

GNANGARA

LAND USE AND WATER MANAGEMENT STRATEGY

FINAL REPORT

JANUARY 2001

Prepared by



WESTERN AUSTRALIAN PLANNING COMMISSION

in conjunction with



WATER AND RIVERS
COMMISSION



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MINISTERS' FOREWORD

The Gnangara Mound is a significant groundwater resource which occurs naturally under the sandy soils of the Swan Coastal Plain. Perth is very fortunate to have such an important, accessible and high quality water supply source. The Mound's groundwater also plays an important part in supporting wetlands, vegetation and wildlife along with the region's other associated environmental values.



The economic growth and expansion of the Perth region is dependent upon a cost-effective and high-quality water supply. It is essential to balance the needs for growth, environmental protection and the long-term security of public drinking water supplies for future generations.



A large portion of the Gnangara Mound is already protected by the existing Underground Water Pollution Control Area (UWPCA). This Strategy recommends a revised UWPCA boundary and presents a framework for future land use planning decision-making in the UWPCA over the Gnangara Mound.

The Gnangara Mound groundwater resources are of supreme value. They are a key factor in achieving sustainable social and economic growth for the region.

A handwritten signature in blue ink, consisting of a large, stylized 'G' and 'K'.

Hon. Graham Kierath MLA
MINISTER FOR PLANNING

A handwritten signature in blue ink, appearing to read 'Kim Hames'.

Hon. Dr Kim Hames MLA
MINISTER FOR WATER RESOURCES

CONTENTS

	Page No
MINISTERS' FOREWORD	iii
EXECUTIVE SUMMARY	1
1.0 INTRODUCTION.....	4
1.1 Background	4
1.2 Strategy Administration.....	7
1.3 Strategy Area.....	7
1.4 Strategy Aims and Objectives	8
2.0 GNANGARA MOUND GROUNDWATER RESOURCES	10
2.1 Groundwater Resources	10
2.2 Public Water Abstraction and Public Water Source Protection.....	10
2.3 Private Water Abstraction	11
2.4 Land Use and Water Quality	14
2.5 UWPCA Boundary Definition.....	15
3.0 THE LAND USE AND WATER MANAGEMENT STRATEGY.....	17
3.1 The Strategy (See Figures 5 and 7).....	17
3.2 Land Use Components of the Strategy	20
3.2.1 Existing and Possible Future Urban Land Uses	20
3.2.2 Rural Land Uses	21
3.2.3 Rural Living	24
3.2.4 Conservation, Recreation and Forestry.....	25
3.2.5 Industrial Land Uses	28
3.2.6 Extractive Industry Land Uses	28
3.2.7 Roads	30
3.2.8 Utilities and Infrastructure.....	31
4.0 STRATEGY IMPLEMENTATION	33
4.1 Land within the Metropolitan Region.....	33
4.2 Outside the Perth Metropolitan Region	35
4.3 Proposed Metropolitan Region Scheme Amendments and Planning Controls	36
4.4 Supporting Statement of Planning Policy (SPP) and Environmental Protection Policy (EPP) ..	37
4.5 Water and Rivers Commission Groundwater Controls	39
4.6 Co-ordination	40

5.0	IMPLEMENTATION PROGRAM AND RECOMMENDATIONS	41
5.1	Implementation Process	41
5.2	Recommendations	41
APPENDIX 1	GLOSSARY	63
APPENDIX 2	ABBREVIATIONS	66
APPENDIX 3	COMMITTEE MEMBERSHIP	68
APPENDIX 4	LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS	69
APPENDIX 5	PUBLIC CONSULTATION	77
APPENDIX 6	REFERENCES.....	78

FIGURES

Figure 1	Location Plan	6
Figure 2	Strategy Area and Planning Precincts.....	9
Figure 3	Existing UWPCA, Priority Source Protection Classifications and Public Water Supply Wells	13
Figure 4	Recommended UWPCA and Priority Source Protection Classifications	16
Figure 5	Land Use Plan.....	22
Figure 6	Gnangara Park Concept Plan.....	26
Figure 7	Zoning and Reservation Plan.....	38

TABLES

Table 1	Gnangara Public Water Supply Wellfields	12
Table 2	Decision-Making Process for Assignment of Groundwater Priority Classifications and MRS Recommendations	18
Table 3	Road Reserve Priority Classifications	30
Table 4	Summary of Attributes of Each Planning Precinct	43
Table 5	Implementation Strategy for Planning Precincts.....	50

EXECUTIVE SUMMARY

The Gnangara Mound is the largest and most important shallow underground water resource in the Perth region. It contains substantial supplies of water which are required to meet current and future public water demands.

The long-term protection of this water resource from contamination is a high priority for the Government and can be achieved only through a co-ordinated whole-of-government approach to land use planning over the Gnangara Mound.

The Western Australian Parliament Select Committee's report on *Metropolitan Development and Groundwater Supplies* (1994) examined the relationship between city growth and development and the need to protect Perth's unique groundwater resources for future water supply.

The Select Committee made many recommendations, one of which was to prepare Land Use and Water Management Strategies for the Jandakot and Gnangara Mounds.

A strategy was prepared for the Jandakot Mound in 1995 with a subsequent amendment to the Metropolitan Region Scheme in 1998 which introduced a Water Catchments reservation and a Rural-Water Protection zone to ensure the long-term protection of groundwater resources.

The Western Australian Planning Commission has now prepared the Gnangara Land Use and Water Management Strategy which covers the Underground Water Pollution Control Areas of the central Gnangara Mound in the Cities of Joondalup, Wanneroo and Swan and the Shires of Gingin and Chittering.

The Strategy examines existing land uses and the impacts on water quality and potential risks of contamination. It makes recommendations on the types of land uses and land zoning that are appropriate in the strategy area.

Extensive public consultation has accompanied the development of the Strategy.

This Strategy addresses a range of issues, including:

- the integration of the planning, environmental and legal issues to achieve the long-term protection of the groundwater resources;
- the recognition of various commitments in the form of existing land uses, public utility infrastructure and Government policies such as the Urban Expansion and Basic Raw Materials Policy Statements;
- the need to prepare guidelines for land use and development over the Gngangara Mound to protect the quality and quantity of groundwater for public water supply;
- the need to protect important wetlands and remnant vegetation.

This Strategy recommends and describes the revised Underground Water Pollution Control Area boundary (UWPCA) and the Priority source protection area classifications for the Gngangara, Mirrabooka and Wanneroo Underground Water Pollution Control Areas based on the most recent scientific studies commissioned by the Water and Rivers Commission (1997 and 1998).

It includes a land use plan which indicates the long-term land use in the Underground Water Pollution Control Area and a land zoning and reservation plan which indicates the proposed Metropolitan Region Scheme (MRS) and local town planning scheme land use categories.

Existing Urban, Urban Deferred and Industrial areas are recognised as Priority 3 source protection areas and existing Special Rural zones as Priority 2 source protection areas. It recommends no further development or expansion of high-risk land use activities in Priority 1 source protection areas and recommends the Government purchase land in Priority 1 areas if landowners wish to sell.

A major feature of this Strategy is the recognition and proposed reservation of the Gngangara Park. The park is to be established for conservation, recreation and forestry purposes and managed by the Department of Conservation and Land Management (CALM) to replace the pine plantation areas as they are progressively harvested over the next 20 years.

The implementation of the Strategy involves an amendment to the Metropolitan Region Scheme to include a Water Catchments reservation over Priority 1 source protection areas and a Rural-Water Protection zone over Priority 2 source protection areas.

Implementation of this Strategy will also rely on local governments to incorporate groundwater protection areas and appropriate land use controls in local town planning schemes. This will be the key public drinking water protection mechanism outside the metropolitan region.

Land use decision-making in the Water Catchments reservation and the Rural-Water Protection zone will be supported by a revised *Statement of Planning Policy No. 3 (As Varied) Gnangara Mound Crown Land* (1995). This will provide guidelines both for land use planning and in conjunction with the Environmental Protection Authority's *Draft Environmental Protection (Gnangara Mound Crown Land) Policy* (1999) will complement environmental guidelines for uses within the policy area.

In addition to this, the EPA is currently developing a policy framework through the Draft State Groundwater Environmental Protection Policy (EPP) to protect important groundwater areas throughout the State. It is expected that regulations will be proposed under this EPP to protect groundwater and related features outside the UWPCA. These policies should present a whole-of-government approach for the protection of the water resource and environmental features.

The future Metropolitan Region Scheme amendment will also involve consultation with affected individual landowners, a formal public advertising and public submission period, approval by the Minister for Planning and both Houses of Parliament.

The proposed amendment to the MRS, a supporting Statement of Planning Policy and Environmental Protection Policy with local town planning scheme amendments would achieve the long-term protection of the Gnangara Mound groundwater resources for the present and future people of Perth.



1.0 INTRODUCTION

1.1 BACKGROUND

Western Australia is the second driest State in the world's driest continent and fresh water is one of our most important natural resources. Our State's economic livelihood and the community's lifestyle, health, gardens, parks, food production, and industry depend on a good-quality and reliable water supply.

The protection of our public water supply is of paramount importance. Groundwater comprises approximately 50 per cent of Perth's water supply.

Most of this water comes from the shallow groundwater resources of the Gnangara Mound, with contributions from the Jandakot Mound and other deeper confined aquifers.

The Gnangara Mound is the largest and most important source of fresh groundwater in the Perth region. It also supports a variety of significant environmental features such as wetlands, shallow cave streams, springs and seepages, and native vegetation dependent on groundwater.

The Mound covers a very large area extending from Gingin Brook and Moore River in the north, to the Gingin Scarp in the east, the Swan River in the south, and the Indian Ocean to the west (See Figure 1).

Private groundwater users also rely on water from the Gnangara and Jandakot Mounds, abstracting groundwater for agricultural, recreational and domestic uses. There are more than 120,000 privately owned bores (wells) in the Perth region.

In 1998, an estimated 280 million kilolitres (kL) of groundwater was allocated for a range of uses including private bores to irrigate domestic gardens, market gardens, public open space and for use by industry. Private groundwater usage was more than three times the amount of groundwater pumped from the aquifers for public drinking water supply by the Water Corporation. About 70 per cent of the total water use in Perth is supplied by groundwater.

As Perth's need for water supplies increases and urban and industrial areas

expand, it is vital to protect our groundwater resources from pollution and overuse. Inappropriate land use has the potential to have a significant effect on the quantity and quality of groundwater resources.

In 1993 the Western Australian Legislative Assembly established a Select Committee to examine a range of issues relating to groundwater protection and prepare a report on *Metropolitan Development and Groundwater Supplies*. This report was released in December 1994, tabled in Parliament in 1995, and endorsed by the then Minister for Planning, Hon. Richard Lewis, on 10 May 1995.

The Select Committee found Perth's groundwater assets were vital for future development and decisive actions were necessary to secure their protection.

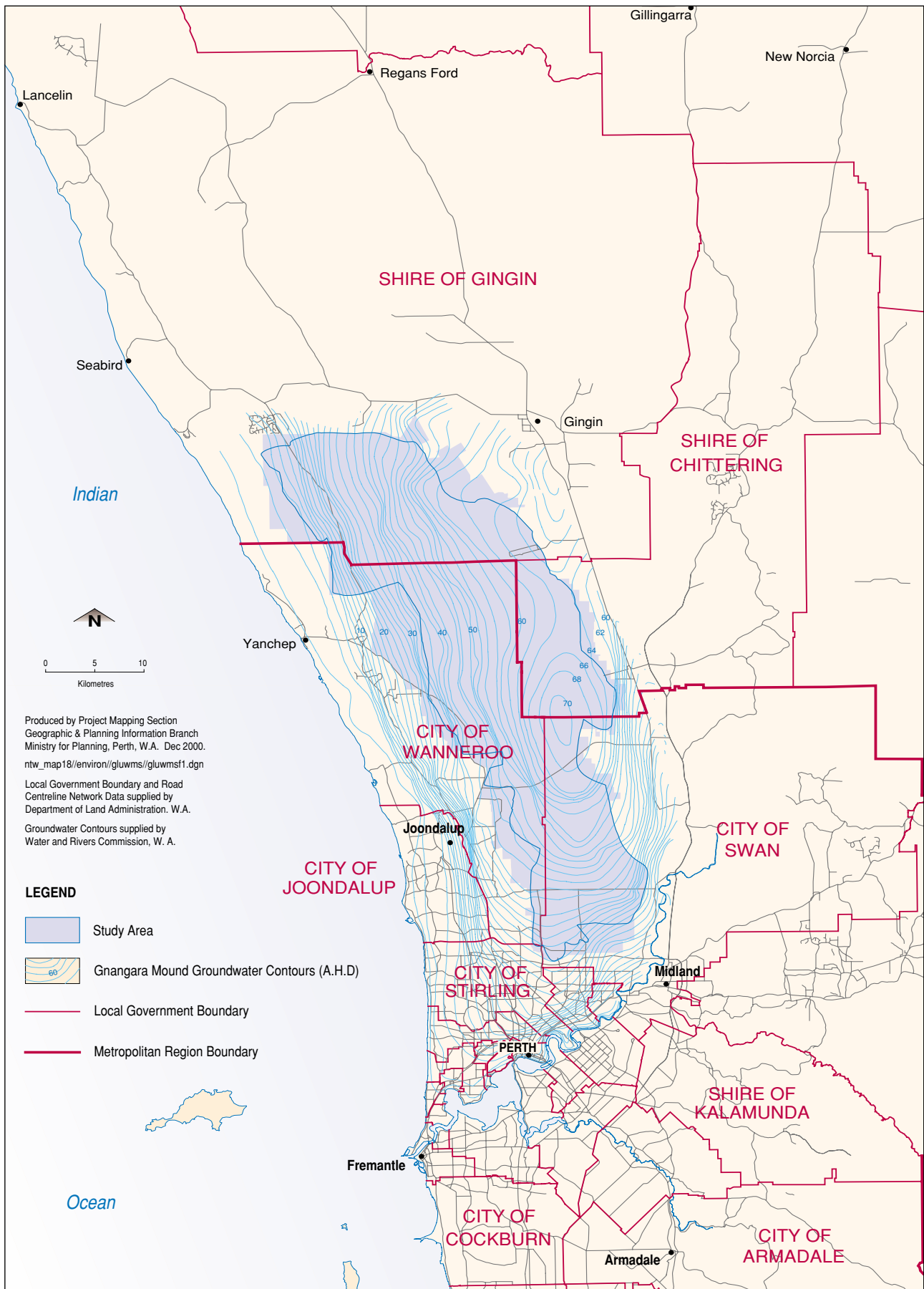
This Strategy is the result of the Select Committee's Recommendation 6 which states:

6.1 “The Select Committee recommends that a Land Use and Water Management Strategy be produced for the Gnangara Mound. This strategy should be produced through a ‘whole-of-government’ co-ordinated approach and incorporated into the Metropolitan Region Scheme. The principal aim of the strategy would be to protect the important groundwater and environmental features of the Mound while allowing the maximum development of the land for the benefit of the community. The strategy would incorporate the existing policies of key Government departments involved in land planning, water protection and the environment and the results of the study from Recommendation No. 4¹.

6.2 The Select Committee also recommends that the strategy incorporate provisions so that the impacts of any land use decision on a groundwater catchment can be assessed in a cumulative way so as to avoid the ‘incremental loss’ effects on water quality.”

¹ Recommendation No. 4 was that a study be undertaken by the Water Authority (now the Water and Rivers Commission and the Water Corporation) in liaison with the EPA (Environmental Protection Authority) and the Department of Planning and Urban Development (now the Ministry for Planning) to review the Priority area boundaries to ensure that they are based on rigorous scientific evidence...

Numeric modelling was undertaken to simulate the groundwater flow systems for the Gnangara and Jandakot Mounds (e.g. production wells, wetlands, lakes and springs). Refer to Section 3.



1.2 STRATEGY ADMINISTRATION

The administration of the Gnamgara Land Use and Water Management Strategy (GLUWMS) involved the establishment of several committees.

A Steering Committee, comprising representatives of the relevant government agencies and local governments within the study area, was formed to guide the preparation of the Strategy.

An intergovernmental Senior Officers Group (SOG) was established in June 1995 to oversee the implementation of the Select Committee recommendations and to manage the study.

A Community Advisory Committee (CAC) was established in December 1995 to provide an opportunity for stakeholders and the community to provide the project team with advice and feedback.

Membership of the Steering Committee, Senior Officers Group and the Community Advisory Committee is shown in Appendix 3.

The Draft Gnamgara Land Use and Water Management Strategy was released in June 1999 for a three-month public comment period which closed on 30 September 1999. A full public consultation strategy was prepared and implemented by the Ministry for Planning.

Meetings were held with individual landowners and several group meetings were held to discuss the draft Strategy. The draft Strategy was also presented and discussed at three public meetings at the City of Wanneroo in conjunction with information nights on the CALM proposals for the Gnamgara Park and the City of Wanneroo Draft Local Rural Strategy.

One hundred and one submissions were received (See Appendix 5). A detailed analysis of each individual submission is available from the Ministry for Planning upon request.

1.3 STRATEGY AREA

The Gnamgara Mound extends over an area of approximately 2,200 square kilometres from Gingin Brook to the north, the Gingin Scarp to the east, the coastline to the west and the Swan River to the south.

The Water and Rivers Commission (WRC) protects public water sources by declaring Underground Water Pollution Control Areas under the *Metropolitan Water Supply, Sewerage and Drainage Act, 1909* (MWSSD) (as amended).

The strategy covers the existing Gnangara, Mirrabooka and Wanneroo Underground Water Pollution Control Area (UWPCA) boundaries. It's area is approximately 800 square kilometres and includes the local governments of Gingin, Chittering, Swan and Wanneroo. The area was divided into planning precincts (see Figure 2).

Groundwater is also taken from coastal schemes along Perth's north-western corridor. These schemes are protected by the Perth Coastal and Gwelup Underground Water Pollution Control Areas.

The Perth Coastal and Gwelup UWPCAs and the strip of land dividing them from the other UWPCAs are not an integral part of this study as this land is, for the most part, classified as a Priority 3 source protection area and developed and/or reserved or zoned in the Metropolitan Region Scheme.

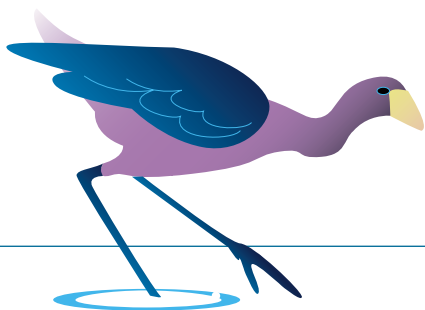
The Water and Rivers Commission (WRC) will undertake a review of the groundwater protection priorities for the Perth Coastal and Gwelup UWPCAs in the future.

1.4 STRATEGY AIMS AND OBJECTIVES

The overall aim of this Strategy is to protect the important groundwater and environmental features of the Gnangara Mound while allowing compatible development of the land for the benefit of the community.

The principal objectives are to:

- protect the public groundwater supplies by promoting land use and development which are consistent with the objectives for the protection and management of the UWPCA and key environmental features;
- provide a planning framework for landowners, local and State government for land use decision-making which complements groundwater protection;
- preserve wetlands and significant vegetation;
- sustain compatible economic and recreational activities and other environmental values.



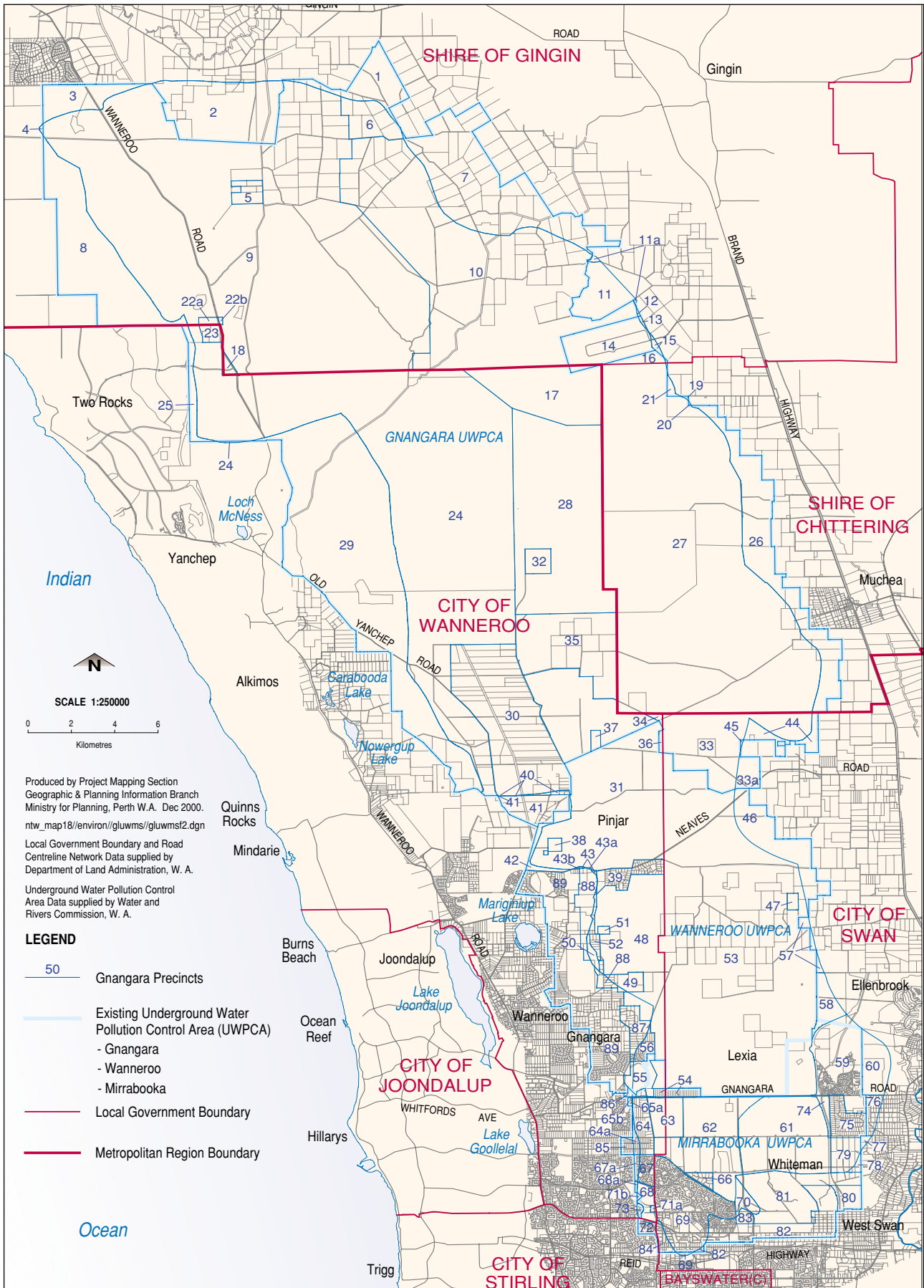


FIGURE 2 STAGY AREA AND PLANNING PRECINCTS

2.0 GNANGARA MOUND

GROUNDWATER RESOURCES

2.1 GROUNDWATER RESOURCES

In Perth there are two types of aquifers – the unconfined or water table aquifer and the confined aquifer. The most readily accessible and widely used groundwater resource is from the water table aquifers of the Gngangara and Jandakot Mounds. In the Perth area the water table aquifer is generally recharged by direct infiltration from rain and water bodies and is vulnerable to contamination. Rainfall recharge to the Gngangara and Jandakot Mounds has been estimated to be 343 million kL per year and total storage in the aquifer has been estimated to be 25.6 billion kL of groundwater (Davidson, 1995).

The Gngangara Mound is the major shallow groundwater resource able to provide the public drinking water requirements for the Perth region and its future growth, as well as the water needs for agriculture and commercial uses. It covers approximately 2,200 square kilometres, extending from the Swan River to the Moore River and Gingin Brook.

The crest of the Gngangara Mound is located between Muchea and Lake Pinjar, where the water table level is as high as 75 m above sea level. Water flows away from this high point towards the Indian Ocean, the Swan River, Ellen Brook and Gingin Brook.

The important recharge areas for the Gngangara Mound are largely undeveloped. Very good quality groundwater can be supplied on a sustainable basis.

The Mound also supports remnant bushland areas and a number of important wetlands, including Loch McNess the lakes Yonderup, Joondalup, Jandabup, Nowergup, Goollelal, Gngangara, Carabooda and Mariginiup and Coogee Springs.

2.2 PUBLIC WATER ABSTRACTION AND PUBLIC WATER SOURCE PROTECTION

Underground Water Pollution Control Areas (UWPCAs) are declared over the recharge areas of Perth's public groundwater supply schemes to protect the quality of drinking water supplies. In these areas, the Water and Rivers Commission administers the by-laws of the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* to manage land use activities with potential to contaminate water resources.

The Water Corporation currently has licences to operate six groundwater abstraction schemes on the Gnangara Mound, namely Pinjar, Wanneroo, Mirrabooka, Gwelup, Yanchep and the Perth Coastal groundwater schemes. A total of 79.1 million KL is abstracted from the Gnangara public water supply wellfields per annum.

Since the development of the first metropolitan groundwater scheme at Mirrabooka in 1970, the proportion of groundwater contributing to Perth's public drinking water supply has increased to 50 per cent, most of which is abstracted from the Gnangara Mound. The WRC manages groundwater abstraction by issuing groundwater licences under the *Rights in Water and Irrigation Act 1914*.

Groundwater allocation programs for public water supply schemes are assessed by the Environmental Protection Authority. The schemes need to be managed in strict accordance with the environmental approval conditions set by the Minister for the Environment.

Figure 3 outlines the existing and proposed public water supply wellfields over the Gnangara Mound. Table 1 outlines the existing and proposed groundwater schemes.

2.3 PRIVATE WATER ABSTRACTION

Horticulture is by far the largest private user of groundwater from the Gnangara Mound, utilising 25 per cent of available water, mostly for vegetable production. Recreation is the second largest, using 13 per cent of the available water for irrigation of ovals, parks and golf courses. Other private wells are used for household, stock and commercial uses.

The Water and Rivers Commission (WRC) currently licenses and manages groundwater abstraction in groundwater areas. The last annual report on *Environmental Management of the Groundwater Abstraction on the Gnangara Mound* (WRC, 1997) lists the interim quotas and allocations of groundwater on the Gnangara Mound with a total private allocation of 280 gigalitres per year.



TABLE 1 GNANGARA PUBLIC WATER SUPPLY WELLFIELDS

GROUNDWATER SCHEME	NUMBER OF WELLS (UNCONFINED AQUIFER)	VOLUME OF GROUNDWATER ABSTRACTED (MILLION KL PER YEAR)
Mirrabooka	34	14
Wanneroo	24	12
Gwelup	12	4.5
Pinjar	14	7.6
Perth Coastal		
Whitfords	4	9
Quinns	15	13
Eglinton	11	11
Yanchep	8	8
SUBTOTAL	122	79.1
Proposed Schemes		
Pinjar Stages 2&3	10	7
East Mirrabooka Stage 3	3	2
Lexia	11	9
Yeal	15	7
Barragoon	28	15
SUBTOTAL	67	40
TOTAL	189	119.1

More detailed information on the resources of the Gnamara Mound is contained in the Part 2 report, Technical Background Information.

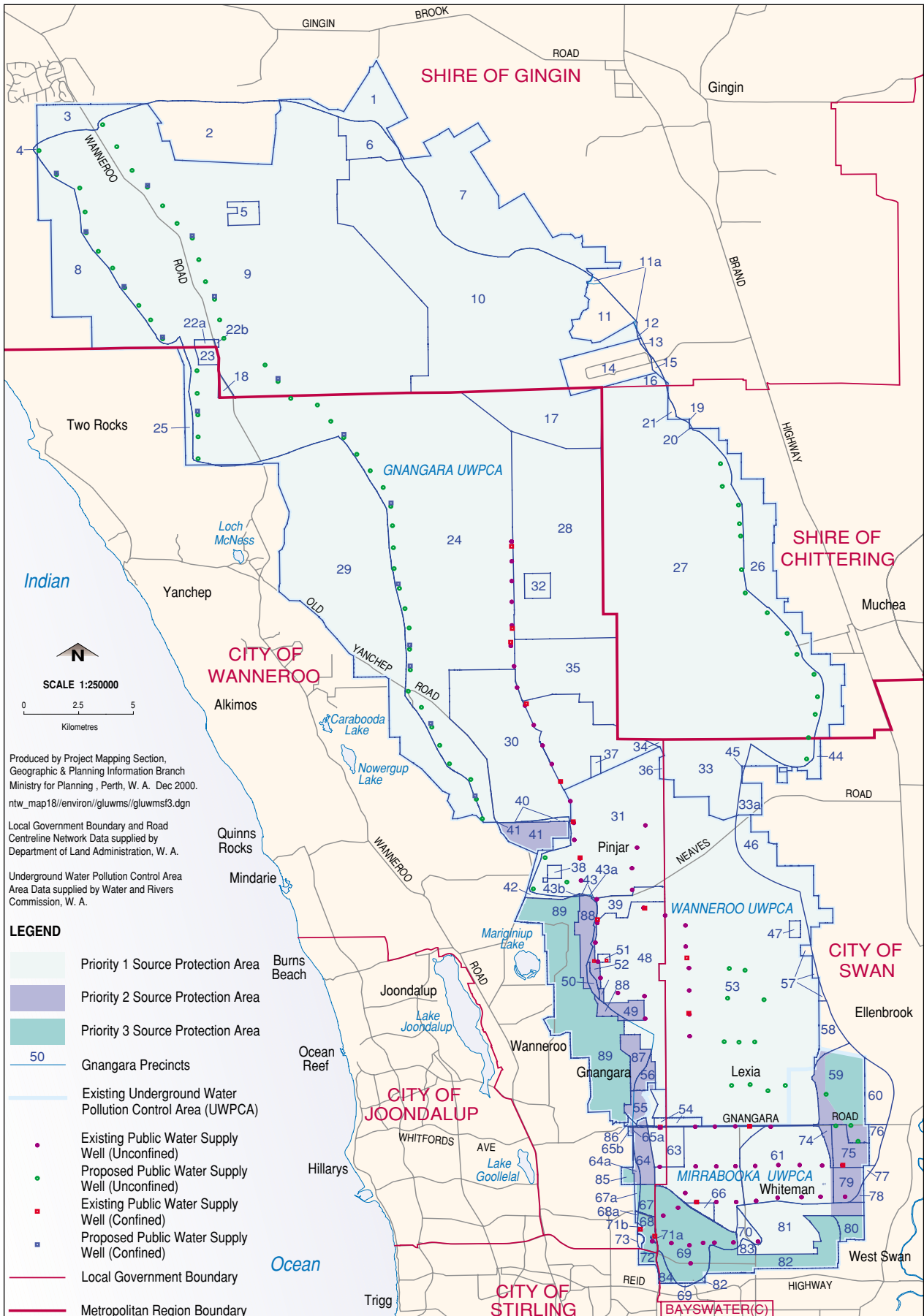


FIGURE 3 EXISTING UWPCA, PRIORITY SOURCE PROTECTION AND PUBLIC WATER SUPPLY WELLS

2.4 LAND USE AND WATER QUALITY

Contamination of the water table aquifer occurs when pollutants move through the soil to the water table. A plume of contaminated groundwater may result as the contaminants migrate in the direction of groundwater flow.

The Select Committee of the Western Australian Legislative Assembly found in its report *Metropolitan Development and Groundwater Supplies* that the nature and extent of contamination are often indicated by the nature and distribution of land uses. For example, intensive horticulture may lead to contamination of groundwater by nutrients, fertilisers and pesticides; service stations can lead to contamination with hydrocarbons; but contamination is unlikely to occur in areas of natural vegetation.

Sources of contamination are often referred to as point or diffuse sources. Point sources of contamination are localised with an identifiable origin such as leaking underground storage tanks. Diffuse contamination sources are those which are caused by a widespread source (or collection of sources) such as septic tanks in unsewered areas.

Perth is fortunate that groundwater resources supplying the public water supply system are generally in excellent condition. However, a study by Hirschberg in 1991 reported in excess of 1000 proven or inferred point sources of contamination in the Perth Basin.

Therefore, it is important that land planning in the Perth region recognises the link between land use and groundwater contamination and promotes appropriate land activities over the most important groundwater recharge areas.

To ensure the sustainable protection of groundwater resources, the WRC has identified three Priority Source classifications within UWPCAs.

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, and would typically include land under Crown ownership. P1 areas are managed in accordance with the principle of risk avoidance and so 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. Provision of public water supply 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 needs 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 to avoid the need for costly water treatment.

2.5 GNANGARA MOUND UNDERGROUND WATER POLLUTION CONTROL AREA BOUNDARY DEFINITION

Underground Water Pollution Control Area (UWPCA) boundaries have previously been based on a combination of cadastral boundaries and hydrogeological knowledge of the groundwater source areas for the production wells.

Based on Recommendation No. 4 of the Select Committee's report into groundwater supplies (1994), that a study be undertaken to review the priority area boundaries to ensure that they are based on rigorous scientific evidence, international consultant Dames & Moore was commissioned in 1995 to conduct the study.

The Dames & Moore study *Review of Groundwater Protection Priority Area Boundaries Gnanagara Mound 1996* used the most up-to-date data and internationally accepted groundwater modelling software to define the groundwater catchments for groundwater schemes and wetlands.

The modelling has been used to re-evaluate the delineation of the UWPCA boundaries and to define additional Environmental Management Areas (EMAs) over the capture zones for environmental features such as wetlands. The draft strategy released in May 1999 proposed a revised UWPCA boundary based on the Dames & Moore study.

Since the release of the draft strategy and during the compilation of this Strategy the WRC has undertaken further study to refine the UWPCA boundary.

The Strategy includes two changes to the groundwater protection area boundary shown in the draft strategy.

The first was a boundary modification in the Landsdale area (Precinct 64) because a bore had been incorrectly located in the original groundwater model. The second change was an amendment to the boundary on public land at Muchea to provide improved flexibility to site future bores away from environmentally sensitive areas.

The recommended UWPCA boundary and Priority classifications are shown on Figure 4.

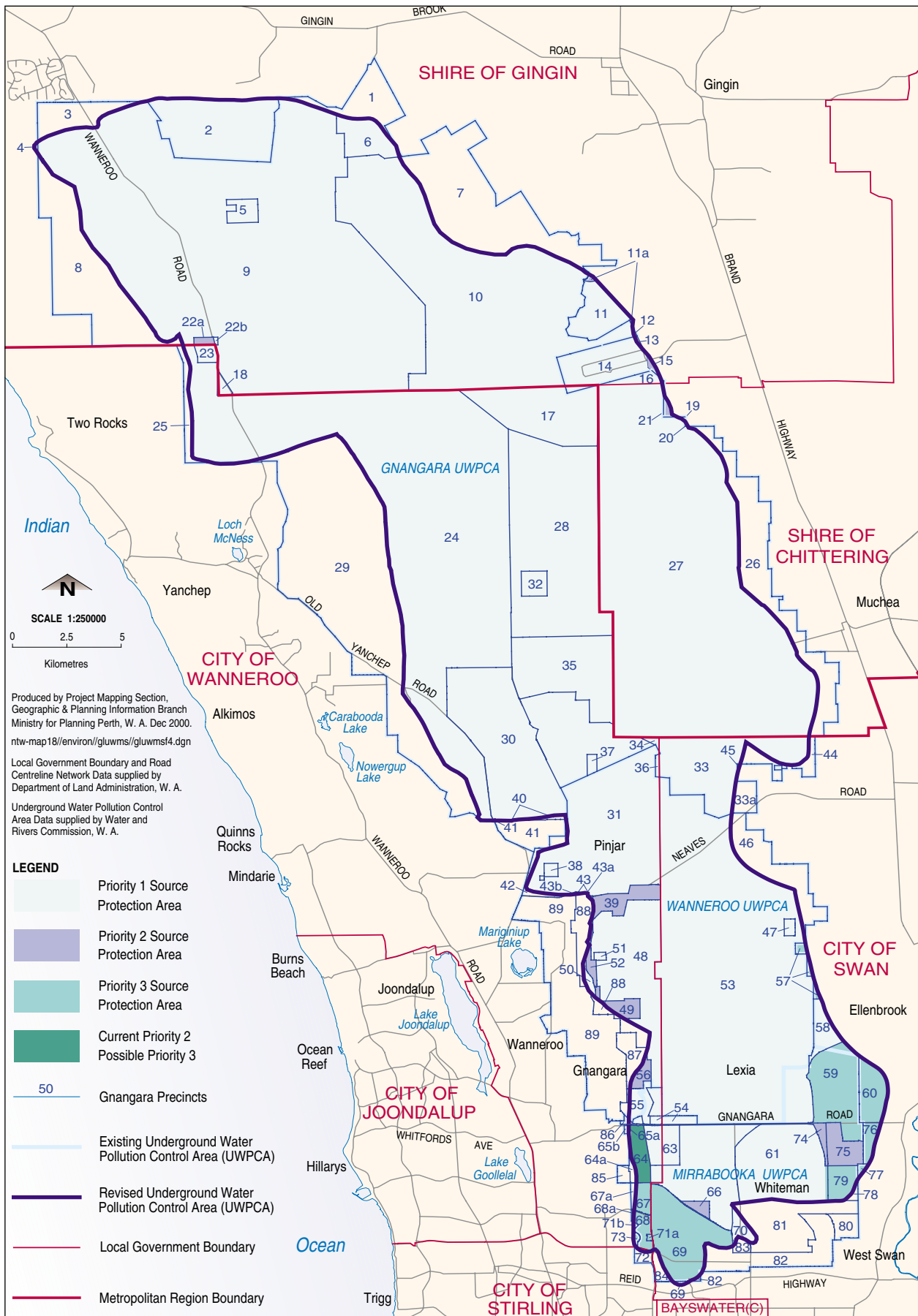


FIGURE 4 RECOMMENDED UWPCA AND PRIORITY SOURCE PROTECTION CLASSIFICATIONS

3.1 THE STRATEGY (SEE FIGURES 5 AND 7)

The Strategy proposes a revised UWPCA and Priority source protection area classifications within the UWPCA and proposes an overall planning and policy framework for land use decision making within the UWPCA.

It proposes that:

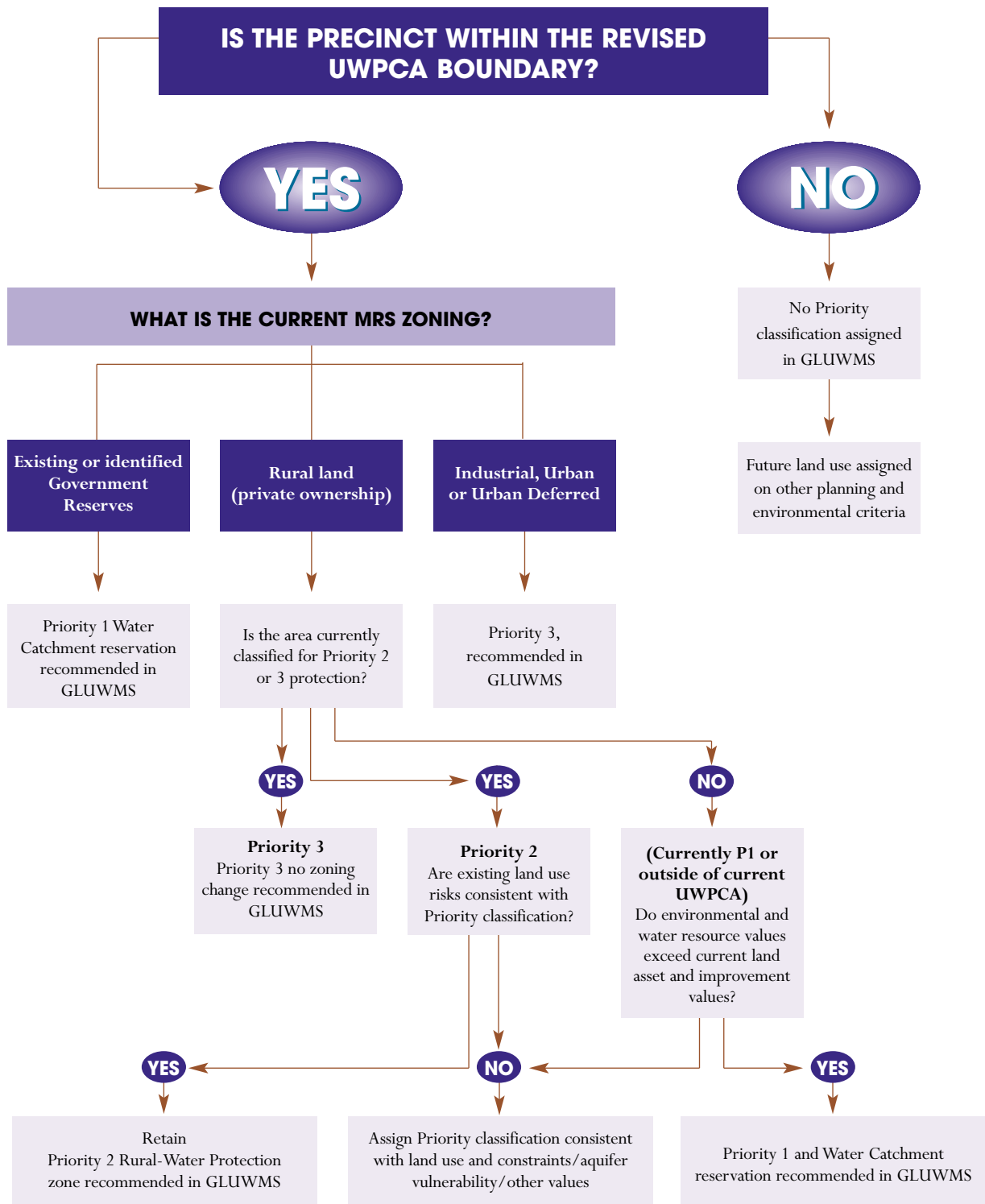
- The Water and Rivers Commission's Priority source protection classification system should be a key factor in determining the preferred land use, land zoning and reservations in the study area .
- Priority 1 source protection areas should be included in a proposed Water Catchment reservation (WCR) in the Metropolitan Region Scheme (MRS), local town planning schemes (TPS) and an equivalent designation outside the MRS;
- Priority 2 source protection areas should be included in a proposed Rural-Water Protection zone (RWPZ) in the MRS, local town planning schemes and in an equivalent zone outside the MRS;
- Priority 3 source protection areas should be retained in their existing zone or reservation in the MRS and local town planning schemes. Future land use and zoning changes would be subject to the normal planning and environmental approval processes.

The strategy area has been divided into distinct planning precincts (see Figure 2) and the attributes of each precinct are assessed to determine the Priority source protection classification (see Tables 4 and 5).

Table 2 outlines the decision-making process for assigning the Priority source protection area classifications (i.e. P1, P2 or P3) and the corresponding proposed land use zone or reservation for the individual planning precincts.

The primary criteria used in assigning the Priority classification for each Precinct are, the strategic importance of the groundwater source and its vulnerability to contamination; the existing land use and tenure; zoning; reservation and Priority classification. Environmental values and the comparison of the groundwater resource values to other current land and improvement values are also considered.

**TABLE 2
DECISION-MAKING PROCESS FOR ASSIGNMENT OF GROUNDWATER
PRIORITY CLASSIFICATIONS AND MRS RECOMMENDATIONS**



A Priority 1 source protection classification is assigned to planning precincts containing Crown and private land where the protection of the water source is of primary importance and the aquifer is vulnerable to contamination. In these areas water resource values are similar to or outweigh the land and improvement values.

A Priority 2 classification is assigned to areas of Crown and private land where the protection of the groundwater source is a strategic priority that must be balanced with current land and improvement values. In these areas, the existing land use and zoning, existing Priority classification (if any), planning constraints, aquifer vulnerability and risk of contamination to the groundwater resource are further considered to determine the Priority classification.

Existing areas of Urban, Urban Deferred and Industrial uses occur in the strategy area. In accordance with the recommendations of the Select Committee report on *Metropolitan Development and Groundwater Supplies* these areas are recommended for Priority 3 protection in recognition of these existing zones. Priority 3 source protection provides less security to the water source than Priority 1 or 2 source protection.

The majority of land within the revised UWPCA is public land designated as State Forest or Public Purposes and already in a Priority 1 source protection classification. Most existing land uses pose a very low risk to the groundwater resources. However, there are pockets of private land, within Priority 1 areas of the revised UWPCA, where land use activities pose some risk of contamination to the groundwater resources. For example, some uses along Gngangara Road should be managed within guidelines to minimise the risk of groundwater contamination.

This Strategy recommends land uses and corresponding land zoning and reservations for land within the UWPCA.

The long-term land uses are shown in Figure 5. The long-term land zoning and reservations are shown in Figure 7.



3.2 LAND USE COMPONENTS OF THE STRATEGY

The Strategy identifies the long-term land uses for the area, the main feature of which is the conservation, recreation and forestry land uses indicated in the proposed Gnangara Park which will ensure the protection of groundwater resources. The land uses shown on Figure 5 are discussed below.

3.2.1 EXISTING AND POSSIBLE FUTURE URBAN LAND USES

The objectives for Urban land within the UWPCA boundary are:

- to minimise the impact of urban development on the groundwater resource and environmental features;
- to restrict urban development to Priority 3 source protection areas.

Most urbanisation over the Mound is restricted to the coastal areas as shown in the *North-West Corridor Structure Plan* (DPUD, 1992) and in the south-east as shown in the *North-East Corridor Structure Plan* (DPUD, 1994).

Existing Urban areas occur in the southern portion of the UWPCA and include Mirrabooka, Malaga, Ballajura, Alexander Heights, Koondoola and Ellenbrook. Urban zones of Ellenbrook, Egerton and Albion and the Urban Deferred zone within West Swan occur in the existing Priority 2 source protection area.

In accordance with recommendations of the Select Committee Report (1994), all existing Urban and future Urban areas will remain zoned Urban or Urban Deferred in the MRS and local town planning schemes and be classified as Priority 3 source protection areas.

Town planning schemes and amendments, subdivision and development proposals seeking approval should:

- incorporate appropriate stormwater collection and disposal methods and water-sensitive design principles to minimise the risk of contamination to groundwater;
- incorporate connection to main sewerage system;
- protect significant wetlands and vegetation and incorporate into open space where possible;
- consider exclusion or specific siting and risk prevention factors for potentially polluting commercial activities;

- include drainage and nutrient management plans which should:
 - minimise fertiliser sources and incorporate effective nutrient-stripping features into drainage systems;
 - control stormwater by creating artificial wetlands and maximising local recharge;
 - dispose of surplus drainage waters to areas where no adverse effects will result;
 - specify ongoing maintenance requirements and management responsibility.

Any amendments to the current Rural zoning of the east Landsdale area (Precinct 64) would be subject to the resolution of all environmental and planning constraints, including the land use compatibility issues with the Telstra facility, monitoring and the approval of a Structure Plan which removes identified contamination risks. Future land use change is also subject to the normal planning and environmental approval process.

It is recommended that, once the proposed zoning and reservation amendments and priority classification changes arising from this Strategy are made, no further urban development should occur within Priority 1 or Priority 2 source protection areas (i.e. in the proposed Water Catchments reservation or Rural-Water Protection zone).

3.2.2 RURAL LAND USES

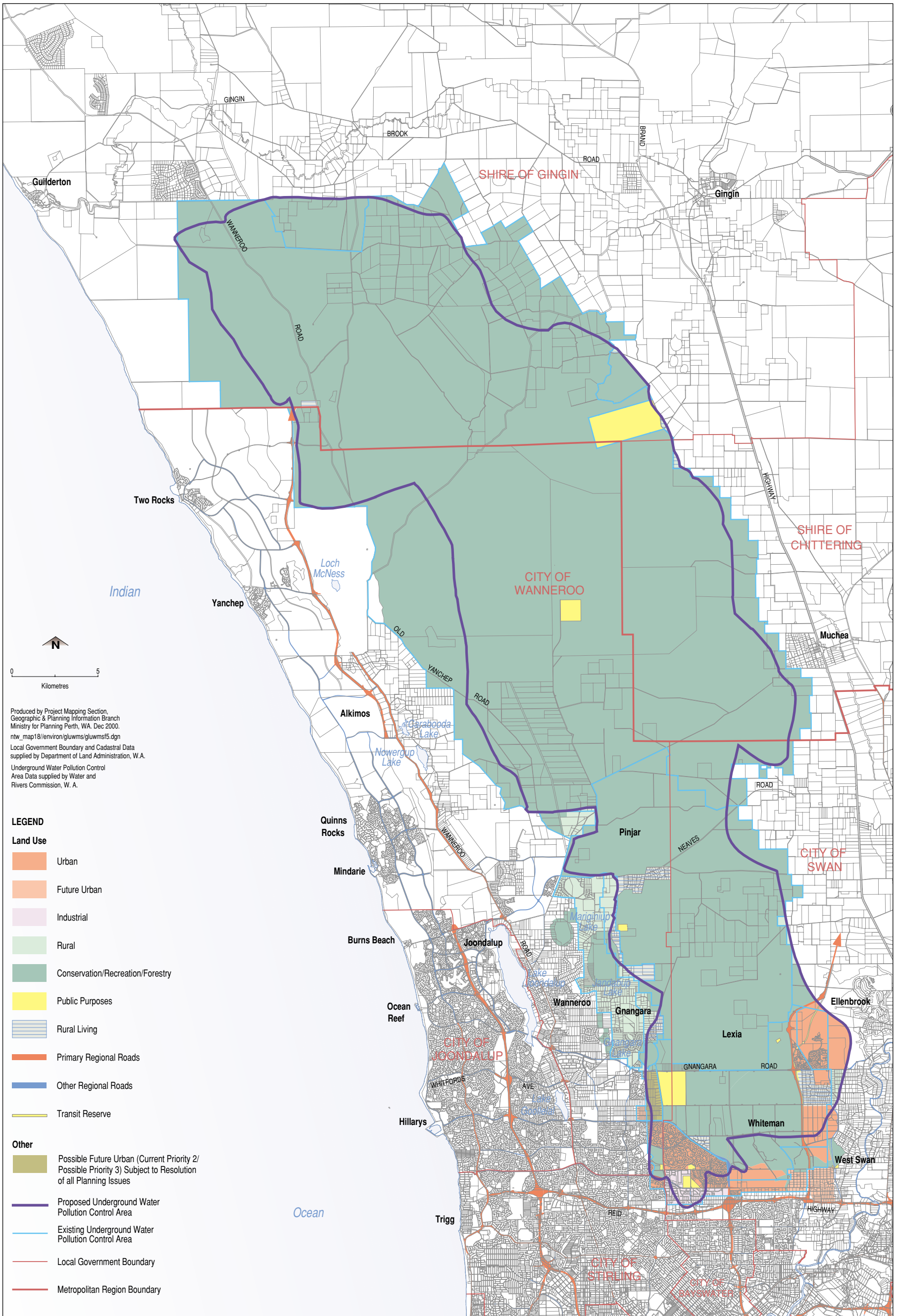
The objectives for MRS Rural zoned land within the UWPCA boundary are:

- to minimise the impact of rural uses on groundwater quality and quantity for water supply and environmental values;
- to support the continuation of appropriate rural uses.

There are large areas of Rural zoned land supporting a wide range of rural uses, which play a significant role in providing opportunities for lifestyle activities, economic development and provision of employment in the strategy area.

The Rural zone in the Metropolitan Region Scheme includes local government Special Rural zones or their equivalent. Rural activities can have variable impacts upon groundwater quality depending on their intensity and their location on the Mound.

Except for some individual cases, rural uses over the Mound are generally of low intensity and have a low impact on the groundwater resources. Some rural areas also contain regionally significant wetlands or remnant bushland.



Stringent land use controls should be placed on land within Priority 1 areas through the introduction of the recommended Water Catchment reservation in the MRS and local town planning schemes.

Because some incompatible rural land uses, such as intensive horticulture, are currently occurring on land in Priority 1 source protection areas, the Strategy recommends that all new development proposals must be compatible with Priority 1 objectives. Land owners within Priority 1 areas will have the opportunity to initiate the sale of their land to the Government. Existing land uses would be recognised and could continue as non-conforming uses under agreed management conditions or permits from the WRC.

Rural land uses in Priority 2 source protection areas are recommended to be rezoned to Rural-Water Protection in the MRS to ensure new proposals meet Priority 2 objectives. The proposed Statement of Planning Policy will provide guidelines on development or expansion of existing incompatible land use activities within the Rural-Water Protection zone.

Town planning schemes and amendments, subdivision and development proposal approvals should:

- include the drinking water source protection objectives and consider developments accordingly;
- minimise off-site impacts;
- ensure drainage mechanisms are in place to reduce the outflow of nutrients;
- exclude rural uses which may adversely affect the quantity and quality of the groundwater resource;
- protect landscape features, significant wetlands and vegetation and other environmental values where possible;
- require all land management activities to incorporate best practice management in relation to groundwater protection.



3.2.3 RURAL LIVING

The objectives for rural living within the UWPCA are:

- to control land use and development to be consistent with the objectives of protecting groundwater quality in Priority 2 source protection areas;
- to provide opportunities where appropriate for subdivision in the Priority 2 source protection areas while, at the same time, ensuring there is minimal conflict with groundwater resources, the natural environment and broader metropolitan objectives;
- to require Special Rural subdivision and development in Priority 2 source protection areas to demonstrate environmental acceptability before the initiation of any amendments to town planning schemes.

The Strategy identifies existing Special Rural zones, existing land uses compatible with a Special Rural zone and areas of land with the potential for rural living (based on groundwater protection criteria only) which are located within the current and proposed Priority 2 source protection areas (see Figure 5 and Table 5).

Provision of public water supply is a high priority in Priority 2 areas and is managed in accordance with the principle of risk minimisation.

It is important to ensure that land use and management controls and subdivision restrictions are applied to ensure that continuation of existing land uses and new development do not pose a threat to the environmental or water supply values of the groundwater resource. Some development is allowed under certain conditions in accordance with WRC guidelines and the by-laws of the MWSSD Act (1909).

The provisions of existing Special Rural zones in town planning schemes within Priority 2 source protection areas should be amended to be consistent with the Rural-Water Protection zone (RWPZ) following the proposed amendments to the MRS.

Groundwater protection objectives should be incorporated into all Special Rural or equivalent zones in Priority 2 source protection areas in the Shires of Gingin and Chittering and the Cities of Wanneroo, Swan and Joondalup town planning schemes.

Town planning schemes, amendments, subdivision and development proposal approval should:

- permit only land uses that conform with the water quality objectives for Priority 2 source protection areas;
- incorporate land use and development control provisions prohibiting unnecessary clearing and promoting revegetation;
- incorporate lot sizes to suit local conditions and be based on land capability and suitability assessment (minimum lot size of 2 hectares based on WRC guidelines);
- incorporate compulsory use of Health Department approved on-site effluent disposal systems;
- require drainage and nutrient management plans incorporating best practice management for all new subdivision or development proposals;
- protect landscape features, significant wetlands and vegetation and other environmental values.

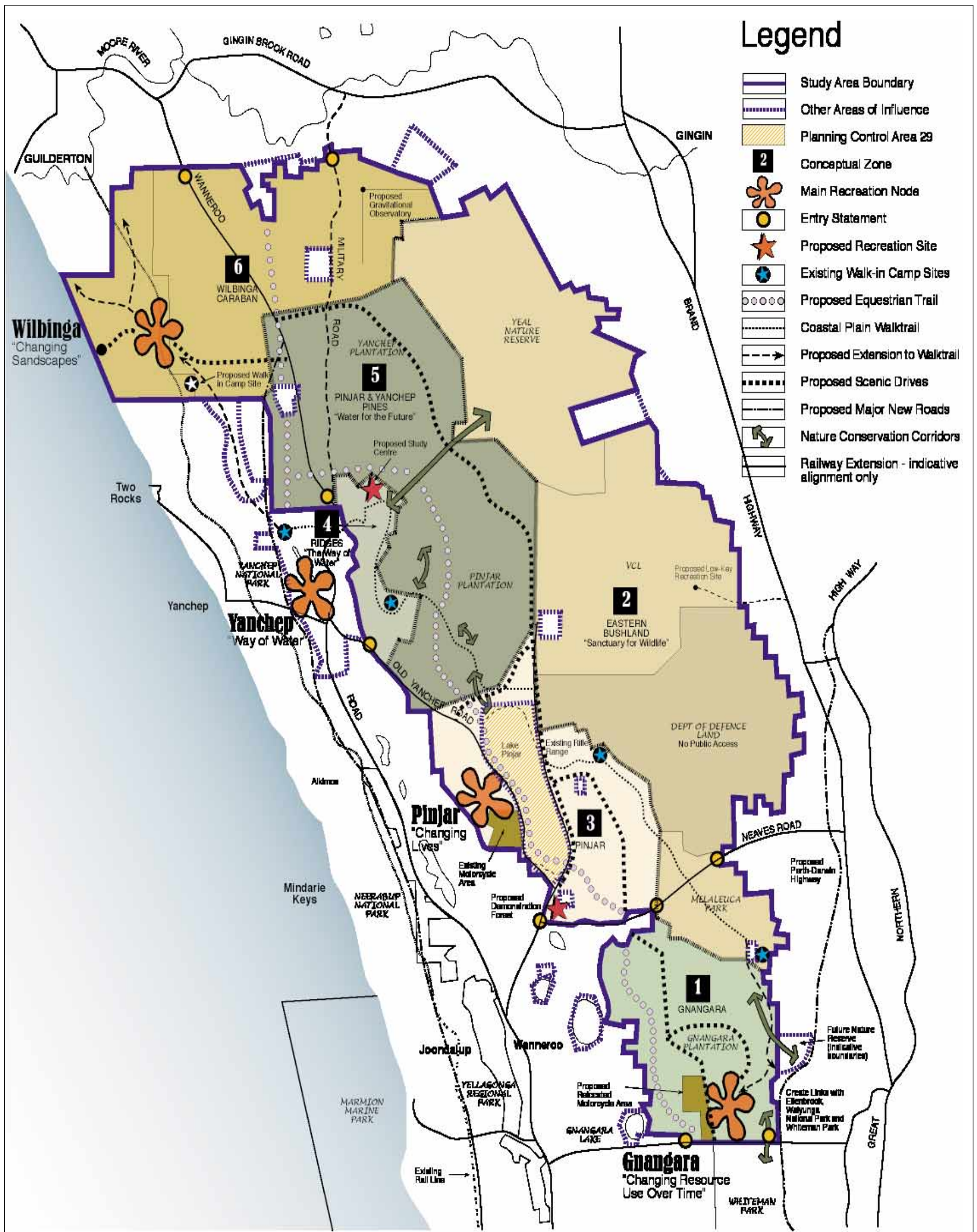
3.2.4 CONSERVATION, RECREATION AND FORESTRY

The objectives for Conservation, Recreation and Forestry land uses within the Strategy area are to:

- ensure there is no degradation of the groundwater resource in Priority 1 source protection areas by avoiding any risk of contamination;
- allow for the continuation of suitable land uses which do not pose an unacceptable risk of contamination to the groundwater resource in Priority 1 areas;
- allow for the continuation of forestry land use activities;
- conserve and enhance significant environmental resources of the area, particularly wetlands and vegetation;
- protect rare and gazetted flora and fauna;
- protect and provide linkages of habitats for fauna in the area;
- accommodate regional cultural, recreational or tourism facilities.

Significant remnant bushland and wetlands along with existing Parks and Recreation reservations, System 6 areas, State Forests, Nature Reserves, Regional Parks and National Parks and areas with significant recreation potential occur in the UWPCA.

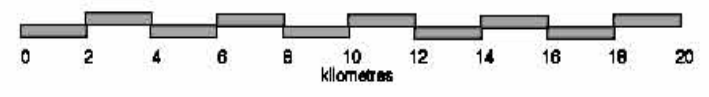
The large areas of existing State Forest can be managed to sustain multiple uses for the protection of groundwater resources, conservation of flora and fauna, provision of recreation opportunities and pine production.



Gnanagara Park

Concept Plan

Gnanagara Technical Working Group
Department of Conservation and Land Management



CALM is proposing to establish the Gngangara Park which would extend from Gngangara Road to north of Yanchep National Park (Figures 5 & 6). Gngangara Park includes 23,000 ha of existing pine plantations, which will be progressively harvested over the next 20 years, and 27,000 ha of surrounding bushland within State Forest No. 65.

Land for Gngangara Park is currently in Crown ownership and the Strategy will enable this area to remain available for the establishment of the Park which may also incorporate other land reserved for Parks and Recreation in the MRS such as the System 6 M8 East Wanneroo wetlands (See Figures 5 and 6).

Gngangara Park will protect water quality on the Mound and offer new, nature-based recreation opportunities with a lessened fire risk in Perth's rapidly developing northern corridor.

As the pines are progressively harvested and the longer term plans for the proposed Gngangara Park are formulated, the predominant land use will change to conservation and recreation activities compatible with the Priority 1 source protection.

Land included in the Conservation, Recreation and Forestry area is identified in Table 5 and shown in Figure 5.

To achieve these objectives, the Strategy proposes to incorporate CALM State Forest lands, some small areas of private land and other Government owned land in the Priority 1 source protection area into a Water Catchment reservation.

In the longer term, a Parks and Recreation reservation should be placed over all land to be included in the proposed Gngangara Park. The timing of the proposed MRS Parks and Recreation reservation should be determined in agreement with CALM.

Town planning schemes, amendments, subdivision and development approvals should:

- prevent urban, industrial development, or further subdivision in Conservation, Recreation and Forestry areas and Priority 1 source protection areas;
- permit only land uses that conform with the water quality objectives for Priority 1 areas;
- prevent intensification or expansion of existing land uses which pose unacceptable risks of degradation to groundwater resources;
- recognise the environmental values of land outside the Priority 1 area within the proposed Gngangara Park area.

3.2.5 INDUSTRIAL LAND USES

The objectives for industrial land within the UWPCA boundary are:

- to exclude industrial development from Priority 1 and 2 source protection areas;
- to contain the extent of industrial land within existing zoned areas;
- to manage the impact on environmental and groundwater resources.

The Industrial zone in the MRS allows for a wide range of industrial land use activities, including heavy industry, service industry and commercial showrooms to be included in the zonings in the local town planning schemes.

Industry is restricted to existing Industrial zones in the MRS and in equivalent zones in local government town planning schemes. There is one existing Industrial zone in the revised UWPCA at Malaga and no new Industrial zones are proposed within the UWPCA boundary.

Town planning schemes, amendments, subdivision and development proposal approvals should:

- exclude industrial uses from the UWPCA which are incompatible with groundwater protection objectives;
- prohibit new industrial or commercial businesses which store, handle or process noxious, toxic or polluting substances in accordance with the land use compatibility table (*Land Use Compatibility in Public Drinking Water Source Areas*), (See Appendix 4);
- minimise off-site environmental impacts;
- provide adequate reticulated stormwater and drainage collection and wastewater disposal systems.

3.2.6 EXTRACTIVE INDUSTRY LAND USES

The objectives for the planning and utilisation of the sand and limestone resources found in the study area are outlined in the *Statement of Planning Policy No. 10 – Basic Raw Materials* (2000).

Sand and limestone mining can occur within UWPCAs subject to stringent conditions. Sand mining operations are regulated through the Department of Minerals and Energy (DOME), the Department of Environmental Protection (DEP) and the local governments.

The WRC manages the impacts on water resources of sand and limestone mines in UWPCAs by issuing permits under the by-laws of the MWSSD Act.

Many of the sand and limestone extraction sites occur on CALM managed lands. CALM currently manages 13 lease agreements for the extraction of sand (1), limestone (11) and diatomaceous earth (1).

The importance of the WAPC's policy statement for Basic Raw Materials and the need for a continuation of supply of basic raw materials from sources located as close as possible to the customer are recognised.

Most of the current extraction sites and future resources of sand in the metropolitan area are located within public water source areas, particularly the Wanneroo and Gnamara UWPCAs. Limestone extraction sites are located principally within the Gnamara UWPCA.

The WRC has prepared a policy and guidelines for construction and silica sand mining in public drinking water source areas.

The policy and guidelines outline management measures to avoid the possible impacts on public drinking water sources. Applications for extractive industries should provide for:

- an adequate vertical separation of mining activity from groundwater table;
- control and management of fuel storage;
- management of waste disposal;
- post mining rehabilitation and end land use guidelines.

3.2.7 ROADS

The major regional transportation corridors in the study area that cross the Priority 1 and 2 source protection areas are Gnangara Road, an ‘Other Regional Road’, and Neaves Road, currently a rural standard local road, but an important east-west regional link.

Main Roads Western Australia are planning the future extension to the Mitchell Freeway, a Primary Regional Road, and are considering the need for a regional road in the east Wanneroo area possibly linking back to Wanneroo and the Mitchell Freeway.

East-west transport links across the Mound are essential to the economic and social development of the northern metropolitan region. Best practice design and management techniques need to be incorporated into the planning, design and construction of roads to avoid the risk of pollution.

As part of the assessment of road proposals, the proponents would need to ensure road alignments avoid impacts on public drinking water sources, undertake detailed risk assessments, incorporate proper design and management of stormwater disposal and prepare emergency response action plans.

It is recommended that road reserves be recognised in relation to the Priority classification of the adjoining land in accordance with Table 3:

TABLE 3 ROAD RESERVE PRIORITY CLASSIFICATIONS

PRIORITY CLASSIFICATION OF ADJACENT LAND	RECOMMENDED PRIORITY CLASSIFICATION	RECOMMENDED ZONE OR RESERVE
All adjoining Protection Areas Priority 1	Priority 1	Water Catchment reservation
Either side Priority 3	Priority 3	No Change
All other combinations	Priority 2	No Change

3.2.8 UTILITIES AND INFRASTRUCTURE

There are several utilities and significant Commonwealth government military uses located in the revised UWPCA. These were pre-existing land uses prior to the gazettal of the UWPCA and are recognised in the Strategy.

Some of these uses may pose risks to the groundwater resource and best practice management should be utilised to minimise the risk of contamination.

The planning and construction of major infrastructure corridors across the Priority 1 source protection areas is a major issue. If the North-West and North-East Corridors grow and the population increases as envisaged there will be a demand for utility services across the Priority 1 source protection areas of the Gngangara Mound.

To balance consideration of the groundwater protection, environmental, social and economic factors in determining public infrastructure provision across Priority 1 areas, it is necessary for a whole-of-government approach and policy position to resolve this issue. Proposals may require formal consideration under the Environmental Protection Act.



The following major utilities and land uses occur in the Strategy area:

- The Water Corporation (WC) operates water treatment plants at Mirrabooka and Wanneroo and a new plant is proposed at Lexia.
- The WC also manages a network of potable water collector mains linking the wellhead pipes to the water treatment plants and then to the distributor supply mains and residential areas. The area also has a network of sewer mains and pump stations.
- Western Power has a gas turbine substation site located in the City of Wanneroo which supplies power to the northern corridor.
- The Telstra Telecommunications Centre is located on Gnangara Road within the boundaries of the City of Swan and the City of Wanneroo. There are land use compatibility issues with surrounding land which need to be resolved. Monitoring and investigations into alternative development options need to be undertaken.
- Alinta Gas is proposing a natural gas pipeline from Bullsbrook to Wanneroo along the Neaves Road reserve through the Priority 1 area.
- Military land uses. The RAAF Muchea Air Weapons Range (which is used for practice bombing) and the Gingin airfield are located on the eastern portion of the UWPCA in the Shire of Chittering and Cities of Swan and Wanneroo.

Existing utility uses in the UWPCA should utilise best practice management to ensure contamination risks to groundwater are minimal and in accordance with the objectives for the respective Priority classifications.



4.1 LAND WITHIN THE METROPOLITAN REGION

Table 4 outlines the areas of land affected by the Strategy. It describes the attributes of each planning Precinct, Figure 7 and Table 5 outline the implementation strategy for each precinct.

Water Catchment Reservation

A Water Catchment reservation (WCR) is recommended for land presently reserved under the MRS as Parks and Recreation, Public Purposes or State Forest as well as for certain areas of private land located in the Priority 1 source protection areas. The WCR is in addition to the existing zone or reservation over the land. Figure 7 shows the proposed long-term land zoning and reservation and Table 5 outlines the implementation strategy for each precinct.

The objective of this reservation is to recognise the Priority 1 source protection objective of ensuring that there is no degradation of the water source.

Land use controls within the proposed Water Catchment reservation should be imposed through the MRS and local town planning schemes guided by a revised *Statement of Planning Policy (As Varied) No. 3 (Gnangara Mound Crown Land) (1995)* (SPP). The SPP will be updated to outline permitted, restricted and non-permitted land uses within the WCR and should accompany the MRS amendment. The draft Environmental Protection (Gnangara Mound Crown Land) Policy (1999) (or equivalent environmental protection policy) should be updated to incorporate areas included in the WCR.

Local planning schemes should be amended to comply with the MRS.

Rural-Water Protection Zone

A Rural-Water Protection zone (RWPZ) is proposed to replace the current Rural zone in the MRS for land located in the Priority 2 source protection areas and identified in Table 5 and Figure 7.

The objective of land use in this zone is to ensure there is no increased risk of pollution to the water source.

Land use controls within the proposed Rural-Water Protection zone (RWPZ) should be imposed through the MRS and local town planning schemes guided by revised *Statement of Planning Policy (As Varied) No. 3 (Gnangara Mound Crown Land)* (1995). Land use provisions of the RWPZ will be guided by the revised SPP which will outline permitted, restricted and non-permitted land uses and should accompany the MRS amendment.

Local planning schemes should be amended to comply with the MRS.

Parks and Recreation Reservation

An MRS Parks and Recreation reservation is proposed for land identified as being for long-term conservation and recreation purposes. This would include land with significant environmental, recreational or landscape values and land identified for inclusion in the Gnangara Park.

Forestry will remain as an interim land use. As the existing pine plantations are harvested, and the proposed Gnangara Park developed the land will be progressively reserved for Parks and Recreation. The timing and specific boundaries of the Parks and Recreation reservation will be determined in agreement with CALM.

In some cases areas of land reserved for Parks and Recreation will also be reserved for Water Catchments. Land with significant environmental values should be included within the Gnangara Mound Crown Land EPP (or equivalent environmental protection policy).

Land included in the proposed Parks and Recreation reservation is identified in Table 5 and Figure 6.



4.2 OUTSIDE THE PERTH METROPOLITAN REGION

Outside the Perth metropolitan region, amendments to local town planning schemes will be used for the implementation of the Strategy.

The success of this Strategy will depend on the non-metropolitan local governments over the Gnangara Mound adopting its recommendations and amending the local town planning schemes to introduce the WCR and RWPZ, and to include additional scheme provisions to control and manage land use and development.

The WAPC will work with local government to determine how groundwater protection can be incorporated into town planning schemes and will assist in the preparation of local scheme amendments and local rural strategies. The proposed SPP will provide the land use control guidelines for uses within the WCR and RWPZ.

One option is to utilise the draft Model Scheme Text which provides a mechanism to introduce Special Control Areas in town planning schemes to apply to significant areas where special provisions in the local scheme may need to apply. These provisions could target a single issue such as the protection of groundwater sources which may overlap other zones or reserves.

Special Control Areas could be shown on the Scheme map as an overlay to any existing zone or reserve. In this way a consistent approach utilising the same land use control provisions and methods to protect the groundwater resources can be achieved between local government in and outside the metropolitan region.



4.3 PROPOSED METROPOLITAN REGION SCHEME AMENDMENTS AND PLANNING CONTROLS

The *Metropolitan Region Town Planning Scheme Act, 1959* (MRTPS Act) and the *Metropolitan Region Scheme* (MRS) provide the regional land use planning framework which, together with the *Town Planning and Development Act, 1928* (MTP&D Act), provide the basis for planning control in the Perth metropolitan region.

The MRS was promulgated in 1963 and has been subject to detailed strategic planning reviews and amendments over time.

Strategic planning reviews, such as this Strategy, are part of an ongoing process which provides for the orderly growth and development of the Perth metropolitan region.

The rezoning or reservation of land within the Perth metropolitan region is by amendments to the MRS and to local town planning schemes. The process for amendments to the MRS is provided for in the *Metropolitan Region Town Planning Scheme Act, 1959*.

When land is included in a Water Catchments reservation or a Parks and Recreation (P&R) reservation, and approval is sought for a particular land use or development for that land the local government will be required to refer the application to the Western Australian Planning Commission (WAPC) for determination.

The WAPC will seek advice from other government agencies where land use or development has the potential to contribute to the degradation of the water source.

Existing land uses which pose an unacceptable risk to the water source will not be allowed to expand. However, these land uses will be allowed to continue at existing approved levels under non-conforming rights, as specified in local town planning schemes.

Under the MRTPS Act where planning applications are refused in a Water Catchments or a Parks and Recreation reservation, applicants may be able to claim compensation and if necessary negotiate for the purchase of their land by the WAPC. In Priority 1 areas outside the metropolitan region the same options for the sale of land to the Government should be available to landowners.

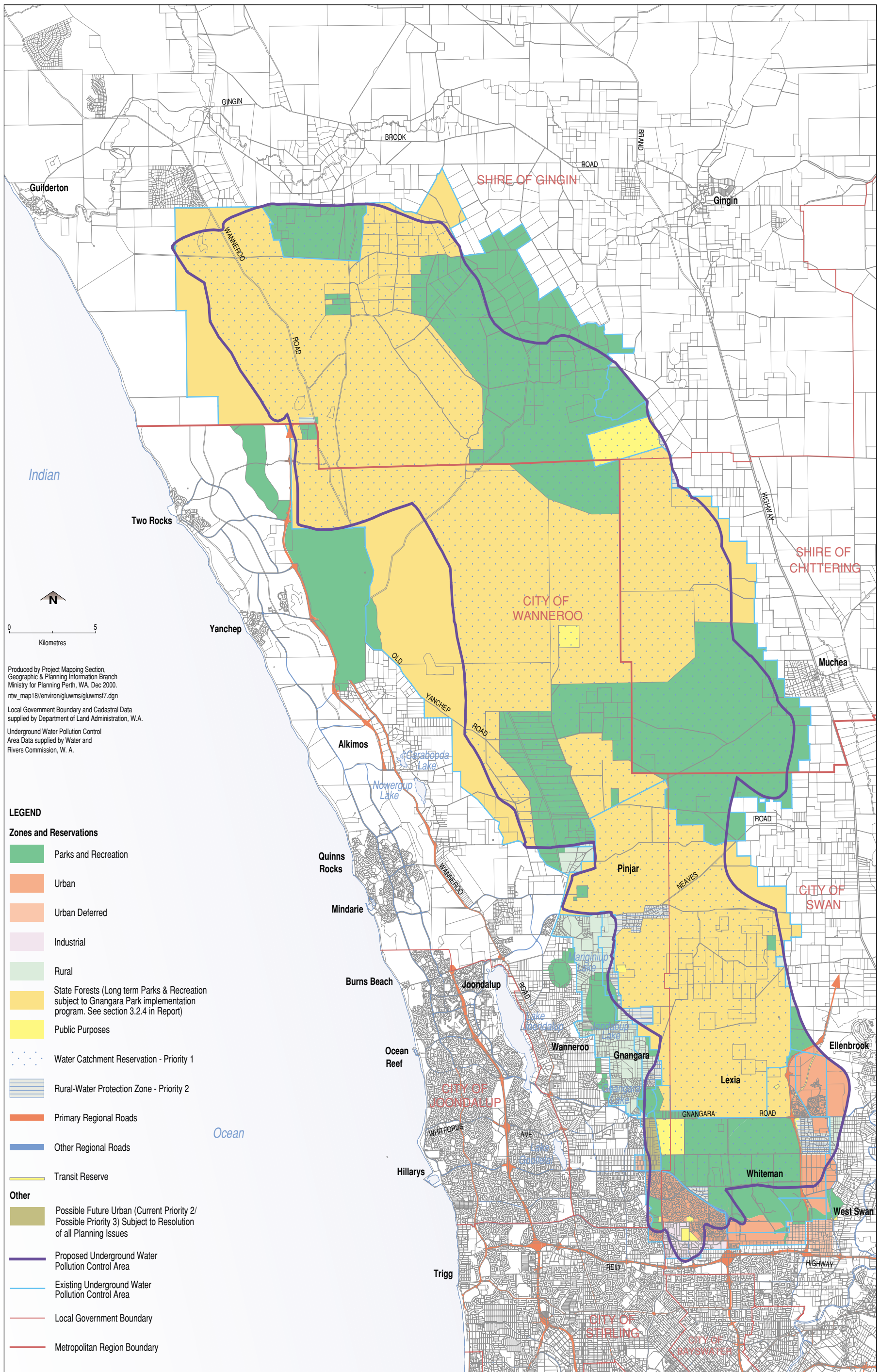
Application for planning approval in the Rural-Water Protection zone should be considered in accordance with advice from the Water and Rivers Commission and the approved uses contained in *Land Use Compatibility in Public Drinking Water Source Areas* (See Appendix 4). The land use classes contained in this table and the proposed SPP will outline acceptable activities in a proposed RWPZ.

In areas outside the MRS where groundwater protection areas are identified in local town planning schemes, the local government would be required to refer all planning applications to the relevant government agencies (MfP, WRC) for advice and comment prior to determination.

4.4 SUPPORTING STATEMENT OF PLANNING POLICY (SPP) AND ENVIRONMENTAL PROTECTION POLICY (EPP)

To support the proposed MRS amendment and local town planning scheme amendments an update of the existing *Statement of Planning Policy No. 3 (As Varied) (Gnangara Mound Crown Land)* (1995) relating to the revised UWPCA will be prepared to guide land use decision-making in the RWPZ and WCR. The SPP objectives should be to:

- protect the quantity and quality of groundwater in the policy area;
- protect native vegetation and wetlands and other environmental values in the policy area;
- promote the sustainable use of groundwater in the policy area;
- encourage recharge of the groundwater resource;
- outline permitted, non-permitted and restricted land uses and the development control processes;



Produced by Project Mapping Section,
Geographic & Planning Information Branch
Ministry for Planning Perth, WA, Dec 2000.
ntw_map18/environ/gluwms/gluwms17.dgn

Local Government Boundary and Cadastral Data
supplied by Department of Land Administration, W.A.

Underground Water Pollution Control
Area Data supplied by Water and
Rivers Commission, W. A.

LEGEND

Zones and Reservations

- Parks and Recreation
 - Urban
 - Urban Deferred
 - Industrial
 - Rural
 - State Forests (Long term Parks & Recreation subject to Gngangara Park implementation program. See section 3.2.4 in Report)
 - Public Purposes
 - Water Catchment Reservation - Priority 1
 - Rural-Water Protection Zone - Priority 2
 - Primary Regional Roads
 - Other Regional Roads
 - Transit Reserve
- Other**
- Possible Future Urban (Current Priority 2/ Possible Priority 3) Subject to Resolution of all Planning Issues
 - Proposed Underground Water Pollution Control Area
 - Existing Underground Water Pollution Control Area
 - Local Government Boundary
 - Metropolitan Region Boundary

- require that local government town planning schemes restrict land uses and development within the policy area to those which are compatible with the above objectives;
- provide clear guidance to the community on water quality objectives and constraints on land uses.

The existing *Environmental Protection Policy (Gnangara Mound Crown Land)* (1992) is being updated and a revised draft *Environmental Protection (Gnangara Mound Crown Land) Policy* 1999 has been prepared. The revised draft EPP will protect environmental values of the Gnangara Mound under the *Environmental Protection Act*. Its objective is to:

- declare under the *Environmental Protection Act*, certain beneficial uses of groundwater, vegetation and wetlands on or under the policy area, to be beneficial uses of the Gnangara Mound Crown Land EPP and to establish a consistent regulatory framework for the protection of these uses.

When promulgated, the draft State Groundwater Environmental Protection Policy may subsume and incorporate the revised draft Gnangara Mound Crown Land EPP.

4.5 WATER AND RIVERS COMMISSION GROUNDWATER CONTROLS

To complement the proposed MRS amendment and local town planning scheme amendments the Water and Rivers Commission will amend the statutory UWPCA boundaries and Priority classifications to accord with the Strategy recommendations.

In addition to the proposed Water Catchments reservation and Rural-Water Protection zone, the Water and Rivers Commission, under the by-laws of the MWSSD Act, advises on the general compatibility of land uses within UWPCAs. The table in Appendix 4 outlines the compatibility of land uses within public drinking water source areas. The by-laws contain provisions, by requiring a permit approval from the WRC, to control activities that use, store or manufacture products that could contaminate groundwater.

It is expected the compatibility table will guide the preparation of local town planning scheme amendments and a future revised Statement of Planning Policy (SPP). The SPP should outline acceptable land uses and the planning application, referral and decision-making process.

Implementation of the MWSSD Act by-laws will complement planning controls of the Water Catchments reservation (Priority 1 areas) and the Rural-Water Protection zone (Priority 2 areas) within the UWPCAs. In Priority 3 areas the MWSSD Act by-laws will be used to protect groundwater quality.

Procedures should be in place for referral of planning applications to the WRC for specialist advice to ensure proposals are compatible with the Priority area classifications and the Land Use Compatibility in Public Drinking Water Source Areas (See Appendix 4).

4.6 CO-ORDINATION

GLUWMS proposes an integrated system of land use controls and regulation. The approach is consistent with the Select Committee's report on *Metropolitan Development and Groundwater Supplies*, which considered a whole-of-government approach is needed to coordinate policies and procedures and avoid duplication.

Key measures to integrate regulatory processes are an agreed and streamlined planning application referral process and adoption of the Statement of Planning Policy and Environmental Protection Policy. These will be overseen by the WAPC, EPA and WRC to achieve a co-ordinated whole-of-government approach.



5.0 IMPLEMENTATION

5.1 IMPLEMENTATION PROCESS

The implementation of the Strategy now requires:

- initiation of amendments to the MRS for the rezoning and reservation of land;
- initiation of amendments to the UWPCA boundary and priority classifications;
- amendments to the existing Statement of Planning Policy and Environmental Protection Policy to establish guidelines on land use and development and resource management in the area;
- local governments to amend their planning schemes and provisions to incorporate the Water Catchments reservation and Rural-Water Protection zone and to recognise the specific objectives of the SPP, EPP and the Strategy;
- referral of planning applications in accordance with the SPP within the Priority 1 and Priority 2 source protection areas to the MfP, WRC and EPA for comment prior to determination;
- approval and implementation of planning proposals consistent with the Water Catchment reservation, and Rural-Water Protection zone and other Government policy objectives;
- promotion of a community awareness program.

5.2 RECOMMENDATIONS

1. Amend the MRS to place a Rural-Water Protection zone over designated Priority 2 areas and a Water Catchment reservation over designated Priority 1 areas on Crown land and areas in private ownership on the Gnangara Mound as soon as possible (MfP/WAPC).
2. Review and update the existing *Statement of Planning Policy (As Varied) No. 3 (Gnangara Mound Crown Land)* (1995) as soon as possible to reflect proposed land use control guidelines (MfP/WAPC).
3. Finalise the *Draft Environmental Protection Policy (State Groundwater) 1998* and the environmental impact assessment guidelines for Environmental Management Areas associated with the public water supplies as soon as possible (DEP/EPA).

4. Reserve land to be included in the proposed Gngangara Park for Parks and Recreation in agreement with CALM. (CALM, MfP, WRC).
5. (a) Amend the statutory UWPCA boundary to accord with the revised scientifically determined boundary in conjunction with the MRS Amendment in Recommendation 1 (WRC).
(b) Refine as required the groundwater source protection area boundaries to account for detailed wellfield design (WRC).
6. Modify the *Metropolitan Water Supply, Sewerage and Drainage Act, 1909* by-laws to reflect the recommended priority classifications (WRC).
7. Agree on a referral process and policy application approach for the assessment of planning applications within the revised UWPCA with the Local Governments, WAPC, WRC and the EPA to ensure a co-ordinated whole-of-government approach (WAPC, WRC, EPA, LG).
8. (a) Amend local town planning schemes within the metropolitan region to accord with the MRS amendment within the statutory time frame (LG, MfP)
(b) In areas outside the metropolitan region, amend local town planning schemes as soon as possible to recognise the revised UWPCA and priority classifications with scheme provisions to reflect the objectives of the SPP and EPP (LG).
9. Prepare strategies, development plans and TPS scheme reviews in the context of the Strategy text and recommendations (LG, MFP, WRC).



TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
1	576	1	native vegetation Gingin	NA	State Forest	Govt	yes	no	high	P1
2	1180	14	extensive grazing/agriculture Gingin	NA	Rural	private	no	yes	very high	none
3	590	1	native vegetation Gingin	NA	State Forest	Govt	yes	no	moderate	P1
4	10	part	native vegetation Gingin	NA	Rural	Govt	no	yes	moderate	none
5	146	5	extensive grazing	NA	Rural	private	yes	yes	high and very high	P1
6	402	1	native vegetation Yeal Nature Reserve Gingin	NA	State Forest	Govt	yes	yes	high	P1
7	2480	1	native vegetation Yeal Nature Reserve	NA	State Forest	Govt	yes	no	very high	P1
8	2018	1	native vegetation Gingin	NA	State Forest	Govt	yes	no	moderate	P1
9	15497	1	pine plant'n/native vegetation Gingin	NA	State Forest	Govt	yes	yes	high/moderate	P1
10	6688	1	State Forest Yeal Nature Reserve Gingin	NA	State Forest	Govt	yes	yes	very high	P1
11	495	3	native vegetation/clear Gingin	NA	Rural	Govt private	no	yes	high	none
11a	60	2	part cleared and native vegetation	NA	Rural	private	no	yes	moderate	none
12	3	1	native vegetation Gingin	NA	State Forest	Govt	yes	no	high	P1
13	7	1	Gingin Airfield	NA	Public Use	Comm Govt	yes	no	high	none
14	695	1	Gingin Airfield	NA	Public Use	Comm Govt	no	yes	high	none
15	24	4	native vegetation ext farming Gingin	NA	Rural	private	no	yes	high	none

TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
16	90	4	native vegetation Gingin	NA	State Forest	Govt	yes	yes	high	P1
17	1265	1	Yeal Nature Reserve native vegetation	Rural	Rural	Govt	yes	yes	high/moderate	P1
18	40	1	pine plantation Wanneroo	State Forest	State Forest	Govt	yes	yes	high	P1
19	3.2	1	native vegetation Chittering	NA	State Forest Water Supply	Govt	yes	no	high	P1
20	17	part	native vegetation Chittering	NA	Rural	private	no	yes	high	none
21	31	part	extensive farming & native vegetation Chittering	NA	Rural	private	no	yes	high	none
22a	39	2	low chill orchard/native vegetation Gingin	NA	Rural	private	yes	yes	moderate	P1
22b	12	1	East Wanneroo Rd part of 22a native vegetation	NA	Rural	private	yes	yes	high	P1
23	80	3	extensive farming native vegetation Wanneroo	Rural	Rural	private	yes	yes	moderate, except west margin where it is very high	P1
24	11163	1	State Forest Wanneroo	State Forest	State Forest	Govt	yes	yes	high/moderate	P1
25	185	1	State Forest Wanneroo	State Forest	State Forest	Govt	yes	no	moderate	P1
26	1728	1	native vegetation Chittering	NA	Water Reservation	Crown Shire of Chittering	yes	no	very high to high	P1
27	11310	1	native vegetation Chittering	NA	State Forest	Govt	yes	yes	mod/high/v high	P1
28	3757	1	native vegetation Wanneroo	State Forest	State Forest	Govt	yes	yes	mod/high/v high	P1

TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
29	5509	1	pine plantation native vegetation Wanneroo	State Forest	State Forest	Govt	yes	no	moderate	P1
30	2362	59	extensive farming piggery P&R poultry horticulture Pinjar	Rural P&R	Rural Govt	private	yes	yes	very high	P1
31	4260	1	pine plantation native vegetation Wanneroo	State Forest	State Forest	Govt	yes	yes	high/v high	P1
32	142	1	Pinjar Power Station Purpose	Public Purpose	Public	Govt	yes	yes	moderate	P1
33	1350	1	RAAF Bombing Range Purpose	Public Purpose	Public Govt	Comm	yes	yes	high	P1
34	23	1	RAAF Bombing Range Purpose	Public Purpose	Public Govt	Comm	yes	yes	high	P1
35	1451	1	RAAF Bombing Range Purpose	Public Purpose	Public Govt	Comm	yes	yes	high	P1
36	56	1	RAAF Bombing Range Purpose	Public Purpose	Public Govt	Comm	yes	yes	high	P1
37	40	1	cleared farmland	Rural	Rural	private	yes	yes	very high	P1
38	44	1	extensive farming Wanneroo	Rural	Rural	private	yes	yes	high	P1
39	252	90	rural living hobby farms Neaves Rd	Rural	Special Rural	private	yes	yes	high and very high	P1
40	12	4	rural South Pinjar	Rural	Rural	private	yes	no	very high	P1
41	756	24	mixed agriculture South Pinjar	Rural/ P&R	Rural/ P&R	private	yes	no	very high	P2
42	120	1	State Forest Wanneroo SE Pinjar	State Forest	State Forest	Govt	yes	no	high	P1
43, 43a & b	8	3	mixed agriculture Neaves Rd	Rural	Rural	private	yes	yes	high	P1/P2/ P3

TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
44	110	1	native vegetation RAAF Bombing Range/State Forest	Public Purpose State Forest	Public Purpose State Forest	Comm Govt State Govt	yes	no	very high	P1
45	3	1	native vegetation	Rural	Rural	private	no	yes Note 1	high	none
46	729	1	native vegetation State Forest	State Forest	State Forest	Govt	yes	no	high	P1
47	41	1	cleared land around a wetland/ grazing Swan	Rural	Rural	private	yes	yes	very high Note 1	P1
48	1707	1	pine plantation Wanneroo	State Forest	State Forest	Govt	yes	yes	high	P1
49	122	8	native vegetation cleared farmland Hawkins Rd	Rural	Rural	private	yes	yes	high	P2
50	45	1	east portion Lake Jandabup	P&R	P&R	Govt	yes	yes	very high	P2
51	21	1	Water Treatment Plant	Public Purpose	Public Purpose	Water Corp	yes	yes	high	P1
52	86	20	native vegetation, cleared farmland Hawkins Rd Wanneroo	Rural	Rural	private	yes	yes	very high to high	P2
53	7720	1	pine plantation /native vegetation Swan	State Forest	State Forest	Govt	yes	yes	high	P1
54	88	27	mixed rural market gardens petrol station turf farm commercial uses	Rural	Rural	private	yes	yes	very high	P1
55	195	1	Lake Gnangara	P&R	P&R	Govt	yes	yes	very high	P1/P2
56	90	48	mixed rural Sydney Rd Wanneroo	Rural	Rural	private	yes	yes	very high	P2
57	61	4	North Lexia	Rural	Rural	private	no	yes Note 1	very high	none
58	250	1	Lexia Wetland	P&R	P&R	WAPC	no	yes Note 1	mod/high	none

TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
59	775	1	Urban Ellenbrook	Urban	Urban	private	yes	yes	high Note 1	P2/P3
60	338	1	Urban East Ellenbrook	Urban	Urban	private	no	yes	mod/high Note 1	none
61	2463	1	Whiteman Park	P&R	P&R	WAPC	yes	yes	high and very high in south-east area	P1
62	1308	1	IP8/Cullacabardee native vegetation small village grazing	Rural	Rural	WAPC	yes	yes	very high	P1
63	285	1	Telstra	Public Purpose	Public Purpose	private	yes	yes	very high	P1
64a & 64b	299	63	rural uses, Landsdale	Rural	Rural	private	yes	yes	high and very high	P2
65a	1	6	Landsdale	Urban	Urban	private	yes	yes	med/high	P2
65b	8	NA	west Landsdale existing urban	Urban	Urban	private	yes	no	low	P2
66	63	13	lakefarm Special Rural	Rural	Rural	private	yes	yes	high	P1
67	105	NA	Urban/ Alex Heights	Urban	Urban	private	yes	yes	mod/high	P3
67a	27	NA	Urban	Urban	Urban	private	yes	no	low	P3
68	60	1	native vegetation Koondoola	P&R	P&R	WAPC	yes	yes	mod/high	P3
69	1251	NA	Urban and Industrial Ballajura	Urban/ Industrial	Urban/ Industrial	private	yes	yes	mod/high	P3
70	107	1	south-west Whiteman Park/IP8	P&R/ Rural	P&R/ Rural	WAPC	yes	yes	high/very high	P1
71a	8	1	Mirrabooka Water Plant	Public Purpose	Public Purpose	Water Corp	yes	yes	high	P3
71b	5	1	Water Reservoir Koondoola	Public Purpose	Public Purpose	Water Corp	no	yes	moderate	none
72	57	NA	Urban, Mirrabooka	Urban	Urban	private	yes	no	low	P3
73	15	NA	Urban Koondoola	Urban	Urban	private	yes	yes	low	none

TABLE 4 SUMMARY OF ATTRIBUTES OF EACH PLANNING PRECINCT

PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
74	60	1	bushland grazing, north-east Whiteman Park	Rural	P&R	Govt	yes	yes	high Note 1	P2
75	205	64	hobby farms equestrian Henley Brook	Rural	Special Rural	private	yes	yes	very high-high Note 1	P2
76	160	many	hobby farms equestrian Henley Brook	Rural	Special Rural	private	no	yes	very high-high Note 1	none
77	40	1	mostly cleared Egerton	Urban Deferred	Rural	private	no	yes	very high Note 1	none
78	40	many	mostly cleared Egerton	Urban Deferred	Rural	private	yes	no	very high	P2
79	100	many	mostly cleared Egerton Deferred	Urban	Rural	private	yes	yes Note 1	very high	P2
80	139	1	south-east Lord St West Swan	Urban Deferred P&R	Urban Deferred P&R	Govt private	yes	no	moderate	P3
81	854	1	south Whiteman Park	P&R	P&R	Govt	yes	no	very high	P1
82	695	NA	Malaga/ Beechboro	Urban Industrial P&R	Urban	private	yes	no	very high	P3
83	49	NA	Ballajura	Rural	Rural	private	yes	no	very high	P1
84	71	NA	Malaga	Industrial	Industrial	private	yes	no	high	P3
85	20	60	Landsdale	Urban	Urban	private	yes	no	moderate	P3
86	25	20	south-west Lake Gnangara	Rural	Rural	private	yes	no	low	P2
87	184	15	east of Sydney/Joyce Rd	Rural P&R	Rural	private	yes	no	low	P2

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PRECINCT NO	AREA (HA)	LOTS	DESCRIPTION/ LOCATION	MRS ZONING	TPS ZONING	OWNER-SHIP	CURRENT UWPCA	WITHIN SCIENTIFIC BOUNDARY	VULNERABILITY TO CONTAMINATION	CURRENT PRIORITY
88	307	36	Between Neaves Rd/Lake Jandabup	Rural P&R	Rural	private	yes	no	low	P2
89	2145	many	Between Neaves Rd/Lake Gngangara	Rural	Rural/ Special Rural	private	yes	no	low	P3

- SF State Forest
- RWPZ Rural-Water Protection zone
- NA Not applicable
- P&R Parks and Recreation
- PWS Public water supply wells
- WCR Water Catchment reservation

Note 1: Some of the public water supply bores in the East Gngangara area draw groundwater from the deeper semi-confined Mirrabooka aquifer. The vulnerability of contamination to this deeper aquifer from land uses is low. The source of groundwater to the environmental features such as wetlands and Ellen Brook is from the shallow superficial aquifer. The vulnerability of contamination from land uses to the superficial aquifer is high to very high.



TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
1 State Forest native vegetation Shire Gingin	P1	low water to asset value	low	none	State Forest Government	Current land uses can continue Precinct no longer in Gngangara UWPCA Incorporate into Gngangara Park
2 Military Rd extensive grazing Shire Gingin North	none	high water to asset value	low/med	P1	WCR Shire TPS Government	Current land uses can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt
3 Wanneroo Rd native vegetation State Forest Shire Gingin	P1	low water to asset value	low	none	State Forest/WCR Shire TPS Government	Current land uses can continue Precinct no longer in UWPCA Incorporate into Gngangara Park
4 native vegetation State Forest Shire Gingin	none	high water to asset value	low	P1	State Forest/WCR Shire TPS Government	Current activities to continue Land use controls by SPP
5 Military Rd extensive grazing Shire Gingin	P1	high water to asset value	low/med	P1	WCR Shire TPS Government	Current activities to continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt.

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DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
6 Yeal Nature Reserve native vegetation Shire Gingin	P1	high water to asset value	low	P1	WCR Shire TPS Government	Current land uses can continue Land use controls by SPP
7 native vegetation Yeal Nature Reserve	P1	low water to asset value	low	none	State Forest Shire TPS Government	Current land uses can continue Precinct no longer in UWPCA
8 State Forest Shire Gingin native vegetation	P1	low water to asset value	low	none	State Forest Shire TPS Government	Current land uses can continue Precinct no longer in UWPCA Incorporate into Gngangara Park
9 State Forest plantation/native vegetation Shire Gingin	P1	high water to asset value	low	P1	WCR/ State Forest Shire TPS Government	Current land uses can continue Land use controls by SPP Incorporate into Gngangara Park
10 State Forest Yeal Nature Reserve Shire Gingin	P1	high water to asset value	low	P1	WCR/State Forest Shire TPS Government	Current land uses can continue Land use controls by SPP
11 Vacant Crown land native veg/clear Shire Gingin	none	high water to asset value	low	P1	WCR Shire TPS Government	Current activities to continue Land use controls by SPP Incorporate into Yeal Nature Reserve
11a Private land Shire Gingin	none	low water to asset value	low	P2	RWPZ Shire TPS Private	Current Land use can continue Land use controls by SPP
12 native vegetation Shire of Gingin	P1	low water to asset value	low	none	Public Purpose Airfield Comm Govt	Current land uses can continue Precinct no longer in Gngangara UWPCA
13 Gingin Airfield	none	high water to asset value	medium	none	WCR/ Public Purpose Comm Government	Current land uses can continue Precinct no longer in Gngangara UWPCA
14 Gingin Airfield	none	high water to asset value	low	P1	WCR Public Use Shire TPS Government	Current land uses can continue Land use controls by SPP and TPS

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DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
15 native vegetation extensive farming Shire Gingin	none	similar water to asset value	low	P2	Rural/ PWPZ Shire TPS Private	New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS
16 State Forest Shire Gingin	P1	high water to asset value	low	P1	State Forest WCR Government	Current land uses can continue Land use controls by SPP Incorporate into Gngangara Park
17 Yeal Nature Reserve	P1	high water to asset value	low	P1	P&R/WCR Government	Current land uses can continue Land use controls by SPP Incorporate into Gngangara Park
18 State Forest pine plantation Wanneroo	P1	high water to asset value	low	P1	WCR Shire TPS Government	Current land use can continue Land use controls by SPP Incorporate into Gngangara Park
19 native vegetation Shire Chittering	P1	low water to asset value	low	none	Rural Shire TPS Private	Current land uses can continue No longer in UWPCA Incorporate into Gngangara Park
20 Pt Lot 1 Timaru Rd Chittering native vegetation	none	similar water to asset value	low	P2	Shire TPS RWPZ Private	New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS

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DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
21 Pt Lot 2527 Timaru Rd Chittering extensive farming & native vegetation	none	moderate water to asset value	low	P2	Shire TPS RWPZ Private	New land uses or expansion of existing land uses should be compatible with Priority 2 objectives Land use controls by SPP and TPS
22a Low chill orchard Wanneroo Rd Shire Gingin	P1	similar water to asset value	med	P2	RWPZ Shire TPS Private	Current activity can continue under agreed management regime to minimise risk of contamination
22b East of Wanneroo Rd native vegetation	P1	high water to asset value	low	P1	WCR Shire TPS Government	Current activities to continue under agreed management regime to minimise risk of contamination Land use controls by SPP and TPS No further subdivision, New land uses or expansion of existing land uses need planning approval Govt will purchase land as it becomes available or landowners can initiate sale to Govt

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
23 Extensive grazing Wanneroo Rd Wanneroo	P1	high water to asset value	low/med	P1	WCR/P&R Shire TPS Government	Current activity can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt
24 State Forest Wanneroo	P1	high water to asset value	low	P1	WCR Shire TPS Government	Current land use can continue Land use controls by SPP Incorporate into Gngangara Park
25 State Forest Wanneroo	P1	high water to asset value	low	none	State Forest Government	Current land use can continue Precinct no longer in UWPCA Incorporate into Gngangara Park
26 native vegetation Shire Chittering	P1	low water to asset value	low	none	State Forest Shire TPS	Current land uses can continue Precinct no longer in Gngangara UWPCA Incorporate into Gngangara Park
27 State Forest native vegetation Shire Chittering	P1	high water to asset value	low	P1	WCR Shire TPS Government	Current land use can continue Land use controls by SPP Incorporate into Gngangara Park
28 State Forest native vegetation Wanneroo	P1	high water to asset value	low	P1	WCR State Forest Shire TPS Government	Current land uses can continue Land use controls by SPP Incorporate into Gngangara Park
29 State Forest pine plantation native vegetation Wanneroo	P1	low water to asset value	low	none	State Forest Government	Current land use can continue Precinct no longer in UWPCA Incorporate into Gngangara Park

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30 mixed agriculture Lake Pinjar	P1	high water to asset value	medium	P1	P&R/ WCR Government	Current activities can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt PCA 45 to be lifted when WCR gazetted
31 State Forest pine plantation native vegetation Pinjar Wanneroo	P1	high water to asset value	low	P1	State Forest/WCR Shire TPS Govt	Current land use can continue Land use controls by SPP Incorporate into Gngangara Park
32 Pinjar Power Station	P1	high asset to water value	high	P1	Public Purpose WCR Government	Current land use to continue using best practice management Land use controlled by EP Act Licence
33 RAAF Bombing Range	P1	high water to asset value	low	P1	P&R/ WCR Shire TPS Comm Government	Current land use can continue Land use controls by SPP
34 RAAF Bombing Range	P1	high water to asset value	low	P1	P&R/ WCR Comm Govt	Current land use can continue Land use controls by SPP
35 RAAF Bombing Range	P1	high water to asset value	low	P1	P&R/ WCR Comm Govt	Current land use can continue Land use controls by SPP
36 RAAF Bombing Range	P1	high water to asset value	low	P1	P&R/ WCR Comm Govt	Current land use can continue Land use controls by SPP

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37 Higgins Rd Pinjar cleared farmland Wanneroo	P1	high water to asset value	med	P1	WCR/ P&R Government	Current activities can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses need planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt
38 extensive grazing Lot 2130 Cecil Rd Wanneroo	P1	high water to asset value	low	P1	P&R/ WCR Government	Current activities can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt
39 rural living, hobby farms Neaves Rd Wanneroo	P1	similar water to asset value	low/med	P2	RWPZ Private	Current land uses can continue Land use controls by SPP and review TPS provisions Govt will not purchase private land
40 Rural South Lake Pinjar Wanneroo	P1	low water to asset value	med	Note 1.	Rural/ P&R Private	Current land uses can continue Precinct no longer in Gnamagara UWPCA PCA 45 to be lifted when WCR gazetted
41 mixed agriculture South Lake Pinjar Wanneroo	P2	low water to asset value	med	Note 1.	P&R/Rural Private	Current land uses can continue Precinct no longer in Gnamagara UWPCA PCA 45 to be lifted when WCR gazetted

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
42 State Forest Wanneroo SE Pinjar	P1	low water to asset value	low	Note 1	State Forest Shire TPS Government	Current land uses can continue Precinct no longer in Gngangara UWPCA Incorporate into Gngangara Park
43 mixed agriculture Neaves Rd Wanneroo	P2	moderate water to asset value	moderate	P2	RWPZ Private	Current land uses can continue Land use controls by SPP and TPS Govt will not purchase private land
43a Neaves Rd Wanneroo	P1	low water to asset value	low	none Note 1	State Forest Government	Current land uses can continue Incorporate into Gngangara Park
43b Neaves Rd Wanneroo	P3	low water to asset value	low	P3 Note 1	Rural Private	Current land uses can continue
44 native vegetation RAAF Bombing Range /State Forest	P1	low water to asset value	low	none	Public Purpose State Forest Comm Govt	Current land uses can continue Precinct no longer in Gngangara UWPCA
45 native vegetation Swan	none	high water to asset value	low	P1	Rural WCR/P&R Government	Current activities can continue under agreed management regime to minimise risk of contamination No further subdivision New land uses or expansion of existing land uses require planning approval Land use controls by SPP and TPS Govt will purchase land as it becomes available or landowners can initiate sale to Govt
46 State Forest Swan	P1	low water to asset value	low	none	State Forest Government	Current land uses can continue Precinct no longer in Gngangara UWPCA Incorporate into Gngangara Park
47 Swan Loc 01497 cleared land around a wetland/grazing falls in semi-confined aquifer area of East Gngangara	P1	high water to asset value	low/med	P1	WCR/Rural Government	Current land use can continue under agreed management regime to minimise risk of contamination Land use controls by SPP and TPS No further subdivision New land uses or expansion of existing land uses should be compatible with Priority 1 objectives Govt will purchase land as it becomes available or landowners can initiate sale to Govt

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
48 State Forest pine plantation Wanneroo	P1	high water to asset value	low	P1	WCR/ State Forest Government	Current land uses can continue Land use controls by SPP Incorporate into Gngangara Park
49 Hawkins Rd Wanneroo native vegetation cleared farmland	P2	similar water to asset value	low/med	P2	RWPZ Private	Current land use can continue Land use controls by SPP and TPS Govt will not purchase private land
50 Jandabup Lake Wanneroo	P2	high water to asset value	low	P1	WCR/ P&R Government	Incorporate into Gngangara Park Management Plan to be prepared recognising groundwater values Incorporate into Gngangara Park
51 Water Treatment Plant	P1	high asset to water value	med/high	P1	WCR Public Purpose Government	Current land uses can continue Land use controls by SPP
52 native vegetation cleared farmland Hawkins Rd Wanneroo	P2	moderate water to asset value	med	P2	RWPZ Private	Current land uses can continue Land use controls by SPP and TPS Govt will not purchase private land
53 State Forest native vegetation Shire Swan	P1	high water to asset value	low	P1	State Forest/ WCR Government	Current land use can continue Land use controls by SPP Incorporate into Gngangara Park
54 Gngangara Road Wanneroo/Swan	P1	high water to asset value	medium (isolated lots pose high risk)	P1	WCR/P&R Government	Current activity can continue under agreed management regime to minimise risk of contamination WRC to investigate water quality impacts of current land uses No further subdivision New land uses or expansion of existing land uses should be compatible with Priority 1 objectives Govt will purchase land as it becomes available or landowners can initiate sale to Govt Incorporate into Gngangara Park
55 Gngangara Lake Wanneroo	P2	high water to asset value	low	P1	WCR/ P&R Government	Incorporate into Gngangara Park Management Plan to be prepared recognising groundwater values
56 mixed rural Sydney Rd Wanneroo	P2	moderate water to asset value	low/med	P2	RWPZ Private	Current land uses can continue Land use controls by SPP and TPS Govt will not purchase private land

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
57 North Lexia Shire Swan falls in semi-confined aquifer area of East Gnangara	none	low water to asset value	low	P3	Rural Private	Current land uses can continue Land use controls by SPP and TPS
58 Lexia Wetland	none	low water to asset value high environ. value	low	P1	WCR/P&R Government	Current land uses can continue Land use control by SPP and TPS Incorporate into Gnangara Park
59 Urban Ellenbrook	P2/P3	low water to asset value	med/high	P3	Urban Private	Current land use can continue
60 East Ellenbrook	none	low water to asset value	low	P3	Urban Private	Current land use can continue using best practice management
61 Whiteman Park	P1	high water to asset value	low /med	P1	WCR/P&R Government	Current land uses can continue using best practice management Land use controls by SPP
62 Cullacabardee/IP8 native vegetation small village	P1	high water to asset value	low/med	P1	WCR/P&R Government	Current land uses can continue using best practice management Land use controls by SPP
63 Telstra Gnangara Rd	P1	high water to asset value	low/med	P1	WCR/ Public Purpose Private	Current land use can continue using best practice management Land use controls by SPP and TPS
64 Rural uses Landsdale	P2	moderate water to asset value	high	P2 possible P3	Private Possible future Urban	Current land uses can continue. Priority 3 subject to the resolution of all planning issues and constraints and the approval of an agreed Structure Plan by Government which removes identified contamination risks
64a Rural uses Landsdale	P2	low water to asset value	high	none	Private Possible Future Urban	Current land use can continue. No longer in Mirrabooka UWPCA
65a Urban Landsdale Wanneroo	P2	low water to asset value	high/med	P3	Existing Urban Private	Current land uses can continue Land use controls by SPP and TPS

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
65b Urban Landsdale Wanneroo	P2	low water to asset value	low	none Note 1.	Urban	Current land uses can continue
66 Lakefarm Special Rural Shire Swan	P1	moderate water to asset value	low/ medium	P2	RWPZ private	Current land uses can continue Land use controls by SPP and review TPS provisions Govt will not purchase private land
67 Urban Alexander Heights	P3	low water to asset value	high/med	P3	Urban private	Current land uses can continue
67a Urban Alexander Heights	P3	low water to asset value	high/med	none	Urban private	Current land uses can continue No longer in Mirrabooka UWPCA
68 native vegetation Koondoola ROS	P3	low water to asset value	low	P3	P&R Government	Current land uses can continue
69 Urban and industrial Ballajura	P3	low water to asset value	high	P3	Urban/Industrial Private	Current land uses can continue
70 South West Whiteman Park/IP8	P1	high water to asset value	low	P1	P&R /WCR Government	Current land uses can continue Land use controls by SPP
71a Water Reservoir Mirrabooka	P3	low water to asset value	low/med	P3	Public Purpose Government	Current land uses can continue using best practice management
71b Mirrabooka Water Treatment Plant	P3	low water to asset value	high/med	none	Public Purpose Water Corp	Current land uses can continue using best practice management
72 Urban Mirrabooka	P3	low water to asset value	high/med	none	Urban Private	Current land use to continue No longer in Mirrabooka UWPCA
73 Urban Koondoola	P3	low water to asset value	med	none	Urban Private	Current land use to continue
74 north-east corner Whiteman Park	P2	moderate water to asset value	low/med	P2	RWPZ Government	Current land use to continue Possible future use for public infrastructure Future land use planned using best practice management

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
75 Henley Brook Hobby farms equestrian Falls mostly in semi-confined aquifer area of East Gnangara City of Swan	P2	moderate water to asset value	low/med	P2	RWPZ Private	Current land use to continue Land use controls by SPP and TPS
76 East Henley Brook Hobby farms equestrian Falls in semi-confined aquifer area of East Gnangara City of Swan	none	low water to asset value	low/med	P3	Rural Private	Current land use to continue using best practice management
77 Urban Deferred mostly cleared Albion Town	none	low water to asset value	med	P3	Urban Private	Current land use to continue using best practice management
78 Urban Deferred mostly cleared Albion Town	P2	low water to asset value	med	none	Urban Private	Current land use to continue Precinct no longer in UWPCA
79 Urban Deferred mostly cleared Albion Town	P2	low water to asset value	med	P3	Urban Private	Current land use to continue using best practice management
80 south-east Lord St West Swan Albion Town	P2/P3	low water to asset value	med	none	Urban P&R Private/ Government	Current land use to continue Precinct no longer in UWPCA
81 South Whiteman Park	P1	low water to asset value	med	none	Possible Urban Government	Current land use to continue Precinct no longer in UWPCA
82 Malaga/Beechboro Urban/Urban Deferred	P3	low water to asset value	high	none	Urban Private	Current land use to continue Precinct no longer in UWPCA
83 Ballajura Rural area	P3	low water to asset value	high	none	Urban Private	Current land use to continue Precinct no longer in UWPCA

TABLE 5 IMPLEMENTATION STRATEGY FOR PLANNING PRECINCTS

DESCRIPTION OF PRECINCT	CURRENT PRIORITY STATUS	VALUES	EXISTING LAND USE RISK	RECOMMENDED PRIORITY STATUS GNANGARA UWPCA	MRS/TPS CATEGORY LONG-TERM LAND TENURE	IMPLEMENTATION STRATEGY
84 Malaga Industrial Area	P3	low water to asset value	high	none Note 1	Industrial Private	Current land use to continue Precinct no longer in UWPCA
85 Landsdale	P3	low water to asset value	med	none Note 1	Urban Private	Current land use to continue Precinct no longer in UWPCA
86 SW Gngangara Lake	P2	moderate/ low water to asset value	med	Part P2/ none	Rural / RWPZ Private	Current land use to continue
87 East Sydney/Joyce Rd	P2	low water to asset value	med	none Note 1	Rural / P&R Private	Current land use to continue Precinct no longer in UWPCA
88 Between Neaves Rd/ Jandabup Lake	P2	low water to asset value	med	none Note 1	Rural / P&R Private	Current land use to continue Precinct no longer in UWPCA
89 Neaves Rd to Gngangara Lake	P3	low water to asset value	low	none Note 1	Rural / Private	Current land use to continue Precinct no longer in UWPCA

Water Asset Value – The value of the water resource for public water supply per planning precinct

Land Asset Value – The value of the land and improvements in \$ terms

SPP	Statement of Planning Policy
TPS	Town Planning Scheme
SF	State Forest
RWPZ	Rural-Water Protection zone
NA	Not applicable
P&R	Parks and Recreation
PWS	Public water supply wells
WCR	Water Catchment reservation

Note 1: Area still falls within the groundwater capture zone for the Perth Coastal or Gwelup Schemes.

Protection boundary for these schemes to be reviewed by WRC. Likely priority classification for privately owned land is Priority 3.

APPENDIX 1

GLOSSARY

abstraction	pumping from an aquifer
aquifer	a geological formation or group of formations able to receive, store and transmit significant quantities of water
artesian aquifer	a confined aquifer under sufficient pressure that water would rise in a well above the ground surface
asset value	the value of land and improvements based on current market value
bedrock surface	the surface of the underlying rock formation
best practice management	the highest level of management able to be undertaken in a particular industry
bore yield	the quantity of water produced from a bore
cadastral	property boundaries as shown on the Department of Land Administration data base
capture zone	the area around a water supply well from which water is sourced
cone of depression	a conical zone of aquifer de-watering that a bore produces when pumping
confined aquifer	an aquifer, confined between an upper and lower layer of relatively impermeable material
contaminants	substances that have the potential to alter the natural composition of water
contaminant plume	the space that contaminated water occupies
diffuse source contamination	contamination originating from a widespread area
discharge features	environmental features such as wetlands that are formed when groundwater discharges to the features
drawdown contour	a change to the water table caused by pumping
Environmental Impact Assessment Guidelines	a series of guidelines prepared by the EPA providing advice to proponents
environmental management area	the land area which is the source of groundwater for discharge features such as wetlands and springs

Environmental Protection Policy	policies prepared under the Environmental Protection Act, 1986 relating to the protection of environmental assets
evapotranspiration	a collective term for evaporation and transpiration
gazetted flora/fauna	flora or fauna that is listed in the Wildlife Conservation Act, 1950 as rare or endangered
gigalitres	a measure of water quantity – one gigalitre equals one thousand million litres or one million kilolitres
groundwater divide	a line delineating where groundwater flows in opposite directions
groundwater flow	the movement of groundwater through an aquifer
groundwater resource	a defined area of groundwater that has beneficial uses
hectare	unit of land area equal to 10,000 m ² or approximately 2.47 acres
hydrocarbons	organic chemicals that are widely used in society that have the potential to contaminate groundwater, e.g. petrol, oil, grease
hydrogeology	the study of groundwater, groundwater flows, quality and the distribution of aquifers
hydrology	the study of water, its properties, distribution and utilisation on and below the earth's surface
land capability	measure of the inherent ability of land to support particular land uses
land suitability	a measure of the inherent ability plus the environmental, socio-economic factors of land to support particular land uses
nutrient stripping	the removal of nutrients from water
permeable	the ability of rock or soil to permit the passage of water
phreatophytic	refers to plants that obtain their water supply in or near the water table
production well	a well or bore that draws groundwater to the surface of the ground
recharge	the process of renewing underground water by infiltration of rainfall
remnant vegetation	remaining areas of natural vegetation

run-off	that part of rainfall which flows off the land surface towards drainage lines
sequential land use	a land use which occurs after the completion of a prior land use
sewage	the mixture of waste fluids and solids flowing in sewers from houses, factories, etc
Statement of Planning Policy	a policy prepared by the WAPC under the Town Planning and Development Act, 1928 (as amended)
superficial formation	a collective term for surface geological formations which, beneath the Swan Coastal Plain, form a thin layer of late Tertiary and Quaternary age formations overlying older formations
supply well	a well or bore that draws water to the surface of the ground
System 6	an area of land defined by the Environmental Protection Authority comprising the Swan Coastal Plain
topography	the shape of the surface of the ground at a local or global level
transpiration	the process where plants take water from the soil and pass it through their stems and leaves to the atmosphere while, at the same time, removing nutrients and trace elements
unconfined aquifer	an aquifer which has its upper boundary at the earth's surface (the upper surface of the groundwater within the aquifer is called the water table)
urbanisation	the process whereby land is developed for urban land uses
underground	an area of land proclaimed under the Metropolitan Water Supply Sewerage
water pollution control area	and Drainage Act 1909 for the purpose of protecting groundwater used for public drinking water supplies
vertical separation	a measure of the vertical distance between the surface of the ground and the groundwater table
water table	the level to which water rises in a well tapping an unconfined aquifer
wellfield	a system of production bores to harvest groundwater
wellhead protection delineation	a process which identifies and maps the capture zone of a well

APPENDIX 2

ABBREVIATIONS

AGWA	Agriculture Western Australia
AWRC	Australian Water Resources Council
CAC	Community Advisory Committee
CALM	Department of Conservation and Land Management
CCWA	Conservation Council of Western Australia
CWE	Coalition of Wanneroo's Environment
DEP	Department of Environmental Protection
DOME	Department of Minerals and Energy
DPUD	Department of Planning and Urban Development
EMA	Environmental Management Area
EMRC	East Metropolitan Region Council
EPA	Environmental Protection Authority
EPP	Environmental Protection Policy
GL	gigalitre
GLUWMS	Gnangara Land Use and Water Management Strategy
HD	Health Department
KL	Kilolitre
LG	Local Government
MfP	Ministry for Planning
MRS	Metropolitan Region Scheme
MWSSD Act	<i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> (as amended)
P&R	Parks and Recreation Reservation
RAAF	Royal Australian Air Force
RWPZ	Rural-Water Protection zone

SOG	Senior Officers Group
SPP	Statement of Planning Policy
SRRPA	Swan Region Ratepayers Association
SVRA	Swan Valley Ratepayers Association
TPS	Town Planning Scheme
UWPCA	Underground Water Pollution Control Area
WAPC	Western Australian Planning Commission
WC	Water Corporation
WCR	Water Catchment reservation
WGAC	Wanneroo Groundwater Advisory Committee
WHPA	Wellhead Protection Area
WRC	Water and Rivers Commission



APPENDIX 3

COMMITTEE MEMBERSHIP

STEERING COMMITTEE

Mr Mike Allen (Chair, MfP)	Mr Keith Barrett (WC)
Mr David Boyd (WRC)	Mr Gary Middle (DEP)
Dr Francis Quadros (HD)	Mr Allan Sands (CALM)
Mr Phil Thompson (City of Joondalup)	Mr Mick McCarthy (Shire of Swan)
Mr Alan Mappin (Shire of Gingin)	Cr Sue Metcalf (Shire of Chittering)
Mr David Nunn (MfP)	

SENIOR OFFICERS GROUP

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Dr Linda Moore (WRC)	Mr Keith Barrett (WC)
Dr Francis Quadros (HD)	Mr Gary Middle (DEP)
Mr David Nunn (MfP)	Mr David Boyd (WRC)
Mr Andrew Moore (MfP)	Mr Allan Sands (CALM)
Mr Allen Carman-Brown (MfP)	

COMMUNITY ADVISORY COMMITTEE

Mr Mike Allen (Chair)	Mr Gary Middle (DEP)
Mr Allan Sands (CALM)	Mr Ross Sheridan (WRC)
Dr Bob Humphries (WC)	Dr Francis Quadros (HD)
Mr Bob Paulin (AGWA)	Cr Rod Henderson (Shire of Swan)
Mr Mick McCarthy (EMRC)	Mr Alan Mappin (Shire of Gingin)
Mr Nick Trandos (WGAC)	Ms Kate Tauss (CWE)
Mr Ivan Ivankovich (SRRPA)	Mr Rod Taylor (Pinjar resident)
Mr Graham Ross (Gingin landowner)	Cr Sue Metcalf (Shire of Chittering)
Ms Sue Hunt (SVRA)	Mr David Wake (CCWA)
Mr Colin Brand (Pinjar resident)	

TECHNICAL OFFICERS

Dr Linda Moore (WRC)	Mr Andrew Moore (MfP)
Mr Allen Carman-Brown (MfP)	Mr Adrian Tomlinson (WRC)

APPENDIX 4

LAND USE COMPATIBILITY IN PUBLIC DRINKING WATER SOURCE AREAS

PURPOSE

To provide information for activities that may affect 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 activities 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*.

GENERAL REQUIREMENTS

The following notes reflect the Water and Rivers 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 which are based on 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, **wellhead protection zones** and **reservoir protection zones** are defined to protect the water source from contamination in the immediate vicinity of production wells and reservoirs. Wellhead 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 two kilometre area around the top water level of a reservoir and include the reservoir itself. These zones do not extend outside water reserves. Additional restrictions apply within these zones.

LAND USE COMPATIBILITY TABLES

These tables should be used as a guideline only. Further information relating to land use and developments 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 affect water resources.

DEFINITIONS USED IN THE FOLLOWING TABLES

<i>Compatible</i>	The development/land use is compatible with the management objectives of the Priority classification.
<i>Incompatible</i>	The development/land use is incompatible with the management objectives of the Priority classification.
<i>Restricted</i>	The development/land use may be compatible with the management objectives of the Priority classification, with appropriate site management practices. Restricted 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 e.g. supplementary feed during seasonal dry periods.
<i>Intensive</i>	Where regular additional inputs are required to support the desired land use. eg irrigation, additional feed, fertilisers.

LAND USE COMPATIBILITY TABLES

AGRICULTURE – ANIMALS

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Apiary	Conditional	Conditional	Conditional
Aquaculture e.g. marron farms, fish farms, algae culture	Incompatible	Conditional	Conditional
Dairy farming	Incompatible	Conditional	Conditional
Feedlots	Incompatible	Incompatible	Conditional
Livestock grazing (extensive)	Conditional	Compatible	Compatible
Livestock grazing (intensive)	Incompatible	Incompatible	Conditional ¹¹
Piggeries	Incompatible	Incompatible	Incompatible
Poultry farming (housed)	Incompatible	Conditional	Conditional
Stables	Incompatible	Conditional	Compatible
Stockholding and saleyards	Incompatible	Incompatible ⁷	Conditional ⁷

AGRICULTURE – PLANTS

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Broadacre cropping i.e. non-irrigated	Incompatible	Conditional ¹	Compatible
Floriculture (extensive)	Incompatible	Conditional	Compatible
Floriculture (intensive)	Incompatible	Incompatible	Conditional
Field horticulture	Incompatible	Incompatible	Conditional
Hydroponic horticulture	Incompatible	Conditional	Conditional
Orchards	Incompatible	Conditional	Compatible
Potted nurseries	Incompatible	Conditional	Compatible
Silviculture (tree farming)	Conditional	Conditional	Compatible
Turf farms	Incompatible	Incompatible	Conditional
Viticulture (wine and table grapes)	Incompatible	Conditional	Compatible



DEVELOPMENT – COMMERCIAL

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Aircraft servicing	Incompatible	Incompatible	Conditional ⁶
Amusement centres	Incompatible	Incompatible	Compatible ⁶
Automotive businesses	Incompatible	Incompatible	Conditional ⁶
Boat servicing	Incompatible	Incompatible	Conditional ⁶
Caravan and trailer hire	Incompatible	Incompatible	Conditional ⁶
Vehicle parking (commercial)	Incompatible	Incompatible	Compatible
Consulting rooms	Incompatible	Incompatible ⁷	Compatible ⁶
Cottage Industries	Conditional	Conditional	Compatible
Drive-in/take-away food shops	Incompatible	Incompatible	Compatible ⁶
Drive-in theatres	Incompatible	Incompatible	Compatible ⁶
Drycleaning premises	Incompatible	Incompatible	Conditional ⁶
Farm supply centres	Incompatible	Incompatible ⁷	Conditional
Fuel depots	Incompatible	Incompatible	Conditional
Garden centres	Incompatible	Incompatible	Compatible
Local shops	Incompatible	Incompatible ⁷	Compatible
Markets	Incompatible	Incompatible	Compatible ⁶
Milk depots	Incompatible	Incompatible	Conditional
Restaurants	Incompatible	Incompatible	Compatible
Service stations	Incompatible	Incompatible	Conditional
Transport depots	Incompatible	Incompatible	Conditional
Veterinary clinics/hospitals	Incompatible	Incompatible ⁷	Conditional
Vehicle wrecking and machinery	Incompatible	Incompatible	Conditional

DEVELOPMENT – INDUSTRIAL

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
General industry	Incompatible	Incompatible	Conditional ⁶
Heavy industry	Incompatible	Incompatible	Incompatible
Light industry	Incompatible	Incompatible	Conditional ⁶
Power stations	Incompatible	Incompatible	Incompatible

DEVELOPMENT – URBAN

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Aged and dependent persons	Incompatible	Incompatible	Compatible ⁶
Amenity buildings	Incompatible	Conditional	Compatible
Airports or landing grounds	Incompatible	Incompatible	Conditional ⁶
Cemeteries	Incompatible	Incompatible	Conditional
Civic buildings	Incompatible	Conditional	Compatible ⁶
Clubs – sporting, recreation or community	Conditional	Conditional	Compatible ⁶
Community halls	Conditional	Conditional	Compatible
Family day care centres	Incompatible	Conditional	Compatible ⁶
Funeral parlours	Incompatible	Incompatible	Compatible ⁶
Health centres	Incompatible	Incompatible	Compatible ⁶
Hospitals	Incompatible	Incompatible	Conditional ⁶
Medical centres	Incompatible	Incompatible	Compatible ⁶

EDUCATION / RESEARCH

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Education centres	Conditional	Conditional	Compatible ⁶
Primary/Secondary schools	Incompatible	Incompatible	Compatible ⁶
Scientific research institutions	Conditional	Conditional	Compatible
Universities	Incompatible	Incompatible	Conditional ⁶

MINING AND MINERAL PROCESSING

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Extractive industries	Conditional ²	Conditional ²	Conditional ²
Mineral exploration	Conditional ⁴	Conditional ⁴	Conditional ⁴
Mining and mineral processing	Conditional ⁴	Conditional ⁴	Conditional ⁴
Tailings dams	Incompatible	Incompatible	Conditional

PROCESSING OF ANIMALS / ANIMAL PRODUCTS

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Abattoirs	Incompatible	Incompatible	Incompatible
Cheese/butter factories	Incompatible	Incompatible	Conditional ⁶
Food processing	Incompatible	Incompatible	Conditional ⁶
Tanneries	Incompatible	Incompatible	Incompatible
Wool-scours	Incompatible	Incompatible	Incompatible

PROCESSING OF PLANTS / PLANT PRODUCTS

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Breweries	Incompatible	Incompatible	Conditional ⁶
Composting/soil blending (commercial)	Incompatible	Incompatible	Conditional
Vegetable/food processing	Incompatible	Incompatible	Conditional ⁶
Wineries	Incompatible	Incompatible	Conditional

SUBDIVISION

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Dog Kennel Subdivisions	Incompatible	Conditional	Conditional
Rural – minimum lot size ‘ 4 hectares (unsewered)	Incompatible	Compatible	Compatible
Rural – minimum lot size ‘ 1 hectare (unsewered)	Incompatible	Incompatible	Compatible
Special rural – minimum lot size ‘ 2 hectares (unsewered) ⁵	Incompatible	Conditional ⁸	Conditional ⁸
Special rural – minimum lot size ‘ 1 hectare (unsewered) ⁵	Incompatible	Incompatible	Conditional 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

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Equestrian centres	Incompatible	Incompatible	Compatible
Golf courses	Incompatible	Incompatible	Conditional
Irrigated recreational parks	Incompatible	Conditional	Conditional
Motor sports i.e. permanent racing facilities	Incompatible	Incompatible	Conditional
Public Swimming Pools	Incompatible	Conditional	Conditional
Rifle Ranges	Conditional	Conditional	Compatible
Temporary recreational activities (active) e.g. four-wheel driving, car rallies	Incompatible	Conditional ³	Conditional ³
Temporary recreational activities (passive) e.g. horse riding, bushwalking	Conditional	Conditional	Conditional

STORAGE OF TOXIC AND HAZARDOUS SUBSTANCES (THS)

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Above-ground storage of THS	Conditional ¹³	Conditional ¹³	Conditional ¹³
Bulk Storage facilities for THS	Incompatible	Incompatible	Conditional ¹²
Underground storage tanks for THS	Incompatible	Incompatible	Conditional

TOURISM ACCOMMODATION

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Bed and breakfast accommodation	Incompatible	Conditional	Compatible
Caravan parks	Incompatible	Incompatible	Conditional ⁶
Holiday accommodation e.g. farm chalets	Incompatible	Conditional ⁹	Compatible ⁶
Motels, lodging houses, hostels	Incompatible	Incompatible	Compatible ⁶

WASTE TREATMENT AND MANAGEMENT

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Deep well injection of liquid wastes	Incompatible	Incompatible	Incompatible
Class I, II and III landfills	Incompatible	Incompatible	Conditional
Class IV and V landfills	Incompatible	Incompatible	Incompatible
Recycling depots	Incompatible	Incompatible	Conditional
Refuse transfer stations	Incompatible	Incompatible	Conditional
Sewers (gravity)	Incompatible	Incompatible	Compatible
Sewers (pressure mains)	Incompatible	Conditional	Compatible
Sewage pump station	Incompatible	Conditional ¹³	Conditional
Used tyre storage facilities (wholesale)	Incompatible	Incompatible	Incompatible
Wastewater treatment plants	Incompatible	Incompatible	Conditional
Water treatment plants	Conditional	Conditional	Conditional

OTHER DEVELOPMENTS

DEVELOPMENT	PRIORITY 1	PRIORITY 2	PRIORITY 3
Caretaker's housing	Conditional	Conditional	Compatible
Construction projects	Conditional	Conditional	Conditional
Forestry	Conditional ¹	Compatible	Compatible
National parks	Compatible	Compatible	Compatible
Nature reserves	Compatible	Compatible	Compatible
Communications receivers/ transmitters	Conditional	Conditional	Conditional
Major transport routes	Incompatible	Conditional ¹⁰	Compatible

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 a wellhead protection zone.



The Draft Gnangara Land Use and Water Management Strategy was released in June 1999 for a three-month public comment period which closed on 30 September 1999. A full public consultation strategy was prepared and implemented by the Ministry for Planning. The report was made available for public inspection during business hours at the:

- offices of the Ministry for Planning
- offices of the Water and Rivers Commission
- offices of the City of Wanneroo, Shire of Gingin, Shire of Chittering and City of Swan
- Public Libraries in all local authorities and the State Library

A Part 1 and Part 2 report and summary brochure were mailed out to all affected landowners, State and local government, stakeholder groups and interested parties. Newspaper advertisement and feature articles were placed in all the local newspapers (the Gingin Times, the Wanneroo Times, the Hills Gazette and the Advocate). Briefings were given as requested to all affected landowners, local authorities, and other interest groups. Displays outlining the draft Strategy objectives, recommendations and affected land were set up at each local authority. Draft Strategy reports, brochures and all other information were issued free of cost.

Many meetings were held with individual landowners and several group meetings were held to discuss the draft Strategy. The draft Strategy was also presented and discussed at three public meetings at the City of Wanneroo in conjunction with information nights on the CALM proposals for the Gnangara Park and the City of Wanneroo Draft Local Rural Strategy.

One hundred and one submissions were received. A detailed analysis of each individual submission is available upon request from the Ministry for Planning.

Twenty-eight submissions supported the Strategy in principle but had specific issues of concern. Seventy-three submissions did not support the Strategy.

The major changes resulting from the public submissions are:

- modifications to the UWPCA boundary along the Muchea area on State Forest land and RAAF land to round out the scalloped modelled UWPCA boundary;
- a change of the Priority classification of Precincts 13, 15, 20, 21 from Priority 1 to Priority 2; and
- an investigation into the existing land use risks of the Landsdale area Precinct 64 resulting in a change from Priority 2 to Priority 3 subject to the resolution of all planning and environmental issues and the approval of an agreed Structure Plan which removes the identified contamination risks and outlines the proposed development of the area.

APPENDIX 6

REFERENCES

- Alan Tingay and Associates. (1994) *Egerton Structure Plan Consultative Environmental Review*, Multiplex Constructions Pty Ltd, Perth.
- Appleyard, S.J. (1993) *Explanatory notes for the groundwater vulnerability to contamination maps of the Perth Basin*, Western Australian Geological Survey, Record 1993/6.
- Australian Heritage Commission. (1994) Printout from the National Estate database. *Ellenbrook National Estate Area – Maralla Area* 018942 5/13/026/0079/01.
- Australian Water Resources Council. (1990) *The Status of Groundwater Contamination and Regulation in Australia*, Occasional Paper No. 1, Water Resources Management Committee, July 1990.
- Australian Water Resources Council. (1992) *National Water Quality Management Strategy, Draft Guidelines for Groundwater Protection*.
- Barber C., Bates L.E., Briegel D. and Lambert M. (1990) *Groundwater pollution from underground storage of petroleum fuels on the Swan Coastal Plain, WA: Preliminary investigations*. CSIRO Division of Water Resources, Report.
- Barber C., Otto C.J., Bates L.E. and Taylor K.J. (1996) *Evaluation of the relationship between landuse changes and groundwater quality in a water supply catchment, using GIS technology: The Gwelup wellfield, Western Australia.* : *Hydrogeology Journal*, 4 (1), pp. 6-19.
- Bowman Bishaw Gorham. (1994) *East Wanneroo Wetlands Natural Resource Mapping*, Report No. MA3140, Bowman Bishaw Gorham Environmental Consultants.
- Cossill and Webley Pty Ltd., Bowman Bishaw and Gorham and Jim Davies and Associates Pty Ltd. (1994) *Drainage and Nutrient Management Programme for the Ellenbrook Development Southern Catchment*, August 1994.
- Dames & Moore. (1996) *Review of Groundwater Protection Priority Area Boundaries Gngangara Mound*, Water and Rivers Commission, p. 53.
- Davidson W.A. (1995) *Hydrogeology and Groundwater Resources of the Perth Region*, Western Australia, Geological Survey of Western Australia, Bulletin pp.142, 257.
- Department of Conservation and Land Management. (1997) *A Park for the People*, Landscape, Autumn Edition.

Environmental Protection Authority. (1990) *A Guide to Wetland Management in Perth*, Bulletin 374.

Feilman Planning Consultants. (1992) *Ellenbrook Public Environmental Review Report*, Ellenbrook Management Pty Ltd, Perth.

Gerritse R.G., Barber C. and Adeney J.A. (1990) *The impact of residential urban areas on groundwater vulnerability: Swan Coastal Plain, Western Australia*, CSIRO Water Resources Series No. 3.

Hill A., Semeniuk C., Semeniuk V. and Del Marco A. (1996) *Wetland Mapping, classification and evaluation, Volume 2, Wetlands of the Swan Coastal Plain*, Water Authority of WA.

Hirschberg K.J.B. (1991) Point Sources of Groundwater Contamination in the Perth Basin and their Significance. Unpublished Geological Survey of WA paper.

Hirschberg, K.J.B. (1991) *Inventory of known and inferred point sources of groundwater contamination, Perth Basin*, Western Australia. Western Australia Geological Survey, Record 1991/7.

Jasinska J., and Knott B. (1994) *Aquatic Fauna in the Gnangara Mound Discharge Areas of the Ellenbrook Catchment*, WA. Department of Zoology, University of Western Australia, Perth.

Kinhill Engineers Pty Ltd. (1995) *Nitrogen application limits for various land uses*, November 1995.

Lantzke N. (1997) *Phosphorus and Nitrate Loss from Horticulture on the Swan Coastal Plain*, Publication 16/97 Agriculture Western Australia.

McArthur, W.M. (1986) *The Gnangara Mound Landforms, Soils and Vegetation*, Gnangara Mound Environmental Review and Management Programme, Water Authority of WA.

Mattiske, E.M. (1994) *Monitoring of the effects of groundwater extraction on native vegetation on the Northern Swan Coastal Plain*, E.M. Mattiske and Associates.

Murdoch University. (1991) *Draft Proposal for Wetlands in the City of Wanneroo*, 48 Environmental Science, Murdoch University.

National Health and Medical Research Council. (1987) *Guidelines for Drinking Water Quality in Australia*, Australian Government Publishing Service.

Otto, C.J., Barber C., and Schlafrig J. (1994) *Evaluation of pathogenic and nutrient contamination of residential borewater in the Gwelup Public Supply Area: CSIRO Division of Water Resources*, July 1994, Report 94/24.

Otto C.J., Bates L.E., and Barber C. (1994) *Evaluation of groundwater quality in the Gwelup UWPCA: Stage 2 Predictive Modelling*, CSIRO Division of Water Resources, 1993, Report 94/5.

Semeniuk C. (1987) *Wetlands of the Darling System – a geomorphic approach to habitat classification*, *Journal of the Royal Society*, 70: 69-87.

Sharma M.L., Byrne J., Barron R.J.W., Laslett D., Bari M. and Pionke H.B. (1989) *Recharge and nutrient leaching beneath market garden crop systems on the Gnangara Mound*, CSIRO Division of Water Resources, p. 32.

Sharma M.L., Kin P.G., Mok J.Y.M., and Gerritse R.G. (1991) *Nitrate and phosphate leaching beneath irrigated horticultural systems*, In: Moore, I.D. (ed), *Modelling the fate of chemicals in the environment*, pp. 109-114.

Sharma M.L., Herne D.E., Kin P.G., and Byrne J.D.M. (1992) *Impact of urban lawns on nutrient contamination of an unconfined aquifer*, Urban Water Research Association of Australia, Research Report No 49, p. 86.

Townley L., Turner J., Barr A., Trefry M., Wright K., Gailitis V., Harris C. and Johnston C. (1993) *Interaction between Lakes, Wetlands and Unconfined Aquifers. Volume 3, Wetlands of the Swan Coastal Plain*, Water Authority of WA.

Water and Rivers Commission. (1997) *Environmental management of groundwater abstraction on the Gnangara Mound*, Annual Report to the Environmental Protection Authority, October 1995 to September 1996, Water and Rivers Commission.

Water and Rivers Commission. (1997) *East Gnangara Water Provisions Plan, Public Environmental Review*, 1997 ISBN 0-7309-7279-8.

Water Authority of WA. (1987) *Perth Urban Water Balance Study*, May 1987. ISBN 0 7244 6719 X.

Water Authority of WA. (1992a) *Environmental management of groundwater abstraction on the Gnangara Mound*, Triennial Report to the Environmental Protection Authority, October 1988 to September 1991, Water Authority of WA.

Water Authority of WA. (1992b) *Gnangara Mound vegetation stress study – results of investigations*, Report No. WG 127, Water Authority of WA.

Water Authority of WA. (1993) *Environmental management of groundwater abstraction on the Gnangara Mound*, Annual Report to the Environmental Protection Authority, October 1991 to September 1992, Water Authority of WA.

Water Authority of WA. (1994) *Environmental management of groundwater abstraction on the Gnangara Mound*, Annual report to the Environmental Protection Authority, October 1992 to September 1993, Water Authority of WA.

Water Authority of WA. (1995a) *Environmental management of groundwater abstraction on the Gnangara Mound*, Triennial Report to the Environmental Protection Authority, October 1991 to September 1994, Water Authority of WA.

Water Authority of WA. (1995b) *Review of Proposed Changes to Environmental Conditions, Gnangara Groundwater Resources* (Section 46). ISBN No. 0 7309 7231 3.

Water Corporation. (1994) *Inventory of Potential Water Supply Schemes*.

Western Australian Legislative Assembly. (1994) Select Committee on *Metropolitan Development and Groundwater Supplies*, WA Legislative Assembly, p. 286.

Western Australian Planning Commission. (1995) *Jandakot Land Use and Water Management Strategy*, ISBN No. 0 7309 5335 1.

Western Australian Planning Commission. (1992) *North West Corridor Structure Plan*.

Western Australian Planning Commission. (1994) *North East Corridor Structure Plan*.



