Residential development and drainage, Amarillo Farm, Karnup

Homeswest

Report and recommendations
of the Environmental Protection Authority

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Summary

This report is to provide the Environmental Protection Authority (EPA) advice to the Minister for the Environment on the environmental factors relevant to the proposal by Homeswest to undertake residential development and drainage works at Amarillo Farm.

Homeswest proposes to make suitable for residential development a large land holding of 3 980 ha, most of which is currently seasonally waterlogged and requires a combination of drainage into the Serpentine River/Peel-Harvey Estuary and filling.

The Amarillo Farm proposal falls within the area covered by the Draft Inner Peel Region Structure Plan (WAPC & Government of Western Australia 1996).

In the EPA's opinion the following are the environmental factors relevant to the proposal:

(a) Surface water;

(b) Wetlands;

(c) Vegetation - System 6

(d) Noise - Serpentine Airfield;

(e) Odour and noise - Piggery;

(f) Groundwater;

(f) Mosquitoes - On-site; and

(h) Mosquitoes - Regional.

The conditions, in the EPA's opinion, to which the proposal should be subject if implemented are in summary:

(a) the proponent should prepare detailed Environmental Management Programmes (EMPs) which address drainage management with particular attention to nutrients (phosphorus and nitrogen), control of discharge to the Serpentine River, and mosquito control. The EMP should incorporate performance monitoring controls;

(b) the proposal should proceed on a staged basis, the proponent demonstrating to the Minister for the Environment on EPA's advice satisfactory performance of the EMPs and EPA requirements before proceeding with subsequent stages. The initial stage should not exceed 10% of the total proposed urban area east of the Serpentine River.

(c) the proposal should meet water quality criteria for phosphorus and nitrogen agreed to by the EPA on advice of the Water and Rivers Commission for drainage to the Serpentine River;

(d) the proponent should complete studies to determine the extent of noise impacts from Serpentine Airfield, the extent of noise and odour impacts from Wandalup Farm, and the extent to which urban uses need to be separated from the proposed Karnup Dandalup groundwater scheme before urbanisation is considered in areas likely to be affected by noise or odour or likely to be within the Karnup Dandalup catchment area;

(e) the proponent's commitments should be made enforceable; and

(f) the proponent should be required to implement an environmental management system.

The procedures, in the EPA's opinion, to which the proposal should be subject if implemented are in summary:

(a) a Technical Review Committee should be established to advise the EPA on the acceptability of the EMPs and performance of implementation;

(b) agreement should be reached with the planning agencies to ensure incompatible land development does not occur in areas affected by excessive noise or odour or which may affect proposed groundwater supplies; and

(c) on-going responsibilities for drainage management should be identified and agreed.

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment note the relevant environmental factors and the EPA objective set for each factor (Section 3).

Recommendation 2

That the Minister for the Environment notes that subject to the satisfactory implementation of the EPA's recommended conditions and procedures (Section 4), including the proponent's environmental management commitments, the proposal can be managed to meet the EPA's objectives.

Recommendation 3

That the Minister for the Environment imposes the conditions and procedures set out in Section 4 of this report. The implementation of the Minister's conditions and procedures are to be audited by the Department of Environmental Protection.

Recommendation 4

That the Minister for the Environment notes:

(i) the scope of this assessment is limited to the proposal as described by the proponent and therefore does not include important matters such as sewage effluent treatment and disposal from the development and impacts from the provision of services to the site such as water, power, gas and transport;

(ii) the advice of the Health Department of Western Australia concerning mosquitoes, and in particular the need for the State Government to consider and implement off-site measures to control mosquito numbers at Amarillo Farm so that the EPA's objectives are most likely achieved; and

(ii) that the planning process, in particular that provided for by amendments to the planning acts and Environmental Protection Act in August 1996 and the Bushplan process, provide the opportunities to ensure that the EPA's objectives for the Vegetation - System 6, Noise - Serpentine Airfield, Odour and noise - Piggery and Groundwater environmental factors are most likely achieved.

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1. Introduction

This report is to provide the Environmental Protection Authority (EPA) advice and recommendations to the Minister for the Environment on environmental factors relevant to the proposal by Homeswest to undertake residential development and drainage works at Amarillo Farm, Karnup.

The proposal was referred to the EPA in February 1995 and the level of assessment set at Public Environmental Review. The Public Environmental Review report, hereinafter called the PER was made available for public review between 22 July 1996 and 16 September 1996.

Further details on the proposal are given in Section 2 of this report. Section 3 discusses environmental factors relevant to the proposal.

Conditions and procedures to which the proposal should be subject if the Minister determines that it may be implemented are set out in Section 4. Section 5 presents the EPA's recommendations to the Minister for the Environment.

Appendix 1 provides figures and maps relating to the proposal. A list of people and organisations that made submissions is included in Appendix 2. Appendix 3 reproduces Water and Rivers Commission (WRC) advice on water quality performance standards and Health Department of Western Australia advice on mosquitoes. References are listed in Appendix 4 and Draft Environmental Conditions appear in Appendix 5.

2. The proposal

The scope of this environmental impact assessment is limited to the proposal to undertake residential development and drainage works at Amarillo Farm as described by the proponent in the PER.

The proposal is located at Karnup between Rockingham and Mandurah, six kilometres inland from the coast (Appendix 1: Figure 1).

The proposal is to make suitable for residential development in a sequential manner a large land holding of 3 980 ha (Appendix 1: Figure 2) most of which is currently seasonally waterlogged (Appendix 1: Figure 1) requiring a combination of drainage into the Serpentine River/Peel-Harvey Estuary and filling.

The proponent would like to commence in Stage A in 3 to 5 years then undertake Stage B (Appendix 1: Figure 2). Amarillo Farm is currently zoned Rural in the Metropolitan Region Scheme and local authority town planning schemes.

Subsoil drains are proposed to be at the Average Annual Maximum Groundwater Level (AAMGL) to minimise groundwater and nutrient transport. Both surface and sub-surface drainage will be directed to large ponds (Appendix 1: Figure 2) to maximise phosphorus retention. A range of other Best Management Practices (BMPs) are proposed to help limit nutrient exports.

The proposal also identifies regional park boundaries for a System 6 recommended area along the Serpentine River. The proposed residential area is in proximity to the Wandalup piggery and Serpentine Airfield and appropriate buffers need to be established. A regional centre and an industry and technology employment area are also proposed (Appendix 1: Figure 2). Two crossings are proposed across the Serpentine River.

The area is expected accommodate a population in the order of 55 000 to 75 000. Development of the area is planned to be staged over more than 20 years.

During the assessment process changes were made to commitments to make them auditable and respond to some environmental concerns, but the overall structure plan (Appendix 1: Figure 2) was not changed.

Table 1. Summary of the proposal

Proposal aspect	Description
Total site area	3 980 ha
Estimated ultimate population	55 to 75 000 people
Life of development phase	20 to 30 years
Area of residential development	1809 ha
Area of regional centre, industry and technology employment area and SECWA easement and active Public Open Space (POS)	433 ha
Area of POS for conservation, regional park, and floodway (includes EPP lakes)	922 ha
Area allocated for POS Drainage function	816 ha
Potential area affected by off-site impacts from Wandalup Farm and Serpentine Airfield	≈ 2 240 ha
Fill requirement	About 7.2 million cubic metres of fill is expected to be required, with about 1.7 million cubic metres being obtained from on-site works. The fill would be placed gradually over the life of the development phase.
Sewerage system	Sewage would be directed to regional treatment facilities in Mandurah.
Adjacent land uses	Adjacent land uses include Special Rural, State Forest and explosives reserve, horticulture and vineyards, and grazing. Uses with off-site impacts which affect the site include the Wandalup Farm Piggery and the Serpentine Airfield. The Draft Inner Peel Region Structure Plan proposes Industrial uses to the south in the long term.

The proposal as described by the proponent does not include matters such as sewage effluent treatment and disposal from the development nor impacts from the provision of services to the site such as water, power, gas and transport. The treatment and disposal of sewage effluent is likely to be an important consideration in the context of the findings of the Southern Metropolitan Waters Study (Department of Environmental Protection 1996) and the policies which apply to the Peel Inlet-Harvey Estuary.

3. Environmental factors

3.1 Relevant environmental factors

In the EPA's opinion, based on the submissions from members of the public and government agencies listed in Appendix 2, the advice of the Water and Rivers Commission and Health Department in Appendix 3 and the references listed in Appendix 4, the following are the environmental factors relevant to the proposal:

(a) Surface water;

(b) Wetlands;

(c) Vegetation - System 6;

(d) Noise - Serpentine Airfield;

(e) Odour and noise - Piggery;

(f) Groundwater;

(g) Mosquitoes - On-site; and

(h) Mosquitoes - Regional.

These relevant factors are discussed in the following Sections 3.2 to 3.9.

3.2 Surface water

Information

Surface waters in the coastal catchment of the Peel-Harvey Estuary, which includes Amarillo Farm, typically contain significant levels of the nutrients phosphorus and nitrogen from fertilisers and human and animal wastes. These waters flow through the Estuary and into the coastal waters, taking the nutrients with them.

Phosphorus and nitrogen are essential for life, including the life of several sorts of algae which grow in the Serpentine River, Peel-Harvey Estuary and coastal waters. These algae can grow and multiply very rapidly with high levels of the nutrients, leading to unacceptable algal blooms.

In the river and estuary the sort of algae which are most likely to grow depend on phosphorus, drawing their nitrogen from the air. These waters already have high concentrations of phosphorus. When these algae die, tides can carry the nitrogen and phosphorus to the near shore coastal waters.

In the coastal waters different (marine) algae are likely to grow which depend on nitrogen. The Southern Metropolitan Coastal Waters Study (Department of Environmental Protection 1996) has found elevated concentrations of nitrogen and chlorophyll-*a* in near-shore waters affected by the outflow from the Estuary.

For these reasons it is important to ensure that the surface water flowing from the site into the Serpentine River has concentrations of phosphorus and nitrogen which are as low as possible and at least conform with established water quality standards.

The Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992 ("the Peel-Harvey EPP") specifies environmental quality objectives for phosphorus at a catchment level and specific performance standards have been prepared for the Amarillo proposal by the WRC (PER Section 12) based on that policy.

No performance standards (target loads or concentrations) have been set for nitrogen for the Peel-Harvey system at this time. The Southern Metropolitan Coastal Waters Study (Department of Environmental Protection 1996) recommends, however, that environmental protection policies and integrated catchment management strategies for the catchment of the Peel-Harvey Estuary should incorporate the objective of minimising nutrient inputs to the coastal waters.

The proponent has proposed a drainage strategy which incorporates BMPs in the residential catchment areas and include ponds to remove nutrients from drainage waters (Appendix 1: Figure 2).

In 1994 the EPA reviewed technical information regarding the likely performance of ponds to remove nutrients (Environmental Protection Authority 1994a). The EPA concluded that "There is a lack of experience in the Perth area with the operation of detention/nutrient stripping ponds and it is difficult to verify their effectiveness in removing nutrients" (Environmental Protection Authority 1994a).

While monitoring has continued at a number of nutrient stripping ponds in the Perth region since 1994, the additional information has not been sufficient to confirm that ponds could provide a long term effective means of phosphorus removal from drainage water.

The Water and Rivers Commission considers that implementation of nutrient stripping ponds together with BMPs outlined in *Planning and management guidelines for water sensitive urban (residential) design* (Environmental Protection Authority, et al. 1994) is likely to reduce phosphorus exports but there is insufficient quantitative data to substantiate this.

The number of variables which affect phosphorus application and then phosphorus export rates make comparisons between different land uses difficult. For example, fertiliser application rates are significantly higher in urban areas than pasture (compare Gerritse, et al. 1990, pg 8 and Arkell 1989, pg 98) but phosphorus export investigations found higher phosphorus concentrations in run-off from pasture (compare Water Authority of Western Australia 1991 and A J Peck and Associates and Associates 1993). Likely variables include ability of the soil to adsorb phosphorus and degree of saturation, availability and flows of transport pathways (i.e. transport in drainage from seasonally waterlogged areas) and phosphorus uptake/export from plants.

In order to keep groundwater flows which can transport nutrients to an acceptable level sub-soil drainage will be set at the Average Annual Maximum Groundwater Level (AAMGL).

A number of public submissions expressed concern that the proposed drainage plan may not adequately control nutrient discharge from the development.

Assessment

The area considered for assessment of this relevant environmental factor is the Serpentine River catchment as defined by the Peel-Harvey EPP.

The EPA's objective in regard to this relevant environmental factor is to "ensure that nutrient discharged from the development:

(a) meets the target level for phosphorus set in the Peel-Harvey EPP, the new water quality standards recommended by the WRC (Appendix 3), and the

(b) nitrogen discharge from the property is not increased beyond existing levels and that future nitrogen discharge meets water quality standards to be agreed by the EPA in consultation with the WRC and DEP; and

(c) that the water quality standards protect the estuary and adjacent coastal waters.

Serpentine River environmental quality objective for the Peel Inlet-Harvey Estuary consistent with performance standards proposed by the WRC and acceptable criteria for nearshore coastal waters".

The EPA notes that the WRC water quality standards for phosphorus have been drafted to ensure the overall Serpentine River catchment target as set by the Peel-Harvey EPP is met. Appendix 3 includes a copy of the WRC water quality standards for phosphorus.

One of the proponent's main arguments in respect of this proposal is that by raising the land surface for residential development phosphorus export would be decreased because the main transport mechanism for phosphorus would be reduced and drainage water would be treated in ponds or by some other means prior to off-site discharge. However, as mentioned above, comparison between land uses is difficult. For this proposal short and long (100 years plus) term phosphorus export predictions could vary significantly being dependent on the continued ability of the soil to adsorb phosphorus and the success of drainage water treatment methods in removing phosphorus so it doesn't reach the Peel-Harvey Estuary.

The WRC have advised that a drainage system based on BMPs and ponds could achieve its specified phosphorus export performance standards which meet the Peel-Harvey EPP (PER 1996, Section 12), but cautions that drainage and nutrient control will be particularly difficult to manage and has inherent risks (Water and Rivers Commission 1996).

The Water and Rivers Commission and Peel Inlet Management Authority have not objected to the proposal proceeding subject to a number of recommendations (Water and Rivers Commission 1996). These include:

- groundwater monitoring and modelling;
- appropriate design of nutrient stripping ponds;
- preparation of a drainage management Environmental Management Programme;
- adoption of the WRC's water quality performance standards for drainage;
- filling of land and setting drains at the AAMGL; and
- the development being staged with adequate demonstration of the effectiveness of the drainage system before each subsequent stage proceeds.

The AAMGL has not yet been determined for Amarillo Farm, but this is a technical matter that can be resolved between the proponent and WRC.

The proponent has given a commitment to investigate and develop alternative phosphorus removal technologies, such as chemical treatment, if water quality standards are not met.

The general use of bauxite residue for sub-soil drainage, as is proposed by the proponent, has not been assessed by the EPA (Environmental Protection Authority 1993b) but in this instance constitutes a trial.

It also noted that the long term effectiveness of nutrient stripping ponds is yet to be determined.

The EPA notes that much of the detail for drainage management (such as the design of trials, ensuring artificial wetlands do not create an insect nuisance for adjacent residents and setting of the AAMGL) is proposed to be dealt with by the proponent through an Environmental Management Programme (EMP). However, some key aspects such as preparing a numerical model or other suitable analysis and forecasting techniques to determine the drainage management requirements of the site following development have not been proposed to be addressed by the proponent in the EMP.

The EPA notes that the PER has not considered the management of nitrogen discharge from the property. In view of the findings of the Southern Metropolitan Coastal Waters Study (Department of Environmental Protection 1996), the EMP should include proposals for management of nitrogen, and criteria to be achieved. These should be consistent with the recommendations of the Southern Metropolitan Coastal Waters Study (Department of Environmental Protection 1996).

The Water Corporation has indicated that it is interested in providing and operating main drainage services including nutrient removal for the area subject to appropriate funding. The

Water Corporation has supported the establishment of a Technical Review Committee to advise on the adequacy of EMP's and performance implementation.

The EPA has noted the Water Corporation's suggestion that Dirk Brook (Appendix 1: Figure 2) be integrated into Amarillo's proposed drainage system. The EPA generally supports this position.

Having particular regard to:

(a) the uncertainty associated with changes to nutrient export from changes in land use and the likely performance of nutrient stripping ponds and BMPs;

(b) the need to demonstrate the success or otherwise of nutrient stripping ponds and BMPs in an urban setting;

(c) the WRC's advice and the view of others particularly that if the proposal proceeds there should be a staging of development with the effectiveness of the nutrient removal systems being reviewed and assessed prior to proceeding with each subsequent stage;

(d) the proponent's commitments, in particular to prepare EMPs and to investigate and develop alternative treatment systems if the initial stage does not meet performance criteria;

it is the EPA's opinion that staging of the development is required to ensure the EPA's objectives are likley to be met. The initial stage of development should not exceed 10% of the total area east of the Serpentine River planned for urban development, as indicated by Stage B (Appendix 1: Figure 2). The proponent should be required to demonstrate that the EMP has been implemented and agreed water quality criteria met before subsequent stages proceed.

It is the EPA's opinion that EMPs should be prepared prior to development works commencing east of the Serpentine River and every five years thereafter, and prior to commencement of works beyond Stage B. The EMPs should include but not be limited to consideration of:

- appropriate modelling and forecasting of nutrient loads based on proposed drainage designs;
- the matters raised in commitments 1 to 4 (Appendix 5);
- performance monitoring with respect to pond efficiency and nutrient export to the Serpentine River;
- other biophysical, pollution and social matters considered appropriate; and

be prepared with public review to the requirements of the EPA.

It is the EPA's opinion that the WRC performance criteria for phosphorus should be adopted. A Technical Review Committee should be established to advise the EPA on the adequacy of the EMPs and their subsequent implementation.

3.3 Wetlands

Information

Two river pools on the Serpentine River are Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 lakes (EPP lakes), and some EPP lakes are located near the eastern boundary of Amarillo Farm (Appendix 1: Figure 3).

The Serpentine River and its associated pools have been included in Regional Park proposals (See Section 3.4 Vegetation - System 6 below).

The proposal will alter drainage into the EPP lakes on the Serpentine River, and subsoil drainage could potentially affect water levels in wetlands along the eastern boundary.

The EPP lakes policy requires the EPA to consider impacts of drainage into and out of EPP lakes.

Assessment

The area considered for assessment of this relevant environmental factor is Amarillo Farm, the EPP lakes on the Serpentine River and beyond and the EPP lakes near the Farm's eastern boundary.

The EPA's objective in regard to this relevant environmental factor is to "ensure Environmental Protection Policy lakes are protected and their key ecological functions are maintained".

There have been significant changes to the natural flows of the Serpentine River since European settlement from changes in land use in its extensive catchment area. Changes to flows from changes to land use at Amarillo Farm are likely to be insignificant given the size of the river's catchment.

The proposed drainage and water management strategies for Amarillo are expected to:

- reduce autumn flows and peak flows into the river as these will be retained in the ponds;
- increase flow durations at moderate flow rates; and
- reduce total nutrient loads into the river, particularly during autumn when flows are typically high in nutrients;

It is the EPA's opinion that the potential net environmental benefits from improved water quality outweigh the potential adverse impacts from minor changes to river flows.

Use of the AAMGL drainage criteria should ensure protection of EPP lakes near the eastern boundary of Amarillo Farm from changes to water levels.

Having particular regard to:

(a) the nature of the EPP wetlands along the Serpentine River;

(b) the likely effect of drainage management proposals on water quality and flows; and

(c) the proposed subsoil drainage levels;

it is the EPA's opinion that its objective for wetlands is most likely to be met by the proposal, provided the development is staged with adequate demonstration of the effectiveness of the drainage system before each subsequent stage proceeds.

3.4 Vegetation - System 6

Information

Amarillo Farm is mostly cleared. The only remaining indigenous vegetation includes a small area of very degraded Banksia woodland, some individual trees in paddocks and some vegetation along the Serpentine River.

The System 6 report notionally identified the Serpentine River and its associated floodplain and vegetation as regionally significant (area M108) and recommended "Areas identified through planning procedures as open space of regional significance should, where appropriate, be designated as Regional Parks".

Boundaries for a Regional Park along the Serpentine River have since been suggested by the proponent (Bowman Bishaw Gorham 1992, PER 1996) and planning agencies (Department of Planning and Urban Development 1993a, 1993b & WAPC and Government of Western Australia 1996). The System 6 boundary, the most recently proposed Regional Park boundary and the proponent's boundary in the PER are shown in Appendix 1: Figure 4. Each proposed boundary includes most or all of the vegetation along the Serpentine River.

The discussion paper *Peel Regional Park, Proposals for establishment, administration and use* (Department of Planning and Urban Development 1993a) proposed that joint management of the park should occur between Peel Inlet Management Authority (PIMA), the Department of Conservation and Land Management and local authorities, with PIMA having a coordinating role in the preparation of management plans.

Boundaries for areas with regionally significant vegetation are being resolved through the System 6 Update/Urban Bushland Strategy Plan process (hereinafter called the Bushplan) which incorporates a whole of government approach involving the EPA, National Parks and Nature Conservation Authority and Western Australian Planning Commission. The results of this process for the Metropolitan Coastal Plain are expected to be published for public comment in mid 1997, and are expected to follow for the Peel Region about a year later.

The Peel Region Scheme, which is currently in preparation and is to be subject to environmental review, can provide the statutory mechanisms to implement the Bushplan recommendations. Amarillo will not be able to commence until after scheme amendments to the Shire of Murray and City of Rockingham's Town Planning Scheme, and in the case of the City of Rockingham the Town Planning Scheme amendment would need to be preceded by a scheme amendment to the Metropolitan Region Scheme. All scheme amendments require referral to the EPA.

Any boundaries determined through scheme amendments would have regard for the floodway as identified by the WRC.

Assessment

The area considered for assessment of this relevant environmental factor is the Swan Coastal Plain.

The EPA's objective in regard to this environmental factor is that "to ensure that regionally significant flora and vegetation communities in System 6 area M108 is adequately protected".

Having particular regard to:

(a) the findings of previous discussion papers published by the State Government regarding the proposed Peel Regional Park;

(b) the Bushplan process;

(b) the scheme amendment process;

it is the EPA's opinion that these processes would provide opportunities to ensure that the EPA's objective for this environmental factor is most likely to be met.

3.5 Noise - Serpentine Airfield

Information

Public submissions identified this environmental factor. Recent DEP investigations suggest unacceptable noise impacts from the Serpentine Airfield (Appendix 1: Figure 1) could extend up to 2 km into the north-east corner of Amarillo.

The EPA position on separating incompatible land uses such as airports and residential areas is documented (See Environmental Protection Authority 1992 & Environmental Protection Authority 1993a).

Assessment

The area considered for assessment of this relevant environmental factor is Amarillo Farm.

The EPA's objective for this environmental factor is to "ensure that where the L_{Amax} exceeds 65 dB(A) or the L_{dn} exceeds 60 dB(A) from an existing airfield, new residential areas should be located outside these areas so that the welfare and amenity of those new residents are not adversely affected".

The proponent has not made a commitment in relation to noise from the Serpentine Airfield, but has for the Wandalup piggery.

It is expected to be five to ten years before the proponent wishes to develop areas likely to be affected by airport noise.

The Peel Region Scheme which is currently in preparation and will be subject to environmental review can provide the statutory mechanisms to ensure urban development is not located in noise impact zones. Schemes can include clauses which ensure recommended separation distances are implemented and not reduced unless studies are completed which justify a reduced separation distance. Furthermore, development at Amarillo will not be able to commence until after scheme amendments occur. All scheme amendments require referral to the EPA.

Having particular regard to:

(a) advice from the DEP that unacceptable noise impacts could extend up to two kilometres into the north-eastern corner of Amarillo Farm;

(b) the proposed staging of the development; and

(b) existing scheme amendment and planning approval processes;

it is the EPA's opinion that the scheme amendment process and completion of a noise study by the proponent at an appropriate phase of the planning approvals process can ensure that the EPA's objective is most likely to be met.

3.6 Odour and noise - Piggery

Information

The largest piggery in Western Australia lies to the south of Amarillo (Appendix 1: Figure 2). Over 5 000 pigs are catered for at the Wandalup Piggery. Off-site impacts from piggeries include odour and noise.

The basis for and the EPA position on separating incompatible land uses is documented (See Environmental Protection Authority 1994b & Environmental Protection Authority 1995 respectively). In summary, where residential development is proposed closer than recommended separation distances and the industry is operating to industry standards and/or licence conditions, the onus should be on the residential developer to show that impacts on future residents would be acceptable. If this can not be demonstrated using scientific studies which meet EPA or DEP standards then development within the buffer zone should not proceed.

The Department of Agriculture's *Environmental management guidelines for animal based industries: Piggeries* (Ryan and Payne 1989) provides appropriate guidelines regarding the separation of incompatible land uses such as residential areas from piggeries. In summary, a separation distance of 5 km is recommended between a piggery and its facilities which caters for more that 5 000 pigs and the nearest townsite boundary (i.e. residential area).

Assessment

The area considered for assessment of this relevant environmental factor is the Wandalup Piggery and land within 5 km radius of the piggery (Appendix 1: Figure 2). This includes a significant portion of Amarillo Farm.

The EPA's objective for this relevant environmental factor is to "ensure that for the existing odour and noise producing land use (ie. Wandalup Farm piggery), new residential areas should be located so that the welfare and amenity of those new residents are not adversely affected".

The proponent's commitments in relation to noise and odour from the Wandalup Farm piggery suggest a separation distance to residential development from the piggery two kilometres less than recommended by Agriculture Western Australia and the EPA.

The staging plan for Amarillo means that it would be five to ten years before the proponent wishes to develop stages likely to be affected by Agriculture Western Australia's and EPA's recommended separation distance.

The Peel Region Scheme which is currently in preparation and would be subject to environmental review can provide the statutory mechanisms to ensure urban development is not located in within the recommended separation distance from the piggery. Schemes can include clauses which ensure recommended separation distances are implemented and not reduced unless studies are completed which justify a reduced separation distance. Furthermore, development at Amarillo will not be able to commence until after scheme amendments occur. All scheme amendments require referral to the EPA.

Having particular regard to:

(a) Agriculture Western Australia's recommended separation distances for piggeries;

(b) the proposed staging of the development;

(c) the lesser buffer distance in the proponent's commitment which does not meet the established criterion;

(d) the need for further study should a reduction of the separation distance be sought; and

(e) existing scheme amendment and planning approval processes;

it is the EPA's opinion that the scheme amendment process and completion of a noise and odour study by the proponent at an appropriate phase of the planning approvals process would provide opportunities to ensure that the EPA's objective is most likely to be met.

3.7 Groundwater

Information

The proposal lies on the western edge of the Karnup Dandalup groundwater mound and groundwater flows westwards in this area off the mound. Land adjoining the eastern boundary of Amarillo is proposed as a future groundwater abstraction/public water supply area by the WRC. Development at the site's eastern boundary is not expected to pollute the groundwater abstraction area unless bores are located along or near the boundary and drawdowns caused localised reversal of the regional groundwater flow. The Water Corporation advised that firm bore locations have not been determined. The WRC has not objected to urban development along the eastern boundary as proposed by the proponent.

Assessment

The area considered for assessment of this relevant environmental factor is that area currently identified as the future Karnup Dandalup Public Water Supply Area and the portion of Amarillo Farm located adjacent to and within the potential drawdown zone from it.

The EPA's objective for this relevant environmental factor is "to ensure that groundwater resources used for public water supply are protected in accordance with NHMRC guidelines and that land uses which could affect both the quality and quantity of groundwater are appropriately controlled."

Agreement by the proponent to provide a 100 m buffer zone along the eastern boundary is expected to assist in ensuring this objective can be met. The proponent's adoption of the AAMGL should ensure drawdown of water levels in the proposed wellfield from subsoil drains is not significant. However, further analysis is required to determine how far the well capture zones are likely to extend in relation to the Amarillo boundary. This will require a study to ensure compatibility.

The Peel Region Scheme which is currently in preparation and would be subject to environmental review can provide the statutory mechanisms to ensure urban development is not located in drawdown zones of the proposed public water supply area. Schemes can include clauses which ensure development does not occur near the proposed public water supply boundary unless studies are completed which determine the required separation distance. Furthermore, development at Amarillo will not be able to commence until after scheme amendments occur. All scheme amendments require referral to the EPA.

Having particular regard to:

(a) the regional groundwater flow;

(b) the possibility of bores being located adjacent to Amarillo and drawdown cones extending into Amarillo;

(c) the proposed staging of the development; and

(d) existing scheme amendment and planning approval processes;

it is the EPA's opinion that the scheme amendment process and completion of a groundwater study by the proponent at an appropriate phase of the planning approvals process provide opportunities to ensure that the EPA's objective is most likely to be met.

3.8 Mosquitos - On-site

Information

Mosquitoes - On-site were identified by the EPA as a relevant environmental factor subsequent to the public submissions phase of the PER, following a detailed submission by the Health Department of Western Australia (Appendix 3).

The Health Department (on behalf of the Mosquito Control Advisory Committee) expressed concern that "mosquitoes will seriously threaten the health and lifestyle of prospective Amarillo residents", and proposed a number of recommendations to be implemented if the Amarillo residential development proceeds.

Regarding mosquitoes on-site, concern was expressed that:

- Freshwater mosquitoes can breed successfully without predation in thick vegetation, which may be proposed in the drainage ponds;
- Freshwater mosquitoes can carry Ross River or Barmah Forest virus;
- Freshwater mosquitoes move significant distances and are not affected by vegetation barriers; and
- Kangaroos are a host for the Ross River and Barmah Forest viruses and may remain in the drainage corridors following urbanisation.

The Health Department's recommendations included that there be no dense vegetation in the drainage ponds, that a Health Department representative be on the Technical Review Committee advising on the EMP to influence drainage pond design, and that the proponent be required to monitor mosquitoes and Ross River virus.

Assessment

The area considered for assessment of this relevant environmental factor is Amarillo Farm and its associated drainage system.

The EPA's objective for this relevant environmental factor is to "to ensure the breeding of mosquitoes is controlled to the satisfaction of the Health Department of Western Australia without adversely affecting other flora and fauna".

The proponent did not make any commitments in regard to this relevant environmental factor.

Having the Health Department on the Technical Review Committee (previously discussed in Section 3.2 above) should enable the ponds to be built in a manner which minimises mosquito breeding and hence the need to use other control methods which could adversely affect other flora and fauna. However, monitoring of mosquitoes would be required to determine the success (or otherwise) of pond building to minimise mosquito breeding.

Having particular regard to:

(a) the advice and recommendations of the Health Department of WA; and

(b) the proposed staging of the development;

it is the EPA's opinion that the proposed development can be managed to meet its objective provided that:

(a) the EMP includes a requirement to develop and implement a mosquito monitoring plan to the satisfaction of the Health Department of WA;

(b) a representative of the Health Department of WA is included on the Technical Review Committee; and

(c) the development is staged with adequate demonstration of the effectiveness of mosquito control before each subsequent stage proceeds.

3.9 Mosquitoes - Regional

Information

The tidal regime in the Peel-Harvey Estuary means that saltmarsh mosquitoes breed in a fortnightly cycle within one kilometre of Amarillo. Saltmarsh mosquitoes disperse up to 10 km from breeding sites regardless of vegetation barriers and some species bite throughout the day. High numbers of saltmarsh mosquitoes (in excess of 100 human biting mosquitoes per trap) have been recorded at Amarillo Farm by the Health Department, despite control efforts.

Saltwater mosquitoes can carry Ross River and Barmah Forest virus. Kangaroos are a host for these viruses and may remain in the drainage corridors following urbanisation.

The Health Department on behalf of the Mosquito Control Advisory Committee has advised that "mosquitoes will seriously threaten the health and lifestyle of prospective Amarillo residents", and proposed a number of recommendations to be implemented if the Amarillo residential development proceeds. In particular it was recommended that the proponent runnel salt-marshes from Lake Goegrup northwards.

Assessment

The area considered for assessment of this relevant environmental factor is the salt-marshes south to Goegrup Lake.

The EPA's objectives for this relevant environmental factor are:

- "that mosquitoes numbers on the site should not adversely affect the health, welfare and amenity of future residents"; and

- "to ensure the breeding of mosquitoes is controlled to the satisfaction of the Health Department of Western Australia without adversely affecting other flora and fauna".

Runnelling as a mosquito control measure has not yet been assessed by the EPA. A study into the ecological effects of runnelling found that acidification did not occur but there was a minor decrease in pH, lower concentrations of NH_4^+, an increased abundance of phytoplankton, primary and secondary consumers, and no significant differences in saltmarsh plant biomass or bird abundance (Latchford 1996).

It is the EPA's opinion that the Minister for the Environment should note the advice of the Health Department of Western Australia concerning mosquitoes, and in particular the need for the State Government to consider and implement off-site measures to adequately control mosquito numbers at Amarillo Farm so that the EPA's objectives are achieved.

4. Conditions and procedures

In the EPA's opinion, the proposal should be subject to the following conditions and procedures if implemented:

4.1 Conditions

In the EPA's opinion, the proposal should be subject to the following conditions if implemented:

(a) The proponent's commitments set out in the PER and as subsequently modified during the assessment process (Appendix 5) should be made enforceable conditions;

(b) The proponent's EMP (refer Appendix 5: Commitment 1) must address the relevant environmental factors and any other reasonable environmental matters and shall include for each stage at least those of the following which the EPA considers necessary and applicable to that stage:

(i) a numerical model or other suitable analysis and forecasting techniques developed to determine the drainage management requirements of the site following development;

(ii) an estimate of existing nutrient mass balance of the site based on detailed on-site measurements;

(iii) proposed post-development nutrient mass balance based on the monitoring results of existing nutrient stripping ponds (on other sites) and other nutrient management measures being proposed by the proponent;

(iv) a comparison of the results of the predicted mass and water balances to proposed water quality criteria for the development;

(v) a range of other biophysical, pollution and social matters as the proponent or EPA sees appropriate;

(vi) a mosquito monitoring program, to the requirements of the EPA on advice from the Health Department of Western Australia. The mosquito monitoring program should be reviewed every 5 years; and

(vii) reference to phosphorus and nitrogen standards to be achieved by the development and agreed to by the EPA on advice of the WRC.

Where in the preparation of the EMP for a particular stage the proponent considers that any of the above does not apply to that stage written confirmation that the EPA is of that view must be sought before the EMP is submitted and the EMP submitted must conform with the EPA's determination.

The EMP should be prepared to the satisfaction of the EPA on advice from the Technical Review Committee (see procedures).

(c) The proposal should proceed on a staged basis with the "initial stage" not exceeding 10% of the total proposed urban area east of the Serpentine River, as identified by Stage B (refer Appendix 1: Figure 2). The proponent should be required to demonstrate that the EMP (Condition (b)) has been implemented and the agreed water quality criteria have been met to the requirements of the Minister for the Environment on advice of the EPA before each stage subsequent to the "initial stage" is commenced.

(d) In order for the EPA to formulate its advice for condition (c) for each subsequent stage, the proponent should prepare and publish an EMP report available for public comment which reports on the performance of the drainage management system to the requirements of the EPA, prior to each subsequent stage. Public comments would be directed to the EPA which may require that the EMP be amended.

(e) The initial phosphorus water quality criteria adopted for this proposal be:

(i) flow weighted annual average total phosphorus concentration of discharging water less than 0.075mg L^{-1}; or

(ii) total mass of phosphorus entering the Serpentine River less than 0.225 kilograms of phosphorus per hectare per annum.

These criteria can be reviewed through the EMP process for each subsequent stage of development.

(f) The proponent should recommend water quality criteria for nitrogen in the EMP which ensure that the nitrogen load from the property is reduced as far as is practicable. This should be to the satisfaction of the EPA on advice from the Technical Review Committee (see procedures).

(g) Prior to seeking approval to urbanise the area indicated by crosshatching in Appendix 1: Figure 2 the proponent should undertake a study to determine the extent of the L_{Amax} 65 dB(A) and L_{dn} 60 dB(A) contours which takes into account the various circuit patterns and different aircraft types in order to determine the worst case contours, to the requirements of the EPA on advice of the DEP and WAPC.

(h) Prior to seeking approval to urbanise the area indicated by hatching in Appendix 1: Figure 2 the proponent should undertake a study to determine the extent of odour and noise impacts from the Wandalup Farm Piggery, to the requirements of the EPA on advice of the DEP and WAPC.

(i) Prior to seeking approval to urbanise land adjacent to the proposed Karnup/Dandalup groundwater scheme area, the proponent should liaise with the WRC to determine areas of the site which could impact on the groundwater scheme and undertake any studies required to the requirements of the EPA.

(j) The proponent should be required to prepare and implement an environmental management plan addressing the implementation of the project so as to ensure the EPA's objectives for the relevant environmental objectives (Section 3) are met. The system should be consistent with the principles adopted in the AS/NZS ISO 14000 (1996) series, including monitoring and auditing and a commitment to continuous improvement.

4.2 Procedures

In the EPA's opinion, the proposal should be subject to the following procedures (which generally complement the conditions above) if implemented:

(a) A Technical Review Committee should be established to advise the EPA on the adequacy of EMP documents prepared by the proponent. Membership to include WRC, DEP,

Health Department and other key agencies (e.g. CALM) with drainage operators (i.e. proponent, local authorities) as observers.

(b) A procedure should be developed with the Minister for Planning and WAPC to ensure only compatible land uses occur in areas affected by noise and odour levels which exceed standards for residential areas, or in areas which could impact on the proposed Karnup/Dandalup groundwater scheme.

(c) A procedure should be established to identify ongoing management bodies responsible for monitoring, managing and operating the drainage system to ensure the relevant environmental criteria are met.

5. Recommendations

The EPA submits the following recommendations:

Recommendation 1

That the Minister for the Environment note the relevant environmental factors and the EPA objective set for each factor (Section 3).

Recommendation 2

That subject to the satisfactory implementation of the EPA's recommended conditions and procedures (Section 4), including the proponent's environmental management commitments, the proposal can be managed to meet the EPA's objectives.

Recommendation 3

That the Minister for the Environment imposes the conditions and procedures set out in Section 4 of this report. The implementation of the Minister's conditions and procedures are to be audited by the Department of Environmental Protection.

Recommendation 4

That the Minister for the Environment notes:

(i) the scope of this assessment is limited to the proposal as described by the proponent and therefore does not include important matters such as sewage effluent treatment and disposal from the development and impacts from the provision of services to the site such as water, power, gas and transport;

(ii) the advice of the Health Department of Western Australia concerning mosquitoes, and in particular the need for the State Government to consider and implement off-site measures to control mosquito numbers at Amarillo Farm so that the EPA's objectives are most likely achieved; and

(ii) that the planning process, in particular that provided for by amendments to the planning acts and Environmental Protection Act in August 1996 and the Bushplan process, provide the opportunities to ensure that the EPA's objectives for the Vegetation - System 6, Noise - Serpentine Airfield, Odour and noise - Piggery and Groundwater environmental factors are most likely achieved.

Table 2. Summary of relevant factors, objectives, proponent's commitments and EPA's opinions.

Relevant Factor	EPA objective	Proponent's commitments	EPA's opinions
Surface water	Ensure that nutrient discharged from the development: (a) meets the target level for phosphorus set in the Peel-Harvey EPP, the new water quality standards recommended by the WRC (Appendix 3), and the (b) nitrogen discharge from the property is not increased beyond existing levels and that future nitrogen discharge meets water quality standards to be agreed by the EPA in consultation with the WRC and DEP; and (c) that the water quality standards protect the estuary and adjacent coastal waters.	Environmental Management Programme (EMP) to be developed. Contingency plan to be developed Implementation of Best Management Practices. Average Annual Maximum Groundwater Level as base for subsoil drains, Only 10% developed until water quality criteria met.	More detail required as to what goes in EMP regarding nutrients - particularly phosphorus and nitrogen. EMPs to permit review of water quality criteria, include additional environmental factors and be available for public comment. Agreement to Water & Rivers Commission phosphorus performance criteria. Minister for Environment on EPA's advice to determine if performance satisfactory for subsequent stages to proceed. Technical Review Committee needed to advise EPA. Outcome oriented staged approach likely to meet EPA's objectives.
Wetlands:	Ensure Environmental Protection Policy (EPP) lakes are protected and their key ecological functions are maintained.	Average Annual Maximum Groundwater Level as base for subsoil drains to limit volume into the riverine EPP lakes and change to water levels in eastern EPP lakes. Ponds to improve water quality.	Project likely to meet EPA's objective.
Vegetation - System 6:	Where possible, impacts upon regionally significant flora and vegetation communities in System 6 area M108 are avoided.	Protect regional park once defined.	Bushplan process should ensure EPA's objective likely to be met.

Table 2. Summary of relevant factors, objectives, proponent's commitments and EPA's opinions.

Noise - Serpentine airfield:	Ensure that where the L_{Amax} exceeds 65 dB(A) or the L_{dn} exceeds 60 dB(A) from an existing airfield, new residential areas should be located outside these areas so that the welfare and amenity of those new residents are not adversely affected.	None	Proponent to do study and planning process to prevent incompatible land uses so that the EPA's objective is likely to be met.
Odour and noise - Piggery:	Ensure that for the existing odour and noise producing land use (ie. Wandalup Farm piggery), new residential areas should be located so that the welfare and amenity of those new residents are not adversely affected.	Commitment includes reference to 3 km separation between piggery and residential land use.	Agriculture Western Australia and EPA recommend 5 km separation between piggeries and residential land use. Proponent to do study and planning process to prevent incompatible land uses so that the EPA's objective is likely to be met.
Groundwater	To ensure that groundwater resources used for public water supply are protected in accordance with NHMRC guidelines and that land uses which could affect both the quality and quantity of groundwater are appropriately controlled..	One hundred metre separation between proposed public water supply boundary and urban land use.	Proponent to do study and planning process to prevent incompatible land uses so that the EPA's objective is likely to be met.
Mosquitoes - On-site:	Control the breeding of mosquitoes without adversely affecting other flora and fauna.	None	Health Department of Western Australia to be on Technical Review Committee so designs minimise mosquito breeding and hence need for other control measures so that the EPA's objective is not compromised. EMP to include mosquito and Ross River virus monitoring programme.
Mosquitoes - Regional:	Mosquitoes numbers on the site should not adversely affect the health, welfare and amenity of future residents.	None	Minister for the Environment to note Health Department of Western Australia's advice that the State government will need to consider and implement off-site mosquito control measures.

Appendix 1
Figures

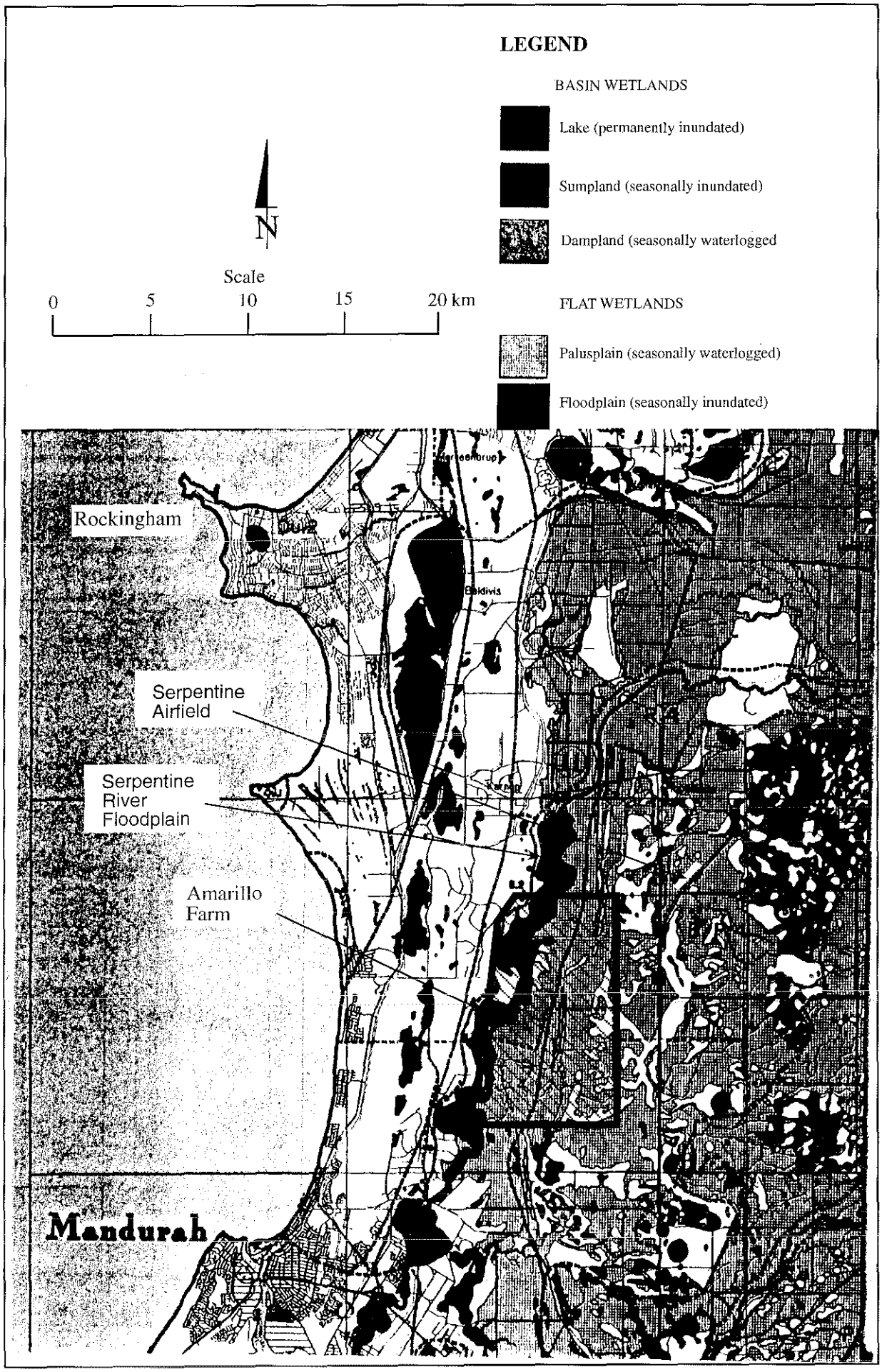

Figure 1. Location of Amarillo farm highlighting its location on palasplain (ie seasonally waterlogged land) and the proximity of Serpentine airfield (Source: Adapted from Water Authority of WA, 1992).

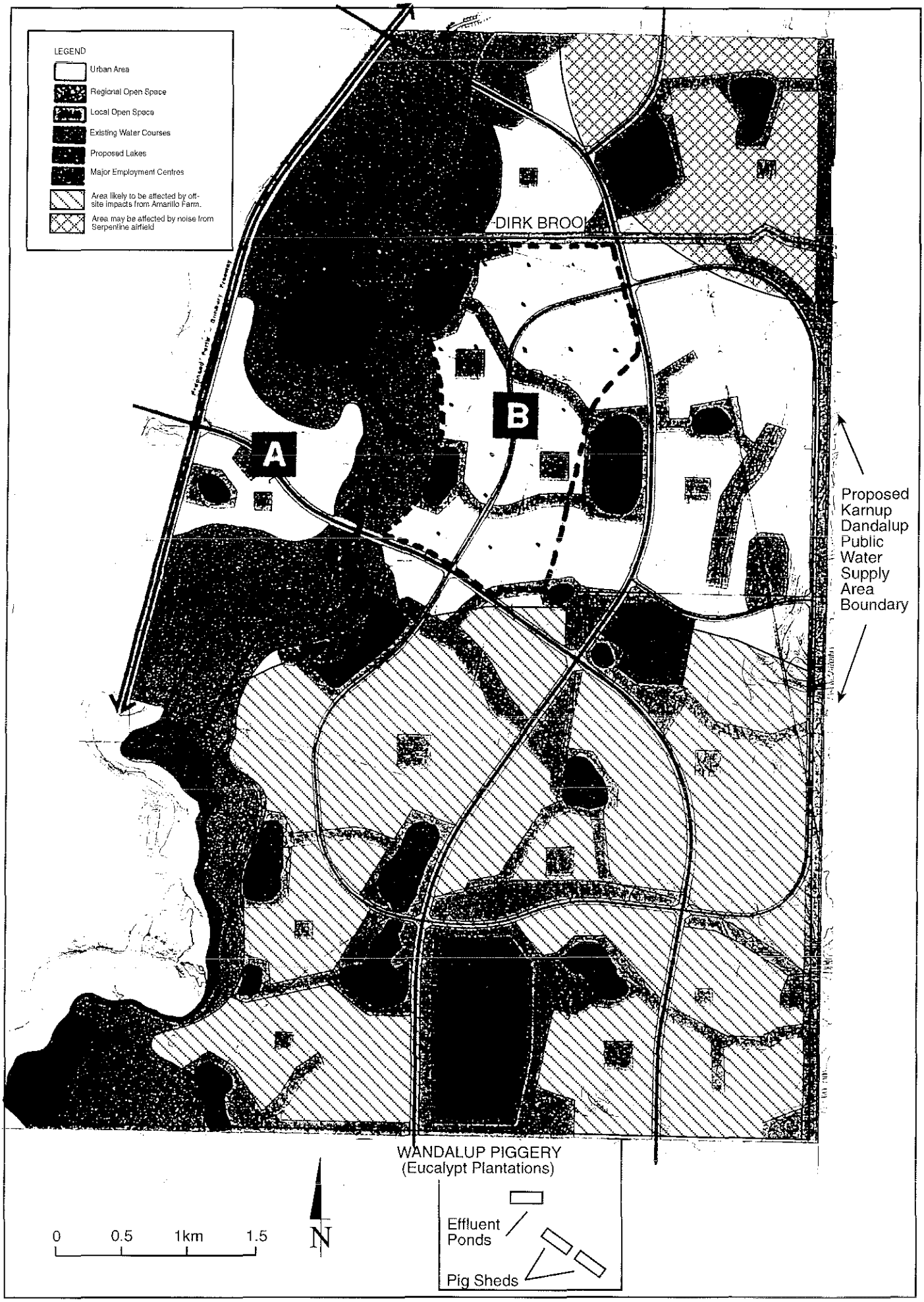

Figure 2. Staging and structure plan for Amarillo farm residential development showing location of Wandalup piggery, Serpentine airfield buffer and proposed public water supply boundary.

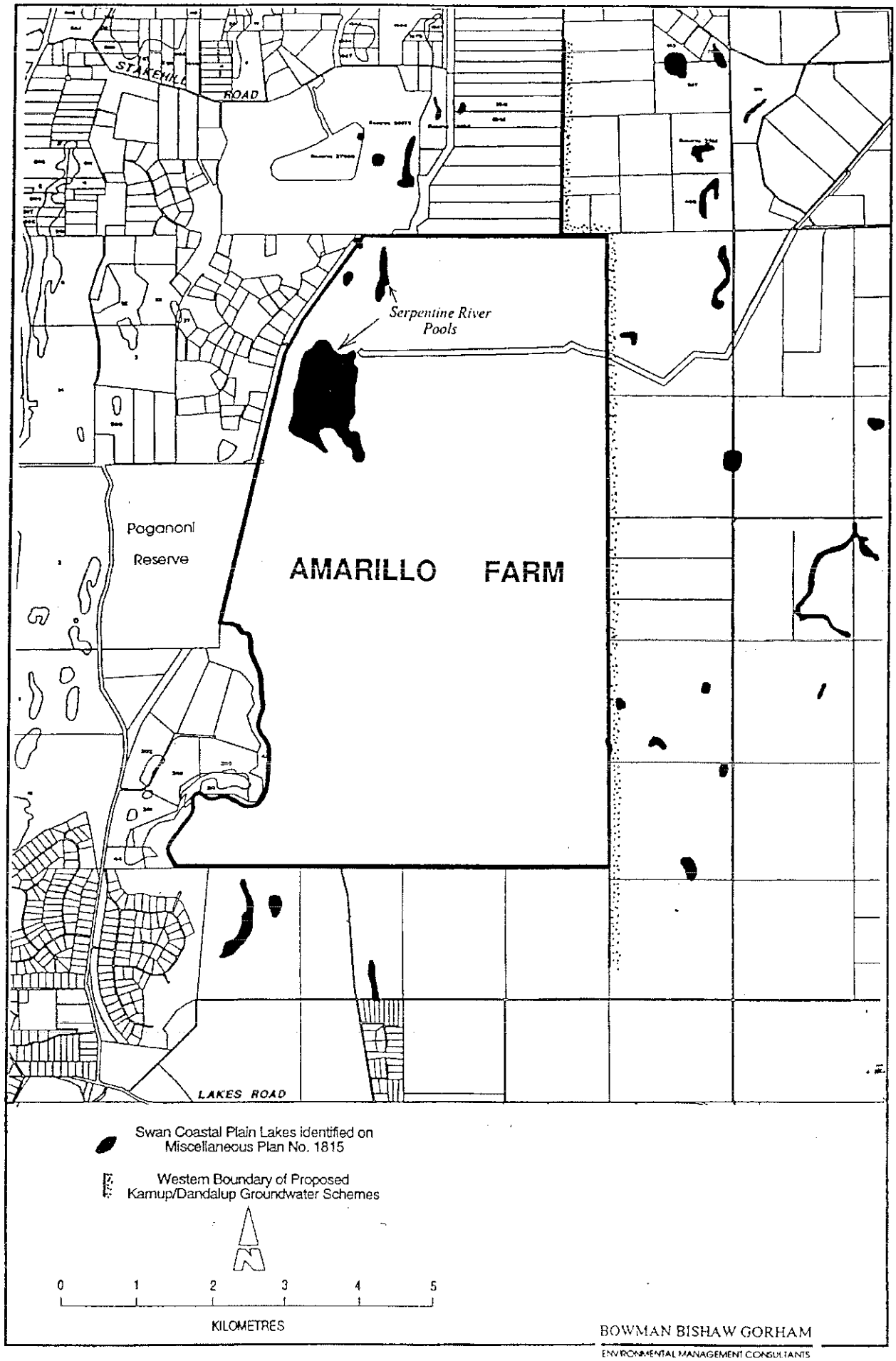

Figure 3. Environmental Protection Policy lakes (Source: Homeswest Amarillo Project Strategic Structure Plan PER

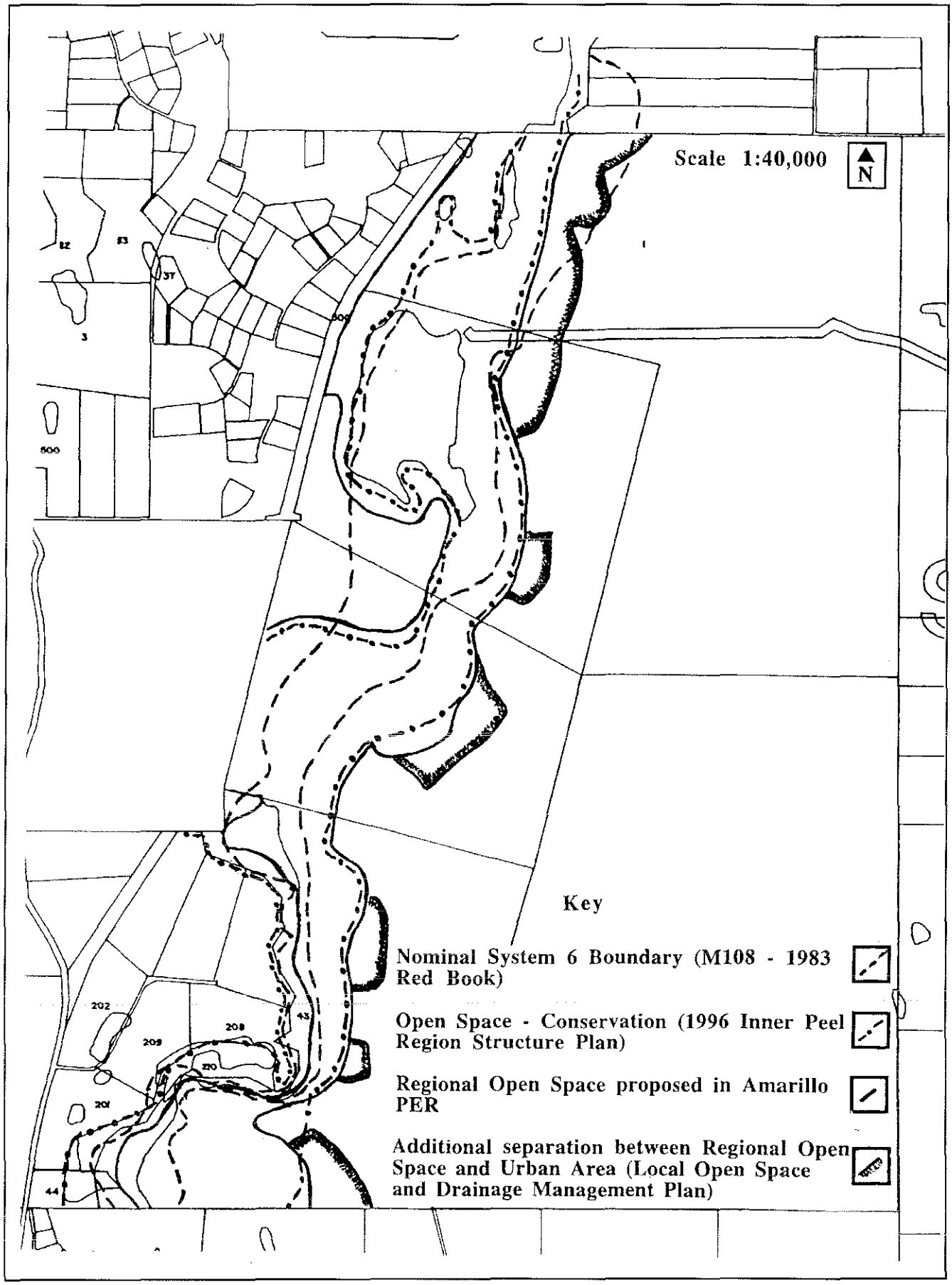

Figure 4. System 6, Inner Peel Region Plan and Amarillo PER boundaries (Serpentine River Open Space).

Appendix 2

List of submitters

State and local government agencies

Agriculture Western Australia
City of Mandurah
City of Rockingham
Department of Conservation and Land Management
Department of Minerals And Energy
Health Department of Western Australia
Ministry for Planning
Shire of Murray
Shire of Serpentine-Jarrahdale
Water and Rivers Commission
Water Corporation
Western Power

Members of the public

Baldivis Community Association
Conservation Council of WA
TJ & MA Lockwood
Conservation of Rockingham and Kwinana's Environment (Inc)
Ms S Pilkington (& 7 other signatures)
Peel Preservation Group
Ms C Richardson
Sport Aircraft Builders Club of WA Inc
Mr J Wunderwald

Appendix 3

Significant advice from WRC and Health Department of Western Australia

Water and Rivers Commission
Recommended Amarillo phosphorus Strategy

Objective

The Water and Rivers Commission recommends that the management of surplus water at the Amarillo subdivision should include best management practices to ensure that phosphorus and water discharges from the site are minimised. Setting a phosphorus export target as the primary objective may tell against minimising phosphorus export and is not recommended. However a standard is required as a performance guarantee and as a trigger to invoke additional control measures to limit phosphorus export.

Best Management Practice

The minimum components of a BMP system are listed below. The BMP system must be designed for approval during the EMP phase.

Best practice is to include;

- detailed studies and modelling of the water and phosphorus balances on the site to optimise design of the management systems.
- riparian vegetation along the drains to trap sediment, prevent erosion and assimilate phosphorus and other deleterious substances
- wetlands to strip nutrients and trap sediments
- a drainage system designed to minimise lowering of groundwater levels by keeping drains above the AAMGL.
- extensive tree plantings in POS and reserves to maximise evaporation and transpiration.
- local use of groundwater to reduce the water table levels and minimise drain flows, preferably including a public irrigation water supply based on local wells.
- sewers to collect all wastewater
- extensive riparian vegetation protection along the Serpentine River.
- "continuous" measurement of phosphorus and water flow in drain outlets from the developed urban areas until there is confidence in the performance of the drainage system.
- conduct trials of alternative treatments to demonstrate that the phosphorus criteria are met and to refine the practice to reduce phosphorus levels further, as far as is practical and economic.

Performance Standard

The BMP approach must be backed by performance standards to protect the Serpentine River and ensure that the practices are properly designed and operated. If the BMP system fails to achieve a flow weighted annual average total phosphorus concentration of discharging waters less than 0.075 mg/L or a total mass of phosphorus entering the Serpentine River less than 0.225 kgP/ha/a additional measures must be employed to reduce the phosphorus levels below those levels.

The Commission believes that phosphorus levels well below these levels will be achieved with the BMP approach.

Appendix 1 - Background to acceptable phosphorus export criteria

General Drain Water Quality

Generalised phosphorus criteria for drains (OCM publication "Catching the Slug" June 1992) includes the following.

phosphorus (mg/L)	Class
less than 0.05	pristine
0.05 to 0.15	Low
0.15 to 0.25	Moderate
0.25 to 0.40	High

The recommendation puts the site within the Low class.

Peel Harvey EPP Phosphorus Criteria

The EPP allowable average phosphorus yield from the Serpentine River Catchment is 0.27 kg/ha/a. At an expected drainage water yield of 3,000 kL/a this represents 0.09 mg/L, if the drainage water is the only export source of phosphorus.

The recommendation allows a phosphorus load of 83% of the EPP areal average load.

Other urban drains

Comprehensive phosphorus monitoring of urban sandy Western Australian drains is not available.

Occasional monitoring of drainage water quality in seven urban sandy sites in Perth undertaken by the Water Authority during 1990/91 gave phosphorus concentrations of 0.014 to 1.72 mg/L for 175 samples with a mean of 0.193 mg/L. This has allowed phosphorus yields in the range 0.095 to 0.538 kg/ha/a to be estimated for the seven sites, 5 of which fell under the Peel Harvey EPP limit of 0.27 kg per ha limit. The monitoring was limited in duration and frequency and can not be reliably extended to the Amarillo site which will have different mixes of residential, commercial and POS areas and different drainage characteristics. The most similar siteto Amarilo and the one with the lowest phosphorus discharge, South Lakes, had a phosphorus concentration of 0.02 to 0.40 mg/L with an average of 0.094 mg/L.

EPA Guidelines for phosphorus in aquatic Ecosystems

EPA guidelines indicate that phosphorus criteria should be determined on a site specific basis. However a phosphorus concentration of 0.1 mg/L is cited as an upper limit, above which deleterious impacts may occur.

Appendix 2 - Urban Drainage Phosphorus sampling (WAWA, 1990/91)

Total phosphorus mg/l	Season	Place	No Samples
0.444	Autumn	Balcatta	10
0.050	Spring	Balcatta	8
0.102	Winter	Balcatta	7
0.377	Autumn	Bayswater II	8
0.080	Spring	Bayswater II	9
0.048	Winter	Bayswater II	8
0.233	Autumn	Bayswater I	10
0.040	Spring	Bayswater I	6
0.130	Winter	Bayswater I	7
0.730	Autumn	Beatrice Ave	6
0.219	Spring	Beatrice Ave	10
0.374	Winter	Beatrice Ave	12
0.322	Autumn	Myaree	10
0.111	Spring	Myaree	11
0.107	Winter	Myaree	9
0.156	Autumn	South Lake	13
0.041	Spring	South Lake	10
0.056	Winter	South Lake	7
0.181	Autumn	Woodlands	5
0.058	Spring	Woodlands	6
0.035	Winter	Woodlands	3

Health Department of Western Australia

Your ref
Our ref 6790/94;7183/94
Enquiries

The Chairman
Environmental Protection Authority
Westralia Square
141 St Georges Terrace
PERTH WA 6000

Attention: Mr Ron Van Delft

Dear Sir

Please find enclosed the Health Department's response to the 'Homeswest Public Environmental Review Proposed Urban Development, Amarillo farm, Karnup' in terms of mosquitoes and mosquito-borne diseases. A response addressing wastewater management issues is likely to be submitted separately.

This development proposes to locate up to 50,000 people in an area where we have substantial evidence that it has serious mosquito nuisance problems and is a high risk Ross River virus area. If this development goes ahead without addressing the issues raised in the attached response I believe that:

(i) mosquitoes will seriously threaten the health and lifestyle of prospective Amarillo residents,
(ii) this in turn is likely to jeopardise the financial viability of the project because people will simply not want to buy or rent houses in the area.

I therefore urge that you take into consideration the contents of the attached response and in particular the recommendations contained therein.

Yours sincerely

Alan Bansemer
COMMISSIONER OF HEALTH

16 September 1996

10132!

HEALTH DEPARTMENT OF WESTERN AUSTRALIA
RESPONSE TO HOMESWEST PUBLIC ENVIRONMENTAL REVIEW, PROPOSED URBAN DEVELOPMENT, AMARILLO FARM, KARNUP

Prepared by AE Wright, Medical Entomologist and
Secretary, Mosquito Control Advisory Committee

Thank you for the opportunity to comment on the Amarillo Farm PER. The Health Department of Western Australia co-ordinates and chairs the Mosquito Control Advisory Committee (MCAC), which was established by Cabinet in 1990 to advise Government (State) concerning matters related to mosquito borne diseases in WA. The MCAC consists of representatives of the following organisations:

Health Department of Western Australia
Water and Rivers Commission (WRC)
Ministry for Planning (MFP)
Department of Conservation and Land Management (CALM)
Local Government Association)
Country Shire Councils Association)WAMA

On Monday 2 September an extraordinary meeting of the MCAC was held specifically to discuss the Amarillo Farm PER. The contents of this submission reflect discussions at that meeting, concerns raised and recommendations of MCAC members.

1. Since the opening of the Dawesville Channel the (intentionally) increased tidal amplitude of the Peel/Harvey estuary system has resulted in fortnightly flooding of hundreds of hectares of tidal saltmarshes fringing the entire estuary system. This extends from the southern end of the Harvey Estuary as far as north as the Serpentine River several kilometres north of Lake Goegrup (ie. within 1km of Amarillo Farm). This has led to extensive fortnightly breeding of the saltmarsh mosquitoes *Aedes camptorhynchus* (all year) and *Aedes vigilax* (summer only). *Aedes camptorhynchus* is the major vector (carrier) of Ross River (RR) and Barmah Forest (BF) viruses throughout the south-west; this species also breeds at lower density in seasonal freshwater wetlands. It can disperse 3-5km away from saltmarsh breeding sites in search of bloodmeals, and will readily bite humans both at night and during the day in mild and/or humid weather ***Aedes vigilax* is the major coastal vector of RR virus throughout most of Australia; this species can readily disperse 10km. (and often further) away from its saltmarsh breeding sites in search of bloodmeals, and it viciously bites humans at any time of day or night. This species is the dominant mosquito during the summer months throughout the Peel Region, including Amarillo Farm**. Further information concerning RR virus can be found in the attached information brochure. However it is important to note that RR virus causes a debilitating, but non-fatal disease lasting an average of 6-12 months. There is no vaccine or cure.

Monitoring data produced by the Health Department funded research and surveillance team at the University of WA Department of Microbiology is enclosed for both the Amarillo Farm monitoring site and the Peel Region as a whole. These data show greatly elevated levels of *Aedes camptorhynchus* and *Aedes vigilax* and elevated levels of Ross River virus since the opening of the Dawesville Channel in 1994.

The Amarillo Farm PER fails to mention the existing year round saltmarsh mosquito and associated Ross River virus problem which already exists at Amarillo Farm. Extensive breeding of saltmarsh mosquitoes alongside the Serpentine River as far South as Lake Goegrup creates a significant and sometimes very serious nuisance problem and associated health risk from Ross River and Barmah Forest viruses in the Amarillo Farm area. Australia -wide it is generally accepted that a significant nuisance occurs when EVS/CO_2 mosquito traps (as used for monitoring in the Peel Region) yield in excess of 100 human-biting mosquitoes per trap. This level is exceeded or greatly exceeded for most of the year at Amarillo Farm despite HDWA efforts to control mosquitoes in the area using larvicides, in collaboration with Peel Region local councils. During 1995/6 the Health Department spent the following on health driven mosquito control and related monitoring in the Peel region:

	$
Surveillance (mosquito and RR virus)	84,270.00
Larvicides	82,550.00
Helicopter Hire	46,660.00
Runnelling research	37,000.00
TOTAL	250,480.00

These figures do not include local council contributions (both financial and personnel), or personnel costs incurred by the Health Department.

On the basis of information outlined above the MCAC believes that existing levels of saltmarsh mosquito breeding within easy (mosquito) flight range of Amarillo Farm are likely to cause a significant adverse impact upon lifestyles of residents there, and a significant associated health risk. Given the progressive nature of planned residential development at Amarillo the mosquito nuisance and associated health threats are likely to seriously impede Homeswest efforts to sell or rent houses within the proposed development.

The above explanation outlines the Health Department's greatest concern about Amarillo, however the MCAC also raised several other mosquito-related concerns as outlined below.

2. **The 300 hectares of constructed wetlands proposed for nutrient stripping purposes (Sections 4.3.3.1 and 5.2.1 of the PER) will create a significant freshwater mosquito breeding problem during the warmer months of the year (October to April), quite separate and in addition to the saltmarsh mosquito problem which already exists**. Specifically, these wetlands will be colonised by *Culex annulirostris* and *Coquillettidia sp. nr. linealis*. Both of these species live in permanent or semi-permanent freshwater bodies with thick emergent vegetation (eg. *Typha, Baumea)* which affords protection from predators such as fish, tadpoles, water beetles and dragonfly larvae, which effectively predate these mosquitoes in open fresh water. The Amarillo PER (p51) comments that:

"If the constructed wetlands form a relatively complete ecosystem this will also encourage the establishment of mosquito predators, such as fish and dragonflies. Control of mosquitoes and midges can also be carried out by chemical means, but this has a number of drawbacks and would only be considered as a management option of last resort".

The MCAC expressed particular concern at this statement and advises that the thick emergent vegetation necessary to the nutrient stripping function of constructed wetlands will prevent predation of mosquito larvae. Furthermore, mosquito control "by chemical means" (ie. larvicides) is rarely cheap or easy, even when mosquito larvae can be readily located by monitors as is the case for saltmarsh mosquitoes.

3. The PER (page 51) suggests that:

"The preliminary design approach at Amarillo is to allow a buffer of open space around each wetland comprising a minimum width of 50 metres to allow for vegetation screens to be planted in the event that a midge or mosquito nuisance develops and to enhance the nutrient removal capability of the wetlands".

Research carried out by Murdoch University on behalf of the Midge Steering Committee has shown that vegetation barriers do help reduce midge dispersal from wetlands. However the reverse is true for mosquitoes. Whilst definitive research has not yet been carried out in WA, US research has clearly shown that mosquitoes disperse most readily through wooded areas (Ginsberg, HS 1986 J. Med. Entomol., 23(2); 146-155). Numerous pieces of anecdotal evidence suggest that this pattern of dispersal also occurs with WA mosquitoes, and also that adult mosquitoes survive longer in wooded areas (Lindsay MDA 1995 PhD. Thesis).

The vegetation screens proposed in the Amarillo PER as a means of reducing mosquito problems will be totally ineffective. Furthermore they will encourage distribution of kangaroos, which are almost certainly the major vertebrate hosts of RR virus. Mosquitoes thus infected can then pass RR virus on to humans.

4. **The proposed minor realignment of the Serpentine River floodplain (page 46 in the Amarillo PER) is not likely to significantly reduce saltmarsh mosquito breeding problems described earlier.** In fact statewide experience suggests human interference with saltmarshes usually (and inadvertently) results in exacerbation of saltmarsh mosquito breeding problems, because most human interference inhibits natural processes of tidal drainage eg. Wyndham, Derby, Broome, Port Hedland, Karratha, Wickham, Carnarvon, Canning River, Alfred Cove, 6IX Tower (Belmont), Point Douro, Coodanup foreshore etc. Furthermore adult mosquitoes affecting Amarillo Farm undoubtedly disperse into the area from breeding sites alongside the Serpentine River at least as far south as Lake Goegrup, and probably further in the case of *Aedes vigilax* during the summer months when mosquito impacts are greatest. This is because people are outdoors more, and therefore more exposed to the unwelcome attention of biting mosquitoes.

5. Increased public access is likely to result from the Peel Inlet Management Authority (PIMA) proposal for a Peel-Harvey Regional Park. **Increased vehicular access is likely to exacerbate saltmarsh mosquito breeding by causing disturbance to the saltmarsh alongside the Serpentine River, as discussed earlier**. It would also jeopardise runnelling as a mosquito control measure (see "Recommendations" below).

6. **Under the draft Peel Region Scheme, a policy document prepared by the Ministry for Planning (MFP), the Amarillo Farm area is designated as having "constraints to development" due to both drainage and mosquito problems.** Accordingly the Amarillo area is not recommended for urban development by the MFP. The Homeswest acquisition of Amarillo and subsequent proposal for substantial urban development appears to ignore this.

IN LIGHT OF THE ABOVE THE MOSQUITO CONTROL ADVISORY COMMITTEE AND THE HEALTH DEPARTMENT OF WA MAKE THE FOLLOWING RECOMMENDATIONS CONCERNING THE PROPOSED AMARILLO FARM DEVELOPMENT BY HOMESWEST.

1. **That the development proposal only be allowed to proceed if runnelling (a system of small channels) is permitted to control *Aedes vigilax* and *Aedes camptorhynchus* breeding on tidal saltmarsh areas located alongside the Serpentine River north of Lake Goegrup.** Mosquito control via the use of larvicides is at best difficult and very expensive, and in practice often not able to deliver sufficient levels of control so as to protect the health and lifestyle of prospective Amarillo residents.

2. **That runnelling as described above should be paid for by Homeswest as an essential part of the cost of necessary infrastructure associated with the proposed Amarillo Farm development.** (ie. in the same way that roads, power supplies, sewerage drainage etc. are) This funding would be provided via the **establishment of a management fund for use over a five year period**. A precedent for this approach exists for canal developments

within the City of Mandurah. Runnelling must be undertaken with full consultation with both the Health Department of WA and the Peel Inlet Management Authority.

3. **An intensive mosquito and Ross River virus monitoring program should be established for the Amarillo Farm area.** This program should be carried out by the Health Department of WA and funded via the Management Fund outlined above.

4. **Vegetation within the proposed 300 hectares of constructed wetlands should be limited to nutrient and water hungry trees with no thick emergent vegetation such as reeds, rushes or sedges (*Typha spp, Baumea spp).*** If such thick emergent vegetation is permitted it will significantly exacerbate what is already a serious mosquito nuisance and associated health risk, as described earlier.

5. **The proposed Technical Review Committee (Section 6.1.2. in the Amarillo PER) should include a Health Department of WA representative with specific entomological expertise.** This is necessary due to the significant influences of mosquitoes and the diseases they carry in the Amarillo area, as described earlier.

6. **The Department of Environmental Protection should ensure that the proponents (Homeswest) fully and adequately address the mosquito related issues raised in this response. If these issues are not adequately addressed and remedied as recommended, the Homeswest proposal may be financially jeopardised because of the seriousness of the mosquito problems at Amarillo.**

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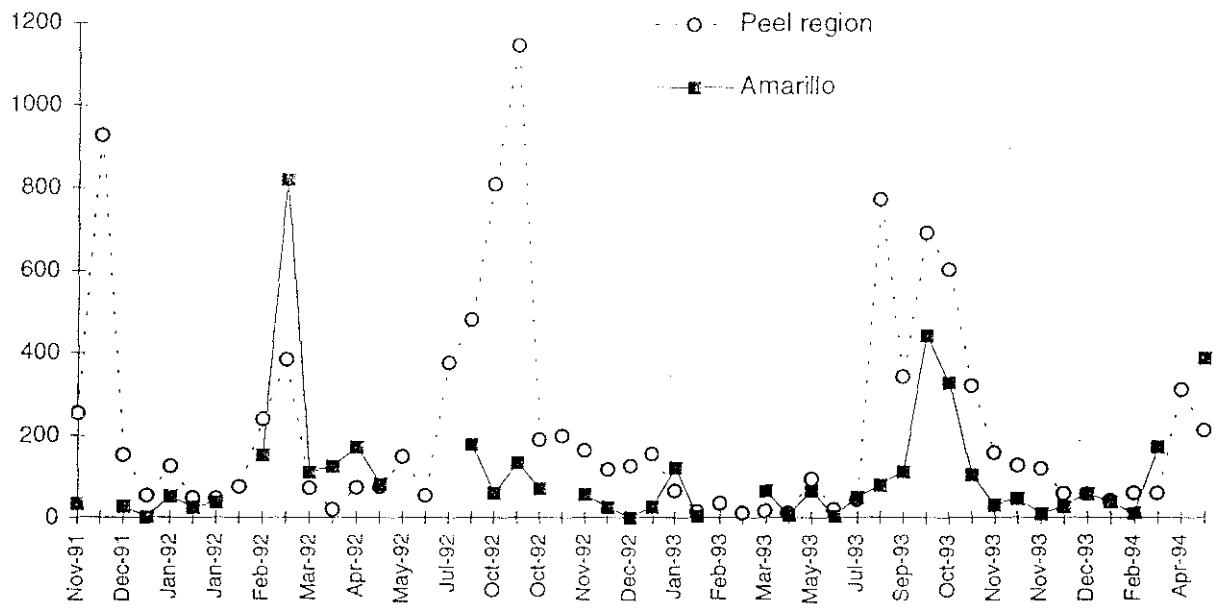
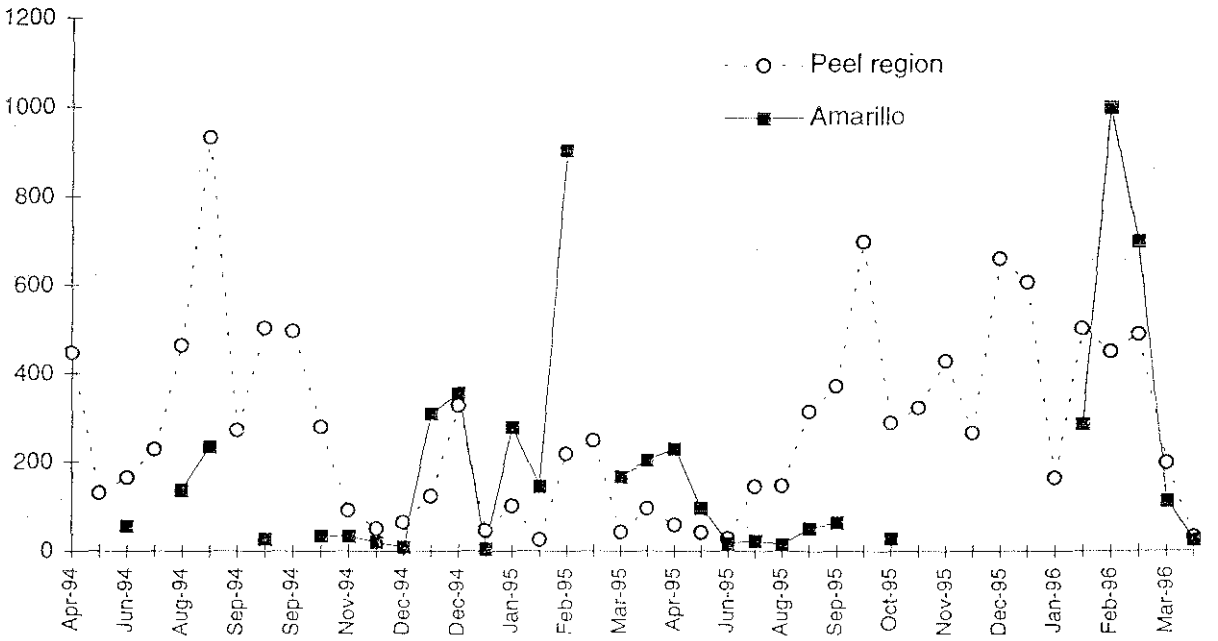
Comparison of average number of mosquitoes/trap/night in the Peel region and at Amarillo Farm, Nov 1991- April 1994



Comparison of average number of mosquitoes/trap/night in the Peel region and at Amarillo Farm, April 1994- March 1996



Appendix 4

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Appendix 5

Draft Recommended Environmental Conditions

Statement No.

RESIDENTIAL DEVELOPMENT AND DRAINAGE, AMARILLO FARM, KARNUP (940)

HOMESWEST

This proposal may be implemented subject to the following conditions:

1 Proponent Commitments

The proponent has made a number of environmental management commitments in order to protect the environment.

1-1 In implementing the proposal, the proponent shall fulfil the commitments made in the Public Environmental Review and subsequently during the environmental impact assessment process conducted by the Environmental Protection Authority, provided that the commitments are not inconsistent with the conditions or procedures contained in this statement.

In the event of any inconsistency, the conditions and procedures shall prevail to the extent of the inconsistency.

The attached environmental management commitments of April 1997 form the basis for consideration by the Chief Executive Officer of the Department of Environmental Protection for auditing of this proposal in conjunction with the conditions and procedures contained in this statement (Attachment 1).

2 Implementation

Changes to the proposal which are not substantial may be carried out with the approval of the Minister for the Environment.

2-1 Subject to these conditions, the manner of detailed implementation of the proposal shall conform in substance with that set out in any designs, specifications, plans or other technical material submitted by the proponent to the Environmental Protection Authority with the proposal.

2-2 Where, in the course of the detailed implementation referred to in condition 2-1, the proponent seeks to change the designs, specifications, plans or other technical material submitted to the Environmental Protection Authority in any way that the Minister for the Environment determines, on the advice of the Environmental Protection Authority, is not substantial, those changes may be effected.

3 Proponent

These conditions legally apply to the nominated proponent.

3-1 No transfer of ownership, control or management of the project which would give rise to a need for the replacement of the proponent shall take place until the Minister for the Environment has advised the proponent that approval has been given for the nomination of a replacement proponent. Any request for the exercise of that power of the Minister shall be accompanied by a copy of this statement endorsed with an undertaking by the proposed replacement proponent to carry out the project in accordance with the conditions and procedures set out in the statement.

4 Environmental Management System

The proponent should exercise care and diligence in accordance with best practice environmental management principles.

4-1 In order to manage the relevant environmental factors, to meet the environmental objectives in Environmental Protection Authority Bulletin 86X, and to fulfil the requirements of the conditions and procedures in this statement, prior to commencement of development works east of the Serpentine River, the proponent shall prepare environmental management system documentation with components such as those adopted in Australian Standards AS/NZS ISO 14000 series, to the requirements of the Environmental Protection Authority.

4-2 The proponent shall implement the environmental management system referred to in condition 4-1.

5 Environmental Management Plans

5-1 The proponent shall minimize phosphorus and nitrogen export from the site into the Serpentine River.

5-2 To achieve the objectives of condition 5-1, prior to seeking subdivision approval or the commencement of development works east of the Serpentine River and in consultation with the Technical Review Committee referred to in procedure 3, the proponent shall prepare Environmental Management Plans which include, but are not limited to:

1 a numerical model or other suitable analysis and forecasting techniques developed to determine the drainage management requirements of the site following development;

2 an estimate of the existing nutrient mass balance of the site based on detailed on-site measurements;

3 predicted post-development nutrient mass balance of the site based on the monitoring results of existing nutrient stripping ponds on other sites and other nutrient management measures proposed by the proponent;

4 a comparison of the results of the predicted mass and water balances with water quality performance criteria for the development;

5 the matters raised in commitments 1 to 4, namely design and management planning (including mosquito control measures in the drainage system), monitoring and reporting, a contingency plan (including cost estimates and feasibility appraisals) and a construction management plan; and

6 reference to the initial phosphorus water quality performance criteria, namely:

(i) flow weighted annual average total phosphorus concentration of discharge water less than 75 µg per litre; or

(ii) total mass of phosphorus entering the Serpentine River less than 0.225 kilograms per hectare per annum;

7 proposed initial nitrogen water quality criteria which would reduce the nitrogen load from the property as far as practicable;

to the requirements of the Environmental Protection Authority on advice of the above-mentioned Technical Review Committee.

5-3 Following the preparation of the Environmental Management Plans required by condition 5-2, the area that the proponent may develop on the east side of the Serpentine River shall be restricted to Stage B as defined on the plan at Attachment 2, until the proponent has complied with condition 5-5.

5-4 The proponent shall implement the Environmental Management Plans required by condition 5-2.

5-5 Prior to seeking subdivision approval or the commencement of development works east of the Serpentine River outside Stage B as defined on the plan at Attachment 2, the proponent shall prepare a performance review as required by condition 6 and demonstrate that the water quality performance criteria in condition 5-2-6 have been met, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority and the Technical Review Committee referred to in procedure 3.

6 Performance Review

The proponent should review their environmental performance to ensure that environmental management meets the environmental objectives and allows for continuous improvement.

6-1 Each five years following commencement of development works for Stage B, and prior to seeking subdivision approval or the commencement of development works east of the Serpentine River outside Stage B as defined on the plan at Attachment 2, the proponent shall carry out a performance review to evaluate environmental performance with respect to the environmental objectives, the performance indicators, and the environmental management system targets, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, the Health Department of Western Australia and the Technical Review Committee referred to in procedure 3.

The performance review shall include, but not be limited to:

1 description of methods to achieve the objective of condition 5-1;

2 reports on the drainage management system with particular reference to nutrient exports and, if appropriate, description of the means of improving drainage system performance;

3 reports on the success of mosquito management measures in the drainage system and mosquito monitoring programme required by condition 7;

4 review of the matters considered in the Environmental Management Plans prepared under condition 5-2, as appropriate; and

5 other biophysical, pollution and social matters as considered appropriate.

Each performance review:

6 may seek the Minister for Environment's agreement to modification of the phosphorus and nitrogen performance standards; and

7 shall have the benefit of public review and include copies of public submissions.

Note 1: Where, in the course of preparing the performance review in accordance with this condition, the proponent considers that any of the above elements 6-2 to 6-6 inclusive are not appropriate, the proponent may request the Minister for the Environment to review the need to include those elements in that and subsequent performance reviews. The Minister for the Environment will determine the request on advice of the Environmental Protection Authority and the Technical Review Committee, and the Health Department of Western Australia in regard to 6.3.

Note 2: The Environmental Protection Authority and the Technical Review Committee may recommend actions to the Minister for the Environment following consideration of the performance review.

Note 3: The Environmental Protection Authority will advise the Minister for the Environment on the need to continue the above-mentioned five yearly performance reviews.

6-2 The proponent shall implement further actions identified as necessary to meet environmental objectives, the performance indicators, and the environmental management system targets which arise from performance reviews.

7 Mosquito Monitoring

7-1 Prior to commencement of any ground disturbing activities, the proponent shall prepare a mosquito and Ross River virus monitoring programme, to the requirements of the Minister for the Environment on advice of the Health Department of Western Australia.

7-2 The proponent shall review the mosquito and Ross River virus monitoring programme required by condition 7-1 at five yearly intervals as part of the performance review required by condition 6, to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority, the Health Department of Western Australia and the Technical Review Committee referred to in procedure 3.

Note: The Environmental Protection Authority will advise the Minister for the Environment on the need to continue the above-mentioned five yearly performance reviews.

7-3 The proponent shall implement the mosquito and Ross River virus monitoring programmes referred to in conditions 7-1 and 7-2.

8 Incompatible Land Uses

8-1 The proponent shall not seek to initiate a rezoning which permits residential development in the area represented by the cross hatching on Attachment 2, nor seek subdivision approvals in the area represented by the cross hatching on Attachment 2, unless the proponent has completed a study to determine the extent of the L_{Amax} 65 dB(A) and L_{dn} 60 dB(A) noise contours which take into account the various circuit patterns and different aircraft types using the Serpentine Airfield, in order to determine the worst case contours, to the requirements of the Department of Environmental Protection.

8-2 The proponent shall not seek to initiate a rezoning which permits residential development in the area represented by the cross hatching on Attachment 2, nor seek subdivision

approvals in the area represented by the single hatching on Attachment 2, unless the proponent has completed a study to determine the extent of odour and noise impacts from the Wandalup Farm Piggery, to the requirements of the Department of Environmental Protection.

8-3 The proponent shall not seek to initiate a rezoning which permits residential development immediately adjacent to the proposed Karnup/Dandalup groundwater scheme area, nor seek subdivision approvals in the area immediately adjacent to the proposed Karnup/Dandalup groundwater scheme area, unless the proponent has liaised with the Water and Rivers Commission to determine areas of the site which could impact on the groundwater scheme and undertaken an appropriate study, to the requirements of the Department of Environmental Protection on advice of the Water and Rivers Commission.

Note: In accordance with procedure 4, the Department of Environmental Protection will advise the Western Australian Planning Commission of the study outcomes resulting from conditions 8-1 to 8-3.

9 Time Limit on Approval

The environmental approval for the substantial commencement of the proposal is limited.

9-1 If the proponent has not substantially commenced the project within seven years of the date of this statement, then the approval to implement the proposal as granted in this statement shall lapse and be void. The Minister for the Environment shall determine any question as to whether the project has been substantially commenced.

Any application to extend the period of seven years referred to in this condition shall be made before the expiration of that period to the Minister for the Environment.

Where the proponent demonstrates to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority that the environmental parameters of the proposal have not changed significantly, then the Minister may grant an extension not exceeding five years.

10 Compliance Auditing

To help determine environmental performance and compliance with the conditions, periodic reports on the implementation of the proposal are required.

10-1 The proponent shall submit periodic Performance and Compliance Reports, in accordance with an audit programme prepared by the Department of Environmental Protection in consultation with the proponent.

Procedure

1 Unless otherwise specified, the Department of Environmental Protection is responsible for assessing compliance with the conditions contained in this statement and for issuing formal clearance of conditions.

2 Where compliance with any condition is in dispute, the matter will be determined by the Minister for the Environment.

3 To assist in the execution of the requirements of conditions 5 and 6, a Technical Review Committee will be established.

The terms of reference of the Technical Review Committee are:

- to advise the Environmental Protection Authority on the adequacy of Environmental Management Plans and performance reviews prepared by the proponent; and

- to advise the proponent in respect to the requirements for each Environmental Management Plan and performance reviews and to provide preliminary advice on the adequacy of the Environmental Management Plan and performance review documents.

Membership of the Technical Review Committee will include officers from core agencies, namely:

1 Department of Environmental Protection;

2 Water and Rivers Commission, representing the Commission and the Peel Inlet Management Authority;

3 Health Department of Western Australia;

4 Department of Conservation and Land Management;

and officers from other involved agencies on an "as needs" basis namely:

5 Office of Water Regulation;

6 Agriculture Western Australia; and

7 Ministry for Planning.

The Technical Review Committee will be convened and chaired by the Department of Environmental Protection.

The proponent and drainage operators may be invited to attend Technical Review Committee meetings as observers.

4 The Minister for Planning and the Western Australian Planning Commission will endeavour to ensure that only compatible land uses occur in areas shown in hatching and cross hatching on the plan at Attachment 2 and land adjacent to the proposed Karnup Dandalup groundwater scheme, until the studies identified in conditions 8-1 to 8-3 are completed.

After completion of the studies identified in conditions 8-1 to 8-3 the Minister for Planning and the Western Australian Planning Commission will endeavour to ensure only compatible land uses occur in areas affected by noise and odour levels which exceed standards for residential areas, or in areas which could impact on the proposed Karnup/Dandalup groundwater scheme.

5 As soon as possible following completion of the first Environmental Management Plan required by condition 5-2, the proponent will facilitate identification of ongoing management bodies responsible for monitoring, managing and operating the drainage system to ensure that the relevant environmental criteria are met. This will be achieved through a consultative process between the Office of Water Regulation and local and regional drainage service providers, including the Water Corporation, the Shire of Rockingham and the Shire of Murray.

ATTACHMENT 1

Proponent's Environmental Management Commitments

April 1997

RESIDENTIAL DEVELOPMENT AND DRAINAGE, AMARILLO FARM, KARNUP (949)

HOMESWEST

Table 5

SUMMARY OF COMMITMENTS (Revised April, 1997)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
A: Management Framework						
Environmental Management Programme (EMP).	1. Prepare and implement an Environmental Management Programme (EMP), including design and management planning, management responsibilities and handover arrangements.	Determine those issues which require more detailed evaluation and technical design input and address each issue as and when required via a staged EMP process. The Proponent to consult with appropriate authorities to initiate the proposed Technical Review Committee.	To develop and implement a staged EMP as the basis for 'best management practice' environmental management of the project's construction and operation phases.	Components of the EMP to be prepared when appropriate and in accordance with the Staging Plan and review requirements of Regulatory Authorities. Design. Site Preparation. Development. Post Development.	WRC, DEP, MFP, Local Authorities and others as agreed and represented on the Technical Review Committee (either as regulators or with observer status only).	Agreement of initial scope, content and period of regulatory scrutiny of EMP with key Decision Making Authorities (DMA's). Subsequent compliance to be checked by Technical Review Committee.
EMP: Monitoring and Reporting.	2. Prepare monitoring and reporting (audit) programmes.	Selection of environmental factors which require monitoring; which parameters; how often; set periods of data review; report results to relevant authorities.	To ensure that the management practices are monitored and assessed.	As above.	As above.	As defined in the EMP.
EMP: Contingency Plan.	3. Prepare a contingency plan.	Selection of optional management techniques to implement if, and when, performance evaluation demonstrates that initial management techniques are unsatisfactory.	To ensure that management practices which are not working are upgraded or replaced.	As above.	As above.	Environmental objectives to be met.
EMP: Construction Management Plan.	4. Prepare a Construction Management Plan and ensure that all contractors involved in the project comply with the environmental management strategies and procedures described in the plan.	Through environmental induction and insertion of environmental specifications in construction contracts, including penalty clauses for non-compliance.	To ensure "best industry practices" are implemented.	Prepare plan prior to subdivision. Implement plan during Site Preparation and Development.	DEP.	Environmental Contract Specifications. Industry Standards.

Table 5
(Cont'd)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
B: Biophysical Impacts						
Serpentine Regional Park.	5. Facilitate implementation of the proposed Serpentine Regional Park.	By consultation with the future Regional Park Manager (or interim nominees) to reconcile the different boundaries and adjacent land uses which have been proposed. Also to provide assistance with the provision of managed access as the development proceeds.	To enable protection of regionally significant vegetation, flora and fauna habitat (Serpentine River) and to allow for managed recreational access.	Agree boundary during the Design phase. Survey boundary during Site Preparation.	CALM, MFP, WRC, PIMA, DEP.	Agreement of boundaries and recreational nodes in accordance with the intent and objectives of the System Six Recommendation for the area.
Serpentine Regional Park.	6. Manage activities on the Amarillo site adjacent to the Serpentine Regional Park.	Contractor specifications (construction phase) and appropriate controls to limit vehicle/pedestrian access during development phase.	To protect the conservation values of the Serpentine Regional Park.	Site Preparation. Development. Post Development.	DEP.	Appropriate controls to prevent vehicle access.
Bridge Crossings.	7. Conduct environmental assessment of bridge crossings to optimise locations and design.	Flood modelling to optimise design and site assessments for route selection.	To minimise upstream flood risk as a result of bridge construction and minimise fringing vegetation and habitat disturbance.	Design.	WRC, DEP.	Statement from WRC.
1-in-100 Year Floodway.	8. Maintain development outside the originally-defined 1-in-100 year floodway until the potential requirement for a third bridge is finalised.	No filling or development to occur within the originally-defined floodway prior to absolute resolution of bridge requirements.	To ensure that the project conforms to the Floodplain Development Strategies prepared by the Water and Rivers Commission.	Design. Site Preparation.	WRC.	Modelling and mapping of floodways and floodplains as conducted by WRC.
Protection of remnant vegetation (locally significant) and wetlands, including EPP wetlands.	9. Incorporate the principal good condition vegetation and on-site wetlands into Public Open Space (POS) including the proposed multi-purpose drainage corridors.	Areas identified and incorporated into structure plan.	To minimise disturbance to good condition remnant vegetation and wetlands (on-site).	Design.	DEP, MFP.	Structure Plan and Subdivision Design.

Table 5
(Cont'd)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
Protection of groundwater-dependent environmental resources: Superficial Aquifer.	10. Ensure that the proposed drainage system does not alter the existing water table regime such that adverse hydrological impacts occur to groundwater-dependent resources.	Where necessary, by designing and implementing the proposed drainage system to maintain the 'average annual maximum groundwater level' (AAMGL).	To protect remnant vegetation and wetlands, both on-site and off-site, from adverse hydrological impacts.	Development. Post Development.	WRC, CALM, DEP.	Annual monitoring and reporting. Maintenance of vegetation and wetland condition at nominated locations on-site (inference is that protection of on-site elements, for example from adverse water table changes, will also protect off-site elements).
Protection of groundwater resources: Leederville Aquifer.	11. Manage the drainage system passing through the Leederville aquifer discharge area (i.e. close to the Serpentine River).	So that piezometric levels in the Leederville aquifer are not adversely affected.	To ensure regional groundwater resources are not adversely impacted.	Design. Development. Post-Development.	WRC.	Width of the Leederville aquifer discharge zone to be defined and agreed prior to subdivision. Water level criteria to be evaluated.
Flooding.	12. Design and construct a drainage system to ensure that the peak rate of discharge following development is no greater than the peak rate of discharge when the site was operated as a pastoral property.	Drainage design and peak flow modelling, drain specifications, including compensation requirements.	To avoid excessive drainage discharges, which may cause flooding in low lying areas along the Serpentine River.	Design. Development. Post development.	WC, WRC, PIMA, and Local Authorities.	With respect to flood history, the development should not exacerbate flood problems in low lying areas along the Serpentine River.
Flooding.	13. Ensure that the drainage system includes appropriate erosion controls and traps for sediment so that sediment transport and siltation does not occur in the regional drainage systems.	By provision of erosion controls and sediment traps; verify effectiveness via monitoring.	To avoid siltation of natural watercourse habitat and obstructions which may cause flooding upstream of the Amarillo site.	Design. Development. Post development.	WC, WRC, PIMA, and Local Authorities.	The development should not contribute to sedimentation or exacerbate flood problems in low lying areas along the Serpentine River.
Groundwater recharge.	14. Develop and implement strategies and incentives to encourage future landowners and land managers to use groundwater in preference to imported scheme water for irrigation.	By encouraging the use of private bores to deliver on-site groundwater for irrigation on lawns, gardens and POS, for example via an Environmental Awareness Brochure or monetary incentive or pricing mechanisms.	To minimise the requirement to export drainage from the site by maximising the use of in-situ groundwater.	On-going during development phase.	WRC and Local Authorities.	Success of strategies to be measured by proportion of landowners with access to a groundwater bore.

Table 5
(Cont'd)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
C: Pollution Issues						
Export of Nutrients and other Urban Stormwater Contaminants.	15. Develop and implement Best Management Practices, consistent with water sensitive design, to minimise contaminant export from the site (including consultation with the Water Corporation to investigate the potential for incorporation of Dirk Brook Drain within the development).	By preparing a Staging Plan (ie to provide for orderly development of the drainage management scheme in the correct sequence) and by preparing Stormwater and Drainage Management Plans for individual urban precincts, on an integrated catchment management basis using accepted BMP technology.	To protect the water quality of the Serpentine River from further adverse changes as a result of the development.	Staging Plan - Design Phase. Stormwater and Drainage Management Plans - Prior to initial subdivision approval within each defined catchment.	WRC, PIMA, DEP (Technical Review Committee), with Local Authorities and WC as observers.	Conform with catchment target for phosphorus. Aim to achieve, to the greatest practicable extent, the relevant ANZECC guidelines for riverine systems.
Phosphorus Export.	16. Minimise export of existing on-site soil/groundwater "store" of phosphorus via the urban drainage system.	By the installation of a drainage system which maintains the 'average annual maximum groundwater level' (AAMGL), until such time that confirmation (satisfactory to EPA) is available that phosphorus export can be controlled irrespective of the depth of the drainage system.	To avoid an increase in the existing export rate of phosphorus which has accumulated in the soil and superficial groundwater as a result of historical fertiliser practises.	Design. Site preparation.	EPA, as above.	Compliance with the AAMGL as the depth criterion for drains. Changes to AAMGL drainage condition can only be considered after achievement of phosphorus export target is demonstrated by monitoring of the initial phase of development on the eastern side of the river.
Phosphorus Export.	17. Design and implement a Phosphorus Management Plan to test the effectiveness of various phosphorus management techniques, including proposed contingency measures, for the initial phase of development on the eastern side of the Serpentine River. The initial phase of development is defined as an area not exceeding 10% of the land earmarked for development east of the Serpentine River.	By conducting strategic trials of various techniques or BMPs for phosphorus control, including fail safe phosphorus removal techniques, on the eastern side of the Serpentine River, i.e. on palusplain areas. Developable land on the western side of the Serpentine River (Area K) is not subject to this commitment.	To remove the uncertainty which currently exists regarding the performance of the Best Management Practice approach, notably constructed wetlands, for phosphorus management.	First phase of development on the eastern side of the Serpentine River in accordance with an agreed Staging Plan and subject to review every 5 years). Note: Development will most likely commence on the western side of the Serpentine River.	EPA, as above.	Achieve the catchment target for phosphorus load in the Serpentine River and apply the WRC performance standards to signal implementation of contingency management measures, i.e. if phosphorus: (i) mass load exceeds 0.225 kg-TP/ha/a, and (ii) flow-weighted annual average concentration exceeds 0.075 mg-TP/L.

Table 5
(Cont'd)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
Phosphorus Export.	18. Monitor the performance of phosphorus management strategies and, if not meeting the applicable standard, then defer subsequent phases of development until such time that it can be demonstrated that the catchment target will be met. The developed area will not exceed 10% of the available land on the eastern side of the Serpentine River until the management strategies are proven to be successful.	By implementing Best Management Practices, monitoring performance and implementing contingency management measures (such as chemical treatment) if and when required. Developable land on the western side of the Serpentine River (Area K) would only be subject to the catchment target if surface water discharge to the river is required.	To ensure that subsequent phases of development (ie after the initial trial phase) will meet the catchment target for phosphorus discharges to the Serpentine River.	First phase of development on the eastern side of the Serpentine River in accordance with an agreed Staging Plan and subject to review every 5 years). Note: Development will most likely commence on the western side of the Serpentine River.	EPA, as above.	Catchment target for phosphorus load in the Serpentine River as specified in the Peel-Harvey EPP (1992), to be met on an annual basis in four years out of five.
Protection of groundwater quality.	19. Identify potential land use management requirements near the eastern boundary of Amarillo in order to protect groundwater quality for potable purposes.	Liaison with the Water and Rivers Commission to ascertain the potential capture zones of future bores and land use management requirements.	To ensure that the potential for groundwater abstraction for potable water supply from the proposed Public Water Supply Area on the eastern side of Amarillo is not adversely affected by the development.	Design (prior to final subdivision approval in the capture zones of future bores).	WRC.	Agreement with Water and Rivers Commission and EPA.
D: Social Surroundings						
Odour emissions from the Wandalup Piggery.	20. Resolve long term options for land use at the southern boundary with the owners of the piggery and relevant authorities.	By consultation and negotiation with the landowner and planning authorities.	To minimise land use conflicts and avoid potential nuisance odour effects on future residents.	Prior to development within the buffer zone.	MFP, DEP.	Agreement of stakeholders regarding long-term strategy for compatible land uses.
Odour.	21. Implement appropriate buffer zone requirements until the odour issue is resolved.	Interim buffer zone to be applied (3 km or in accordance with EPA recommendations). Modifications to the interim buffer zone to be considered on the basis of appropriate technical data (ie via the process of "Dynamic Olfactometry").	To ensure that no residential areas are subject to unacceptable odour levels.	Ongoing	MFP, DEP.	No odour nuisance ie no regular complaints.

Table 5
(Cont'd)

Issue	Commitment Action (What)	(How)	Objective (Why)	Timing (When)	Whose Advice	Measurement / Compliance Criteria
Noise.	22. Ensure that future residential areas will not be exposed to nuisance noise levels from Wandalup Piggery or nearby airfields.	By locating residential areas outside appropriate noise buffer zones. Where necessary, establish noise buffer zones by conducting noise surveys at critical times. Where possible, reduce potential noise problems through consultation and negotiation with relevant landowners.	To ensure minimal noise impact as a result of adjoining land uses.	Design (Prior to subdivision approval in the noise affected areas).	MFP, Local Authorities.	*Noise Abatement (Neighbourhood Annoyance) Regulations 1979* and Murrayfield CER (ANEF contours, etc).
Dust.	23. Implement appropriate dust mitigation measures.	In accordance with EPA Dust Management Guidelines.	To minimise dust generation as a result of construction phase activities and tree harvesting.	Site Preparation. Development.	Local Authorities.	Compliance with industry standards, EPA Dust Management Guidelines and no complaints of nuisance.
Potential mosquito/midge nuisance from constructed wetlands.	24. Minimise nuisance effects arising from potential increased mosquito and/or midge populations due to the proposed constructed wetlands.	By engaging the services of an entomologist and wetland ecologist to contribute to the design process for constructed wetlands and any other BMPs which could provide mosquito/midge habitat.	To ensure minimal mosquito and midge nuisance generated within the development as a result of drainage management techniques.	Design. Site Preparation.	Health Department, Local Authorities.	To be evaluated.
Location of the WANG natural gas pipeline.	25. Determine the levels of risk associated with the gas pipeline and plan adjoining land uses in accordance with that risk.	By consultation with appropriate authorities.	To ensure that future residential areas are not located within an unacceptable risk envelope relative to the gas pipeline.	Design (Prior to subdivision)	MFP, Department of Minerals and Energy (DME), DEP.	DME guidelines.

ATTACHMENT 2

ATTACHMENT 2.