East Wanneroo
Land Use and Water Management Strategy

draft for public comment

November 2005
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East Wanneroo has been a mix of market gardening and rural uses with a rich and colourful history. There have been many changes in the northwest corridor and the City of Wanneroo as Perth continues to grow and expand.

The east Wanneroo community has raised many issues in relation to current water resource planning, allocation and licencing and the lack of strategic land use planning for the area. In particular, many sites set aside for horticultural uses were unable to access water. Clearly, some new direction was needed.

This draft Strategy examines these issues and proposes solutions to, the competing demands for groundwater, future land use and development, environmental protection and facilitates the continuation of a horticultural industry in Wanneroo.

Public consultation is an important part of the planning process and preparation of this draft Strategy.

A Community Consultative Committee, chaired by Member for Wanneroo, Dianne Guise, MLA has worked with the community to develop this draft Strategy.

I thank Dianne and her Committee for their excellent work in working with the community to develop this draft Strategy. The Strategy is now ready for its formal comment period.

I am pleased to be able to release this draft Strategy for public comment.

Hon Alannah MacTiernan MLA
Minister for Planning and Infrastructure
# Contents

- Ministers’ foreword .......................................................... iii
- Summary ................................................................................ v
  1 Overview and purpose ......................................................... 1
  2 Study area ........................................................................... 3
    2.1 Strategy aim and objectives ............................................ 3
  3 Background and community consultation ............................... 5
  4 Key land use planning and water resource management issues .... 6
    4.1 Groundwater management and environment .................... 6
    4.2 Horticulture and agricultural land use ........................... 16
    4.3 Future urban land use .................................................. 19
    4.4 Rural living subdivision ............................................... 22
    4.5 Tourism and heritage values ....................................... 22
  5 Proposed draft land use concept ............................................ 24
    5.1 Provide for new urban development in southern east Wanneroo ... 24
    5.2 New rural living areas ................................................ 32
    5.3 Protect Bush Forever sites and environmental values .......... 35
    5.4 Retain rural zoning in Carabooda/Nowergup and protect significant areas of basic raw materials .......... 38
    5.5 Establish a new Gnangara agricultural/horticultural precinct in State Forest 65 .................................................. 40
  6 Recommended actions ........................................................ 48
  7 Where to from here ............................................................ 49
    7.1 Strategy approval process ............................................. 49
  8 Implementation of strategy .................................................. 50

## Appendices

- Appendix 1: Community consultation on May 2004 preliminary discussion paper ............................................ 51
- Appendix 2: Community forum in November 2004 .................... 52
- Appendix 3: Strategy Committee structure ............................. 53
- Appendix 4: Planning Bulletin 63 Policy for Dealing with Potential Conflicts Between Residential Subdivision and Market Gardens in East Wanneroo .................................................. 54
- Appendix 5: Abbreviations ................................................... 60
- Appendix 6: Glossary .......................................................... 61
- Appendix 7: References ...................................................... 63
The 1992 North West Corridor Structure Plan and the City of Wanneroo’s 2000 Interim Local Rural Strategy have provided the planning framework for land use decision making in the east Wanneroo area. These and other government policies have promoted the retention of rural land in east Wanneroo for agricultural and horticultural purposes.

Since the preparation of these planning strategies and policies there has been enormous growth in the North-West Corridor and environmental changes over the Gnangara Mound resulting from lower rainfall.

Urban development is occurring in the east Wanneroo area and there are increasing land use conflicts and pressures for further change.

Community uncertainty, climate change and declining water table levels over the Gnangara Mound, impacts on the groundwater dependent ecosystems and public and private water supply and changing agricultural economics have all led to this review of future land uses and water resource management responses.

This draft Strategy proposes major land use changes in southern east Wanneroo from Rural to Urban and the establishment of a new agricultural and horticultural area in northern east Wanneroo to replace those areas lost to future urban development.

The detailed planning for these changes will occur as part of future structure planning of the proposed future urban precincts identified in this draft Strategy. Implementation will be by future Metropolitan Region Scheme amendments and City of Wanneroo town planning scheme amendments.

Along with this, more detailed investigation into the establishment of a new agricultural and horticultural area in northern east Wanneroo, based on the use of recycled water from the Beenyup and future Alkimos wastewater treatment plants is also required.

Land use changes and water management strategies need to be coordinated under the overall umbrella of sound management principles for the Gnangara Mound water resource.

The Gnangara Mound is a major part of the existing and future public drinking water supplies for the developing Perth metropolitan area and supports and protects environmental assets and values over much of the northwest Corridor.

There needs to be an overall water resource management plan for the Gnangara Mound to provide a holistic view that takes into account future land use changes, provision for public and private water supplies, pine plantation harvesting and environmental management.
1 Overview and purpose

The North-West Corridor Structure Plan (WAPC, 1992) provided a strategic planning framework based on information available at the time. This plan resulted in the current urban and urban deferred areas east of Wanneroo Road, the existing special rural zones and the remaining area in southern east Wanneroo retained in the rural zone for rural uses and landscape protection. In northern east Wanneroo, a basic raw materials area (Nowergup), an agricultural area (east Carabooda) and a rural/landscape protection area (east of Wanneroo Road) were identified.

Land use decision-making and planning policy at the State and local government levels have been based on the 1992 structure plan, and a major aim has been to control and limit the development and subdivision of the rural land. The objective has been to ensure that productive agricultural land is not fragmented, remains in suitable lot sizes, is available for existing and future agricultural/horticultural production and does not cause or exacerbate conflicts between incompatible land uses.

This policy approach has been implemented for the past 15 years based on the assumption that there are few constraints to using groundwater and rural zoned land for rural, agricultural and horticultural uses.

Due to climate change and lower rainfall, the situation now clearly is different and the overall planning and management of the Gnangara Mound groundwater resource is entering into a new phase where declining watertable levels and availability of groundwater are major issues and limiting factors affecting the whole community.

A land use and water resource management strategy is required for east Wanneroo and Gnangara Mound to provide a long-term framework for managing the land and water resources and the three major demands for groundwater – namely public drinking water supplies, private self-supply for agriculture/horticulture, and environmental water requirements.

Landowners in east Wanneroo have been seeking a resolution to complex land use and water management issues for many years.

The east Wanneroo rural area falls within the Wanneroo groundwater area and is managed by the Department of the Environment (DoE). Groundwater allocation within the Wanneroo groundwater area is divided into 10 sub-areas and is mostly fully allocated.

Traditionally, east Wanneroo has been a major centre of local economic and employment activity based around agricultural and horticultural land uses.
Although horticulture is a significant social and economic activity in Wanneroo, under the current lower-rainfall conditions and declining watertable levels over Gnangara Mound, there is little prospect of new water licences and allocations being made available to enable new horticultural uses and land to be irrigated or for existing uses to expand.

This draft strategy has been prepared with the input from a Steering Committee, Community Consultative Committee and technical group, and proposes a new strategic direction for land use planning and policy in east Wanneroo. It has been released for public comment for a six-week period.

The DoE and Water Corporation currently are carrying out other studies in relation to groundwater and environmental management issues on Gnangara Mound, including the use of a managed aquifer recharge scheme to supply recycled water to assist overall management of the land and water resources in east Wanneroo. These studies may influence the outcome of the final land use plan for east Wanneroo.

Your comments are sought on the proposed land use plan presented in this draft strategy.

The closing date for submissions is 27 January, 2006. A submission form is attached at the rear of this document.
2 Study area

The study area focuses on land zoned rural and reserved for parks and recreation in the Metropolitan Region Scheme (MRS) in east Wanneroo, from the northern areas of Carabooda and Nowergup through to Mariginiup and Gnangara, south of Flynn Drive. It also considers the context of land within the Wanneroo groundwater area in the urban, urban deferred and industrial zones and some areas of pine plantation in State Forest 65 (figure 1).

2.1 Strategy aim and objectives

Aim

To prepare a strategy for sustainable land use and water management in east Wanneroo by integrating the land use planning and development processes with groundwater planning and allocation objectives, the allocation of land for future development and agricultural uses, and the protection of basic raw materials, environmental values and landscape features, for the benefit of the whole community.

Objectives

The principal objectives of the strategy are to:

- provide a framework for land use decision-making that promotes the best use of limited water resources, productive agricultural lands and provides opportunities for future land development to achieve the desired environmental, economic and social outcomes for the benefit of the whole community;

- provide a framework for the continuation and enhancement of east Wanneroo’s contribution to the region’s economic development and employment opportunities;

- promote best management practices for land uses, rural agricultural/horticultural production and water usage;

- identify all relevant substantive planning issues, constraints and opportunities for rural land uses, alternative land uses and other forms of development;

- protect the significant wetlands and remnant vegetation, rural landscape, heritage and other conservation values; and

- improve and provide balanced land use planning and water resource management decision-making processes through better access to information, consultation and understanding between government agencies, landowners and community groups.
Study area boundary and the Metropolitan Region Scheme

Produced by Project Mapping Section, Mapping and GeoSpatial Data Branch, Department for Planning and Infrastructure on behalf of the Western Australian Planning Commission, Perth, WA, October 2005

NB: MRS detail is a simplification of zones and reservations as amended to July 2005

Legend
Reserved lands
- parks and recreation
- railways and port installations
- State forest
- waterways
- primary regional roads
- other regional roads
- public purposes

Zones
- urban
- urban deferred
- central city area
- industrial and special industrial
- rural
- private recreation

City of Wanneroo
City of Joondalup
City of Joondalup

East Wanneroo Land Use and Water Management Strategy
3 Background and community consultation

The East Wanneroo Land Use and Water Management Strategy Community Consultative Committee, established to ensure that community input is incorporated into the preparation of the draft strategy, released the East Wanneroo Land Use and Water Management Strategy - Preliminary Discussion Paper for a three-month public comment period in May 2004.

Three draft land use scenarios were presented to provide preliminary ideas and promote community discussion on possible options for future land use development and water management measures that might be appropriate for east Wanneroo.

A total of 432 submissions were received expressing a wide range of views, including:

- retention of the rural lifestyle and amenity – no future urban zoning;
- retention of the rural lifestyle but wanting some form of future rural subdivision;
- support for future urban zoning as in either scenario 1, 2 or 3, or combinations of the three;
- suggestions for additional urban areas in the Gnangara area; and
- protection of the environment and lakes.

More detailed information is given in appendix 1.

In addition to the comments received on the preliminary discussion paper, a community forum, chaired by Wanneroo MLA Dianne Guise, was held at the City of Wanneroo administration centre in November 2004 to progress community input to the draft strategy.

A new land use scenario was presented to the forum.

The 115 participants were presented with information from the DoE, Department of Agriculture, and Department for Planning and Infrastructure (DPI) and from a vegetable grower’s perspective. Participants were asked to consider the new land use scenario and list key issues under five topics:

- Topic 1 - Groundwater management and environment
- Topic 2 - Horticultural and agricultural land use
- Topic 3 - Possible future urban land use
- Topic 4 - Rural living subdivision
- Topic 5 - Tourism and heritage values

A summary of issues raised at the forum is given in appendix 2.
4 Key land use and water resource management issues

4.1 Groundwater management and environment

The Gnangara Mound groundwater resource is of strategic importance for public and private water extraction and maintenance of natural groundwater-dependent ecosystems.

The mound’s groundwater resources, including the Wanneroo groundwater area, are contained in three aquifers – Superficial, Leederville and Yarragadee. Of the three, the Superficial aquifer provides most water for the public drinking water supply, agriculture, industry, domestic and stock purposes. The confined Leederville and Yarragadee aquifers generally are reserved for future public drinking water supplies and as drought-relief supplies (figure 2).

The study area falls within the Wanneroo groundwater management area, east of the Perth Coastal underground water pollution control area and west of the Gnangara underground water pollution control area.

The Gnangara Mound aquifers are recharged mostly by direct infiltration from rainfall and run-off located largely in the State forest areas in Wanneroo and Gingin and along the base of the Darling Scarp and Dandaragan Plateau.

In 2002, the Indian Ocean Climate Initiative prepared a discussion paper entitled Climate Variability and Change in the South West of Western Australia that predicts changing climatic conditions for the State towards lower rainfall, drier winters and by implication, less recharge of the mound by direct rainfall.

Winter rainfall in Perth has decreased by 15-20 per cent since 1970 (figure 3).

The total recharge into the mound and the storage of groundwater have declined significantly in the past 25 years (figure 4).

The Wanneroo Groundwater Management Plan outlines overall groundwater licences and allocation limits. About 2200 licences have been issued, using approximately 34 gigalitres (GL) per annum allocated for private self-supply, distributed between the 10 sub-areas in the Wanneroo groundwater area (figure 5 and table 1).

The resources of the groundwater area have been allocated fully or are approaching full allocation in most of the sub-areas.

Planning and management of land use on Gnangara Mound is entering a new paradigm where lower rainfall and declining watertable levels, access to and availability of groundwater, and environmental water requirements are major constraints affecting public and private users of groundwater, and future allocations.
**Groundwater resources of the Gnangara Mound**

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**Figure 2**

Source: Department of Environment, 2004

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**Figure 3**

Perth annual rainfall, 1900-2005

Source: Department of Environment, 2004
Groundwater depletion relative to 1979 (GL) for Gnangara Mound (Sy 0.2) (GL).


**Table 1: Wanneroo groundwater area sub-areas and allocations**

<table>
<thead>
<tr>
<th>Sub-Area</th>
<th>Sustainable Limit kL/year</th>
<th>Licensed Allocation kL/year</th>
<th>% of Limit (1)</th>
<th>Balance available for licensing kL/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adams</td>
<td>2 100 000</td>
<td>1 149 293</td>
<td>55</td>
<td>950 707</td>
</tr>
<tr>
<td>Carabooda</td>
<td>8 750 000</td>
<td>8 541 295</td>
<td>98</td>
<td>208 705</td>
</tr>
<tr>
<td>Carramar</td>
<td>2 400 000</td>
<td>1 414 585</td>
<td>59</td>
<td>985 415</td>
</tr>
<tr>
<td>Jandabup</td>
<td>200 000</td>
<td>200 990</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Joondalup</td>
<td>2 100 000</td>
<td>1 710 365</td>
<td>81</td>
<td>389 635</td>
</tr>
<tr>
<td>Lake Gnangara</td>
<td>10 000 000</td>
<td>9 581 275</td>
<td>96</td>
<td>418 725</td>
</tr>
<tr>
<td>Marigniup</td>
<td>5 400 000</td>
<td>5 310 425</td>
<td>98</td>
<td>89 575</td>
</tr>
<tr>
<td>Neerabup</td>
<td>2 500 000</td>
<td>2 632 210</td>
<td>105</td>
<td>0</td>
</tr>
<tr>
<td>Nowergup</td>
<td>2 750 000</td>
<td>2 802 665</td>
<td>102</td>
<td>0</td>
</tr>
<tr>
<td>Pinjar</td>
<td>2 000 000</td>
<td>1 205 230</td>
<td>60</td>
<td>794 770</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38 200 000</strong></td>
<td><strong>34 548 333</strong></td>
<td></td>
<td><strong>3 837 532</strong></td>
</tr>
</tbody>
</table>

Source: Department for Planning and Infrastructure, 2005

**Table 2: Groundwater use**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Allocation (GL)</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horticulture</td>
<td>21</td>
<td>62</td>
</tr>
<tr>
<td>Recreation (ovals, parks, golf courses)</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Irrigated pasture</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Industry</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Turf farms</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Domestic (garden bores)</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

4.1.1 Groundwater demand

Horticulture is the largest private user of groundwater in the Wanneroo groundwater area, using 62 per cent of available water mostly for vegetable production. Recreation uses 10 per cent for irrigation of ovals, parks and golf courses. Irrigated pasture also uses 10 per cent.

Industry, currently concentrated in the southern most portion of east Wanneroo, uses 8 per cent (3 GL per year). Turf farms and domestic use, which includes unlicensed garden bores, each use 5 per cent (2 GL per year) (table 2).

In recent years, demand for licences to take groundwater has increased and it is becoming evident that the rise in private bore abstraction from current approved levels requires stringent management and may not be sustainable.

The Wanneroo groundwater area does not include the public water supply areas and State Forest 65 to the east in which the Water Corporation public water supply borefields and the pine plantations use groundwater.

Public water supply comes mostly from the Wanneroo and Pinjar public water supply wellfields within the Gnangara underground water pollution control area and uses 156 GL per year. Due to lower watertable levels, the Water Corporation has shut a number of production bores in these wellfields. It now is looking at a wide range of options to meet the increasing demand for scheme water, such as new borefields in the Yarragadee aquifer in the South-West of the State, Leederville and Yarragadee aquifers in the Gingin and Jurien groundwater areas, and desalinated sea water (table 3).

4.1.2 Wanneroo groundwater area and sub-area boundaries

The current Wanneroo groundwater area and sub-area boundaries are based on property boundaries and do not reflect the land use pattern, hydrogeology and environmental systems in the area (figure 5).

A review of the sub-area boundaries and allocation limits along with studies to better understand the environmental water requirements to support groundwater-dependent ecosystems (ie wetlands, flora and fauna, ecological processes) is being undertaken by the DoE, using information from the Perth Region Aquifer Modelling System.

This review also relates to another DoE study, which involves a review of the environmental conditions imposed by the Minister for Environment on management of the Gnangara Mound water resources. The study is being undertaken under section 46 of the Environmental Protection Act 1986 and will focus on the allocation of groundwater from the mound for public drinking water supplies, environmental water requirements and for private self-supply (eg horticulture, industry and domestic uses).
## Key land use planning and water resource management issues

Table 3: Public water scheme and allocations

<table>
<thead>
<tr>
<th>Scheme</th>
<th>Aquifer</th>
<th>Water quantity (GL)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gwelup</td>
<td>Superficial</td>
<td>5.28</td>
</tr>
<tr>
<td></td>
<td>Mirrabooka</td>
<td>3.25</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>7.98</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>16.50</strong></td>
</tr>
<tr>
<td>Mirrabooka</td>
<td>Superficial</td>
<td>4.26</td>
</tr>
<tr>
<td></td>
<td>Mirrabooka</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>7.22</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>21.00</strong></td>
</tr>
<tr>
<td>Jandakot</td>
<td>Superficial</td>
<td>2.64</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>1.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>5.70</strong></td>
</tr>
<tr>
<td>Wanneroo</td>
<td>Superficial</td>
<td>7.20</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>9.10</td>
</tr>
<tr>
<td></td>
<td>Yarragadee</td>
<td>11.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>27.40</strong></td>
</tr>
<tr>
<td>Pinjar</td>
<td>Superficial</td>
<td>4.00</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>5.10</td>
</tr>
<tr>
<td></td>
<td>Yarragadee</td>
<td>6.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>15.10</strong></td>
</tr>
<tr>
<td>Lexia</td>
<td>Superficial</td>
<td>3.83</td>
</tr>
<tr>
<td></td>
<td>Mirrabooka</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>4.00</strong></td>
</tr>
<tr>
<td>Neerabup</td>
<td>Superficial</td>
<td>16.80</td>
</tr>
<tr>
<td>(Quinns and Whitfords)</td>
<td>Leederville</td>
<td>12.20</td>
</tr>
<tr>
<td></td>
<td>Yarragadee</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>32.30</strong></td>
</tr>
<tr>
<td>Other artesian</td>
<td>Yarragadee</td>
<td>33.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>33.00</strong></td>
</tr>
<tr>
<td>Yanchep</td>
<td>Superficial</td>
<td>1.00</td>
</tr>
<tr>
<td>By aquifer</td>
<td>Superficial</td>
<td>55.87</td>
</tr>
<tr>
<td></td>
<td>Mirrabooka</td>
<td>3.70</td>
</tr>
<tr>
<td></td>
<td>Leederville</td>
<td>43.04</td>
</tr>
<tr>
<td></td>
<td>Yarragadee</td>
<td>53.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>156.0</strong></td>
</tr>
</tbody>
</table>

Note: * 1 GL = 1,000,000 kilolitres
4.1.3 Better management of existing groundwater and water resources

The DoE views it as most unlikely that the large amounts of groundwater required to use all the land zoned general rural or rural resource (which in Wanneroo District Planning Scheme (DPS) 2 is about 8077 ha of which only 2500 ha (31 per cent) is used for irrigated horticulture) in the study area ever would be available to enable any more land to be used for productive irrigated horticulture.

Management of Gnangara Mound and allocation of groundwater resources need to be based on understanding the resource and managing private and public water abstraction within its sustainable limits.

Best agricultural land management, water management and land use planning practices are required to ensure that the mound’s land and water resources are managed to provide for the environment and public and private water supplies in east Wanneroo.

Note: Most sub-areas are near allocation limits. Distance to wetlands is a limiting factor for groundwater abstraction in some sub-areas. Allocations for these sub-areas currently are under review.

Best management practice includes more efficient irrigation practices by the horticultural industry, management of water use by public and private users and total water management practices in the design of new urban areas.

The DoE and Department of Agriculture have introduced programs, such as Water Wise on the Farm, to provide information and educate irrigators on how to better manage soils and crops and use groundwater more efficiently.

The DoE has initiated a pilot metering program to monitor how much groundwater is used in the irrigation of horticultural crops in Carabooda. This program, and other initiatives such as more vigilant management of existing water licences and allocation practices, and revision of the Wanneroo groundwater area boundary and sub-area boundaries will help to provide better understanding and management of the total groundwater resource.

In addition, the management of pine plantation thinning and harvesting to maximise groundwater recharge, managing understorey vegetation, fire regimes and public abstraction, and undertaking further studies of the Gnangara Mound water resource (such as investigating broader management objectives and preparing a water resource management plan) contribute to better understanding and use of the mound’s water resources.

### 4.1.4 Wetlands and remnant vegetation

East Wanneroo lies on the western portion of Gnangara Mound and falls within the Spearwood and Bassendean soil associations. The landform comprises a prominent dunal ridge east of Wanneroo Road containing Karrakatta soils, smaller inland ridges and slopes, and an inter-dunal swale interface between the Spearwood and Bassendean soil systems along which the low-lying east Wanneroo wetlands (comprising the Herdsman soil association) and seasonally inundated areas are found. Limestone karst landforms and ridges are found in Carabooda/Nowergup in the north.

The area contains many pockets of remnant natural vegetation, with some sites designated as Bush Forever (WAPC, 2000). Some landowners see protection of regionally significant vegetation as a constraint to future development while others consider it fundamental to the protection of east Wanneroo’s environment and landscape character.

The main environmental and landscape features are the chain of linear and circular wetlands and associated vegetation and wildlife of lakes Pinjar, Adams, Neerabup, Carabooda, Marginiup, Jandabup, Gnangara, Yonderup, Nowergup, Coogee Springs, Neerabup, Pipindinny, Beonaddy, Wilgarup and the limestone karst landforms and remnant tuart vegetation to the east of Wanneroo Road and the Gibbs Road area of Carabooda/Nowergup.
Wetlands in the study area have been mapped and classified by geomorphic form and management category in accordance with the Environmental Protection Authority’s (EPA) criteria. The EPA is considering new wetland assessment criteria that will have an influence on future wetland assessment and management category classification (figure 6).

Lower watertable levels are a threat to the survival of the remaining areas of native vegetation, wetlands and wildlife populations that are dependent on groundwater.

The protection of the chain of wetlands and the remaining significant native flora and fauna, urban water drainage and management of nutrient run-off into wetlands, buffer distances around wetlands and management of acid sulfate soils are major issues recognised at the strategic planning level and will need to be considered more fully during the structure planning stage that will result in the preparation of detailed environmental management plans.

4.1.5 Acid sulfate soils

Acid sulfate soil is the common name given to naturally occurring soil and sediment containing iron sulfates. These sulfates generally are found in a layer of waterlogged soil or sediment and are benign in their natural state. However, when disturbed and exposed to air, they oxidise and produce sulfuric acid, iron precipitates, arsenic and concentrations of dissolved heavy metals such as aluminium and iron. Release of dissolved acids and metals can cause harm to the environment and infrastructure, and when in contact, to people or animals.

Planning Bulletin 64 Acid Sulfate Soils (WAPC, 2003) contains planning guidelines for and mapping of these soils in Western Australia.

To ensure subdivision and development of land containing acid sulfate soils is planned and managed to avoid potential and adverse effects on the natural and built environment, the planning bulletin requires that a preliminary site assessment is undertaken to determine the presence or absence of these soils, before zoning changes are approved.

Where acid sulfate soils are found, a detailed site assessment and a soil management plan must be prepared by proponents, and approved by the responsible authorities, to determine the capacity of land to be able to be used for the proposed land use. If the soils can be managed, conditions will be imposed on subsequent subdivision or development.

East Wanneroo has areas of acid sulfate soils, which must be considered in the planning for future land use changes. This issue would need to be resolved before amendments to change the zonings are approved. Where it is
Geomorphic wetlands, EPP wetlands, remnant vegetation and Bush Forever sites

Legend

- Conservation
- Multiple use
- Resource enhancement
- Remnant vegetation - native vegetation
- Remnant vegetation - non-vegetated
- Remnant vegetation - water body

EPP wetland
Bush Forever site
Metropolitan Region Scheme boundary
Local government boundary
Study area boundary

Produced by Project Mapping Section, Mapping and Geospatial Data Branch, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth, WA, October 2005.

Cadastre and administrative boundaries based on information provided with the permission of DLIPFA, 2003.
Acid sulfate soils

Figure 7

Produced by Project Mapping Section, Mapping and Geospatial Data Branch, Department for Planning and Infrastructure on behalf of the Western Australian Planning Commission, Perth, WA October 2005

Soil data supplied by Department of Environment, Western Australia.

Legend
- Moderate to high risk of acid sulfate soils occurring within 3m of natural soil surface
- Low to moderate risk of acid sulfate soils occurring within 3m of natural soil surface
- Nil to low risk of acid sulfate soils occurring within 3m of natural soil surface

Cadastre and administrative boundaries based on information provided with the permission of DLPI 23-2003

GEOCENTRIC DATUM OF AUSTRALIA
demonstrated that these soils can be managed to the satisfaction of the responsible authorities, subsequent structure planning will need to incorporate detailed development strategies for their management (figure 7).

Further technical information on acid sulfate soils is available from the DoE.

4.2 Horticultural and agricultural land use

4.2.1 State horticultural production

Horticulture in Western Australia is undertaken mostly on the sandy soils of the Swan Coastal Plain. According to the Australian Bureau of Statistics (ABS), suitable land on the plain is limited and in 2001, about 16 445 ha were in production with at least 2125 ha in Wanneroo. A breakdown of vegetable production on the plain is shown in table 4. Some of these production areas now have been earmarked for urban development.

Relative to other areas in the region, Wanneroo is recognised as having high-quality soils and water, a climate which enables year-round production of a range of horticultural crops, low frost risk, existing, well-developed infrastructure and close proximity to workforce and markets (figure 8).

In 1992, the Western Australian Water Resource Council forecast that by the year 2015, a total of 8780 ha of land under horticulture would be required to meet growing domestic food supply requirements and export supply.

4.2.2 The importance of Wanneroo

Horticulture and agriculture are significant contributors to the economic and social fabric of the Wanneroo area. These traditional land uses and the association with early migrant settlement have given Wanneroo a rich history and cultural and community identity.

<table>
<thead>
<tr>
<th>Location</th>
<th>Total horticulture area (ha)</th>
<th>Vegetables (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swan Coastal Plain</td>
<td>16 445</td>
<td>5290</td>
</tr>
<tr>
<td>Wanneroo</td>
<td>2125</td>
<td>1429</td>
</tr>
<tr>
<td>Kwinana</td>
<td>596</td>
<td>211</td>
</tr>
<tr>
<td>Rockingham</td>
<td>450</td>
<td>459</td>
</tr>
</tbody>
</table>

Source: Department of Agriculture Western Australia, 2005.
There are many direct and indirect benefits from horticulture and agriculture in the form of provision of fresh food, income, employment, tourism, cultural identity, and their contribution to State and national export markets.

In terms of State production, the Wanneroo area contributes at least $98 million, which is about 2 per cent of total State production of $4.38 billion and 35 per cent of total metropolitan production (ABS, 2001).

The area’s total value-added production (value beyond the farm gate) was at least $239 million. It employs between 4000 and 7000 people.

Wanneroo has about 30 per cent of the total metropolitan horticultural production area and about 5 per cent of the State area. Significant sectors are nurseries, cut flowers and turf farms, and vegetable production.
Wanneroo accounts for about 22 per cent of the State’s total nursery, flower and turf production by value and about 46 per cent of the Perth metropolitan area by area.

Wanneroo produces about 13 per cent of the total State vegetable production and more than 55 per cent of the States production of broccoli, lettuce and strawberries and between 70 and 100 per cent of the Perth metropolitan area’s production of strawberries.

Wanneroo is a major producer of fresh agricultural produce to the Perth market, especially annual horticultural crops (strawberries, lettuce, cauliflower, broccoli, tomatoes), perennial horticultural crops (avocados), and poultry meat.

Table 5 indicates the relative importance in land use terms for many of these niche crops.

The dislocation of agriculture and horticulture from the growing urban fringe has occurred since the early settlement of Perth. From the 1970s, there has been significant dislocation in areas of market gardens around Osborne Park, Tuart Hill, Stirling, Balcatta and progressively northwards, as urban development has occurred.

### Table 5: Production figures for selected enterprises in the Wanneroo area indicating State and regional significance

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Measure</th>
<th>WA</th>
<th>Perth Metro</th>
<th>Wanneroo</th>
<th>Wanneroo/State %</th>
<th>Wanneroo/Perth Metro %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total agriculture</td>
<td>Value $</td>
<td>4.38 billion</td>
<td>280.6 million</td>
<td>98.6 million</td>
<td>2</td>
<td>35</td>
</tr>
<tr>
<td>Total horticulture</td>
<td>Area (ha)</td>
<td>34 788 ha</td>
<td>6,085</td>
<td>1803</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Total nurseries, flowers and turf</td>
<td>Area (ha)</td>
<td>2197</td>
<td>702</td>
<td>323</td>
<td>15</td>
<td>46</td>
</tr>
<tr>
<td>Cultivated turf</td>
<td>Area (ha)</td>
<td>382</td>
<td>260</td>
<td>114</td>
<td>30</td>
<td>44</td>
</tr>
<tr>
<td>Total vegetables</td>
<td>Area (ha)</td>
<td>11 464</td>
<td>2259</td>
<td>1184</td>
<td>10</td>
<td>52</td>
</tr>
<tr>
<td>Broccoli</td>
<td>Area (ha)</td>
<td>438</td>
<td>291</td>
<td>263</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>Area (ha)</td>
<td>1211</td>
<td>160</td>
<td>71</td>
<td>6</td>
<td>45</td>
</tr>
<tr>
<td>Lettuce</td>
<td>Area (ha)</td>
<td>467</td>
<td>347</td>
<td>260</td>
<td>56</td>
<td>75</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>Area (ha)</td>
<td>360</td>
<td>158</td>
<td>147</td>
<td>41</td>
<td>93</td>
</tr>
<tr>
<td>Beans</td>
<td>Area (ha)</td>
<td>308</td>
<td>53</td>
<td>43</td>
<td>14</td>
<td>80</td>
</tr>
<tr>
<td>Strawberries</td>
<td>Area (ha)</td>
<td>122</td>
<td>89</td>
<td>89</td>
<td>73</td>
<td>100</td>
</tr>
<tr>
<td>Avocados</td>
<td>Value $</td>
<td>6.1 million</td>
<td>2.4 million</td>
<td>2.0 million</td>
<td>34</td>
<td>83</td>
</tr>
<tr>
<td>Poultry</td>
<td>Value $</td>
<td>85.4 million</td>
<td>60 million</td>
<td>39.2 million</td>
<td>65</td>
<td>46</td>
</tr>
</tbody>
</table>

Note: ABS statistics significantly under-report the value and area of horticultural production. A study for Agriculture Western Australia by Van Gool and Runge (1999) contained a comparison of ABS statistics and the results of a detailed horticultural study undertaken of the Peel Region. This study revealed that ABS statistics under-reported the gross value of horticultural production by about 56 per cent for vegetables and garden horticulture and 12 per cent for fruit production. In terms of land use, the ABS under-reported the area of production by about 53 per cent for vegetables and garden horticulture and 3 per cent for fruit.
Until recently, it was thought that horticulture could relocate either north or south of the Perth Metropolitan Region with ease, but this no longer is the case, as water in Gingin and many other areas now is allocated fully and experiencing similar issues to Wanneroo with increasing competition for water in the face of climate change.

Horticulture is a significant land use activity in east Wanneroo, but irrigated horticulture, although intensive, occupies only about one-third of the 8077 ha of land zoned general rural and rural resource in Wanneroo DPS 2.

The area is characterised by a large number of small rural lots (2-4 ha) with lot sizes progressively larger to the north. These small lots are used for the intensive production of high-value, niche crops with the average value of production per hectare being among the highest in the State. Where growers have sought to expand, buying or leasing adjacent or nearby land parcels has provided only limited options.

Although some growers may be prepared to invest in more water-efficient irrigation systems and best land management practices, it is unlikely that large amounts of groundwater will be available for the establishment of new horticultural land uses, expansion of existing uses or other groundwater-dependent rural land uses.

Ageing rural landowners, high value of rural land, small lot sizes, changing agricultural/horticultural economics and markets, a limited and declining groundwater supply, conflicts with existing special rural zones and expanding residential development are cited as some of the issues facing the continuance and expansion of the horticultural industry in east Wanneroo, especially in the part of east Wanneroo south of Flynn Drive.

4.3 Future urban land use

It is recognised that quality horticultural land in close proximity to urban populations is a limited resource. For many years, much of east Wanneroo has been zoned rural because of State and local government planning policies, e.g. Statement of Planning Policy 2.5 Agriculture and Rural Land Use Planning (WAPC, 2002), promoting the retention of productive rural zoned land and agricultural/horticultural land uses and not supporting subdivision of productive rural land.

While this may have been justified in the past, a range of factors need to be considered in determining the future direction for land use planning policy for east Wanneroo.
Recent population forecasts for the City of Wanneroo estimate that the population will grow from 107,820 in June 2005 to 147,000 in 2011, and to 217,000 in 2021 (Forecast id:consultants, 2003).

The population of the north-west corridor was 240,188 in 2001, increasing to 245,365 in June 2002 and projected to reach 429,400 by 2031 (DPI, 2003).

Population growth is occurring at a rapid rate. The coastal strip west of Wanneroo Road has an ample medium-term supply of land zoned urban and urban deferred. Currently, east Wanneroo has about 1,100 ha of undeveloped land already zoned urban or urban deferred.

Even though the supply of urban land is adequate for the medium term, there are a range of urban planning, environmental, social and economic arguments relating to the advantages and disadvantages associated with any proposal to change the land use from rural to urban in southern east Wanneroo in the longer term.

A shift away from the traditional horticultural land uses and this economic and employment base would have a significant social and economic impact on east Wanneroo that would need to be managed over the medium to long term.

Arguments for proposing long-term urban in southern east Wanneroo promote the growth model in Network city: community planning strategy for Perth and Peel (WAPC, 2004). Its aims are to achieve a compact city structure resulting in more efficient use of infrastructure, road and transport systems and energy, and provide connected urban growth, employment centres and transport. Future urban population would be close to future employment at Neerabup industrial area and the expanding Wangara and Malaga industrial areas.

Some very compelling environmental arguments favour a long-term change from rural to urban. The impact of climate change is a major factor and it is clear from current research that lower rainfall over the past 30 years, and the
past eight years in particular, has resulted in lower recharge of Gnangara Mound, declining watertable levels and less groundwater available to satisfy the three major demands – public drinking water supplies, the environment, and private self-supply predominantly for horticultural and agricultural uses.

Under the current water allocation and licence system, horticulture and agriculture in east Wanneroo will not be able to expand, and anecdotal reports from growers and industry sources suggest the number of growers on small lots will decline from natural attrition and market forces.

Current water allocation limits in the Wanneroo groundwater area, the severe impact of lower rainfall and the corresponding detrimental impact on the environmental values of Gnangara Mound may result in changes in future public and private water licensing and allocation policy to focus on less abstraction from the superficial aquifers on the mound. These factors pose major constraints to the future viability of southern east Wanneroo’s agricultural/horticultural industry that is dependent on a limited and declining water supply from the superficial aquifer.

The possible longer-term relocation of the agricultural/horticultural industry to northern areas, using managed aquifer recharge for a water supply scheme, would provide security for the industry to remain in close proximity to Perth metropolitan urban centres. In association with the establishment of a new northern agricultural area, a change in land use from rural to urban in the south of the study area would help to buffer the declining watertable levels by providing urban water recharge. Also, a managed cessation of private self-supply for horticulture may help to achieve long-term protection of the Wanneroo lakes system, remnant vegetation and improved groundwater quality.

Social arguments relate to existing land use conflicts between horticulture and encroaching urban development and the existing special rural development, small, inefficient lot sizes, market changes and ageing rural producers opting to leave the industry, and the aspirations of many landowners for more rural subdivision opportunities.

Economic arguments relate to the changing structure of horticultural markets and product supply chains favouring efficient, large-scale horticultural production that can compete with overseas and interstate products for domestic and export markets. There also are high costs involved to change from existing land and irrigation management practices to more efficient practices that growers may be required to adopt as a result of a declining watertable levels, the possibility of more stringent water licence conditions, increased monitoring of the use of groundwater for private irrigation, and/or possible reductions in existing water allocations.
4.4 Rural living subdivision

East Wanneroo has 18 special rural zones with lot sizes varying from 1-4 ha.

There are opposing arguments on the provision of small rural holdings of between 2000 sqm and 2 ha.

One is that it is a very inefficient use of land, infrastructure and public funds. The social services and amenities needed to support this lifestyle choice incur a high public cost borne by the broader community.

The other is that the predominant residential growth corridor is along the coast, west of Wanneroo Road, and east Wanneroo, being so close to the Perth central business district, the coast and other services and facilities, is ideally located to provide for rural smallholdings and this lifestyle choice.

From community consultation, it is clear rural living on a range of lot sizes is considered to be a legitimate lifestyle choice and appropriate for some areas in east Wanneroo. Rural living helps to protect rural landscape values and remnant native vegetation, and can contribute to environmental rehabilitation of degraded rural lands. It also is a buffer between rural uses and urban residential areas. Full-scale urban development was not a favoured option at the November 2004 community forum for the whole of east Wanneroo.

However, at some point in the future (eg 20-plus years), it is possible that existing special rural zones and any new rural living zones may be identified for further urban development, particularly if there is significant landowner support for such a change.

Structure planning and subdivision design for new rural living areas may need to bear this in mind and allow for future road and public transport connections through rural living areas.

4.5 Tourism and heritage values

East Wanneroo contains a variety of rural land uses, heritage features and landscapes and it is important to identify, protect, enhance and promote its cultural and rural landscape character.

Tourism opportunities for the rural and horticultural areas are outlined in the Wanneroo Tourism Strategy (2004-2008), which concentrates on developing tourism across the City of Wanneroo. It considers the rural precincts as one of the key features of the city which differentiates it from comparable regions which are in semi rural locations.
The tourism strategy draws on research, which identifies growing trends with
visitors to seek out authentic and conservation experiences and the link with
current rural areas across the City of Wanneroo.

Carabooda and Nowergup have some significant rural karst landscapes,
containing large remnant tuarts, wetlands and other native vegetation along
with built heritage features and values, such as the historic lime kilns.

The value of this rural area as a recreational and tourism resource will be
enhanced further by the urbanisation of the north-west corridor. The location
of this huge population will create a market in immediate proximity to the rural
area, which may enhance its tourism opportunities.

This is the main theory behind the North Wanneroo Rural Way Project. Part of
the tourism strategy, this project aims to “develop the region as a viable
economic resource whilst maintaining its rural integrity, plus to promote the
rural precinct as a high quality and unique rural region of Western Australia”

The project currently is being progressed by a community steering committee
and task force. Some of the project’s concepts have many synergies with those
proposed in this strategy.

How private landowners manage the rural landscape is an important issue in
relation to scenic values and tourism appeal. If agriculture and horticulture
continue to be displaced from the southern portion of the study area to
Carabooda/Nowergup, and if a new agricultural/horticultural precinct is
established in the pine plantation, this also may create complementary tourism
opportunities.

This strategy proposes the Carabooda/Nowergup area remains zoned rural and
an area east of Wanneroo Road (including the remnant tuart and some karst
areas) be included in a rural living/landscape protection area. This will allow for
future complementary rural subdivision (with the option of using cluster-style
subdivision design) in appropriate locations, and the protection of landscape
values.
5 Proposed draft land use concept

This strategy proposes major land use changes from rural to urban deferred in the area south of Neaves Road. In concert with these changes, it is recommended a new agricultural/horticultural precinct be established in northern east Wanneroo on land in State Forest 65 (figure 9). The new precinct will provide a large, well-designed area that can adopt world’s best practice to provide certainty for agricultural/horticultural uses with secure land and water use rights. It is recommended that the new precinct is based on using recycled water from the Beenyup and/or future Alkimos waste water treatment plants and is independent of rainfall for its water supply.

Proposed land use change from rural to urban needs to be managed over the medium to long term to minimise the social and economic impacts of the gradual loss of and change from active agricultural/horticultural production in the southern areas of east Wanneroo.

The principal elements of the proposed land use plan presented for public comment are:

5.1 Provide for new urban development in southern east Wanneroo

The rationale for proposing new urban areas in southern east Wanneroo is part of a concept to provide guidance for long-term land use planning and certainty for all landowners in the face of changing climatic trends, long-term planning for secure private and public water supplies, changing social and demographic factors and changing agricultural/horticultural production practices and market trends.

There are few physical constraints to urban development in the rural areas of southern east Wanneroo apart from the need to protect its wetlands, areas of significant remnant vegetation, and to manage watertable levels, acid sulfate soils and drainage for new residential areas. All services are available nearby and the area is close to the existing regional road network.

It is proposed that the change in land use be managed by dividing the area into urban precincts, in which development could be staged over a five to 20-year time frame. Logically, those precincts closest to existing infrastructure and residential areas should be developed first.

The logical order of development may be from west to east in defined precincts, but implementation very much will depend on landowners and financial agreements to participate in and prepare town planning scheme amendments and local structure plans for the defined precincts.
Any changes in land use to urban or rural living also need to be timed and located appropriately and not result in isolated new residential communities or unacceptable land use conflicts with existing rural/horticultural land uses.

The delivery of new urban land also depends on the outcome of more detailed investigations into the suitability for urban development, regional, district and local structure planning, and demonstration that all planning and environmental considerations can be achieved.

The orderly staging of the conversion of rural land to urban deferred and then to urban zoned land over the medium to long term will need to be managed through structure planning and MRS and town planning scheme (TPS) rezoning processes. Once the planning framework has been determined, the Western Australian Planning Commission (WAPC) will prepare amendments to the MRS and the City of Wanneroo will prepare DPS 2 amendments to rezone land from rural to urban.

District and local structure planning will determine detailed urban form, subdivision layout and density, population capacity, roads, transport, public transport requirements, service infrastructure, school sites, retail areas, wetland protection and buffer areas, conservation, protection of remnant vegetation and open space requirements, acid sulfate soil and total water management measures (effluent and stormwater disposal, water supply and groundwater, and wetland water level).

Any large-scale urban development in southern east Wanneroo would fit the connected Network City model, with Wanneroo Road as a strong transport link and possibly new north-south transport links through the area. Detailed regional and local road and transport planning is a major issue to be resolved as part of future structure planning for new urban precincts.

Structure planning will need to be undertaken as a collaborative effort between State and local government and landowners.

Future urban proposals may provide guidance and more certainty for some landowners but also may contribute to landbanking and speculation, and the non-productive use of existing rural zoned land for non-agricultural uses until land is required for urban purposes. Some existing rural uses, such as nurseries, chicken farms and mushroom farms, may remain and be buffered from proposed urban development until they cease, negotiate incentives to move (eg land swaps) or it is economically viable to relocate.

East Wanneroo is a greenfield site and there are many opportunities for innovative urban design and the creation of new communities that incorporate sustainable urban form, mixed density areas, and best practice environmental and landscape management measures to protect the area’s significant features.
5.1.1 Infrastructure and servicing

The provision of services (power, water supply, sewerage and wastewater disposal) along with local and regional road infrastructure are part of the urban development process.

All services are available nearby and the area is in close proximity to the regional road network. Further local and regional road planning will need to be undertaken to consider the transport needs and links to and from the proposed new urban areas.

It needs to be recognised by the east Wanneroo community that new and upgraded local and regional roads are needed as part of future urban development in the area.

In the past, planning for new local and regional roads in east Wanneroo has been problematic. The East District Wanneroo Transport Study (Sinclair Knight, 1994) was commissioned to assess future transport needs. It modelled the North-West Corridor Structure Plan and considered four scenarios, recommending scenario 2 revised option C. The study did not consider possible new urban areas as proposed in this strategy.

The WAPC’s 2002 Freight Network Review 2nd Congress (Working Group 2) indicated the need for a future regional north-south transport link to Neerabup (Flynn Drive) industrial area.

Transport requirements, based on an agreed proposed land use plan, for local, regional and public transport is a major issue that requires detailed investigation as part of future more detailed structure planning.

Subject to detailed investigations, there appears to be two options for a major regional road alignment.

One alignment is on the eastern portion of the existing rural zone that would use the existing Sydney Road alignment wherever possible, but would require a link through private property to connect to Neaves Road in the north and to Alexander Drive in the south.

The second option for a regional road alignment, and one that is favoured by the community, is through State Forest 65. This option would require modification to the priority 1 source protection area designation and is dependent on Government decisions and investment in alternative future water supply sources. The Gnangara underground water pollution control area is a significant contributor to Perth’s public drinking water supply and will continue to be so. However, this option may be open for discussion in the longer term.
Due to the uncertainty about a future road alignment through the eastern portion of east Wanneroo, it is proposed to retain the rural zoning on land generally east of Sydney Road until future detailed transport and structure planning determine regional and local road requirements (figure 9).

5.1.2 Management of land use conflicts between rural and urban uses and within urban zones

Until detailed structure planning is undertaken, and land is developed for residential purposes, horticulture will continue in southern east Wanneroo.

However, conflicts between rural and urban land uses do occur and will need to be managed, and the planning system needs to implement policies at the structure planning, rezoning and subdivision stages to ensure land use conflicts are minimised.

The most difficult conflicts occur in east Wanneroo where land is zoned urban and residential development occurs in small stages due to smaller, fragmented land ownership. Landowners may continue to operate market gardens on urban zoned land until they wish to develop the land for residential purposes resulting in a patchwork of residential development and market gardening.

Planning Bulletin 63 Policy for Dealing with Potential Conflicts Between Residential Subdivision and Markets Gardens in East Wanneroo (WAPC, 2003) two sets of circumstances in east Wanneroo:

For residential subdivision in the vicinity of market gardens on land zoned rural in the MRS, the policy objectives are to:

- minimise the effects of residential development on market gardens which are practised in accordance with the relevant legislation, codes of practice and associated industry-specific guidelines;
- minimise the potential for complaints about market gardens from residential areas; and
- provide residents with acceptable standards of amenity in residential areas located in proximity to market gardens.

For residential subdivision and development in the vicinity of market gardens on land zoned urban or urban deferred in the MRS, the primary objective of the policy is to minimise the impact of existing market gardens on residential development and to encourage the progressive relocation and phasing-out of market gardens by urban development.

Planning Bulletin 63 is outlined in appendix 3.
Existing rural uses such as poultry and mushroom farms need to be recognised.

Other WAPC policies, such as Statement of Planning Policy 4.1 State Industrial Buffer Policy (1997) and Statement of Planning Policy 4.3 Poultry Farms Policy (1998) provide guidance for buffer areas around a variety of industrial uses and new residential development (nominal 500 m buffer) and rural-residential (nominal 300 m buffer) around poultry farms.

Policies need to be implemented and reviewed to ensure they suit emerging circumstances as land use in the rural areas changes.

5.1.3 Review the Wanneroo groundwater area boundary and water allocation and licensing system

The boundaries of the Wanneroo groundwater area and 10 sub-areas are based on cadastral boundaries and do not reflect the actual land use, proposed land uses or hydrogeological factors. They should be reviewed and changed.

Groundwater in all sub-areas mostly is fully allocated. No new water licences can be issued to landowners for establishing large new agricultural/horticultural uses in fully allocated or near-allocated sub-areas.

Rationalising the Wanneroo groundwater area boundaries, taking into account existing and proposed land use changes and hydrogeological factors and reducing the number of sub-areas may result in groundwater licences and allocations being managed over fewer, larger sub-areas allowing more flexibility in allocation to be introduced.

In particular, those sub-areas now zoned urban or industrial and in areas where development is approved should have all licences and allocations audited. Any unused licences and allocations could be traded or recouped and if appropriate, redistributed to other existing rural zoned areas within the larger sub-area boundary.

A DoE review and any future reviews need to be undertaken in closer liaison with planning agencies, so the department is more aware of existing and proposed strategic planning, structure planning, and land zoning and subdivision changes.

Where major land use change is proposed by this strategy, arrangements for water licences to be recouped to the DoE could occur; after allowing for allocations for the irrigation of public open space within an urban subdivision. This would be done at the time of structure planning and prior to approval for urban subdivision and commencement of works. Groundwater allocations
then can be retained by the department or reallocated to other areas where water is needed.

Along with a review of the Wanneroo groundwater area sub-areas, existing licences and allocations, proper processes need to be put into place between the DPI, DoE and City of Wanneroo to manage water licences through the land use rezoning and subdivision process.

5.1.4 Total water management of future urban development in southern east Wanneroo

The DoE and the Water Corporation consider that urban land uses have fewer adverse impacts on groundwater quality than the widespread use of fertilisers and chemicals by the existing mix of rural and horticultural uses.

The shallow groundwater table has exacerbated nutrient-leaching problems in some areas and declining watertable levels increase the risk of acid sulfate soil problems.

The removal of the pine plantations and storm water run-off from future urban areas could be managed to help groundwater recharge, which will enhance wetland water levels, help manage groundwater-dependent ecosystems and reverse the decline in wetland and groundwater levels.

New urban areas would need to be designed using best practice water-sensitive urban design to ensure storm water run-off meets required water quality standards and minimises the risk of nutrients and contamination entering wetlands and groundwater systems.

Innovative total water management and water-sensitive urban design needs to be incorporated as part of structure planning and subdivision design for new housing areas.

It is unlikely that domestic garden bores will be permitted in new residential areas in close proximity to wetlands.

However, innovative grey-water re-use for domestic gardens and shared neighbourhood bores may be a consideration in the structure planning and design of new urban areas.

These and other issues would need to be considered in the detailed structure planning and design and construction of new residential areas and infrastructure provision.
5.1.5 Watertable modelling of the draft land use concept

Using the Perth Region Aquifer Modelling System 2.1 and 3.1 in two phases, the DoE has modelled the impact of the draft land use changes along with variations in Water Corporation drinking water abstraction, Forest Products Commission pine clearing and thinning program and rainfall estimates from years 2002 to 2020 to determine the effect on the watertable.

The first phase of the modelling considered only the staged change in land use from rural to urban. It shows that with a small increase in urban land use, as in scenario 1 of the preliminary discussion paper, there is negligible effect on groundwater levels over the modelling period from 2002 to 2010 and that the watertable will continue to fall due to the overriding effect of a decline in rainfall over that period. However, as larger areas of rural land are converted to urban and current private licensed bore abstraction ceases over a larger area of rural east Wanneroo, by 2010, the watertable recovers from 0.5 m to 1.4 m over the whole of east Wanneroo.

The second phase of modelling considered a more realistic scenario in terms of timing and staging of new urban areas. It consisted of staged changes in land use and abstraction along with medium- to high-volume Water Corporation abstraction (150 GL/year), clearing and thinning of pines in accordance with the Forest Products Commission schedule to 2014, the continuation of the short-term average rainfall of 740 mm per annum and the cessation of most private bore abstraction as land use changes from rural to urban.

This modelling still showed a declining watertable trend (as lower rainfall is the main factor in the decline in groundwater levels over Gnangara Mound) until about 2012, when the effect of land use change (ie significantly reduced private licensed bore abstraction and pine clearing and thinning) is felt. By 2020, a recovery in watertable levels (from the minimums observed in the model) of between 0-3 m occurs over much of east Wanneroo (figure 10).
Figure 10: Landuse groundwater modelling
5.2 New rural living areas

This strategy retains the existing special rural zones and proposes new rural living areas, comprising various lot sizes, which will form rural buffers between new urban areas and help to conserve native vegetation and rural landscape values.

Although special rural zones may be considered an inefficient use of infrastructure and residents may come to expect the same provision of local government services as residential areas, it is recognised that rural living is a lifestyle choice many people aspire to and there is a strong market demand for rural living blocks of various sizes in east Wanneroo.

New rural living areas could use a range of existing town planning scheme rural zones, such as special residential (especially as a transition zone from urban to rural), or special rural (lot sizes from 1-4 ha), and rural community (lot sizes from 2000 sqm in the case of cluster-style subdivision to 4 ha for conventional subdivision) to provide more innovative rural subdivision solutions and a range of lot sizes.

New rural living areas are proposed south of Neaves Road between Lake Adams and the existing special rural zone to the east bordering the State forest at east Mariginiup (Meadowlands Estate); east of Lake Jandabup and to the south and south-east of Lake Mariginiup connecting to Lake Jandabup and along portions of Grisker/Badgerup roads (figure 9).

Potential new rural living/landscape protection areas also are proposed in the areas of remnant tuart and karst landforms in Carabooda/Nowergup just east of Wanneroo Road. Although currently zoned rural, these areas generally are not suitable for horticulture (viable large-scale areas) because of surface limestone and remnant vegetation (figure 9).

Rural living areas using the rural community zone may allow for more environmentally sensitive rural living subdivision compared with traditional 2 ha special rural subdivision and will help to retain the natural topography and remnant native vegetation, rehabilitate and enhance degraded rural areas, and enhance the rural landscape character of the area.

Areas also have been identified as basic raw materials resource areas for future limestone extraction. Future conflicts may occur between the desire to protect the landscape and rural amenity and the extraction of limestone. The environmental and social impacts of future extraction need to be managed. Sequential land uses could include innovative rural living subdivision.
5.2.1 Allow for a broader range of complementary land uses in rural areas

The western portion of Carabooda/Nowergup has been identified as a potential rural living/landscape protection area. Well-designed rural living subdivision and additional tourism-related rural uses are to be encouraged as long as they are not wholly groundwater-dependent, retain the heritage, landscape and remnant vegetation values or promote tourism opportunities and small rural enterprises.

These complementary uses would need to be compatible with surrounding agricultural/horticultural uses and not result in conflict.

5.2.2 Special use/rural living areas along Wanneroo Road

The area along Wanneroo Road (between Flynn Drive and Wattle Avenue), currently zoned rural, has been identified for special uses that can take advantage of the Wanneroo Road frontage and high volume of passing traffic. Special uses, such as ancillary tourism-related uses and retail outlets for arts and craft, local produce, special attractions and private recreational uses, would provide for diversity and add to the area’s tourism capability.

Areas behind the Wanneroo Road frontage may support innovative styles of rural living subdivision that can demonstrate retention of landform, remnant vegetation and landscape values, and encouragement of complementary tourism values.

The exact extent of areas and lots suitable for special uses and rural living subdivision needs to be investigated and subject to the preparation of a local structure plan to accompany any future zoning changes to the City of Wanneroo DPS 2, demonstrating planning and environmental objectives and strategies to minimise impacts on Lake Neerabup.

5.3 Protect Bush Forever sites and environmental values

Bush Forever sites and possibly other areas of regional environmental significance can be identified and protected by several mechanisms. Statutory measures can be applied to protect these areas as part of future MRS amendments or local structure planning and TPS amendments.

Bush Forever Amendment 1082/33 currently is being proposed to reserve many of these sites as parks and recreation in the MRS.

Protection of Bush Forever sites and locally significant vegetation also can be achieved by negotiated planning solutions as part of formulating local structure and subdivision plans for future urban and rural living areas.
The City of Wanneroo is preparing a biodiversity strategy that will consider the protection of Bush Forever sites and locally significant vegetation and how to address their protection in DPS 2.

The protection and management of the east Wanneroo wetland system is important. Most wetlands in east Wanneroo are identified as part of the System 6 M8 (DCE, 1983), east Wanneroo wetland chain, are environmental protection policy wetlands and defined as conservation, resource enhancement or multiple use wetland management categories and are reserved as parks and recreation in the MRS (figure 6).

Lakes Gnangara, Badgerup and Little Badgerup, Jandabup, Mariginiup and Little Mariginiup, Adams, Little Coogee and parts of Lake Pinjar are defined as conservation category wetlands, and specific management objectives apply to them.

Existing parks and recreation reservations occur around most of these wetlands and where future urban or rural living subdivision is proposed adjacent to wetlands, these reservations may need to be reviewed and possibly extended as part of future detailed local structure planning to ensure adequate buffers around all significant wetlands. Wetlands or bushland areas also may be set aside in public open space reserves during the local structure planning and subdivision processes as part of the urban development process. Specific environmental management plans would need to be prepared for identified significant areas as part of the subdivision approval process.

A management plan for the east Wanneroo wetlands needs to be agreed to and implemented by the City of Wanneroo, the Department of Conservation and Land Management (CALM) and the WAPC. This study may be commenced by the WAPC in 2006.

A major issue is the declining level of the groundwater table over Gnangara Mound which is having an adverse impact on the wetland ecosystems. Breaches in the EPA minimum summer and winter water level criteria have occurred on most criteria wetlands over a number of years. Lower wetland water levels increase the risk of acid sulfates being released from the peaty wetland soils resulting in further ecosystem degradation and further water quality problems for east Wanneroo.

Stormwater run-off from future urban areas can be managed to recharge groundwater and wetlands to enhance wetland water levels, help manage wetland ecosystems, and reverse the decline in water levels and help meet EPA requirements. However, the quality of stormwater run-off is an issue and new urban areas would need to use best practice water-sensitive urban design.
principles to ensure certain water quality criteria are met to minimise the risk of pollution of groundwater sources.

The management of watertable levels and acid sulfate soils is an important issue that needs to be recognised at this strategic planning level and dealt with at the detailed structure planning level.

The strategy proposes that a broader management plan is undertaken by the Office of Water Strategy to address Gnangara Mound’s water resources.

5.3.1 Landscape protection

The East Wanneroo Landscape Character Assessment Study (URS, 2004) identified the area’s major landscape character types and key features, gave a relative scenic value to each character type, and made recommendations for managing those landscape values and types.

The study highlighted the importance of reiterating the links and interrelationships between the area’s biophysical attributes of groundwater, landform, vegetation and wetlands and its landscape character types. It noted that alterations to groundwater levels over time also may have an adverse impact on the landscape character of the wetlands and associated vegetation communities in particular. Lower watertable levels also may affect the remnant tuart and karst landform system in Carabooda/Nowergup.

Figure 11 outlines east Wanneroo’s landscape management areas.

Using information from the study, the land use concept (figure 9) protects the major wetlands in Wanneroo and identifies a north-west portion of Carabooda/Nowergup for rural living/landscape protection, and much of the area around Lake Mariginiup as rural living.

Horticultural production in the north-west portion of Carabooda/Nowergup is limited due to the presence of limestone. In the longer term, alternative forms of rural living subdivision, such a rural community zone and cluster-style rural living, may be a more sustainable land use compared with traditional rural uses. These types of subdivision would be based on site-specific investigations that demonstrate the suitability of areas, taking into account the protection of the western linear wetland system, tuart and karst systems and hazards. The identification of areas suitable for rural living would be subject to more detailed local structure planning in conjunction with the Rural Way project being undertaken by the City of Wanneroo.
Landscape management areas

Legend
- very high protection
- high protection
- medium to high protection
- medium enhancement
- low enhancement
- very low to low enhancement

City of Wanneroo

Produced by Project Mapping Section, Mapping and Geospatial Data Branch, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth, WA. October 2005

Landscape management data supplied by URS Consulting Engineers.
5.4 Retain rural zoning in Carabooda/Nowergup and protect significant areas of basic raw materials

The strategy proposes that Carabooda/Nowergup remains zoned rural and be available for agricultural/horticultural production and the protection of the significant deposits of sand and limestone in the area (figure 12).

The objectives for the planning and use of the sand and limestone resources in the study area are outlined in Statement of Planning Policy 2.4. Basic Raw Materials (WAPC, 2000).

The policy aim is to identify and protect basic raw material resource locations, key extraction areas and future extraction areas from being developed for incompatible land uses which could limit future exploitation, and ensure that the extraction of basic raw materials does not have an adverse effect on the environment or amenity in the locality of the operation during or after extraction.

Limestone extraction is located mostly in Neerabup and Carabooda/Nowergup. Sand mining is concentrated in Gnaragara and Landsdale in the south of the study area.

Sand and limestone mining can occur within the Wanneroo groundwater area subject to stringent conditions.

The large areas identified as basic raw materials areas mostly are not suitable for broad-scale horticultural use. Limestone extraction is a long-term proposal in many of the resource areas and in others, the quality of the limestone is low (caprock) and may not be suitable for extraction. Some landowners in these areas have expressed concerns about the limited land use options.

Many interim rural/tourism uses (eg chalets, kennels, horse riding/agistment) or other appropriate uses that may be complementary to the objectives of the Rural Way concept, being developed by the City of Wanneroo, are able to occur until the limestone and sand are required for extraction.

Future basic raw materials resource areas also may be a threat to the long-term landscape and scenic values of the area. Site-specific landscape management measures need to be put in place where there is a conflict between preserving landscape and scenic amenity and proposals for future extraction of limestone or sand.
Figure 12

Area of high resource potential. Tenement applications within proposed extensions to National Park.

Legend

- Limestone / limesand resource
- Sand resource
- Priority resource location
- Knob areas of high resource potential which should be held available for current and future extraction
- Extraction area
- Areas of existing extractive industry operation

WAPC reference no.
- Tenement expired
- DOR reference no.
- Pending

- Policy area boundary
- Local government boundary
- Study area boundary

Environmenal and Conservation Reference Chart

<table>
<thead>
<tr>
<th>Reference Area</th>
<th>SWP Reference</th>
<th>Bush Forever Resource Area</th>
<th>Conservation Estate</th>
<th>Regional Park</th>
<th>Comments</th>
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<tr>
<td></td>
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</table>

x: Indicates presence of relevant environmental value.
- Indicates proposed environmental value.

This table highlights areas of environmental significance. A proposed project site is compared to the site to determine the environmental values that are impacted. Relevant Bush Forever sites are listed as relevant authorities prior to initiating project.

Environmental Protection (DEWCP) prior to initiating project.

Consult Department of Environment, Water and Catchment Protection (DEWCP) prior to initiating project.

Regional Parks are designated by DPA and City of Wanneroo for the Environment - June 1992

Conservation Category Wetland (ECW) or EPP Wetland.

Contact the relevant authorities prior to initiating the project.
5.5 Establish a new Gnangara agricultural/horticultural precinct in State Forest 65

This strategy proposes the innovative concept of establishing a new agricultural/horticultural precinct in north Wanneroo to the east of the existing Carabooda/Nowergup rural areas on land currently under pines in State Forest 65 (figure 9).

This could be achieved by providing a sustainable water supply based on a managed aquifer recharge scheme (or artificial recharge) using treated wastewater from the Beenyup and proposed Alkimos wastewater treatment plants and would supply additional irrigation water independent of rainfall and existing private licensed water allocations.

New agricultural/horticultural areas for fruit and vegetable production and other rural uses such as poultry (egg and meat), nurseries, and horse industries, using world’s best management practice in the use of irrigation water, fertilisers and chemicals to produce high-value products, may have multiple benefits and replace existing rural land uses and agricultural/horticultural production displaced by possible new urban development in the southern areas of east Wanneroo.

The use of treated wastewater from the Beenyup and/or Alkimos plants, is an option that can help to achieve the State Water Strategy’s target of 20 per cent use of recycled water by 2012 and achieve significant, long-term benefits for the whole community, the environment, the agricultural/horticultural industry and the management of the Gnangara Mound water resources.

A managed aquifer recharge scheme also may supplement environmental water requirements for the Yanchep cave system and Wanneroo wetlands and, in concert with the controlled clearing and thinning of the pine plantations, buffer the impact of the predicted lower rainfall and reduce the rate of decline of the Gnangara Mound groundwater level.

By these means, some 20 GL of recycled water could be supplied for use by a new agricultural/horticultural industry.

A whole-of-government, holistic and coordinated approach to management of the land and water resources of Gnangara Mound is needed to deliver a sustainable solution to the competing demands on the groundwater resource to all sectors of the community.

This is a significant opportunity to investigate the managed aquifer recharge option and provide for the growth of the agricultural/horticultural industry in east Wanneroo with security of water supply and land tenure. It is an opportunity for the Government to put into action some of the principles of
sustainable environmental management of land, water and agricultural resources promoted in the State Sustainability Strategy (Government Western Australia 2003), State Water Strategy (Government Western Australia 2003), 2003 and State Planning Strategy (WAPC, 1997).

However, many planning, health, environmental and technical issues need to be investigated more fully and resolved before a new agricultural/horticultural area based on a managed aquifer recharge scheme can be adopted by Government, including:

- infrastructure capital costs, cost of water to irrigators, and timing of a recycled water scheme;
- use of State forest land to enable new leasehold agriculture areas to be established, and the coordinated clearing of pine plantation areas;
- agricultural/horticultural economic, production and market issues; and
- environmental issues and potential downstream contamination to public water sources from nutrients, and public health considerations.

### 5.5.1 Suitability and size of the area proposed for a new agricultural/horticultural precinct

The ‘teardrop’ area in State Forest 65 has been identified for a new agricultural/horticultural precinct. Also included are the existing agricultural areas in Carabooda/Nowergup (figure 9).

The proposed area is close to existing transport routes and is well located for the Perth metropolitan area, although there are some constraints, with remnant native vegetation identified as Bush Forever sites, sand and limestone basic raw materials resource areas and the current priority 1 source protection classification.

The pine plantations are on the sandy soils, classified by the Department of Agriculture land capability mapping as class 1, 2 and 3 with a high to fair capability for perennial and annual horticulture and viticulture. About 1200 ha of unconstrained land potentially is suitable for new agricultural/horticultural areas (figure 13).

In southern east Wanneroo, south of Flynn Drive, approximately 2670 ha of land is zoned general rural and rural resource in Wanneroo DPS 2, with only 1155 ha under irrigated cultivation.

Therefore, to replace the current rural land in southern east Wanneroo, if it is subject to future urban development, a larger area potentially can be accommodated in Carabooda/Nowergup and portions of State Forest 65. Other forest areas also may be available for future agriculture/horticulture.
Based on estimated figures from the Water Corporation and the Department of Agriculture, approximately 10 GL of recycled water can service 500 ha of land. Therefore, if 1000 ha of land were to be cleared of pines it would require some 20 GL of recycled water.

Advice from Department of Agriculture is that the State forest land is suitable in terms of location, area, and soil characteristics; however, further feasibility studies may be required.

5.5.2 Land tenure issues
It is proposed that any new agricultural/horticultural land be released on a Crown leasehold basis.

New areas will need to be leasehold in tenure, with a water allocation tied to the lease. In this way, there is a guarantee that the land always will be used for agricultural/horticultural purposes. If freehold was offered, there is no guarantee that the land would be retained for agricultural/horticultural production.

Land could be subdivided into suitable parcels and released, for an annual payment, on a long-term Crown lease basis with certain water licence and allocation rights. The details of this would need to be investigated and a specific model proposed.

This means that the land is retained in government ownership and there can be no pressure from landowners for the land to be rezoned for another use in the future.

This also gives long-term security and certainty to the managed aquifer recharge scheme and the high capital cost of its infrastructure is not jeopardised.

5.5.3 Public acceptance of a managed aquifer recharge scheme using recycled water
The Water Corporation is progressing the concept of using recycled water in areas of the Perth Metropolitan Region and the State. Many technical, environmental, social, economic and health issues need to be considered.

The corporation is driving the Government’s commitment to the objectives of the State Water Strategy and its target of 20 per cent use of recycled water by 2012 and is undertaking detailed investigations into the scientific, engineering, infrastructure cost, pricing and social and public health issues.

Currently, it is engaged in a public communication and consultation program to explore these and other issues of using recycled water.
Figure 13

Land capability for horticulture

Legend
- class 1 and 2 - high capability for horticulture
- class 3 - fair capability for horticulture
- class 4 and 5 - low capability for horticulture
- water feature
- groundwater sub-area
- Metropolitan Region Scheme boundary
- local government boundary
- study area boundary

Produced by Project Mapping Section, Mapping and Geospatial Data Branch, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth, WA October 2005

Land capability data supplied by Department of Agriculture, Western Australia

Cadastre and administrative boundaries based on information provided with the permission of DLI PA 23-2003

GEOCENTRIC DATUM OF AUSTRALIA
The EPA released a discussion paper, Managed Aquifer Recharge using Treated Wastewater on the Swan Coastal Plain, in April 2005. It outlines the background to managed aquifer recharge, and environmental, public health, regulatory, social and Aboriginal heritage issues, benefits and impacts. The recharge scheme using treated wastewater for irrigated horticulture in east Wanneroo is given as a case study in the discussion paper.

5.5.4 Environmental and health issues
The use of treated wastewater has potential benefits and impacts.

The EPA discussion paper states: “The Department of Health advise that the level of treatment of wastewater for use as irrigation water for horticulture via a managed aquifer recharge scheme is dependent on the extent of human exposure.”

For products that are ready to eat (e.g., lettuces) or products that need to be peeled, a different level of treated water is required. However, as most horticultural areas are mixed, it is likely that a managed aquifer recharge scheme would need to use full class A+ (including reverse osmosis treatment) recycled water for irrigation.

This means that the public health risks are much reduced and the Health Department, the agency responsible for setting and regulating public health standards (including water quality and recycled water quality), considers the risks to public health to be manageable. A managed aquifer recharge scheme would need to be assessed fully by the EPA and Health Department and if approved, be subject to stringent conditions and regulations.

5.5.5 Implications for the Gnangara public water supply area and Perth coastal underground water pollution control area
The teardrop area of State Forest 65 proposed for a new agricultural/horticultural precinct currently is within the Gnangara underground water pollution control area and is in a priority 1 source protection area.

The Gnangara Land Use and Water Management Strategy (WAPC, 2001), adopted and recommended a new scientifically modelled underground water pollution control area boundary based on the wellhead capture zones of existing and proposed drinking water supply bores. MRS Amendment 1036/33 has reserved the modified priority 1 source protection area for water catchments in the MRS to protect the area for future public drinking water supply bores.
The modified boundary will exclude a large area of State Forest 65 from the priority 1 area and enable a large portion of the land within the teardrop area potentially to be available for future agriculture/horticulture. The DoE will gazette the modified underground water pollution control area and priority 1 boundary in the near future (figure 14).

The establishment of a new agricultural/horticultural precinct in this area would not have any adverse impact on water quality for the Gnangara public drinking water supply bores, upstream of the proposed new precinct. However, the downgradient impact on public drinking water supply bores in the Perth coastal underground water pollution control area, to the west along the coastal strip, needs to be considered.

The existing and proposed bores in the Perth coastal underground water pollution control area (Quinns, future Eglinton and Alkimos schemes) are to the west along the coast and downgradient from the existing and proposed agricultural/horticultural precinct.

The quality of the recycled water would have to meet stringent public health and environmental water quality criteria (ie class A or class A+ standard), set by the Health Department and the EPA, to ensure there are no potential environmental or public health risks to the public drinking water supply schemes in the Gnangara or Perth coastal underground water pollution control areas, or from consumption of products grown with using water from a managed aquifer recharge scheme.

There also is the risk of contamination to the downgradient public drinking water supply from the use of additional fertilisers, chemicals, herbicides and pesticides in a proposed new agricultural/horticultural precinct. Along with the many other considerations, these risks would need to be assessed and considered in determining the feasibility of establishing the proposed new agricultural/horticultural precinct based on a managed aquifer recharge scheme.

The treated recycled wastewater may need to be of drinking water quality before it could be injected or infiltrated into the aquifer for storage and re-used for irrigation for agricultural/horticultural uses. In this case, it is highly likely the EPA and Health Department would require class A or class A+ advanced treatment (ie reverse osmosis).

This is an expensive process and further investigation is required to assess the economic viability of a new agricultural/horticultural precinct based on a managed aquifer recharge scheme using class A+ treated water.

The public health risk and risk of contamination of native groundwater are considered to be negligible by the DoE and Health Department.
Figure 14: Priority source protection areas

Legend:
- Priority 1 source protection area
- Priority 2 source protection area
- Priority 3 source protection area
- Current priority 2
- Possible priority 3
- Existing underground water pollution control area
- Revised underground water pollution control area
- Metropolitan Region Scheme boundary
- Local government boundary
- Study area boundary

Produced by Project Mapping Section, Mapping and Geospatial Data Branch, Department for Planning and Infrastructure, on behalf of the Western Australian Planning Commission, Perth, WA, October 2005.

Source protection data supplied by Department of Environment, Western Australia.
It should be noted that many public drinking water supply bores in the Perth coastal underground water pollution control area are in existing urban zoned areas within priority 3 source protection areas. Priority 3 is the lowest level of protection in public drinking water areas and aims to provide for a range of land uses and an acceptance of a certain level of risk to the quality of public drinking water within these areas.

To date, there have been no adverse impacts from existing horticulture or urban development on public drinking water supply bores in the Perth coastal priority 3 areas.

5.5.6 Gnangara pine plantation harvesting

The State has entered into an agreement to supply pines to a private company for processing into timber veneer at the new laminated veneer lumber plant in the Neerabup industrial area. A pine clearing and harvesting program has been prepared, taking into account the age, girth and haulage distance of pine trees to the plant. A harvesting program has been agreed to and forms part of the contract between the Government and the company. Under the current harvesting program, areas will be harvested from 2006 to approximately 2025.

The time frame for establishing new agricultural/horticultural precinct(s) on pine plantation areas in State Forest 65 needs to be resolved in relation to the proposed pine harvesting program.

For the timely establishment of a new agricultural/horticultural precinct in Carabooda on former pine plantation areas, the harvesting program in the identified areas would need to occur sooner than 2025.

Changes to the pine harvesting program would need to be considered carefully by Government and the company.
6 **Recommended actions**

The Office of Water Strategy was initiated on 1 July 2005 to support the Premier as the Minister responsible for water resources and to guide strategic direction on water management issues in the State by providing high level advice to the Government on water strategy, coordinating government activity in water, including new source development, demand management and water re-use, and facilitating the development and implementation of strategic water initiatives.

The Office of Water Strategy will be involved in ensuring the necessary technical and planning work is undertaken within desired time frames to achieve this strategy’s outcomes.

1. Consider the draft land use concept plan presented in this strategy at figure 9 as a conceptual framework for future land use planning, and as an input into the preparation of an integrated management strategy for Gnangara Mound. Note: Land use proposals also shall be dependent upon the outcomes of subsequent planning stages (recommendation 6). (all agencies)

2. The Office of Water Strategy is to investigate horticultural precinct(s) in Carabooda and State Forest 65, based on a managed aquifer recharge scheme, (DAWA, DPI, DPC, Treasury, DoE, Water Corporation, CALM, FPC, City of Wanneroo)

3. The Office of Water Strategy is to prepare a coordinated, inter-agency integrated management strategy for the sustainable use of Gnangara Mound land and water resources to include consideration of:
   a) pine plantation management and harvesting, natural vegetation and fire management and implications to regional water balance (FPC, CALM, DoE, Water Corporation);
   b) management of Gnangara Mound underground water pollution control area public drinking water area and future public water source and borefield planning (DoE, Water Corporation, DPI, CALM);
   c) possible land use changes from rural to urban deferred and rural living as proposed in the draft land use concept outlined in this strategy (DPI, City of Wanneroo, DoE);
   d) investigations into a possible managed aquifer recharge scheme to assist in the sustainable management of the Gnangara Mound water resources (Water Corporation, DoE, DPI, DAWA);
   e) investigations into establishing a new agricultural/horticultural precinct based on best management practice, in Carabooda and State Forest 65 (recommendation 2) (DAWA, DoE, DPC, DPI, Water Corporation);
f) investigation into review of Wanneroo groundwater area boundaries and allocations (recommendation 4) (DoE, City of Wanneroo, DPI).

4 The DoE is to review the existing Wanneroo groundwater area sub-area boundaries and water licences (to take account of current land uses) to reduce the number of sub-areas and facilitate trading or recouping of unused water licences. (DoE)

5 The Office of Water Strategy is to set up an inter-agency steering committee to ensure timetables to achieve the listed tasks are met and to report on a quarterly basis to the cabinet sub-committee on water. (OWS)

6 Subject to a final land use plan being adopted by State and local government, the following are to be initiated:

a) The final land use plan is to be adopted for the eastern portion of the North-West Corridor Structure Plan study area to provide the regional planning framework. (All)

b) The City of Wanneroo is to initiate district structure plans for each proposed urban precinct to provide the basis for future amendments to urban deferred in the MRS and urban development zone in DPS 2. (City of Wanneroo, DPI, landowners)

c) As part of (a) and (b), the DPI and City of Wanneroo are to initiate investigation into the regional and local road and transport requirements in east Wanneroo. (DPI, City of Wanneroo)

d) The City of Wanneroo is to initiate further detailed planning for a special use/rural living area along Wanneroo Road and rural living/landscape protection zone for the areas indicatively identified in north Wanneroo to complement the North Wanneroo Rural Way Project. (City of Wanneroo, DPI, landowners)

7 Where to from here?

7.1 Strategy approval process

Release of the draft East Wanneroo Land Use and Water Management Strategy by the WAPC for public comment, consideration of public submissions and modification of strategy for:

- endorsement of final strategy by City of Wanneroo, DoE, DAWA, WAPC, DPC; and
- approval and release of final strategy by Minister for Planning and Infrastructure.


8 Implementation of strategy

The objective is to achieve these actions by the end of 2007:

• complete technical investigations in recommendations 1-4; and

• initiate amendments to the MRS and City of Wanneroo DPS 2 to rezone proposed urban precincts to urban deferred and urban development respectively.

The time frame for amendments to the MRS also is dependent on the outcomes of further investigation and resolution of all planning, environmental and social issues, including the loss and replacement of horticulture, impacts on wetlands, road and infrastructure provision and broad structure planning.

Once MRS urban deferred zoning and DPS 2 urban development zoning is in place, these actions will be required:

• Detailed local structure plans for future urban precincts will need to be prepared as a basis to lift the urban deferred zoning in the MRS. To facilitate structure planning, a partnership between the DPI, the City of Wanneroo and landowners may need to be formed to coordinate the preparation and approval of local structure plans (time line subject to City of Wanneroo and landowners).

• Subdivision plans will need to be prepared and approved.
Appendix 1: Community consultation on May 2004 preliminary discussion paper

Released in May 2004, the preliminary discussion paper presented three land use scenarios outlining a range of new urban land options from minimum, medium to maximum for the southern east Wanneroo area.

In summary, the submissions were:

- Support of some land use change – 258
- Opposed to land use change – 174

The following is an approximate breakdown but some submissions were not entirely clear about which scenario was favoured.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Count</th>
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<tbody>
<tr>
<td>Scenario 1</td>
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<td>22</td>
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<td>Scenario 1/2</td>
<td>16</td>
</tr>
<tr>
<td>Scenario 2/3</td>
<td>98</td>
</tr>
<tr>
<td><strong>No support for scenario 1, 2 or 3</strong></td>
<td>159</td>
</tr>
<tr>
<td><strong>Did not say or unclear</strong></td>
<td>23</td>
</tr>
</tbody>
</table>

The conclusions drawn from the submissions are:

- It is clear that a change in land use was supported; the question is how much, where and when?
- A large number of landowners around Lake Mariginiup were opposed to future urban zoning and an increase in the MRS parks and recreation reservation around the lake.
- Large numbers of landowners in the Gnangara area wanted a future urban zoning.

*Note:* These were counted as no support to either scenario 1, 2 or 3. However, these submissions did support further urban zoning in the east Gnangara area.
Appendix 2: Community forum in November 2004

A summary of the five key issues identified by the 115 participants were:

**Groundwater management and environment**

Issues raised in relation to groundwater and environment were: Wetlands and environment need to be protected; more use should be made of recycled water and grey-water re-use; the impact of new urban development on the watertable level and the danger of acid sulfate soils causing acidification of groundwater need to be understood; the effect of pine harvesting on watertable levels needs to be understood; and there needs to be more efficient use of existing water and control of water licences.

**Horticultural and agricultural land use**

Issues raised in relation to horticultural and agricultural land use were: More use should be made of recycled water and re-use of grey water; need to have land close to Perth to grow food and new agricultural precinct in north needs to be investigated; the effect of pine harvesting on watertable levels needs to be understood; more efficient use of existing water; non-horticultural uses, eg horses also important; need to avoid environmental degradation from use of agricultural chemicals and fertilisers, and conflicts with other uses.

**Future urban land uses**

Issues raised in relation to future urban land use were: While it was recognised that southern east Wanneroo is suitable for future urban, Carabooda should be left as rural; the need to plan for sustainable future urban development and not destroy environmental and landscape values; provide buffers to wetlands and significant remnant vegetation and between urban and rural uses; protect landscape values; and plan transport requirements carefully to avoid major heavy freight routes linking to the Flynn Drive industrial area.

**Rural living land use**

Issues raised in relation to rural living were: Recognise the need for rural living lots; the restriction on second dwellings allowed on rural lots; provide adequate buffers between rural living and urban or other rural uses; and provide for a larger range of permitted rural uses and smaller size rural living lot sizes.

**Tourism and heritage values**

Issues raised in relation to tourism and heritage values were: The need to protect rural character; wetlands and natural areas that have some attraction; build on Wanneroo’s historical old settler past; and create tourism opportunities.
Appendix 3: Strategy Committee Structure

The preparation of this strategy has been managed by a steering committee comprising:

- Mr Mike Allen - Department for Planning and Infrastructure - Chair
- Mrs Dianne Guise - MLA, Member for Wanneroo
- Mr Charles Johnson (Deputy Mr Roman Zagwocki) - City of Wanneroo
- Mayor Jon Kelly JP - (Deputy, Clr Frank Cvitian)- City of Wanneroo
- Mr John Gallagher (Deputy Ross George) - Department of Agriculture Western Australia
- Mr Greg Davis - Department of Environment

Technical advice has been from a Technical Advisory Group comprising:

- Mr Andrew Moore - Department for Planning and Infrastructure - (Project Manager)
- Mr Ron Colman - Department of Environment
- Mr Steve Bellusi - Department of Environment
- Mr Phil Thompson - City of Wanneroo
- Mr Ian Bignell - City of Wanneroo
- Mr Ian Kininmonth - Department of Agriculture Western Australia
- Mr Robert Stokes - Water Corporation

Input from the local community has been from the Community Consultative Committee comprising:

- Mrs Dianne Guise - MLA, Member for Wanneroo - Chair
- Mayor, Jon Kelly JP - Co-Chair
- Mrs Anne Danti - Community member
- Mr Ray Perkins - Community member
- Mr Kerry Langlands - Community member
- Mr David Lloyd - Horse Council of WA
- Mr Ken Rich - Community member (retired)
- Mr Jim Turly - Vegetables WA
- Clr Frank Cvitian (Deputy, Clr Terry Loftus) - City of Wanneroo
- Clr Glynnis Monks (Deputy, Clr Dot Newton) - City of Wanneroo
- Clr Alan Blencowe (Deputy, Clr Sam Salpietro) - City of Wanneroo
Appendix 4: Planning Bulletin 63 Policy for Dealing with Potential Conflicts Between Residential Subdivision and Market Gardens in East Wanneroo

1 Introduction

Much of the East Wanneroo area is zoned for urban development in the Metropolitan Region Scheme (MRS) and is a major source of housing land particularly for first home buyers. East Wanneroo is also traditionally an area for market gardens and other horticultural uses.

Situations can arise where:

a) urban development is proposed in the vicinity of a market garden which is zoned Rural, and where the market garden is expected to remain in productive use;

b) market gardens are zoned for urban development but that development may be delayed because owners are not contemplating subdivision with adjoining land.

In both cases, conflicts can arise between the market garden use and residential development. The most common conflicts arise from agricultural chemical spray drift, noise, dust and odours. The purpose of this bulletin is to advise on the Western Australian Planning Commission (WAPC) policy to minimise the potential for conflict between market gardens and residential land uses in considering applications for subdivision. The policy applies to market gardens and includes fruit and vegetable growing, cut flower production, turf farms, mushroom farms, plant nurseries and other horticultural uses.

2 Recent Practice

East Wanneroo is identified as a major growth area in the North West Corridor Structure Plan and land designated for urban development has progressively been rezoned from Rural to Urban in the MRS to accommodate future housing. A further review of East Wanneroo (the East Wanneroo Land Use and Water Management Strategy – EWLUWMS) is also in progress and will include consideration of options for remaining Rural zoned land.

Urban development will result in the progressive phasing out and relocation of existing market gardens in large parts of East Wanneroo. The continued use of land for market gardens in the land remaining in the Rural zone is however recognised. In these situations there is a need for an appropriate interface between urban development and market gardens at least until the EWLUWMS and long-term zoning intentions are finalised.
Appendix 4: Planning Bulletin 63 (cont.)

The Environmental Protection Authority (EPA) has produced a list of generic buffer distances for industries and other activities. The buffer distance for market gardens is 500m. The EPA recognises that these buffer distances can be modified by appropriate management measures and relies on the planning system to provide adequate buffers or other management measures.

The WAPC has previously accepted that urban development within 500m of market gardens is acceptable provided that memorials are placed on the title of each new lot until such time that the market garden ceases operation.

Following advice from EPA, the more recent practice of WAPC has been to require an Agricultural Practices Impact Assessment and Implementation Plan for subdivisions which have been located within 500m of a market garden or other agricultural activity. The development industry contends this requirement is unfair, without basis and inconsistent with current planning policy and statutory requirements. The requirement has also delayed subdivisions and housing land supply. Several of these assessments have now been undertaken in East Wanneroo which has enabled the WAPC to provide a more definitive policy on measures to ameliorate potential conflicts where these may arise.

3 Market Gardening Practices and Impacts

Over 60 vegetable crops are grown in the Wanneroo area. The major crops are tomatoes, strawberries, leafy vegetables, carrots and brassica species. Most growers tend to specialise in a small number (up to 4) of crops with the crops grown in rotation to minimise pests and diseases. The exceptions are perennial crops and strawberries which generally are not rotated. Crops are grown throughout the year with approximately 2.5 crops produced per year. Farming activities generally occur only during daylight hours although packing may be undertaken in sheds at night.

Conflicts between market gardens and residential development can arise from agricultural spray drift, noise, dust and odours. The assessments undertaken for East Wanneroo suggest that the potential for spray drift is the major issue.

The Queensland Department of Natural Resources has introduced comprehensive guidelines dealing with the interface between agricultural and residential land uses (Planning Guidelines: Separating Agricultural and Residential Land Uses). The guidelines reviewed research on each element of conflict and recommended measures to minimise such conflicts. These recommendations have been endorsed by the (Commonwealth) Primary Industries Standing Committee (Report 82 Spray Drift Management: Principles, Strategies and Supporting Information).
Appendix 4: Planning Bulletin 63 (cont.)

With regard to spray drift, impacts may relate to concerns about exposure to chemicals and odours associated with the chemical. Crops in East Wanneroo are regularly sprayed to control pests, diseases and weeds. The assessment reports identify the chemicals most frequently used together with the active ingredient, frequency of application and level of toxicity. Sprays in market gardens are generally applied by a tractor with a boom spray, by a power spray applied through a lance from a tractor, or for smaller areas, by backpack. Aerial spraying is not used in the Wanneroo area.

There is no current acceptable ambient air standard for agricultural chemical spray drift. There is various legislation controlling the use, storage, movement and disposal of agricultural chemicals. A number of codes of practice and guidelines have also been developed in Western Australia which include advice on managing land use conflicts including spray drift. These recommend a range of measures including spraying during suitable wind conditions, nozzle configuration to increase viscosity, use of anti-drift additives and other precautions which can be taken to reduce spray drift.

Research (Spillman cited in DNR, 1997) found negligible chemical drift at a range 300m downwind from the release point of a chemical spray application. Further research has shown a single row of trees is effective in capturing up to 80 per cent of pesticide spray drift from an application upwind (Harden cited in DNR, 1997) and that a 20m vegetated buffer containing a mix of species and foliage types will reduce spray drift to less than 1 per cent at the sensitive receptor (Centre of Pesticide Application and Safety, University of Queensland cited in DNR, 1997).

On this basis, the Queensland guidelines have adopted a minimum buffer width of 300m where open ground conditions apply which can be reduced to 40m where a 20m vegetated buffer element (with 10m each side for access) can be implemented and maintained between the agricultural use and residential development.

The Queensland guidelines apply to all agricultural activities and are primarily directed at protecting agricultural production and minimising the impact of residential development on these activities. This approach is not appropriate for land zoned Urban in East Wanneroo where the policy is to facilitate residential development and the progressive phasing out of existing market gardens.

The Queensland guidelines also recognise that in areas designated for urban development, a temporary buffer may be appropriate to protect farming operations until the land is developed but depending on the degree of conflict and the lifespan of the buffer area, such temporary buffers may be considered unnecessary.
Appendix 4:  Planning Bulletin 63 (cont.)

With regard to odour, some agricultural chemicals contain strong odours as markers to allow easy identification. These can cause concern even though low concentrations of active ingredients may be present. Odours may also result from organic fertilisers and manure. The Queensland guidelines have adopted 1 per cent of the time (or 88 hours per year) as an appropriate threshold for odour (Holmes cited in DNR, 1997). Odour dispersion is affected by atmospheric stability, wind speed and direction, topography, vegetation and the source of the odour. Assessment studies in East Wanneroo have indicated that odour is not expected to impact on residents above the odour duration threshold of 88 hours per annum because where odours do occur these tend to be of short duration or are rapidly dispersed by strong winds.

Noise from market garden activities such as tractors, sprinklers, cool rooms etc. can impact on residential areas. These activities, however, tend to be intermittent and mainly affect a particular adjacent residence a few hours several times a year.

Dust has been identified as a source of conflict between residential areas and agricultural properties in Queensland where cane farms can generate dust, smoke and ash. Market gardens in Wanneroo, however, generally have a period of less than a week between crops when the seedbed is under preparation. Once planted or seeded, water is applied regularly to ensure crop growth, thus minimising the potential for dust. Assessments have indicated that dust is only likely to impact on development infrequently and should not be considered as a factor contributing to conflict.

In summary, dust, odour and noise are considered to have minimum potential to impact on residential development. The likelihood of complaints is further reduced by the nature of the agricultural activity. Market gardens have traditionally been located and accepted close to urban areas.

Spray drift has been highlighted as the major issue and management practices to minimise the impact of spray drift are considered in the policy. Separate consideration is given to market gardens within existing and future Urban zoned areas, which are regarded as temporary uses, and those on land which is likely to remain zoned Rural where market gardens may remain for the longer term.

4 Objectives

The objectives of the policy, in relation to market gardens on land zoned Rural in the MRS are to:
Appendix 4: Planning Bulletin 63 (cont.)

1) minimise the effects of residential development on market gardens which are practiced in accordance with the relevant legislation, codes of practice and associated industry-specific guidelines;

2) minimise the potential for complaints about market gardens from residential areas;

3) provide residents with acceptable standards of amenity in residential areas that are located in proximity to market gardens.

With regard to market gardens in areas zoned Urban or Urban Deferred in the MRS, the primary objective is to minimise the impact of existing market gardens on residential development and to encourage the progressive relocation and phasing out of market gardens by urban development.

5 Policy measures

For residential subdivision in the vicinity of market gardens on land zoned rural in the MRS, the WAPC will accept:

- Separation distance of 300m which can be reduced to a protected and maintained vegetated buffer strip of a minimum width of 20m, together with adequate additional land for access for maintenance and firebreaks, and specially designed fencing of the type specified below (Note: the design of the vegetated buffer should be based on the Queensland Guidelines (p28) and contain a mix of local Western Australian evergreen species with different growth habits and should include species with long, thin and rough foliage ); and

- prospective purchasers within 300m of the boundary of the market garden to be advised of the existence of the market garden on the contract of sale; and

- memorials to be included on titles of all residential lots within 300m of the boundary of the market garden advising of the location and impacts of the market garden on amenity; or

- alternative measures which it can be demonstrated meet the objectives of the policy to the satisfaction of the WAPC.

For residential subdivision and development in the vicinity of market gardens on land zoned urban or urban deferred in the MRS, the WAPC will accept:

- for residential lots abutting a market garden, specially designed fencing of the type specified below, together with a protected and maintained vegetation buffer of one line of evergreen trees or bushes (minimum 1.5m high) for residential lots abutting a market garden; and
Appendix 4: Planning Bulletin 63 (cont.)

- for roads and open space abutting a market garden, suitable rural fencing of good standard on the boundary of the market garden; and
- prospective purchasers within 300m of the boundary of the market garden being advised of the existence of the market garden on the contract of sale; and
- memorials to be included on titles of all residential lots within 300m of the boundary of the market garden advising of the location and potential impacts of the market garden on amenity; or
- other measures which it can be demonstrated meet the objectives of the policy to the satisfaction of the WAPC.

The specially designed fencing should be 1.8m high and constructed from semi-porous material such as shade cloth or similar to allow airflow. Where a solid fence is preferred, the fence should be 1.8m high with the top 300mm constructed from porous materials (such as lattice work) to allow free airflow through the fence, with the balance of the fence constructed from solid materials.

Where practical, the opportunity should be taken of increasing the separation between market gardens and residential uses by:

- retaining natural features (e.g. vegetated water courses and ridge lines) free from development to act as buffers between newly developing areas and market gardens;
- designing residential areas so that features such as public open spaces (with vegetation screens), road reserves and other compatible uses provide the required separation;
- locating large residential lots incorporating the required buffer area on the boundary between the residential subdivision and the market garden allowing an adequate balance of the lot to be available for the house and normal residential use;
- staging residential subdivision to coincide with the relocation of market gardens.

The provisions of this policy will not apply where a market garden is planning to relocate prior to the release of the lots in the residential subdivision. In this case, the proponent will need to provide evidence of the intended closure such as a statutory declaration, written undertaking from the market gardener, unconditional offer and acceptance for the sale of the property or removal of market garden infrastructure.
Appendix 4: Planning Bulletin 63 (cont.)

6 Information Requirements

Applications for residential subdivision of land within 300m of a market garden(s) should contain relevant information including:

- a plan/aerial photograph showing the location of the market garden(s);
- proposed measures to ameliorate the impacts of the market garden(s) in terms of separation distances, tree planting, fencing, memorials on title, notice to prospective purchasers, residential area design, etc.;
- evidence of any expected relocation of a market garden(s) where relevant.
### Appendix 5: Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CALM</td>
<td>Department of Conservation and Land Management</td>
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<tr>
<td>DAWA</td>
<td>Department of Agriculture of Western Australia</td>
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<tr>
<td>DCE</td>
<td>Department of Conservation and Environment</td>
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<tr>
<td>DoE</td>
<td>Department of Environment</td>
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<tr>
<td>DPC</td>
<td>Department of Premier and Cabinet</td>
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<tr>
<td>DLI</td>
<td>Department of Land Information</td>
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<tr>
<td>DPI</td>
<td>Department for Planning and Infrastructure</td>
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<tr>
<td>DPS</td>
<td>District Planning Scheme</td>
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<td>EPA</td>
<td>Environmental Protection Authority</td>
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<tr>
<td>EPP</td>
<td>Environmental Protection Policy</td>
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<td>FPC</td>
<td>Forest Products Commission</td>
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<tr>
<td>GL</td>
<td>gigalitre</td>
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<tr>
<td>kL</td>
<td>kilolitre</td>
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<tr>
<td>MRS</td>
<td>Metropolitan Region Scheme</td>
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<td>OWS</td>
<td>Office of Water Strategy</td>
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<tr>
<td>SPC</td>
<td>State Planning Commission</td>
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<tr>
<td>TPS</td>
<td>town planning scheme</td>
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<tr>
<td>WAPC</td>
<td>Western Australian Planning Commission</td>
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</table>
### Appendix 6: Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>abstraction</td>
<td>pumping from an aquifer</td>
</tr>
<tr>
<td>aquifer</td>
<td>a geological formation or group of formations able to receive, store and transmit significant quantities of water</td>
</tr>
<tr>
<td>artesian aquifer</td>
<td>a confined aquifer under sufficient pressure that water would rise in a well above the ground’s surface</td>
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<tr>
<td>best practice management</td>
<td>the highest level of management able to be undertaken in a particular industry</td>
</tr>
<tr>
<td>cadastral</td>
<td>property boundaries as shown on the Department of Land Information database</td>
</tr>
<tr>
<td>confined aquifer</td>
<td>an aquifer confined between an upper and lower layer of relatively impermeable material</td>
</tr>
<tr>
<td>contaminants</td>
<td>substances that have the potential to alter the natural composition of water</td>
</tr>
<tr>
<td>contamination</td>
<td>discharge features environmental features such as wetlands that are formed when groundwater discharges to the features</td>
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<tr>
<td>environmental impact assessment guidelines</td>
<td>a series of guidelines prepared by the EPA proving advice to proponents</td>
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<tr>
<td>environmental protection policy</td>
<td>policy prepared under the <em>Environmental Protection Act 1986</em> relating to the protection of environmental assets</td>
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<tr>
<td>gazetted</td>
<td>flora or fauna that is listed in the <em>Wildlife Conservation Act 1950</em> as rare or endangered</td>
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<tr>
<td>gigalitre</td>
<td>a measure of water quantity – one gigalitre equals 1 million kilolitres</td>
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<tr>
<td>Greenfield</td>
<td>an area of land free of urban development</td>
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<tr>
<td>groundwater-dependent ecosystems</td>
<td>Ecosystems (plants, animals and processes) that depend on groundwater for survival</td>
</tr>
<tr>
<td>groundwater</td>
<td>a defined area of groundwater that has beneficial uses resource</td>
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<tr>
<td>hectare</td>
<td>unit of land area equal to 10,000 m² or approximately 2.47 acres</td>
</tr>
<tr>
<td>hydrogeology</td>
<td>the study of groundwater, groundwater flows, quality and the distribution of aquifers</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>hydrology</td>
<td>the study of water, its properties, distribution and utilisation on and below the earth’s surface</td>
</tr>
<tr>
<td>land capability</td>
<td>measure of the inherent ability of land to support particular land uses</td>
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<tr>
<td>nutrient stripping</td>
<td>the removal of nutrients from water</td>
</tr>
<tr>
<td>permeable</td>
<td>the ability of rock or soil to permit the passage of water</td>
</tr>
<tr>
<td>production well</td>
<td>a well or bore that draws groundwater to the ground’s surface</td>
</tr>
<tr>
<td>recharge</td>
<td>the process of renewing underground water by infiltration of rainfall</td>
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<tr>
<td>remnant vegetation</td>
<td>remaining areas of natural vegetation</td>
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<tr>
<td>run-off</td>
<td>that part of rainfall which flows off the land surface towards drainage lines</td>
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<tr>
<td>sequential land use</td>
<td>a land use which occurs after the completion of a prior land use</td>
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<tr>
<td>sewage</td>
<td>the mixture of waste fluids and solids flowing in sewers from houses, factories</td>
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<tr>
<td>statement of planning policy</td>
<td>a policy prepared by the WAPC under the Town Planning and Development Act 1928 (as amended)</td>
</tr>
<tr>
<td>supply well</td>
<td>a well or bore that draws water to the ground’s surface</td>
</tr>
<tr>
<td>System 6</td>
<td>an area of land defined by the EPA comprising the Swan Coastal Plain</td>
</tr>
<tr>
<td>unconfined aquifer</td>
<td>an aquifer which has its upper boundary at the earth’s surface</td>
</tr>
<tr>
<td>urbanisation</td>
<td>the process whereby land is developed for urban land uses</td>
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<tr>
<td>underground water pollution</td>
<td>an area of land proclaimed under the Metropolitan Water Supply Sewerage and Drainage Act 1909 for the purpose of protecting used for public drinking water supplies</td>
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<tr>
<td>groundwater control area</td>
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<tr>
<td>vertical separation</td>
<td>a measure of the vertical distance between the ground’s surface and the groundwater table</td>
</tr>
<tr>
<td>watertable</td>
<td>the level to which water rises in a well tapping an unconfined aquifer</td>
</tr>
<tr>
<td>wellfield</td>
<td>a system of production bores to harvest groundwater</td>
</tr>
</tbody>
</table>
Appendix 7: References


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Appendix 7: References (cont.)


The Western Australian Planning Commission is seeking public comment on this draft East Wanneroo land use and water management strategy. All aspects of the plan will be re-assessed in light of the comments received, before the final document is released. Submissions received will be considered by the WAPC for this project. All submissions will be treated in the strictest confidence.

When making a submission, it is very helpful to:
• clearly state your opinion and the reasons for your opinion;
• If possible, outline possible alternatives or solutions to your area of interest;
• If possible, include the section or page number which relates to your area of interest; and
• Provide any additional information to support your comments.

A public submission form is included overleaf for your convenience. If you prefer to make a comment in an alternative format, please remember to include the relevant details as outlined on the submission form.

THE CLOSING DATE FOR SUBMISSIONS IS
Friday 27 January 2006

If you would like more information on making a submission, please contact:
Project Manager,

East Wanneroo land use and water management strategy
Western Australian Planning Commission
469 Wellington Street
Perth Western Australia 6000

tel: 08 9264 7777
fax: 08 9264 7566
email: corporate@wapc.wa.gov.au
internet: http://www.wapc.wa.gov.au

Please send your submission to:

East Wanneroo land use and water management strategy
Western Australian Planning Commission
469 Wellington Street
Perth Western Australia 6000

WE LOOK FORWARD TO RECEIVING YOUR SUBMISSION
Public submissions on the draft East Wanneroo land use and water management strategy

1. Name: ................................................................................................................................................

2. Organisation (if relevant): ....................................................................................................................

3. Address: .............................................................................................................................................

4. Interest: ................................................................................................................................................
(eg, local resident, business operator, visitor to the region)

I/we would like to make the following comments on the East Wanneroo land use and water management strategy and would like them to be considered in the preparation of the final document.

Comments: .............................................................................................................................................

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