

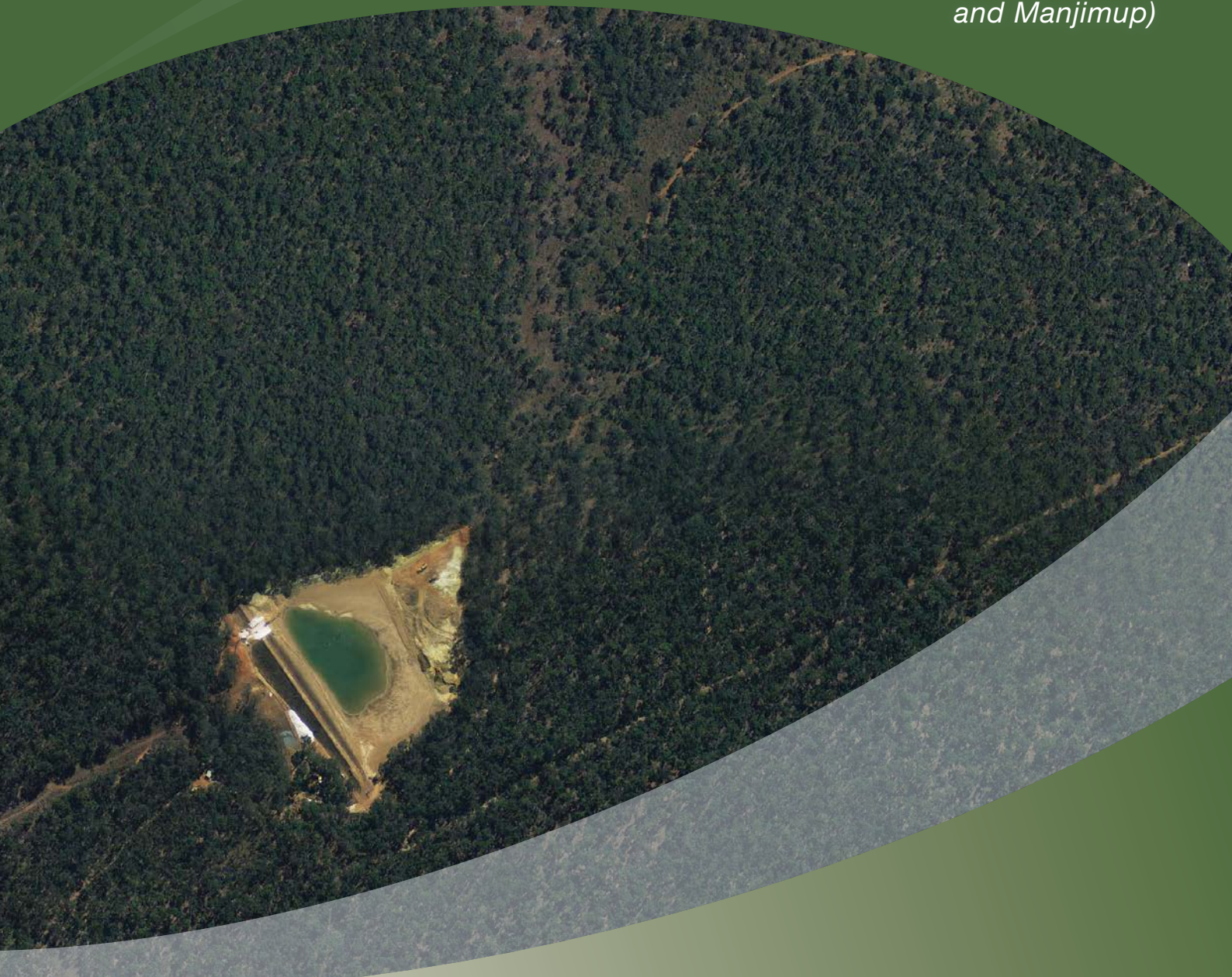


Government of Western Australia  
Department of Water

# Hester Dam Catchment Area

## Drinking water source protection plan

*Warren Blackwood regional water supply scheme  
(Bridgetown, Hester, Boyup Brook, Nannup  
and Manjimup)*



*Looking after all our water needs*

Water resource protection series  
Report WRP 127  
December 2013



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December 2013

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ISSN 1835-3924 (online)

ISBN 978-1-921907-43-2 (online)

### **Acknowledgements**

The Department of Water would like to thank the following for their contribution to this publication: Justin King, Beatrice Franke, Clint Roberts, Jon Kaub, Lanie Ayers, Chris Qiu, Stephen Watson and Nigel Mantle (Department of Water), Michelle Vojtisek, Nathan Conley and Brett Keogh (Water Corporation).

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Cover photograph: *Aerial photograph of the Hester Dam Catchment Area*

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# Contents

Contents .....	iii
Summary .....	v
<b>1 Overview of the Hester Dam drinking water source .....</b>	<b>1</b>
1.1 The drinking water supply system .....	1
1.1.1 Warren Blackwood regional water supply scheme .....	1
1.1.2 Bridgetown Catchment Area .....	1
1.1.3 Hester Dam and catchment boundary .....	1
1.1.4 Water treatment and distribution .....	2
1.2 Water management.....	2
1.2.1 Licence to take water.....	2
1.2.2 Water planning.....	3
1.2.3 Future water needs.....	3
1.3 Characteristics of the catchment.....	3
1.3.1 Physical environment.....	3
1.3.2 Climate.....	3
1.3.3 Hydrology.....	4
1.4 How is this drinking water source currently protected? .....	4
<b>2 Common contamination risks .....</b>	<b>6</b>
2.1 Microbiological risks .....	6
2.2 Physical risks .....	7
2.3 Chemical risks.....	8
<b>3 Contamination risks in this drinking water source.....</b>	<b>9</b>
3.1 Water quality .....	9
3.2 Land uses and activities.....	9
3.2.1 State forest .....	9
3.2.2 Public road.....	11
3.2.3 Public access and unauthorised recreation .....	11
3.2.4 Aboriginal sites of significance and Native title claims .....	12
3.3 Possible future contamination risks.....	12
<b>4 Protecting your drinking water source .....</b>	<b>14</b>
4.1 Proclaiming public drinking water source areas .....	14
4.2 Defining priority areas .....	14
4.3 Defining protection zones.....	15
4.4 Planning for future land uses .....	15
4.5 Using best management practices.....	16
4.6 Enforcing by-laws and surveying the area .....	16
4.7 Responding to emergencies .....	17
4.8 Implementing and updating this plan.....	17
<b>5 Recommendations .....</b>	<b>19</b>
<b>Appendices.....</b>	<b>21</b>
Appendix A — Figures.....	21
Appendix B — Water quality data .....	26
Appendix C — Land use, potential water quality risks and recommended protection strategies.....	29
Appendix D — Photographs .....	34

List of shortened forms .....	35
Glossary .....	37
References .....	41
Further reading .....	43

## Tables

Table 1	Summary of potential water quality risks, land use compatibility and best management practices .....	13
Table 2	Drinking water source protection reports.....	18

## Summary

The Department of Water has prepared this drinking water source protection plan to help protect the quality of water in Hester Dam and safeguard it for drinking water supply. This plan is consistent with the *Australian drinking water guidelines (ADWG)* (NHMRC & NRMCC 2011) and State planning policy no. 2.7: *Public drinking water source policy*.

The Bridgetown Catchment Area, containing Hester Dam, was proclaimed in 1959 under the *Country Areas Water Supply Act 1947*. Hester Dam is approximately 270 km south of Perth and 6 km north-east of Bridgetown, within the Shire of Bridgetown-Greenbushes. Hester Dam supplies drinking water to Hester and forms part of the Warren Blackwood regional water supply scheme.

In order to appropriately protect this drinking water source, a reduced catchment boundary for Hester Dam has been defined based on topographical information (Figure A3). This plan recommends reducing the Bridgetown Catchment Area to about 25 per cent of its current size and renaming it the Hester Dam Catchment Area.

The majority of the Bridgetown Catchment Area covers state forest managed by the Department of Parks and Wildlife (formerly known as the Department of Environment and Conservation). A small number of privately owned residential lots, the Bridgetown Golf Course and the Water Corporation wastewater treatment plant are also located within the existing catchment area (Figure A3). However, the proposed Hester Dam Catchment Area covers only state forest, with all privately held land removed from the new catchment area.

Unauthorised recreational activities within the proposed Hester Dam Catchment Area – including swimming, fishing and marroning – have been identified as the highest contamination risks to this water source. This plan recommends that access to this catchment area is limited to essential personnel and authorised people, except along public road(s). This is consistent with Operational policy no.13: *Recreation within public drinking water source areas on Crown land* (Department of Water 2012). However, approximately 400 ha of state forest will be removed from the existing catchment area where public access will not be restricted by Operational policy no. 13.

Stakeholders consulted during the development of this plan include the Shire of Bridgetown-Greenbushes, Water Corporation, Department of Health, Department of Parks and Wildlife (formerly known as the Department of Environment and Conservation), Department of Mines and Petroleum, South West Aboriginal Land and Sea Council, mining tenement holders and private landowners (residential).

The most important recommendations in this plan are to:

- amend the boundary of the Bridgetown Catchment Area and rename it the Hester Dam Catchment Area

- remove approximately 400 ha of state forest, all privately held land, the golf course and the wastewater treatment plant from the existing Bridgetown Catchment Area
- propose a reservoir protection zone (RPZ) and Priority 1 (P1) area over the entire proposed Hester Dam Catchment Area, due to its small size
- include the boundary of the proposed Hester Dam Catchment Area in the Shire of Bridgetown-Greenbushes local planning schemes
- restrict access to the Hester Dam to prevent unauthorised vehicular and recreational use
- erect signs at appropriate locations along the new boundary of the Hester Dam Catchment Area.

A summary of important information about the proposed Hester Dam Catchment Area is given below.

Local government authority	Shire of Bridgetown-Greenbushes
Locations supplied	Hester, integrated Warren Blackwood regional water supply scheme (Bridgetown, Hester, Boyup Brook, Nannup and Manjimup)
Volume of water held	131 ML capacity (3.6 ha surface area)
Dam completion	1918
Date of drinking water source protection assessment	June 2004
Proclamation status	Bridgetown Catchment Area proclaimed on 26 June 1959 under the <i>Country Areas Water Supply Act 1947</i> .  The boundary of this catchment area will be amended and renamed the Hester Dam Catchment Area when this plan is finalised.
Description of drinking water source	This is a surface water reservoir within state forest. The source is augmented by Millstream Dam and Nannup bore no. 1/07 (Yarragadee aquifer).



# 1 Overview of the Hester Dam drinking water source

## 1.1 The drinking water supply system

### 1.1.1 Hester

Hester is a small town within the Shire of Bridgetown-Greenbushes in south-west Western Australia, approximately 270 km south of Perth and 6 km north-east of Bridgetown (Figure A1). It is predominantly an industrial centre servicing the surrounding agricultural areas.

### 1.1.2 Bridgetown Catchment Area

The existing Bridgetown Catchment Area covers over 700 ha of land surrounding the Hester Dam west of the Hester town site. It comprises almost 600 ha of uncleared state forest, a small number of privately owned residential properties, the Bridgetown Golf Course and the Water Corporation wastewater treatment plant that services Bridgetown (Figure A3).

### 1.1.3 Hester Dam

Hester Dam is located on the Geegelup Brook, a tributary of the Blackwood River, and was built in 1918. Its original purpose was to supply water for railway steam engines, but since 1969 it has been used as the town's drinking water source. The dam wall is approximately 13 m high. The reservoir (Figure D1) has a storage capacity of 131 ML and a surface area of 3.6 ha when full.

The physical catchment for Hester Dam is located entirely within the existing Bridgetown Catchment Area. It covers 182 ha of state forest, which is approximately 25 per cent of the existing Bridgetown Catchment Area (Figure A4).

### 1.1.4 Warren Blackwood regional water supply scheme

Hester Dam is operated by the Water Corporation as part of the Warren Blackwood regional water supply scheme (WBRWSS) that supplies water to the towns of Bridgetown, Hester, Boyup Brook, Nannup and Manjimup. The WBRWSS was recently formed through the amalgamation of the Bridgetown, Nannup and Manjimup schemes. Construction has begun on a pipeline to connect Manjimup Dam with the Nannup and Bridgetown schemes to help secure a reliable water supply for Manjimup. It is also planned to permanently connect the towns of Greenbushes, Balingup, Mullalyup and Kirup to the WBRWSS.

Water is transferred between surface water sources in the WBRWSS to optimise storage and augment sources when supply is insufficient. Nannup bore no. 1/07 – drawing water from the Yarragadee aquifer – supports the WBRWSS. In low rainfall years, groundwater supplied from Nannup bore no. 1/07 is stored in Millstream Dam

and used to augment surface water sources throughout the WBRWSS as required, including Hester Dam.

### 1.1.5 Water treatment and distribution

Raw water drawn from Hester Dam is treated using ultraviolet disinfection and chlorination. The treatment system continuously monitors the performance of the chlorination and ultraviolet treatment systems, as well as turbidity levels, with automated alarms and critical shut-down procedures. Treated water from Hester Dam is then pumped to two 225 kL storage tanks, located east of Hester, for distribution to the Hester town site. Water from these tanks is also distributed to Boyup Brook and the Greenbushes-Balingup scheme in summer or as required.

It should be recognised that although treatment and disinfection are essential barriers against contamination, public drinking water source area (PDWSA) management is the first step in protecting water quality and ensuring a safe drinking water supply. This approach is endorsed by the *Australian drinking water guidelines* (ADWG) (NHMRC & NRMCC 2011) and reflects a preventive, 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, refer to our website <<http://drinkingwater.water.wa.gov.au>>.

## 1.2 Water management

### 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 apply such as abstracting water for domestic purposes only.

The proposed Hester Dam Catchment Area is located within the Hester Surface Water Area which is proclaimed under the *Rights in Water and Irrigation Act 1914*. There is no separate water allocation licence for Hester Dam. Instead, the Water Corporation is licensed by the Department of Water to draw 772 ML per year from the Millstream, Hester and Boyup Brook dams for public water supply. The annual draw of surface water from Hester Dam can vary considerably due to dam works and fluctuating streamflows (Water Corporation 2012a).

### 1.2.2 Water planning

The Department of Water published the *South West regional water plan 2010–2030: Strategic directions and actions* in May 2010. That plan highlights the importance of securing public water supplies, particularly in light of the region's rapid urban development and population growth, while water availability is decreasing at the same time due to a drying climate. It is necessary to improve the protection of PDWSAs from contamination threats. Threats to drinking water quality include activities that contaminate surface water runoff and produce contaminants that leak into groundwater.

The *South West regional water plan* lists a number of strategies and actions to achieve its objectives, including:

- Strategy 5.2 – Protect drinking water sources
- Action 5.2.1 – Develop drinking water source protection plans for all active PDWSAs for consideration in local planning documents.

The preparation of this document contributes to the implementation of the above.

### 1.2.3 Future water needs

The water demand for the WBRWSS is forecast to remain below the licensed allocation for the scheme for the foreseeable future. Nannup bore no. 1/07 is expected to provide necessary security of supply during low rainfall periods (Water Corporation 2012b).

## 1.3 Characteristics of the catchment

### 1.3.1 Physical environment

The Hester Dam Catchment Area is in the Darling Plateau, which consists of a gently undulating, dissected slope with gravelly, pale orange soils cloaked by extensive areas of tall forest. Deep, steep-sided valleys occur throughout the area with occasional impressive dome-shaped granite outcrops.

Soils in the Hester area are predominantly gravels with occasional block laterite outcrops and some elevated areas of sands and sandy loams with heavier alluvials in the deeper valleys.

### 1.3.2 Climate

The area has a temperate climate, characterised by warm, dry summers and cool, wet winters. The average annual rainfall at Bridgetown between 1998 and 2012 was about 722 mm, with most of this falling between May and September. However, during that period, annual rainfall varied from a low of 423 mm in 2010 to a high of 1012 mm in 2005 (Bureau of Meteorology).

### 1.3.3 Hydrology

Elevation in the Hester Dam Catchment Area is 255.85 m AHD at the reservoir (full supply level), rising to 300 m AHD at the head of the catchment. The long-term average stream flow of Geegelup Brook at the dam is estimated to be 80 ML per year (Water Corporation 2009).

## 1.4 How is this drinking water source currently protected?

The existing Bridgetown Catchment Area was proclaimed in 1959 under the *Country Areas Water Supply Act 1947* for the purpose of protecting the public drinking water source from potential contamination. At present, the proclaimed catchment area extends beyond the physical boundary of the catchment for Hester Dam. This plan recommends amending the existing Bridgetown Catchment Area to reflect the physical catchment boundary for the Hester Dam, and renaming it the Hester Dam Catchment Area.

In 2004 the Water Corporation prepared the *Bridgetown Catchment Area (Hester Dam) drinking water source protection assessment*. It presents information about the catchment, identifies risks to water quality and recommends strategies to manage the risks. This document replaces it, and provides more up-to-date information – including a defined priority area and protection zone.

Priority areas and protection zones have not previously been assigned to the Bridgetown Catchment Area; however, the land has been managed as a Priority 1 (P1) area, consistent with Water quality protection note (WQPN) no. 25: *Land use compatibility in public drinking water source areas*. This plan assigns a P1 area and proposes a reservoir protection zone (RPZ) to the entire proposed Hester Dam Catchment Area. The usual 2 km RPZ will not fit within the small Hester Dam Catchment Area boundary, so it covers the entire catchment.

The Water Corporation has implemented best management practices and operational procedures to identify and manage risks to water quality within the catchment area. These include:

- signs to increase public awareness of drinking water protection
- fencing around the reservoir
- maintaining sufficient storage to minimise the effect of inflow events on turbidity and pathogen levels
- inspections of the catchment and water body during high risk rainfall events
- water quality monitoring
- regular patrols and surveys of the catchment area to identify and monitor risks to water quality.

The Water Corporation also enforces the Country Areas Water Supply By-laws 1957 on behalf of the Department of Water where required. To find out more about the by-laws, please see section 4.6: *Enforcing by-laws and surveying the area.*

## 2 Common contamination risks

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

Some contaminants in drinking water can affect human health. Other impurities can affect the water's aesthetic qualities, including its appearance, taste, smell and 'feel' but are not necessarily hazardous to human health. For example, cloudy water with a distinctive odour or strong taste may not be harmful to health, but clear, pleasant-tasting water may contain harmful, undetectable microorganisms (NHMRC & NRMCC 2011). Contaminants can also interfere with water treatment processes, and damage water supply infrastructure (such as iron corroding pipes).

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

For more information about water quality in this PDWSA, see section 3: *Contamination risks in this drinking water source.*

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

### 2.1 Microbiological risks

Pathogens are types of microorganisms that are capable of causing illness. These include bacteria, protozoa and viruses. In drinking water supplies, pathogens 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 area. When people (while fishing, marroning, swimming etc.) or domestic animals come into contact with a body of water, pathogens may enter that water source. This occurs through the direct transfer of faecal material into the water, 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. Monitoring for the presence of *E. coli* in water supplies provides an indication of the level of recent faecal contamination.

Pathogen contamination of a drinking water source is influenced by many factors including the existence of pathogen carriers (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 a month in the natural environment (Geldreich 1996) and *Cryptosporidium* oocysts (cells containing reproductive spores) may survive weeks to months in fresh water (NHMRC & NRMMC 2011).

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

When people consume drinking water contaminated with pathogens the consequences 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 & NRMMC 2011).

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

## 2.2 Physical risks

Turbidity is the result of soil or organic particles becoming suspended in water (cloudiness). Erosion from activities such as off-road driving and clearing vegetation can cause turbidity. Increased turbidity can result in cloudy or muddy-looking water, which is not aesthetically appealing to consumers. Turbidity can also reduce the effectiveness of treatment processes (such as disinfection). This is because pathogens can adsorb onto soil particles and may be shielded from the effects of disinfection. Chemicals can also attach to suspended soil particles. High levels of turbidity in a water body can also affect the environment. It smothers riparian vegetation and reduces the transfer of light within the water column, affecting 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 2011). 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 and 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, septic systems, and faecal matter from domestic or feral animals 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 2011).

Other chemicals and heavy metals can be associated with land uses such as industry and landfill. These may enter drinking water sources and could 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 Hester Dam for microbiological, health-related and aesthetic (non-health-related) characteristics. These data show the quality of water in the PDWSA. 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, chaired by the Department of Health.

A water quality summary for Hester Dam from January 2008 to December 2012 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*.

Raw water exceeded ADWG guideline values for iron, chloride, turbidity, pH and *Escherichia coli*. Elevated turbidity levels and detections of *E. coli* are associated with both low water levels in Hester Dam and rainfall events, where it is likely that accumulated faecal matter is washed into the dam (see Appendix B). Raw water from the Hester Dam is treated before being supplied to consumers to ensure it meets the requirements of the ADWG.

When needed, Hester Dam is augmented by Millstream Dam, which is in turn augmented by Nannup bore no. 1/07. Water can also be transferred between Hester Dam and other surface water storages in the WBRWSS to optimise storage throughout the scheme. As a result, raw-water quality in Hester Dam may vary depending upon the source being used for augmentation.

### 3.2 Land uses and activities

The proposed Hester Dam Catchment Area is located over Crown land that is designated for state forest. Current land uses and activities and their risks to the drinking water source are described below. Table 1, at the end of this section, summarises this information in an easy-to-read format. Appendix C displays a more detailed risk assessment, and includes recommended protection strategies to address water quality risks.

#### 3.2.1 State forest

The proposed Hester Dam Catchment Area is located in state forest (Figure A3), which is vested in the Conservation Commission of Western Australia and managed by the Department of Parks and Wildlife (formerly known as the Department of Environment and Conservation) under the *Conservation and Land Management Act 1984*. Under this act, the Department of Parks and Wildlife prepares management

plans in consultation with the Department of Water and the Water Corporation and submits them to the Minister for Water.

Indigenous state forest is managed according to the *Forest management plan 2004–2013* (Conservation Commission of Western Australia 2004). The state forest surrounding Hester Dam is categorised as an interim forest conservation area in the plan, and is proposed to become a conservation park. Interim forest conservation areas are managed for the same purposes as state forest, including conservation, recreation, water catchment protection and other purposes prescribed by the Conservation and Land Management Regulations 2002 (e.g. beekeeping). However, forest conservation areas are not available for timber harvesting and the priority for management is maintenance of biodiversity.

### *Fire management*

The Department of Parks and Wildlife is responsible for fire management in the catchment, with water quality risks considered in fire management operations. There are several fire management tracks in the state forest (Figure A3). These are maintained regularly to ensure adequate access in the event of a wildfire. However, these tracks also allow unauthorised vehicle access to the reservoir and catchment. The Water Corporation is currently liaising with the Department of Parks and Wildlife to install boom gates across the fire management tracks to restrict unauthorised vehicle access.

### *Native, domestic and feral animals*

There is a significant native wildlife community in the area. Feral animals, including pigs, are rare within the catchment, but domestic dogs and cats may access the catchment given it is close to the Hester township (Figure A2). Feral and domestic animals can introduce pathogens into the catchment and reservoir. Domestic animals and livestock are prohibited within the proposed Hester Dam Catchment Area.

### *Authorised recreation*

Recreation in state forest is managed by the Department of Parks and Wildlife in accordance with Policy statement no. 18: *Recreation, tourism and visitor services* (Department of Environment and Conservation 2006) and Operational policy no.13: *Recreation within public drinking water source areas on Crown land* (Department of Water 2012) and the *Country Areas Water Supply Act 1947*. There are no existing, approved recreational activities within the proposed Hester Dam Catchment Area. Consistent with Operational policy no.13, this plan recommends that new recreational facilities and activities should not be established within the proposed Hester Dam Catchment Area due to the proposed RPZ.

However, the proposed changes to the boundary of the catchment area for Hester Dam will reduce it to 25 per cent of its original size. This removes approximately 400 ha of state forest from the existing catchment area. Public access and recreational opportunities in this area of state forest will not be restricted by the

requirements of Operational policy no. 13 or the Country Areas Water Supply By-laws 1957 and will continue to be managed by the Department of Parks and Wildlife.

### 3.2.2 Public road

Hester Road, a sealed public road, bisects the catchment area (Figure A2). It has been classified by Main Roads Western Australia as an alternate heavy traffic route with signs erected on adjacent routes to encourage its use. The main types of goods transported along Hester Road include timber, hydrocarbons, fertilisers, pesticides and livestock. Road accidents and fuel or chemical spills are potential contamination risks to the reservoir. Ideally, this type of road route should not occur through a drinking water catchment, but as it is an existing, legally established land use, it will remain and any contamination risks should be managed (see WQPN no. 44: *Roads near sensitive water resources* for more details).

### 3.2.3 Public access and unauthorised recreation

Consistent with Operational policy no.13: *Recreation within public drinking water source areas on Crown land* (Department of Water 2012) and the proposed RPZ, this plan recommends that access to the proposed Hester Dam Catchment Area is restricted to officers of the Department of Parks and Wildlife, Water Corporation and Department of Water, fire and emergency services personnel and other authorised people, except along public roads.

#### *Bushwalking*

People have been observed bushwalking within the catchment area, often accompanied by dogs. People and domestic animals can introduce pathogens into the catchment and reservoir, especially within the proposed RPZ.

Under Operational policy no. 13, bushwalking within the RPZ can only occur along public roads. Dogs are prohibited within the catchment, except on public roads, and penalties may apply under the *Country Areas Water Supply Act 1947* and associated by-laws.

#### *Vehicle access*

Vehicles have been observed accessing the catchment along tracks and off-road (e.g. four-wheel drives and trail bikes). Vehicle use within the catchment can increase erosion and contribute to turbidity in the water body, as well as increase the potential for hydrocarbon contamination.

Unauthorised vehicle access is prohibited within the proposed Hester Dam Catchment Area, except on public roads, and penalties may apply under the *Country Areas Water Supply Act 1947* and associated by-laws.

### *Swimming in the reservoir*

Even though the reservoir is fenced, there have been reports of people swimming in it, particularly during summer. Body contact with the water can result in immediate pathogen contamination of the water source.

Bathing in the reservoir and its tributaries is illegal and penalties may apply under the *Country Areas Water Supply Act 1947* and associated by-laws.

### *Fishing and marroning*

Evidence of fishing and marroning has been found in the catchment. These activities also involve body contact with the water and introduce decomposing baits to the reservoir or its tributaries. Both can result in pathogen contamination of the water source.

Fishing and marroning are illegal in the reservoir and tributaries within the proposed Hester Dam Catchment Area and penalties may apply under the *Country Areas Water Supply Act 1947*.

### *Firewood collection*

People have been observed collecting firewood in the catchment, often accompanied by domestic dogs. People and domestic animals can introduce pathogens into the catchment and reservoir, especially within the proposed RPZ. The proposed Hester Dam Catchment Area is not a designated firewood collection area.

## 3.2.4 Aboriginal sites of significance and native title claims

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 are three native title claims within the Hester Dam Catchment Area. These are South West Boorah 2 (WAD253/06), Southern Noongar (WAD6134/98) and Wagyl Kaip (WAD6286/98).

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

The land uses and activities identified in this plan (figures A3 and A4) are not expected to change in the short-term. There are two pending mining tenement applications within the proposed Hester Dam Catchment Area (E70/3407 and E70/3473). Future land uses in the catchment should be assessed in accordance with the Department of Water's Water quality protection note (WQPN) no. 25: *Land use compatibility in public drinking water source areas* and the Western Australian Planning Commission's State planning policy no. 2.7: *Public drinking water source policy*.

**Table 1** Summary of potential water quality risks, land use compatibility and best management practices

Land use/activity	Hazard	Management priority	Compatibility of land use/activity	Best management practice guidance <sup>1</sup>
Swimming in the reservoir	Pathogens from body contact	High	Incompatible Swimming is illegal – penalties may apply	Operational policy no. 13: <i>Recreation within public drinking water source areas on Crown land</i> (Department of Water 2012)  Policy statement no. 18: <i>Recreation, tourism and visitor services</i> (Department of Environment and Conservation 2006)
Fishing and marroning	Pathogens from body contact and decomposing bait	High	Incompatible Fishing and marroning are illegal – penalties may apply	
Off-road vehicle use	Turbidity and hydrocarbons	Medium	Incompatible	
Bushwalking	Turbidity and pathogens	Medium	Incompatible in proposed RPZ	
Firewood collection	Turbidity and pathogens	Medium	Incompatible in proposed RPZ  Not a designated firewood collection area	
Roads and tracks	Hydrocarbons and turbidity	Medium	Existing sealed public road is acceptable  Unsealed tracks need to be managed to control access	WQPN no. 44: <i>Roads near sensitive water resources</i>  WQPN no. 10: <i>Contaminant spills – emergency response</i>
Fire management and wildfires	Turbidity and pathogens	Medium	Compatible with best management practices	<i>Code of practice for fire management</i> (Department of Environment and Conservation 2008)

<sup>1</sup>Water quality protection notes are available <<http://drinkingwater.water.wa.gov.au>> and scroll down to the link for *water quality protection notes*.

## 4 Protecting your drinking water source

This plan aims to protect this drinking water source so that safe drinking water is supplied to the towns of Hester and the WBRWSS. Existing approved land uses in and around the proposed catchment area can continue.

### 4.1 Proclaiming public drinking water source areas

The Bridgetown Catchment Area was proclaimed under the *Country Areas Water Supply Act 1947* in 1959. As part of this plan's preparation, the boundary of the catchment area was reviewed. It was found that the physical catchment for the Hester Dam was much smaller than the proclaimed boundary. This plan recommends amending the boundary of the Bridgetown Catchment Area to reflect the physical catchment of Hester Dam (Figure A5), and renaming it the Hester Dam Catchment Area, under the *Country Areas Water Supply Act 1947*.

Once the proposed Hester Dam Catchment Area is proclaimed, the local government should incorporate the PDWSA into its 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.

For more guidance on appropriate land uses and activities please refer to 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, industrial or commercial).

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 Hester Dam Catchment Area have been determined in accordance with current Department of Water policy. These areas are described below and displayed in Figure A5. 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*.

We propose to assign all land in the Hester Dam Catchment Area as P1 because:

- water from this source is the only supply available to Hester
- current land uses (i.e. state forest) on Crown land are considered acceptable in a P1 area.

### 4.3 Defining protection zones

In addition to priority areas, protection zones are defined in PDWSAs to protect water from contamination in the immediate vicinity of water extraction facilities (i.e. bores or dams). Specific conditions may apply within these zones such as restrictions on the storage of chemicals or prohibition of 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 or downstream of the dam wall. They adopt the priority area of the land over which they occur.

RPZs that occur in the *Metropolitan Water Supply, Sewerage, and Drainage Act 1909* are referred to as 'prohibited zones' and 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, like Hester. Due to the relatively small size of the proposed Hester Dam Catchment Area, the proposed RPZ extends to a maximum of 1.5 km and covers the entire catchment area (Figure A5).

### 4.4 Planning for future land uses

It is recognised under the Western Australian Planning Commission's *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 State planning policy no. 2.7: *Public drinking water source policy* (Western Australian Planning Commission 2003) it is appropriate that the proposed Hester Dam Catchment Area, its priority area and protection zone be recognised in the Shire of Bridgetown-Greenbushes local planning scheme. Any development proposals in the proposed Hester Dam Catchment Area that are inconsistent with advice in our WQPN no.25: *Land use compatibility in public drinking water source areas* or recommendations in this plan, need to be referred to our nearest regional office 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 Parliamentary Committees all advocated protection over a reliance on costly water treatment or the clean-up of contaminated sources required in other parts of the world.

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 criteria. 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, construction and operation 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 WQPNs. 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 have been developed in consultation with stakeholders such as industry groups, agricultural producers, state government agencies and technical advisers. Examples relevant to Hester Dam Catchment Area include WQPN no. 83: *Infrastructure corridors near sensitive water resources*, WQPN no. 96: *Pest animal management in public drinking water source areas*, WQPN no. 44: *Roads near sensitive water resources*, WQPN no. 81: *Tracks and trails near sensitive water resources* and WQPN no. 10: *Contaminant spills – emergency response*, which are listed in this plan's *References* section.

Education and raising awareness (such as through providing information on signs and publications) are key mechanisms for protecting water quality, especially for people visiting the area.

## 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-use activities in PDWSAs, to be an important mechanism to protect water quality. Surveillance and by-law enforcement for the proposed Hester Dam Catchment Area will continue to be undertaken by the Water Corporation.

Signs have been erected within this catchment area to educate and advise the public about activities that are prohibited or regulated. Additional signs will need to be erected at appropriate locations along the revised boundary of the catchment area,



such as near existing tracks, roads and other sites where public access has been identified.

## 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 Shire of Bridgetown-Greenbushes local emergency management committee (LEMC), through the South West emergency management district, should be familiar with the location and purpose of the Hester Dam Catchment Area. A locality plan will be provided to the fire and rescue services headquarters for the hazardous materials (HAZMAT) emergency advisory team. Department of Parks and Wildlife is the lead agency for wildfire control management for most of the catchment area outside of the gazetted fire emergency response zone. The Water Corporation should have an advisory role to the HAZMAT team for incidents in the proposed Hester 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 proposed Hester Dam Catchment Area. These personnel should have an adequate understanding of the potential impacts of spills and use of chemical-based fire fighting substances on this drinking water source.

## 4.8 Implementing and updating this plan

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

With more than 130 PDWSAs across Western Australia, the department prioritises the update of drinking water source protection reports (such as this document). Our aim is to update each report every five years. In some locations, more frequent updates may be required to address changing water quality risks and land uses. These updates allow us to make changes to the PDWSA boundary, priority areas and protection zones if required. They also allow solutions to new water quality risks to be considered.

There are three different types of drinking water source protection report – each providing for different needs. Table 2 below shows the differences between the types of reports.

*Table 2 Drinking water source protection reports*

<b>Drinking water source protection report</b>	<b>Scope and outcome</b>	<b>Consultation</b>	<b>Time to prepare</b>
Drinking water source protection assessment (DWSPA)	Desktop assessment of readily available information.	Targeted	Up to 3 months
Drinking water source protection plan (DWSP)	Full investigation of risks to water quality building on information in the DWSPA.	All stakeholders	6–12 months
Drinking water source protection review (DWSPR)	Review change in land and water factors and implementation of previous recommendations.	Key stakeholders	Up to 3 months

## 5 Recommendations

The following recommendations apply to the proposed Hester Dam Catchment Area. The bracketed stakeholders are those expected to have a responsibility for, or an interest in, the implementation of that recommendation.

1. Amend the boundary of the Bridgetown Catchment Area under the *Country Areas Water Supply Act 1947*, and rename it the Hester Dam Catchment Area. (Department of Water)
2. Incorporate the findings of this plan and location of the Hester Dam Catchment Area (including its priority area and protection zone) in the Shire of Bridgetown-Greenbushes local planning scheme in accordance with State planning policy no. 2.7: *Public drinking water source policy*. (Shire of Bridgetown-Greenbushes)
3. Refer development proposals within the Hester Dam Catchment Area 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 to the Department of Water regional office for advice. (Department of Planning, Shire of Bridgetown-Greenbushes, proponents of proposals)
4. Ensure incidents covered by Westplan–HAZMAT in the Hester Dam Catchment Area are addressed by ensuring that:
  - the Shire of Bridgetown-Greenbushes LEMC is aware of the location and purpose of the Hester Dam Catchment Area
  - the locality plan for the Hester Dam Catchment Area is provided to the Department of Fire and Emergency Services headquarters for the HAZMAT emergency advisory team
  - the Water Corporation acts in an advisory role during incidents in the Hester Dam Catchment Area
  - personnel dealing with Westplan–HAZMAT incidents in the area have ready access to a locality map of the Hester Dam Catchment Area and information to help them recognise the potential impacts of spills on drinking water quality. (Water Corporation)
5. Erect signs including an emergency contact telephone number at appropriate locations along the boundary of the Hester Dam Catchment Area. (Water Corporation)
6. Apply Operational policy no. 13: *Recreation within public drinking water source areas on Crown land* to the management of recreation in the Hester Dam Catchment Area. (Department of Water)
7. Continue best management practices and operational procedures to protect water quality. (Water Corporation)
8. Update this plan after five years. This may require a new plan if substantial changes have occurred. If not, a drinking water source protection review may be developed. (Department of Water)



# Appendices

## Appendix A – Figures

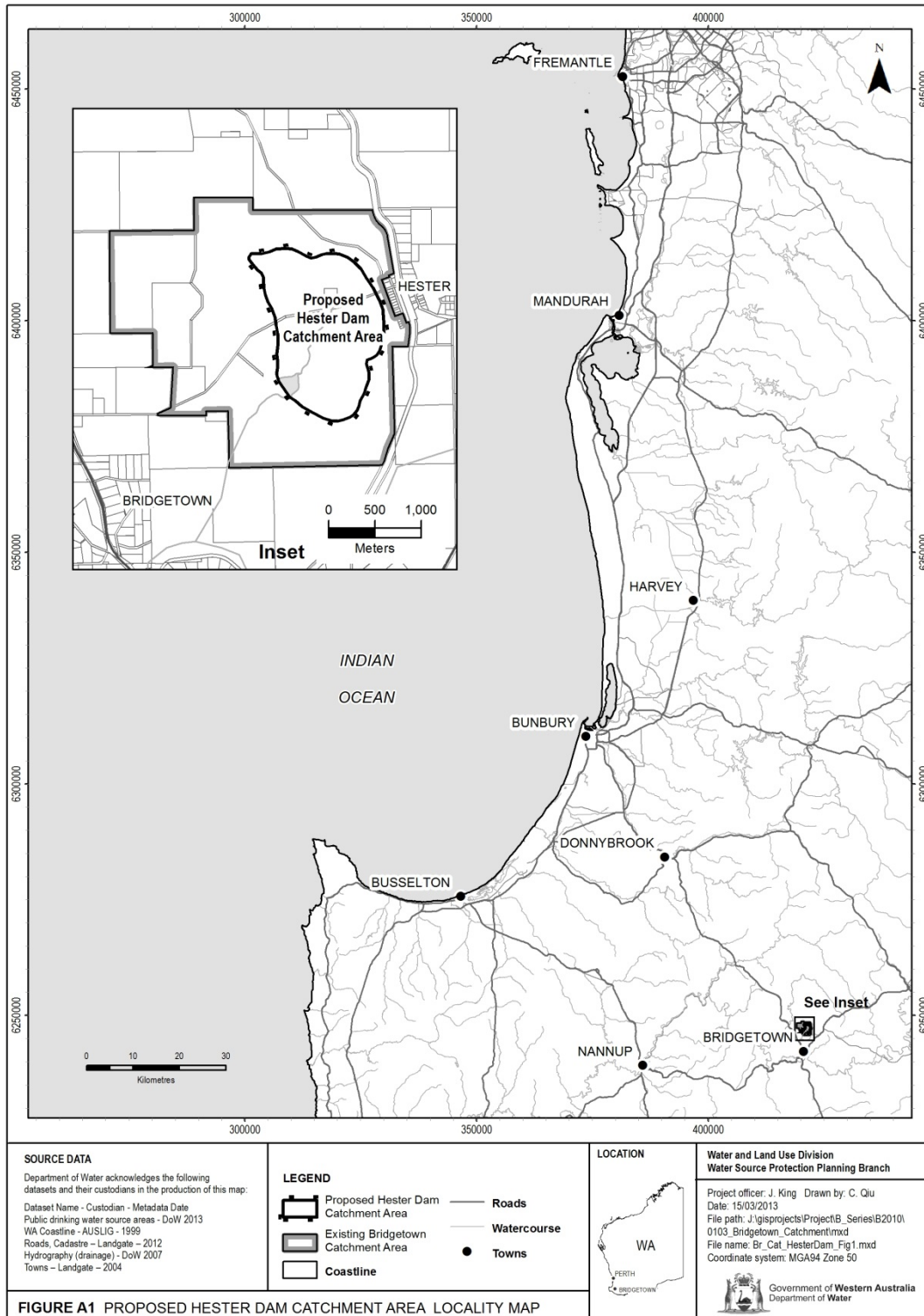


Figure A1 Proposed Hester Dam Catchment Area locality map

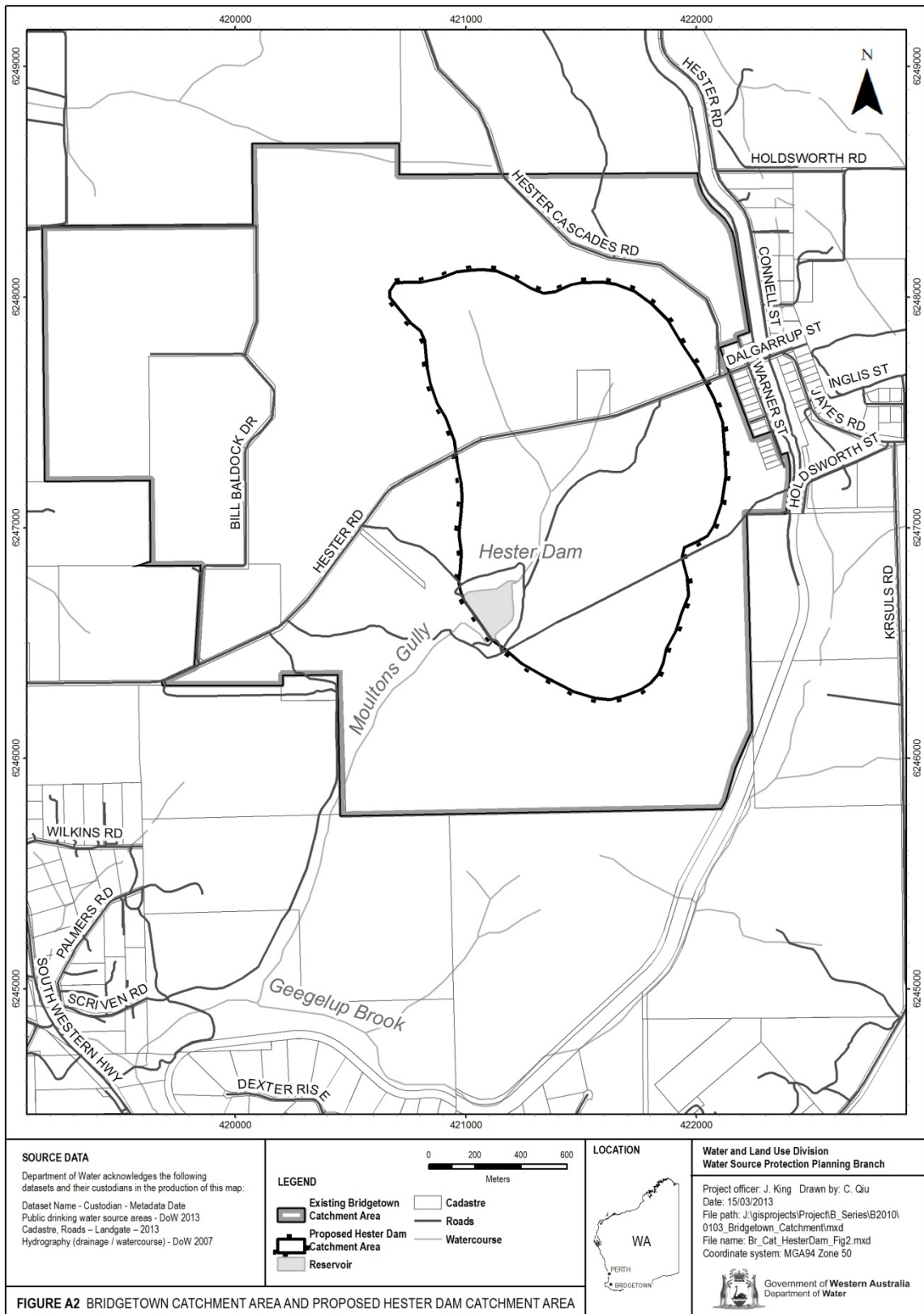


Figure A2 Current Bridgetown Catchment Area and proposed Hester Dam Catchment Area

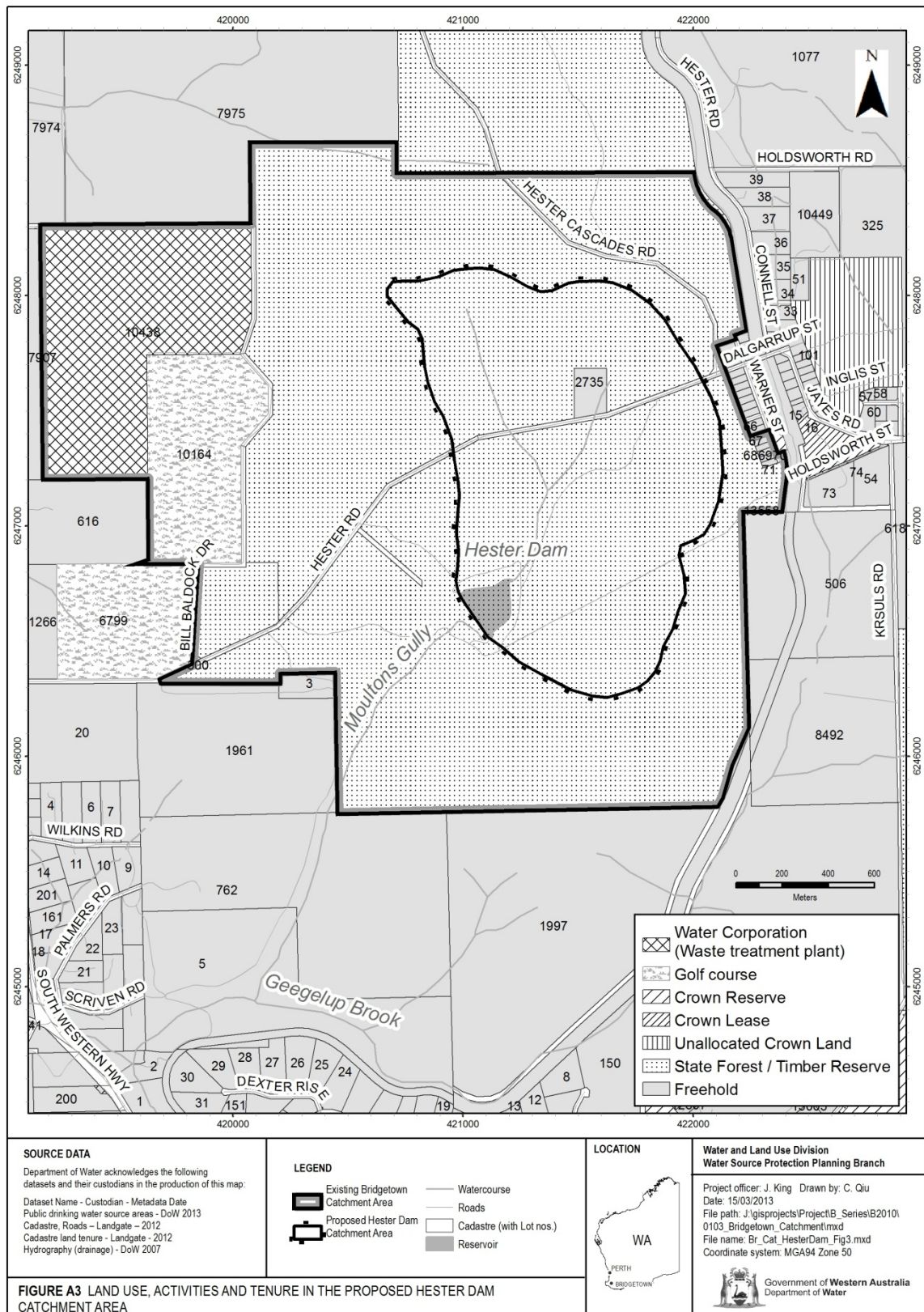


Figure A3 Land use, activities and tenure in the proposed Hester Dam Catchment Area

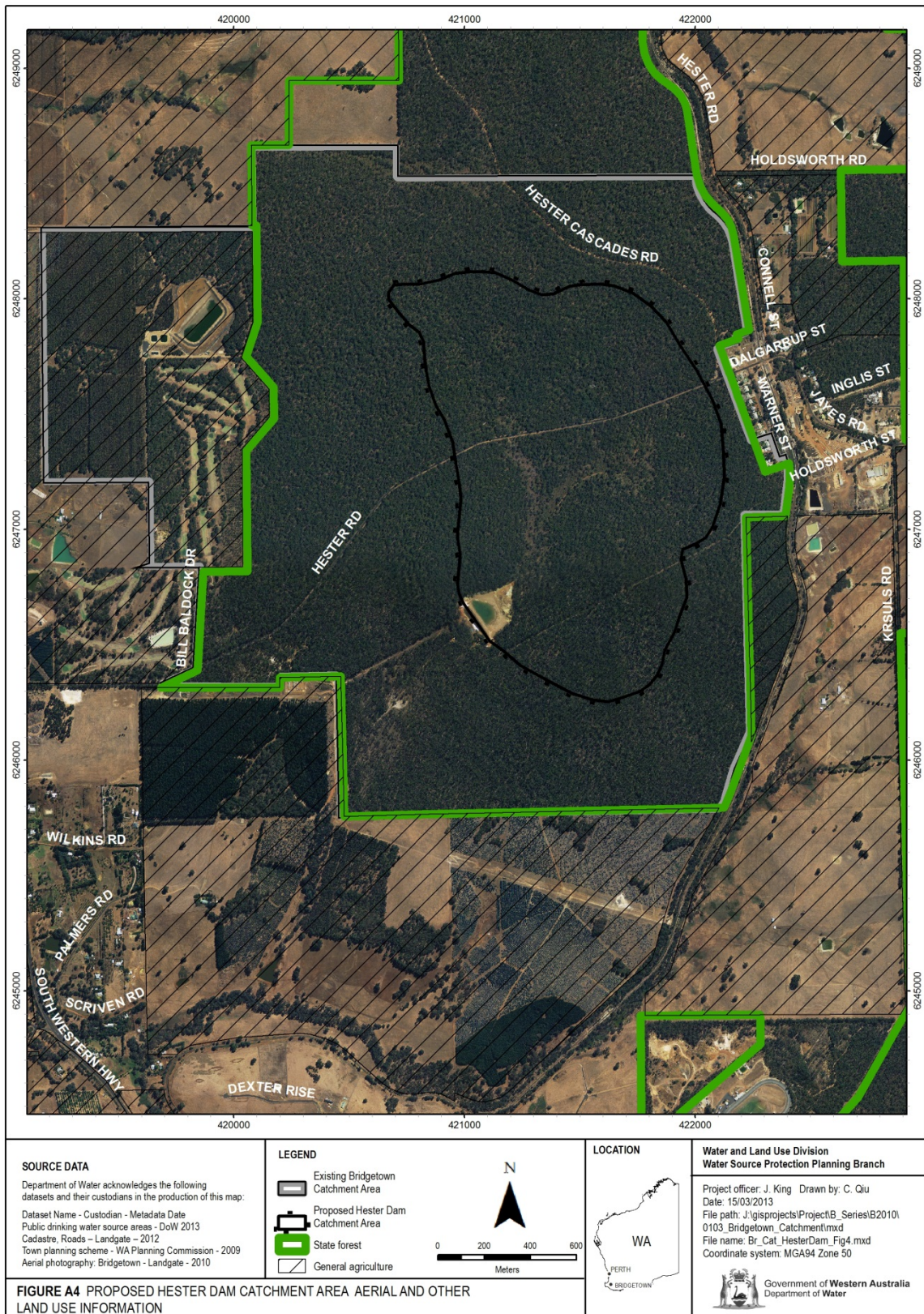


Figure A4 Proposed Hester Dam Catchment Area – aerial and other land use information



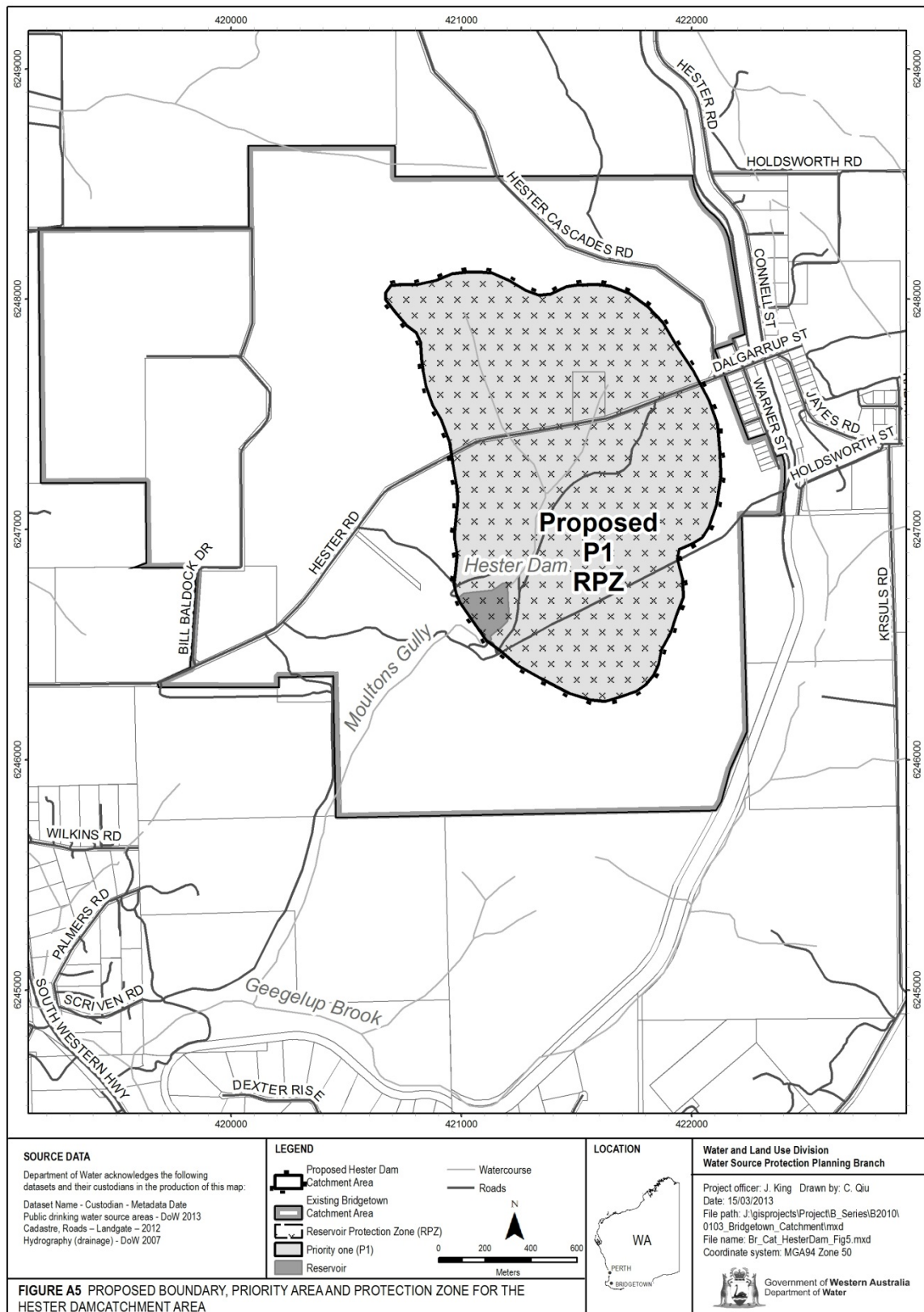


Figure A5 Recommended boundary, priority area and protection zone for the proposed Hester Dam Catchment Area

## Appendix B – Water quality data

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

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

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

The following data represents the quality of raw water from Hester Dam. In the absence of specific guidelines for raw-water quality, the results have been compared with the ADWG values set for drinking water, which defines the quality requirements at the customer's tap. Any water quality parameters that have been detected are reported; those that on occasion have exceeded the ADWG are in bold and italics to give an indication of potential raw-water quality issues associated with this source. The values are taken from ongoing monitoring for the period January 2008 to December 2012.

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 Hester and the Bridgetown regional water supply scheme 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 *Drinking water quality annual report*.

### *Aesthetic characteristics*

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

*Aesthetic detections for Hester Dam*

Parameter	Units	ADWG aesthetic guideline value*	Hester Dam	
			Range	Median
Chloride	mg/L	250	90– <b>250</b>	107.5
Colour (true)	TCU	15	<1–8	2
Hardness as CaCO <sub>3</sub>	mg/L	200	90–161	100
Iron unfiltered	mg/L	0.3	0.004– <b>0.42</b>	0.07
Manganese unfiltered	mg/L	0.1	<0.02–0.034	0.005
pH measured in laboratory	no units	6.5–8.5	<b>6.33–9.2</b>	7.86
Sodium	mg/L	180	49–120	53
Sulfate	mg/L	250	10–34	13
Total filterable solids by summation	mg/L	600	292–519	349.5
Turbidity	NTU	5	0.2– <b>41</b>	1.4
Zinc	mg/L	3	<0.02–0.08	<0.05

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

*Health-related chemicals*

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

### Health-related detections for Hester Dam

Parameter	Units	ADWG health guideline value*	Hester Dam	
			Range	Median
Barium	mg/L	0.7	0.045–0.18	0.11
Boron	mg/L	4	0.04–0.06	0.05
Fluoride (lab)	mg/L	1.5	<0.1–0.15	0.1
Manganese unfiltered	mg/L	0.5	<0.02–0.034	0.005
Nitrate as nitrogen	mg/L	11.29	<0.002–0.08	<0.002
Nitrite plus nitrate as nitrogen	mg/L	11.29	<0.002–0.24	<0.05
Sulfate	mg/L	500	10 - 34	13

\* 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 2011).

† A guideline value of 11.29 mg/L (as nitrogen) has been set to protect bottle-fed infants less than three months of age. Up to 22.58 mg/L (as nitrogen) can be safely consumed by adults and children over three months of age.

### Microbiological contaminants

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

A count less than 20 MPN (most probably number) per 100 millilitres (mL) sample 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, positive *E. coli* counts were recorded in 76 per cent of samples. Approximately 11 per cent of these samples had *E. coli* counts greater than 20 MPN per 100 mL.

Most detections occurred after rainfall events when it is likely that accumulated faecal matter is washed into the dam. Ultraviolet disinfection, chlorine disinfection and storage are barriers to help reduce the risk of microbiological contamination to the public.

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

Land use/ activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
Swimming in reservoir	<p>Pathogens from direct body contact with the water by humans and dogs</p> <p>Turbidity from swimming and bank erosion</p>	<p>High</p> <p>Medium</p>	<p>Human or animal contact with water represents an immediate threat to water quality with the potential for pathogen contamination.</p> <p>Chlorination alone does not provide sufficient protection against <i>Cryptosporidium</i>, for example.</p>	<p>Access to the reservoir is restricted by fencing, however unauthorised access still occurs</p> <p>Water Corporation surveillance</p> <p>Signage, gates and fencing</p> <p>Water quality monitoring</p> <p>Additional ultraviolet disinfection with turbidity monitoring</p>	<p>This is an incompatible activity in the proposed RPZ.</p> <p>Increase signage to promote awareness of the drinking water source.</p> <p>Continue to liaise with Department of Parks and Wildlife to install boom gates across gravel roads/tracks to reduce public access to the catchment.</p> <p>Water Corporation to continue by-law enforcement.</p> <p>Comply with Operational policy no. 13: <i>Recreation within public drinking water source areas on Crown land.</i></p>
Fishing and marroning in reservoir	<p>Pathogens from direct body contact with the water and from decomposing baits</p>	<p>High</p>	<p>Evidence has been found suggesting that fishing and marroning occurs occasionally.</p> <p>These activities involve direct contact</p>	<p>Access to the reservoir is restricted by fencing, however, unauthorised access still occurs</p> <p>Water Corporation</p>	<p>This is an incompatible activity in the proposed RPZ.</p> <p>Increase signage to promote awareness of the drinking water source.</p>

Land use/ activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
	Turbidity from bank erosion and wading	Low	with the water (see swimming above). Fishing and marroning are prohibited activities in the reservoir.	surveillance Signage, gates and fencing Water quality monitoring Additional ultraviolet disinfection with turbidity monitoring	Continue to liaise with Department of Parks and Wildlife to install boom gates across gravel roads/tracks to reduce public access to the catchment. Water Corporation to continue by-law enforcement. Operational policy no. 13: <i>Recreation within public drinking water source areas on Crown land.</i>
Off-road vehicle use, e.g. 4WD and trail bikes (away from public roads and tracks)	Turbidity from eroded sediments Hydrocarbons from fuel and chemical spills	Medium Medium	Unauthorised off-road use of four-wheel drive vehicles and trail bikes occurs in the catchment, potentially close to the reservoir and feeder streams.	Water Corporation surveillance Signage, gates and fencing Water quality monitoring Additional ultraviolet disinfection with turbidity monitoring	This is an incompatible activity. Continue to liaise with Department of Parks and Wildlife to install boom gates across gravel roads/tracks to reduce public access to the catchment. Water Corporation to continue by-law enforcement.
Bushwalking	Pathogens from people, dogs and decomposing litter, especially near the reservoir	Medium	People have been observed bushwalking with dogs within the catchment. Several roads and	Fencing surrounds the reservoir Water Corporation surveillance	This is an incompatible activity in proposed RPZ, acceptable on public roads only. Increase signage to promote awareness of the drinking water

Land use/ activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
	and feeder streams  Turbidity from eroded sediments	Low	tracks allow access to the catchment.  Dogs and public access are prohibited in the catchment.	Signage, gates and fencing  Water quality monitoring  Additional ultraviolet disinfection with turbidity monitoring	source.  <i>Operational policy no. 13: Recreation within public drinking water source areas on Crown land.</i>
Firewood collection	Pathogens from people, dogs and decomposing litter  Turbidity from eroded sediments	Medium  Low	Evidence indicates that people are collecting firewood in the catchment, often accompanied by dogs.  The Hester Dam catchment is not a designated firewood collection area.	Water Corporation surveillance  Signage, gates and fencing  Water quality monitoring  Additional ultraviolet disinfection with turbidity monitoring  Firewood collection is prohibited	This is an incompatible activity in the proposed RPZ.  Increase signage to promote awareness of the drinking water source.  <i>Operational policy no. 13: Recreation within public drinking water source areas on Crown land.</i>
Roads and tracks	Hydrocarbons and chemicals from spills or herbicide use  Turbidity from eroded sediments	Medium  Low	Hester Road, a sealed road that is a recommended heavy haulage route, bisects the catchment – passing 600 m from the	Reservoir detention time  Road maintenance  Water quality monitoring	<i>Hester Road is accepted as an existing, though incompatible, land use in the catchment.</i>  Follow recommendations in WQPN no. 44: <i>Roads near sensitive water resources.</i>

Land use/ activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
			<p>reservoir.</p> <p>There are a few gravel roads within the catchment. Traffic volume on these roads is generally low.</p>	<p>HAZMAT emergency response procedures</p> <p>Additional ultraviolet disinfection with turbidity monitoring</p>	<p>Follow recommendations in WQPN no. 10: <i>Contaminant spills – emergency response</i>.</p> <p>Pesticide use should be in accordance with Statewide policy no. 2: <i>Pesticide use in public drinking water source areas</i> (WRC 2000) and the Public Service Circular 88 <i>Use of herbicides in water catchment areas</i> (PSC 88).</p> <p>Continue to liaise with Department of Parks and Wildlife to install boom gates across gravel roads/tracks to reduce public access to the catchment.</p>
Fire management and wildfires	Turbidity, pathogens from ash and eroded sediments	Medium	<p>Department of Parks and Wildlife undertakes fire management in state forest in accordance with the <i>Forest management plan 2004–2013</i>.</p> <p>The likelihood of wildfire is reduced by fire management operations. Water</p>	<p>Water Corporation and Department of Parks and Wildlife surveillance</p> <p>Department of Parks and Wildlife fire management and Water Corporation advisory role.</p> <p>Water quality monitoring.</p>	<p><i>Accepted as necessary for forest management, with best management practices.</i></p> <p>Follow the <i>Code of practice for fire management</i> (Department of Environment and Conservation 2008)</p> <p>Carry out post-fire water quality monitoring.</p> <p>Manage and where necessary rehabilitate fire access tracks in</p>



Land use/ activity	Potential water quality risks		Consideration for management	Current preventive measures	Recommended protection strategies
	Hazard	Management priority			
			<p>quality issues are considered in fire management operations.</p> <p>Loss of filtering vegetation due to fires increases the risk of pathogens being washed into the reservoir and feeder streams.</p>	<p>Following a wildfire the Water Corporation initiate post-event management procedures.</p> <p>Additional ultraviolet disinfection with turbidity monitoring.</p>	burnt areas.
Feral animal control	<p>Pesticides from baits</p> <p>Pathogens from decomposing animal carcasses</p>	<p>Low</p> <p>Low</p>	Feral pigs are rare in the catchment.	<p>Water Corporation surveillance.</p> <p>Water quality monitoring.</p> <p>Additional ultraviolet disinfection with turbidity monitoring.</p>	<p><i>Accepted as necessary, with best management practices, when required.</i></p> <p>Follow recommendations in WQPN no. 96: <i>Pest animal management in public drinking water source areas.</i></p>

## Appendix D – Photographs



*Figure D1 Hester Dam, photograph by B. Franke 2008*



*Figure D2 Exposed reservoir banks at Hester Dam, photograph by B. Franke 2008*

## List of shortened forms

<b>ADWG</b>	<i>Australian drinking water guidelines</i>
<b>AHD</b>	Australian height datum
<b>ANZECC</b>	Australian and New Zealand Environment Conservation Council
<b>ARMCANZ</b>	Agriculture and Resource Management Council of Australia and New Zealand
<b>FMP</b>	<i>Forest management plan</i>
<b>ha</b>	hectare
<b>HAZMAT</b>	hazardous materials
<b>kL</b>	kilolitre
<b>km</b>	kilometre
<b>LEMC</b>	local emergency management committee
<b>m</b>	metres
<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 <i>Use of herbicides in water catchment areas</i>
<b>PDWSA</b>	public drinking water source area
<b>RPZ</b>	reservoir protection zone
<b>TCU</b>	true colour units
<b>TDS</b>	total dissolved solids
<b>TFSS</b>	total filterable solids by summation

<b>WAPC</b>	Western Australian Planning Commission
<b>WBRWSS</b>	Warren Blackwood regional water supply scheme
<b>Westplan– HAZMAT</b>	Western Australian plan for hazardous materials
<b>WQPN</b>	water quality protection note
<b>WRC</b>	Water and Rivers Commission

# 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 & NRMMC 2011).
<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, 2011</i> (NHMRC & NRMMC 2011) (ADWG) outlines acceptable criteria for the quality of drinking water in Australia (see this plan's Bibliography).
<b>Augment</b>	Augment means to increase the available water supply. For example, pumping back water from a secondary storage/reservoir dam.
<b>Australian height datum</b>	Australian height datum is the height of land in metres above mean sea level. For example, the AHD is +0.026 m at Fremantle.
<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>Drinking water source protection report</b>	This is a report on water quality hazards and risk levels within a public drinking water source area that includes recommendations to avoid, minimise, or manage those risks for the protection of the water supply in the provision of safe drinking water supply.
<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 & NRMMC 2011).
<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>Microbe</b>	A microorganism, usually one of vegetable nature, a germ. Also known as a bacterium, especially one causing illness.
<b>Most probable number</b>	Most probable number is a measure of microbiological contamination.
<b>Nephelometric turbidity units</b>	Nephelometric turbidity units are a measure of turbidity in water.
<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, algaecides, 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>Public drinking water source area</b>	The area from which water is captured to supply drinking water. It includes all underground water pollution control areas, catchment areas and water reserves constituted under the <i>Metropolitan Water Supply, Sewerage, and Drainage Act 1909 (WA)</i> and the <i>Country Areas Water Supply Act 1947 (WA)</i> .
<b>Public sector circular number 88</b>	Circular no: PSC 88 <i>Use of herbicides in water catchment areas</i> . 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 any part of a public water-supply works.

<b>Reservoir protection zone</b>	A buffer measured from the high water mark of a drinking water reservoir, inclusive of the reservoir (usually 2 km). This is referred to as a prohibited zone under the Metropolitan Water Supply, Sewerage, and Drainage Act By-laws 1981.
<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>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 2011).
<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 (TDS). 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>True colour units</b>	True colour units are a measure of degree of colour in water.
<b>Turbidity</b>	The cloudiness or haziness of water caused by the presence of fine suspended matter.
<b>Water quality</b>	Water quality is the collective term for the physical, aesthetic, chemical and biological properties of water.

**Western  
Australian  
hazardous  
materials  
emergency  
management  
scheme**

This is now known as Westplan–HAZMAT.



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RECYCLED CONTENT

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