# ENVIRONMENTAL ASSESSMENT

## Lot 48 Furnissdale Road, Furnissdale


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# APPENDICES

# 1.0 INTRODUCTION

SAS Global Furnissdale Pty Ltd proposes to subdivide Lot 48 Furnissdale Road in Furnissdale (Figure 1) for residential and commercial development. Lot 48 has an area of 4.0848ha and is bound by an un-constructed road to the north, Furnissdale Road to the east, Ronlyn Road to the west, and to the south several large residential lots which face Riverside Drive.

The proposal includes the creation of 42 residential lots and 1 commercial lot at the western end of the property and an internal road network (including on the adjacent road reserve to the north) to service the development (Figure 2). The main characteristics of the subdivision proposal are included in Table 1.

**Table 1: Summary of Key Proposal Characteristics**

| Element | Description |
|---|---|
| Size of land parcel | Lot 48 is 4.0848ha. |
| Area to be developed | 4.0848ha. |
| Current use | Land vacant<br>Remnant bushland<br>Seasonally wet 'estuary peripheral' wetland |
| Proposed use | Residential development |
| Current zoning | Urban under PRS<br>Urban and commercial under TPS No. 4 |
| Works | Clearing<br>Fill<br>Provision of reticulated water, vacuum sewer, power, telephone<br>Internal road system plus creation of gazetted road reserve along northern boundary. |
| Local Government | Shire of Murray |
| Offset | Wetland area (0.9ha) rural equivalent value |
| Proposed environmental management measures | Offset<br>WSUD incorporated in stormwater management<br>Bandicoot relocation in consultation with DEC<br>Dust and fire control during construction<br>Fill used to manage low potential for acid generation<br>Mobile lime dosing unit for dewatering discharge (managed through DoW permit). |

## 1.1 Planning Background

As the Furnissdale Structure Plan (Figure 3) illustrates, development surrounding Lot 48 corresponds with the present semi rural/ residential nature of the locality, with lots averaging 2000m$^2$ to the south and to the north-northwest. Expansion of the

Furnissdale townsite has generally been through the development of smaller lots on Ronlyn and Furnissdale Roads further north. No development of Lot 48 has occurred even though (according to the Shire of Murray) it was zoned Residential R10 under its Town Planning Scheme No.3, until it was superseded by Planning Scheme No.4 in June 1989 (Figure 4).

From a statutory perspective, the Peel Region Scheme zones Lot 48 'Urban' (Figure 5) and as noted above under the Shire of Murray Town Planning Scheme No. 4, the site is zoned 'Residential' R10 with a portion of 'Commercial' land suitable for a corner deli on Ronlyn Road (Figure 4). Given this context, SAS Global Furnissdale Pty Ltd proposes the subdivision of Lot 48 into 30 residential lots of approximately 1,000m$^2$ each and one Commercial lot of 4,081m$^2$ intended as a 'corner store'. There are currently no retail stores in Furnissdale.

Consistent with recent steps in planning towards creating more sustainable communities (via such strategies as *Network City*), the proposed settlement pattern for Furnissdale is a township with a regular, defined town boundary and higher densities where expansion is planned. This is to ensure a "critical mass" of inhabitants within the locality and thus facilitate sustainable, essential service provision and reduce the necessity for sprawling development. In this regard the Furnissdale Structure Plan adopted by the Shire of Murray and the WA Planning Commission in November 2003 is intended to guide the town's future development (Figure 3). Figure 3 depicts Lot 48 within the township's existing boundaries, surrounded by future Residential development to the north and east. Planners for the project advise the proposed subdivision is consistent with the Structure Plan and in a planning context is in keeping with the existing and future development of adjoining landholdings.

## 1.2 Environmental Background

Following a meeting with the Environmental Protection Authority Service Unit (EPASU) on 5 September 2006, it was advised that the subdivision proposal over Lot 48 Furnissdale Road has the potential to be progressed as an Environmental Protection Statement (EPS).

It was advised the factors that will need to be addressed through the EPS process are:

1. Wetlands.

2. Catchment with Special Requirements – Peel Inlet–Harvey Catchment.

3. Native Terrestrial Vegetation.

4. Declared Rare and Priority Flora and other Significant flora and communities (including Threatened Ecological Communities).

5. Native Fauna.

6. Acid Sulphate Soils.

It was further advised that consultation with the following stakeholders was necessary:

- DEC.
- Department for Planning and Infrastructure.
- City of Mandurah [*assumed to read Shire of Murray*].
- Peel Preservation Group Inc.
- Peel Harvey Catchment Council Inc.
- Wetlands Conservation Society.
- Urban Bushland Council WA Inc.
- Conservation Council of Western Australia.
- Wildflower Society of Western Australia.

A copy of the EPASU correspondence detailing the reporting requirements is included in Appendix 1. A copy of the summary of stakeholder consultation is included in Appendix 5.

To identify the environmental values across the site ATA Environmental (2006) undertook a flora and vegetation survey on Lot 48, Ecologia Environmental (2007) carried out a fauna survey, ATA Environmental (2005) also undertook preliminary investigations into the occurrence of Acid Sulfate Soils across the site. Based on the wetland values identified, a range of off-set options were developed and refined in consultation with the EPASU and stakeholders identified above.

Provision of a wetland off-set based on the value of purchasing an equivalent area of land using a clear and logical framework was considered, by the majority of stakeholders, to provide the best environmental outcome. Providing this contribution to the Department of Environment and Conservation (or other suitable entity) was considered the most appropriate to take regional perspective and to combine potential contributions from a number of other small projects that would otherwise be unable to purchase a viable parcel of land.

This report addresses the key environmental issues associated with residential subdivision across the site and management measures to ensure the development can be undertaken in an environmentally acceptable manner. It is the view of the proponent that all the relevant environmental issues have been identified and appropriate management framework put in place such that this assessment can be progressed as an Environmental Protection Statement.

### 1.2.1 Draft Water Quality Improvement Plan

The community consultation document for the draft *Water Quality Improvement Plan for the Rivers and Estuary of the Peel – Harvey System* was released by the EPA in September 2007 (EPA, 2007b). The objective of the draft WQIP is to limit the level of phosphorus reaching the Peel-Harvey waterways to 75 tonnes per year (currently 145t/a). There are 12 actions stated in the draft WQIP which are shown below. Actions 1, 2, 5, 6 and 7 relate to agricultural land and hence not relevant to urban development. All requirements, and mechanisms by which this proposal can and will address the issues in the draft WQIP are clearly demonstrated below.

1. *Use a slow release, low water soluble fertiliser, applied after the break of season, preferably in spring and at reduced rates, on sandy soils in rural areas.*

N/A.

2. *Undertake soil amendment on sandy soils in rural areas.*

N/A.

3. *Use low water soluble fertiliser in urban areas.*

Waterwise and low fertiliser education packs will be made available for new residents to the area for use when designing their own gardens. No active POS is proposed given the proximity to other recreational opportunities and hence no public turf or public gardens requiring fertiliser application are part of this application.

4. *Connect all existing homes to infill sewerage.*

There are no existing houses on this site.

5. *Zero discharge from licensed agricultural premises.*

N/A.

6. *Improve other agricultural practices to reduce phosphorus discharges.*

N.A.

7. *Undertake strategic reafforestation of agricultural land.*

N/A.

*8. Connect to sewerage all homes and properties for new urban developments.*

All lots will be connected to sewerage.

*9. Undertake soil remediation in all new urban developments with sandy soils.*

The site will require fill over much of the development area. The fill to be used will be amended (if necessary) to achieve a minimum 10mL/g PRI over the development area.

*10. Implement Local Planning Policies, Strategies and Planning Conditions that incorporate Best Management Practices where applicable.*

The very small nature of the site provides little opportunity for extensive stormwater treatment systems drainage design, however the small catchment area is expected to generate only small stormwater runoff volumes of good quality. Best Practice water sensitive urban design will be used where possible. Management of other identified environmental factors are discussed in Section 3.

*11. Incorporate Water Sensitive Urban Design in all new developments.*

The Shire of Murray recently adopted "Local Planning Policy No. 50 Water Sensitive Urban Design" which is consistent with the "State Planning Policy 2.9 – Water Resources". It has the stated policy objectives of:

*a. To achieve better integration of land and water planning which results in improved water management outcomes for the Peel – Harvey Catchment..*

b. *To ensure that land use planning decisions are compatible with achievement of the objectives and maintenance of the Environmental Quality Criteria in the* Environmental Policy (Peel Inlet – Harvey Estuary) Policy 1992*, the Ministerial Conditions imposed in Bulletin 994 "Peel Region Scheme" and the Peel – Harvey Coastal Catchment Water Quality Improvement Plan.*

Water Sensitive Urban Design will be incorporated into the development design.

*12. Improve the agricultural and urban drainage system.*

The site is currently unmanaged and illegal dumping together with uncontrolled drainage represents a risk to the Serpentine River and Peel – Harvey Estuary. The development will put in place a managed stormwater treatment system and the land use within each individual lot will remain the responsibility of the lot owner. Illegal dumping is unlikely to occur within the developed land.

This proposal is consistent with the intent of the draft WQIP and will put in place a mechanism for long term management of the land use and drainage system for this portion of the Furnissdale townsite.

# 2.0 EXISTING ENVIRONMENT

## 2.1 Location

The 4.0848ha site is bounded by Furnissdale Road to the east, Ronlyn Road to the west, existing residential development to the south and a road reserve (unconstructed) acting as a firebreak along the northern boundary (Figure 7). The site is 5km south east of the Mandurah CBD and 70km south of Perth (Figure 1).

## 2.2 Geology, Landforms and Soils

Regional 1:50,000 geological mapping for the site (GSWA, 1978) and its surroundings is presented in Figure 6 Lot 48 is located on the Bassendean Dune System which consists of low hill and intervening swampy areas (ATA Environmental, 2006).

The site is situated on Bassendean Sand (Qhgb) of Holocene age, which forms a sub-unit of the Holocene estuarine and lagoonal sediments (Qhg) which are associated with the proximity to the Serpentine River and Peel Inlet–Harvey Estuary.

The site is very gently sloping towards a central wetland area. Topography varies by less than 2m across the site.

Lot 48 is located within a relatively low lying area adjacent to the Serpentine River (Estuarine and Lagoonal Deposits) where the water table can rise to within 2m of the surface forming iron-humus podzol (Gavin Sand) which is often cemented (ATA Environmental, 2006).

## 2.3 Acid Sulfate Soils

WAPC Planning Bulletin 64 indicates that the site is mapped as Low to Moderate Acid Sulfate Soils (ASS) risk within 3m of soil surface. ATA Environmental (2005) undertook a preliminary ASS assessment of Lot 48 in 2005. The results showed that no Actual ASS are present on-site; the surface soils in the central area of the site are potentially acidic; and one sample near the central area of the northern boundary may be indicative of potential acidity at 1.5m depth.

## 2.4 Groundwater and Hydrology

The site is low lying and Average Annual Maximum Groundwater Levels are at or near the surface. The Department of Water (DoW) Perth Groundwater Atlas shows depth to groundwater across the site varies from 1.0m to visible at the surface, consistent with the wetland status of the central portion of the site (DoW, 2007).

The entire site is located outside of the floodway of the Serpentine River, however approximately 80% of the site is within the 100 year flood plain, as is the majority of the existing Furnissdale townsite (Figure 8). Approximately 20% of the site is not affected by flooding.

## 2.5 Wetlands

The Department of Environment and Conservation's Geomorphic Wetland database considers that approximately 0.9ha of the site is "Estuary Peripheral" wetland and classified as Conservation management category (Figure 8). This wetland (UFI 13289) is part of a larger system (over 281ha) that has hydrological associations with the Peel Inlet-Harvey Estuary (Figure 8).

## 2.6 Flora and Vegetation

ATA Environmental (2006) undertook a flora and vegetation survey of the site in 2005. The key findings of the report are presented below and a full copy of the report has been reproduced as Appendix 2.

The survey area is located within the Drummond Botanical District of the Swan Coastal Plain Subregion (Beard, 1990). The typical vegetation sequences are described as *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) on less leached soils.

A search of the DEC Declared Rare and Priority Flora database identified four rare and one Priority 3 species that may potentially occur in the area. They were:

- *Diuris micrantha* (Conservation Status Rare).
- *Diuris drummondii* (Conservation Status Rare).
- *Drakea elastica* (Conservation Status Rare).
- *Caladenia hueglii* (Conservation Status Rare).
- *Dillwynia dillwyniodes.* (Conservation Status Priority 3).

No species of Declared Rare or Priority Flora were recorded from the site during the September and October 2005 site visit.

A search of the DEC's Threatened Ecological Communities (TEC) database revealed that no TEC's were listed within the geographical range of the survey area, which was confirmed as part of the site survey.

Regional scale vegetation assessment by Heddle *et al.* (1980) maps the site as Vasse Complex (Figure 10). The Vasse Complex is generally associated with marine (lagoonal and estuarine) deposits. Vasse Complex has 29% of original extent remaining on the Southern Swan Coastal Plain.

More site specific, ATA Environmental (2006) identified seven discrete vegetation types ranging in condition from Excellent to Degraded (Figure 11). These vegetation types are described below:

ErOW *Eucalyptus rudis* Open Woodland to 5m in height over Tall Shrubland of *Jacksonia sternbergiana*, *Acacia saligna* and *Kunzea ericifolia* to 4m in height over Open Herbland of *Watsonia meriana* var. *bulbillifera*, *Sowerbaea laxiflora*, *Dasypogon bromeliifolius* and *Conostylis aculeata*. This vegetation type was recorded from the eastern and southeastern portions of the site. According to the condition rating scale of Keighery published in Bush Forever (Government of Western Australia 2000), this vegetation type was considered to be in Very Good condition.

ErMrW *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland to 10m in height over Tall Shrubland of *Acacia saligna* and *Viminaria juncea* to 3m in height. This vegetation type is associated with the southern portion of the Conservation Category wetland (CCW) that occurs in the central portion of the site. According to the condition rating scale this vegetation type was considered to be in Very Good condition.

ApOLH *Acacia pulchella* Open Low Heath to 1m in height with scattered *Jacksonia furcellata* over *Dasypogon bromeliifolius* Open Herbland to 0.5m in height. This vegetation type is predominantly regrowth vegetation associated with an area in the eastern portion of the site that had been previously cleared (~3-5 years prior to the survey). As a consequence this vegetation type was considered to be in Good condition.

JsKeTOS *Jacksonia sternbergiana* and *Kunzea ericifolia* Tall Open Scrub to 3m in height with scattered *Eucalyptus rudis* over a Herbland of *Dasypogon bromeliifolius* to 0.2m in height. This vegetation type was recorded from the western portion (and to the immediate west) of the CCW that occurs on the site. According to the condition rating scale this vegetation type was considered to range from Good to Very Good condition.

BaBiAfLOF *Banksia grandis*, *Banksia ilicifolia* and *Allocasuarina fraseriana* Low Open Forest to 8m in height over Tall Shrubland of *Jacksonia sternbergiana* and *Kunzea ericifolia* to 4m ion height over *Macrozamia riedlei* dominated Low Open Shrubland to 1m in height. This vegetation type was recorded from the central western portion of the site and as a result of high levels of weed infestation, including *Ehrharta calycina*, *Cynodon dactylon*, *Briza maxima* and *Hypochaeris glabra*, this vegetation type was considered to be in Good condition.

PeCH *Pericalymma ellipticum* Closed Heath to 1.8m in height with scattered *Jacksonia furcellata* and *Viminaria juncea*. This vegetation type was recorded in a low-lying, inundated area in the north-west of the site. No weed species were recorded in association with this vegetation type and

there were few obvious signs of disturbance. As a consequence the condition of the vegetation type was considered to range from Very Good to Excellent.

KeCTS *Kunzea ericifolia* Closed Tall Scrub to 4m in height with scattered *Eucalyptus rudis* and *Melaleuca preissiana*. This vegetation type was recorded from a slightly waterlogged area in the northwestern corner of Lot 48. This vegetation was associated with a relatively high level of weed infestation, including *Arctotheca calendula*, *Avena barbata*, *Briza maxima* and *Eragrostis curvula* and as a consequence was considered to be in Degraded to Good condition.

A total of 51 species were recorded from the project area, with 40 native species and 11 exotics.

## 2.7 Fauna and Habitat

Ecologia Environment (2007) undertook a Level 2 fauna survey over the project site in 2006 in accordance with EPA Guidance 56 and the subsequent report *SAS Global Ltd Lot 48 Furnissdale Rd, Furnissdale Fauna Survey* is include in Appendix 3.

The key results can be summarised as:

- 15 species of reptile from a potential list of 34 were recorded.
- 3 species of frog from a potential list of 8 were recorded.
- 11 mammal species from a potential list of 22 were recorded, with 5 native species.
- 37 species of non-aquatic bird species from a potential list of 102 were recorded.

Four reptile species, seven mammal species and nine bird species of conservation significance *potentially* occur within the study area. This is discussed in more detail in the Ecologia Environmental (2007) report, however only 1 species, the Southern Brown Bandicoot was considered of "high" likelihood of occurrence on site. This species is Priority 5 under the ranking which are "taxa in need of monitoring". The species is not identified as of conservation significance under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* or Western Australian *Wildlife Conservation Act 1950* and is considered widespread on the Swan Coastal Plain.

The Forest Red-tailed Black Cockatoo was recorded flying over the project site. This species is listed as "Vulnerable" under the EPBC Act and "Schedule 1" – 'Fauna which are Rare and Likely to become extinct' under the WA Wildlife Protection Act. However as this species is entirely dependant on jarrah-marri forest for breeding and the vegetation type at the project site is a small part of a large range of foraging habitat (0.18% of available Vasse Complex), the likelihood of occurrence at this site is considered low.

No regionally endemic species were recorded at the site.

The EPASU has advised that of the bird species identified in the study area by Ecologia, the species in Table 1 are listed as being significant on the Swan Coastal Plain when using the criteria in Bush Forever (Government of Western Australia, 2000) and/or Keighery *et al.* (2006).

**Table 2: As advised by the EPASU, birds listed as being significant on the Swan Coastal Plain using criteria in Government of Western Australia (2000) and Keighery *et al.* (2006) and observed in the study area.**

| Species | Common Name | Significance (Bush Forever) |
|---|---|---|
| *Acanthiza apicalis* | Inland Thornbill | 3 |
| *Acanthiza chrysorrhoa* | Yellow-Rumped Thornbill | 3 |
| *Sericornis frontalis* | White-Browed Scrubwren | 3 |
| *Smicrornis brevirostris* | Weebill | 3 |
| *Accipiter fasciatus* | Brown Goshawk | 4 |
| *Haliastur sphenurus* | Whistling Kite | 4 |
| *Phaps chalcoptera* | Common Bronzewing | 3 |
| *Malurus splendens* | Splendid Fairy-Wren | 3 |
| *Acanthorhynchus superciliosus* | Western Spinebill | 4 |
| *Manorina flavigula* | Yellow-Throated Miner | 4 |
| *Phylidonyris novaehollandiae* | New-Holland Honeyeater | 4 |
| *Collurincincla harmonica* | Grey Strike-Thrush | 3 |
| *Pachycephala pectoralis* | Golden Whistler | 3 |
| *Calytorhyncus banksii naso* | Red-Tailed Black Cockatoo | P3 Locally Extinct |

The EPASU also advised that a number of mammals and reptiles species identified on site are listed by Keighery *et al* (2006) as significant on the Swan Coastal Plain.

**Table 3: As advised by the EPASU, mammals and reptiles listed as being significant using Keighery et *al.* (2006) and observed in the study area**

| Scientific Name | Common Name | Conservation Significance [1] |
|---|---|---|
| **MAMMALS** | | |
| *Dasyurus geoffroii* | Chuditch or Western Quoll | VU, R1 |
| *Phascogale tapoatafa* | Brush-Tailed Phascogale | P3 |
| *Myrmecobius fasciatus* | Numbat | R1,(locally extinct) |
| *Isoodon obesulus fusciventer* | Quenda or Southern Brown Bandicoot | P5 |
| *Macropus irma* | Western Brush Wallaby | P4 |
| *Trichosurus vulpecula* | Common Brushtail Possum | Category4 |
| *Cercartetus concinnus* | Western Pygmy-Possum | Category3 |
| **REPTILES** | | |
| *Underwoodisaurus milii* | Barking Gecko | Category3 |
| *Ctenotus impar* | Odd-Striped Ctenotus | Category3 |
| *Ctenotus labillardieri* | Red-Legged Skink | Category3 |
| *Ramphotyphlops pinguis* | Fat Blind Snake | Category3 |
| *Demansia psammophis* | Reticulated Whip Snake | Category4 |
| *Echiopsis curta* | Bardick | Category4 |
| *Elapognathus coronatus* | Crowned Snake | Category4 |

1 Regionally declining species (Government of Western Australia 2000b).
Category 3 = habitat specialists with a reduced distribution on the Swan Coastal Plain and the EEEA Project Area;
Category 4 = wide-ranging species with reduced populations on the Swan Coastal Plain and the EEEA Project Area

### 2.7.1 Ecological Linkage Value

Lot 48 is bordered on the south, east and west by existing roads and/or developed residential areas. It is the southern extremity of a much larger wetland system extending north and east. There may have historically been some hydrological connection to the Serpentine River but this has been severed with the construction of Riverside Drive and the Furnissdale townsite many decades ago. In terms of an ecological linkage the site could be described as a 'dead end' with only limited 'stepping stone' linkage value for mobile avian fauna. The extensive areas of remnant vegetation east of Furnissdale Road provides a more intact vegetated connection through to the Serpentine River.

# 3.0 ENVIRONMENTAL FACTORS AND THEIR MANAGEMENT

## 3.1 Wetlands

### 3.1.1 EPA's Objectives

The EPA's Position Statement No. 4 on the environmental protection of wetlands (EPA, 2004) sets out the EPA's overarching goals for wetlands.

### 3.1.2 Identified Wetland Values

Hill *et al.* (1996) provide a comprehensive list of characteristics, functions, uses and attributes of wetlands in Perth. The relevant functions and values of the wetland within Lot 48, and more broadly through the remainder of UFI 13289, are described in more detail below, together with proposed mitigation and management strategies.

3.1.2.1 Groundwater Recharge

Wetlands can act as both a recharge point and a loss point for groundwater. The 0.9ha portion of wetland on Lot 48 has very little 'catchment' for surface water flow to significantly impact on groundwater recharge and hence would provide little value in this regard. The larger wetland system receives seasonal surface water overflow from Barragup Swamp which would act to supplement regional groundwater flow. Superficial groundwater flow would be towards the estuary. The significant areas of salt scald across the larger portion of wetland (outside of the project area) and the 'estuary peripheral' wetland type suggest the soil profile has significant salt store leading to localised groundwater salinisation.

From a local and regional perspective, groundwater recharge from this small area of wetland could not be considered a significant 'value'.

3.1.2.2 Flood Control

No development is allowed within river floodways that would cause 'backing up' of floodwaters and increase the risk of flooding further upstream, however the site is not within the floodway.

Development is not precluded in the designated flood fringe, providing the minimum habitable floor level to be at least 0.5m above the 100 year flood level.

Approximately 80% of Lot 48 is within the Serpentine River 100 year flood fringe (Figure 8). Similarly, the eastern expanse of the wetland is also part of the flood fringe, providing a similar function and contains areas of floodway.

A large area of the existing Furnissdale townsite is within the flood fringe of the Serpentine River. Lot 48 and the larger area of flood fringe is not considered to provide a significant role in flood mitigation and hence is not considered a significant value of this wetland.

3.1.2.3 Sediment Retention, Nutrient/Pollutant Absorption and Nutrient Export

As Lot 48 receives negligible surface flow, it plays little role in removal of sediments. The 0.9ha of wetland vegetation on-site may provide a small benefit in nutrient absorption however the remaining 281ha of wetland UFI 13289 has far greater capacity to attenuate flow, reduce sediment loads and attenuate nutrients and pollutants before they enter the groundwater or flow through to the Peel Inlet-Harvey Estuary.

The potential for the project to contribute to sediment or nutrient loads is discussed in more detail in Section 3.2.

The value of the portion of wetland in Lot 48 in retaining sediments and nutrient/pollutant absorption is not considered to be a significant function within a local and regional context.

Close to source infiltration and sediment capture will be a key element of the subdivision design. The need for importation of fill will allow the use of higher Phosphorus Retention Index (PRI) material that will provide improved phosphorus removal compared to the natural soils of the area.

3.1.2.4 Nursery / Breeding Area and Wildlife Habitat

A Level 2 fauna assessment was undertaken by Ecologia Environmental (2007) in accordance with EPA Guidance Statement No. 56 to determine fauna habitats, biodiversity and ecological function within the project area.

The report logically concludes that as development for housing requires clearing of native vegetation, there will be a loss of some native fauna biodiversity and ecological function. However, the report also states that only two species of conservation significance may occur on site; the Southern Brown Bandicoot and the Forest Red Tailed Black-Cockatoo. The bandicoot is the only species likely to have an established population on or near to the site. It is recommended that a trapping and relocation program be undertaken to ensure no individuals are harmed during construction activities. This would occur just prior to clearing works commencing, in accordance with advice from the DEC.

The value of the site as wildlife habitat and / or refuge is diminished by proximity to existing residential areas and unrestricted dog and cat movement, vehicle access across the site, and significant weed invasion.

The function of this portion of wetland is replicated throughout the remaining 281ha of wetland and additional upland areas (Figure 8).

In a regional and State context, the loss of 0.9ha of wetland is not likely to result in a significant loss to nursery or breeding areas of the region, and bandicoot trapping and relocation is proposed (refer to Section 3.4.3).

3.1.2.5 Contribution to the Maintenance of Existing Processes or Natural Systems

The wetland part of the site forms a 0.9ha south western extent of the Estuary – Peripheral Wetland System which occurs to the east. The existing Furnissdale townsite probably severed the direct link to the Serpentine River in the general vicinity during the raising of lots levels and during road construction. The site retains some ecological functions but its role in the broader maintenance of processes and natural systems is questionable. The site forms no ecological linkage value given the housing and roads bordering three sides, and the historical changes in the hydrology from construction of the existing townsite prevents any direct links to the Serpentine River.

On this basis it is concluded that the development of the 0.9ha of wetland and 3.1ha upland area will not significantly impact on maintenance of existing process or natural systems outside of Lot 48.

### 3.1.3 Potential Impact to Wetland Values

The development site of approximately 4.0848ha would normally attract a requirement to provide Public Open Space (POS); 3,677$m^2$ of open space (excluding the commercial lot) would generally need to be provided. Incorporation of the existing 0.9ha of wetland and a standard 50m buffer as POS will not allow for a connected, consistent or viable urban design. Therefore to make the most efficient use of the remaining urban zoned land adjacent to the townsite, it is intended that contribution to the maintenance and improvement of existing facilities adjacent to the Serpentine River foreshore and the nearby York Street park would provide a better outcome to the community than a very small pocket of 'unusable' Public Open Space.

Furthermore, given the requirement for importation of between 1 – 2m of fill to meet the minimum habitable floor level requirements for the flood fringe, there is little opportunity to retain mature trees within the developed landscape. As a result there will be a loss of 0.9ha of wetland and associated habitat. However, with the relocation program proposed for the Southern Brown Bandicoot, there is not expected to be a significant impact on fauna of conservation significance and the habitat values provided by the 0.9ha site are well represented throughout the remaining 281ha of this wetland.

With the use of close to source infiltration of stormwater, and no untreated discharge to the remaining wetland area, there is not expected to be any significant impact on existing processes or natural systems. The existing road reserve along the northern boundary will provide a hard edge to development and a fence will be installed along the

northern edge of the road reserve to prevent fauna being injured on the road and restrict unauthorised access (subject to approval by the current land owner). As there is no surface water flow south across this site and it represents the southern extremity of the system, and approximately 0.3% of the wetland will be lost, there will be no significant change to the hydrology of the adjacent wetland.

### 3.1.4 Wetland Off-sets

Although the potential impacts to wetland UFI 13289 are not expected to be significant, SAS Global Furnissdale Pty Ltd recognise that a 0.9ha portion of the Conservation Category Wetland will be lost as a result of this development. In accordance with the EPA's Position Statement No. 9 *Environmental Offsets* (EPA, 2006a) and EPA's draft Guidance Statement No. 19 *Environmental Offsets* (EPA, 2007a) and further to advice provided by the EPASU in correspondence dated 12 September 2006, the proponent has developed an offsets package that will enable a net environmental benefit outcome from this project.

Appendix 4 provides a summary of the information required by the EPA when assessing the environmental offsets proposed for a project, in accordance with draft EPA Guidance Statement No. 19. The proposed offset table summary should be read in conjunction with the other commitments provided in this Environmental Assessment Report.

Four potential off-set options were proposed for discussion with the EPA Service Unit and relevant stakeholders (however it is important to remember that the area in question totals 0.9ha). The four off-set options included:

***Option 1 – Cost to Purchase Equivalent Area***

- Using available information on rural sales in the area (or seek advice from a professional valuer), estimate a per hectare cost to purchase an equivalent area of wetland land and provide this amount of funds to DEC (or other appropriate entity identified by the EPA).

- This option provides an independently derived figure related to the cost of purchase of a similar portion of land with similar environmental values, it is defensible and open and allows the DEC (or other appropriate entity) to utilise the funds in the most appropriate manner as they decide, which may include pooling resources to enable purchase a larger land holding. Valuation would be undertaken on rural zoned land that is largely under native vegetation and contains a portion of seasonal wetland to most closely represent the development site in Furnissdale.

***Option 2 – Cost the Wetland Values***

- Identify individual wetland values.

- Determine costs to replace each 'value'.

- This is an extremely difficult option to 'cost', e.g. how much is Central and South vegetation community (1.3ha) in "Good" condition worth as opposed to closed scrub of *Melaleuca sp.* and *Eucalyptus rudis* fringing (0.9ha) in "Very Good" condition.

- A similar option would be for the DEC to identify an area of land and SAS commit to recreating the missing 'values' (or equivalent) up to the standard of values at Lot 48.

- This option was considered very difficult to effectively measure and implement.

***Option 3 – Peel Region Nature Restoration Trust***

- This option involves the establishment of a "charitable trust" where the charitable purpose is environmental protection or restoration.

- Contributions from other off-sets in the Peel Region could contribute to a trust fund where a Management Board (made up of representatives from the Peel Region) would identify suitable projects that would benefit from a regional scale perspective and funding source to provide long term benefits.

- This project would enable a coordinated approach to environmental restoration / rehabilitation projects on a larger scale, rather than an ad-hoc approach of individual projects of limited scale.

- It is proposed that this off-set package would:

  - Seek support from relevant stakeholders (DEC, EPA, City of Mandurah, Shire of Murray, Peel Development Commission, community representative).

  - Establish the legal framework for a trust.

  - Propose an appropriate composition of Management Board.

  - Draft objectives of the fund to act as a basis for development of the Constitution.

  - Nominate a relevant agency to oversee Board establishment and operation.

- It is proposed that if this concept were to be accepted by the EPA the cost of establishment as outlined above could be bonded (mechanisms are available through Local Government and CALM legislation) allowing environmental approval to be granted. This would allow the development to proceed and provide confidence to the EPA that the establishment of the Trust would occur.

- Through stakeholder consultation, it was identified that a similar process has been initiated in the Peel region, the "Peel Community Foundation". So contribution to an established Foundation that has environmental improvement as an objective could also be considered.

***Option 4 – Rehabilitation Works***

- Ecosystem restoration or rehabilitation are considered 'primary offsets' in the EPA Position Paper. As a like for like offset, justification of an area for rehabilitation can be clearly linked back to an area proposed to be impacted.

- The proposed subdivision for Lot 48 will impact on approximately 0.9ha of wetland. To provide a net environmental benefit, rehabilitation of at least this area of land would be required.

- It is intended that rehabilitation works would be undertaken in areas already set aside for conservation but requiring active management to improve (i.e. money would not be used for purchase but for on-the-ground management).

Stakeholder consultation was undertaken in April, 2007 on the four off-set options; a summary of the consultations, issues raised and responses are provided in Appendix 5. Included in the consultation were officers from the EPASU, the Regional Offices of DEC, DOW and DPI, the Shire of Murray, the Peel Preservation Group Inc., the Peel Harvey Catchment Council Inc. and the Southwest Catchment Council. The Conservation Council of Western Australia and Wildflower Society of Western Australia were also approached to provide comment.

While general concern was expressed at the potential development of a portion of a Conservation Category Wetland, there was general recognition that from a planning perspective Lot 48, as an area of urban zoned land, represented a logical extension of the existing Furnissdale townsite. The Shire of Murray favoured Options 3 and 4 but Options 1 and 4 was generally viewed as the most appropriate to provide an off-set with some concern expressed that the money be used by DEC locally to provide the benefit.

A further round of consultation was undertaken in July 2007 when a draft copy of this Environmental Assessment Report was provided to the Shire of Murray, DoW, DEC, PHCC, Peel Preservation Group and the Conservation Council for comment. The additional comments received and a response to them have also been included in Appendix 5.

As a result of the assessment of off-set options and outcome of consultation, the proponent proposes the process described in "Option 1" above as the recommended off-set to mitigate the potential impacts on a 0.9ha portion of Estuary Peripheral Conservation Category Wetland. If acceptable, the proponent will prepare an "Off-Set Implementation Strategy", in consultation with the Shire of Murray, and to the satisfaction of the DEC detailing the parameters to be provided to the valuer, which

valuer(s) will be used and when the funds will be transferred to the DEC (or other appropriate entity).

## 3.2 Catchment with Special Requirements – Peel Inlet–Harvey Catchment

### 3.2.1 EPA's Objective

The EPA's objectives for the Peel Inlet-Harvey Estuary are that the environmental quality objectives for the Peel Inlet–Harvey Estuary specified in the *Environmental Protection (Peel Inlet–Harvey) Policy 1992* and that the water quality guidelines specified in the EPA Bulletin 711 for the protection of aquatic ecosystems are met.

### 3.2.2 Management

The subject site is located within the Swan Coastal Plain Catchment of the Peel Inlet-Harvey Estuary, which has a history of poor water quality. The objective of the *Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992* is to reduce the input of nutrients, particularly phosphorus, into the Peel Inlet-Harvey Estuary through a number of means, which includes appropriate land management by landowners in the policy area.

For urban development in areas of reticulated sewerage (as this site is), uncontrolled and untreated stormwater run-off is the key medium for export of nutrients off-site and into the Peel Inlet–Harvey Estuary. The primary aim for stormwater management within this site is for minimised collection, and on-site retention and infiltration of both stormwater and entrained contaminants from the 30 lots. On-site retention and infiltration of stormwater will limit the impact of the development upon the surrounding catchment, and will ensure compliance with current DEC Stormwater Management Principles.

The stormwater management hierarchy applied in Western Australia is as follows:

- Retain and restore natural drainage lines – retain and restore existing valuable elements of the natural drainage system.

- Implement 'at source' controls – planning, organisation and behavioural techniques to minimise the amount of pollution entering the drainage system.

- Maximise local infiltration – infiltration of rainfall as high in the catchment as possible, to minimise runoff.

- Limit use of 'in-system' management measures – collection/treatment of runoff, where limitation to local infiltration is not practicable due to local hydrologic conditions.

Specific principles of the Statement applying to urban drainage design are:

- Rainfall from a 1:1 year ARI event should be retained and infiltrated on-site, unless it can be clearly demonstrated that achievement of this objective is impractical due to the hydrologic conditions of the site.

- Runoff from all impervious areas, i.e. roads and buildings, should be directed to soakwells or other infiltration structures which are able to accommodate a 1:1 year ARI event prior to overflow.

- Controls which incorporate vegetation are generally considered an effective water quality management measure. These should be used both as single management measures (eg. Swales and filter strips) and as links between infiltration measures.

- Large and infrequent storm events, such as 1:5 and 1:10 year ARI events, can be mitigated through the use of "soft engineered" retention or detention areas, that may be integrated within public open space/linear multiple use corridors.

These principals are incorporated into the subdivision design and the overarching principle of no untreated run-off to the adjacent wetland is a feature of the design to protect hydrology patterns of the neighbouring wetland and minimise nutrient export. This project is consistent with the achievement and maintenance of Environmental Quality Objectives for the Peel Inlet–Harvey Estuary and will not detrimentally affect the water quality guidelines as specified in EPA Bulletin 711.

## 3.3 Native Terrestrial Vegetation and Declared Rare and Priority Flora and other Significant Flora and Communities (including Threatened Ecological Communities)

### 3.3.1 EPA's Objective

The EPA's objective for native vegetation is to maintain the abundance, diversity, geographic distribution and productivity of flora at the species and ecosystem levels through the avoidance or management of adverse impacts and through improvement in knowledge. The objective for significant flora and communities is to protect Declared Rare and Priority Flora consistent with the provisions of the *Wildlife Conservation Act 1950*.

### 3.3.2 Management

As described in Section 2.6, ATA Environmental (2006) undertook a flora and vegetation survey of the site in 2005 (Appendix 2). Figure 10 shows the regional vegetation complex mapping and Figure 11 shows the vegetation type and condition mapping as a

result of the survey work by ATA Environmental. With regard to flora and vegetation of the site, ATA Environmental (2006) concluded that:

- No TEC's were identified on site.
- No species of Declared Rare or Priority Fauna were recorded from the site during the September and October 2005 site visit.
- Seven vegetation units were identified that ranged in condition from Degraded to Excellent.
- Of the 512 plant species identified, 22% were non-native.

ATA Environmental (2006) identified the majority of vegetation occurring on-site corresponded with Floristic Community Types (FCT) 5 and 11. Both types are described as well reserved and at low risk in terms of their conservation status.

The loss of 4ha of Vasse Complex represents approximately 0.1% of the remaining Vasse Complex on the Swan Coastal Plain (System 6 area and part System 1), of which 1,227ha are in secure tenure (EPA, 2006).

Therefore, as no species of Declared Rare or Priority Flora have been identified, the FCT's are well reserved and at low risk in terms of their conservation status, the 4ha site represents approximately 0.1% of Vasse Complex, and the site is adjacent to extensive areas of similar vegetation type; the significance of the site on a local, regional and State level is considered low.

## 3.4 Native Fauna

### 3.4.1 EPA's Objective

The EPA's objective in relation to native fauna is to maintain the abundance, diversity, geographic distribution and productivity of native fauna at the species and ecosystem level through the avoidance or management of adverse impacts and improvement in knowledge.

### 3.4.2 Management

As described in Section 2.7, Ecologia (2007) undertook a level 2 fauna survey over the site. As part of that assessment and in accordance with EPA Guidance Statement No. 56, Ecologia assessed the potential impacts from the project on fauna and associated values (Appendix 3). A summary of the outcomes are presented below.

1. Threatening processes:

- Vegetation clearing.
- Vehicle strikes.
- An increase in feral fauna populations.
- Noise Pollution.
- Dust and Fire.

2. Impacts on fauna habitats:

   Impacts on fauna habitats within Lot 48 cannot be mitigated as all vegetation will be cleared, however areas of adjacent bushland may also be impacted by the threatening processes listed above.

3. Impacts on faunal assemblages:

   The biodiversity of native fauna at Lot 48 will be permanently reduced. Some increase may occur when housing development has finished and gardens become established.

   Ecological function within Lot 48 will be permanently affected. Some recolonisation by native species may occur once homes and gardens are established.

4. Impacts on fauna species of Conservation Significance:

   The population of Southern Brown Bandicoots likely to be present at Lot 48 require removal to prevent significant individual mortality during clearing. Direct mortality due to vehicle strikes and indirect mortality following displacement into areas of adjacent bushland where competition from established individuals may occur.

   The site is not suitable nesting habitat for the Forest Red-Tailed Black-Cockatoo and not well suited for foraging. It is unlikely that this species, as well as the white-tailed *Calyptorhynchus sp.* cockatoos will be significantly impacted by the proposed development.

### 3.4.3 Management Recommendations

Ecologia recommended the following management items to mitigate the impacts of development on native fauna:

1. Relocate the local bandicoot population to nearby bushland if available or incorporate them into DEC reintroduction programmes. DEC personnel should be contacted for advice on suitable relocation areas or breeding programmes and regulator sign-off on the methods to be used should be obtained prior to relocation. Relocation should occur in winter months.

2. Clearing should take place immediately following bandicoot relocation activities.

3. Avoid vehicle strikes by ensuring contractor awareness of the potential for bandicoots and other fauna to be in the area. Reduce speed limits and avoid driving at dusk, dawn, or at night.

4. Keep the project area free from food scraps, human waste and other material likely to attract feral fauna such as foxes and cats into the project area.

5. Clearing should be rapid to reduce the amount of disturbance to fauna in adjacent bushland. Noise reduction measures should be considered. Clearing will occur from the southern and western ends to allow escape of any remaining mobile fauna to neighbouring remnant vegetation.

6. Dust suppression measures should be implemented, including a reduction of vehicle speed on unsealed roads.

7. To avoid fire damage to adjacent bushland, contractor vehicles should be fitted with fire extinguishers and personnel should be trained in their use. A fire prevention strategy should be considered.

SAS Global Furnissdale Pty Ltd commits to implementation of the above management recommendations to mitigate potential impacts on native fauna, in consultation with DEC.

## 3.5 Acid Sulfate Soils

### 3.5.1 EPA's Objective

The EPA's objectives for water management are relevant to Acid Sulfate Soils (ASS). These are to maintain the quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected. Also to ensure the quality of water emissions does not adversely affect environmental values of the health, welfare and amenity of people and land uses, and meet statutory requirements and acceptable standards.

### 3.5.2 Management

The preliminary ASS assessment undertaken by ATA Environmental (2005) identified potential acidity in two locations on the site (Appendix 6). The report concluded that the only area likely to be at significant risk of acidification in the event that the site was disturbed is the central area which is the most low lying.

ATA Environmental (2005) concluded that as more than 1m of fill will be brought in to cover much of the site and there will be minimal disturbance of soils following the placement of fill (with the exception of vacuum sewer installation, and stormwater systems in some sections of the site), there is low risk of impacts from ASS during development.

### 3.5.3 Management Recommendations

ATA Environmental recommended the following management items to mitigate the potential impacts of development on ASS:

1. Filling of the site to design levels should be undertaken progressively, immediately following the stripping of vegetation.

2. The initial 300mm layer of fill imported to the site should be alkaline materials such as crushed limestone or lime sands as this will neutralise any acidity in the unlikely event that acidification reactions occur.

3. Any dewatering discharge should be directed to one of the readily available mobile lime dosing units to ensure that the pH can be adjusted to be above 6 at all times.

4. Any natural existing soils excavated from the site during the construction of service trenches should either be directed off-site to a facility approved for treating ASS where they can be assessed and neutralised appropriately in accordance with guidelines or placed directly on a constructed limestone pad for treatment on-site.

SAS Global Furnissdale Pty Ltd commits to implementation of the above management recommendations to mitigate potential impacts on ASS.

# 4.0 CONCLUSIONS

The following environmental factors were identified, in consultation with relevant stakeholders, as relevant to the proposed residential development of Lot 48 Furnissdale Road in Furnissdale:

1. Wetlands.

2. Catchment with special requirements – Peel Inlet–Harvey Catchment.

3. Native Terrestrial Vegetation.

4. Declared Rare and Priority Flora and other significant flora communities (including threatened ecological communities).

5. Native fauna.

6. Acid Sulfate Soils.

The proposed development will directly impact on 0.9ha of wetland (UFI 13289). The values of groundwater recharge, flood control, sediment retention and nutrient and pollutant absorption, wetland habitat, hydrological function will be lost from this portion of the wetland, however the remaining 99.7% of this wetland system will not be affected by this development and therefore the loss of these values in a local, regional or State context are not considered significant.

The site will be serviced by vacuum sewer and therefore the main source of potential nutrient export is removed.

The DOW's stormwater management principles, such as close to source infiltration and no untreated run-off to the adjacent wetland, will be incorporated into the detailed subdivision design to minimise nutrient export from the site. Clean fill with a high PRI will be used to further minimise phosphorus export from the site. The EPA's objectives for the Peel Inlet–Harvey Estuary will not be impacted by this proposal.

The proposed development will impact on approximately 4ha of remnant vegetation ranging in condition from Degraded to Very Good. No species of Declared Rare or Priority Flora have been identified, the Floristic Community Types are well reserved and at low risk in terms of their conservation status, the site represents approximately 0.1% of Vasse Complex, and the site is adjacent to extensive areas of similar vegetation type; the significance of the site on a local, regional and State level is considered low. The EPA's objective for native terrestrial vegetation will not be significantly impacted as a result of this proposal.

Provided that the management recommendations detailed in Section 3.4.3 are implemented, the EPA's objective for native fauna will not be significantly impacted.

ASS can be managed to meet the EPA's objectives with the implementation of management recommendations detailed in Section 3.5.3.

SAS Global Furnissdale Pty Ltd provide the following commitments to ensure the EPA's objectives are not compromised:

1. The following environmental off-set will be provided to off-set the loss of approximately 0.9ha of CCW.

    - Using available information on rural sales in the area (or seek advice from a professional valuer), estimate a per hectare cost to purchase an equivalent area of wetland land and provide this amount of funds to DEC (or other appropriate entity identified by the EPA).

    - Prepare an "Off-set Implementation Strategy", to the satisfaction of the DEC and in consultation with the Shire of Murray, that details the off-set process and implementation strategy.

2. Detailed subdivision design will incorporate the relevant elements of the DOW's *Stormwater Management Manual for Western Australia* where practicable.

3. SAS Global Furnissdale Pty Ltd will organise to relocate the local bandicoot population to nearby bushland (if available) or incorporate them into DEC reintroduction programmes. DEC personnel will be contacted for advice on suitable relocation areas or breeding programmes and regulator sign-off on the methods to be used will be obtained prior to relocation.

4. Clearing will take place immediately following bandicoot relocation activities and contractors made aware of need to protect bandicoots if seen on or near the site.

5. Dust suppression measures will be implemented in accordance with Shire requirements.

6. A fire prevention strategy will be prepared for the construction phase.

7. Filling of the site to design levels should be undertaken progressively, immediately following the stripping of vegetation.

8. The initial 300mm layer of fill imported to the site should be alkaline materials such as crushed limestone or lime sands as this will neutralise any acidity in the unlikely event that acidification reactions occur.

9. Any dewatering discharge should be directed to one of the readily available mobile lime dosing units to ensure that the pH can be adjusted to be above 6 at all times.

10. Any natural existing soils excavated from the site during the construction of service trenches should either be directed off-site to a facility approved for treating ASS where they can be assessed and neutralised appropriately in accordance with guidelines or placed directly on a constructed limestone pad for treatment on-site.

This proposal represents a logical extension of the existing Furnissdale townsite, in an area zoned Urban and provides a much needed retail outlet for the town. The site contains the southern most tip (0.3%) of an extensive wetland system that exists as a result of its proximity to the Peel Inlet–Harvey Estuary. This portion of wetland and remnant vegetation on-site has not been identified as of local or regional significance.

Therefore, provided that the commitments identified above are satisfactorily implemented, it is considered that the project can be implemented with no off-site degradation of wetland values. The loss of wetland values from the 0.9ha will be off-set by the provision of a proportionate financial contribution to the DEC (or appropriate entity) for its use as appropriate.

# 5.0 REFERENCES

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Kieghery, B. J. *et al.* (2006) *The Vegetation, Flora, Fauna and Natural Areas of the Peel Harvey Eastern Estuary Area Catchment (Swan Coastal Plain).*

# FIGURES

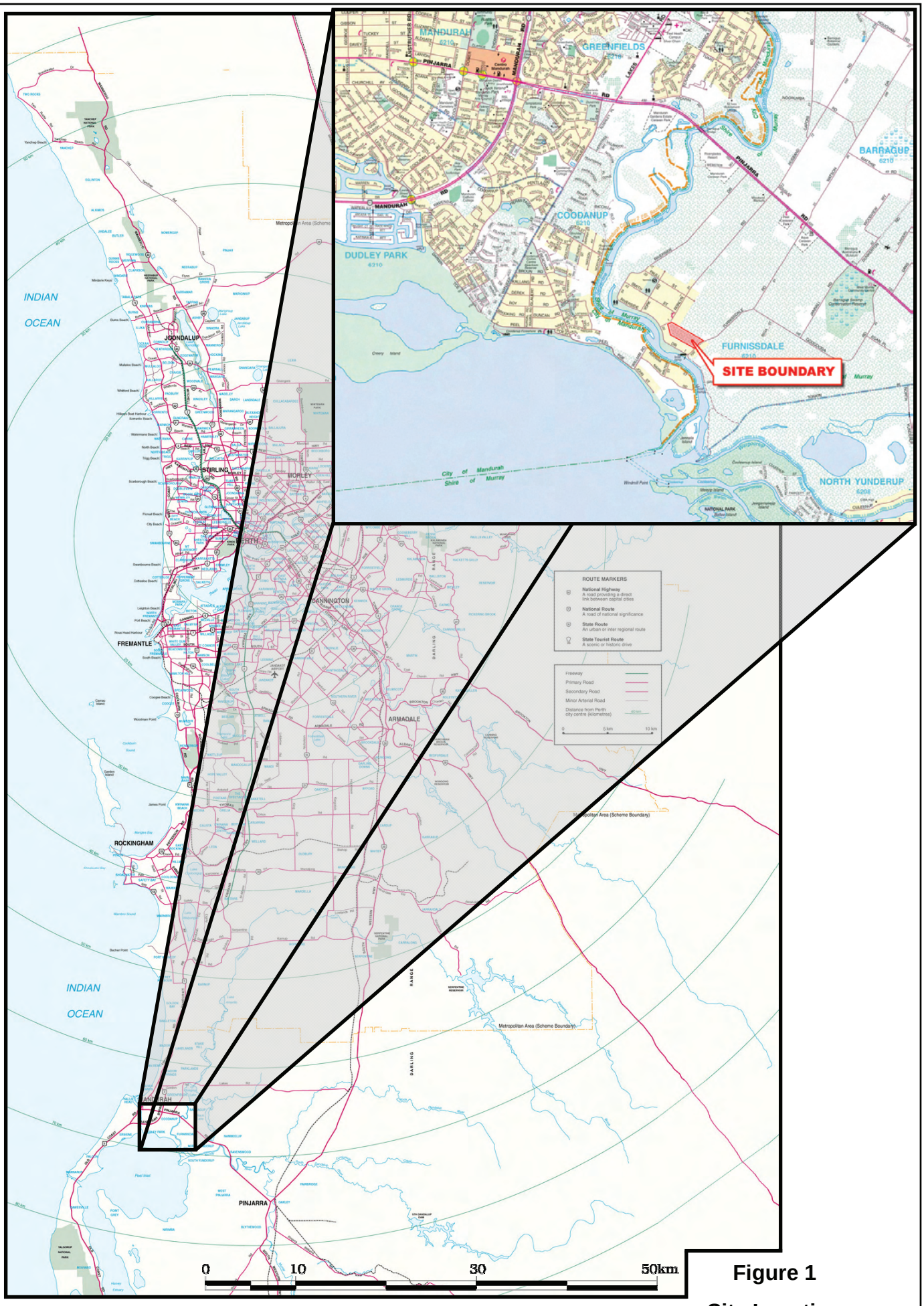


**Figure 1**

**Site Location**

Source: DOLA, 2002

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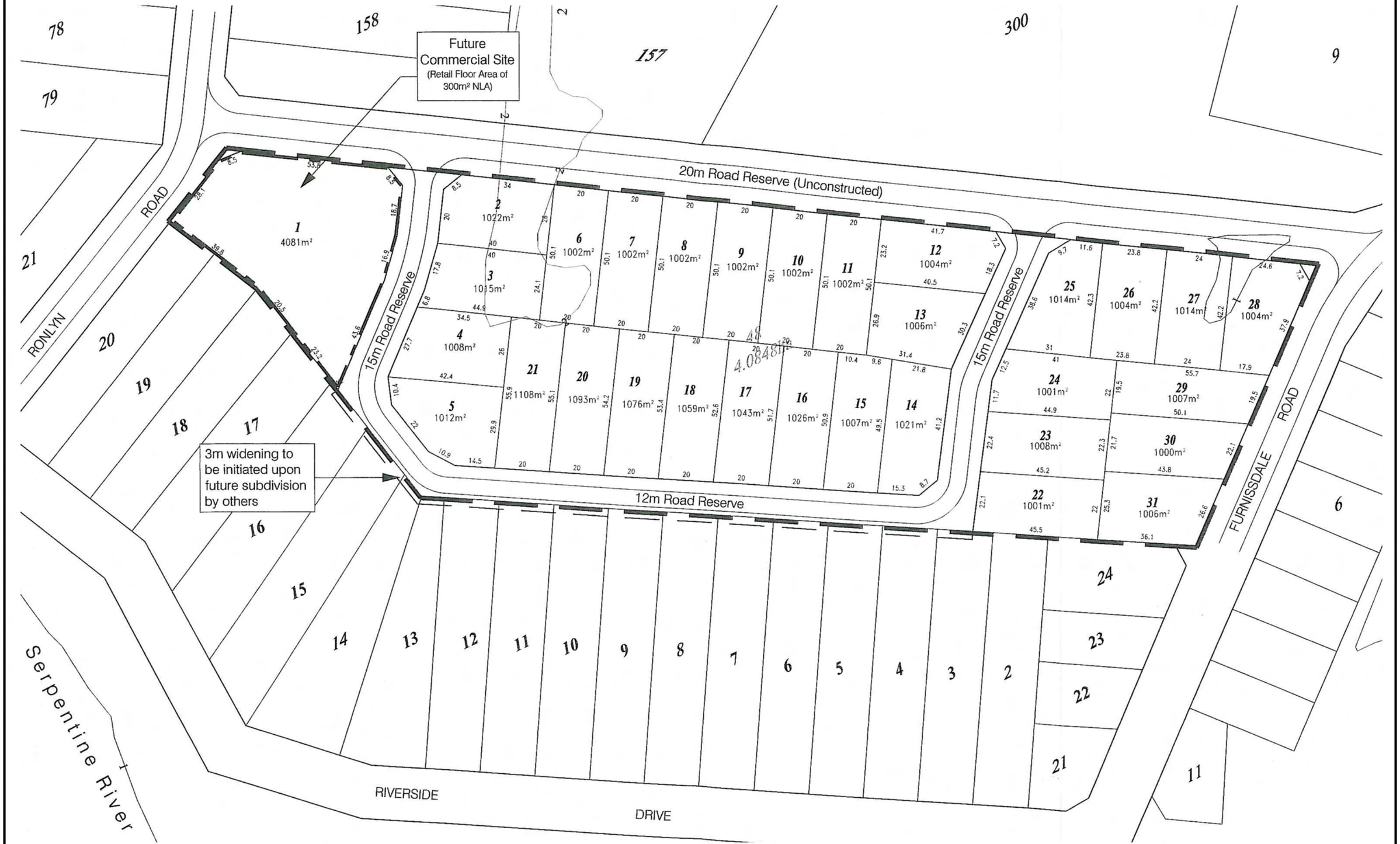


**Figure 2**

**Subdivision Plan**

Source: Chappell and Lambert, 28th May 2005

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RPS

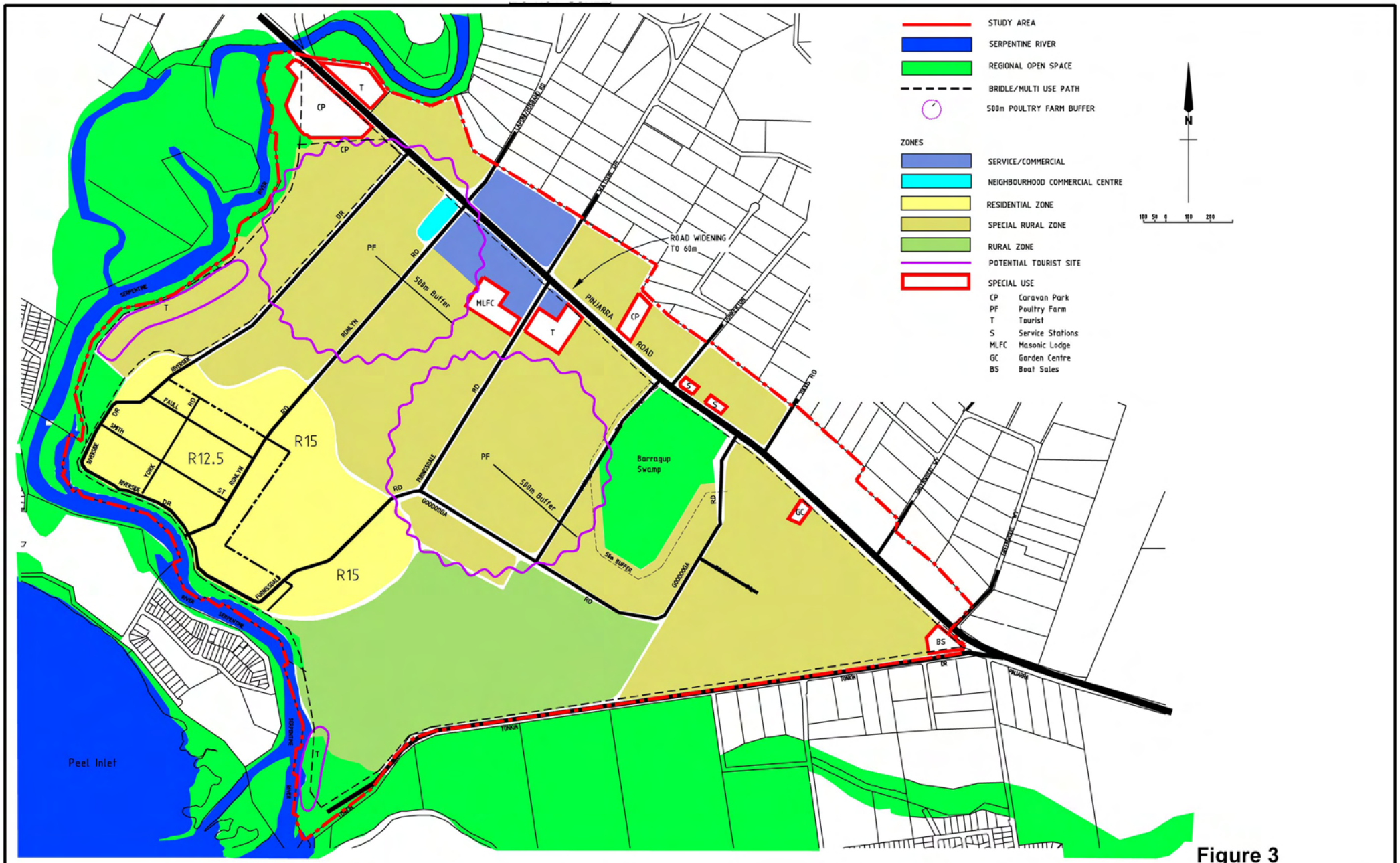


**Figure 3**

**Furnissdale Structure Plan**

Source: Gutteridge Haskins & Davey, May 2001

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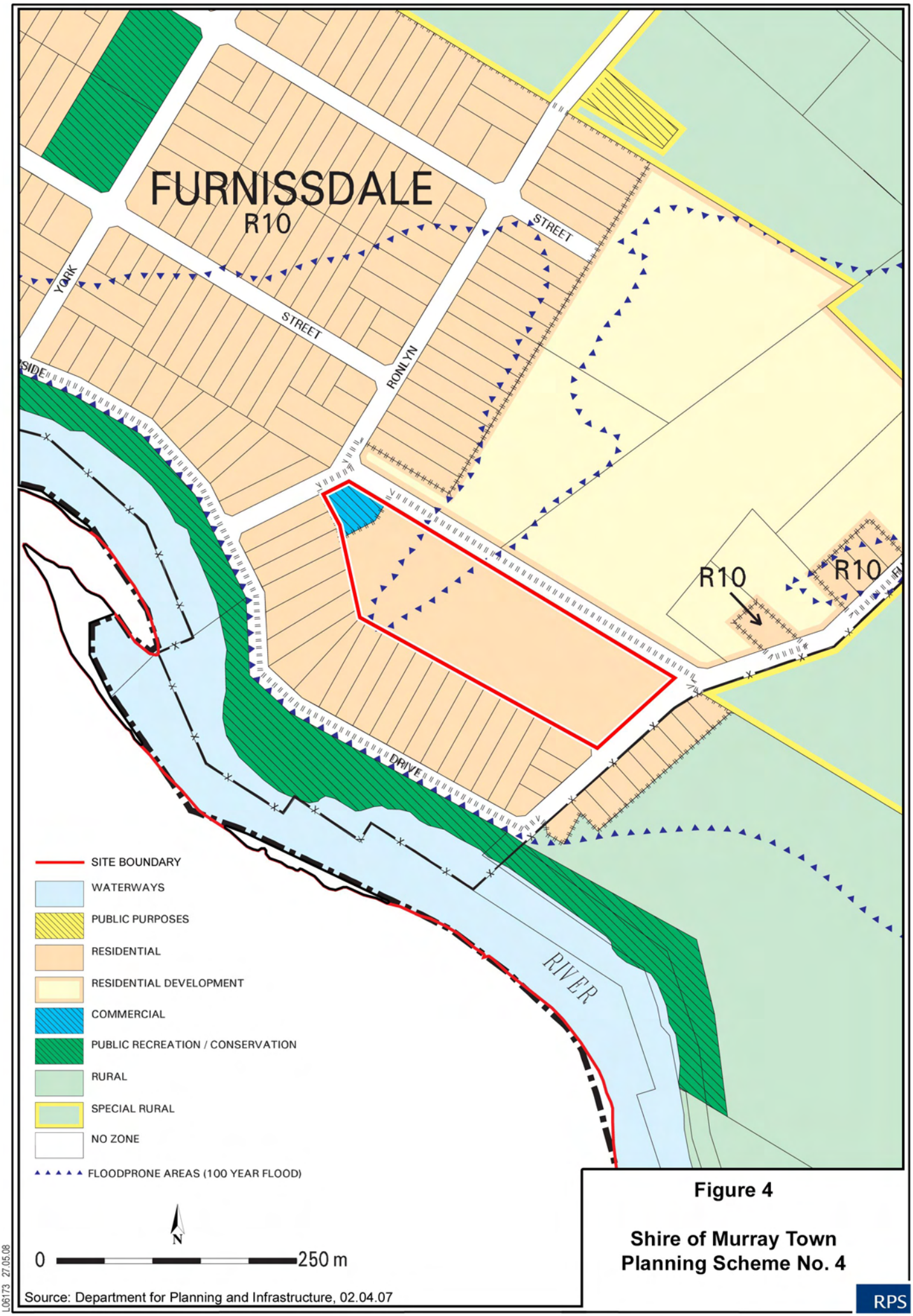


Source: Department for Planning and Infrastructure, 02.04.07

**Figure 4**

**Shire of Murray Town Planning Scheme No. 4**

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**Figure 5**

**Peel Region Scheme**

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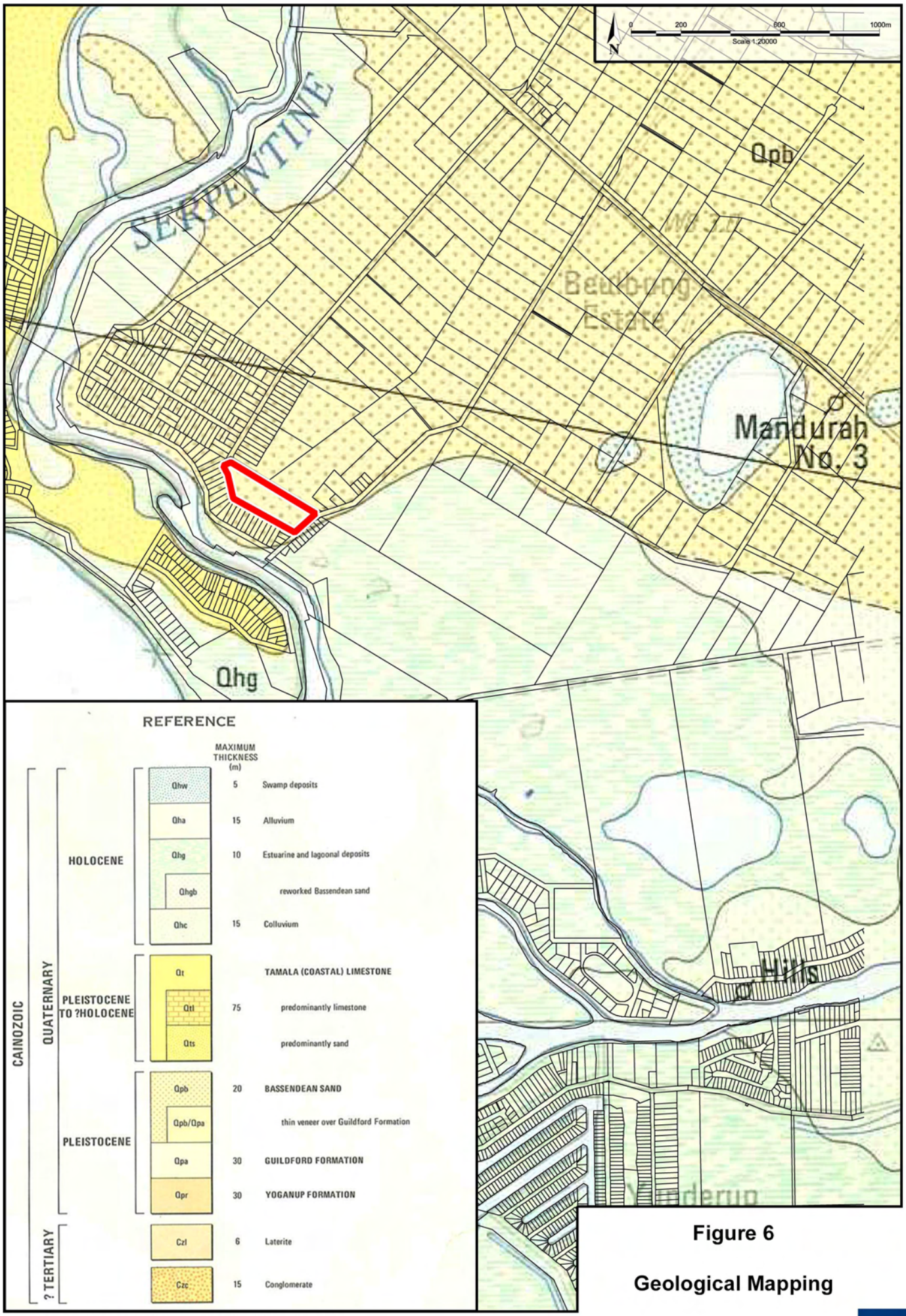


**Figure 6**

**Geological Mapping**

Source: Geology Mapping - Geological Survey of Western Australia

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**Figure 7**

**Aerial Photograph of Site**

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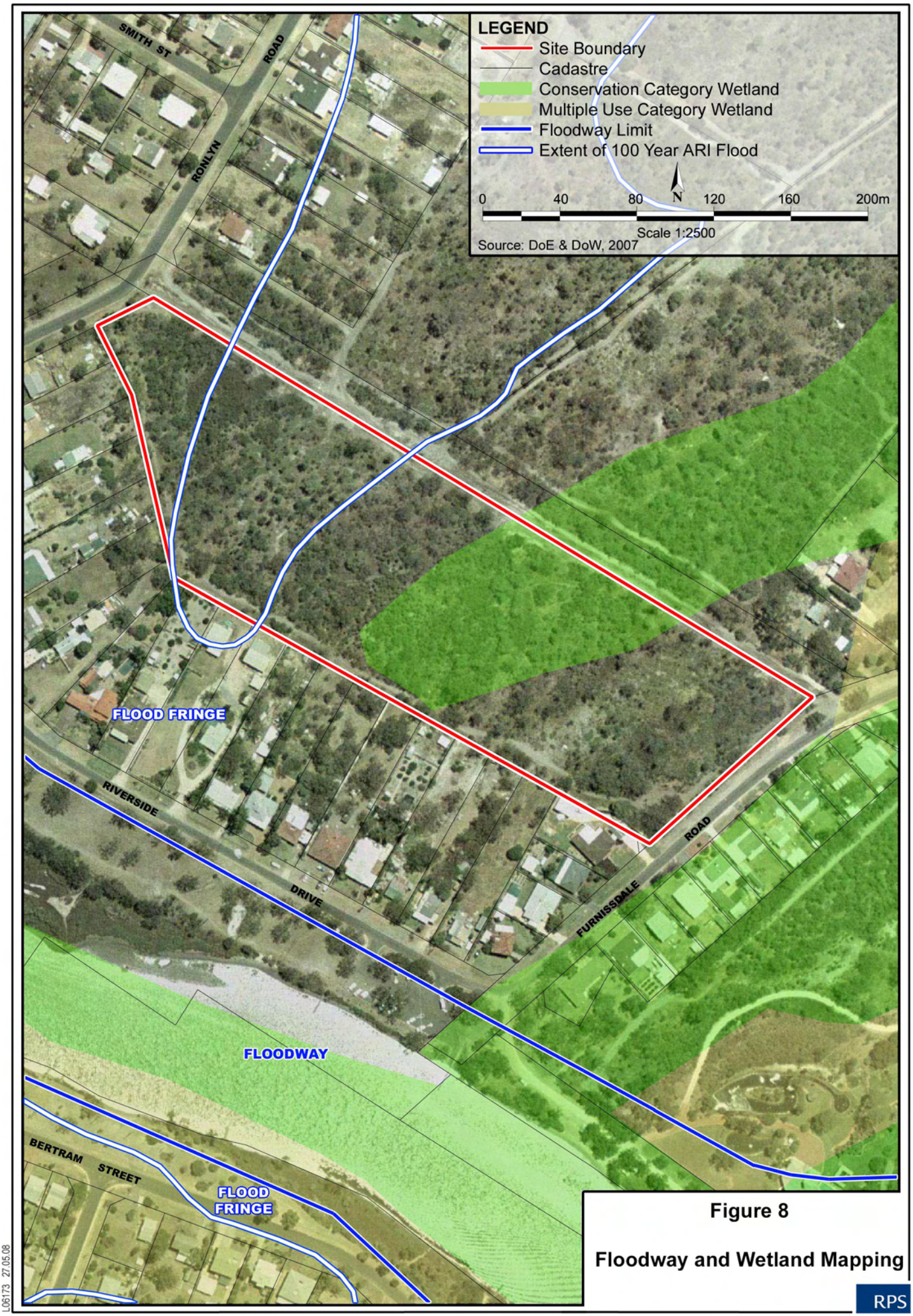


**Figure 8**

**Floodway and Wetland Mapping**

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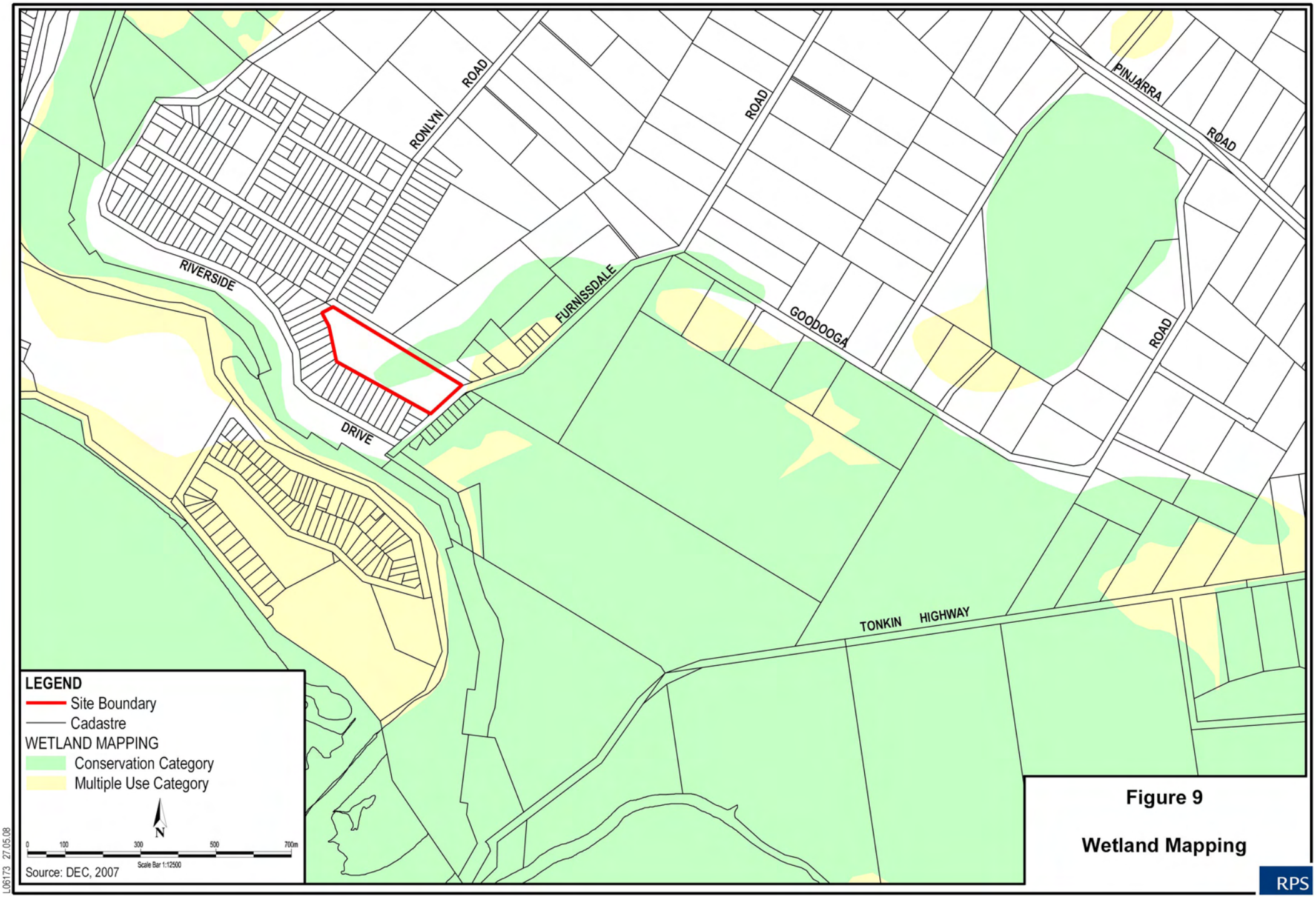


**Figure 9**

**Wetland Mapping**

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**Figure 10**

**Vegetation Complex Mapping**

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RPS

metres

0 10 20 30 40 50

SCALE 1 : 1 250 @ A3

**LEGEND**

- Subject Land Boundary
- Cadastral Boundary
- 2 — Topographic Contour, m
- Current Conservation Category Wetland Boundary
- Proposed Subdivision
- Vegetation Type Boundary
- Q7 — Flora Quadrat, 10 x 10m

VEGETATION CONDITION

(Legend Source: BUSH FOREVER, Govt. of W.A.)

| | |
|---|---|
| P | Pristine (Not Applicable) |
| Ex | Excellent |
| VG | Very Good |
| G | Good |
| D | Degraded |
| CD | Completely Degraded (NA) |

NOTE: For full description see text.

VEGETATION TYPES

**ErOW** *Eucalyptus rudis* Open Woodland over Tall Shrubland of *Jacksonia sternbergiana, Acacia saligna* and *Kunzea ericifolia* over Open Herbland of *Watsonia meriana* var. *bulbillifera, Sowerbaea laxiflora, Dasypogon bromeliifolius* and *Conostylis aculeata*

**ErMrW** *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland over Tall Shrubland of *Acacia saligna* and *Viminaria juncea*

**ApOLH** *Acacia pulchella* Open Low Heath with scattered *Jacksonia furcellata* over *Dasypogon bromeliifolius* Open Herbland

**JsKeTOS** *Jacksonia sternbergiana* and *Kunzea ericifolia* Tall Open Scrub with scattered *Eucalyptus rudis* over a Herbland of *Dasypogon bromeliifolius*

**BgBiAfLOF** *Banksia grandis, Banksia ilicifolia* and *Allocasuarina fraseriana* Low Open Forest over Tall Shrubland of *Jacksonia sternbergiana* and *Kunzea ericifolia* over *Macrozamia riedlei* dominated Low Open Shrubland

**PeCH** *Pericalymma ellipticum* Closed Heath with scattered *Jacksonia furcellata* and *Viminaria juncea*

**KeCTS** *Kunzea ericifolia* Closed Tall Scrub with scattered *Eucalyptus rudis* and *Melaleuca preissiana*

SOURCES: BASE - Chappell & Lambert, 11-2005 ; WETLAND - DLI, 7-11-2005 ;

RONLYN RD

RIVERSIDE DRIVE

FURNISSDALE ROAD

Cleared

PeCH VG-Ex

KeCTS D-G

BgBiAfLOF G

JsKeTOS G-VG

ErMrW VG

ApOLH G

ErOW VG

Current CC Wetland

Q1 Q2 Q3 Q4 Q5 Q6 Q7

27704
2060

ATA Environmental
environmental scientists

LOT 48 FURNISSDALE ROAD
FURNISSDALE
FLORA & VEGETATION SURVEY
**VEGETATION TYPES & CONDITION**

L06173 27.05.08

**Figure 11 Vegetation Type and Condition Mapping (from ATA Environmental, 2006)**

RPS

RPS

# APPENDIX 1

## Correspondence from EPASU dated 12 September 2006

Environmental Protection Authority

The Atrium,
Level 8, 168 St Georges Terrace,
Perth, Western Australia 6000.
Telephone: (08) 6364 6500. Facsimile: (08) 6364 6522.

Postal Address: PO Box K822,
Perth, Western Australia 6842.
Website: www.epa.wa.gov.au

15 SEP 2006

Mr Tony Beamish
Managing Director
SAS Global Property Group
PO Box 6872
WEST PERTH WA 68721

*Your Ref:*
*Our Ref:* CRN217723 202/06
*Enquires:* Teresa Bryant (6467 5432)
*Email:* teresa.bryant@dec.wa.gov.au

Dear Sir

**PROPOSED SUBDIVISION OF LOT 48 FURNISSDALE ROAD, FURNISSDALE**

I refer to your meeting on 5 September 2006 with officers of the Environmental Protection Authority Service Unit (EPA SU) regarding the above proposal.

As discussed, the EPA Chair has informally advised the EPA SU that the proposal has the potential to be progressed as an Environmental Protection Statement (EPS). At the meeting an overview of the EPS process, particularly in comparison to a Public Environmental Review, was provided. It was also explained that the EPA has the same requirement for the amount of information in all levels of assessment, including EPS and PER.

It was agreed the EPA SU would provide you with information on the environmental factors it considers should be addressed and identify stakeholders that should be consulted for an EPS. Also included is an outline of the work the EPA SU considers will be necessary to address the environmental factors.

**Environmental Factors**

**1. Wetlands**

The EPA's Position Statement No. 4 on the environmental protection of wetlands (EPA, 2004) sets out the EPA's overarching goals for wetlands.

*Describe the values of the wetland to be impacted by the proposal?*

- Map the wetland within the proposal area and adjacent area, and classify into wetland type, in accordance with the global geomorphic wetland classification system based on characteristics of landform and water permanence (Semeniuk & Semeniuk 1995).

  Reference: Semeniuk CA & Semeniuk V 1995. 'A geomorphic approach to global classification for inland wetlands', *Vegetatio* 118: 103-124.

- Identify and assess the functions, values and significance of wetlands within the proposal area and adjacent area and describe them in a local, regional and state context.
- Describe and assess the potential direct and indirect impacts that may result from any use or development, allowed by the proposal, on any wetlands, including their buffers, within the proposal area and adjacent area.
- Describe and assess the potential direct and indirect impacts that may result from any changes to the local hydrology as a result of the development, including stormwater/drainage impacts, allowed by the proposal, on any wetlands within the proposal area and adjacent area.
- Describe and assess how removal of the wetland within the proposal area may impact the remainder of the wetland and describe management mechanisms to be implemented, including but not limited to buffer requirements and setbacks, stormwater management, drainage, effluent management, rehabilitation and restoration, to ensure that the integrity, functions, environmental values and long term viability of the remaining wetlands will be maintained.
- With an accurate assessment of the wetland's values, in consultation with the Department of Environment and Conservation (DEC), develop an Environmental Offset Program, consistent with the EPA's Position Statement No.9 *Environmental Offsets*, (January 2006), that considers the values of the wetland impacted by the proposal, an appropriate mechanism for compensating the loss of the wetland, such as acquisitions of potential sites or provision of a financial contribution to DEC, to mitigate the loss of the values caused by the proposal.

Demonstrate whether the proposal is in accordance with the following:

- Environmental Protection Authority 2005. *Environmental Guidance for Planning and Development*, Draft Guidance Statement No. 33, Environmental Protection Authority, Perth, as well as utilising all relevant references in Attachment B4-3, including but not confined to Hill et al, 1996a and b, and V & C Semeniuk Research Group, 1998b.
- Environmental Protection Authority 2004. *Environmental Protection of Wetlands*, Position Statement No. 4, Environmental Protection Authority, Perth.
- Environmental Protection Authority 2006. *Environmental Offsets*, Position Statement No.9, Environmental Protection Authority.

**2. Catchment with Special Requirements – Peel Inlet-Harvey Catchment**

The EPA's objectives for the Peel Inlet-Harvey Estuary are that the environmental quality objectives for the Peel Inlet-Harvey Estuary specified in the Environmental Protection (Peel Inlet-Harvey) Policy 1992 and the water quality guidelines specified in EPA Bulletin 711 for the protection of aquatic ecosystem are met.

*How will drainage and nutrients from the proposal be managed?*

- Describe and assess the potential direct and indirect impacts that may result from any use or development, allowed by the proposal, on water quantity and quality within the proposal area, the adjacent wetlands and Serpentine River/Peel Inlet.
- Detail how compliance with the Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992 implemented through the Statement of Planning Policy No 2 1992 *The Peel-Harvey Coastal Plain Catchment* is to be achieved.

### 3. Native Terrestrial Vegetation

The EPA's objective is to maintain the abundance, diversity, geographic distribution and productivity of flora at he species and ecosystem levels through he avoidance or management of adverse impacts and through improvement in knowledge.

*Are the community types present in the Proposal area well represented?*

- A survey of the remnant vegetation should be conducted:
  - to identify priority species and threatened ecological communities in conjunction with a search of the Department of Conservation's database;
  - to identify the community types present; and,
  - to determine the condition of the remnant vegetation.
- The survey should result in a map of the plant communities on the property and record sufficient sites in the area to describe the plant communities and to enable the floristic community types to be determined. A map showing the condition of the vegetation should also be produced.
- Identify and assess the values and significance of vegetation communities and flora within the proposal area and immediate adjacent area and describe and prioritise these values in a local, regional and State context. Liaise with relevant DEC (formerly DoE and CALM) officers to define the regional context.
- In the event that significant vegetation and flora are impacted by the proposal, in consultation with DEC, include in the Environmental Offset Program developed for the loss of the wetland, actions to mitigate the loss of significant vegetation and flora, consistent with the EPA's Position Statement No.9 Environmental Offsets, (January 2006).

The survey(s) shall meet the requirements specified in the EPA's Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (June, 2004).

### 4. Declared Rare and Priority Flora and other significant flora and communities (including threatened ecological communities)

The EPA's objective is to protect Declared Rare and Priority Flora consistent with the provisions of the Wildlife Conservation Act 1950.

*Are Declared Rare and/or Priority Flora present in the amendment area?*

- Identify species of Declared Rare and Priority Flora that may be directly or indirectly impacted by the proposal.
- Identify other species or communities of significance that may be impacted by the proposal and discuss the reason for their conservation significance. These species or communities may include undescribed taxa; new records for the region; species or taxa that are endemic to the region or at the limit of their range; or species confined to specific sites of limited occurrence in the region.
- Subject to the appropriate permits, retain voucher specimens for all significant species and lodge them with the WA Herbarium.
- In the event that Declared Rare Flora, Priority Flora, and other significant flora and communities (including threatened ecological communities) are impacted by the proposal, in consultation with DEC, include in the Environmental Offset Program developed for the loss of the wetland, actions to mitigate the loss of Declared Rare Flora, Priority Flora, and other significant flora and communities (including threatened ecological communities), consistent with the EPA's Position Statement No.9 Environmental Offsets, (January 2006).

The survey(s) shall meet the requirements specified in the EPA's Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (June, 2004). Any additional targeted flora survey work should meet the standards specified in Guidance No. 51 and be designed in consultation with relevant DEC (formerly DoE and CALM) officers.

**5. Native Fauna**

The EPA's objective in relation to native fauna is to maintain the abundance, diversity, geographic distribution and productivity of native fauna at the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

*Are fauna present on the site, particularly in wetland areas? If fauna habitats are present, are Specially Protected (Threatened) Fauna present?*

- Undertake a field survey to determine the existing abundance, species diversity and geographic distribution of terrestrial fauna, including Specially Protected (Threatened) Fauna
- Identify and assess the values and significance of faunal assemblages within the proposal area and immediate adjacent area and describe these values in a local, regional and State context. Liaise with relevant DEC (formerly DoE and CALM) officers to define the regional context.
- Discuss the representation of habitat, and known or likely faunal assemblages, in existing conservation and other secure reserves, suitable for any identified Specially Protected (Threatened) Fauna, CALM Priority Fauna and other regionally significant fauna that will be impacted by the proposal.
- Identify and assess the potential impacts (direct and indirect) on these fauna as a result of the implementation of the proposed Amendment.
- In the event that significant fauna and faunal assemblages are impacted by the proposal, in consultation with DEC, include in the Environmental Offset Program developed for the loss of the wetland, actions to mitigate the loss of significant fauna and faunal assemblages, consistent with the EPA's Position Statement No.9 Environmental Offsets, (January 2006).

The survey(s) shall meet the requirements specified in the EPA's Guidance Statement No. 56 *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (June 2004). For this bioregion where the region is extensively cleared the level of survey required will be a Level 2 Survey incorporating background research, reconnaissance surveys and detailed surveys as outlined in Guidance 56 Appendix 2.

**6. Acid Sulphate Soils**

The EPA's objectives for water management are relevant to Acid Sulfate Soils (ASS). These are to maintain the quality of water so that existing and potential environmental values, including ecosystems maintenance, are protected. Also to ensure the quality of water emissions does not adversely affect environmental values of the health, welfare and amenity of people and land uses, and meet statutory requirements and acceptable standards.

*Are Acid Sulfate Soils present within the area?*

- Undertake a preliminary field investigation involving a desktop assessment and site inspection to ascertain whether acid sulphate soils exist within the proposal area. If the results of the desktop assessment and site inspection suggest that ASS may be

present, or the results are inconclusive, an intrusive investigation involving soil sampling and analysis should be undertaken.

- Describe and assess the potential direct and indirect impacts that may result from the mobilisation of ASS as a result of the development, allowed by the proposal, on and adjacent to the proposal area.
- Describe management measures to ensure ASS are managed.

**Stakeholders**

- DEC + DoW
- Department for Planning and Infrastructure
- City of Mandurah
- Peel Preservation Group Inc
- Peel Harvey Catchment Council Inc
- Wetlands Conservation Society
- Urban Bushland Council WA Inc
- Conservation Council of Western Australia
- Wildflower Society of Western Australia

Please note that the EPA may consider other environmental factors and community groups relevant. Also that if you proceed with an EPS, you may be contacted by other individuals and groups wanting to be part of the consultation process.

As required by the Administrative Procedures under the *Environmental Protection Act* (1986), the EPA is unable to set the level of assessment at EPS until you have undertaken the required consultation and provided the EPA with a copy of your assessment document. In undertaking the assessment, it is important that you are able to demonstrate to the EPA that you have consulted with the relevant stakeholders in an appropriate fashion.

Should you decide to proceed with an EPS, it will be necessary for you to meet with Mr Mark Jefferies, Manager, Planning and Infrastructure Branch, not the EPA Chair as previously advised.

Please do not hesitate to contact Teresa Bryant on 6467 5432 should you have any queries or require additional information.

Yours sincerely

Warren Tacey
for A/Director
Environmental Impact Assessment

12 September 2006

cc Ben Hollyock, RPS BBG

RPS

# APPENDIX 2

**Flora and Vegetation Survey of Lot 48 Furnissdale Road, Furnissdale**
(ATA Environmental, 2006)

# SAS GLOBAL PROPERTY GROUP

# FLORA AND VEGETATION SURVEY LOT 48 FURNISSDALE ROAD, FURNISSDALE

**VERSION 1**

**OCTOBER 2006**

**REPORT NO: 2006/217**

ATA Environmental
*environmental scientists*

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An internal quality review process has been applied to each project task undertaken by us. Each document is carefully reviewed by core members of the consultancy team and signed off at Partner level prior to issue to the client. Draft documents are submitted to the client for comment and acceptance prior to final production.

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**Report No:** 2006/217

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# 1. INTRODUCTION

## 1.1 Background and Scope of Work

In October 2005 ATA Environmental was commissioned by SAS Global Property Group to conduct a flora and vegetation survey of Lot 48 Furnissdale Road, Furnissdale in support of a subdivision application over the site.

The objective of the survey was to:

- Record all native flora species occurring from the study area;
- Map vegetation types present and vegetation condition;
- Map locations of any significant plant populations recorded; and
- Assess the significance of flora and plant communities.

The flora survey was conducted in accordance with the Environmental Protection Authority's Guidance Statements No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004a) and *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* (EPA, 2002). This report provides the results of the survey conducted for Lot 48 Furnissdale Road, Furnissdale.

## 1.2 Location

The study area investigated for this assessment is bounded by Furnissdale Rd to the east, Ronlyn Rd to the west, a firebreak and existing residences to the south to the south and an unconstructed road reserve to the north (Figure 1). Lot 48 Furnissdale Rd is situated in the location of Furnissdale, approximately 5km south east from the Mandurah town centre and 70km south from the City of Perth. The total survey area is approximately 4ha.

## 1.3 Site Description

### 1.3.1 Climate

The climate of Lot 48 Furnissdale Rd is classified as Mediterranean (similar to Perth), which is characterised by mild wet winters and hot dry summers. Average annual rainfall is 875mm with the majority falling between May-August (Bureau of Meteorology 2003). The average annual maximum temperature for Mandurah is 23.0$^{o}$C and the minimum is 12.4$^{o}$C. February is the hottest month of the year with an average maximum of 29.5$^{o}$C, while July is the coolest month with an average maximum of 8.6 $^{o}$C. Mean minimum temperature ranges from 8.6$^{o}$C in July to 17.0$^{o}$C in February. The annual pan evaporation for the Perth area is 1819 mm, which far exceeds the annual rainfall of the Perth and Mandurah regions.

### 1.3.2 Geology, Geomorphology and Soils

Lot 48 Furnissdale Rd is located on the Bassendean Dune System (Pinjarra Urban Geology Map GL28), which consists of low hills and intervening swampy areas (McArthur 1991). The soils of the Bassendean Dune System (Qpb) vary in response to drainage status and depth to groundwater. Lot 48 is located within a relatively low lying area adjacent to the Serpentine River (Estuarine and Lagoonal Deposits), where the water table can rise to within 2m of the surface forming an iron-humus podzol (Gavin Sand) which is often cemented.

### 1.3.3 Bioregional Data

Western Australia supports 53 biogeographical subregions. The survey area is located in the Perth subregion of the Swan Coastal Plain bioregion. The Swan Coastal Plain Bioregion is a low lying coastal plain, mainly covered with woodlands. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone (McKenzie *et al.*, 2003).

According to Beard (1990), the vegetation of the survey area is located within the Drummond Botanical District of the Swan Coastal Plain Subregion. The typical sequences of vegetation comprise mainly *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; woodland of Tuart (*Eucalyptus gomphocephala)*, Jarrah *(E. marginata)* and Marri (*Corymbia calophylla)* on less leached soils.

## 2. FLORA AND VEGETATION

### 2.1 Methodology

A flora and vegetation survey of the area was conducted by Mr Shaun Grein, a qualified Botanist from ATA Environmental, on 29 September and 4 October 2005. This survey was supplemented by floristic data collected and vegetation mapping undertaken during the September 2000 survey. The survey was conducted to determine if any of the significant species identified by the Department of Environmental and Conservation (formerly the Department of Environment and Conservation (DEC)) actually occur or are likely to occur on the site. This was based on sampling within seven quadrats of 10m x 10m dimension located in representative vegetation types. This method complies with the EPA's guidelines for flora surveys as outlined in Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004a) and *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* (EPA, 2002). The timing of the survey was considered optimal for the identification of the majority annual and ephemeral species, including any Declared Rare and Priority potentially occurring within the survey area.

Vehicle access was limited to the perimeter of the site and the survey was conducted by traversing the area by foot. The major vegetation type and associated flora were surveyed and delineated using a colour aerial photograph. The vegetation was described and mapped according to the structure and species composition of the dominant stratum using the system adopted in Bush Forever (Government of Western Australia, 2000).

Prior to conducting the field survey, a search of the DEC Declared Rare and Priority Flora database (DEC, 2005) was undertaken to identify significant flora that could potentially occur in the survey area. This investigation encompassed a review of the following databases:

- DEC's *'Threatened (Declared Rare) Flora'* database; and
- DEC's *'Declared Rare and Priority Flora List'* which contain species that are Declared Rare (Conservation code R or X for those presumed to be extinct) poorly known (Conservation codes 1, 2 or 3) or require monitoring (Conservation Code 4).

The results of the DEC database search are presented below in Table 1.

**TABLE 1**
**SIGNIFICANT FLORA FROM DEC DATABASE THAT MAY POTENTIALLY OCCUR IN THE STUDY AREA**

| Species | Conservation Status | Preferred Habitat | Flowering Period |
|---|---|---|---|
| *Diuris micrantha* | R | Grey or brown sand, clay loam | Sep–Oct |
| *Diuris drummondii* | R | White or brown sand or loam, limestone, laterite. Coastal areas. | Jun-Sep |
| *Drakea elastica* | R | Loam. Flats, hillsides. | Jul–Sep |
| *Caladenia huegelii* | R | Sand, sandy clay. Winter-wet low-lying flats. | Sep–Oct |
| *Dillwynia dillwynioides* | P3 | Sand over limestone. | Sep–Dec. |

A search of DEC's Threatened Ecological Communities (TEC) database was also conducted for the survey area prior to undertaking the field assessment. No TECs were listed as potentially occurring in the geographical range of the survey area.

## 2.2 Vegetation

### 2.2.1 Vegetation Complexes

Heddle *et al.* (1980) identified the vegetation within the survey area as part of both the Bassendean Complex – Central and South and the Vasse Complex. This Bassendean – Central and South vegetation complex is a transition vegetation complex occurring on the Bassendean Dune complex and consists of a of Woodland of *Eucalyptus marginata-C-calophylla* with a well defined second storey of *Allocasuarina fraseriana* and *Banksia grandis* on the deeper soils and closed scrub on the moister soils. The understorey reflects similarities with the adjacent vegetation complexes (Heddle *et al.,* 1980). The vegetation survey confirmed that the drier portions of the vegetation present on the site were analogous with the Bassendean – Central and South vegetation complex.

The Vasse Complex is associated with marine (lagoonal and estuarine) deposits and generally consists of a mixture of closed scrub of *Melaleuca* species fringing woodland of *Eucalyptus rudis-Melaleuca* species and an open woodland of *Eucalyptus gomphocephala-E. marginata-C. calophylla*. The vegetation survey confirmed that the wetter portions of Lot 48 were consistent with this description.

The Bassendean Complex – Central and South vegetation complex has 27% of its original extent remaining on the Southern Swan Coastal Plain, while approximately 29% of the original extent of the Vasse Complex remains on the Southern Swan Coastal Plain.

### 2.2.2 Vegetation Types

A total of seven discrete vegetation types were identified from survey area during the September and October 2005 site assessment. These vegetation types are mapped in Figure 2 and described below.

ErOW — *Eucalyptus rudis* Open Woodland to 5m in height over Tall Shrubland of *Jacksonia sternbergiana, Acacia saligna* and *Kunzea ericifolia* to 4m in height over Open Herbland of *Watsonia meriana* var. *bulbillifera*, *Sowerbaea laxiflora*, *Dasypogon bromeliifolius* and *Conostylis aculeata*. This vegetation type was recorded from the eastern and southeastern portions of the site. According to the condition rating scale of Keighery published in Bush Forever (Government of Western Australia, 2000), this vegetation types was considered to be in Very Good condition (see Section 2.2.3 for details).

ErMrW — *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland to 10m in height over Tall Shrubland of *Acacia saligna* and *Viminaria juncea* to 3m in height. This vegetation type is associated with the southern portion of the Conservation Category wetland (CCW) that occurs in the central portion of the site. According to the condition rating scale of this vegetation types was considered to be in Very Good condition.

ApOLH *Acacia pulchella* Open Low Heath to 1m in height with scattered *Jacksonia furcellata* over *Dasypogon bromeliifolius* Open Herbland to 0.5m in height. This vegetation type is predominantly regrowth vegetation associated with an area in the eastern portion of the site that had been previously cleared (~3-5 years prior to the survey). As a consequence this vegetation type was considered to be in Good condition.

JsKeTOS *Jacksonia sternbergiana* and *Kunzea ericifolia* Tall Open Scrub to 3m in height with scattered *Eucalyptus rudis* over a Herbland of *Dasypogon bromeliifolius* to 0.2m in height. This vegetation type was recorded from the western portion (and to the immediate west) of the CCW that occurs on the site. According to the condition rating scale of this vegetation type was considered to range from Good to Very Good condition.

BaBiAfLOF *Banksia grandis, Banksia ilicifolia* and *Allocasuarina fraseriana* Low Open Forest to 8m in height over Tall Shrubland of *Jacksonia sternbergiana* and *Kunzea ericifolia* to 4m in height over *Macrozamia riedlei* dominated Low Open Shrubland to 1m in height. This vegetation type was recorded from the central western portion of the site and as a result of high levels of weed infestation, including *Ehrharta calycina, Cynodon dactylon, Briza maxima* and *Hypochaeris glabra,* this vegetation type was considered to be in Good condition.

PeCH *Pericalymma ellipticum* Closed Heath to 1.8m in height with scattered *Jacksonia furcellata* and *Viminaria juncea*. This vegetation type was recorded in a low-lying, inundated from the northwestern portion of the site. No weed species were recorded in association with this vegetation type and there were few obvious signs of disturbance. As a consequence the condition of the vegetation type was considered to range from Very Good to Excellent.

KeCTS *Kunzea ericifolia* Closed Tall Scrub to 4m in height with scattered *Eucalyptus rudis* and *Melaleuca preissiana.* This vegetation type was recorded from a slightly waterlogged area in the northwestern corner of Lot 48. This vegetation was associated with a relatively high level of weed infestation, including *Arctotheca calendula, Avena barbata, Briza maxima* and *Eragrostis curvula* and as a consequence was considered to be in Degraded to Good condition.

### 2.2.3 Vegetation Condition

The condition of the vegetation was assessed using the condition rating scale of Keighery published in Bush Forever (Government of Western Australia, 2000) and is mapped in Figure 2. Keighery's condition rating scale ranges from Pristine (which the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure in no longer intact and without native plant species). A description of the vegetation condition ratings applicable to the survey area are outlined below.

**Excellent (E)** Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species

**Very Good (VG)** Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

**Good (G)** Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

**Degraded (D)** Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.

The vegetation condition within the survey area ranged from Excellent to Degraded. The majority of vegetation was in Very Good condition due to the presence of some aggressive weed species, partial clearing and the use of the area for rubbish dumping.

### 2.2.4 Conservation Significance of Vegetation

A search of DEC's TEC database was undertaken by ATA Environmental prior to conducting the survey. The absence of TECs occurring in the geographical range of the survey area according to DECs database was confirmed by ATA Environmental in its analysis of floristic data collected during the September and October 2005 site assessments.

Using the data from the 10m x 10m quadrats and referencing the species to those contained in Gibson *et al.* (1994), the majority of the vegetation within the survey area is inferred as corresponding closely with Floristic Community Types (FCT) 5 and 11. FCT 5 - Mixed Shrub Damplands, commonly has no consistent understorey and dominants may include *Banksia ilicifolia* or *Kunzea ericifolia.* This FCT has been recorded from both the Bassendean and Vasse land units and is considered to be well reserved and at low risk in terms of its conservation status (Gibson *et al.,* 1994).

FCT 11 – Wet forests and woodland are well reserved within the Swan Coastal Plain and at low risk in terms of its conservation status, occurring on both Bassendean sands and heavier soils. Gibson *et al.,* (1994) describes FCT 11 as being generally dominated by *Eucalyptus rudis* and/or *Melaleuca rhaphiophylla,* extending over a range between Bullsbrook and Pinjarra.

Neither FCT 5 nor FCT 11 is listed as a Threatened Ecological Community at the State or Commonwealth (EPBC Act) level.

## 2.3 Flora

A total of 51 (40 native and 11 non-endemic species) species representing 21 families were recorded from the seven 10m x10m quadrats sampled within the survey area during the September and October 2005 survey. Families with the greatest representation of taxa were Poaceae (Grass family - 7 species, all non-native), the Myrtaceae (Eucalyptus family - 6 taxa, all native) and the Papilionaceae (pea family – 5 species, all native). This family composition is typical of the flora of the southwest of Western Australia, and similar to that of the Mandurah coast region which has the same two dominant families (Trudgen, 1991).

A full list of flora recorded from the seven quadrats sampled within the survey area during the September and October 2005 surveys is presented in Appendix 1 while the quadrat-based data is included in Appendix 2.

### 2.3.1 Conservation Significance of Flora

No species of Declared Rare or Priority Flora were recorded from the site during the September and October 2005 site visit. It is most likely that the significant flora species identified in the DEC database searches would have been identified during the September and October 2005 if they occurred in the study area.

# 3. CONCLUSIONS AND RECOMMENDATIONS

## 3.1 Flora and Vegetation

The following conclusions have been made regarding the flora and vegetation assessment conducted for Lot 48 Furnissdale Rd, Furnissdale:

- No TECs were listed by DEC as occurring in the geographical range of the survey area and this was confirmed during ATA Environmentals September and October 2005 site survey.

- The Bassendean Complex – Central and South vegetation complex has 27% of its original extent remaining on the Southern Swan Coastal Plain, while approximately 29% of the original extent of the Vasse Complex remains on the Southern Swan Coastal Plain.

- No species of Declared Rare or Priority Flora were recorded from the site during the September and October 2005 site visit. The significant flora species identified in the DEC database searches are likely to have been identifiable at the time of the September 2005 survey.

- Seven vegetation types were identified from the survey area. Vegetation condition ranged from Degraded to Excellent. A total of 51 species of plants (40 native and 11 non-native) were recorded from the seven 10m x 10m quadrats sampled during the 2005 surveys.

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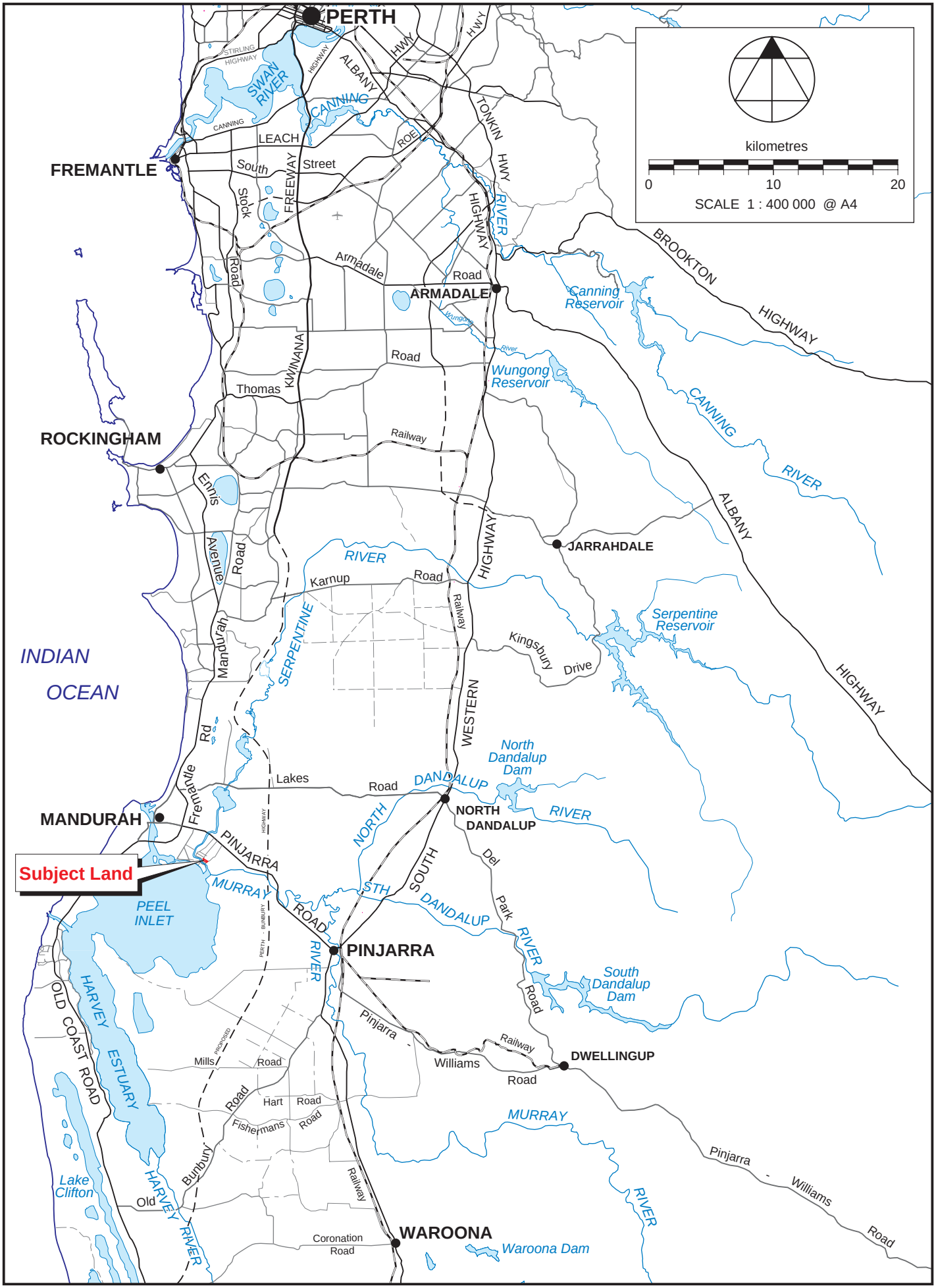
# FIGURES

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ATA Environmental
environmental scientists

LOT 48 FURNISSDALE ROAD, FURNISSDALE
FLORA AND VEGETATION SURVEY

**REGIONAL LOCATION**

FIGURE 1

PRINTED: Tue 31 Oct 06

metres

0 10 20 30 40 50

SCALE 1 : 1 250 @ A3

## LEGEND

- Subject Land Boundary
- Cadastral Boundary
- 2 — Topographic Contour, m
- Current Conservation Category Wetland Boundary
- Proposed Subdivision
- Vegetation Type Boundary
- Q7 — Flora Quadrat, 10 x 10m

VEGETATION CONDITION

(Legend Source: BUSH FOREVER, Govt. of W.A.)

| | |
|---|---|
| P | Pristine (Not Applicable) |
| Ex | Excellent |
| VG | Very Good |
| G | Good |
| D | Degraded |
| CD | Completely Degraded (NA) |

NOTE: For full description see text.

VEGETATION TYPES

**ErOW** *Eucalyptus rudis* Open Woodland over Tall Shrubland of *Jacksonia sternbergiana, Acacia saligna* and *Kunzea ericifolia* over Open Herbland of *Watsonia meriana* var. *bulbillifera, Sowerbaea laxiflora, Dasypogon bromeliifolius* and *Conostylis aculeata*

**ErMrW** *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland over Tall Shrubland of *Acacia saligna* and *Viminaria juncea*

**ApOLH** *Acacia pulchella* Open Low Heath with scattered *Jacksonia furcellata* over *Dasypogon bromeliifolius* Open Herbland

**JsKeTOS** *Jacksonia sternbergiana* and *Kunzea ericifolia* Tall Open Scrub with scattered *Eucalyptus rudis* over a Herbland of *Dasypogon bromeliifolius*

**BgBiAfLOF** *Banksia grandis, Banksia ilicifolia* and *Allocasuarina fraseriana* Low Open Forest over Tall Shrubland of *Jacksonia sternbergiana* and *Kunzea ericifolia* over *Macrozamia riedlei* dominated Low Open Shrubland

**PeCH** *Pericalymma ellipticum* Closed Heath with scattered *Jacksonia furcellata* and *Viminaria juncea*

**KeCTS** *Kunzea ericifolia* Closed Tall Scrub with scattered *Eucalyptus rudis* and *Melaleuca preissiana*

SOURCES: BASE - Chappell & Lambert, 11-2005 ; WETLAND - DLI, 7-11-2005 ;

RONLYN RD

Cleared

PeCH
VG-Ex

KeCTS
D-G

BgBiAfLOF
G

JsKeTOS
G-VG

ErMrW
VG

ApOLH
G

ErOW
VG

Cleared

Current CC Wetland

Cleared

Cleared

Cleared

Q1 Q2 Q3 Q4 Q5 Q6 Q7

157 301 300 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 48 24 2 6 4 5

FURNISSDALE ROAD

RIVERSIDE DRIVE

27704
2060

ATA Environmental
environmental scientists

LOT 48 FURNISSDALE ROAD
FURNISSDALE
FLORA & VEGETATION SURVEY

**VEGETATION TYPES & CONDITION**

FIGURE 2

SGF5-1/FLAS/26_217/26_217F2.dgn DATUM: MGA50 DRAWN: GLM 13-9-06 CHECKED: SG 13-9-06

# APPENDICES

# APPENDIX 1

# FLORA SPECIES LIST
# LOT 48 FURNISSDALE RD, FURNISSDALE

**APPENDIX 1**

**FLORA SPECIES LIST**
**LOT 48 FURNISSDALE RD, FURNISSDALE**

| **FAMILY/species** | # Sites Recorded from |
|---|---|
| 016A ZAMIACEAE | |
| *Macrozamia riedlei* | 2 |
| 031 POACEAE | |
| * *Avena barbata* | 1 |
| * *Briza maxima* | 3 |
| * *Cynodon dactylon* | 1 |
| * *Ehrharta calycina* | 2 |
| * *Eragrostis curvula* | 1 |
| * *Lagurus ovatus* | 1 |
| * *Poa annua* | 1 |
| 032 CYPERACEAE | |
| *Baumea articulata* | 1 |
| *Lepidosperma angustatum* | 2 |
| *Lepidosperma longitudinale* | 3 |
| 039 RESTIONACEAE | |
| *Desmocladus flexuosus* | 1 |
| *Meeboldina cana* | 4 |
| 052 JUNCACEAE | |
| *Juncus pallidus* | 2 |
| 054C DASYPOGONACEAE | |
| *Dasypogon bromeliifolius* | 4 |
| 054E PHORMIACEAE | |
| *Dianella revoluta* | 1 |
| 054F ANTHERICACEAE | |
| *Sowerbaea laxiflora* | 6 |
| *Thysanotus multiflorus* | 1 |
| *Tricoryne elatior* | 1 |
| 055 HAEMODORACEAE | |
| *Conostylis aculeata* | 5 |
| 060 IRIDACEAE | |
| *Patersonia occidentalis* | 2 |

| | |
|---|---|
| * *Watsonia meriana* var. *bulbillifera* | 4 |
| 066 ORCHIDACEAE | |
| *Caladenia flava* | 1 |
| 070 CASUARINACEAE | |
| *Allocasuarina fraseriana* | 1 |
| 090 PROTEACEAE | |
| *Banksia grandis* | 1 |
| *Banksia ilicifolia* | 1 |
| *Banksia littoralis* | 1 |
| 131 LAURACEAE | |
| *Cassytha racemosa* | 1 |
| 163 MIMOSACEAE | |
| *Acacia pulchella* | 2 |
| Acacia saligna | 6 |
| 165 PAPILIONACEAE | |
| *Aotus procumbens* | 3 |
| *Hardenbergia comptoniana* | 1 |
| *Jacksonia furcellata* | 3 |
| *Jacksonia sternbergiana* | 5 |
| *Viminaria juncea* | 4 |
| 185 EUPHORBIACEAE | |
| *Phyllanthus calycinus* | 1 |
| 226 DILLENIACEAE | |
| *Hibbertia subvaginata* | 1 |
| 273 MYRTACEAE | |
| *Astartea scoparia* | 3 |
| *Eucalyptus rudis* | 4 |
| *Kunzea ericifolia* | 7 |
| *Melaleuca preissiana* | 1 |
| *Melaleuca rhaphiophylla* | 1 |
| *Pericalymma ellipticum* | 1 |
| 281 APIACEAE | |
| *Daucus glochidiatus* | 1 |
| 288 EPACRIDACEAE | |
| *Conostephium pendulum* | 1 |
| *Lysinema ciliatum* | 1 |
| 341 GOODENIACEAE | |
| *Dampiera linearis* | 1 |

345 ASTERACEAE

| | | |
|---|---|---|
| * | *Arctotheca calendula* | 1 |
| * | *Hypochaeris glabr*a | 1 |
| | *Schoenia filifolia* | 1 |
| * | *Ursinia anthemoides* | 2 |

* denotes introduced/non-native species

# APPENDIX 2

# QUADRAT DATA

**APPENDIX 2**

# QUADRAT DATA
# LOT 48 FURNISSDALE RD, FURNISSDALE

## Site Q1

**Described:** SBG **Date:** 27/09/2005 **Type:**Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50 384162mE**;** 6396407mN

**Vegetation** *Eucalyptus rudis* Open Woodland over Tall Shrubland Jacksonia *sternbergiana*, *Acacia saligna* and *Kunzea ericifolia* over Open Herbland of *Watsonia meriana* var. *bulbillifera*, *Sowerbaea laxiflora*, *Dasypogon bromeliifolius* and *Conostylis aculeata.*

**Vegetation Condition:** Very Good

**Fire History:** 10 years +

**Species List:**

| Quad Name | Cover (%) | Class | Height (m) |
|---|---|---|---|
| *Acacia saligna* | 5 | 5-10% | 2.5 |
| *Aotus procumbens* | *1* | *1-5%* | *1.2* |
| *Astartea scoparia* | *2* | *1-5%* | *1.5* |
| *Conostylis aculeata* | *5* | *5-10%* | *0.3* |
| *Dasypogon bromeliifolius* | 5 | 5-10% | 0.6 |
| *Ehrharta calycina* | <1 | <1 % | 1 |
| *Eucalyptus rudis* | 5 | 5-10% | 5 |
| *Hardenbergia comptoniana* | <1 | <1 % | creeper |

| | | | |
|---|---|---|---|
| *Jacksonia sternbergiana* | 5 | 5-10% | 3 |
| *Juncus pallidus* | 1 | 1-5% | 1.2 |
| *Kunzea ericifolia* | 10 | 10-25% | 4 |
| *Meeboldina cana* | 1 | *1-5%* | *0.4* |
| *Patersonia occidentalis* | 1 | 1-5% | 0.5 |
| *Sowerbaea laxiflora* | 2 | 1-5% | 0.5 |
| *Viminaria juncea* | 1 | 1-5% | 2 |
| *Watsonia meriana var. bulbillifera* | 2 | 1-5% | 0.5 |

# Site Q2

**Described** SBG **Date:** 27/09/200 **Type:**Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50384109mE; 6396412 mN

**Vegetation** *Eucalyptus rudis* and *Melaleuca rhaphiophylla* Woodland over Tall Shrubland of *Acacia saligna* and *Viminaria juncea*

**Vegetation Condition:** Very Good

**Fire History:** 10 years +

**Species List**

| Name | Cover(%) | Class | Height (m) |
|---|---|---|---|
| *Acacia saligna* | 5 | 5-10% | 2 |
| *Aotus procumbens* | 2 | 1-5% | 1.5 |
| *Astartea scoparia* | 2 | 1-5% | 0.6 |
| *Cassytha racemosa* | <1 | <1 % | creeper |
| *Conostylis aculeata* | <1 | <1 % | 0.5 |
| *Eucalyptus rudis* | 15 | 10-25% | 10 |
| *Jacksonia sternbergiana* | 1 | 1-5% | 2 |
| *Juncus pallidus* | <1 | <1 % | 0.6 |
| *Kunzea ericifolia* | 10 | 1-5% | 1.2 |
| *Lepidosperma angustatum* | <1 | <1 % | 0.5 |
| *Meeboldina cana* | <1 | <1 % | 0.5 |
| *Melaleuca rhaphiophylla* | 10 | 5-10% | 6 |
| *Sowerbaea laxiflora* | <1 | <1 % | 0.5 |
| *Viminaria juncea* | 10 | 5-10% | 3 |
| *Watsonia meriana var. bulbillifera* | 1 | 1-5% | 0.5 |

# **Site** Q3

**Described:** SBG **Date:** 27/09/2005 **Type:**Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50384136 mE: 6396412 mN

**Habitat** flat, previously cleared, good regrowth

**Vegetation** *Acacia pulchella* Open Low Heath with scattered *Jacksonia furcellata* over *Dasypogon bromeliifolius* Open Herbland

**Vegetation Condition:** Good

**Fire History:** 10+ years

**Species List:**

| Name | Cover (%) | Class | Height (m) |
|---|---|---|---|
| *Acacia pulchella* | 60 | 50-75% | 1 |
| *Acacia saligna* | <1 | <1 % | 1.5 |
| *Conostylis aculeata* | <1 | <1 % | 0.2 |
| *Dasypogon bromeliifolius* | 20 | 10-25% | 0.5 |
| *Jacksonia furcellata* | 5 | 5-10% | 2 |
| *Jacksonia sternbergiana* | <1 | <1 % | 1.8 |
| *Kunzea ericifolia* | 5 | 5-10% | 0.5 |
| *Macrozamia riedlei* | <1 | <1 % | 0.5 |
| *Meeboldina cana* | 1 | 1-5% | 0.3 |
| *Sowerbaea laxiflora* | 1 | 1-5% | 0.2 |
| *Viminaria juncea* | 1 | 1-5% | 2 |
| *Watsonia meriana var. bulbillifera* | *<1* | *<1 %* | *0.5* |

# Site Q4

**Described:** SBG **Date:** 4/10/2005 **Type:** Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50384029 mE; 6396475 mN

**Vegetation** *Jacksonia sternbergiana* and *Kunzea ericifolia* Tall Open Scrub with scattered *Eucalyptus rudis* over a Herbland of *Dasypogon bromeliifolius*

**Vegetation Condition:** Good to Very Good

**Fire History:** 10+ years

**Species List:**

| Name | Cover (%) | Class | Height (m) |
|---|---|---|---|
| *Acacia saligna* | 1 | 1-5% | 1.8 |
| *Briza maxima* | <1 | <1 % | 0.5 |
| *Conostylis aculeata* | 1 | 1-5% | 0.4 |
| *Dasypogon bromeliifolius* | 30 | 25-33.3% | 0.2 |
| *Desmocladus flexuosus* | <1 | <1 % | 0.3 |
| *Eucalyptus rudis* | 2 | 1-5% | 5 |
| *Jacksonia sternbergiana* | 30 | 25-33.3% | 3 |
| *Kunzea ericifolia* | 30 | 25-33.3% | 3 |
| *Lagurus ovatus* | <1 | <1 % | 0.3 |
| *Lepidosperma longitudinale* | <1 | <1 % | 0.6 |
| Meeboldina cana | <1 | <1 % | 0.5 |
| *Patersonia occidentalis* | <1 | <1 % | 0.5 |
| *Schoenia filifolia* | <1 | <1 % | 0.3 |
| *Sowerbaea laxiflora* | 5 | 5-10% | 0.5 |
| *Thysanotus multiflorus* | <1 | <1 % | creeper |
| *Ursinia anthemoides* | <1 | <1 % | 0.3 |
| *Watsonia meriana* var. *bulbillifera* | <1 | <1 % | 0.5 |

# **Site** Q5

**Described:** SBG **Date:** 4/10/2005 **Type:** Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50383921 mE; 6396473 mN

**Vegetation** *Banksia grandis, Banksia ilicifolia* and *Allocasuarina fraseriana* Low Open Forest over Tall Shrubland of *Jacksonia sternbergiana* and *Kunzea ericifolia* over *Macrozamia riedlei* dominated Low Open Shrubland

**Vegetation Condition:** Good

**Fire History:** 10+ years

**Species List:**

| Name | Cover (%) | Class | Height (m) |
|---|---|---|---|
| Acacia saligna | <1 | <1 % | 2.5 |
| Allocasuarina fraseriana | 15 | 10-25% | 8 |
| Banksia grandis | 15 | 10-25% | 8 |
| Banksia ilicifolia | 10 | 5-10% | 6 |

| | | | |
|---|---|---|---|
| Briza maxima | <1 | <1 % | 0.3 |
| Caladenia flava | <1 | <1 % | 0.3 |
| Conostephium pendulum | <1 | <1 % | 0.3 |
| Conostylis aculeata | <1 | <1 % | 0.2 |
| Cynodon dactylon | 2 | 1-5% | 0.2 |
| Dasypogon bromeliifolius | 1 | 1-5% | 0.2 |
| Daucus glochidiatus | <1 | <1 % | 0.2 |
| Dianella revoluta | <1 | <1 % | 0.4 |
| Ehrharta calycina | <1 | <1 % | 0.6 |
| Hibbertia subvaginata | <1 | <1 % | 0.2 |
| Hypochaeris glabra | <1 | <1 % | 0.3 |
| Jacksonia furcellata | 1 | 1-5% | 3 |
| Jacksonia sternbergiana | 5 | 1-5% | 4 |
| Kunzea ericifolia | 10 | 5-10% | 4 |
| Lepidosperma angustatum | 2 | 1-5% | 0.3 |
| Macrozamia riedlei | 2 | 1-5% | 1 |
| Phyllanthus calycinus | <1 | <1 % | 0.4 |
| Sowerbaea laxiflora | 1 | 1-5% | 0.3 |
| Tricoryne elatior | <1 | <1 % | 0.2 |
| Ursinia anthemoides | <1 | <1 % | 0.3 |

# **Site** Q6

**Described:** SBG **Date:** 4/10/2005 **Type:** Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50383908 mE;6396548 mN

**Vegetation** *Pericalymma ellipticum* Closed Heath with scattered *Jacksonia furcellata* and *Viminaria juncea*

**Vegetation Condition:** Very Good to Excellent

**Fire History:** 10+ years

**Species List:**

| **Name** | **Cover** (%) | **Class** | **Height (m)** |
|---|---|---|---|
| Acacia saligna | <1 | <1 % | 2 |
| Aotus procumbens | <1 | <1 % | 0.5 |
| Astartea scoparia | 1 | 1-5% | 1.2 |
| Jacksonia furcellata | 5 | 5-10% | 2.5 |
| Kunzea ericifolia | <1 | <1 % | 2 |
| Lepidosperma longitudinale | <1 | <1 % | 0.5 |
| Pericalymma ellipticum | 90 | >75% | 1.8 |
| Viminaria juncea | 1 | 1-5% | 3 |

# **Site** Q7

**Described:** SBG **Date**: 4/10/2005 **Type:** Quadrat (10x10m) **Season:** Excellent

**Location:** Lot 48 Furnissdale Rd

**Quadrat Centrum/MGA Zone:** 50 383880 mE; 6396584 mN

**Vegetation** *Kunzea ericifolia* Closed Tall Scrub with scattered *Eucalyptus rudis* and *Melaleuca preissiana*

**Vegetation Condition:** Degraded to Good

**Fire History:** 10+ Years

**Species List:**

| Name | Cover (%) | Class | Height (m) |
|---|---|---|---|
| Acacia pulchella | <1 | <1 % | 0.3 |
| Arctotheca calendula | <1 | <1 % | 0.3 |
| Avena barbata | 1 | 1-5% | 0.3 |
| Banksia littoralis | <1 | <1 % | 1 |
| Baumea articulata | <1 | <1 % | 0.5 |
| Briza maxima | 2 | 1-5% | 0.3 |
| Dampiera linearis | <1 | <1 % | 0.3 |
| Eragrostis curvula | <1 | <1 % | 0.5 |
| Eucalyptus rudis | 5 | 5-10% | 8 |
| Kunzea ericifolia | 80 | >75% | 4 |
| Lepidosperma longitudinale | 2 | 1-5% | 0.6 |

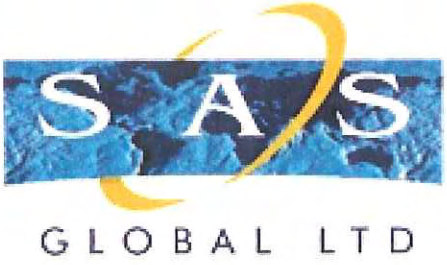
| | | | |
|---|---|---|---|
| Lysinema ciliatum | <1 | <1 % | 0.4 |
| Melaleuca preissiana | 1 | 1-5% | 44 |
| Poa annua | 5 | 5-10% | 0.2 |
| Sowerbaea laxiflora | <1 | <1 % | 0.5 |

RPS

# APPENDIX 3

**SAS Global Ltd, Lot 48**
**Furnissdale Road, Furnissdale**
**Fauna Survey**
(Ecologia Environment, Perth)

# SAS GLOBAL LTD
# Lot 48 Furnissdale Rd, Furnissdale
# Fauna Survey




**7 May 2007**

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# Table of Contents

# Tables



# Figures

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# Executive Summary

SAS Global Property Group proposes to subdivide a 4 ha block for housing at Lot 48 Furnissdale Road, Furnissdale. The project is yet to be referred to the EPA; however, it is anticipated that the proposal will be assessed by the EPA at the Environmental Protection Statement (EPS) level. As part of the approvals process, a Level 2 fauna assessment is required in accordance with Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004). This document outlines the methods and outcomes of a vertebrate fauna survey of the project area.

The survey methods used by *ecologia* are aligned with the Environmental Protection Authority's Guidance Statement No. 56 (EPA 2004) and Position Statement 3 (EPA 2002). The fauna assessment was undertaken using a variety of sampling techniques, comprising systematic and opportunistic sampling. Systematic sampling refers to data methodically collected over a fixed time period in a discrete habitat type, using an equal or standardised sampling effort. In this case, 20 trapping sites were set up which used (in total) ten Bucket and ten pipe pit traps, 20 Elliott box traps, 20 cage traps and 40 funnel traps. Bird censuses were conducted for a total of 120 min, and bat recordings were made for 180 min using an ANABAT bat detector. Opportunistic sampling includes data collected non-systematically within and outside fixed sampling sites. Opportunistic foraging for amphibians, reptiles and mammals was conducted throughout Lot 48 during the day and at night. A total of 480 min of foraging was conducted. Secondary evidence of animals was recorded, as were opportunistic sightings of fauna during setup, shutdown and other activities on site.

Two conservation significant species were recorded at Lot 48. A population of Southern Brown Bandicoots (*Isoodon obesulus fusciventer*) inhabits the property. These are classified as Priority 5, 'taxa in need of monitoring', by the Department of Environment and Conservation. A Forest Red-tailed Black-Cockatoo, *Calyptorhynchus banksii naso*, was also recorded flying overhead. *C. banksii naso* is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act* and as Schedule 1, 'fauna which are rare or likely to become extinct', under the *WA Wildlife Conservation Act 1950*. The species is unlikely to be resident within the property as no suitable habitat exists within the project area.

To determine likely impacts on fauna a risk assessment was conducted (Appendix C). This was used to identify threatening processes and impacts on fauna habitats, biodiversity and ecological function within the project area and in the surrounding uncleared bushland. The management recommendations arising from the analysis are as follows:

1. Relocate the local bandicoot population to nearby bushland if available or incorporate them into Department of Environment and Conservation reintroduction programmes. DEC personnel should be contacted for advice on suitable relocation areas or breeding programs and regulator sign-off on the methods to be used should be obtained prior to relocation. Relocation should occur in winter months.
2. Clearing should take place immediately following bandicoot relocation activities.
3. Avoid vehicle strikes by ensuring contractor awareness of the potential for bandicoots and other fauna to be in the area. Reduce speed limits and avoid driving at dusk, dawn, or at night.

4. Keep the project area free of food scraps, human waste and other materials likely attract feral fauna such as foxes and cats into the project area.
5. Clearing should be rapid to reduce the amount of disturbance to fauna in adjacent bushland. Noise reduction measures should be considered.
6. Dust suppression measures should be implemented, including a reduction of vehicle speed on unsealed roads.
7. To avoid fire damage to adjacent bushland, contractor vehicles should be fitted with fire extinguishers and personnel should be trained in their use. A fire prevention strategy should be considered.

**Table S.1.1** Conformance of project to relevant EPA Position Statement No 3

| REQUIREMENT | RELEVANCE TO PROJECT | PROJECT COMPLIANCE |
|---|---|---|
| Impact on Biodiversity | Where impact on biodiversity cannot be avoided, the proponent must demonstrate that the impact will not result in unacceptable loss. | Impact on biodiversity cannot be avoided. It is recommended that prior to clearing a trapping grid be set and any bandicoots caught relocated to an area to be determined following consultation with stakeholders, including the DEC. No other conservation significant fauna have been recorded in the project area. |
| State, National and International Agreements, Legislation and Policy on Biodiversity | Information gathered for environmental impact assessment in Western Australia meets State, National and International Agreements, Legislation and Policy in regard to biodiversity conservation. | Prior to the field survey a tally of rare fauna listed under State, Federal and International agreements potentially occurring in the project area was prepared and these fauna were targeted during opportunistic diurnal and nocturnal searches. Impacts to species listed under relevant legislature are addressed in Section 5. |
| EPA Standards, Requirements and Protocols | The quality of information and scope of field surveys meets the standards, requirements and protocols as determined and published by the EPA. | Because of the location of the proposed development and the scale of impact, a Level 2 survey was required to conform to EPA Guidance Statement 56 (EPA 2004). This comprised a literature review and reconnaissance survey and a detailed survey of the vertebrate fauna. |
| Biodiversity Conservation and Ecological Function Values | Sufficient information is provided to address biodiversity conservation and ecological function values. | Impacts to species are addressed in Section 5. A risk assessment has also been conducted (Appendix C) to identify threatening process and methods for managing them. |
| State Biological Databases | Terrestrial biological surveys will be made publicly available and will contribute to the bank of data available for the region. | Survey data has been collated and will be submitted to DEC as per fauna licensing conditions. |

# 1.0 INTRODUCTION

## 1.1 PROJECT OVERVIEW

SAS Global Property Group proposes to subdivide a 4 ha block for housing at Lot 48 Furnissdale Road, Furnissdale (Figure 1.1). The project is yet to be referred to the EPA; however, it is anticipated that the proposal will be assessed by the EPA at the Environmental Protection Statement (EPS) level. As part of the approvals process, a Level 2 fauna assessment is required in accordance with Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004).

## 1.2 LEGISLATIVE FRAMEWORK

The *Environmental Protection Act 1986* is "an Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of environmental pollution, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing." Section 4a of this Act outlines five principles that are required to be addressed to ensure that the objectives of the Act are addressed. Three of these principles are relevant to native fauna and flora:

- *The Precautionary Principle*

  Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

- *The Principles of Intergenerational Equity*

  The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

- *The Principle of the Conservation of Biological Diversity and Ecological Integrity*

  Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Projects undertaken as part of the Environmental Impact Assessment (EIA) process are required to address guidelines produced by the EPA, in this case Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact in Western Australia (EPA 2004), and principles outlined in the EPA's Position Statement No. 3 Terrestrial Biological Surveys as an element of Biodiversity Protection (EPA 2002).

Native fauna and fauna in Western Australia are protected at a Federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and at a State level under the *Wildlife Conservation Act 1950* (WC Act).

The EPBC Act was developed to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance, to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and to promote the conservation of biodiversity. The EPBC Act includes provisions to protect native species (and in particular prevent the extinction, and promote the recovery, of threatened species) and ensure the conservation of

migratory species. In addition to the principles outlined in Section 4a of the EP Act, Section 3a of the EPBC Act includes a principle of ecologically sustainable development dictating that decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.

The WC Act was developed to provide for the conservation and protection of wildlife in Western Australia. Under Section 14 of this Act, all fauna and flora within Western Australia is protected; however, the Minister may, via a notice published in the *Government Gazette*, declare a list of fauna taxa identified as likely to become extinct, or is rare, or otherwise in need of special protection. The current listing was gazetted on the 8 February 2005.

## 1.3 SURVEY OBJECTIVES

SAS Global Ltd commissioned *ecologia* Environment (*ecologia*) to undertake a baseline biological survey of the vertebrate fauna of Lot 48 Furnissdale Rd, Furnissdale as part of the environmental impact assessment for the project.

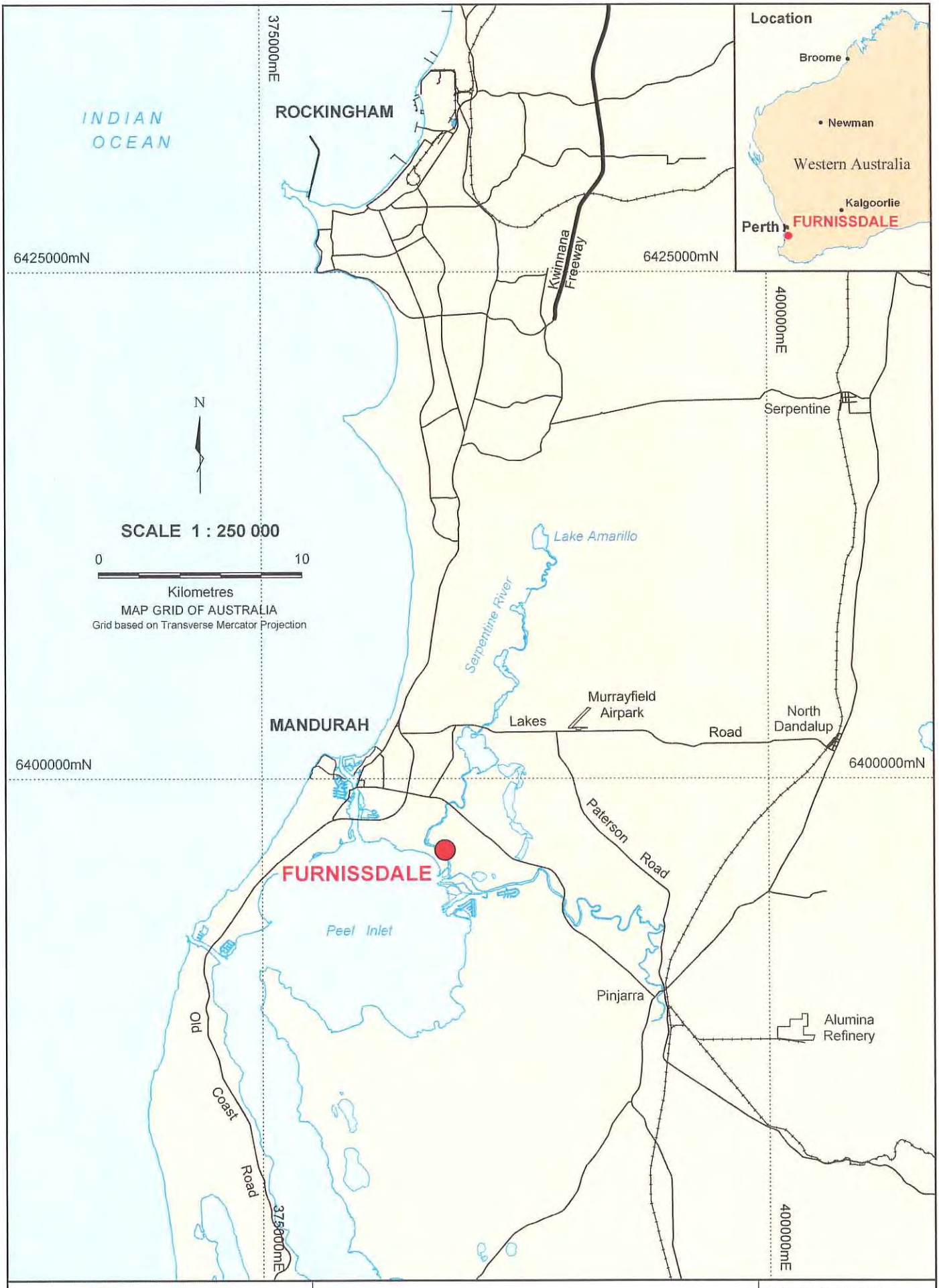
The EPA's objectives with regards to fauna management are to:

- maintain the abundance, species diversity and geographical distribution of terrestrial fauna; and
- protect Specially Protected (Threatened) fauna, consistent with the provisions of the *Wildlife Conservation Act 1950.*

Hence, the primary objective of this study was to provide sufficient information to the EPA to assess the impact of the project on the vertebrate fauna of the area, thereby ensuring that these objectives will be upheld.

Specifically, the objectives this survey was to undertake a survey that satisfies the requirements documented in EPA's Guidance Statement 56 and Position Statement No. 3, thus providing:

- A review of background information (including literature and database searches);
- An inventory of vertebrate fauna species occurring in the study area, incorporating recent published and unpublished records;
- An inventory of species of biological and conservation significance recorded or likely to occur within the project area and surrounds;
- An appraisal of the current knowledge base for the area, including a review of previous surveys conducted in the area which are relevant to the current study;
- A review of regional and biogeographical significance, including the conservation status of species recorded in the project area; and
- A risk assessment to determine likely impacts of threatening processes on vertebrate fauna within the study area.




ecologia ENVIRONMENT

| | |
|---|---|
| Client: | SAS GLOBAL LTD |
| Project: | LOT 48 FURNISSDALE ROAD |

# LOCATION PLAN FOR LOT 48 FURNISSDALE ROAD FURNISSDALE

| | |
|---|---|
| Date: | 21 March 2007 |
| Scale: | 1:250 000 |
| Author: | S.F. / S.C. |
| Figure No. | 1.1 |
| A4 | Plan No. FSD-001 |

# 2.0 BIOPHYSICAL ENVIRONMENT

## 2.1 CLIMATE

The nearest Bureau of Meteorology weather station was at Mandurah Park (recording station 9572); climatic data are available here up until 2001. Lot 48 Furnissdale Rd lies approximately 4 km to the south-east of Mandurah and therefore experiences similar meteorological conditions. The climate is Mediterranean, experiencing most rainfall during the winter months of June and July, with rainfall maxima of 190 mm and 175 mm, respectively. Mean daily maximum temperature peaks in February at 30°C and is lowest in July at 17°C, while the mean daily minimum is lowest in July and August at 8.6°C and highest in January and February at 17°C (Figure 2.1).

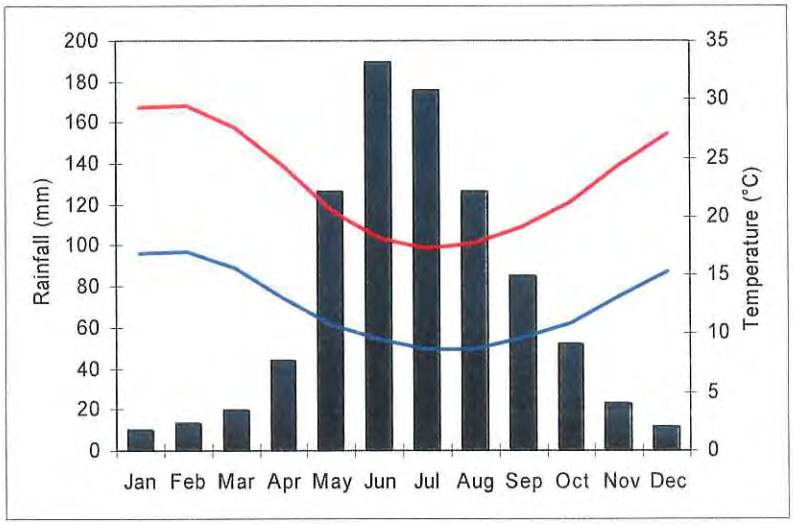



**Figure 2.1** **Mean climatic data for Mandurah**

2006 was the driest year on record for Perth, located approximately 65 km north of the study area. During the winter months Perth received just 230.4 mm, compared to a mean winter rainfall of 485 mm. Rainfall in June, usually the wettest month, was just 24.6 mm compared with an average of 182 mm for the month. It is likely that the study area experienced similar climatic anomalies during the 12 months prior to the survey.

During the initial three days of the survey rain fell at the study area. The rainfall figures for Mandurah during the survey are shown below in Table 2.1.

**Table 2.1** **Rainfall during the survey**

| Date | Day | Max Temp (°C) | Min Temp (°C) | Rain (mm) |
|---|---|---|---|---|
| 28-Nov | Tuesday | 18.5 | 24.6 | 0 |
| 29-Nov | Wednesday | 14.7 | 21.3 | 4 |
| 30-Nov | Thursday | 16.7 | 21.7 | 2 |
| 1-Dec | Friday | 13 | 25.5 | 0.2 |
| 2-Dec | Saturday | 14.2 | 28.2 | 0 |
| 3-Dec | Sunday | 18 | 30.1 | 0 |
| 4-Dec | Monday | 15.2 | 24.2 | 0 |

## 2.2 BIOREGIONAL DESCRIPTION

Several zoogeographic regions are recognised in continental Australia. In WA, regions can be most broadly defined as the mesic Bassian region of the south-west, the Torresian region of subtropical northern WA, and the inland arid Eyrean region. On a finer scale, the Interim Biogeographic Regionalisation (Version 6.1) for Australia (IBRA) sees the continent divided into 85 biogeographic regions based on characteristics of climate, fauna, vegetation, landforms and geology. In WA there are 26 regions, and the Furnissdale area lies within the Swan Coastal Plain 2 subregion (DEH 2004) (Figure 2.1)

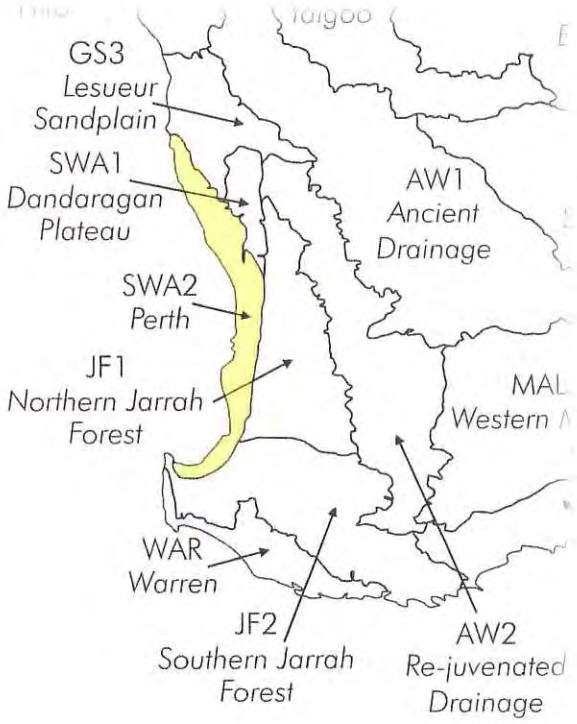



Figure 2.2 The Swan Coastal Plain 2 subregion (from IBRA v6.1)

According to the biodiversity audit of Western Australia's 53 biogeographic subregions, conducted by the Department of Conservation and Land Management (CALM) in 2002, the Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands (CALM 2002). It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted mesozoic sediments dominated by Jarrah woodland. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-marri woodlands and Melaleuca shrublands, are extensive only in the south. The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, and coastal limestone. Heath and/or Tuart woodlands occur on limestone, Banksia and Jarrah-Banksia woodlands occur on Quaternary marine dunes of various ages, and Marri occurs on colluvial and alluvial soils. The SCP includes a complex series of seasonal wetlands as well as offshore islands such as Rottnest, Carnac and Garden Islands. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean. The subregional area is 1,333,901 ha, of which 10.8% is vested in

conservation reserves (CALM 2002). Most clearing has occurred in the central, eastern and southern portions of the sub-region.

## 2.3 SURVEY METHODS

The survey methods adopted by *ecologia* are aligned with the Environmental Protection Authority's Guidance Statement No. 56 (EPA 2004) and Position Statement 3 (EPA 2002).

The project area occurs on the Swan Coastal Plain biogeographic region. Based on the location and the scale of the development, Guidance Statement No. 56 recommends that a Level 2 survey be undertaken (Detailed Field Survey). The purpose of a Detailed Survey is to enhance the level of knowledge at a local scale, and requires:

> *"One or more visit/s in each season appropriate to the bioregion and the faunal group being surveyed. Generally, maximum survey will be the season that follows the season of maximum rainfall, but there will be need to time surveys according to seasonal activity patterns of some faunal groups (e.g. molluscs or amphibians)."*

## 2.4 DETERMINATION OF SURVEY SAMPLING DESIGN AND INTENSITY

Prior to the development of survey methods, a review was undertaken of factors likely to influence survey design (Table 2.2).

**Table 2.2** Factors likely to influence survey design (from EPA 2004; 12-13).

| FACTOR | COMMENT |
|---|---|
| Bioregion – level of existing survey/ knowledge of the region and associated ability to predict accurately. | Data was sourced from the WA Museum fauna database, DEC threatened fauna database, Birds Australia database, and biological surveys of the Peel region. The literature review revealed no surveys in Furnissdale suburb, and limited numbers of baseline fauna surveys in the Peel region. A comprehensive vertebrate fauna survey was therefore undertaken. |
| Landform special characteristics/ specific fauna/ specific context of the landform characteristics and their distribution and rarity in the region. | A Conservation Category wetland is present in a portion of the study area which may support higher densities of amphibians. |
| Lifeforms, life cycles, types of assemblages and seasonality (e.g. migration) of species likely to be present. | Birds, reptiles, amphibians and mammals are expected to inhabit the site. Amphibians are most active after seasonal rains in late autumn, but birds, reptiles and mammals may be adequately sampled during periods of warmer temperature associated with summer months. |
| Level of existing knowledge and results of previous regional sampling (e.g. species accumulation curves, species/ area curves). | Few fauna surveys have been undertaken in the Peel region and while these were considered comprehensive at the time, they did not include species accumulation curves or species/area curves. |

| | |
|---|---|
| Number of different habitats or degree of similarity between habitats within a survey area. | Seven distinct vegetation assemblages have been identified within the study area (ATA 2006). Weeds are widespread within the lot and while many of the vegetations assemblages were classified as in good to very good condition, much of the habitat appeared degraded. Dumping of waste materials and the death of some of the larger trees within the lot has further reduced the value of the habitat for fauna. |
| Climatic constraints (e.g temperature or rainfall that preclude certain sampling methods). | Warm temperatures and wet conditions during the survey period meant that the full gamut of vertebrate fauna could be sampled. Several trap types – funnel, bucket, pipe, Elliott box and cage traps – were deployed to capture as wide a variety of fauna as possible. |
| Sensitivity of the environment to the proposed activities. | Clearing of the study area will remove all fauna habitat. To ensure that no conservation significant fauna are impacted a comprehensive fauna survey was required. |
| Size, shape and location of the proposed activities. | The area to be cleared is small and is located immediately adjacent to existing housing along its southern border, in an area zoned for residential development. The study area forms a portion of a wider area that is likely to be developed for real estate in the coming years. |
| Scale and impact of the proposal. | The study area is approximately 4 ha and will result in the clearing of all of the vegetation. In order to determine which fauna are to be displaced a comprehensive fauna survey was required. |

## 2.5 LITERATURE REVIEW AND DATABASE SEARCHES

Relevant surveys of similar scale undertaken in the Peel region are few. A comprehensive fauna survey was undertaken as part of the environmental approvals process associated with the Peel Deviation Perth-Bunbury Highway (*ecologia* 1996). A desktop and reconnaissance survey was also undertaken as part of this development (*ecologia* 1997). A further desktop survey was undertaken as part of this project (*ecologia* 1999), as well as for the development of Mandurah Lot 300 (*ecologia* 2003), and for the Perth-Mandurah Railway (Bowman *et al.* 2002).

Several databases were consulted in the formulation of potential fauna (and conservation significant fauna) lists as discussed in Chapters 3 and 4 and the appendices:

- Western Australian Museum FaunaBase;
- Birds Australia BirdData;
- DEH protected matters database;
- DEC threatened fauna database;
- Relevant field guides; and
- Previous reports.

## 2.6 SURVEY TIMING

The survey was conducted in summer between the 28th November and 4th December 2006.

## 2.7 SAMPLING METHODS

The survey was undertaken using a variety of sampling techniques, including systematic and opportunistic sampling. Systematic sampling refers to data methodically collected over a fixed time period in a discrete habitat type, using an equal or standardised sampling effort. Opportunistic sampling includes data collected non-systematically outside fixed sampling sites. Total survey effort is presented in Table 2.3.

### 2.7.1 Systematic Sampling

#### Terrestrial Mammals and Herpetofauna

Trapping for terrestrial mammals and herpetofauna was undertaken using a standardised trapping format comprising a combination of pit-fall traps, Elliot box traps, funnel traps and cage traps. Traps were open for seven nights.

Trap Specifications

1. Pit-trap and drift fence: Ten PVC pipe (16 cm diameter, minimum 50 cm deep) and ten 20 L plastic buckets (30 cm diameter, 40 cm deep) were established at each site. A six metre flywire drift fence (30 cm high) bisected the pits, directing fauna into the traps.
2. Elliott box traps: Twenty medium-sized Elliott box traps (9 x 9 x 32 cm) were located in each site, and baited with Universal Bait (a mixture of peanut butter, rolled oats and sardines). One Elliott trap was placed near each pit trap.
3. Funnel traps: 40 Funnel traps (Ecosystematica Type III) were placed in association with drift fences with one at either end of every drift fence.
4. Cage traps: 20 cage traps were used with one cage trap near each pit trap.

#### Avifauna

Twenty minute set-time surveys were used to document the avifauna present within the project area. During each set-time survey an ornithologist recorded the number of individuals of each species seen while actively searching a 2.0 ha area. This technique is the basis for the ongoing continental-scale avifaunal survey of Australia: the Birds Australia Atlas project.

Survey effort was concentrated between the post-dawn (06:00-09:00) and pre-dusk (15:00-18:00) time periods, as these are deemed to be the optimal time to record most bird species. Censuses between these times were conducted as well, as these surveys may yield species less frequently observed in the early morning or late evening, e.g. diurnal raptors.

#### Bats

Bat echolocation calls were detected using an ANABAT II system (Titley Electronics, Ballina, NSW). The ANABAT Bat Detector is able to transform ultrasonic bat echolocation calls for analysis with computer software. The transformed calls were stored on Minidiscs and played back onto a PC for analysis. Mr Bob Bullen identified acoustic calls.

### 2.7.2 Opportunistic Sampling

#### Spotlighting

The study area was searched at night using a combination of road transects using vehicle-mounted spotlights and opportunistic ground searches using head torches and hand held spotlights for nocturnal species, such as geckos, snakes and nocturnal birds.

#### Foraging

Opportunistic sites were searched for cryptic species, which comprised searching beneath the bark of dead trees, breaking open old logs, stumps and dead free-standing trees, investigating burrows and recording tracks, diggings and scats, and over-turning logs and stones. Sites were selected on the basis of their representative nature of the study area, and also based upon whether they were well-represented by the systematic trapping effort.

#### Secondary Evidence

Tracks, diggings, scats, burrows and nests were recorded where possible.

#### Opportunistic Sightings

The presence of species was recorded while searching, travelling and during trap establishment within the study area during the day and night.

**Table 2.3** Survey Effort

| | PIT TRAPS (TRAP NIGHTS) | FUNNELS (TRAP NIGHTS) | ELLIOTTS (TRAP NIGHTS) | CAGES (TRAP NIGHTS) | BIRD CENSUS (MINS) | DIURNAL OPP. SEARCH (MINS) | BAT RECORDING (MIN) | NIGHT SEARCHING (MIN) |
|---|---|---|---|---|---|---|---|---|
| Site | 140 | 280 | 140 | 140 | 120 | 240 | 180 | 240 |

## 2.8 ANIMAL ETHICS

Surveying was conducted as per *ecologia*'s Animal Ethics Code of Practice, which conforms to Section 5, Wildlife Studies, of the Australian code of practice for the care and use of animals for scientific purposes (NHMRC 2004: 39-43). In all cases, fauna were identified in the field and released at the point of capture.

## 2.9 TAXONOMY AND NOMENCLATURE

Field identification of vertebrate species was based on the following field guides:

| | | |
|---|---|---|
| Mammals | .... | Menkhorst & Knight (2001) |
| Skinks | .... | Storr *et al.* (1999) |
| Bats | .... | Churchill (1998); Menkhorst & Knight (2001) |
| Dragons | .... | Cogger (2000), Storr *et al.* (1983) |

| | | |
|---|---|---|
| Birds | .... | Simpson & Day (2004) |
| Goannas | .... | Cogger (2000), Storr *et al.* (1983) |
| Snakes | .... | Storr *et al.* (2002) |
| Geckos | .... | Storr *et al.* (1990); Cogger (2000) |
| Reptiles | .... | Cogger (2000), Wilson & Swan (2003) |
| Legless Lizards | .... | Storr *et al.* (1990); Cogger (2000) |
| Amphibians | .... | Tyler *et al.* (2000); Cogger (2000) |

Nomenclature for mammals, birds and reptiles and amphibians within this report are as per the WA Museum's FaunaList.

## 2.10 DATA ANALYSIS

### Species richness

The number of species present (species richness) is the most simplistic representation of species diversity (Fowler and Cohen, 1990) and is a basic indicator of diversity used for this survey.

### Randomised Species Accumulation Curves

Species accumulation curves were randomised 1000 times using EstimateS (Version 8.0, Colwell 2005) software. Fauna data were plotted as the number of species observed against individuals as the ordinate (Thompson and Withers 2003). Total species richness was estimated using the Michaelis-Menten function, an asymptotic curve commonly used for estimations of this nature (Colwell and Coddington 1994).

## 2.11 IMPACT RISK ASSESSMENT

A risk assessment (Appendix C) was undertaken to determine potential impacts arising from the development on vertebrate fauna and the residual impacts following the implementation of management strategies identified in this document (Section 5.0). Significance of the risks is classified as either "High" (site/issue specific management programmes required, advice/approval from regulators required), "Medium" (specific management and procedures must be specified) or "Low" (managed by routine procedures).

## 2.12 SURVEY TEAM

The zoology team responsible for the survey was Dr Stewart Ford, PhD, Victoria Cartledge, BSc (Hons.) and Mr Dean Bradshaw.

# 3.0 RESULTS

## 3.1 SURVEY LIMITATIONS

**Table 3.1** Summary of survey limitations

| CONSTRAINT | RELEVANT (yes/no) | COMMENT |
|---|---|---|
| Competency/ experience of the consultant carrying out the survey. | No | Experienced and competent consultants were used. |
| Scope (what faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions). | No | All faunal groups were sampled, including amphibians during the initial wet period of the survey. |
| Proportion of fauna identified, recorded and/ or collected. | No | All fauna were identified in the field. |
| Sources of information (previously available information as distinct from new data). | Yes – moderate | Few previous fauna surveys relevant to the area and region were available. |
| The proportion of the task achieved and further work which might be needed. | No | The survey is complete. |
| Timing/ weather/ season/ cycle. | No | Early summer is good for fauna surveys on the Swan Coastal Plain because of high daytime temperatures and moderate night-time temperatures; an initial wet period resulted in high amphibian activity. |
| Disturbances which affected results of the survey (e.g. fire, flood, accidental human intervention). | No | There were no disturbances. |
| Intensity (in retrospect was the intensity adequate). | No | The intensity of trapping within the survey area was high. |
| Completeness (e.g. was relevant area fully surveyed). | No | The relevant area was fully surveyed. |
| Resources (e.g. degree of expertise available in animal identification to taxon level). | No | All animals captured were able to be identified to species level. |
| Remoteness and/ or access problems. | No | Access was not a problem. |
| Availability of contextual (e.g. biogeographic) information on the region. | No | The Swan Coastal Plain has been intensively studied. |
| Efficacy of sampling methods (i.e. any groups not sampled by survey methods). | No | The sampling methods used covered all fauna groups adequately. |

## 3.2 FAUNA ASSEMBLAGES

### 3.2.1 Reptiles

Fifteen species of reptile were recorded within the proposed site (Appendix A1), from a potential species list of 34 (Appendix B1). Skinks (Scincidae) were the best represented group in the sample, with 11 of the 17 skink species potentially occurring in the area recorded during the survey. The reptile assemblage also included four families that were represented by a single species: one gecko (Gekkonidae), one elapid snake (Elapidae), one dragon (Agamidae), and one species of legless lizard (Pygopodidae).

### 3.2.2 Amphibians

Three of the eight potential frog species known to occur in the area were recorded during surveying (Appendices A1 & B1). These were three of the five expected Myobatrachids (ground-dwelling or burrowing frogs), while the two expected Hylids (tree frogs), *Litoria adelaidensis* and *Litoria moorei* were not recorded. This may be due to seasonal influences, as hylids prefer wetter conditions, such as those occurring during winter rains.

### 3.2.3 Mammals

Twenty-two species of mammals have the potential to occur within the project area, as shown in Appendix B1. Of these, eleven were recorded during the survey (Appendix A2). Six species were non-native. Five native mammals were recorded: the Western Grey Kangaroo (*Macropus fuliginosus*), Southern Brown Bandicoot or Quenda (*Isoodon obesulus fusciventer*), Common Brushtail Possum (*Trichosurus vulpecula*) and two bats, Gould's Wattled Bat (*Chalinolobus gouldii*) and the Southern Forest Bat (*Vespadelus regulus*). The most commonly recorded mammal was the introduced House Mouse.

### 3.2.4 Birds

182 bird species occur in the region, 80 of which are found in aquatic environments and are therefore not expected to occur at Furnissdale. Of the remaining 102 birds, 37 species from 17 families were recorded within the proposed site (Appendix A3 and B3).

The most strongly represented families within the proposed development location were the Meliphagidae (Honeyeaters; 6 species), Acanthizidae (Thornbills and allies; 5 species) and Psittacidae (Parrots; 4 species). The most common species within the study area were the Silverye (*Zosterops lateralis*), Red-capped Parrot (*Platycercus spurius*), Red Wattlebird (*Anthochaera carunculata*) and Australian Ringneck (*Platycercus zonarius*).

## 3.3 Sampling Adequacy

Sampling adequacy can be estimated using species accumulation curves and extrapolation of each curve to the asymptote (predicted maximum number of species) using Michaelis-Menten modelling (Colwell 2005). Using this system, the total species richness for the project area can be estimated.

Species accumulation curves for trapping data and bird censusing have been calculated and are provided below. All the curves are tending toward the horizontal suggesting a point of diminishing return in terms of new species for sampling effort.

### 3.3.1 Reptiles

The species accumulation curve for reptiles is shown in Figure 3.1, below. It suggests that with further trapping, more species would be recorded. The number of individuals required to be trapped (survey effort) would have to be much greater, requiring many more night's trapping, to approach the theoretical maximum of 34 species. It is unlikely that the 4 ha of Lot 48 would support this many species, particularly given the homogeneity of the habitat.

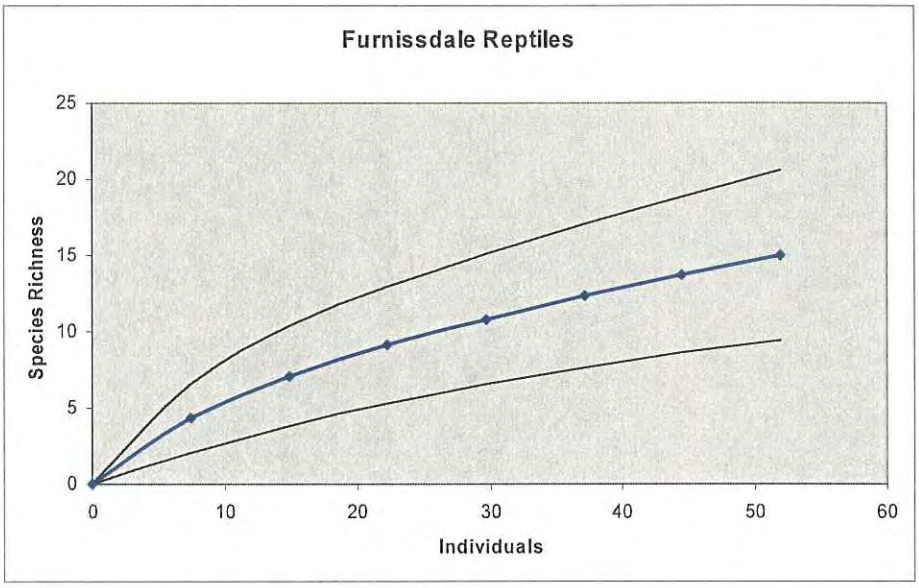



**Figure 3.1 Reptile species accumulation curve**

### 3.3.2 Amphibians

The amphibian species accumulation curve is shown on the next page in Figure 3.2. It suggests that the full complement of amphibian species present at the time of surveying has been recorded. This is misleading, however, because there are potentially a further five amphibian species present that were not recorded during the survey. These may be present during cooler, wetter winter months rather than the summer. It is likely that the species accumulation curve is misleading in this respect.

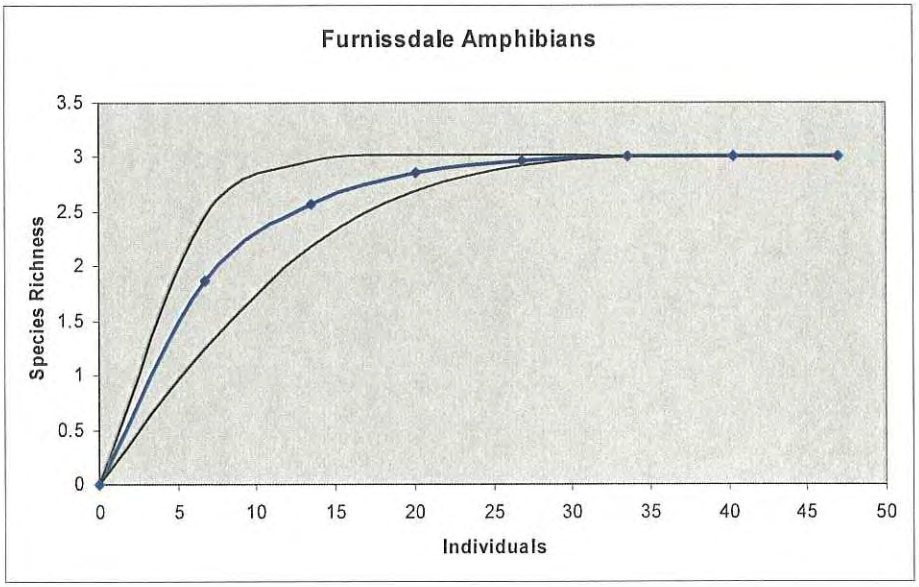



**Figure 3.2 Amphibian species accumulation curve**

### 3.3.3 Mammals

The mammal species accumulation curve is of limited relevance, as only those individuals captured in traps are recorded. Mammals that are large, or opportunistically recorded, or bats that were recorded using recording software, were not trapped and hence are not included on the species accumulation curve, which lacks eight of the 11 species recorded. This is a shortcoming of the analysis. The species accumulation curve for trappable mammals is shown in Figure 3.3, below. It suggests that all trappable mammals present at the time of surveying were recorded.

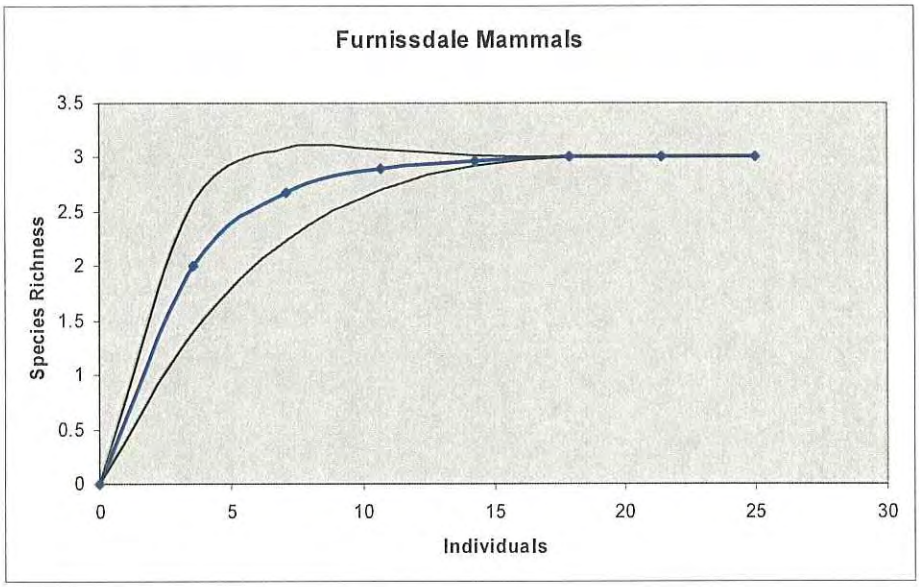



**Figure 3.3 Mammal species accumulation curve**

### 3.3.4 Birds

All bird species recorded during systematic surveying are included in the species accumulation curve, shown in Figure 3.4, below. Similar to the reptile curve, it suggests that with further survey effort, more species would be recorded. The potential species list for the area includes 102 birds. However, of that total many are expected to be rare or transitory and therefore a significantly greater survey effort would be required to record them, if indeed they are present. In fact, based on the model shown in Figure 3.4, a maximum of 50 bird species is expected within Lot 48, significantly less than the 102 potentially occurring.

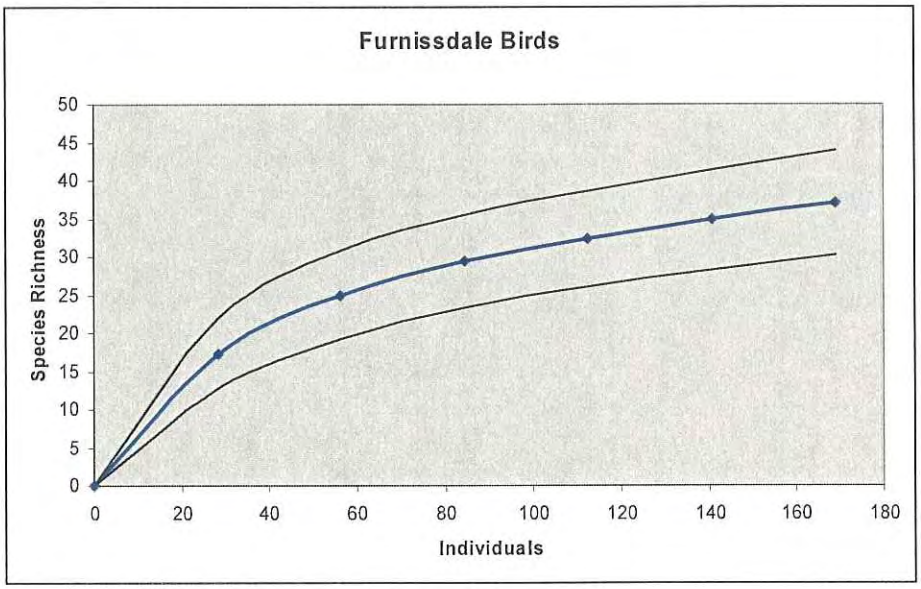



**Figure 3.4 Bird species accumulation curve**

# 4.0 CONSERVATION SIGNIFICANT FAUNA

## 4.1 STATUTORY FRAMEWORK

Fauna species that have been formally recognised as rare, threatened with extinction, or as having high conservation value are protected by law under Commonwealth and State legislation. At the national level, fauna are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Within WA, rare fauna are listed under the *Western Australian Wildlife Conservation Act 1950: Wildlife Conservation (Specially Protected Fauna) Notice 2006(2).* International Agreements include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA).

Schedule 1 of the Commonwealth EPBC Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent. Definitions of categories relevant to fauna occurring or potentially occurring in the project area are provided in Table 4.1.

**Table 4.1** Definitions of relevant categories under the EPBC Act.

| CATEGORY | DEFINITION |
|---|---|
| Endangered (EN) | The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction. |
| Vulnerable (VU) | Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate. |
| Migratory (M) | Species are defined as migratory if they are listed in an international agreement approved by the Commonwealth Environment Minister, including:<br>• the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state;<br>• The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA); or<br>• The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA). |

Classification of rare and endangered fauna under the WA Wildlife Conservation (Specially Protected Fauna) Notice 2005 of the *Wildlife Conservation Act 1950* recognises four distinct schedules, as listed in Table 4.2 below. In addition, the Department of Environment and Conservation (DEC) maintains a Priority Fauna list which typically includes those removed from the *WA Wildlife Conservation Act 1950* and other species known from only a few populations or in need of monitoring. Five Priority Codes are recognised, as detailed in Table 4.3.

**Table 4.2** Definition of Schedules under the Wildlife Conservation Act 1950

| SCHEDULE | DEFINITION |
|---|---|
| Schedule 1 (S1) | Fauna which are Rare or likely to become extinct, are declared to be fauna that is in need of special protection. |
| Schedule 2 (S2) | Fauna which are presumed to be extinct, are declared to be fauna that is in need of special protection. |
| Schedule 3 (S3) | Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection. |
| Schedule 4 (S4) | Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned above. |

**Table 4.3** Definition of DEC Priority Codes

| PRIORITY | DEFINITION |
|---|---|
| Priority One (P1) | Taxa with few, poorly known populations on threatened lands.<br>Taxa which are known from few specimens or sight records from one or a few localities, on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. |
| Priority Two (P2) | Taxa with few, poorly known populations on conservation lands.<br>Taxa which are known from few specimens or sight records from one or a few localities, on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. |
| Priority Three (P3) | Taxa with several, poorly known populations, some on conservation lands.<br>Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. |
| Priority Four (P4) | Taxa in need of monitoring.<br>Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could if present circumstances change. These taxa are usually represented on conservation lands. |
| Priority Five (P5) | Taxa in need of monitoring<br>Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years. |

## 4.2 CONSERVATION SIGNIFICANT FAUNA POTENTIALLY OCCURING IN THE STUDY AREA

Seven mammal, nine bird four reptile species of conservation significance have the potential to occur within the study area. Their conservation status and likelihood of occurrence are shown in Table 4.4.

**Table 4.4 Conservation significant fauna potentially occurring in study area.**

Note: Description of conservation significance codes provided in Tables 5.1 to 5.3
EPBC = *Environment Protection and Biodiversity Conservation Act 1999*
WCA = *Wildlife Conservation Act 1950 Specially Protected Fauna Notice 2006(2)*
DEC = DEC Priority fauna

| SPECIES | COMMON NAME | CONSERVATION SIGNIFICANCE | | | HABITAT | LIKELIHOOD OF OCCURRENCE |
|---|---|---|---|---|---|---|
| | | EPBC | WCA | DEC | | |
| **MAMMALS** | | | | | | |
| *Dasyurus geoffroii* | Western Quoll | VU | S1 | | Utilises bush remnants and corridors; confined to wet and dry sclerophyll remnants, but has been recorded regularly within 10km of Furnissdale. | **MODERATE**<br>**Regular records within 10km** |
| *Falsistrellus mackenziei* | Western False Pipistrelle | | | P4 | Most records from mature Karri forest but also known from wetter stands of Jarrah and Tuart, and woodland on the Swan Coastal Plain. | **LOW**<br>**Predominantly a forest dweller** |
| *Hydromys chrysogaster* | Water Rat | | | P4 | Occurs in waterways and wetlands that support its main prey items such as molluscs and crustaceans. | **LOW**<br>**Requires aquatic environments** |

| SPECIES | COMMON NAME | CONSERVATION SIGNIFICANCE | | | HABITAT | LIKELIHOOD OF OCCURRENCE |
|---|---|---|---|---|---|---|
| | | EPBC | WCA | DEC | | |
| *Isoodon obesulus fusciventer* | Southern Brown Bandicoot | | | P5 | Prefers areas with dense understorey vegetation, particularly around swamps and along watercourses. | **HIGH** **Resident population recorded during survey** |
| *Myrmecobius fasciatus* | Numbat | VU | S1 | | Occurs in a variety of habitats including woodland and shrublands where it shelters in hollow logs, tree hollows and burrows. | **LOW** **Possible record at nearby Barragup Swamp Reserve in 2002** |
| *Pseudocheirus occidentalis* | Western Ringtail Possum | VU | S1 | | Occurs in areas of forest and dense woodlands and requires tree hollows and/or dense canopy for refuge and nesting. | **MODERATE** **Has been recorded within 15km several times in the past decade** |
| *Phascogale tapoatafa ssp. (WAM M434)* | Brush-tailed Phascogale | | S1 | | Forest and woodland where suitable tree hollows are available. | **LOW** **Not recorded in previous 50 years** |

| SPECIES | COMMON NAME | CONSERVATION SIGNIFICANCE | | | HABITAT | LIKELIHOOD OF OCCURRENCE |
|---|---|---|---|---|---|---|
| | | EPBC | WCA | DEC | | |
| **BIRDS** | | | | | | |
| *Ardeotis australis* | Australian Bustard | | | P4 | May occur in open or lightly wooded grasslands. | LOW<br>No suitable open habitat |
| *Calyptorhynchus banksii naso* | Forest Red-tailed Black-Cockatoo | VU | S1 | | Restricted to the forests of the south-west. It requires tree hollows to nest and breed and is entirely dependent on jarrah-marri forest. | LOW<br>Recorded during survey, but no suitable habitat |
| *Calyptorhynchus baudinii* | Baudin's Black-Cockatoo | EN | S1 | | Forests, woodlands. Heavier forested areas of SW. | LOW<br>Several records nearby in recent years, but no suitable habitat |
| *Calyptorhynchus latirostris* | Carnaby's Black-Cockatoo | EN | S1 | | Open woodlands, scrublands and sandplain areas. | LOW<br>Several records nearby in recent years, but no suitable habitat |
| *Charadrius rubricollis* | Hooded Plover | | | P4 | Frequents the margins and shallows of salt lakes; also along coastal beaches. | LOW<br>No suitable habitat |

| SPECIES | COMMON NAME | CONSERVATION SIGNIFICANCE | | | HABITAT | LIKELIHOOD OF OCCURRENCE |
|---|---|---|---|---|---|---|
| | | EPBC | WCA | DEC | | |
| *Falco peregrinus* | Peregrine Falcon | | S4 | | Prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land. | LOW<br>Not recorded in the region in the past 10 years. |
| *Ninox connivens connivens* | Barking Owl (southwestern population) | | | P2 | Inhabits dense vegetation, particularly forests and thickets of melaleuca. | LOW<br>No records nearby and habitat unsuitable. |
| *Numenius madagascariensis* | Eastern Curlew | | | P4 | A migratory visitor observed on reef flats, sandy beaches and coastal estuaries | LOW<br>No suitable habitat |
| *Tyto novaehollandiae novaehollandiae* | Masked Owl (southern ssp.) | | | P3 | An inhabitant of forests and woodlands; nests in tree hollows. | LOW<br>Recorded at Birchmont, 20km away, within past decade |
| **REPTILES** | | | | | | |
| *Ctenotus gemmula* | A skink (Swan Coastal Plain Population) | | | P3 | Pale sand-plains supporting heaths in association with banksia or mallee woodland | LOW<br>No records in Peel region |
| *Lerista lineata* | A skink | | | P3 | Sandy and coastal heath and shrubland on lower west coast between Perth and Mandurah | MODERATE<br>Has been recorded in the Peel region |

| SPECIES | COMMON NAME | CONSERVATION SIGNIFICANCE | | | HABITAT | LIKELIHOOD OF OCCURRENCE |
|---|---|---|---|---|---|---|
| | | EPBC | WCA | DEC | | |
| *Morelia spilota imbricata* | Carpet Python (southwestern ssp.) | | S4 | | Generalist. Often arboreal, but may inhabit the burrows of other animals. Widespread and secretive. | **MODERATE**<br>**Uncommon but widespread, many records from the Swan Coastal Plain.** |
| *Neelaps calonotus* | Black-striped Snake | | | P3 | Occurs on dunes and sand-plains vegetated with heaths and eucalpyt/banksia woodlands | **LOW**<br>**No nearby records and unsuitable habitat** |

## 4.3 CONSERVATION SIGNIFICANT FAUNA RECORDED DURING SURVEYING

### 4.3.1 Mammals

The only mammal species listed in Table 4.4 that was recorded during the survey was the Southern Brown Bandicoot or Quenda, *Isoodon obesulus fusciventer*, several individuals of which were captured. The bandicoot is listed as Priority 5, *Taxa in need of monitoring*, by the DEC. It commonly occurs in coastal scrub and heathy forest (Menkhorst and Knight, 2001) and is widespread on the Swan Coastal Plain.

### 4.3.2 Birds

One conservation significant bird species was recorded, the Forest Red-tailed Black-Cockatoo, *Calyptorhynchus banksii naso*. The cockatoo is listed as Vulnerable under the EPBC Act and as Schedule 1, 'Fauna which are Rare and likely to become extinct', under the WA Wildlife Conservation Act (1950). It occurs in a variety of habitats including tall open forests, woodlands, grasslands, scrublands, floodplains, river margins and wetlands (Pizzey and Knight 2003). While it is most frequently recorded in forested areas of the Darling Scarp, there are several records in the Peel region in and other areas of the coastal plain (Birds Australia 2007). These records are probably of foraging birds; they are entirely dependent on jarrah-marri forest for breeding.

## 4.4 REGIONALLY ENDEMIC FAUNA

Regionally endemic vertebrate fauna include those species restricted to a particular region or sub-region, in this case the Swan Coastal Plain. Taking into account the location of Lot 48 Furnissdale Rd, the regional endemics potentially occurring in the project area include the skinks *Ctenotus gemmula* and *Lerista lineata*, and the Black-striped Snake *Neelaps calonotus*, included in Table 4.4. None of these were recorded during surveying and none have previously been recorded within a 15 km radius (DEC records), although the WA Museum has records of *L. lineata* from the Peel region.

# 5.0 IMPACT ASSESSMENT

## 5.1 THREATENING PROCESSES

A risk assessment was conducted to determine the major processes likely to impact fauna within the project area (Appendix C1). Activities that are likely to adversely impact conservation significant fauna are vegetation clearing, vehicle strikes, an increase in feral fauna populations, noise pollution, dust, and fire. Impacts on local populations in surrounding bushland were also taken into account, although the fauna native to Lot 48 were of primary interest.

- Vegetation clearing and the associated removal of fauna habitat will result in the loss of local vertebrate communities, a reduction in biodiversity and a loss of ecological function, as well as displacement of local fauna into surrounding areas where they are likely to face competition from established individuals.
- Vehicle strikes on surface-dwelling and burrowing fauna have the potential to cause fauna mortality.
- An increase in the number of feral animals may result in increased mortality of fauna in surrounding bushland if predatory ferals are attracted by food scraps etc. left by humans. Other feral fauna such as rats and mice may also displace native fauna from adjacent habitats.
- Noise made by machinery during clearing and building operations may negatively impact fauna in adjacent bushland.
- Dust formed during clearing and driving on unsealed roads may have an effect on the vegetation closest to the Lot 48 development, reducing its value as fauna habitat.
- Accidental fire arising from clearing and building activities may destroy vegetation in surrounding bushland, resulting in a loss of fauna habitat and direct mortality.

## 5.2 IMPACTS ON FAUNA HABITATS

Impacts on fauna habitats within Lot 48 cannot be mitigated as all vegetation will be cleared, however areas of adjacent bushland may also be impacted by the threatening processes listed above.

## 5.3 IMPACTS ON FAUNAL ASSEMBLAGES

### 5.3.1 Biodiversity

The biodiversity of the native fauna at Lot 48 will be permanently reduced. Some increase may occur when housing development has finished and gardens become established, particularly as larger trees mature, but this will be offset by physical subdivision barriers (fences) and an increase in the number of feral fauna inhabiting the area. Feral fauna introduced by homeowners also have the potential to reduce native biodiversity in adjacent bush blocks if they are not carefully managed. The least affected group is likely to be birds, which are able to move in and out of the area, but are also susceptible to predation by cats.

### 5.3.2 Ecological Function

As with biodiversity, ecological function within the project area will be permanently affected. Some recolonisation by native species may occur once homes and gardens are established, but feral fauna will probably dominate and only native fauna that have adapted to human areas are likely to return. Again, the least affected vertebrate group is likely to be the birds, which are most likely to use the urban habitat, particularly if native plants are established in gardens.

## 5.4 IMPACTS ON FAUNA SPECIES OF CONSERVATION SIGNIFICANCE

### 5.4.1 Southern Brown Bandicoot, *Isoodon obesulus fusciventer*, Priority 4

If the population of Southern Brown Bandicoots resident at Lot 48 is not removed prior to clearing significant individual mortality may result. Direct mortality due to vehicle strikes is a factor as is indirect mortality following displacement of the local population into areas of adjacent bushland, where they are likely to face competition from established individuals.

### 5.4.2 Forest Red-tailed Black-Cockatoo, *Calyptorhynchus banksii naso*, Vulnerable, Schedule 1

The individual observed was flying overhead and not utilising the habitat in Lot 48. The project area lacks suitable nesting habitat for this species and little impact is anticipated other than a potential reduction in foraging habitat, for which the project area is not well suited. It is likely that this species, as well as the white-tailed *Calyptorhynchus* sp. cockatoos, are occasional visitors to the area and will not be significantly impacted by the proposed development.

# 6.0 MANAGEMENT RECOMMENDATIONS

The following management items are recommended to mitigate impacts of the development on native fauna:

1. Relocate the local bandicoot population to nearby bushland if available or incorporate them into Department of Environment and Conservation reintroduction programmes. DEC personnel should be contacted for advice on suitable relocation areas or breeding programs and regulator sign-off on the methods to be used should be obtained prior to relocation. Relocation should occur in winter months.
2. Clearing should take place immediately following bandicoot relocation activities.
3. Avoid vehicle strikes by ensuring contractor awareness of the potential for bandicoots and other fauna to be in the area. Reduce speed limits and avoid driving at dusk, dawn, or at night.
4. Keep the project area free of food scraps, human waste and other materials likely attract feral fauna such as foxes and cats into the project area.
5. Clearing should be rapid to reduce the amount of disturbance to fauna in adjacent bushland. Noise reduction measures should be considered.
6. Dust suppression measures should be implemented, including a reduction of vehicle speed on unsealed roads.
7. To avoid fire damage to adjacent bushland, contractor vehicles should be fitted with fire extinguishers and personnel should be trained in their use. A fire prevention strategy should be considered.

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# APPENDIX A FAUNA SPECIES RECORDED

## Appendix A1 Herpetofauna observed in the study area

| FAMILY & species | Common Name |
|---|---|
| **AMPHIBIA** | |
| MYOBATRACHIDAE | |
| *Crinia insignifera* | Squelching Froglet |
| *Heleioporus eyrei* | Moaning Frog |
| *Pseudophryne guentheri* | Günther's Toadlet/Crawling Frog |
| **REPTILIA** | |
| AGAMIDAE | |
| *Pogona minor* | Bearded Dragon |
| ELAPIDAE | |
| *Notechis scutatus* | Tiger Snake |
| GEKKONIDAE | |
| *Christinus marmoratus* | Marbled Gecko |
| PYGOPODIDAE | |
| *Lialis burtonis* | Burton's Legless Lizard |
| SCINCIDAE | |
| *Acritoscincus trilineatum* | Western Three-lined Skink |
| *Ctenotus australis* | A skink |
| *Ctenotus fallens* | A skink |
| *Ctenotus impar* | South-western Odd-striped Skink |
| *Ctenotus labillardieri* | Red-legged Skink |
| *Egernia kingii* | King's Skink |
| *Hemiergis quadrilineata* | Two-toed Earless Skink |
| *Lerista elegans* | A skink |
| *Menetia greyii* | Common Dwarf Skink |
| *Morethia obscura* | Woodland Flecked Skink |
| *Tiliqua rugosa* | Bobtail |

## Appendix A2 Mammals observed in the study area

| FAMILY & Species | Common Name |
|---|---|
| CANIDAE | |
| **Vulpes vulpes* | Red Fox |
| **Canis familiaris* | Domestic Dog |
| FELIDAE | |
| **Felis catus* | Cat |
| LEPORIDAE | |
| **Oryctolagus cuniculus* | Rabbit |
| MACROPODIDAE | |
| *Macropus fuliginosus* | Western Grey Kangaroo |
| MURIDAE | |
| **Mus musculus* | House Mouse |
| **Rattus rattus* | Black Rat |
| PERAMELIDAE | |
| *Isoodon obesulus fusciventer* | Southern Brown Bandicoot |
| PHALANGERIDAE | |
| *Trichosurus vulpecula* | Brushtail Possum |
| VESPERTILIONIDAE | |
| *Chalinolobus gouldii* | Gould's Wattled Bat |
| *Vespadelus regulus* | Southern Forest Bat |

**Appendix A3 Bird species observed in the study area.**

| FAMILY & species | Common Name |
|---|---|
| ACANTHIZIDAE | |
| *Acanthiza apicalis* | Inland Thornbill |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill |
| *Gerygone fusca* | Western Gerygone |
| *Sericornis frontalis* | White-browed Scrubwren |
| *Smicrornis brevirostris* | Weebill |
| ACCIPITRIDAE | |
| *Accipiter fasciatus* | Brown Goshawk |
| *Haliastur sphenurus* | Whistling Kite |
| *Pandion haliaetus* | Osprey |
| CAMPEPHAGIDAE | |
| *Coracina novaehollandiae* | Black-faced Cuckoo Shrike |
| CHARADRIIDAE | |
| *Phaps chalcoptera* | Common Bronzewing |
| *Streptopelia senegalensis* | Laughing Turtle-dove |
| CORVIDAE | |
| *Corvus coronoides* | Australian Raven |
| CRACTICIDAE | |
| *Cracticus tibicen dorsalis* | Australian Magpie |
| *Cracticus torquatus* | Grey Butcherbird |
| DICRURIDAE | |
| *Grallina cyanoleuca* | Australian Magpie-lark |
| *Rhipidura fuliginosa* | Grey Fantail |
| *Rhipidura leucophrys* | Willie Wagtail |
| HALCYONIDAE | |
| *Dacelo novaeguineae* | Laughing Kookaburra |
| HIRUNDINIDAE | |
| *Hirundo nigricans* | Tree Martin |
| MALURIDAE | |
| *Malurus splendens* | Splendid Fairy-wren |
| MELIPHAGIDAE | |
| *Acanthorhynchus superciliosus* | Western Spinebill |
| *Anthochaera carunculata* | Red Wattlebird |
| *Lichenostomus virescens* | Singing Honeyeater |
| *Lichmera indistincta* | Brown Honeyeater |
| *Manorina flavigula* | Yellow-throated Miner |
| *Phylidonyris novaehollandiae* | New-Holland Honeyeater |
| PACHYCEPHALIDAE | |
| *Colluricincla harmonica* | Grey Shrike-thrush |
| *Pachycephala pectoralis* | Golden Whistler |
| *Pachycephala rufiventris* | Rufous Whistler |
| PARDALOTIDAE | |
| *Pardalotus striatus* | Striated Pardalote |
| PELECANIDAE | |
| *Pelecanus conspicillatus* | Australian Pelican |
| PODARGIDAE | |
| *Podargus strigoides* | Tawny Frogmouth |
| PSITTACIDAE | |
| *Cacatua roseicapilla* | Galah |
| *Calyptorhynchus banksii naso* | Forest Red-tailed Black-Cockatoo |
| *Platycercus spurius* | Red-capped Parrot |
| *Platycercus zonarius* | Australian Ringneck |
| ZOSTEROPIDAE | |
| *Zosterops lateralis* | Silvereye |

# APPENDIX B REGIONAL FAUNA DATA

**Appendix B1 Herpetofauna previously recorded or expected to occur within the region**

| FAMILY & species | Common Name | WAM (local area) | WAM (regional area) | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|
| **AMPHIBIA** | | | | | | |
| HYLIDAE | | | | | | |
| *Litoria adelaidensis* | Slender Tree Frog | | x | | | |
| *Litoria moorei* | Motorbike Frog or Bell Frog | x | | x | | |
| MYOBATRACHIDAE | | | | | | |
| *Crinia georgiana* | Quacking Frog | x | | | | |
| *Crinia glauerti* | Glauert's Froglet | | | | x | |
| *Crinia insignifera* | Squelching Froglet | x | | | x | x |
| *Heleioporus eyrei* | Moaning Frog | x | | x | | x |
| *Limnodynastes dorsalis* | Bullfrog or Banjo Frog | | x | | | |
| *Pseudophryne guentheri* | Günther's Toadlet or Crawling Frog | x | | | | x |
| **REPTILIA** | | | | | | |
| AGAMIDAE | | | | | | |
| *Pogona minor* | Bearded Dragon | x | x | | | x |
| CHELUIDAE | | | | | | |
| *Chelodina oblonga* | Long-necked tortoise | | | x | | |
| ELAPIDAE | | | | | | |
| *Demansia psammophis reticulata* | Yellow-faced Whipsnake | | x | | | |
| *Echiopsis curta* | Bardick | | x | | | |
| *Elapognathus coronatus* | Crowned snake | | x | | | |
| *Neelaps bimaculatus* | Black-naped snake | | x | | | |
| *Notechis scutatus* | Tiger Snake | | x | x | | x |
| *Simoselaps bertholdi* | Jan's banded snake | | x | | | |
| *Parasuta gouldii* | Black-headed Snake | | x | x | | |
| *Pseudonaja affinis* | Dugite | | x | x | | |
| GEKKONIDAE | | | | | | |
| *Christinus marmoratus* | Marbled Gecko | x | | x | | x |
| *Underwoodisaurus milii* | Barking Gecko | | x | | | |
| PYGOPODIDAE | | | | | | |
| *Aprasia repens* | Sandplain Worm Lizard | x | | | | |
| *Delma fraseri fraseri* | Fraser's Legless Lizard | | x | | | |
| *Lialis burtonis* | Burton's Legless Lizard | x | | x | | x |

| FAMILY & species | Common Name | WAM (local area) | WAM (regional area) | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|
| SCINCIDAE | | | | | | |
| *Acritoscincus trilineatum* | Western Three-lined Skink | x | x | | | x |
| *Cryptoblepharus plagiocephalus* | Fence Skink | x | x | x | | |
| *Ctenotus australis* | A skink | x | x | | | x |
| *Ctenotus fallens* | A skink | | | | | x |
| *Ctenotus impar* | South-western Odd-striped Skink | x | x | x | | x |
| *Ctenotus labillardieri* | Red-legged Skink | | x | | | x |
| *Egernia kingii* | King's Skink | x | x | | | x |
| *Egernia napoleonis* | South-western Crevice Skink | | x | x | | |
| *Hemiergis quadrilineata* | Two-toed Earless Skink | | x | x | | x |
| *Lerista distinguenda* | A skink | | | x | | |
| *Lerista elegans* | A skink | x | x | x | | x |
| *Menetia greyii* | Common Dwarf Skink | x | x | x | | x |
| *Morethia butleri* | A skink | | | x | | |
| *Morethia lineoocellata* | A skink | x | x | | | |
| *Morethia obscura* | Woodland Flecked Skink | | | x | | x |
| *Tiliqua occipitalis* | Western Bluetongue | | | x | | |
| *Tiliqua rugosa* | Bobtail | | x | | x | x |
| TYPHLOPIDAE | | | | | | |
| *Ramphotyphlops australis* | Southern Blind Snake | x | | x | | |
| *Ramphotyphlops pinguis* | Fat Blind Snake | | x | | | |

**Appendix B2 Mammals previously recorded or expected to occur within the region**

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|
| BOVIDAE | | | | | | | |
| *Bos taurus* | European Cattle | | | | | x | |
| BURRAMYIDAE | | | | | | | |
| *Cercartetus concinnus* | Western Pygmy-possum or Mundarda | | | x | | | |
| CANIDAE | | | | | | | |
| **Vulpes vulpes* | Red Fox | | | | x | x | x |
| **Canis familiaris* | Domestic Dog | | | | | | x |
| DASYURIDAE | | | | | | | |
| *Antechinus flavipes leucogaster* | Mardo | | | x | | | |
| *Dasyurus geoffroii* | Western Quoll, Chuditch | x | | | | | |
| *Phascogale tapoatafa tapoatafa* | Brush-tailed Phascogale or Wambenger | x | x | x | | | |
| EQUIDAE | | | | | | | |
| *Equus caballus* | Horse | | | | | x | |
| FELIDAE | | | | | | | |
| **Felis catus* | Cat | | | | | | x |
| LEPORIDAE | | | | | | | |
| **Oryctolagus cuniculus* | Rabbit | | | | x | | x |
| MACROPODIDAE | | | | | | | |
| *Macropus fuliginosus* | Western Grey Kangaroo | | | | x | x | x |
| *Macropus irma* | Western Brush Wallaby | | | x | | | |
| MURIDAE | | | | | | | |
| **Mus musculus* | House Mouse | | x | x | x | | x |
| *Hydromys chrysogaster* | Water rat | | x | x | | | |
| *Rattus fuscipes* | Bush rat | | x | x | | | |
| **Rattus rattus* | Black Rat | | x | x | x | | x |
| MYRMECOBIIDAE | | | | | | | |
| *Myrmecobius fasciatus* | Numbat or Walpurti | | | x | | | |
| PERAMELIDAE | | | | | | | |
| *Isoodon obesulus fusciventer* | Southern Brown Bandicoot | | x | x | x | x | x |
| PHALANGERIDAE | | | | | | | |
| *Trichosurus vulpecula vulpecula* | Common Brushtail Possum | | x | x | x | | x |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|
| POTOROIDAE | | | | | | | |
| *Bettongia penicillata ogilbyi* | Brush-tailed Bettong or Woylie | x | | | | | |
| VESPERTILIONIDAE | | | | | | | |
| *Chalinolobus gouldii* | Gould's Wattled Bat | | | x | N/A | | x |
| *Vespadelus regulus* | Southern Forest Bat | | x | x | N/A | | x |

**Appendix B3 Birds previously recorded or expected to occur within the region**

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| ACANTHIZIDAE | | | | | | | | |
| *Acanthiza apicalis* | Inland Thornbill | | | x | x | x | x | x |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill | | | x | x | x | x | x |
| *Acanthiza inornata* | Western Thornbill | | | x | x | x | | |
| *Gerygone fusca* | Western Gerygone | | | x | x | x | x | x |
| *Sericornis frontalis* | White-browed Scrubwren | | | x | x | x | x | x |
| *Smicrornis brevirostris* | Weebill | | | x | x | x | | x |
| ACCIPITRIDAE | | | | | | | | |
| *Accipiter cirrhocephalus* | Collared Sparrowhawk | | | | x | | | |
| *Accipiter fasciatus* | Brown Goshawk | | | | x | | | x |
| *Aquila audax* | Wedge-tailed Eagle | | | | | x | | |
| *Aquila morphnoides* | Little Eagle | | | x | x | | | |
| *Circus approximans* | Swamp Harrier | | | | x | x | | |
| *Elanus caeruleus axillaris* | Australian Black-shouldered Kite | | | x | | | | |
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | | | | x | | | |
| *Haliastur sphenurus* | Whistling Kite | | | | x | x | | x |
| *Hamirostra isura* | Square-tailed Kite | | | x | | | | |
| *Pandion haliaetus* | Osprey | | | | | x | | x |
| ANATIDAE | | | | | | | | |
| *Anas castanea* | Chestnut Teal | | | | x | | | |
| *Anas gracilis* | Grey Teal | | | | x | | | |
| *Anas platyrhynchos* | Mallard | | | | x | | | |
| *Anas rhynchotis* | Australasian Shoveler | | | | x | | | |
| *Anas superciliosa* | Pacific Black Duck | | | | | x | | |
| *Aythya australis* | Hardhead | | | | x | | | |
| *Biziura lobata* | Musk Duck | | | x | | | | |
| *Chenonetta jubata* | Australian Wood Duck | | | | x | | | |
| *Cygnus atratus* | Black Swan | | | | x | | | |
| *Malacorhynchus membranaceus* | Pink-eared Duck | | | | x | | | |
| *Oxyura australis* | Blue-billed Duck | | | | x | | | |
| *Tadorna tadornoides* | Australian Shelduck | | | | x | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| *Stictonetta naevosa* | Freckled Duck | | | x | | | | |
| ANHINGIDAE | | | | | | | | |
| *Anhinga melanogaster* | Darter | | | x | x | x | | |
| APODIDAE | | | | | | | | |
| *Apus pacificus pacificus* | Fork-tailed Swift | | | x | | | | |
| ARDEIDAE | | | | | | | | |
| *Ardea alba* | Great Egret | | | | x | x | | |
| *Ardea pacifica* | Pacific Heron | | | | | x | | |
| *Botaurus poiciloptilus* | Australasian Bittern | | | x | | | | |
| *Egretta garzetta* | Little Egret | | | | x | | | |
| *Egretta novaehollandiae* | White-faced Heron | | | | x | x | | |
| *Egretta sacra* | Eastern Reef Egret | | | | x | | | |
| *Ixobrychus minutus dubius* | Little Bittern | | | x | | | | |
| *Nycticorax caledonicus hilli* | Nankeen Night Heron | | | x | x | | | |
| ARTAMIDAE | | | | | | | | |
| *Artamus cinereus* | Black-faced Woodswallow | | | | x | x | | |
| *Artamus cyanopterus* | Dusky Woodswallow | | | | x | | | |
| *Artamus personatus* | Masked Woodswallow | | | | | x | | |
| CAMPEPHAGIDAE | | | | | | | | |
| *Coracina novaehollandiae* | Black-faced Cuckoo Shrike | | | | x | x | | x |
| *Lalage tricolor* | White-winged Triller | | | x | x | x | | |
| CASUARIDAE | | | | | | | | |
| *Dromaius novaehollandiae* | Emu | | | | | x | | |
| CHARADRIIDAE | | | | | | | | |
| *Charadrius leschenaultii leschenaultii* | Greater Sand Plover | | | x | x | | | |
| *Charadrius mongolus* | Lesser Sand Plover | | | | x | | | |
| *Charadrius ruficapillus* | Red-capped Plover | | | | x | | | |
| *Charadrius rubricollis* | Hooded Plover | | x | x | | | | |
| *Elseyornis melanops* | Black-fronted Dotterel | | | | x | | | |
| *Pluvialis dominica* | American Golden Plover | | | x | | | | |
| *Pluvialis fulva* | Pacific Golden Plover | | | | x | | | |
| *Pluvialis squatarola* | Grey Plover | | | | x | | | |
| *Vanellus tricolor* | Banded Lapwing | | | x | | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| CLIMACTERIDAE | | | | | | | | |
| *Climacteris rufa* | Rufous Treecreeper | | x | x | | | | |
| COLUMBIDAE | | | | | | | | |
| *Columba livia* | Rock Dove | | | | x | | | |
| *Ocyphaps lophotes* | Crested Pigeon | | | | x | x | x | |
| *Phaps chalcoptera* | Common Bronzewing | | | | x | x | | x |
| *Phaps elegans* | Brush Bronzewing | | | | | x | | |
| *Streptopelia chinensis* | Spotted Turtle-Dove | | | | x | | | |
| *Streptopelia senegalensis* | Laughing Turtle-dove | | | | x | x | | x |
| CORVIDAE | | | | | | | | |
| *Corvus coronoides* | Australian Raven | | | x | x | x | x | x |
| CRACTICIDAE | | | | | | | | |
| *Cracticus tibicen dorsalis* | Australian Magpie | | | x | x | x | x | x |
| *Cracticus torquatus* | Grey Butcherbird | | | x | x | x | | x |
| *Strepera versicolor* | Grey Currawong | | | | x | x | x | |
| CUCULIDAE | | | | | | | | |
| *Cacomantis flabelliformis* | Fan-tailed Cuckoo | | | | x | | | |
| *Chrysococcyx basalis* | Horsfield's Bronze Cuckoo | | | x | x | x | | |
| *Chrysococcyx lucidus* | Shining Bronze-Cuckoo | | | | x | x | | |
| *Cuculus pallidus* | Pallid Cuckoo | | | | x | | | |
| DICAEIDAE | | | | | | | | |
| *Dicaeum hirundinaceum* | Mistletoebird | | | | x | | | |
| DICRURIDAE | | | | | | | | |
| *Grallina cyanoleuca* | Australian Magpie-lark | | | | x | x | x | x |
| *Rhipidura fuliginosa* | Grey Fantail | | | x | x | x | x | x |
| *Rhipidura leucophrys* | Willie Wagtail | | | x | x | x | x | x |
| FALCONIDAE | | | | | | | | |
| *Falco berigora* | Brown Falcon | | | | x | x | | |
| *Falco cenchroides* | Australian Kestrel | | | | x | x | x | |
| *Falco longipennis* | Australian Hobby | | | | x | | | |
| *Falco peregrinus* | Peregrine Falcon | | x | x | x | | | |
| HAEMATOPODIDAE | | | | | | | | |
| *Haematopus longirostris* | Pied Oystercatcher | | | | x | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| HALCYONIDAE | | | | | | | | |
| *Dacelo novaeguineae* | Laughing Kookaburra | | | x | x | x | | x |
| *Todiramphus sanctus* | Sacred Kingfisher | | | x | x | x | | |
| HIRUNDINIDAE | | | | | | | | |
| *Hirundo nigricans* | Tree Martin | | | | x | x | | x |
| *Hirundo neoxena* | Welcome Swallow | | | x | | x | x | |
| LARIDAE | | | | | | | | |
| *Chlidonias hybridus* | Whiskered Tern | | | | x | | | |
| *Larus novaehollandiae* | Silver Gull | | | x | x | x | | |
| *Stercorarius parasiticus* | Arctic Jaeger | | | | x | | | |
| *Sterna anaethetus* | Bridled Tern | | | | x | | | |
| *Sterna bergii* | Crested Tern | | | | x | | | |
| *Sterna bengalensis* | Caspian Tern | | | | x | x | | |
| *Sterna hirundo* | Common Tern | | | | x | x | | |
| *Sterna leucoptera* | White-winged Black Tern | | x | x | | | | |
| *Sterna nereis nereis* | Fairy Tern | | x | x | x | | | |
| MALURIDAE | | | | | | | | |
| *Malurus elegans* | Red-winged Fairy-wren | | | x | | | | |
| *Malurus splendens* | Splendid Fairy-wren | | x | x | x | x | x | x |
| *Stipiturus malachurus westernensis* | Southern Emu-wren | | | x | | | | |
| MELIPHAGIDAE | | | | | | | | |
| *Acanthorhynchus superciliosus* | Western Spinebill | | | x | x | x | | x |
| *Anthochaera carunculata* | Red Wattlebird | | | x | x | x | x | x |
| *Anthochaera lunulata* | Western Wattlebird | | | x | x | | | |
| *Epthianura albifrons* | White-fronted Chat | | | x | x | | | |
| *Lichenostomus ornatus* | Yellow-plumed Honeyeater | | | x | | | | |
| *Lichenostomus virescens* | Singing Honeyeater | | | x | x | x | | x |
| *Lichmera indistincta* | Brown Honeyeater | | | x | x | x | | x |
| *Manorina flavigula* | Yellow-throated Miner | | | x | x | x | | x |
| *Melithreptus chloropsis* | White-naped Honeyeater | | | x | | | | |
| *Phylidonyris nigra* | White-cheeked Honeyeater | | | | x | | | |
| *Phylidonyris novaehollandiae* | New-Holland Honeyeater | | | x | x | x | | x |
| MEROPIDAE | | | | | | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| *Merops ornatus* | Rainbow Bee-eater | | | | x | x | | |
| MOTACILLIDAE | | | | | | | | |
| *Anthus australis australis* | Richard's Pipit | | | x | x | | | |
| NEOSITTIDAE | | | | | | | | |
| *Daphoenositta chrysoptera* | Varied Sitella | | | x | x | x | | |
| OTIDIDAE | | | | | | | | |
| *Ardeotis australis* | Australian Bustard | x | | | | | | |
| PACHYCEPHALIDAE | | | | | | | | |
| *Colluricincla harmonica* | Grey Shrike-thrush | | | x | x | x | | x |
| *Pachycephala pectoralis* | Golden Whistler | | | | x | x | | x |
| *Pachycephala rufiventris* | Rufous Whistler | | | x | x | | | x |
| PARDALOTIDAE | | | | | | | | |
| *Pardalotus punctatus* | Spotted Pardalote | | | | x | | | |
| *Pardalotus striatus* | Striated Pardalote | | x | x | x | x | x | x |
| PASSERIDAE | | | | | | | | |
| *Stagonopleura oculata* | Red-eared Firetail | | | x | | | | |
| PELECANIDAE | | | | | | | | |
| *Pelecanus conspicillatus* | Australian Pelican | | | | x | x | | x |
| PETROICIDAE | | | | | | | | |
| *Eopsaltria australis griseogularis* | Western Yellow Robin | | | x | | | | |
| *Eopsaltria georgiana* | White-breasted Robin | | x | x | | | | |
| *Microeca fascinans* | Jacky Winter | | | | x | | | |
| *Petroica goodenovii* | Red-capped Robin | | | | x | | | |
| *Petroica multicolor* | Scarlet Robin | | | x | x | x | | |
| PHALACROCORACIDAE | | | | | | | | |
| *Phalacrocorax carbo novaehollandiae* | Great Cormorant | | | x | x | | | |
| *Phalacrocorax melanoleucos* | Little Pied Cormorant | | | x | x | x | | |
| *Phalacrocorax sulcirostris* | Little Black Cormorant | | | x | x | x | | |
| PHASIANIDAE | | | | | | | | |
| *Coturnix ypsilophora* | Brown Quail | | | x | | x | | |
| PODARGIDAE | | | | | | | | |
| *Podargus strigoides* | Tawny Frogmouth | | | x | | | | x |
| PODICIPEDIDAE | | | | | | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| *Podiceps cristatus australis* | Great Crested Grebe | | | x | x | | | |
| *Poliocephalus poliocephalus* | Hoary-headed Grebe | | | x | x | | | |
| *Tachybaptus novaehollandiae* | Australasian Grebe | | | x | x | x | | |
| POMATOSTOMIDAE | | | | | | | | |
| *Pomatostomus superciliosus* | White-browed Babbler | | | x | | | | |
| PSITTACIDAE | | | | | | | | |
| *Cacatua galerita galerita* | Sulphur-crested Cockatoo | | | x | x | | | |
| *Cacatua roseicapilla* | Galah | | | | x | | | x |
| *Cacatua sanguinea* | Little Corella | | | | x | | | |
| *Calyptorhynchus banksii naso* | Forest Red-tailed Black Cockatoo | | x | | x | x | | x |
| *Calyptorhynchus latirostris* | Carnaby's Cockatoo | | x | x | x | | | |
| *Calyptorhynchus baudinii* | White-tailed Black Cockatoo | | | | | x | | |
| *Neophema elegans* | Elegant Parrot | | | x | x | | | |
| *Platycercus icterotis* | Western Rosella | | x | x | x | | | |
| *Platycercus spurius* | Red-capped Parrot | | x | x | x | x | | x |
| *Polytelis anthopeplus* | Regent Parrot | | x | x | x | x | | |
| *Platycercus zonarius* | Australian Ringneck | | x | x | x | x | x | x |
| *Trichoglossus haematodus* | Rainbow Lorikeet | | | | x | | | |
| RALLIDAE | | | | | | | | |
| *Fulica atra australis* | Eurasian Coot | | | x | x | | | |
| *Gallinula tenebrosa* | Dusky Moorhen | | | x | x | x | | |
| *Gallinula ventralis* | Black-tailed Native-hen | | | | x | | | |
| *Gallirallus philippensis mellori* | Buff-banded Rail | | | x | x | | | |
| *Porphyrio porphyrio* | Purple Swamphen | | | | x | | | |
| *Porzana fluminea* | Australian Spotted Crake | | | | x | x | | |
| RECURVIROSTRIDAE | | | | | | | | |
| *Cladorhynchus leucocephalus* | Banded Stilt | | | | x | | | |
| *Himantopus himantopus* | Black-winged Stilt | | | | x | | | |
| *Recurvirostra novaehollandiae* | Red-necked Avocet | | | | x | | | |
| ROSTRATULIDAE | | | | | | | | |
| *Rostratula benghalensis australis* | Australian Painted Snipe | | | x | | | | |
| SCOLOPACIDAE | | | | | | | | |
| *Actitis hypoleucos* | Common Sandpiper | | | | x | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| *Arenaria interpres* | Ruddy Turnstone | | | | x | | | |
| *Calidris acuminata* | Sharp-tailed Sandpiper | | | | x | | | |
| *Calidris alba* | Sanderling | | | | x | | | |
| *Calidris canutus* | Red Knot | | | | x | | | |
| *Calidris ferruginea* | Curlew Sandpiper | | | | x | | | |
| *Calidris melanotos* | Pectoral Sandpiper | | | | x | | | |
| *Calidris ruficollis* | Red-necked Stint | | | | x | | | |
| *Calidris subminuta* | Long-toed Stint | | | | x | | | |
| *Calidris tenuirostris* | Great Knot | | | | x | | | |
| *Heteroscelus brevipes* | Grey-tailed Tattler | | | | x | | | |
| *Limosa lapponica* | Bar-tailed Godwit | | | | x | | | |
| *Limosa limosa* | Black-tailed Godwit | | | | x | | | |
| *Numenius madagascariensis* | Eastern Curlew | | | | x | | | |
| *Numenius phaeopus* | Whimbrel | | | | x | | | |
| *Tringa glareola* | Wood Sandpiper | | | x | x | | | |
| *Tringa nebularia* | Common Greenshank | | | x | x | | | |
| *Tringa stagnatilis* | Marsh Sandpiper | | | | x | | | |
| *Xenus cinereus* | Terek Sandpiper | | | | x | | | |
| STRIGIDAE | | | | | | | | |
| *Ninox novaeseelandiae* | Boobook Owl | | x | x | x | x | | |
| SYLVIIDAE | | | | | | | | |
| *Cinclorhamphus cruralis* | Brown Songlark | | | | x | | | |
| *Megalurus gramineus gramineus* | Little Grassbird | | | x | x | | | |
| THRESKIORNITHIDAE | | | | | | | | |
| *Platalea flavipes* | Yellow-billed Spoonbill | | | | x | x | | |
| *Platalea regia* | Royal Spoonbill | | | | x | | | |
| *Threskiornis molucca* | Australian White Ibis | | | | x | x | | |
| *Threskiornis spinicollis* | Straw-necked Ibis | | | | x | x | | |
| TURNICIDAE | | | | | | | | |
| *Turnix varia varia* | Painted Button-quail | | | x | | | | |
| TYTONIDAE | | | | | | | | |
| *Tyto alba* | Barn Owl | | x | x | | | | |
| *Tyto novaehollandiae* | Masked Owl | | | x | | | | |

| FAMILY & species | Common Name | DEC Rare Fauna Database | WAM (local area) | WAM (regional area) | Birds Australia BirdData | *ecologia* 1996 | *ecologia* 1997 | This survey |
|---|---|---|---|---|---|---|---|---|
| ZOSTEROPIDAE | | | | | | | | |
| *Zosterops lateralis* | Silvereye | | | x | x | x | | x |

# APPENDIX C RISK ASSESSMENT

**Appendix C1 Fauna impact risk assessment**

## Fauna Impact Risk Assessment

*Project: Lot 48 Furnissdale* | *Location: Furnissdale* | *Date: 12 February 2007*

| Risk Issue | Aspect (Event) | Impact | Inherent Risk | | | | Controls | Residual Risk | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Likelihood | Consequence | Risk Level | Significance | | Likelihood | Consequence | Risk Level | Significance |
| **Lot 48 Furnissdale** | | | | | | | | | | | |
| Vegetation clearing | Removal of fauna habitat | Loss of local vertebrate fauna communities | 5 | 4 | 20 | High | Relocation of local bandicoot population | 5 | 3 | 15 | High |
| Vegetation clearing | Removal of fauna habitat | Adverse impact to ecological function | 5 | 3 | 15 | High | The entire lot will be cleared, therefore impact to ecological function is unavoidable. | 5 | 3 | 15 | High |
| Vegetation clearing | Removal of fauna habitat | Loss of biodiversity | 5 | 3 | 15 | High | The entire lot will be cleared, therefore a loss of local biodiversity is unavoidable. | 5 | 3 | 15 | High |
| Vegetation clearing | Removal of fauna habitat | Adverse impact on surrounding bushland | 4 | 4 | 16 | High | Displacement of fauna into surrouning habitats will result in competition with established fauna in those areas, causing stress and potentially death of fauna. Bandicoots should be relocated to areas further away than local bushland. | 4 | 2 | 8 | Med |
| Vehicle Strikes | Digging during clearing | Fauna mortality | 4 | 3 | 12 | High | Burrowing animals such as some skinks, snakes and amphibians will not be able to avoid machinery during clearing operations. | 4 | 3 | 12 | High |
| Vehicle Strikes | Surface vehicle movements during construction and operation phases. | Fauna mortality | 3 | 4 | 12 | High | Low speed limits should be set. Avoid driving during dusk, dawn and at night. Ensure contractors are aware of native bandicoot population and the need to avoid impacting individuals. Surface-dwelling fauna should be able to avoid machinery during clearing. | 2 | 4 | 8 | Med |

## Fauna Impact Risk Assessment

*Project: Lot 48 Furnissdale* | *Location: Furnissdale* | *Date: 12 February 2007*

| Risk Issue | Aspect (Event) | Impact | Inherent Risk | | | | Controls | Residual Risk | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Likelihood | Consequence | Risk Level | Significance | | Likelihood | Consequence | Risk Level | Significance |
| Increased feral fauna | Human activity leading to an increase in the number of perdatory feral fauna | Increased predation pressure on native fauna in surrounding area. | 3 | 4 | 12 | Med | Contractors responsible for clearing should remove food scraps to avoid encouraging foxes, which could prey on native bandicoot populations in surrounding bushland. | 2 | 4 | 8 | Med |
| Increased feral fauna | Human activity leading to an increase in the number of displacing feral fauna | Displacement of native fauna in surrounding areas | 3 | 3 | 9 | Med | Contractors responsible for clearing should remove food scraps to avoid increasing populations of rats and mice, which displace native fauna | 2 | 3 | 6 | Low |
| Noise pollution | Noise from clearing and building activities | Disruption of local fauna populations | 3 | 2 | 6 | Med | Clearing should be perfomed as quickly as possible to minimise impacts on native fauna in surrounding bushland. Noise controls should be implemented during clearing and building activities. | 2 | 2 | 4 | Low |
| Dust | Dust emissions arising from clearing | Image to adjacent vegetation resulting in loss of fauna habitat or reduction of fauna habitat value | 3 | 2 | 6 | Med | Dust supression measures should be implemented, including a reduction of road speeds on unsealed roads. Roads should be sealed prior to building activities. | 2 | 2 | 4 | Low |
| Fire | Fire arising from clearing activities | Degradation of fauna habitat and populations in adjacent bushland | 2 | 4 | 8 | Med | A fire prevention strategy should be implemented. Contractor vehicles should be fitted with fire extinguishers & all personnel trained in their use. | 1 | 4 | 4 | Low |
| Fire | Fire arising from clearing activities | Fauna mortality | 2 | 4 | 8 | Med | A fire prevention strategy should be implemented. Contractor vehicles should be fitted with fire extinguishers & all personnel trained in their use. | 1 | 4 | 4 | Low |

**Appendix C2 Likelihood and Consequence criteria used in the fauna impact risk assessment**

| Likelihood: | | |
|---|---|---|
| **Value** | **Description** | **Criteria** |
| 5 | Almost Certain | Environmental issue will occur, is currently a problem or is expected to occur in most circumstances. |
| 4 | Likely | Environmental issue has been a common problem in the past and there is a high probability that it will occur in most circumstances. |
| 3 | Possible | Environmental issue may have arisen in the past and there is a high probability that it could occur at some time. |
| 2 | Unlikely | Environmental issue may have occurred in the past and there is a moderate probability that it could occur at some time but not expected. |
| 1 | Rare | Environmental issue has not occurred in the past and there is a very low probability that it may occur in exceptional circumstances. |

| Consequence: | | |
|---|---|---|
| **Value** | **Description** | **Criteria** |
| 5 | Catastrophic | Significant impact to fauna species of conservation significance or regional biodiversity |
| 4 | Major | Impact to fauna species of conservation significance in project area. |
| 3 | Moderate | Loss of fauna biodiversity in project area. |
| 2 | Minor | Short term or localised impact to fauna biodiversity. |
| 1 | Insignificant | No impact to fauna of conservation significance or biodiversity. |

## Appendix C3 Risk Matrix used in the fauna impact risk assessment

**Risk Matrix:**

| Risk Assessment Rating | | LIKELIHOOD | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| | | ALMOST CERTAIN | LIKELY | POSSIBLE | UNLIKELY | RARE |
| | | Is expected to occur in most circumstance | Will probably occur in most circumstance | Could occur | Could occur but not expected | Occurs in exceptional circumstances |
| CONSEQUENCES | 5 - CATASTROPHIC<br>Significant impact to fauna species of conservation significance or regional biodiversity | 25 | 20 | 15 | 10 | 5 |
| | 4 - MAJOR<br>Impact to fauna species of conservation significance in project area. | 20 | 16 | 12 | 8 | 4 |
| | 3 - MODERATE<br>Loss of fauna biodiversity in project area. | 15 | 12 | 9 | 6 | 3 |
| | 2 - MINOR<br>Short term or localised impact to fauna biodiversity. | 10 | 8 | 6 | 4 | 2 |
| | 1 - INSIGNIFICANT<br>No impact to fauna of conservation significance or biodiversity. | 5 | 4 | 3 | 2 | 1 |

| | |
|---|---|
| 11-25 | High risk, site/issue specific management programmes required, advice/approval from regulators required. |
| 6 – 10 | Medium risk, specific management and procedures must be specified. |
| 1 – 5 | Low risk, managed by routine procedures. |

RPS

# APPENDIX 4

## Draft Guidance Statement No.19 Recommended Information

## Recommended information to include in the proponent's assessment documentation when environmental offsets are proposed

| A The proposal / scheme | B Key information used to develop offsets |
|---|---|
| Lot 48 Furnissdale Road, Furnissdale. 30 lot residential and 1 commercial lot subdivision in urban zoned land on edge of existing Furnissdale townsite. (Refer to Section 1 of Environmental Review document.) | Information used to identify key environmental issues and develop offsets include:<br>• ATA Environmental (2005) "Preliminary Acid Sulfate Soil Assessment – Lot 48 Furnissdale Road". For SAS Global Property Group, Perth.<br>• ATA Environmental (2006) "Flora and Vegetation Survey Lot 48, Furnissdale Road, Furnissdale". For SAS Global Property Group, Perth.<br>• Ecologia Environment (2007) *SAS Global Ltd Lot 48 Furnissdale Rd, Furnissdale Fauna Survey*, for SAS Global Ltd, Perth.<br>• Site inspections.<br>• Other published information (Refer to Section 5 of Environmental Review document for full list of references.) |

| C Potential environmental impacts, on-site management measures and residual environmental impacts | | | | | |
|---|---|---|---|---|---|
| **List potential impacts on environment (general description)** | **State whether critical or high value asset/s involved** | **Summarise on-site management measures proposed to minimise each potential environmental impact.** | **List alternative measures that could result in avoidance of significant residual environmental impacts, and why these are not preferred by those responsible for the project.** | **Identify potential residual environmental impacts having regard for key environmental values and environmental criteria/targets/guidelines.** | **Are offset/s proposed?** |
| **Biophysical**<br>- Wetlands. Direct impact on 0.9ha of CCW.<br>- Refer to Section 3 of Environmental Review document. | Wetland: Critical asset | Define edge of wetland and protect against uncontrolled access and rubbish dumping through installation of fencing; reduction of garden weeds by physical separation to wetland; passive surveillance to reduce anti-social activities in wetland. | Excise wetland and buffer from the development area was considered but not possible given small nature of the development site. Excision of wetland and buffer would lose most of developable land and hamper expansion of Furnissdale townsite and project would not be viable and degradation of wetland area would continue. | Development over 0.9ha of a 281ha Estuary Peripheral CCW. | Yes. |

| D What offsets are proposed? | | |
|---|---|---|
| **Identify potential residual environmental impacts.** | **List environmental offsets for residual impact.** | **Is the offset direct or contributing?** |
| Development over 0.9ha of a 281ha Estuary Peripheral CCW. | Offset 1. Contribute equivalent value of wetland area to DEC for purchase of like – for – like wetland area for inclusion in Conservation Estate or rehabilitation or protection mechanisms (e.g. fencing, signage, ranger services). | Direct. |

| E Information to assist EPA to assess the robustness of the offsets package. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Offset** | **Show how the offset activity counterbalances the residual impacts for a net environmental benefit.** | **What approvals are needed to implement offset.** | **What ongoing management, monitoring and completion criteria will apply?** | **How long before offset is likely to meet objectives? How long will benefits last?** | **What are main risks to successful implementation and contingencies?** | **Consultation?** | **Project specific technical advice.** | **Other comments relevant to selection of offsets** |
| **Offset 1.**<br>Contribute equivalent value of wetland area to DEC for purchase of like – for – like wetland area for inclusion in Conservation Estate or rehabilitation or protection mechanisms | Gain of 0.9ha (or better) of CCW wetland into conservation estate : Loss of 0.9ha of wetland with Very Good vegetation condition but aggressive weeds, partial clearing and rubbish dumping. | EPA approval of EIA.<br>DEC agreement to take on funds and disperse appropriately.<br>Sale and vesting of identified wetland. | Completion criteria is DEC confirmation of transfer of funds.<br><br>On-going management of acquired land will be within DEC Reserves management program. | Benefit will be on disbursement of funds e.g. purchase of additional wetland area.<br>If incorporated into Conservation estate then benefit will be indefinite. | A risk to successful implementation is funds redirected from offset project. Tracked and transparent expenditure can allow community scrutiny of funds use. | Consultation has occurred with EPA SU, the Regional Offices of DEC, DOW and DPI, the Shire of Murray, the Peel Preservation Group Inc., the Peel Harvey Catchment Council Inc. and the Southwest Catchment Council. | Refer to Section 5 of Environmental Review document. | Offset developed in accordance with EPA advice of 12/9/2006. |

# APPENDIX 5

## Stakeholder Consultation Summary

# STAKEHOLDER CONSULTATION

A range of key stakeholders in the potential residential development of Lot 48 Furnissdale Road, Furnissdale were identified by the EPA in correspondence of 12 September 2006. As part of the consultation, a description of the proposal, the setting and key environmental issues associated with the project were highlighted. Four offset options were tabled at a meeting with Gary Williams and Glen Mcleod-Thorpe in February 2007 (refer to Section 3.1.4 of the Environmental Assessment Report). As part of the consultation process, these options were outlined with a request to identify which off-set(s) were considered to provide the best environmental outcome.

A joint meeting was held with the Department of Environment and Conservation, Department of Water, Peel Harvey Catchment Council Inc. and South West Catchment Council on 3 April 2007. A meeting and site inspection was also held with the Peel Preservation Group on 3 April 2007 to discuss the potential environmental impacts and the offset options being considered.

Comment was sought and provided by the Department for Planning and Infrastructure and Shire of Murray.

The Wildflower Society of Western Australia and the Conservation Council were also contacted with a request to provide comment.

The key issues raised during the consultation and the favoured off-set option are outlined below:

- ***Need to consider avoidance first, before off-set options are considered.***

  **Response** – Avoidance was investigated but the constraints of the site precluded retention of the wetland and a suitable buffer within the built form. Constraints included the small size of the development, the key location adjacent to the existing townsite and the ability to retain impacts within the site boundary. These issues are detailed within the associated Environmental Assessment Report.

- ***Concern with precedent setting, ie. Development of a CCW by provision of an offset.***

  **Response** – The EPA's Position Statement No. 9 clearly sets out when an offset can be used and when it is not appropriate. Lot 48 can be considered due to planning considerations and minimisation of environmental impacts. This is not considered to 'set a precedent' for wetland development as the site is zoned Urban under the Peel Region Scheme and Residential – R10 under the Shire of Murray Town Planning Scheme. Furthermore the land is within an existing townsite, represents a logical 'rounding off' of development and such consolidation of urban development would allow for the provision of walkable, convenience shopping for the residents and an upgrading to the local public open space.

- ***Strong concern with lack of POS. It was suggested that including at least a portion of wetland in POS could address this issue.***

  **Response** – The small size of the overall development footprint precludes the reservation of the wetland or buffer in an area of POS as site costs could not be recovered. Also the management costs associated with maintaining such as small area of wetland when 281 ha of the same wetland system exists adjacent to the site is not considered justifiable. Contributing to the upgrade of existing POS areas such as the foreshore of the Serpentine River that naturally act as a focal point for the community was seen as providing a better outcome.

  The possibility of recovering the costs of setting aside wetland reservation by increasing density was also investigated. However it is likely that this would be opposed by the existing residents as higher density development is not consistent with the existing Furnissdale townsite.

- ***It was advised that the development of a trust similar to Option 3 is in the preliminary stages of formation. Concern was also expressed that simply giving money to DEC did not allow community involvement and probably would not result in any 'visible' outcome.***

  **Response** – If Option 3 was considered the most suitable option then it would be far better to value add to a process already underway and that would be further investigated.

  It would be expected that DEC utilises funds in a way that provides an environmental benefit to the wider community as they can focus on regional scale issues.

- ***Concern was expressed that rehabilitation of an area already within the conservation estate does not provide a net increase in conservation reserve (reference to Option 4). Concern was also raised that rehabilitation quality is rarely as good as mature wetland community.***

  **Response** - Option 4 is aimed at providing a net environmental benefit with a focus on environmental values rather land tenure (as significant resources can be spent on 'buying land' without any improvement in environmental outcomes).

  Rehabilitation has to be considered over the long term before all wetland values can be replaced as does long term management of an existing wetland so values can be maintained.

- ***The Peel preservation Group raised the issue that some very good vegetation exists on-site and opportunities for finding a similar wetland in the area as an offset are limited.***

  **Response** – The problems with trying to identify a similar suitable wetland area for inclusion within the conservation estate are recognised and is main reason why a range of other options have been proposed that look beyond a like for like transfer of land to the conservation estate. Other key issues such as on-going management need to also be considered.

- ***Overall Options 1 and 4 were consistently identified as the favoured offset options.***

  **Response** – Option 1 was chosen as the preferred option as it has been used in the past and the 'process' by which to transfer the money has been established, is transparent and accountable.

- ***The Shire of Murray stated an opposition to development within a CCW but that off-set options 3 and 4 maybe considered by the Shire where compensation money is used for rehabilitation projects in the Furnissdale and Barragup areas.***

  **Response** – The environmental values of Lot 48 have been investigated in detail and described in the report. While there will be a loss of 0.9ha of wetland, this will not compromise the values of this wetland system and the off-set options and management mechanisms described in the report are considered to provide a suitable outcome from the constraints and opportunities of the site.

  Options 3 and 4 could be used by the DEC if they were decided to provide the best environmental outcome, this would be a decision to be made by the Department.

A further round of consultation was undertaken in July 2007 when the draft Environmental Assessment Report was circulated for comment. This was provided to the Shire of Murray, Department of Water, Department of Environment and Conservation, Peel Harvey Catchment Council, the Peel Preservation Group Inc. and the Conservation Council. Response was received from the Peel Preservation Group Inc. and the Department of Water. The issues raised and response to them are outlined below:

- ***The area under consideration does contain some very good vegetation, some not included in the flora survey carried out by ATA Environmental. Additional species include* Melaleuca pressiana *(some around 300 years old),* Exocarpus sparteus *or native cherry (at least 8 specimens which is almost non-existent in the area and* Phleborcarya ciliate.**

  **Response** – It is noted that *Exocarpus sparteus* and *Phleborcarya ciliate* were not included in the ATA Flora Report, however botanists from RPS advise that none of the three species are listed as Declared Rare or Priority species. However further assessment will be undertaken during detailed design to see if there is opportunity to retain specimens within road reserves or potentially salvage timber if the tree cannot be saved.

- ***Potential ASS at 1.5m cannot be disregarded when allowing for foundations, drainage etc.***

  **Response** – Management of potential ASS has been addressed in Section 3.5 including 4 management responses. An ASS Management Plan will also be necessary if any dewatering is proposed and will be assessed through the current statutory approval processes for groundwater abstraction licence. ASS management for installation of infrastructure is readily manageable through standard engineering practices.

- ***The fact that "A large area of the existing Furnissdale townsite is within the flood fringe of the Serpentine River" does not excuse us repeating this historical error. The report expects 1 -2 m of fill to be required to meet minimum levels.***

  **Response** – Development within the 1 in 100 year flood fringe is acceptable provided minimum habitable floor levels are achieved. This is explained in Section 3.1 of the report.

- ***As this area is very low-lying the effects of climate change must be considered - as rainfall decreases the 100year flood plain may become less important that the expected rise in sea levels. Research suggests that this area will be inundated as water levels rise.***

  **Response** – It is understood that current WAPC foreshore setback policy accounts for potential sea level rise. This development complies with current setback policy and flood management strategy for the region.

- ***We challenge the suggestion that the loss of 0.9 ha of wetland is not significant. Areas of Conservation Category Wetland are being "whittled away" at a very significant rate, as this proposal shows.***

  **Response** – The offset proposed is in accordance with EPA policy and has been developed after assessment of the conservation values of this portion of wetland, in the context of the wetland systems in a local and regional framework. This is addressed in Section 3.1 of the Report.

- ***The developer would have been aware of the wetland when this Lot was purchased, but now argues that its conservation "will not allow for a connected or viable urban design".***

  **Response** – Assessment of the development potential of urban zoned land are based on many factors, including current Government and agency policy. This development complies with current agency policy including the new environmental offsets framework developed by the EPA.

- ***Opportunities to find similar wetland in the area (for replacement as part of a mitigation package) are very limited.***

  **Response –** The difficulty in finding a similar 'available' wetland in the area is noted. By providing an agreed sum of money to the DEC, they can use a regional perspective when funds may be better utilised for a better environmental outcome. This does not preclude purchase of a local wetland if available, but allows a broader view.

- ***Some significant mature trees occur in the area. These should be saved even though the 1-2m fill will provide "little opportunity to retain mature trees within the development landscape". Perhaps the developer should be looking at alternative style buildings such as "pole homes" which would not require the amount of fill and would provide excellent views.***

  **Response –** It is expected that fill would be used only to raise the slab or base of houses (and possibly for road reserves if necessary). Given that existing trees would need to be cleared from under pole houses to enable construction and minimise fire risk, this is unlikely to provide significant additional areas to retain trees. SAS Global will look at greater detail in retention of trees within the proposed subdivision during detailed design and investigate the 'sensitivity' of the species to cope with neighbouring development pressure.

- ***Pumping stations should be used instead of gravity drainage for sewerage, to avoid the severe problems caused by dewatering.***

  **Response –** It is understood that vacuum sewer will be used, consistent with similar services in the area. This design combined with appropriate timing of service construction (ie when water table is lowest) will minimise or possibly avoid the need to dewater.

- ***From a waterways management perspective the loss of any riparian vegetation in such close proximity to an already highly degraded waterway (Serpentine River and Ramsar listed Peel-Harvey Estuarine system) is not supported by the Department of Water (DoW). The removal of further native vegetation, especially at the bottom of the catchment can only further compound the water quality problems plaguing these waterways.***

  **Response –** The loss of approximately 0.9ha of wetland is not expected to have a significant detrimental impact to water quality of the Serpentine River or Peel – Harvey Estuary, refer to Sections 3.1 and 3.2 for management response. Given the location of this section of estuary peripheral wetland, any nutrient stripping function of surface water or groundwater is expected to be minimal.

- ***Implementation of the DoW's Stormwater Manual via subdivision design is considered a poor compromise for this site compared to the retention of the natural wetland vegetation complex. The manual adopts a clear objective for the identification and retention of natural drainage features (such as CCW's) via the land use planning process. However, in this instance for a variety of economic reasons, it is understood that this landholding cannot accommodate both urban development, and retention of the CCW. The DoW maintains that a reconsideration of lot density and yield could offer a mutually acceptable compromise.***

  **Response** – This proposed development will result in the loss of approximately 0.9ha of (urban zoned) wetland out of a 281 ha wetland system. Given the existing urban development along 3 sides of the site and the location at the extremity of the wetland, the viability of the portion of wetland and management resources that would be necessary to maintain ecological function suggest other beneficial uses could be considered. The proximity of the site to the existing townsite and provision of a needed retail site offer a number of benefits to the Furnissdale community. The provision of contributions to upgrade of existing POS, wetland offset contributions, provision of a boundary road network, size of the retail site and cost of installation of services puts significant economic pressure on the viability of the project. The proposition that density increases could offset provision of wetland POS and buffer zones was explored above.

- ***Acidification is an important consideration, however soil amendment to increase nutrient assimilation on-site should also be a mandatory commitment. This should be informed by a detailed nutrient budget calculation resulting from the proposed urban development of the site.***

  **Response** – The use of soil amendment and high PRI soil for fill will assist in binding phosphorus directed to the stormwater system. A detailed nutrient budget calculation for a site of this size is not expected to provide a model with a significant degree of reliability. Allocating resources towards implementation best practice nutrient control is considered to provide a better environmental outcome.

RPS

# APPENDIX 6

**Preliminary Acid Sulfate Assessment – Lot 48 Furnissdale Road**
(ATA Environmental, Perth)

## PRELIMINARY ACID SULFATE SOIL ASSESSMENT – LOT 48 FURNISSDALE ROAD

### Background

SAS Global Pty Ltd has acquired Lot 48 Furnissdale Road Furnissdale for the purpose of undertaking a residential development.

ATA Environmental has been engaged to undertake a limited ASS assessment of the site. The preliminary assessment was required as the property and the nature of the proposed development triggered the need for further assessment based on the screening assessment tool provided in Planning Bulleting PB64 (See Attachment 1 -Copy of completed Assessment).

### Description of Land

Lot 48, Furnissdale Road is located in Furnissdale approximately 90km south of Perth and 5km south-east of the Mandurah Town centre.

The lot consists of 4.08ha of land set back approximately 200m from the Serpentine River.

The land between the lot and the Serpentine River and Lot 48 has been developed for Residential development as land immediately to the north and south.

The property itself is vegetated as is the undeveloped land to the east. The vegetation itself appears to have been disturbed over many years particularly in the areas where it adjoins the developed land fronting the Serpentine River.

On the basis of a field examination, the soils on the property are mainly grey white Bassendean sands with some evidence of silty and clayey material in the lower lying areas.

The site is of low elevation with the current land surface varying in elevation from 0.7-0.9m in central areas through to 1.5-1.7m in areas at the northern and southern end of the property.

At the time of the field inspection much of the property was wet under foot with standing water in some areas.

### Nature of Proposed Development

SAS Global propose to subdivide and develop the land in accordance with the attached subdivision layout.

Engineering advice is that in order to comply with the requirement for all development to be above flood levels, the finished floor height for the development will be approximately 2.1m. This will be achieved by importing clean fill into the site to achieve the required finished floor levels. The depth of fill will vary from approximately 1.7m in the central areas of the site, tapering to 0.3m at the northern and southern boundary of the site.

The site will be serviced with water, power, telephone, vacuum sewer and piped stormwater. The use of vacuum sewer means that the sewers will be laid at relatively shallow depth (1-1.5m) and as a result the deepest service is likely to be the stormwater piping which may extend to a depth of 2m below the finished surface levels.

Although most of the services will be installed at shallow depth, there will be some need to trench in some of the current natural surface soils and this will result in the need to dewater in parts of the site and excavate some natural soils. As a result it was considered prudent to undertake a preliminary assessment of the soils on the site.

**Assessment**

Examination of the ASS potential mapping contained in Planning Bulletin 64 indicates that the site is mapped as low- moderate ASS risk.

Soil samples were taken at 5 locations on 29 August 2005 across the site using a hand auger to take samples to the water table or in some cases marginally below it. The sample locations are shown on the attached subdivision plan.

Samples were taken at 0.25m intervals through the soils profile and placed in ziplock plastic bags. The bags were squeezed to eliminate air as far as possible and then placed in chilled eskies. On completion of the sampling the samples were taken directly to a field laboratory for completion of ASS field tests and then stored in a frozen condition.

The ASS field tests were performed under the supervision of an experienced Environmental Scientist who interpreted the results.

The results are summarised in Attachment 2.

The results have been assessed against the following criteria:

- pHf<4 Actual Acid Sulfate Soils.
- pHox<3 Potential Acid Sulfate Soils.
- pHf-pHox >2 Potential Acid Sulfate Soils.

The results show that:

- no Actual Acid Sulfate Soils are present on the site;
- the surface soils in the central area of the site near sample location 3 are potentially acidic as the pHox for the surface sample was less than 3; and
- the soils in the vicinity of sample location exhibited a pHf of 6.11 and pHox of 3.99. This represents a change of greater than 2 pH units and may be indicative of potential acidity.

It is concluded that the only area likely to be at significant risk of acidification I the event that the site was disturbed is the central area of the site which is the most low lying area.

**Acid Sulfate Soil Management Plan**

Based on this preliminary assessment, it is concluded that potentially acidic soils are likely to be present in the upper part (0.5-1m) of the natural soil profile in the central, lower lying area of the site.

During the site inspection, no evidence was observed that acidification has or is occurring on the site or adjacent developed land.

This suggests that there is a low risk of impacts during the development process particularly in view of the following features of the development:

- The importation of fill over the entire site with more that 1m of fill being placed over much of the site.

- The minimal disturbance of the soils following placement of fill. The only disturbance will be for trenching to install sewers and stormwater systems and then only in limited areas of the site as much of this work will occur in the imported fill.

In view of these findings, it is not considered that further investigations are justified and it is recommended that the following management measures are taken to provide an absolute safeguard against impacts:-

- Filling of the site to design levels should be undertaken progressively, immediately following the stripping of vegetation.

- The initial 300mm layer of fill imported to the site should be alkaline materials such as crushed limestone or lime sands as this will neutralise any acidity in the unlikely event that acidification reactions occur.

- Any dewatering discharge should be directed to one of the readily available mobile lime dosing units to ensure that the pH can be adjusted to be above 6 at all times.

- Any natural materials excavated from the site during the construction of service trenches should either be directed off-site to a site approved for treating Acid Sulfate Soils where they can be assessed and neutralised appropriately in accordance with guidelines or placed on a constructed limestone pad for treatment on-site (Treatment rate to be established in accord ace with guidelines following testing of stockpiled materials).

Western Australian Planning Commission

# ACID SULFATE SOILS

## APPLICANT SELF - ASSESSMENT FORM

***PLEASE COMPLETE THIS SELF-ASSESSMENT FORM AND ANSWER THE FOLLOWING:***

## STEP 1: *IS THERE EVIDENCE OF A SIGNIFICANT RISK OF DISTURBING ACID SULFATE SOILS AT THIS LOCATION?*

### Question 1:

Is the land depicted in Figures 1 - 10 of the Western Australian Planning Commission's Planning Bulletin No. 64: Acid Sulfate Soils as having a 'high risk of Actual Acid Sulfate Soil (AASS) & Potential Acid Sulfate Soil (PASS) < 3m from surface'?

Note: Planning Bulletin No. 64: Acid Sulfate Soils can be downloaded from: http://www.wapc.wa.gov.au/publications/policies/bulletins/PB64/64Nov03.html

***TICK BOX AS APPROPRIATE:*** YES ☐ NO ☒

### Question 2:

Is the land located in an area, whether depicted in Figures 1 - 10 or not, where site characteristics and local knowledge lead you to form the view that there is a significant risk of disturbing acid sulfate soils at this location?

***TICK BOX AS APPROPRIATE:*** YES ☒ NO ☐

**If YES to either of these two questions go to Step 2.**

**If NO to both of these questions no further investigation is required. Sign this form and submit it with your application.**

## STEP 2: ARE ANY OF THE FOLLOWING WORKS PROPOSED, OR LIKELY TO BE CARRIED OUT, ON THE LAND?

### Question 3:

Are any dewatering works proposed to be undertaken?

***TICK BOX AS APPROPRIATE:*** YES [X] NO [ ]

### Question 4:

Is the surface elevation ≤ 5m AHD and is excavation of ≥ 100m$^3$ of soil (i.e. 10 standard dump truck loads) proposed?

***TICK BOX AS APPROPRIATE:*** YES [X] NO [ ]

### Question 5:

Is the surface elevation > 5m AHD and is excavation of ≥ 100m$^3$ of soil (i.e. 10 standard dump truck loads) with an excavation depth of ≥ 2m proposed?

***TICK BOX AS APPROPRIATE:*** YES [ ] NO [ ]

**If YES to any of these three questions go to Step 3.**

**If NO to all of these questions no further investigation is required. Sign this form and submit it with your application.**

## STEP 3: CARRY OUT PRELIMINARY SITE ASSESSMENT IN ACCORDANCE WITH DEPARTMENT OF ENVIRONMENT GUIDELINES.

Note: Copies of documents in the Acid Sulfate Soils Guidelines Series and further technical advice and information can be obtained from the Contaminated Sites page on the Department of Environment's website at http://www.environ.wa.gov.au/contaminatedsites.

### Question 6:

Did the Preliminary Site Assessment reveal the presence of acid sulfate soils?

***TICK BOX AS APPROPRIATE:*** YES [X] NO [ ]

**If YES to this question go to Step 4.**

**If NO to this question then no further investigation is required. Sign this form and submit it with your application together with the written results of the Preliminary Site Assessment.**

## STEP 4: CARRY OUT DETAILED SITE ASSESSMENT IN ACCORDANCE WITH DEPARTMENT OF ENVIRONMENT GUIDELINES.

### Question 7:

Did the Detailed Site Assessment reveal the presence of acid sulfate soils?

***TICK BOX AS APPROPRIATE:*** YES ☑ NO ☐

**If YES to this question you should consider modifying the design of the proposal to ensure that there is no disturbance to acid sulfate soils at this location. Regardless of whether you modify the design or not, sign this form and submit it with your application together with the written results of the Preliminary and Detailed Site Assessments.**

**If NO to this question then no further investigation or work is required. Sign this form and submit it with your application together with the written results of the Preliminary and Detailed Site Assessments.**

***APPLICANT SIGNATURE:***

NOEL JOHN DAVIES (PARTNER ATA ENVIRONMENTAL
Full Name

Signature

31/8/05
Date

***TICK BOX FOR ATTACHMENTS AS APPROPRIATE:***

☑ Preliminary Site Assessment Results

☐ Detailed Site Assessment Results

☑ The Proposal Has Been Designed To Avoid Disturbance Of Acid Sulfate Soils At This Location As far as possible. — Additional Management Measures have been proposed

## Attachment 2

ATA Environmental
environmental scientists

Project: SGF-2005-001-ASS
Field Sampler: SB
Field Tester: MDVW/JF
Date: 31/08/2005

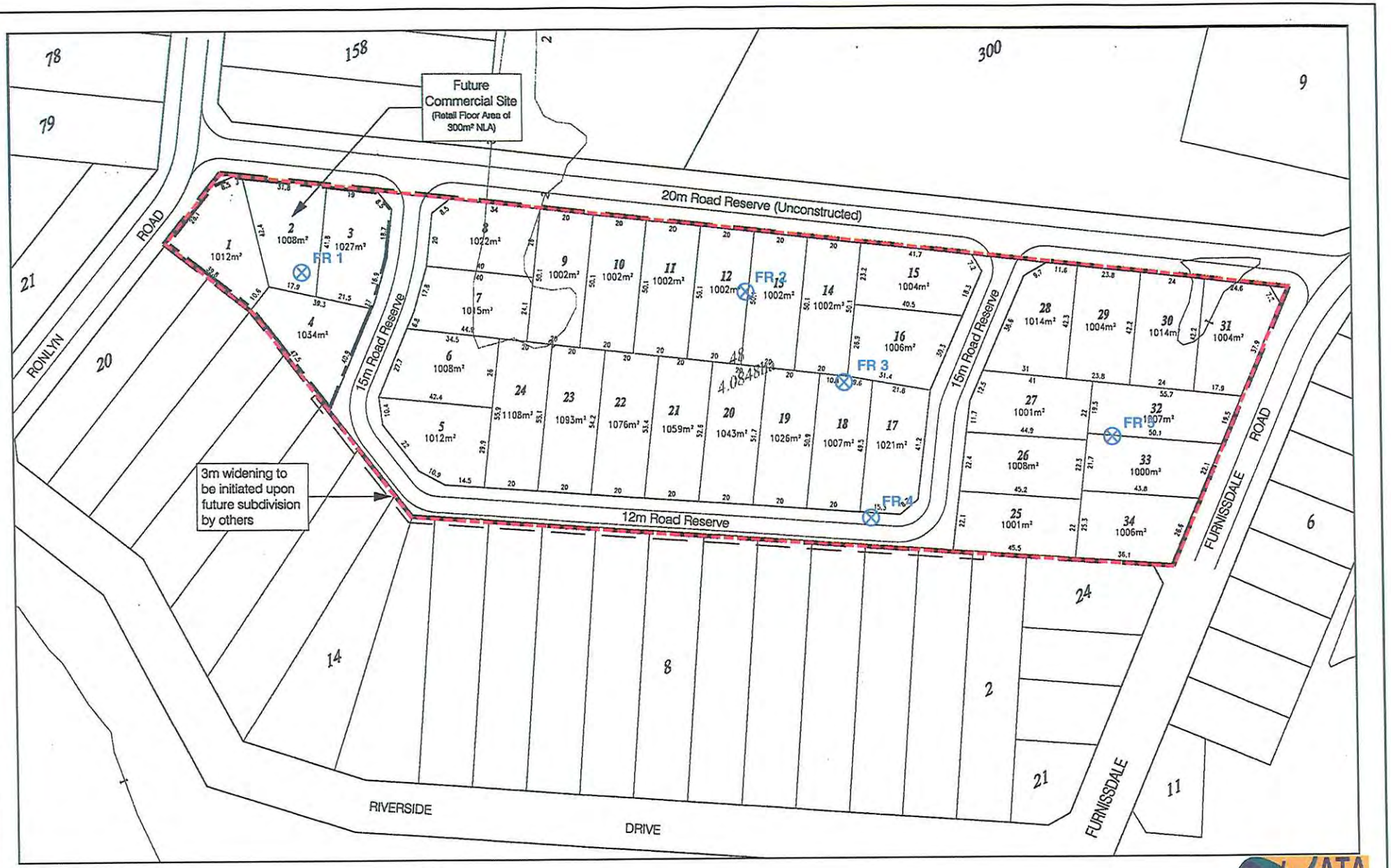
Notes:

| | |
|---|---|
| pHF | pH of deionised water sample |
| pHFOX | pH of hydrogen peroxide sample |
| H2O | (Deionised) water |
| H2O2 | Hydrogen peroxide |

Reaction Rate:

| | |
|---|---|
| (X) Low | Slight effervescence |
| (XX) Medium | Moderate reaction |
| (XXX) High | Vigorous reaction |
| (V) Extreme | Volcano: vigorous reaction, gas evolution and heat generation commonly >80C |

| No. | Sample ID | | pHF | pHFOX | Reaction | | |
|---|---|---|---|---|---|---|---|
| | | | | | Rate (X-V) | Odour | Other comments |
| | $H_2O$ | | 6.65 | | | | Measured prior to sample: |
| | $H_2O_2$ | | 5.39 | | | | Measured prior to sample: |
| 1 | FR1 | 0 | 5.6 | 4.08 | | | |
| 2 | FR1 | 0.25 | 5.54 | 4.14 | | | |
| 3 | FR1 | 0.5 | 5.59 | 3.9 | | | |
| 4 | FR1 | 0.75 | 5.58 | 3.85 | | | |
| 5 | FR1 | 1 | 5.62 | 4.41 | | | |
| 6 | FR2 | 0 | 5.09 | 3.92 | | | |
| 7 | FR2 | 0.25 | 4.43 | 3.73 | | | |
| 8 | FR2 | 0.5 | 5.11 | 4.22 | | | |
| 9 | FR2 | 0.75 | 5.41 | 4.21 | | | |
| 10 | FR2 | 1 | 4.94 | 4.17 | | | |
| 11 | FR2 | 1.25 | 5.45 | 3.57 | | | |
| 12 | FR2 | 1.5 | 6.11 | 3.99 | | | |
| 13 | FR3 | 0 | 6.23 | 2.15 | XXX | | Slow reaction |
| 14 | FR3 | 0.25 | 6.28 | 5.04 | X | | |
| 15 | FR4 | 0 | 5.74 | 4.26 | | | |
| 16 | FR4 | 0.25 | 5.13 | 4.01 | | | |
| 17 | FR4 | 0.5 | 5.5 | 4.41 | | | |
| 18 | FR4 | 0.75 | 5.44 | 4.58 | | | |
| 19 | FR5 | 0 | 6 | 4.34 | | | |
| 20 | FR5 | 0.25 | 5.47 | 4.2 | | | |
| DUP1 | FR5 | 0.25 | 5.64 | 4.26 | | | |
| 21 | FR5 | 0.5 | 5.55 | 4.94 | | | |
| 22 | FR5 | 0.75 | 5.81 | 5.09 | | | |




LEGEND

Subject Land Boundary

FR 1 Sample Location

metres

0 15 30 45 60

APPROXIMATE SCALE 1 : 1 300 @ A3

BASE SOURCE: Chappell & Lambert, 28-07-05, Plan 2062-11B

ATA Environmental
environmental scientists

PRELIMINARY ACID SULFATE SOILS ASSESSMENT
LOT 48 FURNISSDALE ROAD, FURNISSDALE
**SAMPLING LOCATIONS**
FIGURE 1

PRINTED: Thu 01 Sep 05 DRAWN BY: TE 1-09-05 CHECKED BY: ND 1-09-05 DATUM: Not Spacially Correct SGF5-1/SGF5-1IET 1-09-05.dgn