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PROPOSED URBANISATION OF AMARILLO FARM

ENVIRONMENTAL ASSESSMENT

February, 1995

Prepared for:
Homeswest
99 Plain Street
EAST PERTH WA 6004

Prepared by:
Bowman Bishaw Gorham
1298 Hay Street
WEST PERTH WA 6005
Telephone: (09) 481 8588
Facsimile: (09) 481 8338

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1.0 INTRODUCTION AND BACKGROUND

1.1 Proponent and Development Proposal

Homeswest is the proponent for the Amarillo landholding, which is proposed to be developed for urban residential purposes. Whilst the property is large (approximately 3980 hectares), it straddles and/or abuts the Serpentine River for its' full north-south extent and consequently a significant proportion of the site can not be developed because of existing floodway and proposed regional park constraints. Nevertheless, the site still represents a substantial landholding for residential development and, in comparison to many of the fragmented land parcels in the South West Corridor, offers strategic opportunities to assist in fulfilling the demand for urban land in the region on a relatively large scale. The location of Amarillo is shown on Figure 1.

1.2 Background

Since purchase of the property in 1992, Homeswest has basically pursued two avenues of activity in respect of current and future changes to the 'pre-purchase' land use, which was predominantly pastoral:

- establishment of approximately 1000 hectares of plantation forest for the primary purpose of harvesting for woodchips, although a proportion may be retained to form the basis of urban forestry initiatives to assist drainage and nutrient management and landscape enhancement;
- conduct of hydrological investigations and modelling of stormwater and groundwater dynamics (water quality and quantity) in order to prepare a Nutrient, Drainage and Groundwater Management Strategy for the proposed urban development.

The latter work has been primarily aimed at resolving the technical feasibility of residential development in terms of overcoming the drainage constraints at the site.
Derivation of the drainage strategy has occurred concurrently with preparation of a draft Structure Plan for the site; documentation of these aspects has now been submitted for regulatory assessment and the Amarillo study team is confident that a satisfactory solution has been found.

1.3 Purpose of this Document

This document assesses the potential environmental impacts of the urban development proposal in order to confirm the broad environmental acceptability of the residual effects (ie. after application of appropriate management techniques).

It is intended that this document functions as a formal referral to the Environmental Protection Authority (EPA) of Homeswest's development proposal.

2.0 EVALUATION OF PRINCIPAL ENVIRONMENTAL ISSUES

This section identifies the principal environmental issues and, for each issue, briefly discusses the management framework which is available to minimise adverse environmental effects. The potential environmental impacts are then assessed with cognisance of the management which would be applied.

The impact assessment conducted herein is only preliminary but is believed to be sufficient to indicate the broad environmental acceptability of the proposal. Whilst the majority of technical work to date has focussed on resolution of the drainage issue, this section seeks to demonstrate that the full suite of environmental issues have been considered (to the extent necessary at present) in the planning of Amarillo's urbanisation.

2.1 System 6 Recommendation M108, Goegrup Lakes

As the northern part of M108 embraces the entire section of the Serpentine River which occurs within the Amarillo property, it was one of the first issues addressed during preliminary structure planning of the site.

(i) Issues

System 6 areas are recognised as high priorities for conservation/recreation by the EPA and development proposals which impinge upon these areas are rigorously assessed. However, the proper perspective at Amarillo is that the draft Structure Plan which has been prepared is not impinging upon (ie. reducing) an existing System 6 area, because the area has never been precisely defined. Homeswest is seeking to define, essentially for the first time, an appropriate boundary for the 'System 6 values' which are recognised along the Serpentine River so that the area can be adequately protected during future refinement of the development proposal. Therefore the primary issue at this stage is to define the boundary for that portion of M108 within Amarillo.

A discussion paper has previously been submitted to the (then) EPA which nominates a boundary for consideration:

> Bowman Bishaw Gorham (November 1992), Provisional Regional Park Boundary for Urban Structure Plan, Discussion Paper, Prepared for Homeswest.

The current draft Structure Plan prepared by Homeswest generally reflects the boundary nominated in the above report.

An important secondary issue is the size of buffer allocated to the identified 'core conservation area'; this is critical to acceptance of the nominated boundary as the area embraced by the boundary includes all of the recognisable elements of conservation value and a nominated buffer area, which is currently pasture.

Another issue of importance is delegation of responsibility for management of M108 when the boundary is resolved. It is suggested that an appropriate management framework will be identified during the planning process for Amarillo, ie., at the same time as the issue of administrative boundaries and zonings are resolved (Amarillo straddles the MRS boundary, which is an administrative boundary for many instrumentalities, and the Shire of Murray, which is on the southern side of the MRS, does not have an urban zoning in its Town Planning Scheme).

(ii) Management

Current policies and recommendations are that the M108 area should form part of a Regional Park. Planning for the Peel Regional Park is now well advanced and this includes most of M108, however the portion within the Metropolitan Region Scheme boundary is not included in this planning initiative.

Homeswest's development proposal has the advantage that it will facilitate regional park planning for the entire M108 area as the matter needs to be addressed during the rezoning process for Amarillo. It would seem logical to extend the proposed Peel Regional Park further north.

To ensure co-ordination of planning and management of the Peel Regional Park, a joint management agreement between PIMA, CALM and local authorities has been

recommended (DPUD, 1993). This joint approach also seems logical for the balance of M108 within Amarillo, however if it is to apply then PIMA's area of management responsibility would also need to be extended.

(iii) Assessment

The proposed development would have a beneficial effect in that stock would be removed from the foreshore where grazing has previously occurred in an unlimited fashion. Whilst Homeswest has generally improved the fencing along the foreshore, some restricted grazing is still allowed in order to reduce the fuel load because of the summer fire hazard.

As the Amarillo site becomes fully urbanised, potential indirect impacts on the System 6 area may arise due to increased recreational activities as population expansion occurs and due to pest introductions (domestic animals and weeds). The advantage which Amarillo offers in comparison to established urban areas abutting river and estuarine systems, is that it is a 'greenfields' development and appropriate management measures can be introduced from outset. For example, fencing or other means of access restrictions can be introduced early in the development process. Nodes of recreational activity can be established and sanctuary zones identified in order to protect areas of highest conservation value. Implementation of these techniques early in the development phase is considerably easier than 'retro-fitting' in established urban areas.

2.2 Phosphorus Export to Serpentine River

Consideration of the likely water quality of drainage from the development proposal to the Serpentine River is a fundamental environmental concern, particularly in regard to the phosphorus content of this drainage water.

(i) Issues

The change in land use from pasture to urban needs to be consistent with the Statement of Planning Policy (SPP No. 2), which aims to prevent land uses that are likely to result in excessive nutrient export into the drainage system. The current pastoral use on this landform and soil type is recognised, on the basis of broader catchment studies, as responsible for high phosphorus discharges in drainage and comparatively, the change in land use to urban can almost be welcomed as a potential improvement to the existing

situation. However, the objective of the SPP No.2 is to ensure that changes in land use result in the minimum phosphorus discharge practicable, and therefore it needs to be demonstrated that a significant reduction would occur in the export of phosphorus from the site to the Serpentine River.

Apart from the specific catchment export criterion which has previously been derived from the Peel-Harvey EPP environmental quality objectives (ie. 0.375 kg-P/ha/yr), it is difficult to define qualitative targets such as "minimise phosphorus export" and/or "demonstrate a significant reduction", other than in subjective terms. The abovementioned criterion is no longer applied as a yardstick for assessment of development proposals and current emphasis is on the degree to which Water Sensitive Design and Best Management Practices for nutrient reduction are implemented.

Another issue is that shallow groundwater contains elevated levels of phosphorus from historical fertiliser practices and therefore changes to groundwater drainage from the site will likely change the rate of phosphorus discharge, albeit temporarily until a new equilibrium is reached. This needs to be assessed from the perspective of the degree of improvement which will ultimately be attained.

(ii) Management

The approach to phosphorus management at Amarillo is outlined in the Conceptual Nutrient, Drainage and Groundwater Management Strategy which was distributed to DEP/WAWA/DPUD for review in early January,1995. In broad terms the principal management alternatives under consideration are as follows:

- minimisation of the quantity of drainage which is required to be exported, by the use of fill, urban forestry and on-site use of groundwater;
- removal of phosphorus from drainage prior to discharge by treatment in constructed biological wetlands.

(iii) Assessment

The draft Structure Plan allocates large areas of the site as multi-functional POS/drainage/forestry zones on the basis of water and nutrient management requirements, which is considered to be of significant environmental benefit in comparison to the

existing pastoral use. Furthermore, estimates of phosphorus export from the site, presented in the Conceptual Nutrient, Drainage and Groundwater Management Strategy mentioned above, suggest that there is potential for a substantial reduction in phosphorus losses from the site when it is developed for urban purposes in comparison to the pre-development pasture situation (at least a 50% reduction but likely to be much greater).

The calculations in the drainage strategy document ignore the present phosphorus content of the shallow groundwater as they are based on figures derived from drainage studies in urban areas elsewhere ie., the figures assume long-term equilibrium conditions for a 'mature' or fully developed site. One of the interim impacts of the development proposal is that groundwater drainage may be enhanced which would consequently result in an acceleration of discharge from the existing soil/groundwater store of phosphorus. This would only be a relatively short term effect but is difficult to quantify. However it is believed that the important mitigating factor is the longer term improvement to the phosphorus regime at the site (refer to drainage strategy document).

2.3 Odour Emissions from Wandalup Piggery

The Wandalup Piggery facilities are located approximately 1-1.5 kilometres from the southern boundary of the Amarillo site.

(i) Issues

The principal issues associated with the relatively close proximity of the piggery are socio-environmental (nuisance from odour and noise emissions) as well as environmental (phosphorus contamination of surface and groundwaters). Only odour is considered in this section; noise is discussed in Section 2.8 below and the phosphorus issue is well recognised by the regulatory agencies and need not be discussed at this stage (important items for future consideration are the degree of compliance with licence conditions and the use of Gull Road drain for the licenced discharge, which is on the Amarillo property).

Noxious odours emitted from the pig sheds, solids settling pit and the wastewater treatment ponds may be detectable within a reasonable proportion of the southern sector of the Amarillo property during certain circumstances. The most likely circumstances are during stable atmospheric conditions and light southerly winds (ie., south and south-east winds mostly but also part of the site would be affected by south-westerly winds). Analysis of regional meteorological data indicates that these conditions may occur for about 25% of the time, often at night and early mornings.

(ii) Management

The primary management method to prevent nuisance effects from noxious odour emissions in future residential areas is to apply a suitable buffer zone around the piggery. A buffer zone has not yet been established around Wandalup but, in the absence of technical data upon which a reliable buffer zone could be derived, the EPA's recommended separation distance between major piggeries and residential areas is 5 kilometres, notwithstanding that other land uses may be suitable within this zone. Note that this is an interim recommendation based on buffer zones applied in Victoria, and may be an excessive separation distance depending on specific site circumstances.

Detailed site investigations would be required to define a specific buffer zone around the Wandalup piggery for adjacent residential use. This may involve a complex process of atmospheric dispersion modelling based on the results of "dynamic olfactometry", for which there is little experience in Western Australia. Homeswest has been reluctant to pursue this management approach to date, essentially for four reasons:

- the timing of initial development and the rate at which subsequent stages would progress suggests that there is more than sufficient time for alternative solutions to emerge without the need for precise definition of a buffer zone in the short term;
- a simpler means of buffer zone determination may be derived locally on the basis of practical experience with other odour sources;
- land uses other than residential, but within an urban zoning framework, could be acceptable within the buffer zone;
- the timeframe for full development of the Amarillo site is substantial, and other management techniques and options will likely arise for consideration in that time, including relocation of the piggery.

Other management options would involve focussing attention on the piggery as opposed to buffer zone considerations within the Amarillo property. For example, the upgrading of waste handling and treatment techniques may have potential to reduce odour emissions and therefore significantly reduce buffer zone requirements. In the longer term, relocation of the piggery may emerge as the most practical and economic solution.

(iii) Assessment

Homeswest is seeking a staged assessment by the EPA for the Wandalup odour issue. For the purposes of initial structure planning for the site, a three kilometre buffer has been nominated around the piggery. It is proposed that the first stage of assessment recognises this as an interim buffer whilst a range of issues which may affect the need for, and size of, a buffer are investigated in more detail.

The second stage of assessment would involve precise definition of an appropriate buffer zone through detailed technical investigation, and determination of the land uses which could occur within the buffer zone.

Rezoning of the site would be sought during the first stage assessment.

2.4 Water Resource Protection - Superficial Groundwater

(i) Issues

The issues associated with superficial groundwater resources at Amarillo in respect of proposed residential development are the potential for contamination of groundwater and the potential for water quantity changes. The latter issue relates to the need to control the water table to prevent flooding of houses and is considered to be the principal issue requiring evaluation.

Water quality issues are also important but in this respect the potential effects on groundwater quality at Amarillo are no different to elsewhere on the Swan Coastal Plain where urbanisation has occurred over shallow groundwater resources.

(ii) Management

The primary focus of management attention is on the water quantity issue, notably the degree to which the water table can be controlled or altered without causing adverse effects, either on-site or off-site. The Conceptual Nutrient, Drainage and Groundwater Management Strategy (January, 1995) presents two options for consideration. One option involves no change to the average maximum water table position whilst the second option involves some lowering of the water table to assist in reducing the need for fill. (The reader is referred to the drainage management strategy document for further detail on this matter).

The manner in which the water table is controlled is also an important management consideration. Lowering of the water table by the use of sub-soil drains is actively discouraged by the Water Authority because, amongst other things, it means there is likely to be a requirement to discharge large volumes of groundwater from the site. The volume of water is not necessarily a concern, however it may create water quality management problems due to the mobilisation of nutrients.

Notwithstanding the above, the Water Authority does support lowering of the water table by using urban forestry (perennial trees) as a management technique, as opposed to conventional drainage methods. In addition, maximising the on-site utilisation of groundwater for domestic and public parks and garden irrigation is also favoured by the Water Authority as a means of water balance management.

(iii) Assessment

From the environmental perspective, the degree of water resource protection (shallow groundwater) is related to the presence of remnant vegetation and wetlands which may be reliant on a specific water table regime for maintenance. It follows that some lowering of the water table could be entertained to the extent that damage does not occur to any of these ecosystem elements which may have been identified. The ecological condition and conservation value of these elements are also important considerations for review.

As discussed further in Sections 2.6 and 2.7 below, none of the remnant vegetation and damplands on the eastern side of the Serpentine River are considered to have regional conservation significance. Therefore it has been concluded that some water table drawdown would be acceptable despite the potential for further deterioration in the remnant ecosystem elements on the site. At present the draft Structure Plan protects these elements within the proposed linked POS network. This is because they are perceived to be locally significant, at least from the landscape perspective. However it is not critical that these remnants are sustained in view of the substantial revegetation which is proposed during development of the site and also the construction of artificial wetlands which are intended to be designed as fully functional ecosystems. Any loss of remnant within the site would be substantially compensated for by replacement, rehabilitation and enhancement.

The issue of conservation of water resources for future potable supply (eg. the Water Authority's proposed Serpentine/Dandalup groundwater abstraction area is located to the east, adjoining the eastern boundary of Amarillo) also requires assessment. The degree to which the water table to the east is lowered as a result of drainage management within Amarillo is uncertain, as the ultimate drainage strategy has yet to be finalised. Groundwater modelling conducted to date, as outlined in the recent conceptual drainage strategy document, suggests that the drainage options under consideration may lower the water table by up to 0.5 metres at a distance of 700 metres to the east of the site. This may limit somewhat the Water Authority's future abstraction options and yields from the superficial aquifer in close proximity to the site, although it is doubtful if there would be a major impact on the total amount of water available from the proposed borefield. A mitigating factor is that utilisation of groundwater for 'ex-house' uses will be actively encouraged as part of the drainage and groundwater management strategy for Amarillo, which has the potential to reduce the demand for scheme water significantly; this needs to be balanced with potential localised effects to the Water Authority's proposed borefield.

There are more substantive tracts of remnant vegetation on private land immediately to the east of the site which may be considered to be locally significant in the context of the paucity of native vegetation in the vicinity. This vegetation is not protected from clearing and is subject to a variety of on-going disturbances such as weed invasion and stock access. Phreatophytic (groundwater dependent) components of these remnants may experience reduced water availability if there is water table drawdown due to development on Amarillo. However the groundwater and stratigraphic investigations conducted on the Amarillo property indicate that the presence of 'coffee rock' layers in the sub-surface would act to mitigate the effects of a lower water table within the main or regional superficial aquifer. This is because the coffee rock provides a localised perching mechanism for recharge water which would tend to reduce the impact of any regional drawdown effects.

2.5 Water Resource Protection - Leederville Formation

(i) Issues

Hydrological evidence from the Water Authority's regional monitor bore network indicates that there is potential for upward leakage from the underlying Leederville Formation aquifer into the superficial aquifer near to the Serpentine River. Therefore, lowering of the

water table within the superficial aquifer (by drainage, abstraction via bores and/or plantation forestry) would tend to increase the rate of upward leakage, if leakage is occurring.

(ii) Management

The need for management of this issue is believed to be low because the leakage from the Leederville Formation to the superficial is only potential leakage; ie, there is not an unrestricted flow path between the two aquifers. Obviously a substantial increase in the rate of upward leakage would be considered undesirable from a water conservation perspective, but this could be readily managed by minimising the drawdown of the superficial aquifer.

(iii) Assessment

The primary evidence of upward leakage potential is from the differential hydrological heads recorded in Water Authority bores located near the western boundary of Amarillo Farm (refer to Peck and Davies, October 1993, Amarillo Farm Final Hydrology Report). However, these bores and other deep bores drilled for the Amarillo investigations, indicate that leakage is likely to be strongly attenuated, if not prevented, by confining layers which separate the aquifers. For example, a deep bore on the western boundary encountered glauconitic sandstone at 64 metres below ground level (mbgl), clay at 78 and 87 mbgl, and shale at 185 mbgl. Two of the three deep bores drilled on the eastern side of the Serpentine River also encountered confining layers (a third bore did not encounter a confining layer to a depth of 75 mbgl, which was the limit of rods available to the driller at the time). The other two bores recorded a dense black clay layer at 14-16 mbgl and dense grey to black clay layer at 54-57 mbgl, respectively.

Another mitigating factor is that the zone of potential upward leakage only encompasses a portion of the Amarillo site. Evaluation of relative water level gradients in the Leederville Formation and the superficial aquifer indicates that the difference in water levels decreases to the east and eventually there is no potential for upward leakage. Calculations by A.J. Peck and Associates and presented in the hydrology report cited above, reveal that the potential for leakage is zero at approximately the 6 metre water table contour. Potential leakage would be downwards to the east of this line and therefore there is a potential upward leakage from the underlying Leederville aquifer only over a relatively narrow strip of the Amarillo property which is actually proposed for development (refer to Figure 2).

2.6 Wetlands (EPP Lakes and other wetlands)

(i) Issues

EPP Lakes: There are four wetlands on the site which are protected in accordance with the Swan Coastal Plain Lakes Environmental Protection Policy (1992). All are located in the north-west of the property, as shown on Figure 3; two are pools on the Serpentine River while two are groundwater-fed wetlands to the west of the river. It is recognised that no action can be taken that results in "...filling, mining, excavation, pollution or changes in drainage capable of reducing or destroying the values..." of any EPP wetland without the approval of the Minister for the Environment, and that there is an implicit preference for protection rather than to allow any disturbance.

There are several EPP wetlands located on adjacent land, including to the north (on the western side of the Serpentine River) and others to the east and south (Figure 3). Direct disturbance is not an issue in this instance but potential changes to groundwater hydrology, particularly water table levels, as a result of urban development and drainage within Amarillo, need to be considered.

Other Wetlands: The Water Authority's Wetland Mapping System recognises five types of wetland at Amarillo, namely sumpland, dampland, river channel, floodplain and palusplain. Nearly the entire portion of the site on the eastern side of the Serpentine River is mapped as palusplain, apart from the low dunes and sandy rises and some areas of dampland/sumpland. Bulletin 686 and the preliminary management categories assigned by the Water Authority's wetland work have been used to assist environmental planning decisions for the site.

(ii) Management

EPP Lakes: The EPP wetlands on-site have been assigned various management categories, including resource enhancement, multiple use and conservation. The latter applies to the river pools, whilst the two sumplands have been given the categories denoting lower conservation priority. All but one of these wetlands are included in the proposed Regional Park which is the primary management response to the recognised values. The fourth wetland, a sumpland, is partly within the site and partly within the freeway reserve for the future extension of the Kwinana Freeway.

As the off-site EPP wetlands will not be directly impacted by the development, the selection of an appropriate management response is dependent on the degree of water table change which may be induced by the drainage strategy. Management of water table change on-site would be the most likely response, rather than attempting any 'in-lake' management technique.

Other Wetlands: The approach adopted for Amarillo is that any wetland area with residual natural attributes, despite being significantly degraded, has value in a development context even if only to form the basis for future landscape enhancement. Therefore the management response is to retain these areas in a linked POS system so that decisions on how they are best incorporated or utilised can be made during subsequent detailed planning phases. The draft Structure Plan has 'captured' all damplands and portions of palusplain with residual natural values within the POS/drainage network.

(iii) Assessment

EPP Lakes: None of the on-site EPP lakes will be deleteriously affected by the development proposal. Little, if any, development is proposed in the north-west sector where these lakes are located. They will not be affected by potential water table alteration on the eastern side of the river because of the hydrological boundary represented by the river. There will be no direct discharge of drainage to any of the wetlands. "Lake Amarillo" is an EPP wetland and, as it is actually a pool on the Serpentine River, it will receive some drainage from residential areas but only after it has been treated through a constructed biological wetland filter. Furthermore, Lake Amarillo is currently subject to severe sedimentation problems due to inflow from the Dirk Brook Drain and Homeswest is actively liaising with the Water Authority (who have responsibility for the Dirk Brook Drain) to ensure that the appropriate steps are implemented to rectify the problem as soon as possible.

As mentioned above, some of the off-site EPP wetlands may be affected by water level changes. The groundwater modelling indicates that the potential drawdown could be most marked on the eastern side of the property (up to 0.5 metres drawdown at a distance of 700 metres to the east) which would affect 2-3 EPP wetlands. There are two principal mitigating factors in respect of the potential impacts of regional water table drawdown:

- it is most likely that the regional water table has risen in the past due to the extent of clearing which has occurred and consequent changes to the water balance with the conversion of native vegetation to pasture, therefore any drawdown may simply reverse this trend;
- the apparent local perching of groundwater above coffee rock would also act to dampen the effects of any regional water table decline.

Detailed assessment is not warranted at this stage because the drainage strategy has not been finalised and therefore the magnitude of the issue is indeterminate. Also, the location and current condition of the EPP wetlands require verification as the regional wetland mapping conducted for the EPP has sometimes been misleading.

Other Wetlands: The majority of Amarillo outside of the proposed Regional Park (and therefore subject to development impact) is mapped as palusplain ie, seasonally waterlogged flats. The ecological impact of development on these areas will be negligible as they are a completely altered ecosystem due to clearing for pasture. Remnant areas which have not been cleared will be retained and enhanced during the development of the multiple use drainage network.

2.7 Remnant Vegetation

(i) Issues

The extensive clearing of the Swan Coastal Plain for agriculture, particularly south of Perth, requires that the presence of remnant vegetation is carefully examined and evaluated in respect of its potential conservation significance.

A recent Waterways Commission study of the fringing vegetation of the Serpentine River in the Shire of Serpentine-Jarrahdale and City of Rockingham (Report No. 38) concluded that the *Juncus kraussii* community on the Amarillo property is of "regional significance in terms of the extent of the sedgeland. The conservation value of this area is extremely high."

(ii) Management

The management approach to the remnant vegetation issues at Amarillo has three main components:

- assessment of vegetation condition and fragmentation in order to properly assess residual conservation values;
- incorporation of all of the high value fringing vegetation along the Serpentine River into the proposed Regional Park and therefore protecting it for recreation/conservation;
- incorporation of most pockets of remnant vegetation throughout the site within the linked POS network, which will comprise about 13% of the site, exclusive of land allocated for artificial wetlands, new growth tree plantations and active POS.

(iii) Assessment

The basis upon which any potential impacts on the areas of remnant vegetation (outside of the proposed Regional Park) are considered acceptable is that they do not have regionally significant conservation value. Whilst they will be retained, there is potential for some adverse effect to be induced as a result of hydrological changes, as discussed in Section 2.4 above.

This assessment and conclusion is at odds with the Waterways Commission report, which states that the *Juncus kraussii* community of high conservation value is apparently extensive and therefore has the implication that it continues outside of the proposed Regional Park. The report's findings are disputed on two grounds. Firstly, the sedgeland is not extensive as it is characterised by a relatively fragmented distribution and patches of variable density (it is even more reduced now because the site is again being actively managed as a pastoral property, since lying idle for the period 1989-1991). Secondly, much of the sedgeland is not original vegetation as it would have developed as a result of a combination of the water table rising (creating more areas with sufficient water availability for the species) and the fact that it is not palatable to stock. Therefore the "extensive" attribute of the sedgeland is an artefact of agricultural practice and consequently has no significance for the conservation of native vegetation (Trudgen M.E., 1993, Vegetation and Flora Conservation Values at Homeswest's Amarillo Property).

2.8 Potential Noise Disturbance

(i) Issues

Establishment of new residential developments in rural areas where there are potential noise emitting activities (which may have been located in the area largely because of the isolation from neighbours who may become aggrieved) is a common issue at the fringe of urban areas. Amarillo has three potential sources of noise disturbance to the south, namely a dog kennel Special Rural estate, Wandalup Farms piggery and Murrayfield Airpark, and one potential source to the north-east, namely a small aircraft landing strip.

(ii) Management

Management options for residential developments which encroach within the noise 'influence' of an existing land use include application of the buffer zone concept, provision of noise shielding devices, alteration to the method of operation of the noise emitting land use to reduce noise intensity and, relocation of the noise emitting land use. The need for noise management will be kept under review during subsequent detailed planning phases for the Amarillo development.

(iii) Assessment

At present none of the potential noise generating activities in the vicinity of the site represent a constraint to the proposed residential development of Amarillo. Some brief comments are provided below in support of this preliminary conclusion.

- The dog kennel Special Rural estate is not a substantial noise source and is too remote to be of concern (the northern boundary of the estate is located approximately 1800 metres from the southern boundary of Amarillo).

- The Murrayfield Airpark was the subject of two Consultative Environmental Reviews (CER's) prepared in 1993. The Airpark was approved on the basis of the second CER. Figure 4, reproduced from this CER, shows the northern training circuit for the Airpark as being just outside the southern boundary of Amarillo. Figure 5 shows that the 25 ANEC contour for the ultimate capacity of the Airpark falls well outside the southern boundary of Amarillo. The 25 ANEC contour is regarded by aviation authorities as being the upper limit for residential development.

- There is conflicting anecdotal evidence regarding noise from the Wandalup piggery (the principal source of noise is the pigs during feeding), but some advice suggests that noise may be audible at night under certain circumstances for up to three kilometres from the sheds. No noise monitoring has been conducted to assess if a nuisance effect would be likely. The sheds housing the pigs are located approximately 1,500 metres south of Amarillo's southern boundary and, given the nominal three kilometre buffer zone for odours (Section 2.3 above), there is ample separation between the noise source and future residences. Piggery noise may only be an issue of concern if the buffer zone is substantially reduced, and would need to be investigated at the time.

- The small aircraft landing strip to the north-east of the site (1,500m from the NE corner) is believed to be for private purposes only and therefore does not support sufficient aircraft traffic to be of concern.

2.9 Water Quality in Constructed Wetlands

(i) Issues

There will be a large area of constructed wetlands which will have two principal functions; firstly they will be designed to maximise the retention of stormwater and groundwater drainage during winter to provide for phosphorus removal mechanisms to operate and secondly, they will provide an aesthetic resource to improve the landscape of Amarillo for future residents. The first function requires that the wetlands are biologically productive to assist in the removal of dissolved phosphorus and, consequently there is a risk that one of the main responses will be phytoplankton blooms or other forms of nuisance aquatic growth which could produce undesirable aesthetic effects. In addition, the wetlands may provide ideal breeding grounds for mosquitoes and chironomid midges. In summary, the main issue with water quality in the constructed wetlands is to have a highly productive system without the nuisance effects which can occur in unstable or overly productive ecosystems.

(ii) Management

Diversity is the key factor in a wetland system which will act to minimise the expression of biological productivity in a nuisance fashion. Therefore the most strategic management

response is good hydrological design to maximise mixing throughout the wetland and good biological design to incorporate as many features of a natural system as possible (fringing vegetation, extensive shallows with aquatic macrophytes, deep pools, introduction of aquatic fauna etc).

Encouragement of macrophyte banks in extensive shallow areas is a common design feature of constructed wetlands for water pollution control. Management of productivity and replenishment of phosphorus uptake can then be undertaken by harvesting strips of macrophytes and hence removal of biomass and phosphorus.

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 should only be considered as a management option of last resort.

(iii) Assessment

It is acknowledged that there is very little local experience in the use of constructed wetlands for phosphorus removal and that most case studies are from overseas although there is some experience accumulating in the eastern states. However the overseas case studies demonstrate that considerable water quality improvement can be obtained through the use of artificial wetlands as water pollution control ponds. Importantly, they are used extensively in urban situations for stormwater treatment and are often incorporated as features in public open space. There seem to be very few reports of nuisance effects deriving from water quality problems within these wetlands.

2.10 100 Year Floodway

(i) Issues

The issues associated with the floodway are essentially threefold:

- protection of the proposed development from the effects of floodwaters;
- protection of the flow path of floodwaters during the development process to ensure that there are no deleterious flood effects caused upstream of the site;
- ensuring that any encroachment within the floodway, which may be deemed acceptable on hydrological grounds, is ecologically acceptable.

(ii) Management

Protection of the floodway is clearly defined by the Water Authority's Floodplain Management Strategy in which no development is permitted within the central floodway and there are specific requirements for backfill to meet if residential development is proposed within the flood fringe.

(iii) Assessment

The 100 year floodway is very broad in most sectors of the Serpentine River floodplain through the Amarillo property. However the edges of the floodway do not define a strong ecological boundary in this area and notwithstanding that much of the vegetation and natural habitat within the floodway has been cleared for pasture. Therefore the modified floodway determined by the Water Authority (which has involved a reduction in the extent of the floodway and therefore the 'non-developable' area within the site) has not generally exposed areas of significant ecological value that would need to be assessed prior to consideration for development.

Furthermore, the nominated Regional Park boundary (refer to Section 2.1 above) is considered to be an adequate response to the recognisable conservation values within the floodway and peripheral areas, as it encompasses all of the high conservation value areas associated with the river and enables representative fringing and transition areas to be enhanced if there is considered to be potential value to the community if rehabilitated.

2.11 Management of Tree Plantations

(i) Issues

Revegetation of land in the Peel-Harvey catchment, particularly with deep-rooted perennial trees, has always been a strategic objective of the overall nutrient management strategy. Plantation forestry within an urban environment is relatively novel in Western Australia and this in itself is an issue due to the experimental flavour which is attributed to something new in this context.

The persistence and sustainability of the trees is an issue because the trees are required to act as 'permanent pumps' for groundwater control.

(ii) Management

The alternative to urban forestry as a partial means of drainage management is further reliance on constructed wetlands for the treatment of drainage prior to discharge from the site. In the final outcome constructed wetlands may be sufficient, but this can not be determined during this advanced stage of planning and in any event, this reliance would be against the philosophy expressed in the "treatment train" approach of water sensitive design. Therefore trees are seen as an important component of the strategy for Amarillo and, given their additional aesthetic appeal and landscape value, should be considered essential elements despite any perceived management disadvantages.

Should there occur a catastrophic tree death over large areas of the site, the resultant rapid change in water balance, including potential water table rise, would be easily managed by the installed sub-soil drain system. Therefore management to ensure a guaranteed minimum tree cover is only a desirable objective, not an essential one.

Forestry management expertise is readily available in Western Australia so the issue of tree sustainability is not of great concern. Management responsibility would likely be via a consultative committee comprising representatives with appropriate expertise and co-ordinated by the relevant local authority.

(iii) Assessment

On the issue of persistence, it is erroneous to assume that all the trees would be the same age or a species monoculture, with consequent greater risk of a calamitous event destroying large areas of plantation. Amarillo would be developed over at least a 30-40 year lifespan which would mean that the trees would be in a variety of age classes. In addition, a mix of species would be planted in the longer term urban forestry areas, in comparison to the present emphasis on mostly Tasmanian Bluegums for the interim period, when yield for woodchips is a primary consideration.

2.12 Serpentine River Bridge Crossings

(i) Issues

Two bridge crossings are proposed for access to residential areas on the eastern side of the Serpentine River. The issues associated with bridges include site selection and alignment, construction impacts and hydrological effects once the bridge is constructed.

(ii) Management

Site selection and bridge design are the two primary elements to which management attention can be applied in order to minimise potential adverse effects of the bridge crossings.

Whilst the broad locations of the crossings have been determined from preliminary planning and transport studies, there is still sufficient flexibility in the selection of final crossover points and alignments to allow environmental factors to be properly addressed. In addition, the 'footprint' of each bridge can be altered through design to cater for hydrological requirements in respect to flood mitigation. Some foreshore impacts could also be addressed through good design.

(iii) Assessment

The two crossings are located at the northern and central sectors of the site, respectively (a 1:10,000 aerial photograph and overlay showing potential bridge crossings is available on request). Preliminary appraisal of these broad locations suggests that environmentally acceptable crossings can be selected. The reasons for this conclusion include:

- at both locations the river is restricted to well-defined channels and relatively narrow associated floodway, therefore the expansive and ecologically productive pools have been avoided;
- in the northern sector in particular, the main channel of the river is actually a constructed "drain", which is a result of historical river training works, and the original foreshore and fringing vegetation has been lost;
- the immediate river environs, including the majority of the floodway, have been grazed continuously for many years in both sectors and, due to the replacement of dryland vegetation with pasture there is no ecological linkage with the fringing vegetation and river environment;
- there are sections of the central sector where the fringing vegetation is also relatively depauperate and therefore, as with the northern sector, a minimum impact crossing should be readily selected.

3.0 CONCLUSION

The preliminary environmental assessments conducted in Section 2.0 indicate that Amarillo Farm could be developed for urban residential purposes, with appropriate management, in an environmentally acceptable fashion. None of the identified issues are considered to be an absolute impediment to the development proposal.

Drainage management has always been recognised as the key issue at Amarillo and considerable effort has been expended in deriving a workable solution. A Conceptual Nutrient, Drainage and Groundwater Management Strategy for the site was submitted for review in January 1995. That document, in combination with the evaluation conducted herein, demonstrates the technical and environmental feasibility of the change in land use proposed for the site.

Detailed management plans need to be prepared for specific issues, supported by additional investigations in some instances and/or monitoring of performance. However, it is believed that sufficient information is available from the work that has been conducted to date to confirm environmental acceptability. Refinement of strategies, design and management (plans and responsibilities) are the primary on-going tasks for technical implementation of the project.

FIGURES

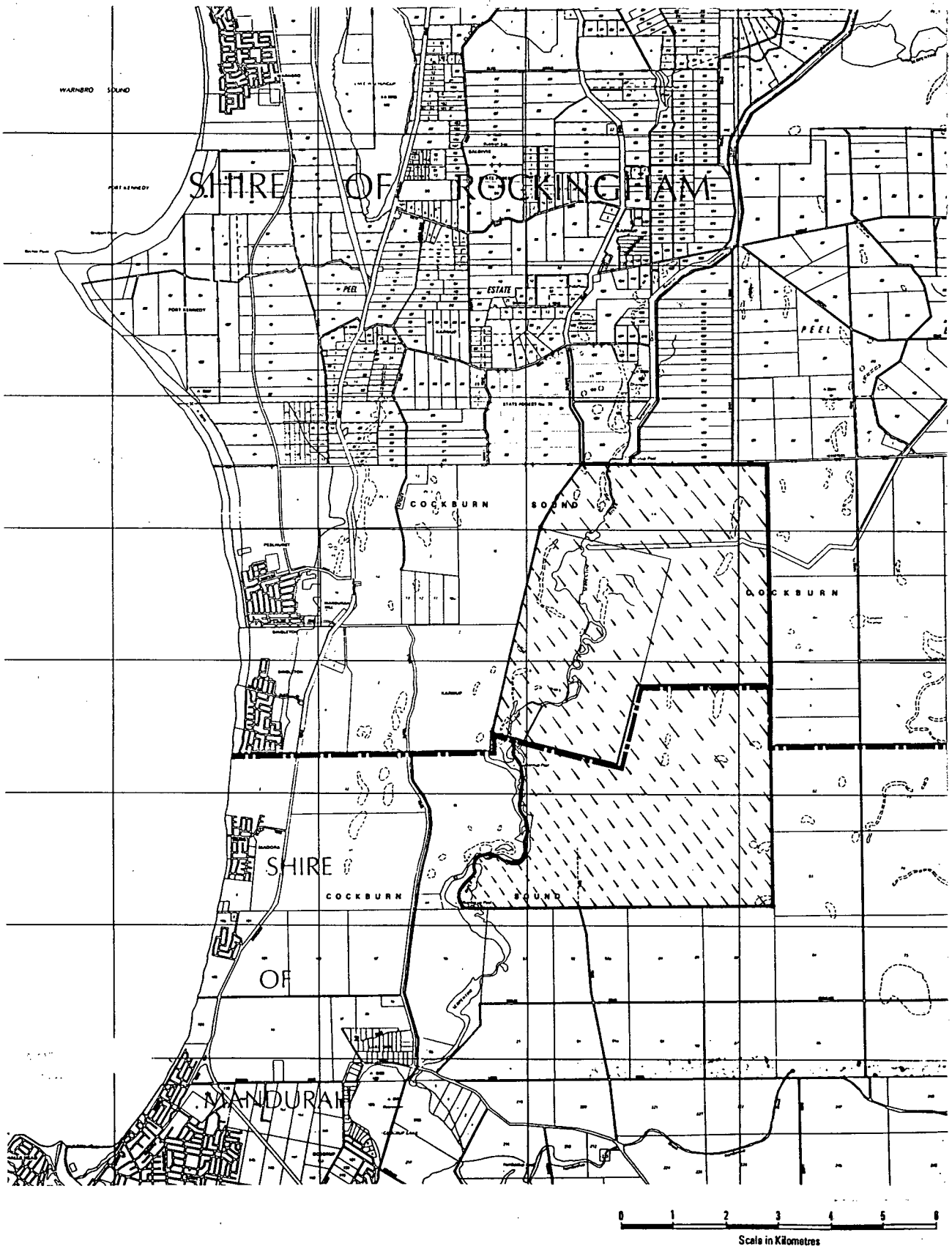
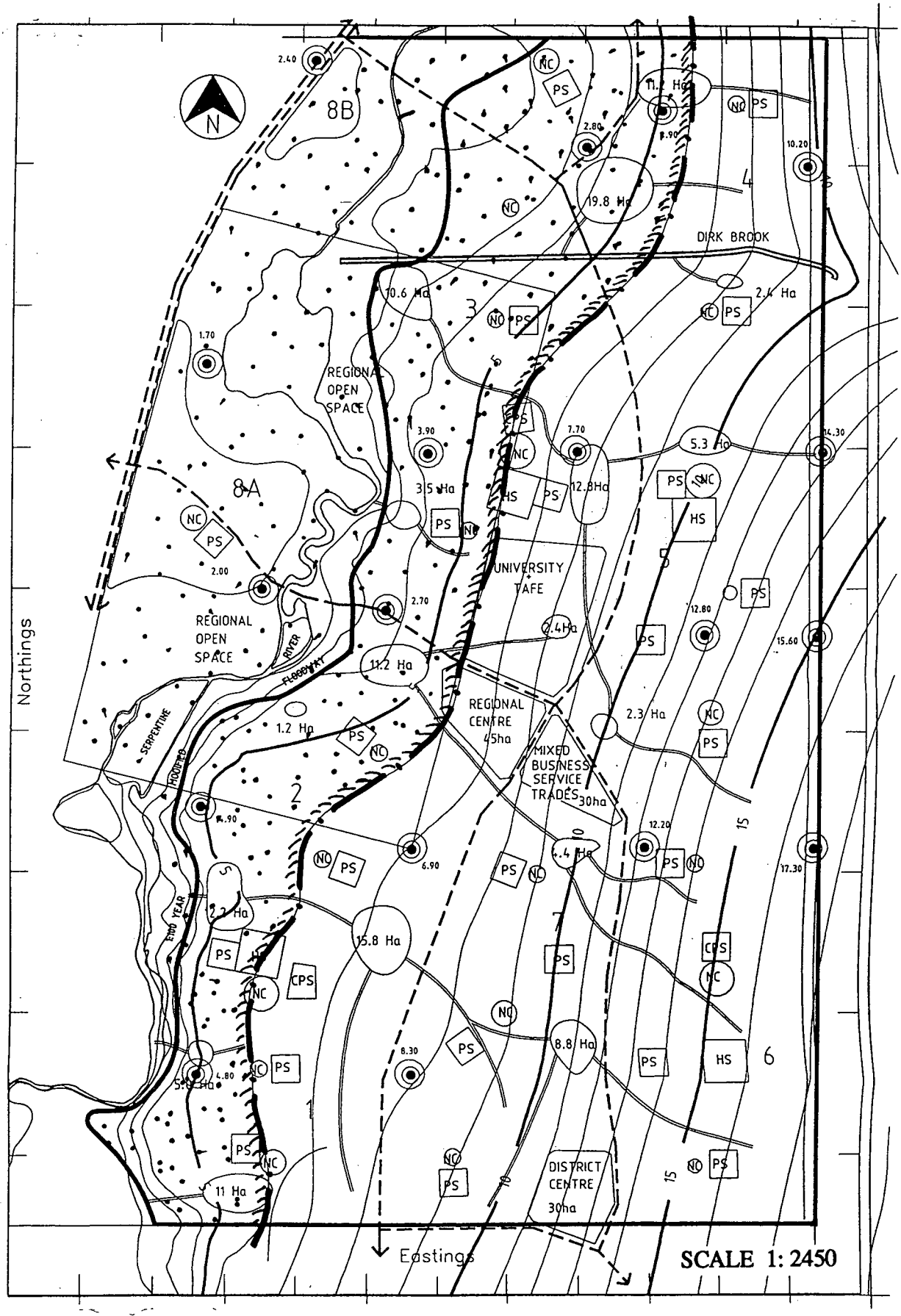


FIGURE 1: LOCATION



Upward / Downward ("Potential" Leakage)

FIGURE 2: ZONE OF POTENTIAL UPWARD LEAKAGE FROM LEEDERVILLE AQUIFER

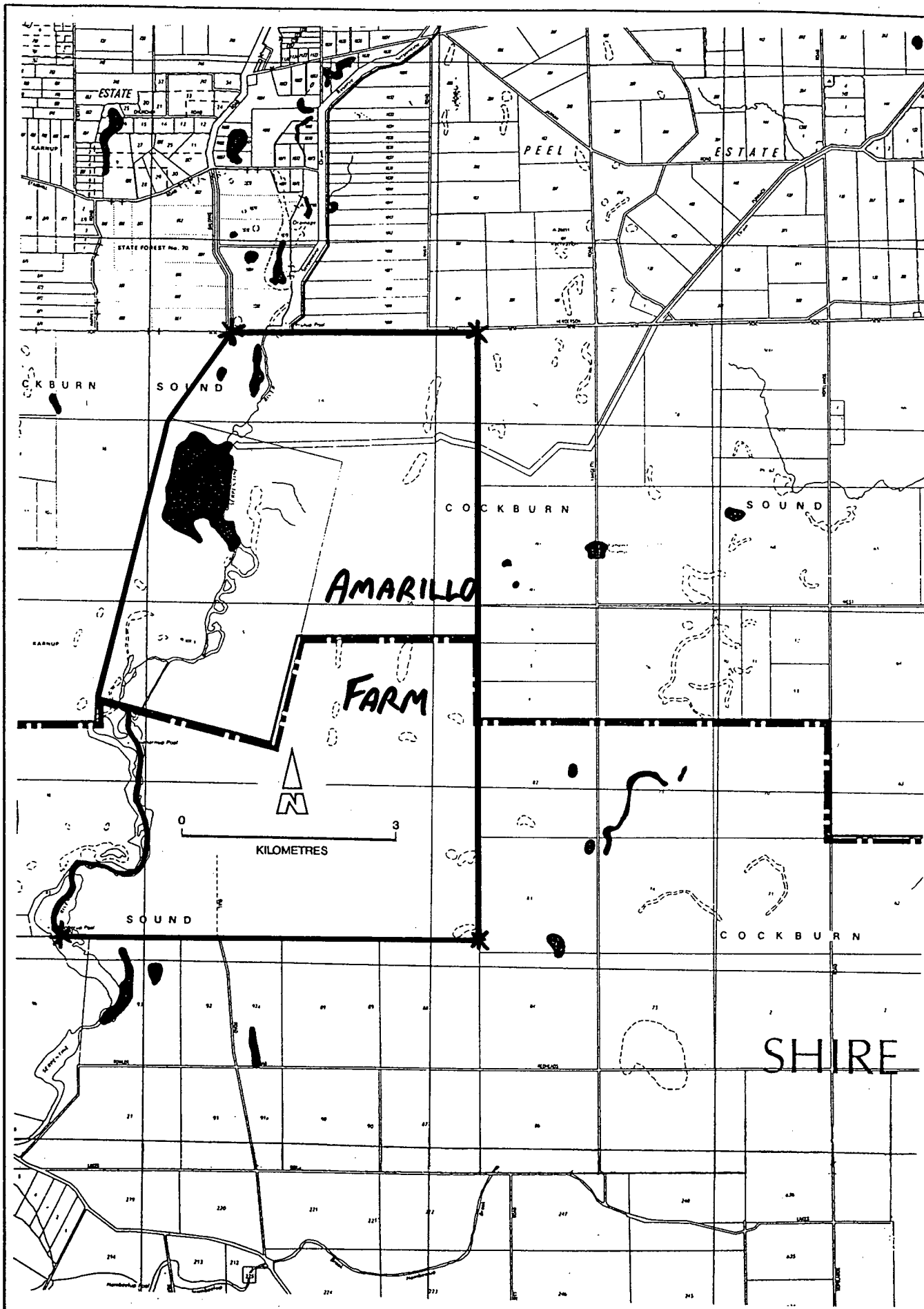


FIGURE 3: EPP WETLANDS

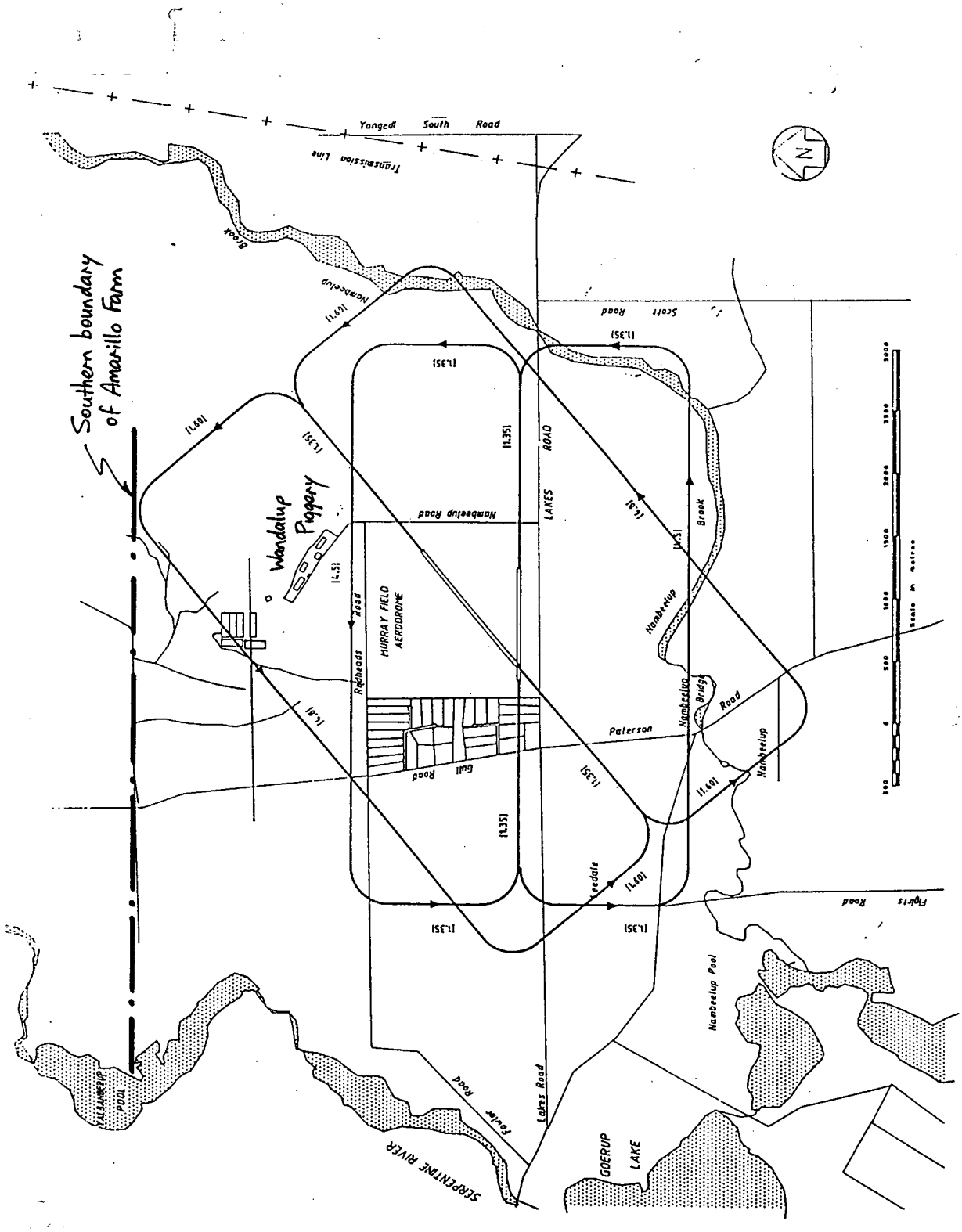
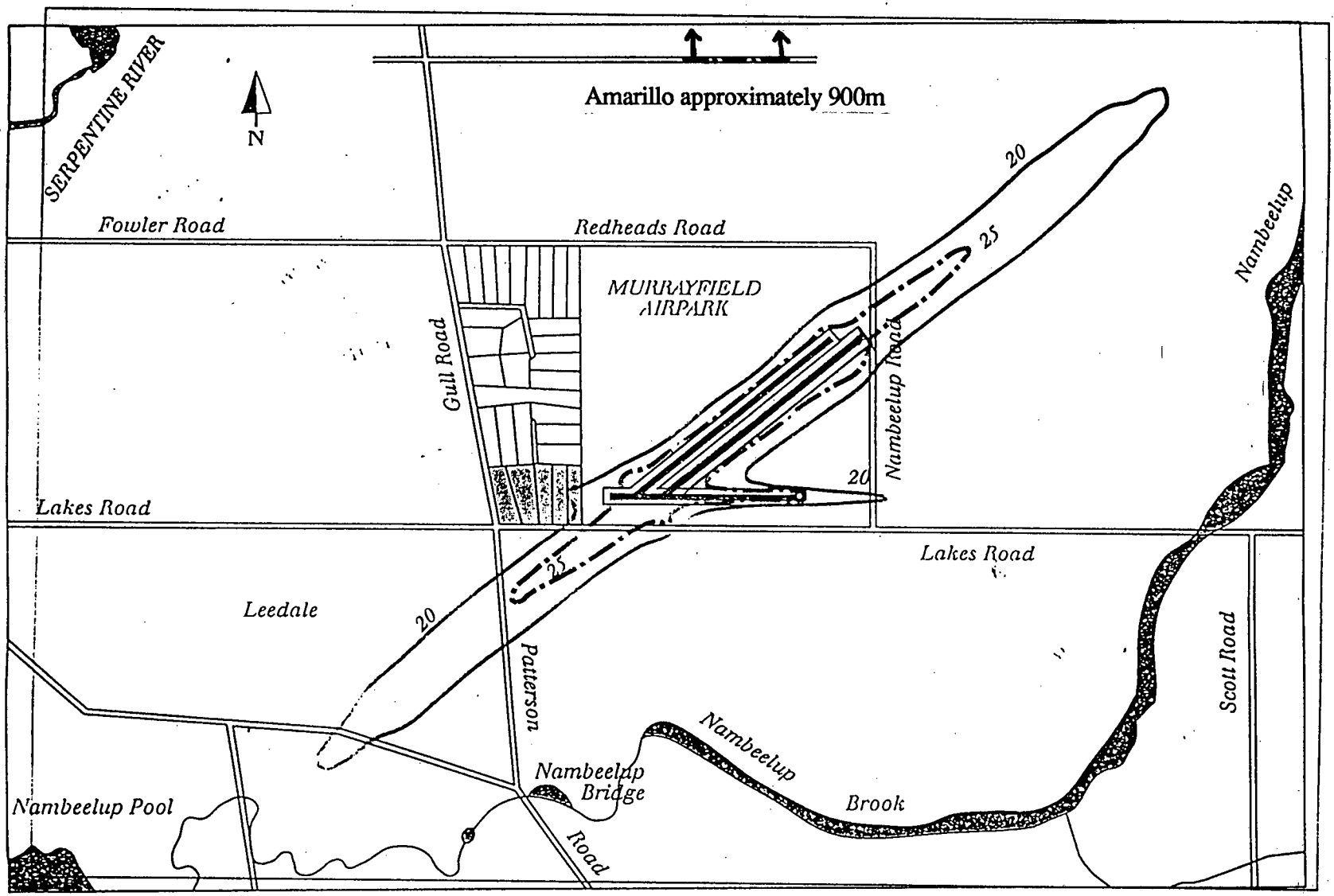


FIGURE 4: TRAINING CIRCUITS
MURRAYFIELD AIRPARK

FIGURE 5: ANEF CONTOURS



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