ions: Na (sodium), K (potassium), Ca (calcium), Mg (magnesium), Cl equivalent (chloride), alkalinity equivalent, SO <sub>4</sub> equivalent (sulfate) or S (sulfur) in grams, Fe (iron), Mn (manganese), and SiO <sub>2</sub> (silicon oxide). It is used as a more accurate measure than total dissolved solids. The higher the value, the more solids that are present and generally the saltier the taste.
<b>Treatment</b>	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes, including drinking and discharge to the environment.
<b>Turbidity</b>	The cloudiness or haziness of water caused by the presence of fine suspended matter.
<b>Wastewater</b>	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
<b>Water quality</b>	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.

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