



NULLAGINE WATER RESERVE

WATER SOURCE PROTECTION PLAN

Nullagine Town Water Supply



WATER RESOURCE PROTECTION SERIES

WATER AND RIVERS COMMISSION REPORT WRP 18

1999



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COMMISSION

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Cover Photograph: Tailings at the Beaton Creek Gold Mine, Nullagine



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Water and Rivers Commission
Policy and Planning Division

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Reference Details

The recommended reference for this publication is:
Water and Rivers Commission 1999, *Nullagine Water Reserve Water Source Protection Plan: Nullagine Town Water Supply*, Water and Rivers Commission, Water Resource Protection Series No. WRP 18.

ISBN 0-7309-7378-6

ISSN 1326-7442

*Text printed on recycled stock
May, 1999*



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 Water Reserve at Nullagine 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 Nullagine Town Water Supply is obtained from a Water Corporation wellfield which draws groundwater from unconfined sandstone and alluvial sediments.

The town water supply source has the potential to be contaminated from the local rubbish tip, leach pads used for mineral processing and fuel storage at the production bores, service stations and the power station.

The existing Water Reserve boundary should be modified to take in key recharge areas and future town water supply sources.

The reserve should be given a dual classification with a Priority 3 source protection area over the townsite and the rest of the reserve 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 East Pilbara, Pastoralists and Graziers Association and the Conservation Council. Comments received were considered in the preparation of this plan.



1. Introduction

Nullagine is located approximately 250 kilometres south east of Port Hedland between Marble Bar and Newman (see **Figure 1**). It is a service town for the local mining and pastoral industries. The town water supply for Nullagine comes from a wellfield operated by the Water Corporation.

The existing Water Reserve is located within the administrative boundary of the Shire of East Pilbara.

The climate of the region is arid with an average annual rainfall of about 300 millimetres. Rainfall is unreliable and irregular with most of it falling between December and April as a result of tropical thunderstorms and cyclonic activity. Annual pan evaporation is approximately 3500 millimetres.

There have been problems in providing a reliable public water supply particularly after years of drought.

2. Hydrogeology

The town of Nullagine is located on the Nullagine River on steeply dipping metamorphosed sedimentary rocks of the Archaean Mosquito Creek Formation (Davidson, 1992). These rocks are mainly shale and phyllite with occasional veins of quartz and minor sandstone beds.

The Fortescue Group (consisting of Hardy Sandstone) overlays the Mosquito Creek Formation unconformably in the hills to the west and south of Nullagine.

At Garden Pool, the Nullagine River cuts through a gorge in the Fortescue Group and flows north eastwards over the softer Mosquito Creek Formation with a floodplain about 500 to 700 metres wide. The river terraces and floodplain are underlain by alluvium up to 13 metres thick.

The alluvial aquifers are recharged during river flows (AGC, 1987). There is also some recharge from direct rainfall infiltration but because the alluvial layers are relatively thin, only small quantities of groundwater are held in storage. The fractured sandstone aquifers are

recharged by river flow where they sub-crop under alluvium. There is also minor recharge to fractured joints in the rock and sandstone aquifers.

The current licensed allocation for the scheme is 80 ML/annum. There are three bores used for water supply (7/87, 1/91 and 6/92) with three monitoring bores (MRD bore, 2/83 and 7/92) and the town well is used for irrigation (see **Figure 2**). Production bores are screened in sandstone and alluvial sediments.

As the aquifers are unconfined and recharged directly by rainfall and river flows they are considered vulnerable to contamination.

3. Existing and proposed land use

The existing Water Reserve covers the entire Nullagine townsite. This includes residential and commercial areas which support the surrounding mining and agricultural industries. Specific land uses include a motel, caravan park, cemetery, service stations, shops and a power station. There is also a small but growing tourist industry with many visitors interested in amateur prospecting and fossicking.

The Bonney Downs pastoral lease (3114/1208) exists over most of the existing Water Reserve outside of the town.

Outside of the townsite there is some mining and mineral processing on mining tenements.

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.



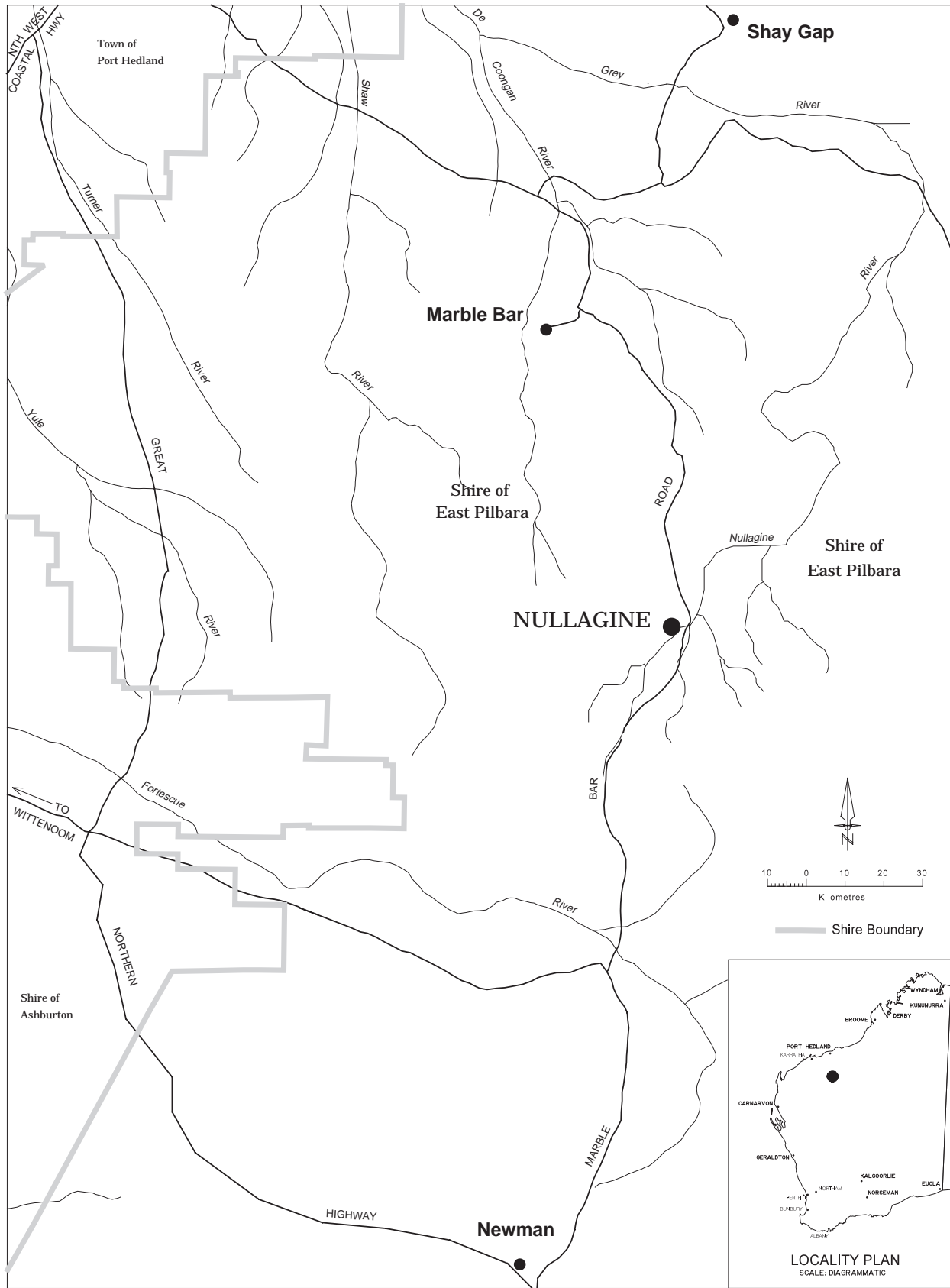


FIGURE 1. NULLAGINE LOCALITY MAP

Figure 1. Nullagine locality map



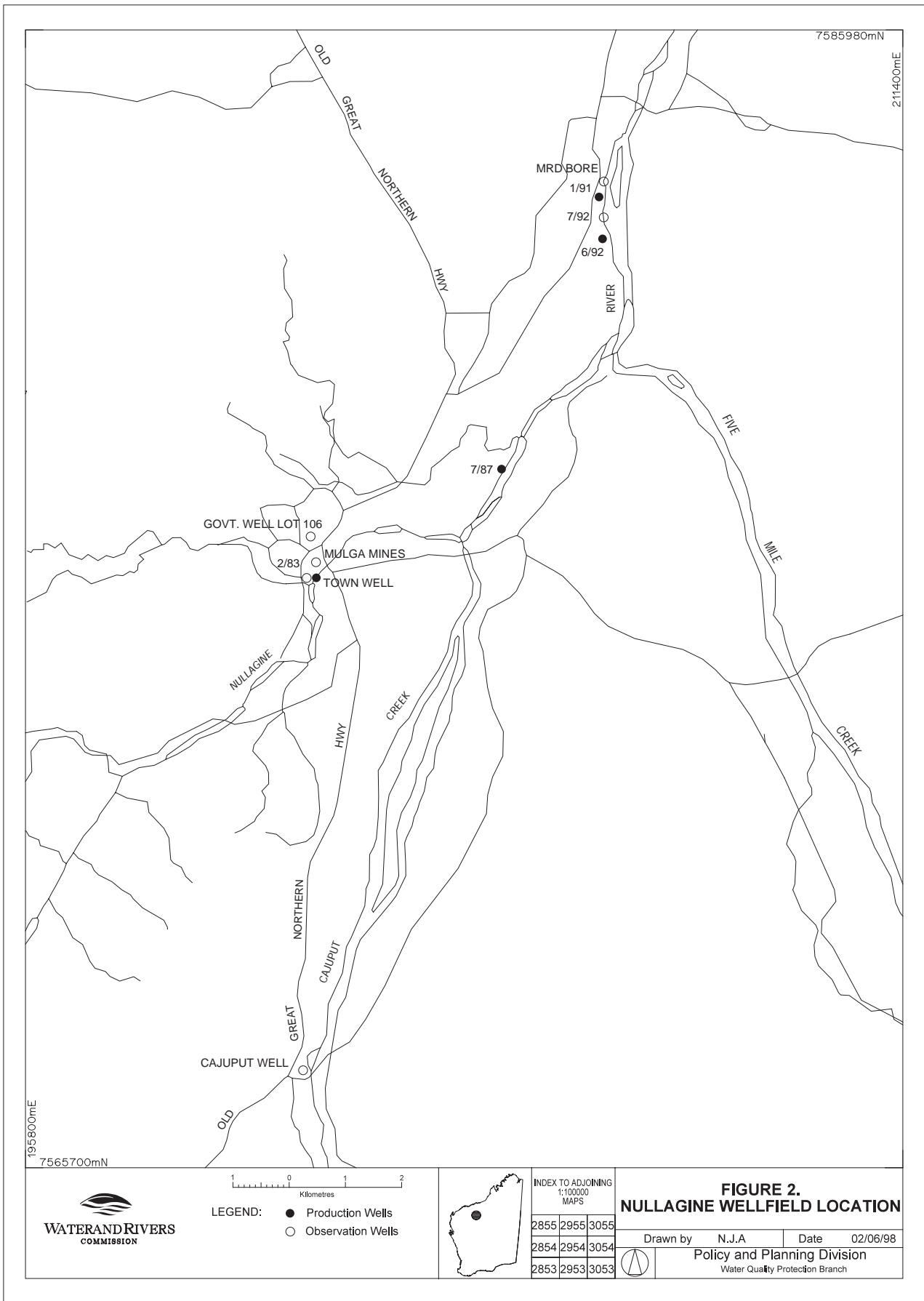


Figure 2. Nullagine wellfield location



Table 1. Potential sources of contamination within the Nullagine Water Reserve

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
1.	Underground storage tank at Nullagine Roadhouse.	<ul style="list-style-type: none"> 4 underground fuel storage tanks, 3 x 20 000 litres and 1 x 17 000 litres. 	High	Moderate	<ul style="list-style-type: none"> Single walled tanks. 	When upgraded, storage tanks to meet Commission's guidelines for Underground Fuel Storage Tanks
2.	Underground storage tank at Conglomerate Hotel.	<ul style="list-style-type: none"> 3 underground fuel storage tanks, 2 x 30 000 litres and 1 x 13 000 litres. 	High	Moderate	<ul style="list-style-type: none"> Single walled tanks. 	When upgraded, storage tanks to meet Commission's guidelines for Underground Fuel Storage Tanks
3.	Nullagine rubbish tip	<ul style="list-style-type: none"> Leaching of contaminants into groundwater. Material dumped is mainly domestic waste. 	High, situated close to the Nullagine River.	High	<ul style="list-style-type: none"> Trench and fill method used. 	<ul style="list-style-type: none"> Investigate the potential impact of tip on groundwater quality. Line rubbish tip with an impervious material.
4.	Beaton Gold Mine	<ul style="list-style-type: none"> Stormwater runoff induced slump on right bank side of cyanide leach pad. Risk of leachate from pad. Storage of chemicals in security compound. Evidence of spills of chemicals within and outside security compound. 	High, cyanide is toxic.	Moderate, pad is currently not operational.	<ul style="list-style-type: none"> Security compound which is lined with plastic liner. 	<ul style="list-style-type: none"> Pad requires rehabilitation. Removal of chemicals and contaminated soil from site.

(Continued)

Map ref.	Issue	Risks/Threats	Potential Impact	Likelihood	Current Preventative Measures	Suggested Protection Measures
5.	Diesel storage at production bores.	<ul style="list-style-type: none"> 2000 litre above ground storage tanks at bores 1/91, 7/87, 6/92. Leaking of tanks or pipelines causing contamination directly at bore. 	High	Moderate	<ul style="list-style-type: none"> Adequately bunded however, evidence of diesel staining around pumps (may be lost when servicing). Town well has been electrified. 	<ul style="list-style-type: none"> Assess condition of bund around pumps. Possibly electrify bore 1/91. Removal of contaminated soil.
6.	Fuel storage at power station.	<ul style="list-style-type: none"> Diesel-fuelled power supply to town Above ground storage tank of 55 000 litres. 	High, spill likely to migrate into alluvial aquifer.	Moderate	Bunded, although evidence of staining near refuelling area.	<ul style="list-style-type: none"> Removal of contaminated soil. Check bund condition around refuelling area.
7.	Shire of East Pilbara depot.	<ul style="list-style-type: none"> Above ground storage tank of 18 000 litres. 	Moderate	Low	Bunded with a dirt bund.	Upgrade bunding to W&RC guidelines for bunding (Appendix 3).
n/a	Nutrient/microbial contamination of water supply.	<ul style="list-style-type: none"> Possible leaking from septic tanks. Swimming in Nullagine River. 	Low	Low, density of septics is low, and few people swimming in river.	None	None
n/a	Marble Bar Road (Old Great Northern Highway)	Vehicles using this road transport bulk liquid fuel and chemicals for mineral processing.	High	Low, dependent on road condition & construction design.	None	<ul style="list-style-type: none"> Shire of East Pilbara 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
n/a	Pastoral activities	Nutrient/bacterial contamination from animals.	Very low	Very low	Grazing is extensive with low stocking rates.	None

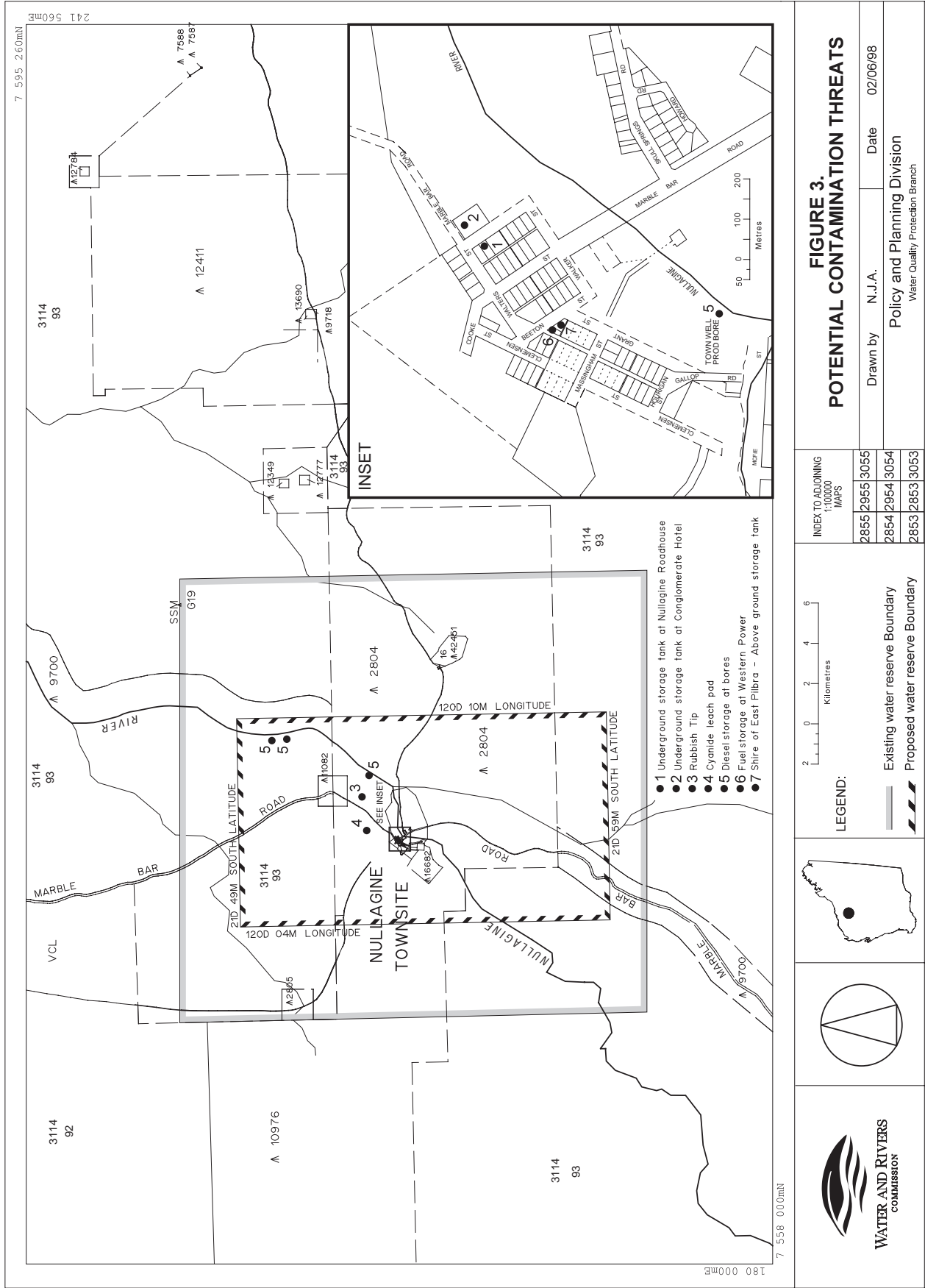


Figure 3. Potential contamination threats



5. Proposed proclaimed area

The existing and proposed Water Reserves are shown in **Figure 4**.

The modifications to the Water Reserve can be justified as follows:

- The proposed reserve incorporates the key recharge areas of the wellfield including the Nullagine River and the surrounding hills; and
- The proposed reserve includes the identified future water sources in the Hardy Sandstone and Mosquito Creek formations (Davidson, 1992) which, although recognised as not of high quality, have the capacity to provide supplementary quantity to Nullagine's town water supply;
- The area has been reduced to exclude areas that are unlikely to be used in the medium to long term for public water supply.

The proposed Water Reserve is rectangular with the north western corner corresponding to latitude 21°49'00" S and longitude 120°04'00" E. The south eastern corner corresponds with latitude 21°59'00" S and longitude 120°07'00" E.

The proposed Water Reserve should be given a dual priority classification.

The part of the reserve that lies over the town of Nullagine should be classified for Priority 3 source protection for the following reasons:

- The area is urbanised;
- The land use activities in the town present a risk to the water source and thus should be managed to minimise this pollution risk; and
- Alternative water sources exist outside of the Nullagine townsite.

The remainder of the reserve should be classified for Priority 1 source protection for the following reasons:

- The land is largely under reserve;
- The area forms the key recharge area for production bores;
- The wellfield forms a strategic water source for the town of Nullagine;
- The aquifer is unconfined and would be susceptible to contamination if intensification of land use was to occur; and
- The existing pastoral and mining land uses can be managed so that they are compatible with the management objectives of Priority 1 source protection areas.

In addition, wellhead protection zones consisting of a 300 metre radius (for town well) and 500 metre radius (for bores 7/87, 1/91, and 6/92) around each production bore should be established. Specific restrictions for fuel storage will apply in these zones.



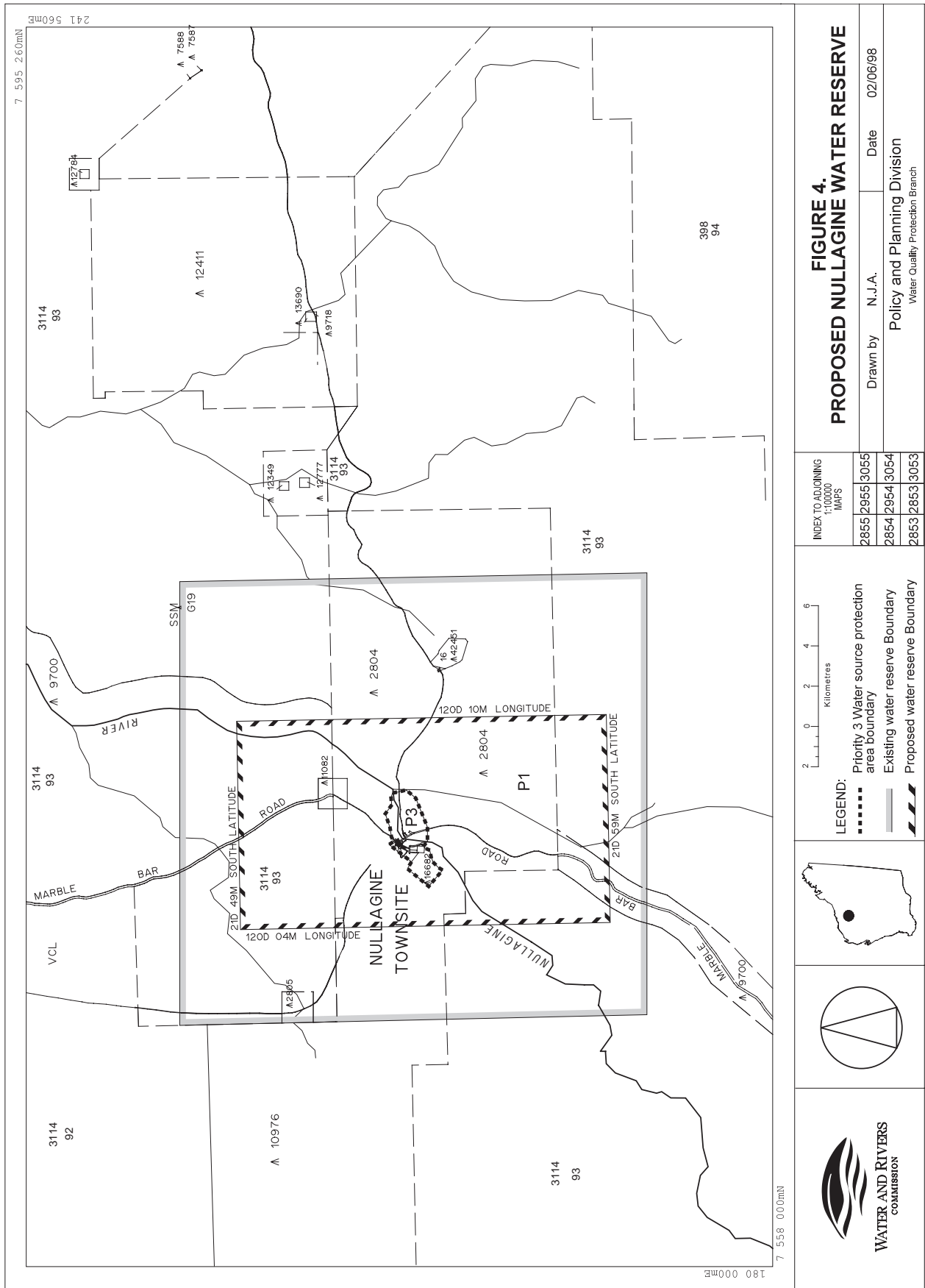


Figure 4. Proposed Nullagine Water Reserve



Recommendations

1. The proposed changes to the Nullagine Water Reserve should be gazetted 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 Note – *Land Use Compatibility in Public Drinking Water Source Areas* (see **Appendix 1**) and reflect the dual pty classification of 1 and 3 given to parts of the Water Reserve.
3. All development proposals in the Water Reserve which are likely to impact on water quality should be referred to the Water and Rivers Commission.
4. Signs should be erected along the boundaries of the Water Reserve to define the reserve and promote public awareness of the need to protect water quality.
5. Incidents covered by WESTPLAN – HAZMAT in the Nullagine Water Reserve should be addressed through the following measures:
 - The Shire of East Pilbara Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Nullagine Water Reserve.
 - The locality plan for the Nullagine Water Reserve 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 Nullagine Water Reserve.
 - Personnel dealing with WESTPLAN - HAZMAT incidents in the area given ready access to a locality map of the Water Reserve and training to understand the potential impacts of spills on the groundwater resource.
6. A surveillance program should be established to identify any incompatible land uses or potential contaminant threats within the Water Reserve.
7. The impact of the Nullagine rubbish tip on water quality should be investigated. In addition, the tip should be lined with an impervious material.
8. The cyanide leach pad at the Beaton Gold Mine should be rehabilitated and chemicals stored on-site removed.
9. Upgrade the underground fuel storage tanks at the Conglomerate Hotel and the Nullagine Roadhouse to meet the Commission's guidelines (**Appendix 2**).
10. Upgrade the bund at the Shire of East Pilbara depot to meet the Commission's guidelines for bunding (**Appendix 3**).
11. Contaminated soils from the power station should be removed from site and the condition of bund around the refuelling area should be assessed.
12. Contaminated soil around production bores should be removed from site and bund condition around pumps assessed. Possibly pursue electrification of bore 1/91.



-
13. 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 Water Reserve.	Program Manager, Protection Planning (WRC).	1999/2000
2.	Incorporation into land planning strategies.	Shire of East Pilbara.	Ongoing
3.	Referral of development proposals: (i) WRC to provide the Shire of East Pilbara with guidelines for referral of development proposals. (ii) referral of development proposals.	(i) Program Manager, Assessment and Advice (WRC) (ii) Shire of East Pilbara, Ministry for Planning, Department of Minerals and Energy and Department of Environmental Protection.	(i) 1998/99 (ii) Ongoing
4.	Erection of signs: (i) development of guidelines for signage. (ii) determine number and location of signs required. (iii) erect signs.	(i) Program Manager, Protection Planning (WRC). (ii) Regional Manager, North West Region (WRC/WC). Regional Manager, North West Region (WRC/WC).	(i) 1999/2000 (ii) 1999/2000 (iii) To be arranged.

(Continued)

5.	<p>Incidents covered by WESTPLAN – HAZMAT in the Nullagine Water Reserve should be addressed through the following measures:</p> <p>(i) The Shire of East Pilbara Local Emergency Management Advisory Committee (through the Karratha Emergency Management District) being familiar with the location and purpose of the Nullagine Water Reserve.</p> <p>(ii) The locality plan for the Nullagine Water Reserve 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 Nullagine Water Reserve.</p> <p>(iv) Personnel dealing with WESTPLAN - HAZMAT incidents in the area given ready access to a locality map of the Water Reserve and training to understand the potential impacts of spills on the groundwater resource.</p>	<p>(i) Shire of East Pilbara Local Emergency Management Advisory Committee through WRC (Karratha region)</p> <p>(ii) WRC (North West Region)</p> <p>(iii) Water Corporation</p> <p>(iv) Shire of East Pilbara 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>Surveillance program:</p> <p>(i) develop guidelines for the surveillance of Water Reserves.</p> <p>(ii) implement the surveillance program.</p>	<p>(i) Program Manager, Assessment and Advice (WRC).</p> <p>(ii) Regional Manager, North West Region (WRC/WC).</p>	<p>(i) 1999/2000</p> <p>(ii) On completion of surveillance guidelines.</p>
7.	<p>Initiate investigation of the Nullagine rubbish tip and the potential for contamination to groundwater and provide advice on the lining of the tip.</p>	<p>Program Manager, Assessment and Advice (WRC).</p>	<p>To be arranged</p>
8.	<p>Provide advice to the DME on the need to rehabilitate the cyanide leach pad at the Beaton Gold Mine and on site clean-up.</p>	<p>Program Manager, Protection Planning (WRC).</p>	<p>1998/99</p>
9.	<p>Provide advice for the upgrade of the underground storage tanks at the Conglomerate Hotel and the Nullagine Roadhouse.</p>	<p>Program Manager, Assessment and Advice (WRC).</p>	<p>On upgrading of Underground Storage Tank</p>
10.	<p>Provide advice to the Shire of East Pilbara for the upgrade of the bunding of the above ground diesel storage tank at the depot.</p>	<p>Program Manager, Assessment and Advice (WRC).</p>	<p>1998/99</p>

(Continued)

11.	Remove contaminated soils from the power station and assess the condition of bund around the refuelling area.	Western Power	To be arranged
12.	(i) Contaminated soil around bores to be removed from site in conjunction with the assessment of bund condition around pumps. (ii) If cost viable, bore 1/91 should be electrified.	(i) Regional Manager, North West Region, Water Corporation. (ii) Regional Manager, North West Region, Water Corporation.	(i) To be arranged (ii) To be arranged
13.	Review of this plan and recommendations.	Water Quality Protection Branch (WRC).	(i) Initial review-1999. (ii) Full review-2002/03.

References

Australian Groundwater Consultants 1987, *Groundwater Scheme Review Nullagine*, Report No WG 24, Water Authority of Western Australia.

Davidson, W. A. 1992, *Nullagine Town Water Supply Groundwater Drilling Investigation 1992*, Hydrogeology Report 1992/39 Geological Survey of Western Australia.



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

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.

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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 ⁸	Restricted ⁸
Special rural - minimum lot size = 1 hectare (un-sewered) ⁵	Incompatible	Incompatible	Restricted ⁸
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 ³	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.
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 2

Underground fuel storage tanks in Public Drinking Water Source Areas



UNDERGROUND FUEL STORAGE TANKS IN PUBLIC DRINKING WATER SOURCE AREAS

Purpose

To provide information for activities 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 to underground storage tanks used to store petroleum hydrocarbons ie petrol, diesel, oils, solvents in Public Drinking Water Source Areas (PDWSAs).

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, Water Reserves and Catchment Areas.

General requirements

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

Any proposal to locate an underground fuel storage tank system within a public drinking water source area should be submitted to the Water and Rivers Commission for assessment and consideration of a permit.

The submission should include:

- A completed permit application form
- A site plan showing the location of all existing and proposed UPS systems
- A written description accompanied by design drawings providing detail of the proposed UPS system

These systems also require approval from the Department of Minerals and Energy and the local government authority.

Tank Construction

All tanks and pipe work should be constructed of either corrosion resistant materials or steel, provided they have corrosion resistant coating and cathodic protection.



All tanks and pipe work (including delivery and remote fill lines) should be double walled construction with an interstitial leak monitoring space.

Tank Installations

All tanks and pipe work should pass an approved Equipment Integrity Test prior to installation.

Backfill around tanks should be free from rocks exceeding 50 mm in diameter, organic matter and refuse. Backfill shall be placed and compacted in a manner to avoid damage to tanks and fittings.

Any tanks situated below the water table should be anchored to prevent any movement which could damage the pipe work and fittings connected to the tank.

The owner or contractor should advise the Commission 48 hours prior to the tank installation, so an authorised inspector can be present during the installation process.

Tank Overfill Protection

All tank systems should have containment sumps around the fill points capable of containing any significant spill. Sumps should be constructed so that they don't capture stormwater run-off or washdown water.

Any fuel spill contained within the sump should be removed, treated and disposed of by an authorised waste disposal contractor.

All UPS systems should include one of the following overfill prevention systems:

- Automatic shut off device to prevent further delivery of product once a certain level in the tank is reached
- An audible and visible overfill alarm which is activated when the tank is 90% full

Other Equipment

Containment sumps constructed of corrosion resistant material should be installed beneath all dispensers. The sumps should be capable of containing any spill from the dispensing system.

Dispenser sumps should be regularly inspected and action taken to ensure that any liquid in the sump is reclaimed for appropriate disposal. Product collected in these sumps should be collected and stored prior to disposal in accordance with Department of Environmental Protection's Waste Management Division requirements.



Monitoring

All tank systems should have the provision for leak monitoring and include, as a minimum, **all** of the following:

- Two soil vapour monitoring bores installed in diagonally opposite corners of each tank system pit.
- Monitoring of the interstitial space to detect any leakage from the primary containment system. Provision should be made for liquid and vapour recovery from the interstitial spaces in the pipework.
- Automatic tank leak detector to signal when a significant leak occurs and actuate controls to shut off product flow in pressurised piping.

Monitoring frequency for all monitoring equipment will be specified in the Permit conditions.

More information

The Commission welcomes 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



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 bunded compounds.

All chemicals stored within the bunded 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).

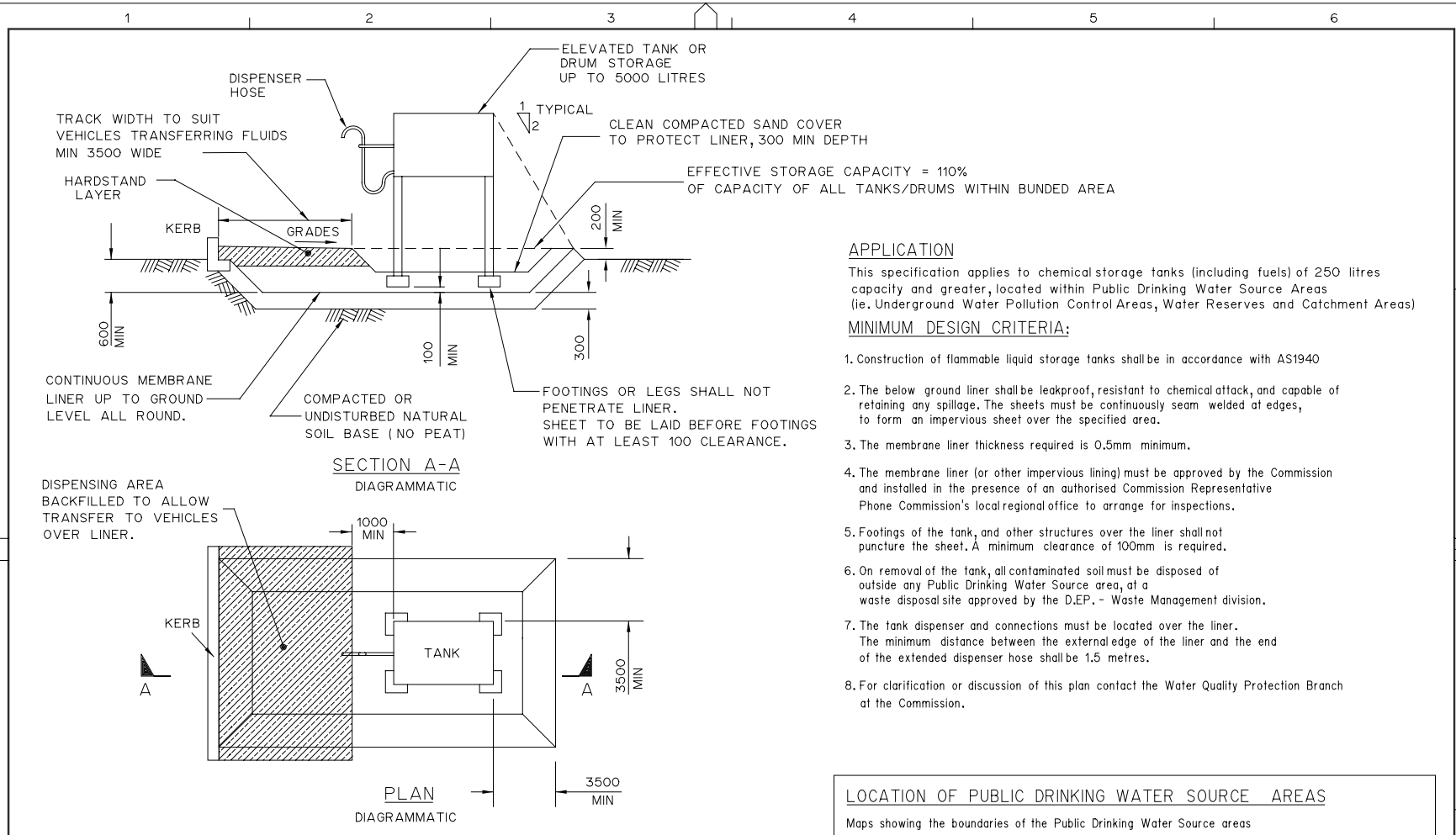
More information

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

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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
FILE	PROJECT	PLAN	CAD	A4
		No. 1	ISSUE	
			A	MF

Appendix 4

Plates of potentially contaminating threats





Plate 1. Underground fuel storage at the Conglomerate Hotel



Plate 2. Diesel fuel storage at bore 1/91





Plate 3. Diesel fuel storage at the Western Power Station



Plate 4. Nullagine rubbish tip





Plate 5. Cyanide leach pad at Beaton Creek

