



HARDING DAM

WATER SOURCE PROTECTION PLAN

West Pilbara Water Supply Scheme



WATER RESOURCE PROTECTION SERIES

WATER AND RIVERS COMMISSION REPORT WRP 15

1999



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COMMISSION

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Cover Photograph: The Harding Dam



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Water and Rivers Commission
Policy and Planning Division

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Foreword

Water Source Protection Plans

Water Source Protection Plans establish the level of protection required within Water Reserves. The plans identify sources of contamination that should be investigated and set out programs for management of the resource. Water Source Protection Plans are developed in consultation with affected landowners and industry groups and relevant government agencies.

Proclaiming Water Reserves under the *Country Areas Water Supply Act (1947)* protects the quality of water sources in country Western Australia. The Act's by-laws enable the Water and Rivers Commission to control potentially polluting activities, to regulate land use, inspect premises and to take steps to prevent or clean up pollution.

The Water and Rivers Commission aims to work proactively with planning agencies to incorporate water protection in the land planning process. Decisions on land use zoning and subdivision applications have a significant impact on the protection of water sources. The Commission supports the amendment of Town Planning Schemes and Development Strategies that reflect land use compatible with Water Source Protection Plans.

This Water Source Protection Plan provides a basis for establishing compatible land uses within the Harding Dam Catchment Area and is a mechanism for practical implementation of the Commission's protection strategies. Local government decision-makers, State planning authorities and operational staff are encouraged to recognise this document as a basis for ensuring the long term protection of this groundwater resource for generations to come.

Water quality protection framework

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. The Commission has developed policies for the protection of public drinking water source areas

(PDWSAs) that include three levels of priority classification.

Priority 1 (P1) source protection areas are defined to ensure that there is **no degradation** of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of **risk avoidance** and so land development is generally not permitted.

Priority 2 (P2) source protection areas are defined to ensure that there is **no increased risk of pollution** to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of **risk minimisation** and so some development is allowed under specific guidelines.

Priority 3 (P3) source protection areas are defined to **minimise the risk of pollution** to the water source. P3 areas are declared over land where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through **management guidelines** rather than restrictions on land use. If the water source does become contaminated, then water may need to be treated or an alternative water source found.

In addition to priority classifications, **well-head protection zones** and **reservoir protection zones** are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Well-head protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Special restrictions apply within these zones.



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Summary

The Harding Dam Water Reserve is located south of Roebourne, in the Pilbara region of Western Australia. The reserve contains the Harding Dam of which feeds from tributaries of the Harding River, one of the major drainage systems in the region. The Harding Dam is approximately 20 km south of Roebourne. The dam was constructed in 1983-1984 and is used in conjunction with the Millstream wellfield as part of the West Pilbara Water Supply Scheme (Water Corporation, 1997).

The Harding Dam experiences water quality problems that are usually associated with 'reservoir overturn' events and associated inflows. These events cause elevated turbidity and when the guideline level for supply is exceeded, the supply is switched to the Millstream wellfield.

Possible contamination risks to the Harding Dam catchment are recreational use of the reservoir and catchment, stray cattle and spillage of diesel carried on two railways that traverse the catchment. The plan recommends measures that will manage these risks.

The existing Harding Dam Water Reserve boundary should be modified from a cadastral boundary to coincide with the hydrological catchment boundary to capture only land which is contributing to the Harding Dam. In addition, the proposed catchment area should be classified for Priority 1 source protection.

This plan has undergone extensive consultation during the development process. Discussions were held with key stakeholders prior to the preparation of the draft plan. The draft plan was released for comment to key stakeholders including affected landowners, Water Corporation, Ministry for Planning, Department of Environmental Protection, Department of Land Administration, Department of Conservation and Land Management, Shire of Ashburton, Shire of Roebourne, Pastoralists and Graziers Association and the Conservation Council. Comments received were considered in the preparation of this plan.



1. Introduction

The Harding Dam is approximately 40 km southeast of Karratha in the Pilbara Region of Western Australia (**Figure 1**). The dam was constructed in 1983-1984 to augment the water supply from the Millstream wellfield (WAWA, 1995).

The Harding Dam Water Reserve lies within the Shires of Roebourne and Ashburton.

The Water Corporation operates the West Pilbara Water Supply Scheme which utilises water supply from the Harding Dam in conjunction with the Millstream wellfield to supply industrial and domestic water supply to the towns of Dampier, Karratha, Wickham, Roebourne, Point Samson and Cape Lambert.

The current conjunctive licensed allocation for abstraction from the Harding Dam with the Millstream aquifer is 15 GL/annum.

Water from the Harding Dam is used in the West Pilbara Water Supply Scheme except when water quality problems persist or the water level in the dam is below a certain level. At these times, water is taken from the Millstream aquifer. The use of Harding Dam as a water source is generally restricted to approximately eight months of the year. It is proposed to construct a water treatment plant to improve the water quality of the dam which will ultimately increase its use.

The Harding Dam catchment experiences extremely variable rainfall due to the incidence of tropical cyclones and depressions. The average annual rainfall for the region is 330 mm with a low of 3.4 mm and a high of 1060 mm recorded at Roebourne, where in excess of 100 years data has been collected. Typically the rainfall occurs between January and June.

2. Hydrology

The Harding Dam catchment covers part of the northwest area of the Hamersley Basin. In this region, the Lower Proterozoic Fortescue Group (consisting mainly of volcanic rocks) have been intruded by Cooya Pooya Dolerite. The walls of the gorges and nearby hills are covered by scree consisting of large dolerite boulders, with very little soil material occurring within the scree. Runoff is high due to the intense rainfall events and relatively impervious nature of the catchment.

Soil types consist of solonised and alluvial soils that have been disturbed and are susceptible to erosion. These soils represent a large source of sediment to the dam.

The Harding Dam Catchment (**Figure 2**) has an area of approximately 1100 km² and the mean annual flow in the Harding River is 38 GL/year (Dames and Moore, 1982). Flow is irregular and varying in quantity with no certainty that the river will flow in any particular month or year. Runoff is generally greater for the months January to June due to tropical cyclone and thunderstorm activity.

The full supply level of the dam is 60 m AHD resulting in a storage capacity of 63 800 m³ and surface area of 14 km².

The Harding Dam occasionally has problems with water quality deterioration, particularly with turbidity, iron, manganese, phytoplankton, taste and odour (WAWA, 1992). Water quality problems are associated with large inflows and as a consequence of seasonal destratification and reservoir turnover.

An aerator was installed in the dam in 1986 in an attempt to overcome water quality problems. This appears to have been successful in overcoming taste and odour problems but turbidity continues to be a problem (WAWA, 1992).

For approximately 8 months of the year, turbidity levels are below 5 NTU (Nephelometric Turbidity Units). For the remaining period, turbidity increases to between 7 and 20 NTU which above NH&MRC (1996) aesthetic drinking water guidelines. The Water Corporation is currently investigating the use of microfiltration and deep bed filtration techniques for treating turbidity at Harding Dam.

Salinity levels in the dam range from 100 to 500 mg/L with an average of 200 mg/L. This is well within NH&MRC guidelines.

3. Existing and proposed land use

Most of the existing Harding Dam Water Reserve is covered by Land Act Reserve 35798 which is jointly vested with the Water and Rivers Commission and Water Corporation for water supply purposes.

Part of the upper catchment of the Harding Dam is in the Millstream-Chichester National Park that is managed by CALM. A review of the Millstream-Chichester National Park Management Plan is being undertaken.

Parts of the catchment are also under pastoral lease including Mount Welcome (3114/265) and Pyramid (3114/268) leases. Cattle and sheep are grazed on these leases.

The Cooya Pooya homestead (**Plate 4**) is located close to the full supply level of the dam and has been registered by the Heritage Council. There is potential



for this site to be developed for heritage and conservation purposes.

There is access to the Water Reserve for recreation with visitors entering via non-gazetted tracks. Aboriginal cultural sites such as the Cooya Pooya homestead, Table Top Hill and other cultural sites are also visited by Aboriginal people.

Two railways traverse the catchment. The Pannawonica to Cape Lambert railway (operated by Robe River Mining Co. Pty Ltd) runs parallel to the Harding River (**Plate 1**). The Dampier to Paraburdoo railway (operated by Hamersley Iron Pty Ltd) crosses the upper reaches of the catchment.

There are several tracks through the catchment which serve for recreational purposes. The Cooya Pooya Road services the Pannawonica to Cape Lambert railway and is used for access into the catchment.



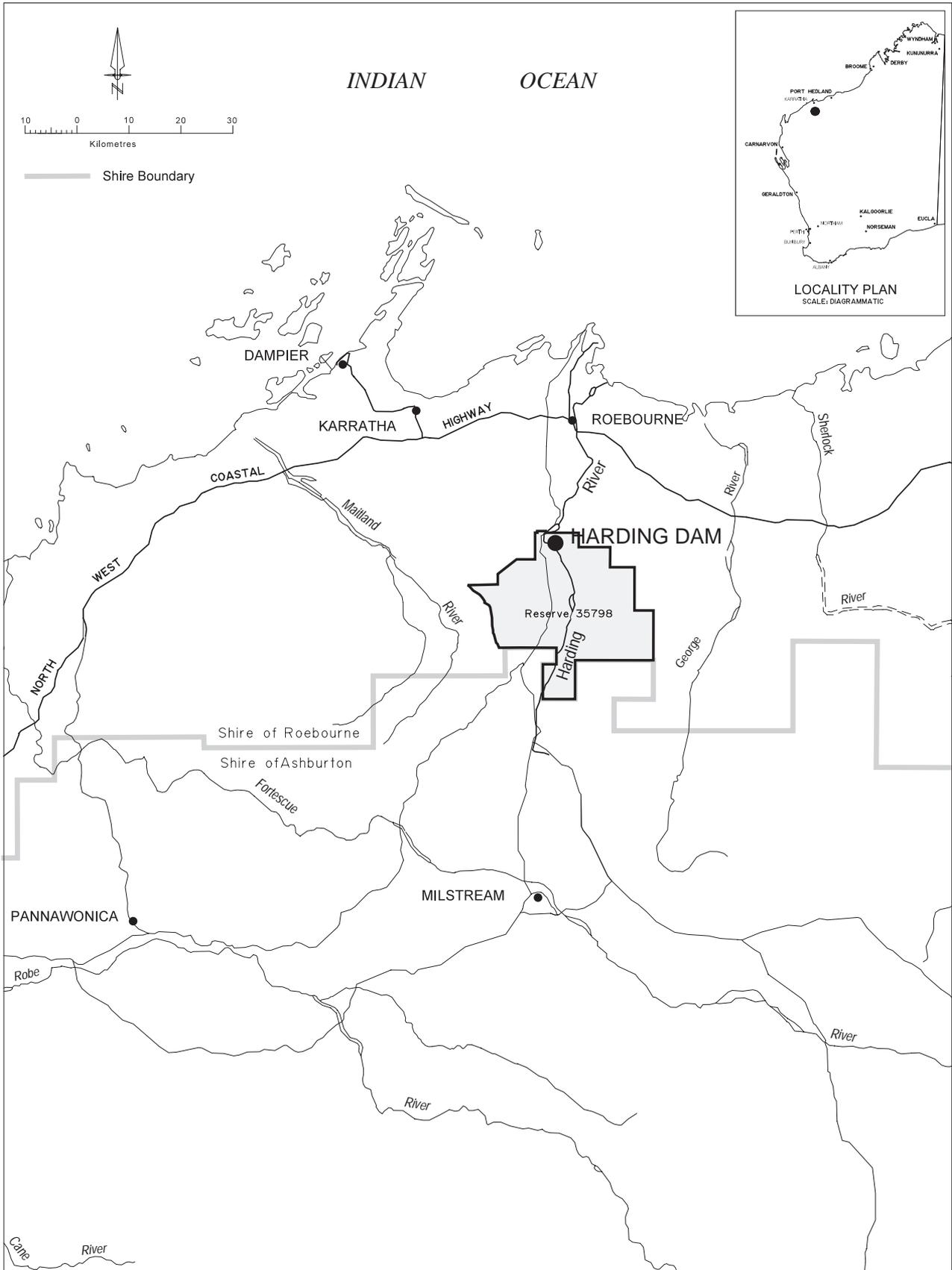


Figure 1. Harding Dam locality map



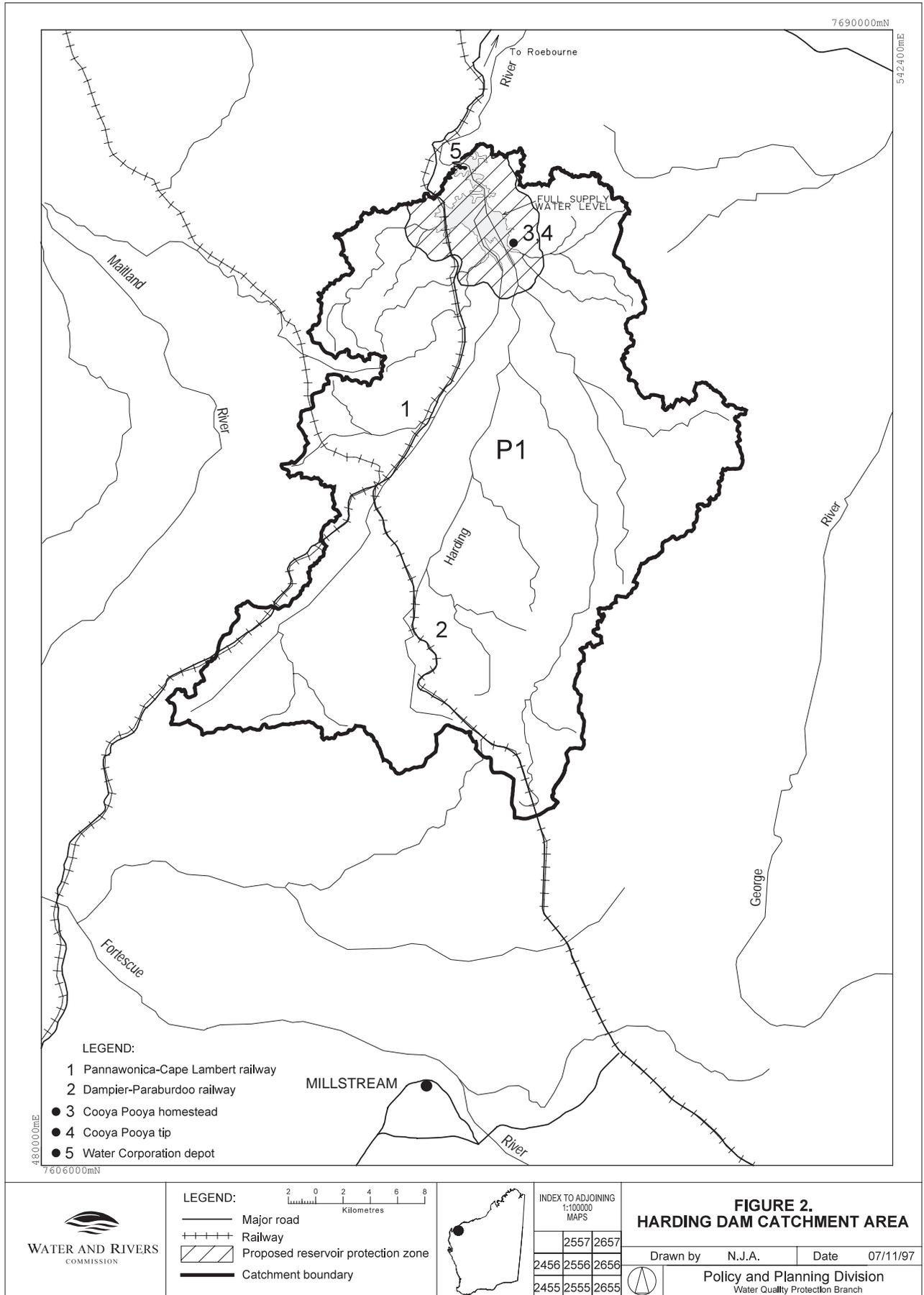


Figure 2. Harding Dam catchment area



4. Potential for contamination

Table 1. Identified potential contaminant threats in the proposed Water Reserve. Potential Impact indicates the level of risk the issue is to the water source and Likelihood indicates the chance of the issue contaminating the water source. **Figure 3** shows a map of potential contaminant threats.



Table 1. Potential sources of contamination within the Harding Dam Water Reserve

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
1	Transport of diesel along Pannawonica - Cape Lambert railway	<ul style="list-style-type: none"> • Three diesel tankers (one 100 000 L and two 40 000 L tankers) dispatched to mine weekly on separate runs. • Two locomotives hauling iron ore (up to 10 trips daily) carry up to 17000 L of diesel. 	High, especially where railway lies within high water mark of dam	Low	<p>The following measures are in place to prevent derailment:</p> <ul style="list-style-type: none"> • Broken rail detection. • Drag detectors. • Hot wheel detection. • High water alarms. 	<ul style="list-style-type: none"> • Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee familiar with Water Reserve. • Water Reserve locality plan provided to HAZMAT Emergency Advisory Team. • The Water Corporation advising HAZMAT Emergency Advisory Team during incidents • Personnel dealing with WESTPLAN - HAZMAT incidents given training to understand potential impacts of spills on groundwater resources.
2	Transport of diesel along Dampier - Paraburdoo railway	<ul style="list-style-type: none"> • Three diesel tankers (480 000 L each) dispatched weekly. • Two locomotives hauling iron ore (up to 15 trips daily) carry up to 17 000 L of diesel. • Track maintenance equipment carrying from 400 to 15000 L of fuel. 	Medium, railway is located in upper catchment	Low	<p>Measures in place to prevent derailment:</p> <ul style="list-style-type: none"> • Broken rail and dragging equipment detection. • Hot bearing and hot wheel protectors. • Fail safe train air brakes. • Regular ultrasonic track monitoring. • Track flood flow indicators on key water crossings. • Railway shutdown in cyclones. 	<ul style="list-style-type: none"> • Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee familiar with Water Reserve. • Water Reserve locality plan provided to HAZMAT Emergency Advisory Team. • The Water Corporation advising HAZMAT Emergency Advisory Team during incidents • Personnel dealing with WESTPLAN - HAZMAT incidents given training to understand potential impacts of spills on groundwater resources.

(Continued)

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
3	Development of abandoned Cooya Pooya homestead	<ul style="list-style-type: none"> Development may be incompatible with water resource protection May increase access to catchment. 	Unknown, until proposal put forward.	Moderate, Cooya Pooya lies within high water mark of dam	Not applicable	Commission and the Water Corporation continue to jointly manage Cooya Pooya homestead
4	Rubbish tip at abandoned Cooya Pooya homestead	Agricultural waste, cans, bottles in tip.	Low, tip is not in use.	Moderate, Cooya Pooya lies within high water mark of dam	<ul style="list-style-type: none"> Water Corporation and the Commission have conducted a limited clean-up of the site. Water Corporation tests water in dam close to tip site and no contaminate leaching has been detected. 	Water Corporation to continue to sample water quality near tip site during routine sampling.
5	Chemical storage at Water Corporation compound	Storage of fuels, solvents and oils (Plate 3).	Low	Low, quantities stored are minor.	<ul style="list-style-type: none"> Secure compound. Concrete base. Water Corporation currently assessing need for compound. 	Chemical storage area be bunded to Commission's requirements (Appendix 3).
n/a	Proposed Karratha - Tom Price road	<ul style="list-style-type: none"> Acute contamination from traffic accidents causing spills. Cumulative impacts from stormwater runoff. Increased access to the catchment area and reservoir. 	Moderate – if located within catchment area.	Low	Road route is planned to be outside catchment area.	Liaison with the Commission during planning stages.

(Continued)

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
n/a	Mount Welcome, Woodbrook and Pyramid pastoral leases	Cattle and sheep straying onto reserve resulting in degradation of vegetation, nutrient and microbiological contamination.	Low	Low	<ul style="list-style-type: none"> • Controlled culling of stray animals. • Education of station owners to repair fences and remove animals from Water Reserve. 	Water Corporation to establish management agreement with pastoral leaseholders which addresses water quality issues.
n/a	Derelict railway carriages lying in riverbed of the Harding River (Plate 2).	Locomotives may contain residual fuel or other chemicals, which could leach contaminants into the groundwater system.	Minimal, carriages have been vandalised and fuel/chemical storage removed	Minimal	<ul style="list-style-type: none"> • Robe River Mining Co. Pty Ltd suggests that as most remaining carriages have been vandalised for scrap metal, locomotives would have been removed after derailment. • No evidence of buried locomotives. 	None

(Continued)

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
n/a	Recreation on the reservoir and within Water Reserve	<p>See Appendix 1 for list of current incidence of recreational activities.</p> <ul style="list-style-type: none"> • Access to Water Reserve via non-gazetted tracks to Aboriginal cultural sites, Cooya Pooya homestead and Table Top Hill. 	See Appendix 1	See Appendix 1	<p>Country Areas Water Supply Act by-laws enable prosecution for illegal recreation within Water Reserves.</p> <p>By-laws 31, 34, 35 and 36 of this Act have been amended to state:</p> <ul style="list-style-type: none"> • Bathing is allowed more than 300 m upstream of the high water mark of the dam. • Cutting of timber for campfires is allowed. • Hunting, shooting and fishing not permitted within the high water mark of the dam. <p>Signage by Water Corporation explains catchment constraints.</p>	<ul style="list-style-type: none"> • A recreation management plan should be developed in consultation with CALM if there is increased pressure/illegal access to the catchment that may impact on water resources. • Access to the catchment should be controlled through the management of access tracks.

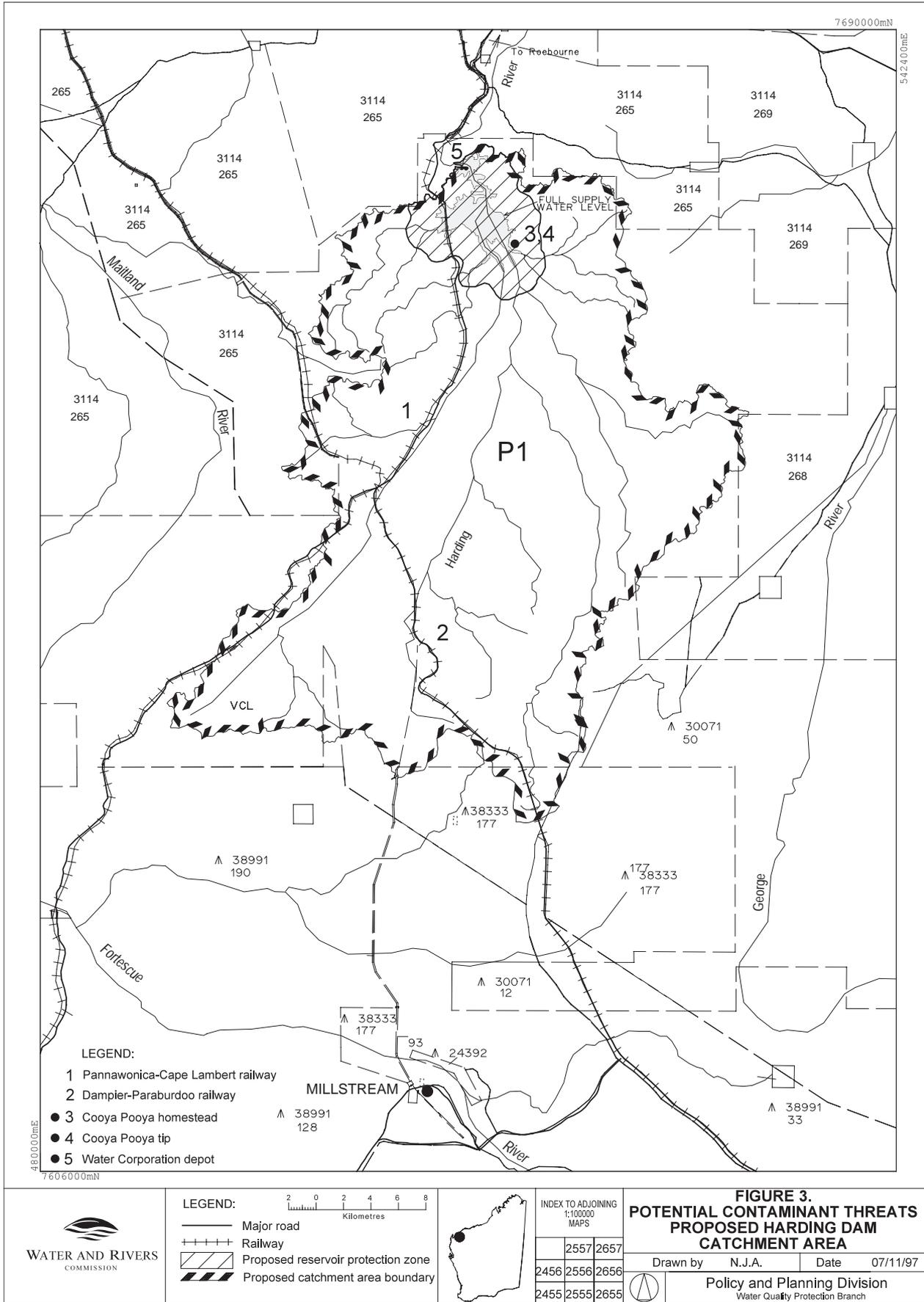


Figure 3. Potential contamination threats



5. Proposed proclaimed area

The existing Harding Dam Water Reserve is shown in **Figure 4** along with the catchment area boundary. The catchment area boundary follows the topographic divide of the Harding River catchment and is the proposed boundary of the Harding Dam Catchment Area. The modification can be justified as it includes only the watershed of the Harding River.

The proposed Harding Dam Catchment Area should be classified for Priority 1 source protection. This classification is justified for the following reasons:

- The Harding Dam is of strategic importance to towns that are part of the West Pilbara Water Supply Scheme.
- All water within this boundary has the potential to contribute to flow in the Harding River, and end up in the reservoir.

- Most of the catchment lies within Land Act Reserve 35798, which is vested for water supply purposes.
- The remaining land is in the Millstream Chichester National Park or is under pastoral lease. Both of these land uses are compatible with the water resource protection objectives for Priority 1 areas.
- Any intensification of land use or increased access to the catchment has the potential to contribute to water quality problems.

In addition, a reservoir protection zone consisting of a 2 kilometre area around the top water level of the reservoir (and including the reservoir) should be established. Specific restrictions will apply in this area.



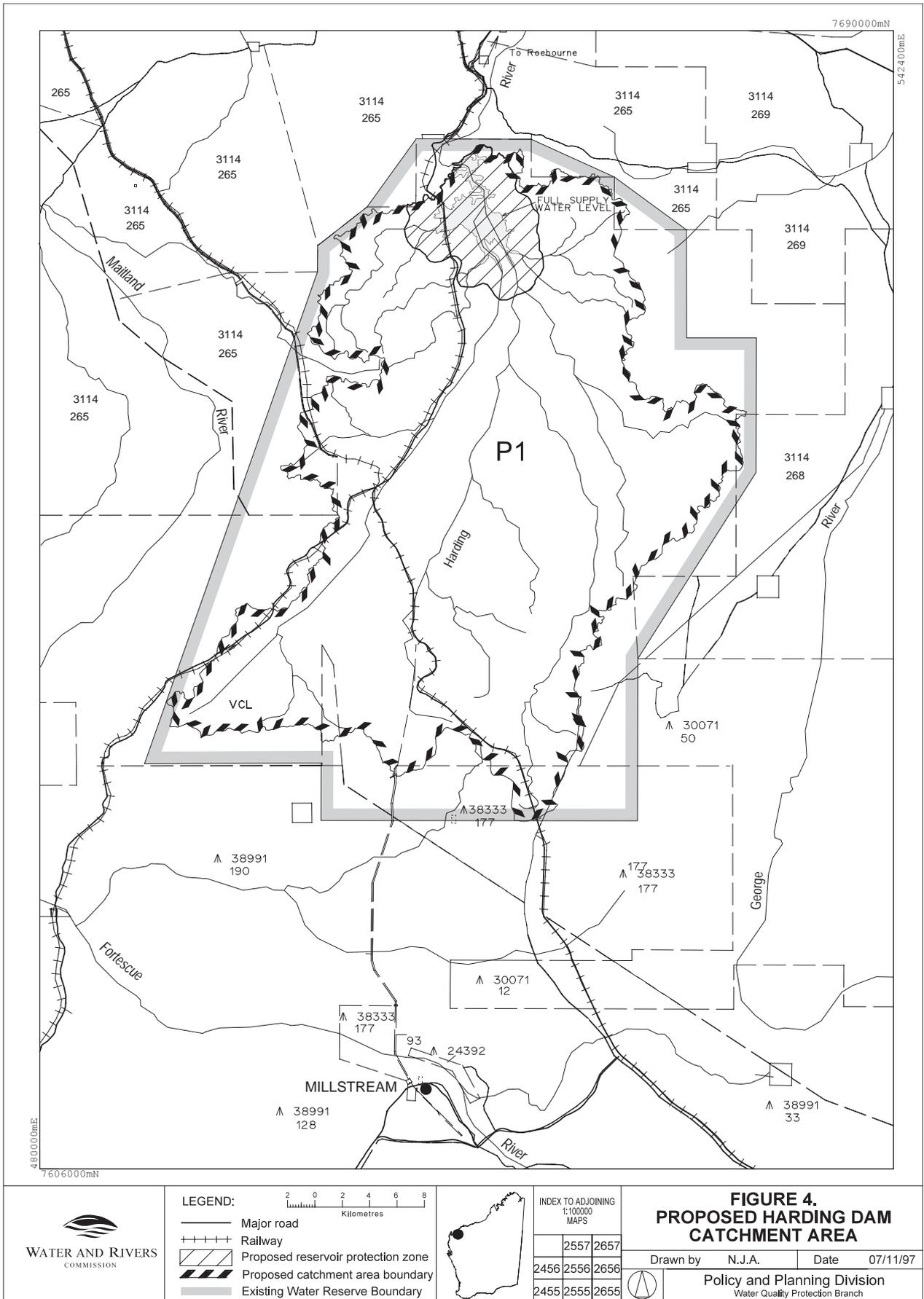


Figure 4. (Proposed) Harding Dam Catchment Area



Recommendations

1. The Harding Dam Catchment Area should be proclaimed under the *Country Areas Water Supply Act 1947*.
2. Planning strategies should incorporate the management principles outlined in the Water and Rivers Commission's *Water Quality Protection Notes- Land Use Compatibility in Public Drinking Water Source Areas (Appendix 2)* and reflect the Priority 1 classification given to the catchment area.
3. All development proposals within the catchment area which are likely to impact on water quality should be referred to the Water and Rivers Commission.
4. The location of the recently installed signage around the catchment should be reviewed because of the new boundary changes and the new road route proposed for the area.
5. Incidents covered by WESTPLAN – HAZMAT in the Harding Dam Catchment Area should be addressed through the following measures:
 - The Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Harding Dam Catchment Area.
 - The locality plan for the Harding Dam Catchment Area being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.
 - The Water Corporation advising the HAZMAT Emergency Advisory Team during incidents in the Harding Dam Catchment Area.
 - Personnel dealing with WESTPLAN - HAZMAT incidents in the area given ready access to a locality map of the Catchment Area and training to understand the potential impacts of spills on the groundwater resource.
5. A surveillance program should be established to identify incompatible land uses or potential contaminant threats within the catchment area.
6. Catchment surveillance and by-law enforcement activities for the Harding Dam catchment should be delegated to the Water Corporation and consideration be given to delegation and joint catchment management with CALM for land within the reserve south of AMG 7668N.
7. Chemical storage at the Water Corporation compound should be bundled to the Commission's requirements (**Appendix 3**).
8. A management agreement addressing water quality protection issues, including cattle straying over the Water Reserve should be established with the leaseholders on the Mount Welcome, Woodbrook and Pyramid pastoral leases.
9. Continuation of water quality monitoring close to the Cooya Pooya homestead.
10. Review the modifications made to the Country Areas Water Supply Act by-laws 31, 34, 35 and 36. A recreation management plan should be developed for the Water Reserve which will control potentially contaminating activities.
11. Implementation of these recommendations should be reviewed one year after this plan is endorsed. A full review of this protection plan should be undertaken approximately every five years.



Implementation Strategy

No.	Description	Implemented by	Timing
1	Gazettal of catchment area.	Program Manager, Protection Planning, (WRC)	1999/2000
2	Incorporation into land planning strategies.	Shire of Roebourne / Shire of Ashburton & Ministry for Planning	Ongoing
3	Referral of development proposals: (i) provide Shires of Roebourne and Ashburton with guidelines for referral of development proposals. (ii) referral of development proposals.	(i) Program Manager, Assessment and Advice (WRC) Shires of Roebourne and Ashburton, Ministry for Planning, (ii) Department of Environmental Protection and the Department of Minerals and Energy	1998/99 Ongoing
4	Erection of signs: (i) Review current catchment signage. (ii) Determine location and quantity of signs (if required).	(i) Water Corporation, WRC and Department of Conservation and Land Management (ii) Water Corporation and WRC	To be arranged

(Continued)

No.	Description	Implemented by	Timing
5	<p>Incidents covered by WESTPLAN – HAZMAT in the Harding Dam Catchment Area should be addressed through the following measures:</p> <p>(i) The Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Harding Dam Catchment Area.</p> <p>(ii) The locality plan for the Harding Dam Catchment Area being provided to the Fire and Rescue Services headquarters for the HAZMAT Emergency Advisory Team.</p> <p>(iii) The Water Corporation advising the HAZMAT Emergency Advisory Team during incidents in the Harding Dam Catchment Area.</p> <p>(iv) Personnel dealing with WESTPLAN - HAZMAT incidents in the area given ready access to a locality map of the Catchment Area and training to understand the potential impacts of spills on the groundwater resource.</p>	<p>(i) Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee through WRC (Karratha region)</p> <p>(ii) WRC (North West Region)</p> <p>(iii) Water Corporation</p> <p>(iv) Shires of Roebourne and Ashburton Local Emergency Management Advisory Committee</p>	<p>(i) 1998/99</p> <p>(ii) 1998/99</p> <p>(iii) Ongoing</p> <p>(iv) Ongoing</p>
6.	<p>Catchment surveillance:</p> <p>(i) develop guidelines for surveillance.</p> <p>(ii) develop joint agency agreement on catchment management and by-law enforcement between the Water Corporation, Water and Rivers Commission and Department of Conservation and Land Management.</p> <p>(iii) implement surveillance program.</p>	<ul style="list-style-type: none"> • Program Manager, Assessment and Advice, Water Quality Protection (WRC) • WRC, Water Corporation and CALM • As per agreement 	To be arranged
7.	Bunding of chemical storage at the Water Corporation compound	Regional Manager, North West Region (WC)	To be arranged
8.	<p>Management agreement with pastoral lease holders</p> <p>(i) Develop management agreement with leaseholder of Mount Welcome, Woodbrook and Pyramid Leases</p>	(i) Regional Managers of WRC and Water Corporation	To be arranged

(Continued)

No.	Description	Implemented by	Timing
9.	Continue water quality sampling close to Cooya Pooya tip site.	Regional Manager, North West Region (WC)	1998 - 1999
10.	(i) Review CAWS Act (1947) by-law modifications for recreation. (ii) Develop a recreation management plan for Harding Dam Water Reserve	(i) Program Manager, Protection Planning (WRC) (ii) Regional Manager, North West Region (WRC) with CALM and Water Corporation	To be arranged
11.	Review of this plan and recommendations.	Program Manager, Protection Planning, Water Quality Protection (WRC)	Initial review after 1 year. Full review after 5 years

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Glossary

Abstraction	Pumping groundwater from an aquifer.
Allocation	The quantity of groundwater permitted to be abstracted by a well licence, usually specified in kilolitres/year (kL/a).
Alluvium (alluvial)	Detrital material which is transported by streams and rivers and deposited.
Aquifer	A geological formation or group of formations able to receive, store and transmit significant quantities of water.
Bore	A narrow, lined hole drilled to monitor or withdraw groundwater.
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Confined Aquifer	An aquifer that is confined between shale and siltstone beds and therefore contains water under pressure.
Diffuse Source Pollution	Pollution originating from a widespread area e.g. urban stormwater runoff, agricultural runoff.
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Groundwater	Water which occupies the pores and crevices of rock or soil.
Hydrogeology	The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality.
Leaching / Leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater, the material washed out is known as leachate. Leachate can pollute groundwater and waterways.
m AHD	Australian Height Datum. Height in metres above Mean Sea Level +0.026 m at Fremantle.
Nutrient Load	The amount of nutrient reaching the waterway over a given time (usually per year) from its catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.



Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms.
Point Source Pollution	Specific localised source of pollution e.g. sewage or effluent discharge, industrial waste discharge.
Pollution	Water pollution occurs when waste products or other substances e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Public Water Source Area	(PWSA) As for UWPCA, but allowing the taking of groundwater for public supplies.
Recharge	Water infiltrating to replenish an aquifer.
Recharge Area	An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface.
Runoff	Water that flows over the surface from a catchment area, including streams.
Saltwater Intrusion	The inland intrusion of saltwater into a layer of fresh groundwater.
Scheme Supply	Water diverted from a source (or sources) by a water authority or private company and supplied via a distribution network to customers for urban, industrial or irrigation use.
Storage Reservoir	A major reservoir of water created in a river valley by building a dam.
Stormwater	Rainwater which has run off the ground surface, roads, paved areas etc and is usually carried away by drains.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
Unconfined Aquifer	An aquifer containing water, the upper surface of which is lower than the top of the aquifer. The upper surface of the groundwater within the aquifer is called the watertable.
Underground Water Pollution Control Area	UWPCA) An area defined under the Metropolitan Water Supply Sewerage and Drainage Act, in which restrictions are put on activities that may pollute the groundwater.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water Quality	The physical, chemical and biological measures of water.
Watertable	The upper saturated level of the unconfined groundwater.
Wellfield	A group of bores to monitor or withdraw groundwater.



Appendix 1

Incidence of recreational activities in the Harding Dam Catchment

Activity	Current	Incidence		Current	Impact	
	High	Medium	Low	High	Medium	Low
Horse Riding			X			X
Trail Bike Riding			X			X
Firewood Gathering			X			X
Camping			X			X
Bush Walking			X			X
Hunting			X			X
Car Rallies			X			X
Angling/Fishing			X			X
Illegal Crops			X			X
4WD/Off Road Vehicles	X				X	
Picnicking/BBQ/Fires		X			X	
Rock/Gravel Removal			X			X
Rubbish Dumping			X			X
Swimming			X			X
Boating/Canoeing			X			X
Photography/Artists			X			X
Bird Watching			X			X
Mountain Bikes			X			X
Educational Research			X			X
Prospecting			X			X
Nature Based Tourism, Tours etc.			X			X



Appendix 2

Land use compatibility in Public Drinking Water Source Areas



LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

To provide information on land use and activities that may impact on the quality of the State's water resources.

These notes provide a basis for developing formal guidelines in consultation with key stakeholders.

Scope

These notes apply to existing and proposed land use within Public Drinking Water Source Areas (PDWSAs).

PDWSAs include Underground Water Pollution Control Areas, Water Reserves and public water supply catchment areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, and the *Country Areas Water Supply Act 1947*.

Preamble

The following notes reflect the Commission's current position. They are recommendations only, and may be varied at the discretion of the Commission.

Overview of Protection Framework

The Water and Rivers Commission is responsible for managing and protecting Western Australia's water resources. The Commission has developed policies for the protection of public drinking water source areas that include three levels of priority classification of lands within PDWSAs.

Priority 1 (P1) source protection areas are defined to ensure that there is **no degradation** of the water source. P1 areas are declared over land where the provision of the highest quality public drinking water is the prime beneficial land use. P1 areas would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of **risk avoidance** and so land development is generally not permitted.

Priority 2 (P2) source protection areas are defined to ensure that there is **no increased risk of pollution** to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority in these areas. P2 areas are managed in accordance with the principle of **risk minimisation** and so some development is allowed under specific guidelines.



Priority 3 (P3) source protection areas are defined to **minimise the risk of pollution** to the water source. P3 areas are declared over land where water supply sources need to co-exist with other land uses such as residential, commercial and light industrial developments. Protection of P3 areas is achieved through **management guidelines** rather than restrictions on land use. If the water source does become contaminated, then water may need to be treated or an alternative water source found.

In addition to priority classifications, **well-head protection zones** and **reservoir protection zones** are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Well-head protection zones are usually circular, with a radius of 500 metres in P1 areas and 300 metres in P2 and P3 areas. Reservoir protection zones usually consist of a 2 kilometre buffer area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Special restrictions apply within these zones.

Tables showing Land Use Compatibility with the PDWSA protection strategy

These tables should be used as a guideline only. Further information relating to land use and development within PDWSAs including those not listed in the table, can be obtained from the Commission's Water Quality Protection Branch.

These tables do not replace the need for assessment by the Commission. Please consult the Commission regarding any land use proposals in Public Drinking Water Source Areas that may impact on water resources.

Definitions used in the following tables

<i>Compatible</i>	The land use is compatible with the management objectives of the priority classification.
<i>Incompatible</i>	The land use is incompatible with the management objectives of the priority classification.
<i>Restricted</i>	The land use may be compatible with the management objectives of the priority classification, with appropriate site management practices. Restricted developments /activities should be referred to the Commission for assessment on a case specific basis.
<i>Extensive</i>	Where limited additional inputs are required to the land to support the desired land use. eg supplementary animal feed only during seasonal dry periods.
<i>Intensive</i>	Where regular additional inputs are required to support the desired land use. eg irrigation, non forage animal feed dominates, fertilisers.



More information

We welcome your comment on these notes. They will be updated from time to time as comments are received or activity standards change. The Commission is progressively developing Water Quality Protection Notes and Guidelines covering land uses described in the attached tables. Advice on available guidance documents may be obtained by contacting the Commission.

If you wish to comment on the notes or require more information, please contact the Commission's Water Quality Protection Branch at the Hyatt Centre in East Perth.

Phone: (08) 9278 0300 (business hours) or Fax:(08) 9278 0585

Tables showing Land use compatibility with PDWSA protection objectives

AGRICULTURE - ANIMALS

Land use	Priority 1	Priority 2	Priority 3
Apiaries	Restricted	Restricted	Restricted
Aquaculture eg. marron farms, fish farms, algae culture	Incompatible	Restricted	Restricted
Dairy Farming	Incompatible	Restricted	Restricted
Feedlots	Incompatible	Incompatible	Restricted
Livestock grazing (extensive)	Restricted	Compatible	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Restricted ¹¹
Piggeries	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Restricted	Restricted
Stables	Incompatible	Restricted	Compatible
Stockholding and saleyards	Incompatible	Incompatible ⁷	Restricted ⁷

AGRICULTURE - PLANTS

Land use	Priority 1	Priority 2	Priority 3
Broad acre cropping i.e. non-irrigated	Incompatible	Restricted ¹	Compatible
Floriculture (extensive)	Incompatible	Restricted	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Restricted
Field horticulture	Incompatible	Incompatible	Restricted
Hydroponic horticulture	Incompatible	Restricted	Restricted
Orchards	Incompatible	Restricted	Compatible
Potted Nurseries	Incompatible	Restricted	Compatible
Silviculture (tree farming)	Restricted	Restricted	Compatible
Turf Farms	Incompatible	Incompatible	Restricted
Viticulture (wine & table grapes)	Incompatible	Restricted	Compatible



DEVELOPMENT - COMMERCIAL

Land use	Priority 1	Priority 2	Priority 3
Aircraft Servicing	Incompatible	Incompatible	Restricted ⁶
Amusement Centres	Incompatible	Incompatible	Compatible ⁶
Automotive businesses	Incompatible	Incompatible	Restricted ⁶
Boat Servicing	Incompatible	Incompatible	Restricted ⁶
Caravan and trailer hire	Incompatible	Incompatible	Restricted ⁶
Vehicle parking (commercial)	Incompatible	Incompatible	Compatible
Consulting rooms	Incompatible	Incompatible ⁷	Compatible ⁶
Cottage Industries	Restricted	Restricted	Compatible
Drive in / take-away food shops	Incompatible	Incompatible	Compatible ⁶
Drive -in theatres	Incompatible	Incompatible	Compatible ⁶
Dry Cleaning Premises	Incompatible	Incompatible	Restricted ⁶
Farm supply centres	Incompatible	Incompatible ⁷	Restricted
Fuel depots	Incompatible	Incompatible	Restricted
Garden Centres	Incompatible	Incompatible	Compatible
Laboratories (analytical , photographic)	Incompatible	Incompatible	Compatible
Shops ⁷ and shopping centres	Incompatible	Incompatible ⁷	Compatible
Markets	Incompatible	Incompatible	Compatible ⁶
Milk depots	Incompatible	Incompatible	Restricted
Restaurants	Incompatible	Incompatible	Compatible
Service Stations	Incompatible	Incompatible	Restricted
Transport Depots	Incompatible	Incompatible	Restricted
Veterinary Clinics / hospitals	Incompatible	Incompatible ⁷	Restricted
Vehicle wrecking and machinery	Incompatible	Incompatible	Restricted

DEVELOPMENT - INDUSTRIAL

Land use	Priority 1	Priority 2	Priority 3
General Industry	Incompatible	Incompatible	Restricted ⁶
Heavy Industry	Incompatible	Incompatible	Incompatible
Light Industry	Incompatible	Incompatible	Restricted ⁶
Power Stations	Incompatible	Incompatible	Incompatible

DEVELOPMENT - URBAN

Land use	Priority 1	Priority 2	Priority 3
Aged and dependent persons	Incompatible	Incompatible	Compatible ⁶
Amenity buildings	Incompatible	Restricted	Compatible
Airports or landing grounds	Incompatible	Incompatible	Restricted ⁶
Cemeteries	Incompatible	Incompatible	Restricted
Civic buildings	Incompatible	Restricted	Compatible ⁶
Clubs -sporting, recreation or community	Restricted	Restricted	Compatible ⁶
Community halls	Restricted	Restricted	Compatible
Family Day Care Centres	Incompatible	Restricted	Compatible ⁶



Funeral parlours	Incompatible	Incompatible	Compatible ⁶
Health Centres	Incompatible	Incompatible	Compatible ⁶
Hospitals	Incompatible	Incompatible	Restricted ⁶
Medical centres	Incompatible	Incompatible	Compatible ⁶

EDUCATION / RESEARCH

Land use	Priority 1	Priority 2	Priority 3
Education centres	Restricted	Restricted	Compatible ⁶
Primary / Secondary Schools	Incompatible	Incompatible	Compatible ⁶
Scientific Research Institutions	Restricted	Restricted	Compatible
Universities	Incompatible	Incompatible	Restricted ⁶

MINING AND MINERAL PROCESSING

Land use	Priority 1	Priority 2	Priority 3
Extractive Industries	Restricted ²	Restricted ²	Restricted ²
Mineral Exploration	Restricted ⁴	Restricted ⁴	Restricted ⁴
Mining and mineral processing	Restricted ⁴	Restricted ⁴	Restricted ⁴
Tailings Dams	Incompatible	Incompatible	Restricted

PROCESSING OF ANIMALS / ANIMAL PRODUCTS

Land use	Priority 1	Priority 2	Priority 3
Abattoirs	Incompatible	Incompatible	Incompatible
Cheese / butter factories	Incompatible	Incompatible	Restricted ⁶
Food Processing	Incompatible	Incompatible	Restricted ⁶
Tanneries	Incompatible	Incompatible	Incompatible
Wool-scours	Incompatible	Incompatible	Incompatible

PROCESSING OF PLANTS / PLANT PRODUCTS

Land use	Priority 1	Priority 2	Priority 3
Breweries	Incompatible	Incompatible	Restricted ⁶
Composting / soil blending (commercial)	Incompatible	Incompatible	Restricted
Vegetable / food processing	Incompatible	Incompatible	Restricted ⁶
Wineries	Incompatible	Incompatible	Restricted



SUBDIVISION

Land use	Priority 1	Priority 2	Priority 3
Dog Kennel Subdivisions	Incompatible	Restricted	Restricted
Rural - minimum lot size = 4 hectares (un-sewered)	Incompatible	Compatible	Compatible
Rural - minimum lot size = 1 hectare (un-sewered)	Incompatible	Incompatible	Compatible
Special rural - minimum lot size = 2 hectares (un-sewered) ⁵	Incompatible	Restricted ⁶	Restricted ⁶
Special rural - minimum lot size = 1 hectare (un-sewered) ⁵	Incompatible	Incompatible	Restricted ⁶
Urban residential	Incompatible	Incompatible	Compatible ⁶

Note: Subdivision of land to lots of any size is incompatible within Priority 1 areas.

SPORT AND RECREATION

Land use	Priority 1	Priority 2	Priority 3
Equestrian centres	Incompatible	Incompatible	Compatible
Golf courses	Incompatible	Incompatible	Restricted
Irrigated recreational parks	Incompatible	Restricted	Restricted
Motor sports i.e permanent racing facilities	Incompatible	Incompatible	Restricted
Public Swimming Pools	Incompatible	Restricted	Restricted
Rifle Ranges	Restricted	Restricted	Compatible
Temporary recreational activities (active) eg four wheel driving, car rallies	Incompatible	Restricted ⁹	Restricted ³
Temporary recreational activities (passive) eg. horse riding, bush walking	Restricted	Restricted	Restricted

STORAGE OF TOXIC AND HAZARDOUS SUBSTANCES (THS)

Land use	Priority 1	Priority 2	Priority 3
Above ground storage of THS	Restricted ¹³	Restricted ¹³	Restricted ¹³
Bulk Storage Facilities for THS	Incompatible	Incompatible	Restricted ¹²
Underground storage tanks for THS	Incompatible	Incompatible	Restricted

TOURISM ACCOMMODATION

Land use	Priority 1	Priority 2	Priority 3
Bed and Breakfast accommodation	Incompatible	Restricted	Compatible
Caravan Parks	Incompatible	Incompatible	Restricted ⁶
Holiday accommodation eg farm chalets	Incompatible	Restricted ⁹	Compatible ⁶
Motels, lodging houses, hostels	Incompatible	Incompatible	Compatible ⁶



WASTE TREATMENT AND MANAGEMENT

Land use	Priority 1	Priority 2	Priority 3
Deep well injection of liquid wastes	Incompatible	Incompatible	Incompatible
Class I, II and III Landfills	Incompatible	Incompatible	Restricted
Class IV and V Landfills	Incompatible	Incompatible	Incompatible
Recycling depots	Incompatible	Incompatible	Restricted
Refuse transfer stations	Incompatible	Incompatible	Restricted
Sewers (Gravity)	Incompatible	Incompatible	Compatible
Sewers (Pressure Mains)	Incompatible	Restricted	Compatible
Sewage pump station	Incompatible	Restricted ¹³	Restricted
Used tyre storage / disposal facilities	Incompatible	Incompatible	Incompatible
Wastewater treatment plants	Incompatible	Incompatible	Restricted
Water treatment plants	Restricted	Restricted	Restricted

OTHER DEVELOPMENTS

Land use	Priority 1	Priority 2	Priority 3
Caretaker's housing	Restricted	Restricted	Compatible
Construction projects (not tabled)	Restricted	Restricted	Restricted
Forestry	Restricted ¹	Compatible	Compatible
National Parks	Compatible	Compatible	Compatible
Nature Reserves	Compatible	Compatible	Compatible
Communications receivers / transmitters	Restricted	Restricted	Restricted
Major Transport Routes	Incompatible	Restricted ¹⁰	Compatible

Table reference notes:

1. Restrictions apply to fertiliser application rates, with strict controls on the application of pesticides and field operations.
2. Restrictions apply to the storage of fuels and chemicals, with strict guidelines for rehabilitation.
3. Restrictions on the use of fuel and chemicals apply.
4. Subject to conditions placed on lease.
5. Special rural development requires appropriate planning justification, including provisions in the town planning scheme text.
6. Must be connected to deep sewerage, where practical, or otherwise to an approved waste disposal system that meets water quality protection objectives.
7. May be permitted if this use is incidental to the overall land use in the area and consistent with planning strategies.
8. Restrictions apply to siting of effluent disposal systems in areas with poor land capability and a shallow depth to groundwater.



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9. Restrictions apply on density of accommodation.
 10. Restrictions apply on road design and construction and the types of goods that may be carried.
 11. Restrictions apply to stocking levels.
 12. May be permitted if the type, volume and storage mechanisms for chemicals are compatible with water quality protection objectives.
 13. Activity is incompatible in wellhead protection zones.



Appendix 3

Above ground chemical storage tanks in Public Drinking Water Source Areas





ABOVE GROUND CHEMICAL STORAGE TANKS IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

To provide information for facilities that may impact on the quality of the State's water resources.

These notes provide a basis for developing formal best management practice guidelines in consultation with key stakeholders.

Scope

These notes apply in Public Drinking Water Source Areas where chemicals that are potentially polluting, toxic or hazardous (including fuel) are stored in above ground tanks.

Chemicals covered by these notes include:

- Substances listed in Section 4 of the *Australian Water Quality Guidelines for Fresh and Marine Waters* published by the Australian and New Zealand Environment and Conservation Council (ANZECC), 1992.
- Substances described in the current Schedules of the *Poisons Act 1964*.
- Concentrates and substances listed in Schedule Classes 3 to 9 of the *Explosive and Dangerous Goods Act, Classification Order of 1988*.

Chemicals used for hygiene or similar non-commercial purposes in quantities less than 25 litres are excluded.

These notes apply to permanent facilities that will be used for 12 months or more. For temporary installations (used for less than 12 months) refer to Water Quality Protection Note – *Temporary Above Ground Fuel Storage in Public Drinking Water Source Areas*.

Public Drinking Water Source Areas (PDWSAs) describe areas declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947* for the management and protection of sources of water used for public drinking water supply. They include Underground Water Pollution Control Areas (UWPCAs), Water Reserves and Catchment Areas.

Three priority classification areas have been defined in PDWSAs. They are **P1, P2 and P3**. Priority is determined by land tenure, land use and water flow paths. Different management strategies apply in each priority area. For further details refer to Water Quality Protection Note – *Land Use Compatibility in Public Drinking Water Source Areas*.

Above ground chemical storage tanks also require approval from the Department of Minerals and Energy (DME).

General recommendations

The following notes reflect the Commission's current position. They are recommendations only and may be varied at the discretion of the Commission.



Proposals for above ground chemical storage systems in PDWSAs will need to be assessed by the Water and Rivers Commission prior to DME approval. The proposal should include:

- A site plan showing the location of the facility.
- Construction details of tank containment compounds.
- An inspection and maintenance schedule for the facility to ensure effective containment of chemicals.

If the proposal is located in a UWPCA, permit approval from the Commission is also required.

Chemicals including petroleum products should not be stored within 2 kilometres of the top water level of public water supply reservoirs.

In P1 and P2 public drinking water source areas, elevated tanks are not permitted in wellhead protection zones.

In P1 and P2 public drinking water source areas, the total storage volume shall not exceed 5000 litres.

Containment Compound Design

Storage tanks and associated containment compounds should comply with the current Australian Standard 1940, the *Explosive and Dangerous Goods Act 1961* and its regulations.

Storage tanks should be located within containment compounds that effectively capture and contain chemical spills. These compounds should capture any leak or jet of liquid from any perforation of the tank or associated equipment. The Commission's minimum design criteria are appended to these notes as **Plan No. 1**.

Compounds should be constructed of waterproof reinforced concrete or approved equivalent, which is not adversely affected by contact with chemicals captured within them.

The minimum compound volume should be 110% of the capacity of the largest container system, plus 25% of the **total capacity of all** other separate containers within the compound.

Underground pipe-work carrying product from the tank external to the bund is unacceptable in P1 and P2 areas. Underground pipe-work should be secondary contained in P3 areas. In P1 and P2 areas, aboveground pipe-work must be secondary contained. Pipe-work within the bund does not require secondary containment.

Compounds should have sufficient capacity to contain spilt chemicals and not be overtopped during extreme rainfall events. Additional capacity for rainfall captured within the compound should be calculated using a 1 in 100 year return frequency storm event over 24 hours. Design methods should be used as described in the current edition of *Australian Rainfall and Runoff* produced by the Institution of Engineers, Australia.

Tank equipment such as dispensing hoses, valves, meters, pumps, and gauges should be located within the compound.

Security should be provided to guard against vandalism when the site is unattended. This should include:

- Fencing of the tank compound or adequate security controls at the site.
- Locks on unattended dispensing hoses.

The base of the compound should grade towards a liquid retention sump to facilitate recovery of spilt liquids. The sump should be emptied by pumping, **not** through a valved gravity outlet, which could inadvertently be left open.

Incompatible or reactive chemicals should be stored in separate banded compounds.

All chemicals stored within the banded compounds should be clearly labelled detailing the nature and quantity of chemicals stored within containers. Sight gauges indicating the current volume are recommended for tanks larger than 250 litres.



Chemical transfer areas

All chemical transfer activities (in and out of tanks) should occur on an impervious sealed area; kerbed, graded or bunded to prevent liquid runoff to the environment.

Chemical transfer areas should drain away from the perimeter bund to a containment pit. The pit should be capable of holding stormwater from at least a 48 hour, 2 year return frequency storm event, in addition to containing potential chemical spills. Designs should provide for the safe and efficient movement of vehicles.

Operation of containment compounds

Chemical spills should be cleaned up immediately. The spilt liquid and clean-up material should be removed, treated and disposed of outside any PDWSA in accordance with requirements of the Department of Environmental Protection's (DEP) Waste Management Division.

The compound should be maintained to prevent accumulation of stormwater and litter. Only stormwater assessed as uncontaminated by a suitably qualified and experienced person may be released to soaks or off-site drainage systems.

In **P1 and P2** areas, one of the following measures should be used to prevent accumulation of stormwater:

- A roofed structure that extends at least 1 metre past the edge of the compound. Side walls or vertical roof turn-downs should be used where necessary to prevent intrusion of wind-driven rainfall.
- A reliable assessment and management procedure for disposal of stormwater. The procedure should be documented and submitted to the Commission for approval.

In **P3** areas, adoption of one of the following measures is recommended:

- Collect and dispose of stormwater outside any PDWSA in accordance with the requirements of the DEP -Waste Management Division.
- Treat stormwater on-site in a separation unit capable of removing contaminating substances. The method of treatment will depend on whether effluent is discharged to sewer or disposed of on-site in soaks. Any liquid released to the environment should conform to the criteria for Raw Water for Drinking Water Supply given in *Australian Water Quality Guidelines for Fresh and Marine Waters* – ANZECC (1992).

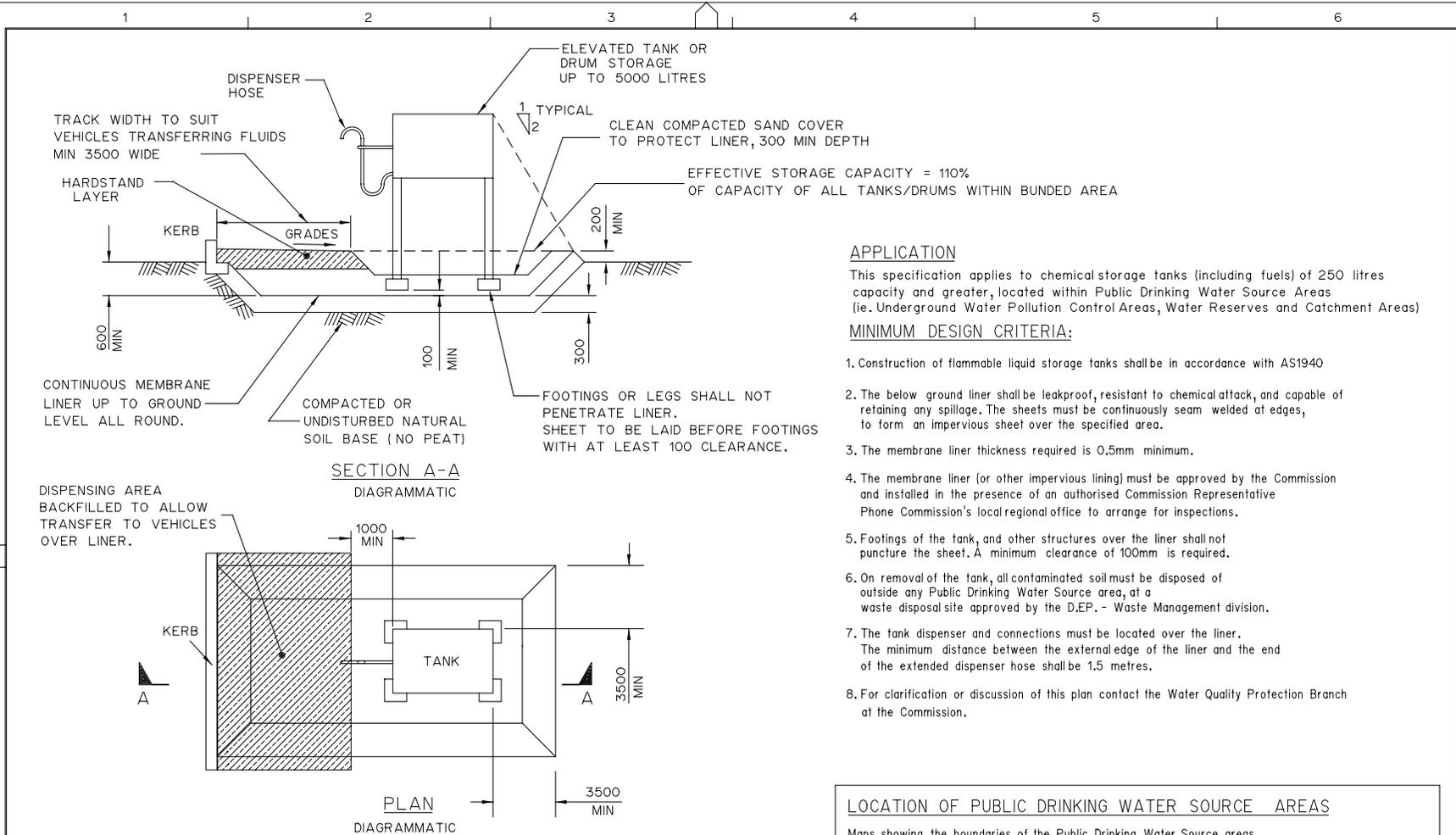
More information

We welcome your comment on these notes. They will be updated from time to time as comments are received or industry standards change.

If you wish to comment on the notes or require more information, please contact the Commission's Water Quality Protection Branch at the Hyatt Centre in East Perth.

Phone: (08) 9278 0300 (business hours) or Fax: (08) 9278 0585





APPLICATION

This specification applies to chemical storage tanks (including fuels) of 250 litres capacity and greater, located within Public Drinking Water Source Areas (ie. Underground Water Pollution Control Areas, Water Reserves and Catchment Areas)

MINIMUM DESIGN CRITERIA:

1. Construction of flammable liquid storage tanks shall be in accordance with AS1940
2. The below ground liner shall be leakproof, resistant to chemical attack, and capable of retaining any spillage. The sheets must be continuously seam welded at edges, to form an impervious sheet over the specified area.
3. The membrane liner thickness required is 0.5mm minimum.
4. The membrane liner (or other impervious lining) must be approved by the Commission and installed in the presence of an authorised Commission Representative. Please contact the Commission's local regional office to arrange for inspections.
5. Footings of the tank, and other structures over the liner shall not puncture the sheet. A minimum clearance of 100mm is required.
6. On removal of the tank, all contaminated soil must be disposed of outside any Public Drinking Water Source area, at a waste disposal site approved by the D.E.P. - Waste Management division.
7. The tank dispenser and connections must be located over the liner. The minimum distance between the external edge of the liner and the end of the extended dispenser hose shall be 1.5 metres.
8. For clarification or discussion of this plan contact the Water Quality Protection Branch at the Commission.

LOCATION OF PUBLIC DRINKING WATER SOURCE AREAS
Maps showing the boundaries of the Public Drinking Water Source areas are available from the Water and Rivers Commission. Please phone (08) 9278 0300 for more information.

NOTE : ALL DIMENSIONS IN MILLIMETRES UNLESS SHOWN OTHERWISE.

ISSUE DATE	REVISION	DRN	REC	APPD

DES REF	RECOMMENDED
DATE	
DRN	
CHD	APPROVED



PUBLIC DRINKING WATER SOURCE PROTECTION AREAS - SPECIFICATION FOR ELEVATED CHEMICAL AND FUEL STORAGE TANKS				ORIGINAL SHEET SIZE A4
FILE	PROJECT	PLAN	ISSUE	
		No. 1	A	

Appendix 4

Plates of potential contaminating threats





Plate 1: The Pannawonica - Cape Lambert railway.



Plate 2: Derelict railway carriages in the Harding riverbed.





Plate 3: Storage of diesel and other chemicals at the Water Corporation compound.



Plate 4: The Cooya Pooya homestead.

