Appendix D

Flora, Vegetation and Fauna Report (ENV 2013)

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FLORA, VEGETATION AND FAUNA ASSESSMENT, KEANE ROAD

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Prepared for

WATER CORPORATION

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This flora survey was conducted under the following licences issued by the Department of Environment and Conservation; Licence to take flora for scientific or other prescribed purposes: SL010155 issued to Narelle Whittington and SL009905 issued to Damian Buller.

STATEMENT OF LIMITATIONS

Scope of Services

This environmental site assessment report ('the report') has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and ENV.Australia Pty Ltd (ENV) ('scope of services'). In some circumstances the scope of services may have been limited by factors such as time, budget, access and/or site disturbance constraints.

Reliance on Data

In preparing the report, ENV has relied on data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ('the data'). Except as otherwise stated in the report, ENV has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or in part on the data, those conclusions are contingent upon the accuracy and completeness of the data. ENV will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, unavailable, misrepresented or otherwise not fully disclosed to ENV.

Environmental Conclusions

In accordance with the scope of services, ENV has relied on the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, express or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and for no other party. ENV assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including, without limitation, matters arising from any negligent act or omission of ENV or for any loss or damage suffered by any other party relying on the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness

of any conclusions, and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

ENV will not be liable to update or revise the report to take into account any events or circumstances occurring or facts becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report, nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

EXECUTIVE SUMMARY

ENV.Australia Pty Ltd (ENV) was commissioned by the Water Corporation in August 2012, to undertake a Level 2 Flora and Vegetation Assessment and a Level 1 Fauna Assessment for the proposed Keane Road Sewer Main, Forrestdale (the study area). The Water Corporation has two possible options for the route of the sewer main which were surveyed concurrently. ENV understands that the impact of the two proposed sewer route options, which will have an approximately 10 m wide corridor, will either be 2.11 ha or 2.32 ha depending on the selected route.

The purpose of this study is to provide information on the significance of the flora, vegetation and fauna within the study area as part of supporting documentation for environmental approvals to construct the sewer infrastructure. This study may also provide supporting documentation for an application for a Native Vegetation Clearing Permit (NVCP) under the *Environmental Protection Act 1986* (EP Act).

The field survey was conducted on the 19th of October 2012 and recorded 94 taxa from 76 genera and 30 families.

No plant species listed as Threatened under the *Environment Protection and Biodiversity Conservation Act 1999* or as Declared Rare Flora pursuant to the *Wildlife Conservation Act 1950* were recorded during the survey.

One Priority Flora, *Jacksonia gracillima* (Priority 3), was recorded in the study area. The presence of *Jacksonia gracillima* (Priority 3) does not form a statutory constraint to development of the study area. There is no written policy on responding to the presence of Priority Flora within proposed development sites. The presence of these species is dealt with by the Department of Environment and Conservation on a case by case basis.

Fifteen introduced species were identified during the survey. Two of these are listed as Declared Plants within the Swan Coastal Plain; Arum Lily (**Zantedeschia aethiopica*), and One Leaf Cape Tulip (**Moraea flaccida*).

The study area is mapped as the Southern River Complex: Vegetation consists of open woodland of *Corymbia calophylla*, *Eucalyptus marginata* and *Banksia* spp. with fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* along creek beds. The pre-European vegetation in the Southern River Complex, which the study area is situated, is considered to be Vulnerable.

Four vegetation units were identified within the study area. These units are considered to represent four Floristic Community Types; SCP21c 'Low lying *Banksia attenuata* woodlands or shrublands' and SCP04 '*Melaleuca preissiana* damplands' SCP5 'Mixed Shrub damplands' and either SCP8 'Herb rich shrublands in claypans' or SCP10a 'Shrublands on dry clay flats'.

SCP21c is listed as a Priority Ecological Community by the Department of Environment and Conservation. Priority communities do not form a statutory constraint to development. There is no written policy on how to respond to the presence of Priority Ecological Communities within proposed development sites. The presence of these communities is dealt with by the Department of Environment and Conservation on a case by case basis.

SCP8 Herb rich shrublands in claypans and SCP10a Shrublands on dry clay flats both are listed as Threatened Ecological Communities by both the State and the Commonwealth. ENV advises that the presence of the Threatened Ecological Community needs to be confirmed by the Department of Environment and Conservation. If the Department of Environment and Conservation confirms the presence of the Threatened Ecological Community, they may seek a retention outcome in relation to the specific site characteristics.

The site is mapped by the Department of Environment and Conservation as supporting Conservation and Multiple Use Category wetlands. The wetlands cover the majority of the site according to the Geomorphic Wetland mapping. Conservation category wetlands are in the highest category of protection afforded by WA State legislation, and are listed as Environmentally Sensitive Areas under the *Environment Protection Act*.

The study area consists of three fauna habitat types; *Banksia* Woodland, *Melaleuca* Shrubland and Cleared Land. During the field survey a total of 26 vertebrate fauna species were recorded comprising one reptile, 23 avifauna and two mammal species.

A database search resulted in 27 conservation significant fauna species potentially occurring in the study area. Of these, one species, the Quenda which is a Priority 5 listed species by the Department of Environment and Conservation was recorded. Based on ecology, habitat present and fauna records, four species are classified as 'Likely' to occur (*Calyptorhynchus banksii naso*, *Calyptorhynchus baudinii*, *Calyptorhynchus latirostris* and *Merops ornatus*), six species are classified as 'Possible' to occur, ten species are classified as 'Unlikely' to occur and six are classified as 'Highly Unlikely' to occur.

1 INTRODUCTION

1.1 THE PROJECT

ENV.Australia Pty Ltd (ENV) was commissioned by the Water Corporation in August 2012, to undertake a Level 2 Flora and Vegetation Assessment and a Level 1 Fauna Assessment for the proposed Keane Road Sewer Main, Forrestdale (the study area). The Water Corporation has two possible options for the route of the sewer main which were surveyed concurrently. ENV understands that the impact of the two proposed sewer route options, which will have an approximately 10 m wide corridor, will either be 2.11 ha or 2.32 ha depending on the selected route (Figure 1).

The purpose of this study is to provide information on the significance of the flora, vegetation and fauna within the study area as part of supporting documentation for environmental approvals to construct the sewer infrastructure. This study will provide supporting documentation for an application for a Native Vegetation Clearing Permit (NVCP) under the *Environmental Protection Act 1986* (*EP Act).*

1.2 Objectives

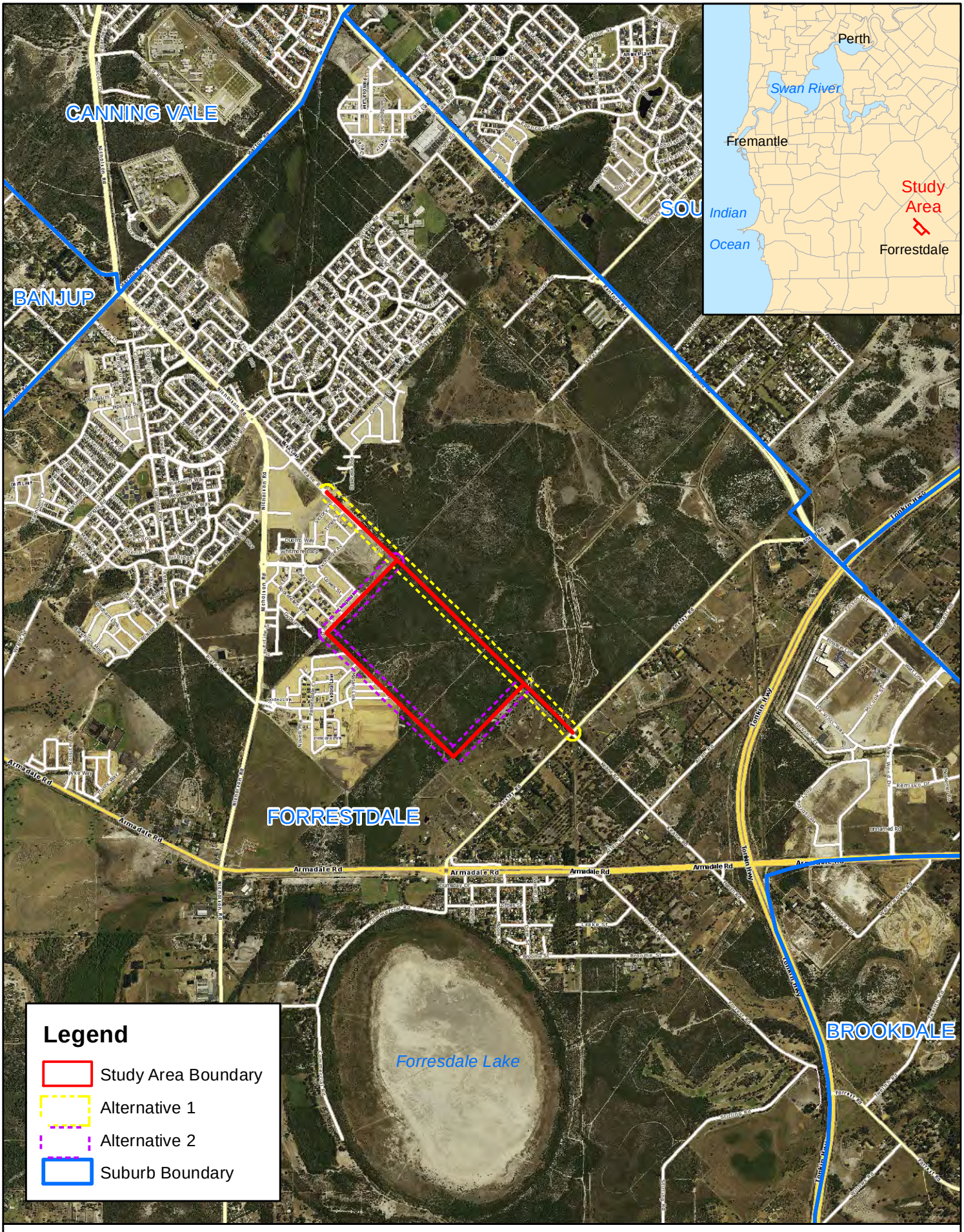
The objectives of the flora, vegetation and fauna assessment were to:

- conduct a comprehensive flora, vegetation and fauna database and literature review;
- compile an inventory of vascular plant species;
- provide an inventory of fauna species and habitats that occur or potentially occur in the study area;
- conduct targeted searches and flag the presence of field-identifiable plant species of conservation significance;
- record the occurrence of introduced plant species;
- document any potential signs of dieback disease;
- assess and map vegetation condition;
- document, describe and map the vegetation associations present;
- identify and map locations of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs);
- provide a list of suitable plant species for use in rehabilitation;

- provide recommendations to minimise the impact of construction on native flora and fauna; and
- assess the proposed development against the ten native Vegetation Clearing Principles as detailed in Schedule 5.0 of the EP Act 1986.

1.2.1 Location

The study area is approximately 4.43 ha in size and is located 1 km north of Forrestdale in the City of Armadale (Figure 1). The closest intersection is Keane Road and Anstey Road, Forrestdale. The study area consists of remnant vegetation with cleared areas for firebreaks and informal walking paths.



env Australia

CLIENT		**JOB NO.**
Water Corporation		J113163
AUTHOR	**DRAWN**	**DATE**
D. Buller	M. Mikkonen	05-03-13
SCALE	**PROJECTION**	
1:30,000 @ A4	GDA 94 MGA 50	

Location of Study Area

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 1

1.3 BACKGROUND TO THE PROTECTION OF FLORA, VEGETATION AND FAUNA

Flora and fauna is protected formally and informally by various legislative and non-legislative measures, which are as follows:

Legislative Protection

- *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*);
- *Wildlife Conservation Act 1950* (*WC Act*);
- *Environmental Protection Act 1986* (*EP Act*); and
- *Agriculture and Related Resources Protection Act 1976* (*ARRP Act*).

Non-Legislative Protection

- Western Australian Department of Environment and Conservation (DEC) Priority lists for flora and vegetation; and
- Recognition of locally significant populations by the DEC.

A short description of each is given below. Other definitions, including species conservation categories, are provided in Appendix A for flora and Appendix B for fauna. Conservation categories for ecological communities are provided in Appendix C.

Environment Protection and Biodiversity Conservation Act 1999

The *EPBC Act* aims to protect Matters of National Environmental Significance. Under the *EPBC Act*, the Commonwealth Department of Sustainability, Environment, Water, Populations and Communities (SEWPAC) lists threatened species and communities in categories determined by criteria set out in the Act (*www.environment.gov.au/epbc/index.html*) (Appendix A2 and Appendix B2 and Appendix C2).

Projects likely to impact on matters of national environmental significance should be referred to SEWPAC for assessment under the *EPBC Act*.

Wildlife Conservation Act 1950

The Western Australian DEC lists flora and fauna under the provisions of the *WC Act* as protected according to their need for protection (Appendix A for flora and Appendix B for fauna).

Flora is given Declared Rare status when populations are geographically restricted or are threatened by local processes. In addition, under the *WC Act*, by Notice in the

Western Australian Government Gazette of 9 October 1987, all native flora (spermatophytes, pteridophytes, bryophytes and thallophytes) is protected throughout the State.

Fauna are classified as Schedule 1 to Schedule 4 according to their need for protection (Appendix B).

Environmental Protection Act 1986

Declared Rare Flora (DRF) and TECs are given special consideration in environmental impact assessments, and have special status as Environmentally Sensitive Areas (ESAs) under the *EP Act* and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

Exemptions for a clearing permit do not apply in an ESA. In addition, habitat necessary for the maintenance of indigenous fauna is a clearing principle and assessed during consideration of applications for a NVCP.

Agriculture and Related Resources Protection Act 1976

Plants may be 'Declared' by the Agriculture Protection Board (APB) under the *ARRP Act 1976 (WA)*. Declared Plants are gazetted under five categories (P1-P5), which define the action required. Details of the definitions of these categories are provided in Appendix D. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties (Department of Agriculture and Food Western Australia [DAFWA] 2012).

The Environmental Weed Strategy for Western Australia (EWSWA) (Department of Conservation and Land Management [CALM] 1999) contains criteria for the assessment and ranking of weeds in terms of their environmental impacts, invasiveness and distribution (Appendix D). The Strategy defines environmental weeds as 'plants that establish themselves in natural ecosystems and proceed to modify natural processes, usually adversely, resulting in the decline of the communities they invade.'

The DEC Invasive Plant Prioritization (IPP) Process (DEC 2012) was developed to progress the EWSWA (CALM 1999). The prioritisation process focuses on a "species-led" and "site-led" approach to set priorities for weed management on DEC managed lands for each DEC region of WA. The IPP process is also developed to assist other landholders in their management of weeds.

The Australian Government along with the State and Territory governments has endorsed 20 species as Weeds of National Significance (WONS). Four major criteria were used in determining WONS:

- The invasiveness of a weed species;

- A weed's impacts;
- The potential for spread of a weed; and
- Socio-economic and environmental values.

Each WONS has a national strategy and a national coordinator, responsible for implementing the strategy. WONS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts (Commonwealth of Australia 2012).

Department of Environment and Conservation Priority Lists

The DEC lists 'Priority' flora and fauna that have not been assigned statutory protection under the *WC Act*, but which are under consideration for declaration as DRF or Scheduled fauna. Flora and fauna assessed as Priority 1-3 are considered to be in urgent need of further survey. Priority 4 taxa require monitoring every 5-10 years and Priority 5 taxa are subject to a specific conservation program (Appendix A).

The DEC maintains a list of PECs which identifies ecologically valuable communities that need further investigation before possible nomination for TEC status.

Once listed, a community is a PEC, and when endorsed by the Western Australian Minister of Environment becomes a TEC, and protected as an ESA under *Environmental Protection (Clearing of Native Vegetation) Regulations* 2004 (Appendix B).

Informal Recognition of Flora

The International Union for Conservation of Nature (IUCN) publishes an international listing of species of conservation importance, known as the IUCN Red List (IUCN 2012). This list identifies those species most in need of conservation attention. The IUCN Red List is used for conservation planning, decision making and monitoring by government agencies, wildlife departments, conservation-related non-governmental organisations (NGOs), natural resource planners, educational organisations, and many others interested in preserving biodiversity.

Certain populations or communities of flora and fauna may be of local significance or interest because of their patterns of distribution and abundance. For example, a species may be locally significant because they are range extensions to the previously known distribution, or are newly discovered taxa (and have the potential to be of more than local significance). In addition, many species are in decline as a result of threatening processes (land clearing, grazing, changed fire regimes), and relict populations of such species assume local importance for the DEC. It is not uncommon for the DEC to make comment on these species of interest.

2 BIOPHYSICAL ENVIRONMENT

2.1 CLIMATE

The study area is located on the Swan Coastal Plain, this region experiences a Mediterranean climate characterised by hot, dry, summers and cool, wet, winters with an average maximum summer temperature of 30.8°C and an average minimum winter temperature of 11°C (Bureau of Meteorology [BoM] 2012) (Figure 2).

The average annual rainfall recorded at Perth Aero, the nearest BoM station, 20 km north of the study area, is 771.7 mm, with the majority of precipitation occurring in winter (BoM 2012) (Figure 2). Perth Aero recorded 694 mm of rain in the 12 months prior to survey (September 2011 – August 2012), 77.7 mm below the long term average rainfall of 771.7 mm for the same period (BoM, 2012). The three months prior to survey (June-August 2012), Perth Aero recorded 282.8 mm of rainfall, 35% below the 436.6 mm average rainfall for the same period (BoM 2012).

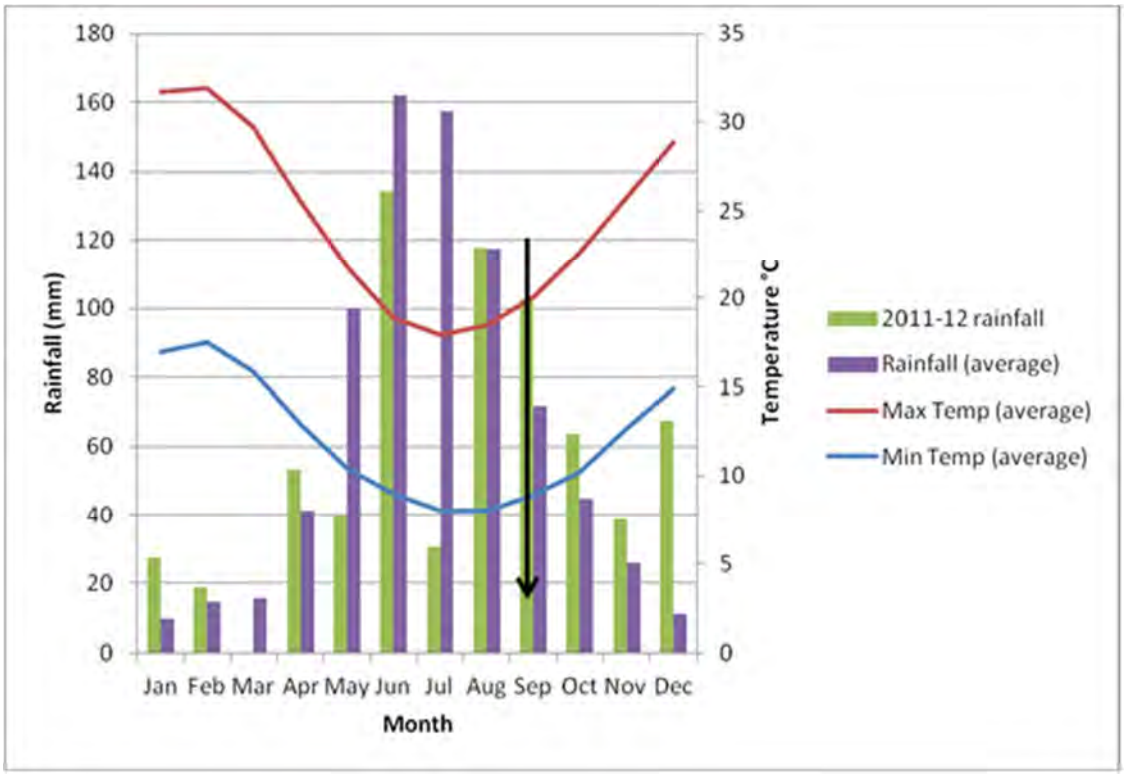


Figure 2: Average long-term (1944-2012) and 2012 Monthly Rainfall and Average Maximum and Minimum Temperatures (1944-2012) for Perth Aero (BoM, 2012). Arrow indicates survey time.

2.2 GEOLOGY AND SOILS

The study area occurs on the Swan Coastal Plain portion of the Darling System (Churchward & McArthur 1980). Soils of the Swan Coastal Plain have been described by

Churchward and McArthur (1980) as consisting of aeolian and fluviatile deposits. The study area occurs on:

- Southern River: Sandplain with low dunes and many intervening swamps; iron and humus podzols, peats and clays (Churchward & McArthur 1978)

Geological mapping of the Perth Metropolitan Region as part of the 1:50000 Geological Series, has identified the soils of study area as belonging to the following units (GSWA 1986) (Figure 3):

- (Sp_1) Peaty Sand - grey to black, fine to medium-grained, moderately sorted quartz sand, slightly peaty of lacustrine origin.
- (Sp_8) Sand - white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals.
- (Sp_{10}) Sand: as S_8 over sandy clay to clayey sand of the Guildford formation, of eolian origin.

2.3 BIOGEOGRAPHIC REGIONALISATION FOR AUSTRALIA

The Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical/ geological attributes (SEWPAC 2012c). These bioregions are subdivided into 419 subregions, as part of a refinement of the IBRA framework (SEWPAC 2012c).

The study area is located in the Perth subregion (SWA02) of the Swan Coastal Plain bioregion (Thackway & Cresswell 1995). The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone (Mitchell et al. 2002). Vegetation can be characterised by heath and/or Tuart woodlands on limestone, Banksia and Jarrah-Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvials (Mitchell et al. 2002).

2.4 BROAD VEGETATION TYPES

Mapping of the Swan region vegetation of Western Australia was completed on a broad scale (1:250,000) by Heddle et al. (1978). The study area is situated in South West Botanical Province and the Darling Botanical District (Beard 1990). This region typically consists of forest country with related woodlands and is divided into four subregions or botanic subdistricts. The study area is located within the Swan Coastal Plain Subregion in the Drummond Botanical Subdistrict, which consists mainly of the following vegetation communities:

- *Banksia* Low Woodland on leached sands and *Melaleuca* Swamps in poorly drained areas;
- Woodland of Tuart (*Eucalyptus gomphocephala*); and
- Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) on less leached soils (Beard 1990).

Vegetation complexes of the Darling System, in which the Swan Coastal Plain occurs, have been mapped by Heddle et al. (1978). The study area contains one Swan Coastal Plain vegetation complex which is related to the underlying soil profile (Figure 4):

- Southern River Complex – Open woodland of *Eucalyptus calophylla – E. marginata – Banksia* spp. with fringing woodlands of *E. rudis – Melaleuca rhaphiophylla* along creek beds (Heddle et al. 1978).

This vegetation complex belongs to a combination of several major geomorphic units: Bassendean Dunes/Pinjarra Plain/Spearwood Dunes (Government of Western Australia 2000b).

The Southern River Complex was estimated to have 19.8% native vegetation remaining based on the pre-European extent with 1.5% in secure tenure (EPA 2006). More recently the Perth Biodiversity Project (PBP 2010) has mapped native vegetation extent by vegetation complex on the Swan Coastal Plain. It is estimated that 19.7% of Southern River Complex remains compared to its pre-European extent (PBP 2010) (Table 1).

The EPA recognises vegetation complexes that are not well represented in reserves as being significant. Vegetation complexes which have 10-30% remaining may be considered regionally significant. Proposals that would affect a vegetation complex with 10% or less remaining are likely to be formally assessed by the EPA (EPA 2006).

Table 1: Broad Vegetation Types within the Study Area and their Regional Representation

	Pre-European area (ha)[1]	Current extent (ha) [1]	Remaining (%)[1]	Pre-European % in IUCN Class I-IV Reserves[1]	Conservation Status[2]
IBRA Bioregion Swan Coastal Plain	1,501,209.2	587,832.9	39.16	10.13	Vulnerable
Vegetation Types (Beard 1979/ Shepherd et al. 2001) Swan Coastal Plain Bioregion					
1001	57410.23	14151.90	7.19	1.14	Critically Endangered
968	136188.20	9798.61	24.65	1.12	Endangered

[1] Government of Western Australia (2011)

[2] EPA (2000)

2.5 GEOMORPHIC WETLANDS

In an effort to protect wetlands on the Swan Coastal Plain, the DEC developed a dataset, mapping the location and management category of wetlands on the Swan Coastal Plain (DEC 2012g). A management category is assigned to each wetland, which provides guidance on the nature of the management and protection of the wetland.

The DEC Geomorphic Wetlands Dataset identified several wetlands of both Conservation and Multiple Use management categories as occurring within the study area (DEC 2012g) (Figure 5).

2.6 CONSERVATION ESTATE

2.6.1 Bush Forever and Ecological Linkages

Bush Forever is a State Government Policy and program that identifies 51,200 ha of regionally significant vegetation for protection, covering 26 vegetation complexes (Government of Western Australia 2000a; 2000b). This amounts to approximately 18% of the original vegetation on the SCP portion of the Perth metropolitan area (Government of Western Australia 2000a; 2000b).

Regionally significant vegetation has been identified based on criteria relating to its conservation value. Important criteria in the identification process include the achievement, where possible, of a comprehensive representation of all the ecological communities originally occurring in the region, principally through protecting a target of at least 10% of each vegetation complex in the Bush Forever project boundary (Government of Western Australia 2000a; 2000b).

The study area is mapped as Bush Forever Site No. 342, also known as the Anstey/Keane Dampland and Adjacent Bushland, Forrestdale (Government of Western Australia 2000a). The next nearest Bush Forever sites to the study area are: Balannup Lake and Adjacent Bushland, Southern River/Forrestdale (Bush Forever site 413), abutting the northern edge of Site 342 and the Piarra Nature Reserve, Forrestdale (Bush Forever Site 262), approximately 0.6 km south-west of the study area (Government of Western Australia 2000a). Forrestdale Lake is a seasonal brackish lake situated 1.2 km south of the study area (AHC 2000). The wetland is listed as an 'Indicative Place' on the Australian Heritage Commission Register of the National Estate, Bush Forever Site no. 345 (Government of Western Australia 2000a) and as a RAMSAR wetland in the Directory of Important Wetlands in Australia (SEWPAC 2012a).

2.7 PREVIOUS BIOLOGICAL STUDIES

Previous biological surveys most relevant to the current survey include:

- Heron Park Phase Two Flora and Vegetation Assessment (ENV 2010).

The key findings of the report are provided below. It should be noted that differences in survey timing, extent and the size and locations of each study area will influence the results of each survey. For further details of specific survey methods and timing please refer to the original report.

- No plant species listed as Threatened under the EPBC Act or as DRF pursuant to the WC Act were recorded during the survey.
- One Priority Flora, *Jacksonia gracillima* (Priority 3), was recorded in the study area.
- SCP21c 'Low lying *Banksia attenuata* woodlands or shrublands' and SCP04 '*Melaleuca preissiana* damplands' were identified as occurring on site. These Floristic Community Types are not protected under Federal or State Legislation. SCP21c is listed as a Priority Ecological Community by the DEC.
- The DEC's Geomorphic Wetlands Dataset identifies five Multiple Use wetlands as occurring within the study area.

3 METHODS

3.1 FLORA ASSESSMENT

The survey was consistent with a single season Level 2 survey as per the EPA requirements for environmental surveying and reporting for flora and vegetation in Western Australia, as set out in the following documents:

- *Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No.2* (EPA 2000);
- *Environment Protection of Wetlands. Position Statement No. 4* (EPA 2001);
- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002);
- *EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51* (EPA 2004b); and
- *EPA Guidance for the Level of Assessment for Proposals affecting Natural Areas within the System 6 Region and Swan Coastal Plain Portion of the System 1 region. Guidance Statement No. 10* (EPA 2006).

3.1.1 Database Review

The desktop study provided background information on the flora and vegetation of the project area. This involved a search of the following sources:

- DEC combined biological database *NatureMap* (DEC 2012b);
- DEC Threatened and Priority Flora database (DEC 2012f);
- DEC Threatened and Priority Ecological Communities information (DEC 2012d);
- IUCN Red List (IUCN 2012);
- SEWPAC Protected Matters Search Tool (SEWPAC 2012b); and
- previous flora surveys (refer to Section 2.7).

A request for a database search was submitted to the DEC September 5th 2012 within 5 kilometres of coordinates 32°08'04.23"S and 115°56'19.42"E to obtain a list of DRF/T or Priority flora, and TECs and PECs near the project area. These sources were used to

compile a list of expected DRF or Priority species and TECs and PECs that may occur on the landforms in the project area.

3.1.2 Field Survey

The field survey was conducted on 19th October 2012, with 2 person-days invested in the field survey.

Flora and Vegetation Assessment

The survey included the assessment of one site, consisting of six quadrats and four relevés (Figure 6). Quadrats are vegetation survey plots which are accurately measured out as 5 x 20 m and marked at the NW corner using a handheld Garmin GPS unit. Relevés are 'unmarked quadrats', where a centre point is marked and an area equivalent to that of a quadrat is visually approximated around this point for the purpose of estimating species composition and cover.

The information recorded at each quadrat included landscape features, surface soil colour and texture, bare ground, litter cover, disturbance, fire age, aspect and vegetation condition (Government of Western Australia 2000b). Each species of plant at each quadrat was recorded, including information on height and percentage cover.

Targeted or Systematic Searches

Habitats and locations likely to support conservation significant flora were targeted for searches. Further opportunistic collections focused on the location of taxa not recorded in the quadrats and on locations of introduced species. For each population of significant flora identified the following was recorded:

- Co-ordinate locations (using handheld GPS units);
- Description of vegetation association present;
- Estimation of population size; and
- Photograph of plant *in situ*, where possible.

If a specimen was collected, a voucher will be lodged at the Western Australian Herbarium.

Targeted or Systematic Searches for Introduced Species

A targeted survey of the study area was undertaken, focussing on:

- Declared plants listed under the ARRP Act; and

- Other environmental weed species as listed by DEC on FloraBase (WAH 2012), and based on results of previous surveys in and adjacent to the study area.

3.1.3 Taxonomy and Nomenclature

Where field identification of plant taxa was not possible, specimens were collected systematically for later identification by taxonomists utilising identification keys including, Flora of Australia (1981-2011), AusGrass (Sharp & Simon 2002), EUCLID (EUCLID 2006), WATTLE (Maslin 2001), relevant taxonomic papers published in journals including Australian Systematic Botany (1988-2011) and Nuytsia (1975-2011). If required, resources of the Western Australian Herbarium (WAH) were also utilised.

The species list was checked against FloraBase (WAH 2012) to determine the species' conservation status. Threatened and Priority Flora were verified against the *EPBC Act* listing of threatened species to determine federal listing.

Introduced species were checked against the Environmental Weed Strategy for Western Australia (CALM 1999) and the DEC Invasive Plant Prioritisation Process – Swan Weed Assessment List (DEC 2012a), to determine their ranking in terms of environmental impact, and the ARRP Act was consulted to determine if any are Declared Plants.

3.1.4 Statistical Analysis

To determine the likely occurrence of TECs or PECs, a multivariate analysis was undertaken. This analysis involved transformation (presence-absence) and normalisation of the data, and computation of a similarity matrix based on Bray-Curtis similarity. The matrix allows comparison of the study area's species data similarity against Gibson et al. (1994) FCTs data and allows determination of the probability that the vegetation communities represent TECs or PECs. A dendrogram was computed, using hierarchical agglomerative cluster analysis using Primer-E version 6.1.5 (Clarke & Gorley 2006).

3.2 VEGETATION MAPPING

The vegetation associations were described based on their structure and species composition, as defined by quadrat data, results of the multivariate analysis and field observations. Vegetation was mapped in the field using handheld GPS (Garmin) units and high-resolution aerial photographs, which in the office were digitised using GIS software (OziExplorer and ArcGIS 9.3.1).

The vegetation descriptions were referenced against Gibson et al. (1994) to determine the Floristic Community Types ('FCTs') present and the potential for the study area to support TECs or PECs. FCTs were defined on the basis of Multivariate Analysis of quadrat data, species composition, soils and topography.

Vegetation condition was mapped in the field using handheld GPS (Garmin) units and high-resolution aerial photographs, which in the office were digitised using GIS software (OziExplorer and ArcGIS 10). Vegetation condition was assessed based on Bush Forever (Government of Western Australia 2000b) /Trudgen (1991) (Appendix E).

3.3 FAUNA ASSESSMENT

The survey was carried out in a manner designed to be consistent with the Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of fauna surveys in Western Australia, as set out in the following documents:

- *Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3* (EPA 2002);
- *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56* (EPA 2004a); and
- *Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA-DEC 2010).

3.3.1 Database Review

The purpose of the desktop review was to gather background information on the study area and the vertebrate fauna that it may support. This involved a search for records (using a 20 km buffer around the location of: 32°08'08"S, 115°56'09" from the following databases:

- Western Australian Museum (WAM) and DEC combined biological database *NatureMap* (DEC 2012b);
- DEC Threatened and Priority Fauna database (DEC 2012e);
- SEWPAC Protected Matters Search Tool (also known as an EPBC search) (SEWPAC 2012b); and
- Birdata, Birds listed by Birdlife Australia (Birdlife Australia 2012a).

Collectively, these sources were used to compile a list of species that have been recorded or that may potentially occur in the region (Appendix F). This list will invariably include some species that do not occur in the study area, as some fauna have a limited or patchy distribution, exhibit a high level of habitat specificity, are locally extirpated or were erroneously identified in previous surveys. Extinct species, clearly erroneous records and species with a high level of habitat specificity for habitats not present in the study area were excluded from this list and species which are predominantly marine in nature and do not occupy terrestrial habitats represented in the study area (i.e. Terns, Gulls, Albatross, Sandpipers).

3.3.2 Field Survey

The purpose of the field survey was to verify the accuracy of the review and to further delineate and characterise the habitat and faunal assemblages in the study area. The fauna field survey consisted of a fauna habitat assessment and opportunistic observations.

Habitat Assessment

Five habitat assessments were completed during the field survey (Appendix G; Figure 7). Each habitat was scored numerically on the basis of the presence and complexity of fauna microhabitats including vegetation cover, presence of water, tree hollows, loose bark, leaf litter etc. In addition the habitat assessment included the identification of landscape features such as soil type, rock type, vegetation type and disturbance levels. The numerical scoring system individually ranked 24 microhabitat variables as a value between 0-3 based on whether it was common (3), moderately common (2), rare (1) or not present (0). The composition and presence of ground and vegetation cover was also assessed and scores were given based on their percentage cover of the 100 x 100 m quadrat. Three was the highest possible score for each feature and corresponded to a high habitat value, while zero was the lowest value reflecting a feature that was absent and/or provided little to no fauna habitat value. For each assessment the scores were tallied to give a total numerical value out of a possible 70.

Opportunistic and Targeted Observations

Fauna were opportunistically observed and recorded during the foot traverse of site. Field staff investigated scats, tracks, burrows and other traces of animals throughout the entire study area. Where conservation significant species were located, the coordinates were recorded by GPS.

3.3.3 Taxonomic Identification

The taxonomy and naming of wildlife species is dynamic because of the ongoing description of new species, and increased understanding of the relationships of taxa through genetic, morphological and vocal studies. The taxonomy and nomenclature (common and scientific names) in this report follows authorities supplemented by the latest scientific articles which update the established names for frogs (Tyler & Doughty 2009); reptiles (Wilson & Swan 2010); mammals (van Dyck & Strahan 2008), and birds (Gill & Donsker 2012). This latter authority has replaced the taxonomic treatment of Christidis and Boles (2008) for birds.

Fauna species were identified in the field, where needed using standard field guides or scientific publications for frogs (Tyler & Doughty 2009; Tyler & Knight 2009); reptiles (Storr et al. 1999; 2002; Wilson & Swan 2010), birds (Pizzey & Knight 2007; Simpson & Day 2010) and mammals (van Dyck & Strahan 2008; Menkhorst & Knight 2011).

4 RESULTS

4.1 SURVEY LIMITATIONS AND CONSTRAINTS

It is important to note the specific constraints imposed on surveys. Constraints are often difficult to predict as is the extent to which they influence survey effort. Survey constraints of the Keane Road Sewer main flora and vegetation survey are detailed in Table 2.

Table 2: Limitations and Constraints Associated with the Keane Road Sewer Main Flora, Vegetation and Fauna Survey

Variable	Impact on Survey Outcomes
Access	No access problems were encountered.
Experience	The botanists and zoologists who executed these surveys were practitioners suitably qualified in their respective fields. • Coordinating Botanist: Narelle Whittington (Principal Botanist); • Coordinating Zoologist: Dr Ronald Firth (Principal Zoologist) • Field Staff: Damian Buller (Environmental Biologist), Narelle Whittington and Ronald Firth. • Taxonomy: Peter Jobson (Senior Botanist / Taxonomist); • Botanical Data Interpretation and Reporting: Narelle Whittington and Damien Buller. • Zoological Data Interpretation and Reporting: Ron Firth and Chris Knuckey (Environmental Biologist).
Timing, weather, season.	The survey was conducted during Spring. Therefore, the seasonal conditions for the survey were considered optimal. Flora composition changes with time particularly over the seasons and with seasonal conditions. A large proportion of arid flora is herbaceous annuals and ephemerals with specific growing periods and rainfall requirements. Fire history also affects the composition of flora. Therefore, botanical surveys completed at different times will have varying results. The timing, weather and season of the survey did not limit the survey outcomes and would not have impacted the occurrence of conservation significant fauna.
Scope: Life forms sampled	The scope of this project included the sampling of flora and the description of vegetation associations and floristic Community types. This survey scope also included searching and sampling for significant

Variable	Impact on Survey Outcomes
	flora and describing vegetation condition. A Level 1 fauna survey was carried out which included habitat assessments and opportunistic fauna records which was deemed adequate for this site.
Sources of information	The Swan Coastal Plain bioregion has been extensively surveyed; as a result, numerous published and unpublished flora surveys have been undertaken in the area. Those most relevant to the current study are listed in Section 2.7.
Completeness	The study area was accessible and the survey season was considered to be optimal and the time spent conducting the survey was considered to be adequate. It was considered that all vegetation types and fauna habitats within the study area were adequately surveyed; with quadrats, relevés and vegetation mapping notes recorded for all vegetation and fauna habitat types.

4.2 FLORA

4.2.1 Overview of Flora

A total of 94 taxa (including species, subspecies, varieties and forms) from 76 genera and 30 families were recorded from the study area. The most frequently recorded families were: Myrtaceae (14 taxa), Fabaceae (12 taxa), and Proteaceae (9 taxa). The most frequently recorded genera were *Melaleuca* (5 taxa), *Drosera* (5 taxa), *Jacksonia* (3 taxa) and *Banksia* (3 taxa). An average of 18.1 species were recorded in each quadrat, with a standard deviation of ± 5.6.

Quadrat data, including photographs, is presented in Appendix H, the flora by site matrix in Appendix I and the flora inventory in Appendix J.

4.2.2 Flora of Conservation Significance

No Threatened species pursuant to the EPBC Act and/or gazetted as DRF (Threatened) pursuant to the WC Act were recorded during the survey.

One Priority flora as recognised by the DEC, was recorded during the survey:

- *Jacksonia gracillima* (P3);

Jacksonia gracillima (Plate 1) was recorded during the current survey from eight locations, representing approximately 13 individuals in the study area. Details of locations are in Appendix K and presented in Figure 8.

Plate 1: *Jacksonia gracillma* (P3). *Source: ENV*

One further species of conservation significance was noted during the survey (*Petrophile rigida*). This species is of taxonomic interest as this record represents a significant extension from its known range.

Petrophile rigida (Plate 2) was recorded during the current survey from one location, representing four individuals in the study area.

Plate 2: *Petrophile rigida. Source: ENV*

The review of previous surveys and DEC database searches identified 26 DRF/T and Priority flora previously recorded within 5 km of the study area; six DRF /T taxa, four P1 taxa, one P2 taxa, five P3 taxa and ten P4 taxa.

The likelihood of these 26 conservation significant taxa occurring in the study area is shown in Table 3.

Table 3: Assessment of the likely occurrence of DRF and Priority Flora (as per DEC Database Searches) in the Study Area

Conservation Status	Species	Life Form	Habitat Information (WAH 2011, DEC 2012b)	Suitable Habitat Present	Number of Records[1]	Closest Record[2]	Likelihood of occurrence in the study area
T	*Caladenia huegelii*	Perennial	Grey or brown sand or clay loam, Coastal plain, near river or swamps.	Yes	10	>1 km	Likely
T	*Diuris purdiei*	Perennial	Grey-black sand, moist. Winter wet swamps.	Yes	4	>1 km	Likely
T	*Drakaea elastica*	Perennial	Brown dry rocky soils on flood plain and on rangeland.	No	1	>5 km	Likely
T	*Drakaea micrantha*	Perennial	White-grey sand	Yes	2	>5 km	Likely
T	*Lepidosperma rostratum*	Perennial	Brown. Peaty sand, clay.	Yes	5	>5 km	Likely
T	*Verticordia plumosa* var. *pleiobotrya*	Perennial	Clay, sandy loam. Seasonally inundated swamps, road verges.	Yes	1	>5 km	Likely
P1	*Acacia lasiocarpa* var. bracteolate long peduncle variant (G.J Keighery 5026)	Perennial	Grey or black sand over clay in swampy areas or winter wet lowlands.	Yes	1	>10 km	Likely
P1	*Austrostipa jacobsiana*	Perennial	Wets over limestone, sandy clay pans, seasonally damp salinized soils.	No	1	>5 km	Likely
P1	*Eremaea asterocarpa* subsp. *brachyclada*	Perennial	Deep grey sand.	Yes	1	>5 km	Likely

Conservation Status	Species	Life Form	Habitat Information (WAH 2011, DEC 2012b)	Suitable Habitat Present	Number of Records[1]	Closest Record[2]	Likelihood of occurrence in the study area
P1	*Schoenus pennisetis*	Annual	Grey or peaty sand, sandy clay. Swamps, winter-wet depressions.	Yes	2	>1 km	Likely
P2	*Acacia benthamii*	Perennial	In sand, typically on limestone breakaways.	No	1	>5 km	Likely
P3	*Byblis gigantea*	Perennial	Sandy-peat swamps. Seasonally wet areas.	Yes	3	>1 km	Likely
P3	*Eryngium pinnatifidum* subsp. *palustre*	Perennial	Clay or sandy clay of claypans and seasonally wet flats.	Yes	1	Not Known	Not Known
P3	*Jacksonia gracillima*	Perennial	Grey or brown sand or sandy loam on plains and wetlands.	Yes	7	Within study area	Within study area
P3	*Schoenus capillifolius*	Annual	Brown mud of claypans.	No	2	>5 km	Likely
P3	*Stylidium longitubum*	Annual	Sandy clay or clay of seasonal wetlands.	Yes	3	>1 km	Likely
P4	*Aponogeton hexatepalus*	Perennial	In mud of freshwater ponds, rivers or claypans.	Yes	3	>5 km	Likely
P4	*Dodonaea hackettiana*	Perennial	Sand of outcropping limestone.	No	1	>10 km	Possible
P4	*Drosera occidentalis* subsp. *occidentalis*	Perennial	Sandy and clayey soils. Swamps and wet depressions.	Yes	2	>1 km	Likely
P4	*Grevillea thelemanniana* subsp. *thelemanniana*	Perennial	Winter-wet heathland swamp.	Yes	1	>15 km	Unlikely

Conservation Status	Species	Life Form	Habitat Information (WAH 2011, DEC 2012b)	Suitable Habitat Present	Number of Records[1]	Closest Record[2]	Likelihood of occurrence in the study area
P4	*Jacksonia sericea*	Perennial	Calcareous and sandy soils.	Yes	2	>1 km	Likely
P4	*Microtis quadrata*	Annual	Coastal swamps	No	1	>10 km	Possible
P4	*Ornduffia submersa*	Annual	Clay pan soils, wetlands/seasonally inundated depressions.	Yes	6	>1 km	Likely
P4	*Thysanotus glaucus*	Perennial	White, grey or yellow sand, sandy gravel.	Yes	3	>5 km	Likely
P4	*Tripterococcus paniculatus*	Perennial	Grey, black or peaty sand. Winter-wet flats	Yes	6	>1 km	Likely
P4	*Verticordia lindleyi* subsp. *lindleyi*	Perennial	Sand, Sandy clay. Winter-wet depressions	Yes	10	>1 km	Likely

[1] Number of DEC records from database search area (DEC, 2012f)

[2] Closest DEC record to study area (DEC, 2012f)

'Likely' = suitable habitat present and records less than 5 km from the study area.
'Possible' = suitable habitat present, but records within 5 to 10 km from the study area
'Unlikely' = a lack of suitable habitat, and/or there are no records closer than 10 km from the study area

4.2.3 Introduced Flora

Fifteen introduced species were recorded; their locations are presented in Figure 9 and detailed in Appendix L.

None of these species are registered as WONS. Two of these species are listed as Declared Plants under the ARRP Act. All 15 species are listed as environmental weeds, as defined by the *Environmental Weed Strategy for Western Australia* (CALM 1999). The rating and criteria for these species' inclusion under this strategy, as well as their rating against the invasiveness criteria of the DEC Invasive Plant Prioritization Process (DEC 2012a), is presented in Table 4.

Table 4: Introduced Flora Recorded in the Study Area, Including Their Rating by the Environmental Weed Strategy (CALM 1999) and the DEC Invasive Plant Prioritization Process (DEC 2012a)

Taxon (Common Name)	Rating (CALM 1999)	Criteria (DEC 2012a)		
		Ecological Impact	Invasiveness	Feasibility of Control
**Arctotheca calendula (capeweed)*	Moderate	Moderate	Moderate	Low
**Briza maxima* (blowfly grass)	Moderate	Unknown	Rapid	Low
**Carpobrotus edulis* (hottentot fig)	Moderate	Unknown	Rapid	High
**Cortaderia selloana* (pampas grass)	High	High	Rapid	Moderate
**Crassula natans* var. *minus* (pond stone crop)	Moderate	Low	Rapid	Unknown
**Cynodon dactylon* (couch)	Moderate	High	Rapid	Moderate
**Ehrharta longiflora* (annual veldt grass)	Moderate	Unknown	Rapid	Moderate
**Eragrostis curvula* (african lovegrass)	High	Unknown	Rapid	Low
**Hypochaeris glabra* (flat weed)	Moderate	Moderate	Rapid	Low
**Lotus subbiflorus* (hairy birdsfeet)	unknown	Unknown	Rapid	Low
**Moraea flaccida* (one leaf cape tulip)	High	High	Moderate	Moderate
**Poa annua* (winter grass)	Mild	Unknown	Unknown	Unknown

Taxon (Common Name)	Rating (CALM 1999)	Criteria (DEC 2012a)		
		Ecological Impact	Invasiveness	Feasibility of Control
**Ursinia anthemoides*	Moderate	Unknown	Rapid	Unknown
**Vulpia myuros* (rats tail fescue)	Moderate	Unknown	Rapid	Unknown
**Zantedeschia aethiopica* (Arum lily)	High	High	Moderate	Low

The two species listed as Declared Plants on the Swan Coastal Plain identified during the survey (Figure 9) were:

- Arum Lily (**Zantedeschia aethiopica*) (Plate 3) listed as P1 for the Whole State; and
- One Leaf Cape Tulip (**Moraea flaccida*) (Plate 4) listed as P1 for the Whole State.

Plate 3: : Arum Lily (*Zantedeschia aethiopica)

Source: ENV

Plate 4: One Leaf Cape Tulip (**Moraea flaccida*) Source: WAH (2012)

4.3 VEGETATION

4.3.1 Vegetation Associations

Four vegetation associations were identified across the study area (Figure 10). The extent of each association is presented in Table 5.

Table 5: Vegetation Associations and their Extent in the Study Area

Map Reference Vegetation Code	Vegetation Association	Extent in Study Area (%)	Extent in Study Area (ha)
KRZ1 & KRZ3 MpMr	Low Open Woodland of *Melaleuca preissiana, Melaleuca rhaphiophylla,* over *Regelia ciliata, Kunzea glabrescens, Acacia pulchella* and *Hypolaena exsulca.*	9	0.41
KRZ2 & KRZ6 Kg	Tall Open Scrub of *Kunzea glabrescens* with *Regelia ciliata, Melaleuca viminea, Hypolaena exsulca, Baumea juncea* and *Acacia pulchella* with scattered *Melaleuca preissiana.*	14	0.59
KRZ4 Ba	Woodland of *Banksia attenuata* and *Banksia ilicifolia* over *Kunzea glabrescens, Hibbertia subvaginata, Melaleuca thymoides, Dasypogon bromeliifolius, Lyginia imberbis* and *Phlebocarya ciliata.*	10	0.45
KRZ5 Mv	Shrubland of *Melaleuca viminea* over *Centrolepis polygyna, Isolepis cernua* var. *setiformis, *Crassula natans* var. *minus* and **Lotus subbiflorus.*	1	0.03

4.3.2 Vegetation Condition

Vegetation condition ranged from Completely Degraded to Excellent (Figure 11). Vegetation clearing for access tracks and fire breaks, recreational vehicle access, urban development and weeds within and adjacent to the study area were the most frequently observed impacts on native vegetation.

The entire study area was dissected by an access track; this has been mapped as Completely Degraded and covered 66% of the study area (Table 6). In some areas the track did not influence the condition of the vegetation adjacent and therefore the vegetation was regarded to be in excellent condition. In other areas the track has been used by recreational vehicles and this has contributed to the disturbance and introduction of weeds into the adjacent vegetation, therefore reducing the condition.

Approximately 15.48% of the study area was in Excellent condition (Table 6). Areas mapped as Excellent show relatively low levels of disturbance, with exception of the track, with low densities of aggressive weeds.

Table 6: Vegetation Condition Recorded in the Study Area

Vegetation Condition	Area (ha)	Proportion of Study Area (%)
Excellent	0.68	15.4
Very Good	0.01	0.3
Good	0.51	11.5
Degraded	0.29	6.6
Completely Degraded (cleared)	2.94	66.2
Total	4.43	100

Fire age was variable across the site and ranged between Young (one to four years since last fire) to Old (eight to 12 years since the last fire).

4.3.3 Floristic Community Types

The FCTs represented by the vegetation within the study area were inferred by statistical analysis (Primer) and further data interpretation, as shown in Table 7 below. Due to the inconclusive results of the statistical analysis there was a need to further analyse the data to clarify what FCTs best correlate with the vegetation associations in the study area. This involves reviewing site data for other factors that are diagnostic for FCTs, including the presence of indicator species, soil types and landform position.

Table 7: Floristic Community Type Analysis

ENV Vegetation Association	Floristic Community Types[1]	Similarity %	Comments	ENV Inferred Floristic Community Type
MpMr (KRZ1 & KRZ3) Low Open Woodland of *Melaleuca preissiana*...	SCP14-Deeper Wetlands on sandy soils	25.8	SCP14 is only known to occur north of Perth and so the analysis results are considered incorrect. SCP4 is more likely to occur on site and there are similarities between SCP4 and the flora on site.	SCP4-*Melaleuca preissiana* damplands
	SCP12 – *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands	20.7	The vegetation is not representative of SCP12 as the vegetation was a *Melaleuca* woodland and many of the typical species of SCP12 was absent.	
	SCP6 – Weed dominated wetlands on heavy soils	19.5	SCP6 is not known to occur on the landform type that is present at the site.	
Kg (KRZ2 & KRZ6) Tall Open Scrub of Kunzea glabrescens….	SCP14-Deeper Wetlands on sandy soils	25.8	SCP14 is only known to occur north of Perth and so the analysis results are considered incorrect. SCP4 is more likely to occur on site and there are similarities between SCP4 and the flora on site.	SCP5-Mixed Shrub damplands
	SCP12- *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands	22.64	The vegetation is not represented by SCP12 as the majority of the species typical of SCP12 were not present.	
	SCP11-Wet forests and woodlands	21.69	The vegetation is not represented by SCP11 as the majority of the species typical of SCP11 were not present.	

ENV Vegetation Association	Floristic Community Types[1]	Similarity %	Comments	ENV Inferred Floristic Community Type
Ba (KRZ4) Woodland of *Banksia attenuata* and *Banksia ilicifolia*…..	SCP22-*Banksia ilicifolia* woodlands	26.5	Even though *Banksia ilicifolia* was present on site it was not dominant and the majority of the other typical species for this vegetation type were absent.	SCP21c-Low lying *Banksia attenuata* woodlands or shrublands (Priority 3)
	SCP21c-Low lying *Banksia attenuata* woodlands or shrublands	19.91	Even though *Banksia menziesii*, which is a common species found within SCP21c, was not recorded from the site, the vegetation does have the most similarity with SCP21c in terms of landscape characteristics and understory species.	
	SCP23a-Central *Banksia attenuata – Banksia menziesii* woodlands	17.82	Due to the low lying situation of the vegetation community it is unlikely that the vegetation is represented by 23a	
Mv (KRZ5) Shrubland of *Melaleuca viminea*……	SCP12- Melaleuca teretifolia and/or Astartea aff. fascicularis shrublands	14.63	The vegetation is not represented by SCP12 as the majority of the species typical of SCP12 was not present.	Due to the lack of species present within the community it is not possible to determine the FCT for the site through data

ENV Vegetation Association	Floristic Community Types[1]	Similarity %	Comments	ENV Inferred Floristic Community Type
	SCP16-Highly saline seasonal wetlands	11.76	SCP16 is not known to occur in the area therefore it is unlikely the vegetation type is present on site.	analysis, however based on the soil, location, and community structure the site is likely to be either SCP8 Herb rich shrublands in claypans (listed as 'Vulnerable' by the state and 'Critically Endangered' under the EPBC Act 1999) or SCP10aShrublands on dry clay flats (listed as 'Endangered' by the state and 'Critically Endangered' under the EPBC Act 1999)
	SCP18-Shrublands on calcareous silts	11.11	SCP18 is known to occur on lake deposits therefore would not be present on site.	

1. Gibson et al. 1994

4.3.4 Regional Representation

Vegetation associations described in the study area were not able to be correlated with the Beard (1979)/ Shepherd et al. (2001) broad vegetation types. This is due to the Beard mapping being undertaken at a scale of 1:250 000 and the site being surveyed at a much finer scale.

4.3.5 Vegetation of Conservation Significance

Of the four vegetation associations mapped on site two are considered to be of conservation significance. Ba (KRZ4) has been identified as FCT SCP21c-Low lying *Banksia attenuata* woodlands or shrublands, which is listed as a Priority 3 by the Species and Communities Branch, DEC.

The other vegetation association considered to be of conservation significance is Mv (KRZ5) which, although it is unable to be definitively identified to a single FCT, is conclusively either SCP8 Herb rich shrublands in claypans (which is listed as Vulnerable by the state and Critically Endangered under the EPBC Act) or SCP10a Shrublands on dry clay flats (which is listed as Endangered by the state and Critically Endangered under the *EPBC Act*).

4.3.6 Wetlands

The DEC Geomorphic Wetlands Dataset identified wetlands of both Conservation and Multiple Use management categories as occurring within the study area (Figure 5). The unique identification numbers (UFI) of the 13 wetlands within the study area are provided within Table 8.

Table 8: Unique Identification Number of Wetlands within the Study Area

Wetland UFI	Management Category
13347	Multiple Use
7219	
14844	
14876	
7384	Conservation Category
14167	
14891	
7482	
14893	
14165	
15183	
15427	
14170	
14875	

4.4 FAUNA

4.4.1 Habitat Assessment

The study area contains three habitat types; *Banksia* Woodland, *Melaleuca* Shrubland and Cleared Land which encompasses all land where native vegetation has been cleared e.g. tracks, roads etc (Figure 12).

Banksia Woodland

The Banksia Woodland covers approximately 0.16 ha of the study area (3.56%).The woodland is dominated by *Banksia attenuata* and *Banksia ilicifolia* over *Kunzea glabrescens*, *Hibbertia subvaginata*, *Melaleuca thymoides*, *Dasypogon bromeliifolius, Lyginia imberbis* and *Phlebocarya ciliata*. The *Banksia* Woodland is the highest ranked habitat within the study area with an average habitat value of 23. High habitat values are driven by the soft sands which provide burrowing suitability for borrowing and digging amphibians, reptiles and mammals. The *Banksia* Woodland also has a relatively high cover for all three vegetation layers (overstorey, midstorey and understorey) which provide habitat for a range of different avifauna species. Due to the low topography much of the surrounding area becomes seasonally inundated following large periods of rainfall, as such most of this habitat received high values for its close proximity to water which provides a drinking resource for mammals and breeding habitat for amphibians. The ground contained relatively high amounts of leaf litter and woody debris which provides habitat for ground dwelling fauna.

Melaleuca Shrubland

The *Melaleuca* shrubland is the most widespread and dominant habitat within the study area, it covers approximately 1.34 ha of the study area (30.07%). The habitat is dominated by *Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca viminea* and *Kunzea glabrescens* over *Regelia ciliata*, *Centrolepis polygyna and Isolepis cernua* var*. setiformis*. The average habitat value for *Melaleuca* shrublands is 18.75 with a habitat score ranging from 18-20. High habitat values are driven by the soft sand which provides burrowing suitability for borrowing and digging amphibians, reptiles and mammals. The surrounding area was inundated with water and the habitat received high scores for its close proximity to water and the value it provides for species who prefer or are dependent on a water resource. The *Melaleuca* Shrublands have a high proportion of leaf litter cover and understorey vegetation of herbs, grasses and sedges which provides suitable habitat for ground dwelling species. The lack of overstorey vegetation is suited to larger birds such as raptors that may utilise the area when foraging.

Cleared Land

The cleared land covers approximately 2.95 ha of the study area (66.37%). The cleared land is completely degraded, it composes of sand tracks and fire breaks which run the length of the study area. These areas are sparsely vegetated and provide very little

microhabitat complexity, lacking cover and food resources for vertebrate fauna. While the soft sands are well suited for digging and burrowing vertebrate species, the lack of vegetation will discourage species from utilising these areas. No habitat assessments were undertaken in these areas due to the lack of habitat it provides for vertebrate fauna.

4.4.2 Fauna Assemblage

All fauna previously recorded in the vicinity of the site are listed in Appendix F. As a Level 1 survey was conducted, a limited number of fauna were recorded during the survey, particularly ground dwelling reptiles and mammals. A total of 26 species were recorded from within the study area, 253 species have been previously recorded within the vicinity of the study area.

Amphibians

A total of twelve species of amphibians have been previously recorded in vicinity of the study area (Appendix F). The amphibians most likely to occur are the Western Banjo Frog (*Limnodynastes dorsalis*) and the Turtle Frog (*Myobatrachus gouldii*).

No amphibians were recorded during the fauna assessment.

Reptiles

Sixty-three species of reptile have been previously recorded in the vicinity of the study area (Appendix F). Reptiles likely to occur at the site include the Variegated tree Dtella (*Gehyra variegata*), the Bobtail (*Tiliqua rugosa rugosa*) and the Western Bearded Dragon (*Pogona minor minor*).

One species of reptile was recorded during the fauna assessment, a Dugite (*Pseudonaja affinis*).

Avifauna

Two hundred and twenty-four species of birds have been previously recorded in the vicinity of the study area (Appendix F). Many of these are unlikely to occur at the site, since these records are from a larger area encompassing a wide range of habitats and include rare birds that only occur on a transitory basis.

Twenty-four species of bird from seventeen families were recorded during this survey including three species belonging to the family Meliphagidae (Honeyeaters) and three species belonging to the family Columbidae (Pigeons, Doves). Other common birds of the study area included the Galah (*Eolophus roseicapilla*), Pacific Black Duck (*Anas superciliosa*) and Splendid Fairywren (*Malurus splendens*).

Mammals

Twenty-five species of mammal have previously been recorded in the vicinity of the study area (Appendix F). Many of these are unlikely to occur at the site, since these records are from larger areas encompassing a wide range of habitats, and small mammals tend to be habitat-specific.

During the fauna assessment evidence of two mammal species were recorded. This included evidence of one native mammal, the Quenda (Southern Brown Bandicoot; *Isoodon obesulus*) and one introduced mammal species, the Rabbit (*Oryctolagus cuniculus*).

4.4.3 Fauna of Conservation Significance

There are 27 conservation significant fauna species which have been previously recorded within the vicinity of the study area (Appendix M). Some of these are unlikely to occur on the site as they have a limited or patchy distribution, high level of habitat specificity, are locally extinct or were erroneously recorded in previous surveys.

Evidence of one species was recorded during the survey, the Quenda which is a Priority 5 listed species by the DEC. Four species of conservation significant species are considered 'Likely' to occur within the study area: Forest Red-tailed Cockatoo (*Calyptorhynchus banksii naso*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and the Rainbow Bee-eater (*Merops ornatus*) (Appendix O). A further six species are considered 'Possible' to occur, ten species are considered 'Unlikely' to occur and six are classified as 'Highly Unlikely' to occur; based on their ecology, habitat present and fauna records (Appendix M).

5 DISCUSSION

5.1 CONTEXT

A total of 94 taxa (including species, subspecies, varieties and forms) from 76 genera and 30 families were recorded from the study area. An average of 18.1 species was recorded in each quadrat, with a standard deviation of ± 5.6.

The flora species richness recorded during the survey is considered to be low for the area and for the condition of the vegetation. The average flora richness per quadrat recorded during this survey, 18.1 species per quadrat, is lower than the species richness recorded by Gibson et al. (1994) within the FCTs represented on site. For example Gibson et al. (1994) recorded a mean species richness of 36.9 species within SCP04 '*Melaleuca preissiana* damplands' and 40.5 species within SCP21c 'Low lying *Banksia attenuata* woodlands or shrublands'.

Part of the difference in species richness can be attributed to survey differences, variation and environmental factors. The survey differences include that Gibson et al. (1994) conducted a larger number of quadrats (16 within both SCP04 and SCP21c) and that these quadrats were conducted within vegetation of best condition for each FCT. In contrast, the current survey is based on six quadrats and is adjacent to disturbed areas.

Environmental factors including the low rainfall experienced in the year prior to the survey being undertaken have also affected the species richness. However, it is not possible to quantify the extent that low rainfall would have impacted on the current species diversity within the study area. For example, the low rainfall may have suppressed the rejuvenation of species that usually germinate seasonally.

5.2 FLORA OF CONSERVATION SIGNIFICANCE

No threatened species pursuant to the *EPBC Act* and no plant taxa gazetted as DRF/Threatened pursuant to the WC Act were recorded in the study area. This is despite five species listed as Endangered and one listed as Vulnerable by the *EPBC Act* being identified as potentially occurring in the study area. These include four orchid species, one sedge species and one shrub species.

The four Endangered / Vulnerable orchids (*Caladenia huegelii*, *Diuris purdiei*, *Drakaea elastica* and *Drakaea micrantha*) are all perennial species persisting as tubers in the soil and only identifiable when in flower. Orchids are known to be sensitive to rainfall and in low rainfall seasons may flower late in the season or not at all. Suitable habitat for all of these species is present within the study area. These species were not recorded during the survey but potentially could be present.

The remaining Endangered species, one sedge species (*Lepidosperma rostratum*) and the one shrub species (*Verticordia plumosa* var. *pleiobotrya*), were searched for and neither were located. ENV considers that these species would have been present at the time of the survey and as they were not recorded, these species are not expected to occur within the study area.

One Priority 3 Flora was located within the study area, *Jacksonia gracillima* (P3). *Jacksonia gracillima* is known from two locations in Western Australia, Forrestdale and Busselton-Capel. Eleven records exist in the vicinity of Forrestdale, approximately 6 km south east of the study area, and ten records exist in the vicinity of Busselton-Capel, approximately 213 km south of the study area (DEC 2012f). The number of individuals present at each of these locations has not been recorded. Thus, it is not possible to determine the significance of the population recorded within the study area. However, there are two distinct populations and the individuals of *Jacksonia gracillima* recorded within the study area increases the known Forrestdale populations. The field survey included a targeted search for this species and it is considered unlikely that additional individuals occur within the study area. The presence of *Jacksonia gracillima* (Priority 3) does not form a statutory constraint to development of the study area. There is no written policy on how to respond to the presence of Priority Flora species within proposed work sites. The presence of these species is dealt with by the DEC on a case by case basis.

Of the remaining Priority Flora identified as potentially occurring within the study area, 15 are perennial species and five are annual species. Individuals of the 15 perennial species should have been identifiable and present at the time of the survey. Therefore, it is considered unlikely that these species occur within the study area. The annual species, *Schoenus capillifolius* (P3) and *Microtis quadrata* (P4), occur within habitat that is not present on site. The remaining annual priorities, *Schoenus pennisetis (P1), Stylidium longitubum* (P3) and *Ornduffia submerse* (P4) are known to favour seasonally wet flats (WAH 2012). The low winter rainfall experienced during 2010 may have affected the emergence of these species, and they may occur on site.

The survey was undertaken at the appropriate time of year (spring); however the low winter rainfall in the region may have affected the emergence of some orchid and/or annual species within the study area.

5.3 VEGETATION OF CONSERVATION SIGNIFICANCE

The vegetation association Ba is considered to be representative of SCP21c, despite SCP22 generating the highest percentage similarity with the vegetation (26.5% similarity). Both of these FCTs are listed as PECs by the DEC and based on factors, including the landform on which they occur and their position on the Swan Coastal Plain, the vegetation could represent either FCT. However, the vegetation association, Ba, is considered to represent SCP21c. This comparison is supported by the dominant

and typical species identified by Gibson et al. (1994) as being characteristic of SCP21c. Importantly, the dominant overstorey species are common between the vegetation unit and SCP21c; these being *Banksia attenuata* and *Banksia menziesii*. In contrast the overstorey species of SCP22, *Banksia ilicifolia* was sparse within the vegetation on site. SCP21c is known to occur within the Harrisdale area and has been inferred as occurring within the surrounding Bush Forever sites including sites 262, 342 and 413 (Government of Western Australia 2000b).

SCP21c is listed as a Priority 3 PEC by the DEC. Priority communities listed by the DEC have no formal protection. There is no written policy on how to respond to the presence of PECs within proposed development sites. The presence of these communities is dealt with by the DEC on a case by case basis.

The analysis identified SCP12, SCP16 and SCP18 as possible FCTs for vegetation association Mv; however these were not considered to be probable based on the lack of typical species present at the site and also the location. The site is neither a saline seasonal wetland or within a lake deposit.

Given the very low diversity of vegetation association Mv, a single FCT could not be determined. Based on the soil, location, and community structure it can however be concluded that the site is likely to be either SCP8 Herb rich shrublands in claypans or SCP10a Shrublands on dry clay flats. Both these FCTs have been previously recorded within close proximity (one record is as close as 250 m away). Both of these FCTs are listed as TECs by both the State and the Commonwealth.

ENV advises that the presence of the TEC needs to be confirmed by the DEC. The DEC advises that it is not able to make decisions regarding the presence of a TEC without receiving a flora and vegetation report in conjunction with a planning application as part of the statutory approvals process.

If the DEC identifies that the vegetation within the site is not representative of the TEC then no further action will need to be taken regarding this matter. ENV considers that under this circumstance the vegetation association Mv will not pose a constraint to development.

If the DEC confirms the presence of the TEC, they may seek a retention outcome in relation to the specific site characteristics. The DEC makes decisions regarding TECs on a case by case basis. It is ENVs understanding that many factors influence the constraints and requirements imposed by the DEC in regards to the presence of a TEC. These include but are not limited to: the size and condition of the remnant within the study area; the representation and condition of the TEC in other remnants in the local area; and the representation of the TEC within protected areas. The DEC typically seeks at a minimum, the retention of vegetation in good or better condition plus a management buffer.

5.4 VEGETATION CONDITION AND INTRODUCED FLORA

Fifteen introduced species were recorded within the study area. The majority of these are considered to be common agricultural and bushland weeds in the region (Hussey et al. 2007). None of these species are registered as WONS, however, all 15 species are listed as environmental weeds, as defined by the Environmental Weed Strategy for Western Australia (CALM 1999).

Two Declared Plants were recorded within the study area: Arum Lily (**Zantedeschia aethiopica*) and One Leaf Cape Tulip (**Moraea flaccida*). These species are listed as P1 for the Whole State.

5.5 REGIONAL REPRESENTATION

The study area is mapped as Southern River Complex (Heddle et al. 1978). The Southern River Complex was estimated to have 19.8% native vegetation remaining based on the pre-European extent with 1.5% in secure tenure (EPA 2006).

More recently the Perth Biodiversity Project (PBP 2010) has mapped native vegetation extent by vegetation complex on the Swan Coastal Plain. It is estimated that 19.7% of Southern River Complex remains compared to its pre-European extent (PBP 2010).

The EPA's policy on the protection of native vegetation in Western Australia, in the context of pre-European vegetation extent remaining, is based on the following criteria:

From purely a biodiversity perspective and taking no account of any other land degradation issues, there are several key criteria now being applied where clearing is still occurring (EPA 2000):

- The threshold level below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type; and
- A level of 10% of the original extent is regarded as being a level representing "endangered".

The pre-European vegetation in the Southern River Complex, which the study area is situated, is under the threshold level set by the EPA (EPA 2000). Due to the study area being below the 30% threshold level, the EPA would expect alternative mechanisms to be put forward to address the protection of biodiversity (EPA 2000).

5.6 BUSH FOREVER

The Government of Western Australia has endorsed Bush Forever as the means of seeking the appropriate protection and management of areas of regionally significant

bushland on the Swan Coastal Plain Portion of the Perth Metropolitan Region and a balance between environmental, social and economic objectives.

The majority of the survey area is within a Bush Forever site that has been identified as containing regionally significant bushland with some existing protection. The vegetation varies between Good and Excellent condition in these areas.

The site meets criteria for regionally significant vegetation based on its representation of ecological communities, diversity, rarity (species and communities, Scientific or evolutionary importance, and General Criteria for the protection of wetlands.

5.7 WETLANDS

The site is mapped by the DEC as supporting Conservation and Multiple Use Category wetlands. The wetlands cover the majority of the site according to the Geomorphic Wetland mapping (DEC 2012g). Each of the vegetation associations mapped on site correlate with this information as they are either wetland communities or are likely to occur on low lying landscapes with higher soil moisture. Due to the broad scale of the DEC wetland mapping however, tracks have also been mapped as wetlands. Therefore more than half of the site (66.2%) does not actually contain wetland vegetation (Figure 5).

Conservation category wetlands are in the highest category of protection, and they are ESAs under the EP Act. Conservation Category wetlands are also identified for protection and enhancement in the Western Australian Planning Commission State Planning Policy 2.9 – Water Resources.

5.8 FAUNA HABITAT TYPES

The study area consists of three habitat types; *Banksia* Woodland dominated by *Banksia attenuata* and *Banksia ilicifolia*, *Melaleuca* Woodland dominated by *Melaleuca preissiana, Melaleuca rhaphiophylla, Melaleuca viminea* and *Kunzea glabrescens* and Cleared Land. Both the *Banksia* Woodland and *Melaleuca* Woodland habitats included in the study area border severely degraded areas which contain low fauna habitat value. Furthermore the habitat included in the study area is a very small proportion in comparison to the bushland surrounding the area. Species that occur within these habitats are likely to utalise these areas on a short term basis only (i.e. when commuting between neighbouring habitats).

Banksia Woodland

High habitat values of the *Banksia* Woodland are driven by the soft sands and high densities overstorey, midstorey and understorey vegetation layers. The soft sands provide ideal habitat for borrowing and digging amphibians such as the Banjo Frog (*Limnodynastes dorsalis*), reptiles such as Burton's Legless Lizard (*Lialis burtonis*) and

mammals such as the Quenda/Southern Brown Bandicoot (*Isoodon obesulus*). The ground contains relatively high amounts of leaf litter and woody debris providing ground dwelling fauna, particularly reptiles, places to bask and forage while keeping hidden from predators. The high cover values of overstorey, midstorey and understorey vegetation are ideal for small passerine species such as the Hooded Robin (*Melanodryas cucllata*) and Splendid Fairy Wren (*Malurus splendens*) which forage low to the ground for small insects. *Banksia* species are an important food resource for many species both common species such as honeyeaters but also for threatened species such as the three Black Cockatoo species known to occur across the region. Black Cockatoo feed on the flowers and seeds of *Banksia* species (Groom 2011) which is historically a large component of the species diet and has extensively cleared due to urban expansion (Johnstone & Kirkby 2011). The Banksia Woodland in the study area is however highly degraded and covers a small area (< 1 ha) and clearing of the study area will have minimal impact to any species that occur in this habitat.

Melaleuca Shrubland

High habitat vales of the *Melaleuca* Woodlands are due to the soft sand for burrowing species and the high proportion of leaf litter which provides suitable cover for ground dwelling species. Reptile species, in particular, forage and bask amongst the leaf litter as it provides cover from predators above e.g. small skinks such as *Hemiergis quadrilineata*, legless lizards such as *Pygopus lepidopodus* and snakes such as the Bardick (*Echiopsis curta*). The dense *Melaleuca* shrubs provide foraging habitat for small common passerines which feed on insects and small reptiles such as the Rufous Whistler (*Pachycephala rufiventris*), Western Gerygone (*Gerygone fusca*) and Grey Shike-thrush (*Colluricincla harmonica*). The *Melaleuca* and *Kunzea*, when in flower, provide a foraging resource for a suite of common nectivorous species such as the Red Wattlebird (*Anthochaera carunculata*) and the Tawny-crowned Honeyeater (*Gliciphila melanops*). This habitat coverage within the study area is minimal in comparison to the surrounding bushland, clearing of this land will have minimal effect on any species which occur in the area.

Cleared Land

The Cleared Land within the study area provides very little fauna habitat. Species most likely to occur in this area are generalist species that are common and widespread throughout the region. Birds include the Australian Magpie (*Gymnorhina tibicen*), Australian Raven (*Corvus coronoides*) and the Australian Ringneck (*Barnardius zonarius*). Ground dwelling fauna are only likely to occur when commuting to and from neighbouring habitats, as such any species which occurs within this habitat is not dependent on it and will not be affected by the planned development.

5.9 FAUNAL ASSEMBLAGE

A total of 26 species were recorded from within the study area, comprising one reptile, 23 birds and two mammals. A total of 253 species have been previously recorded within the vicinity of the study area. As this was a Level One survey to assess fauna habitat types, many of the potentially occurring species were not recorded. For example, many of the ground dwelling reptiles and mammals are mainly recorded or captured from trapping techniques employed during a Level Two survey. In addition, some potentially occurring species are nocturnal and the surveys were conducted during the day.

The expected fauna assemblage of the study area consists of species that are generally common and widespread throughout the region and are not dependent upon the habitat found within the study area.

5.10 CONSERVATION SIGNIFICANT FAUNA

No conservation significant species were recorded during the survey. Four species of conservation significant fauna are considered as 'Likely' to occur in the study area; Forest Red-tailed Cockatoo, Baudin's Black Cockatoo, Carnaby's Black Cockatoo and the Rainbow Bee-eater.

Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo (FRBC) is distributed throughout the humid and subhumid southwest of Western Australia from Gingin through the Darling Ranges to the southwest, from approximately Bunbury to Albany (Johnstone & Storr 1998). The FRBC occurs in pairs or small flocks, or occasionally in large flocks of up to 200 birds (Johnstone & Storr 1998). The FRBC usually inhabits dense Jarrah (*Eucalyptus marginata*), Karri (*Eucalyptus diversicolor*) and Marri forests that receive more than 600 mm average annual rainfall (Chapman 2007). This species breeds in the southwest between October and November. The FRBC feeds primarily on Marri and Jarrah fruit (SEWPAC 2011). They have also been known to feed on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri, Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone & Kirkby 1999). The FRBC population is estimated at approximately 15,000 birds (Johnstone & Kirkby 1999). The primary threat to the FRBC is the loss of habitat loss due to clearing and forestry (Garnett et al. 2011). The FRBC has been frequently recorded within the vicinity of the study area. While historically the species was more common in the south-west of its distribution, degradation and clearing of foraging resources in the southwest have meant a dynamic expansion of the species onto the Swan Coastal Plain, particularly within the Perth region (Johnstone & Kirkby 2011). Habitat suitable for the species within the study area is limited and degraded. the vegetation of the study area provides no known foraging, roosting or breeding species for the FRBC and there will be minimal impact to the species by the proposed development.

Baudin's Cockatoo

The Baudin's Cockatoo is distributed throughout the south western humid and sub humid zones, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany (Johnstone & Storr 1998). This species forages primarily in eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds (Johnstone & Kirkby 2008). They also feed on a wide range of seeds of *Eucalyptus, Banksia, Hakea* and exotic *Pinu*s (Pine) species, as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone & Kirkby 2008; Johnstone & Storr 1998). Baudin's Cockatoo is mostly a postnuptial nomad, although some populations are resident (Johnstone & Kirkby 2008). Most Baudin's Cockatoos breed in the deep south-west in spring-summer, from around October to March. Following breeding birds leave nesting areas and amalgamate to form large foraging flocks. These flocks generally migrate north to the main non-breeding wintering area in the northern Darling Range between Collie and Mundaring (Johnstone & Kirkby 2008). The total population of Baudin's Cockatoo is estimated to be about 15 000 birds, and has declined greatly in the last 50 years primarily from habitat destruction (Johnstone & Kirkby 2008). The Baudin's Black Cockatoo has been frequently recorded within the vicinity of the study area. The *Banksia attenuata* within the *Banksia* Woodland habitat is a potential food resource for the species (Chapman 2007; Johnstone & Kirkby 2008; SEWPAC 2011). This habitat within the study area is limited (0.16 ha) and widely distributed in the bushland surrounding the study area. Due to the limited habitat suitable of the species and its degraded condition, there will be minimal impact to the Baudin's Black Cockatoo.

Carnaby's Cockatoo

The Carnaby's Cockatoo is listed as Endangered under the *EPBC Act* and Schedule 1 under the WC Act. Carnaby's Cockatoo is endemic to southwest Western Australia, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last 45 years, and is now locally extinct in some areas (Johnstone & Storr 1998; Shah 2006). In the last 45 years the species has suffered a 50% reduction in its abundance due to the extensive clearing of core breeding habitat in the wheatbelt, and the clearing of food resources upon the Swan Coastal Plain (Cale 2003). The total population of Carnaby's Cockatoo is currently estimated at 40,000 (Garnett et al. 2011). Breeding usually occurs from early July to mid-December, in the semi-arid and subhumid interior of WA's wheatbelt (Johnstone & Storr 1998). The Carnaby's Black Cockatoo (DEC 2012e) has been previously recorded throughout the vicinity of the study area. The *Banksia attenuata* and *Banksia ilicifolia* of the *Banksia* Woodland habitat within the study area provides potential foraging habitat for the species (Groom 2011; Valentine & Stock 2008; SEWPAC 2011). This habitat encompasses a small area and is highly disturbed. As such, there is likely to be minimal impact to the Carnaby's Black Cockatoo.

Rainbow Bee-eater

The Rainbow Bee-eater is listed as Migratory under the EPBC Act. This species is one of the most common and widespread birds in Australia with a distribution that covers the majority of Australia (Barrett et al. 2003). In Western Australia this bird can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone & Storr 1998). Although the species was not recorded during this survey it has been previously recorded in the vicinity of the study area (DEC 2012e). The study area provides suitable foraging habitat and suitable nest sites in the sandy soil and can be expected in all of the habitats present. The species is not however, dependent on the habitats represented in the study area, and the common and widespread distribution of this species ensures that the proposed development will not impact upon its conservation status.

6 RECOMMENDATIONS

ENV.Australia makes the following recommendations:

6.1 FLORA

- Clearing of any TEC or PEC vegetation should be avoided;
- As a matter of principle, any clearing of native vegetation should be kept to a minimum;
- Existing tracks should be used where possible and vehicles should avoid parking, turning or reversing into vegetation;
- Clearing of known locations of all Priority flora should be avoided wherever possible; and
- Hygiene practices should be put into place to avoid the spreading of weeds.

6.2 FAUNA

The following recommendations are provided to manage and minimise impacts on fauna:

- Clear the vegetation in stages to enable the resident fauna to seek refuge outside of the study area;
- Any conservation significant ground dwelling species found during the clearing process need to be trapped and translocated by appropriately trained zoologists;
- No dead, standing or fallen timber should be removed unnecessarily;
- Where possible, current tracks and cleared sections should be used for site access to minimise the impact on the area's fauna and habitat;
- Boundaries of areas to be disturbed should be clearly demarcated to prevent any erroneous damage to habitat; and
- Clear during the non-breeding season for Black Cockatoos to avoid disturbance of breeding.

7 ASSESSMENT OF FINDINGS AGAINST THE CLEARING PRINCIPLES

Any clearing of native vegetation requires a permit under Part V Division 2 of the *EP Act*, except where an exemption applies under Schedule 6 of the *EP Act*, or where the clearing is prescribed by regulations in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Exemptions do not apply in an ESA.

Each of the ten clearing principles, as outlined in the *EP Act* 1986, are individually assessed below, within the scope and knowledge of this flora, vegetation and fauna assessment. This project may be at variance with four of the ten clearing principles, depending upon the areas proposed for future impacts.

PRINCIPLE A - NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES A HIGH LEVEL OF BIOLOGICAL DIVERSITY

The flora species richness recorded during the survey is considered to be low for the area and for the condition of the vegetation. The average flora richness per quadrat recorded during this survey, 18.1 species per quadrat, is lower than the species richness recorded by Gibson et al. (1994) within the FCTs represented on site. For example Gibson et al. (1994) recorded a mean species richness of 36.9 species within SCP04 '*Melaleuca preissiana* damplands' and 40.5 species within SCP21c 'Low lying Banksia attenuata woodlands or shrublands'.

A total of 26 vertebrate fauna (one reptile, 23 birds and two mammals) were recorded in the study area. The study area contains three habitat types namely *Banksia* Woodland, *Melaleuca* Shrubland and Cleared Land.

A total of 253 fauna have been previously recorded in the vicinity of the study area from the database search. These consist of 12 amphibians, 63 reptiles, 153 birds and 25 mammals. The proposed development is unlikely to disrupt the fauna assemblage of the study area as the fauna are generally common and widespread throughout the region and are not dependent upon the study area.

Therefore, clearing in the study area is unlikely to be at variance with this principle.

PRINCIPLE B - NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES THE WHOLE OR A PART OF, OR IS NECESSARY FOR THE MAINTENANCE OF, A SIGNIFICANT HABITAT FOR FAUNA INDIGENOUS TO WESTERN AUSTRALIA

No fauna taxa of conservation significance were recorded during the current survey of the study area. Four fauna species of conservation significance are considered as 'Likely' to occur within the project area as it provides suitable habitat; the Forest Red-tailed Black Cockatoo, Baudin's Black Cockatoo, Carnaby's Black Cockatoo and the Rainbow

Bee-eater. All four species of conservation significance likely to occur within the study area are wide-ranging, mobile and not dependent on the study area.

The *Banksia* Woodland of the study area provides a potential foraging resource for the Carnaby's Cockatoo and Baudin's Cockatoo. The *Banksia* Woodland covers a small proportion of the study area and is highly disturbed. Furthermore *Banksia* Woodlands are widespread in the surrounding bushland, as such the Black Cockatoo Species will not be impacted by the clearing of this habitat within the study area.

The Rainbow Bee-eater is a common and wide-ranging species. The study area provides potential foraging and nesting habitat for the species. The species is however, not dependent on the habitats represented within the study area as such the species local or regional status will not be impacted by clearing of the habitats within the study area.

Therefore, clearing in the study area is unlikely to be at variance with this principle.

PRINCIPLE C - NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT INCLUDES, OR IS NECESSARY FOR THE CONTINUED EXISTENCE OF, RARE FLORA

No Threatened species pursuant to the EPBC Act and/or gazetted as Declared Rare Flora (Threatened) pursuant to the WC Act were recorded during the survey.

Therefore, clearing in the study area is unlikely to be at variance with this principle.

PRINCIPLE D: NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT COMPRISES THE WHOLE OR PART OF, OR IS NECESSARY FOR THE MAINTENANCE OF, A THREATENED ECOLOGICAL COMMUNITY

Vegetation association Mv (KRZ5) which, although it is unable to be definitively identified to a single FCT, is conclusively either SCP8 Herb rich shrublands in claypans (listed as Vulnerable by the state and Critically Endangered under the *EPBC Act*) or SCP10a Shrublands on dry clay flats (listed as Endangered by the state and Critically Endangered under the *EPBC Act*).

The disturbances associated with the project are therefore likely to be at variance with this principle.

PRINCIPLE E: NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT IS SIGNIFICANT AS A REMNANT OF NATIVE VEGETATION IN AN AREA THAT HAS BEEN EXTENSIVELY CLEARED

Vegetation associations described in the study area were not able to be correlated with the Beard (1979)/ Shepherd et al. (2001) broad vegetation types. This is due to the Beard mapping being undertaken at a scale of 1:250 000 and the site being surveyed at a much finer scale.

More recently the Perth Biodiversity Project (PBP 2010) has mapped native vegetation extent by vegetation complex on the Swan Coastal Plain. It is estimated that 19.7% of Southern River Complex remains compared to its pre-European extent (PBP 2010).

The pre-European vegetation in the Southern River Complex, which the study area is situated, is considered to be Vulnerable (EPA 2000)

Disturbances associated with the project may be at variance with this principle.

PRINCIPLE F: NATIVE VEGETATION SHOULD NOT BE CLEARED IF IT IS GROWING IN, OR IN ASSOCIATION WITH, AN ENVIRONMENT ASSOCIATED WITH A WATERCOURSE OR WETLAND

The site is mapped by the DEC as supporting Conservation and Multiple Use Category wetlands. The wetlands cover the majority of the site according to the Geomorphic Wetland mapping (DEC 2010).

Conservation category wetlands are in the highest category of protection, and they are recognised as ESAs under the EP Act. Conservation Category wetlands are also identified for protection and enhancement in the Western Australian Planning Commission State Planning Policy 2.9 – Water Resources.

This project is at variance with this principle.

PRINCIPLE G: NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO CAUSE APPRECIABLE LAND DEGRADATION

The gradient across the site is less than five metres (Landgate 2012). The uniformity of the landscape means it is unlikely to be effected by erosion. Due to the scale of proposed clearing it is unlikely to have effect on salinity, nutrient export, acidification or flooding.

Therefore, disturbances associated with the project are unlikely to be at variance with this principle.

PRINCIPLE H: NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO HAVE AN IMPACT ON THE ENVIRONMENTAL VALUES OF ANY ADJACENT OR NEARBY CONSERVATION AREAS

The study area is mapped as Bush Forever Site No. 342, also known as the Anstey/Keane Dampland and Adjacent Bushland, Forrestdale (Government of Western Australia 2000a). The next nearest Bush Forever sites to the study area are; Balannup Lake and Adjacent Bushland, Southern River/Forrestdale (Bush Forever site 413), abutting the northern edge of Site 342 and the Piarra Nature Reserve, Forrestdale (Bush Forever Site 262), approximately 0.6 km south-west of the study area (Government of Western Australia 2000a).

Therefore, disturbances associated with the project may be at variance with this principle.

PRINCIPLE I: NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO CAUSE DETERIORATION IN THE QUALITY OF SURFACE OR UNDERGROUND WATER

As the proposed disturbance area is along existing tracks and involves minimal vegetation clearing, it is unlikely to affect surface or groundwater deterioration.

Therefore, disturbances associated with the project are unlikely to be at variance with this principle.

PRINCIPLE J: NATIVE VEGETATION SHOULD NOT BE CLEARED IF THE CLEARING OF THE VEGETATION IS LIKELY TO CAUSE, OR EXACERBATE, THE INCIDENCE OR INTENSITY OF FLOODING

As the proposed disturbance area is along existing tracks and involves minimal vegetation clearing it is unlikely to cause or exacerbate the instance of flooding in the area.

Therefore, disturbances associated with the project are not likely to be at variance with this principle.

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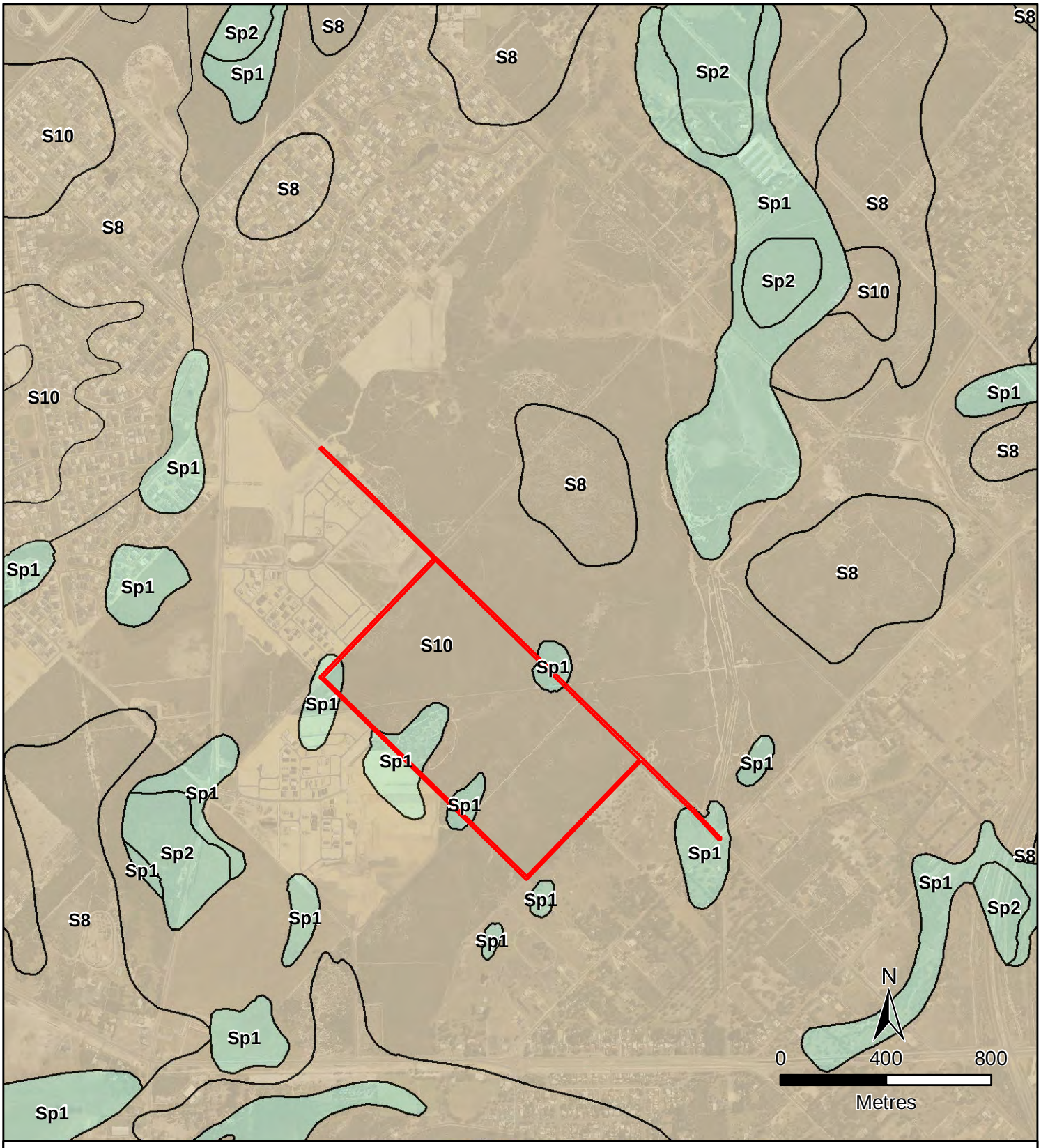
FIGURES



Legend

Sp1 PEATY SAND - grey to black, fine to medium-grained, moderately sorted quartz sand, slightly peaty, of lacustrine origin

S8 SAND - white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals,

S10 SAND - as S8 over sandy clay to clayey sand of the Guildford Formation, of eolian origin

Geological Survey of WA, 1:50K Surface Geology

env Australia

CLIENT	JOB NO.
Water Corporation	J113163
AUTHOR	**DRAWN**	**DATE**
D. Buller	T. Ellis	02-10-12
SCALE	**PROJECTION**
1:20,000@ A4	GDA 94 MGA 50

Geology of the Study Area

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 3

CLIENT
Water Corporation

JOB NO.
J113163

AUTHOR
D. Buller

DRAWN
T. Ellis

DATE
02-10-12

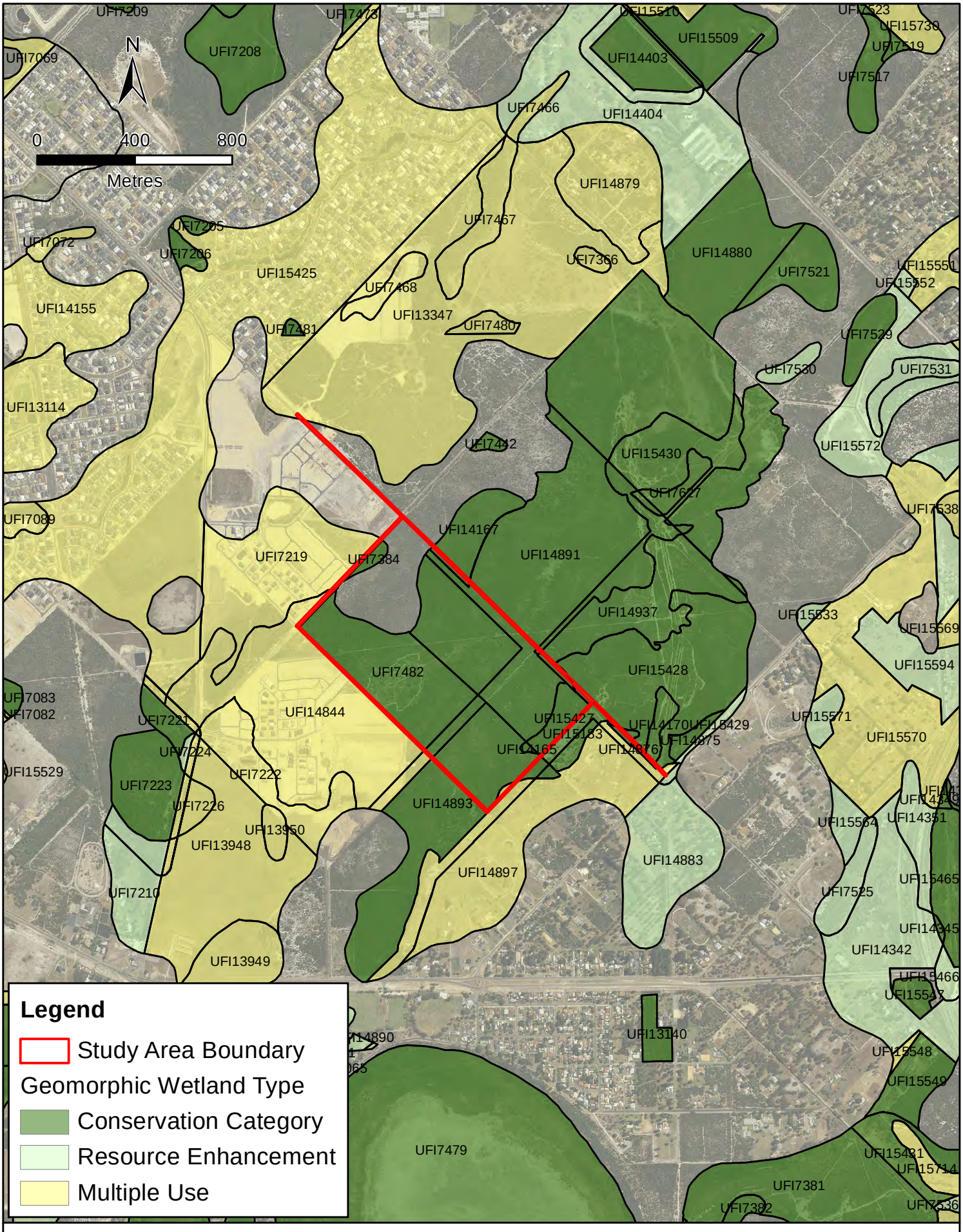
SCALE
1:50,000 @ A4

PROJECTION
GDA 94 MGA 50

System 6 Vegetation Complexes of the Study Area

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 4

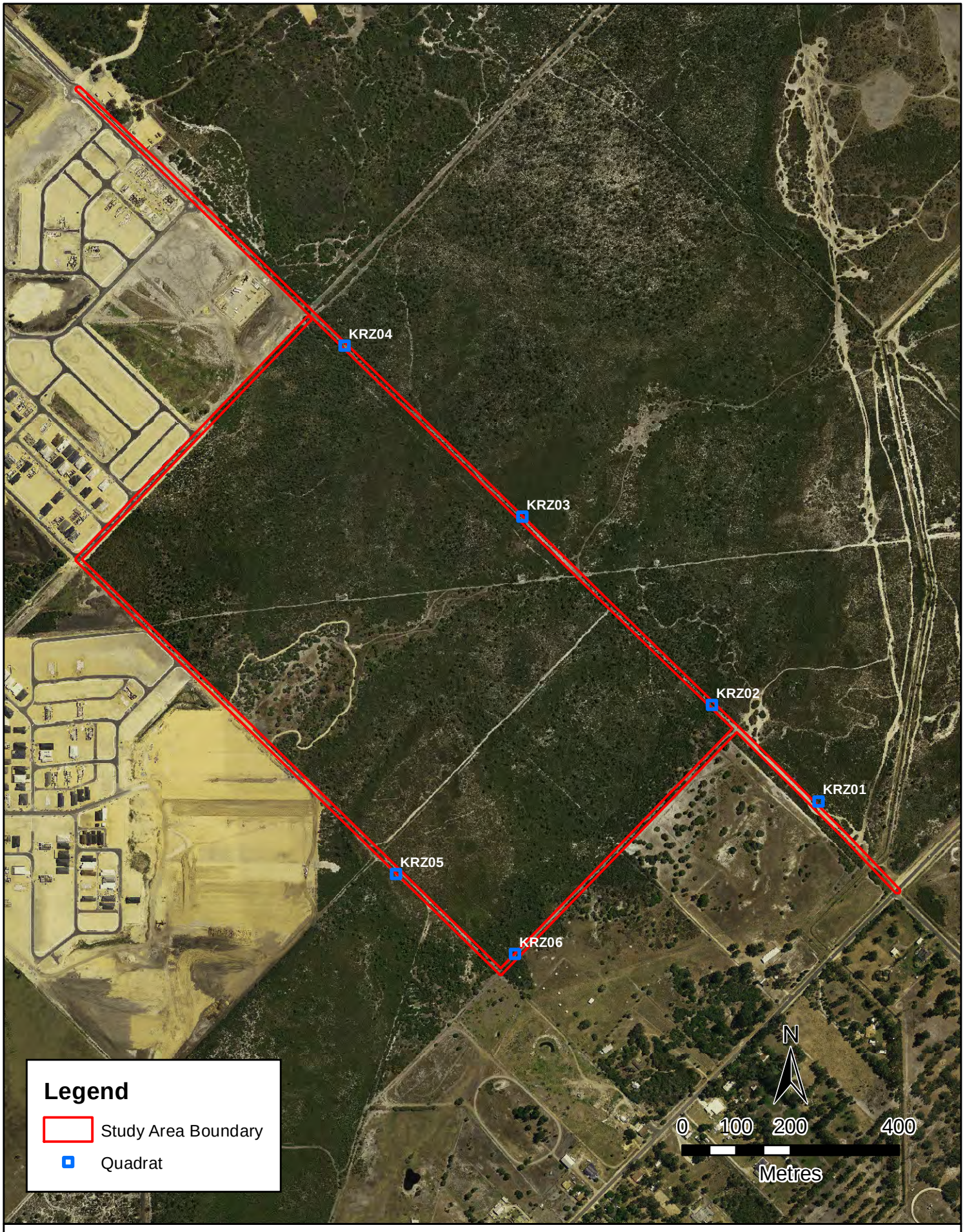


CLIENT: Water Corporation
JOB NO.: J113163
AUTHOR: D. Buller
DRAWN: T. Ellis
DATE: 16-10-12
SCALE: 1:20,000 @ A4
PROJECTION: GDA 94 MGA 50

Geomorphic Wetlands

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 5



CLIENT
Water Corporation

JOB NO.
J113163

AUTHOR
D. Buller

DRAWN
M. Mikkonen

DATE
17-10-12

SCALE
1:9,000 @ A4

PROJECTION
GDA 94 MGA 50

Flora Quadrat Locations

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 6

CLIENT
Water Corporation

JOB NO.
J113163

AUTHOR
C. Knuckey

DRAWN
M. Mikkonen

DATE
15-10-12

SCALE
1:9,000 @ A4

PROJECTION
GDA 94 MGA 50

Fauna Habitat Assessment Locations

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 7

CLIENT
Water Corporation

JOB NO.
J113163

AUTHOR
D. Buller

DRAWN
M. Mikkonen

DATE
17-10-12

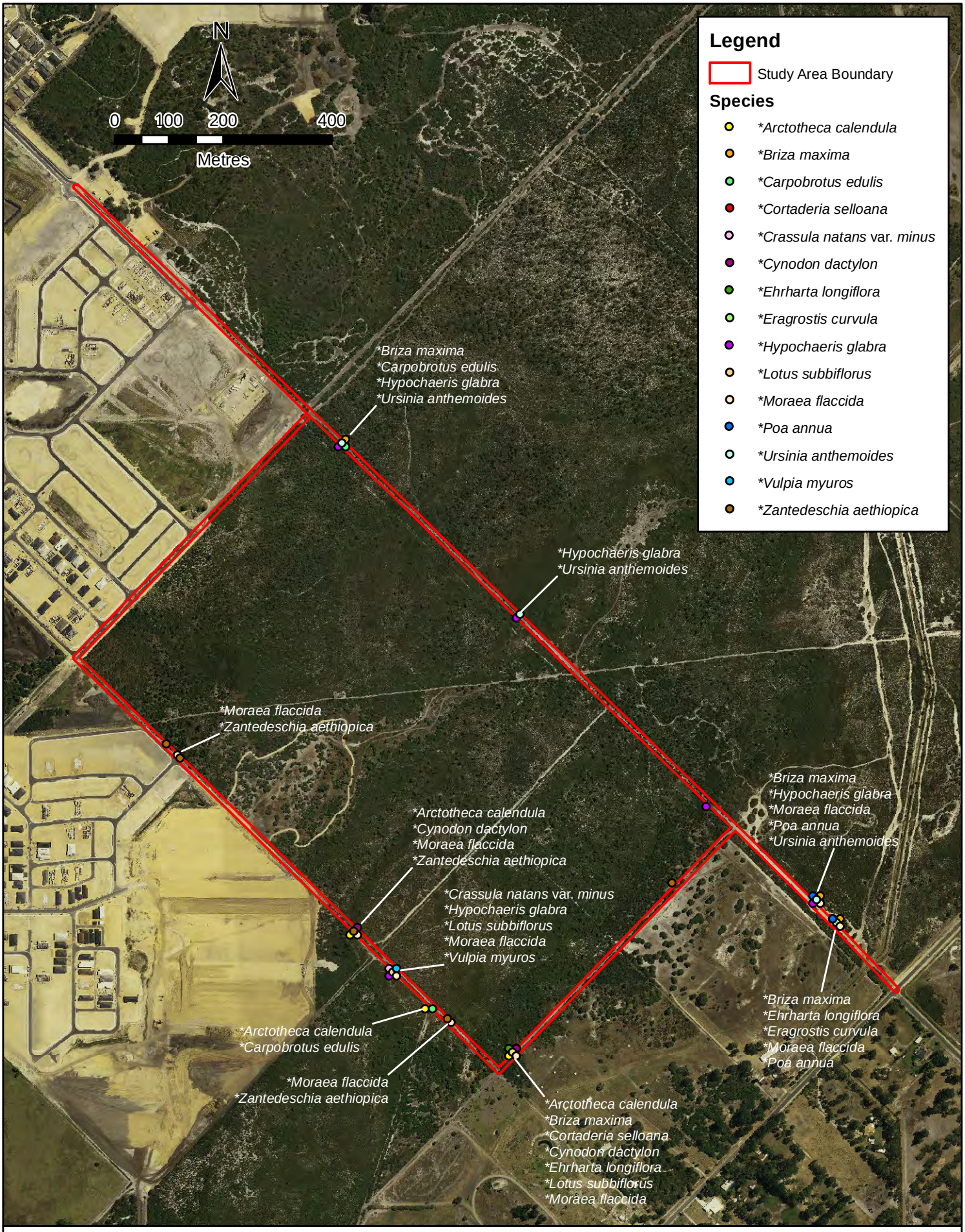
SCALE
1:9,000 @ A4

PROJECTION
GDA 94 MGA 50

Location of Conservation Significant Flora

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 8



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M. Mikkonen

DATE
17-10-12

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1:9,000 @ A4

PROJECTION
GDA 94 MGA 50

Location of Introduced Flora

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 9

Legend

Survey Area

Vegetation Association

- MpMr — Low Open Woodland of *Melaleuca preissiana, Melaleuca rhaphiophylla,* over *Regelia ciliata, Kunzea glabrescens, Acacia pulchella* and *Hypolaena exsulca.*
- Kg — Tall Open Scrub of *Kunzea glabrescens* with *Regelia ciliata, Melaleuca viminea, Hypolaena exsulca, Baumea juncea* and *Acacia pulchella* with scattered *Melaleuca preissiana.*
- Ba — Woodland of *Banksia attenuata* and *Banksia ilicifolia* over *Kunzea glabrescens, Hibbertia subvaginata, Melaleuca thymoides, Dasypogon bromeliifolius, Lyginia imberbis* and *Phlebocarya ciliata.*
- Mv — Shrubland of *Melaleuca viminea* over *Centrolepis polygyna, Isolepis cernua* var. *setiformis, *Crassula natans* var. minus and **Lotus subbiflorus.*
- Cleared

Kg
Ba
Kg
MpMr
Ba
MpMr
Ba

CLIENT: Water Corporation
JOB NO.: J113163
AUTHOR: N. Whittington
DRAWN: T. Ellis
DATE: 28-11-12
SCALE: 1:4,000 @ A3
PROJECTION: GDA 94 MGA 50

10a
10b

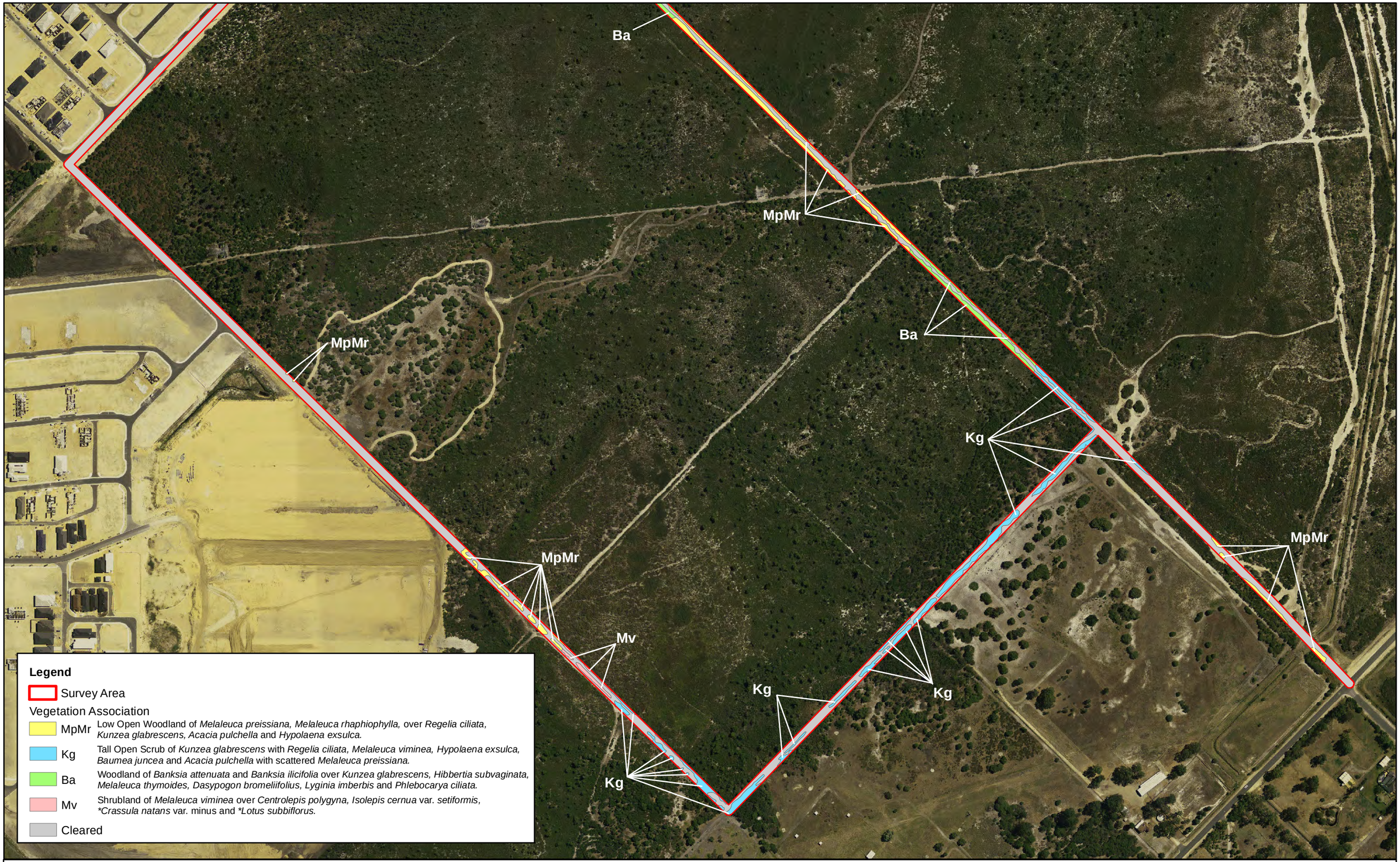
N

0 50 100 150
Metres

Vegetation Association Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 10a



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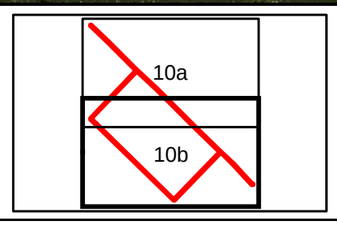
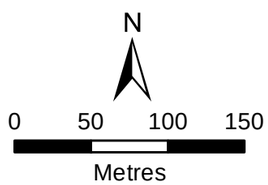
CLIENT	JOB NO.
Water Corporation	J113163
AUTHOR / DRAWN / DATE	
N. Whittington / T. Ellis / 28-11-12	
SCALE	PROJECTION
1:4,000 @ A3	GDA 94 MGA 50





Vegetation Association Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE **10b**

Legend

Survey Area

Vegetation Condition

Excellent

Very Good

Good

Degraded

Completely Degraded

CLIENT
Water Corporation

JOB NO.
J113163

AUTHOR
N. Whittington

DRAWN
T. Ellis

DATE
01-11-12

SCALE
1:4,000 @ A3

PROJECTION
GDA 94 MGA 50

11a

11b

N

0 50 100 150

Metres

Vegetation Condition Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 11a

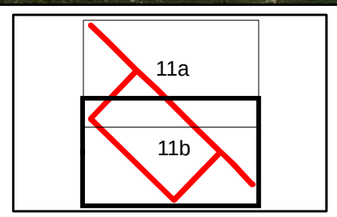
Legend

- Survey Area

Vegetation Condition

- Excellent
- Very Good
- Good
- Degraded
- Completely Degraded

CLIENT: Water Corporation		JOB NO.: J113163
AUTHOR: N. Whittington	DRAWN: T. Ellis	DATE: 01-11-12
SCALE: 1:4,000 @ A3	PROJECTION: GDA 94 MGA 50	



N

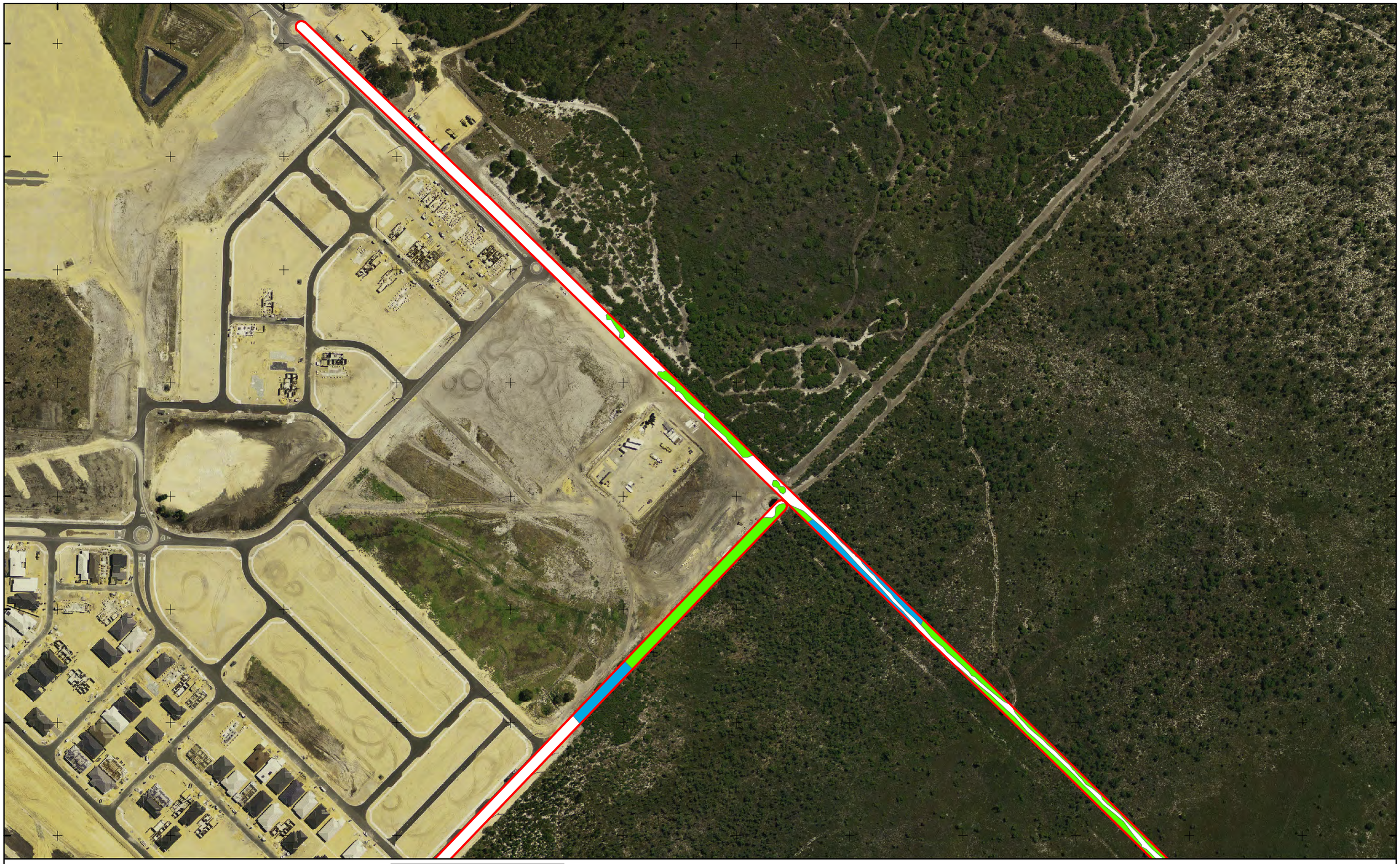
0 50 100 150

Metres

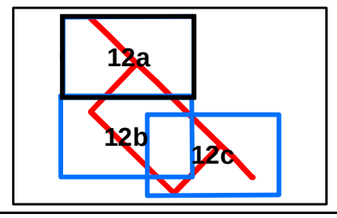
Vegetation Condition Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE **11b**



CLIENT: Water Corporation
JOB NO.: J113163
AUTHOR: R. Firth
DRAWN: M. Mikkonen
DATE: 12-10-12
SCALE: 1:3,000 @ A3
PROJECTION: GDA 94 MGA 50



N

0 50 100
Metres

Legend

- Survey Area

Habitat

- Banksia Woodland
- Melaleuca Shrubland
- Cleared

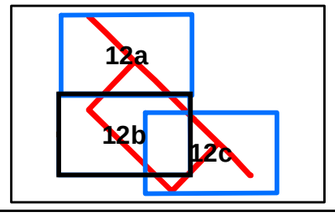
Fauna Habitat Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE **12a**

env Australia

CLIENT Water Corporation		**JOB NO.** J113163
AUTHOR R. Firth	**DRAWN** M. Mikkonen	**DATE** 12-10-12
SCALE 1:3,000 @ A3	**PROJECTION** GDA 94 MGA 50	



N

0 50 100

Metres

Legend

- Survey Area

Habitat

- Banksia Woodland
- Melaleuca Shrubland
- Cleared

Fauna Habitat Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE 12b

399,600 399,700 399,800 399,900 400,000 400,100 400,200 400,300 400,400 400,500 400,600 400,700

6,444,100 6,444,000 6,443,900 6,443,800 6,443,700 6,443,600 6,443,500 6,443,400

CLIENT
Water Corporation

JOB NO.
J113163

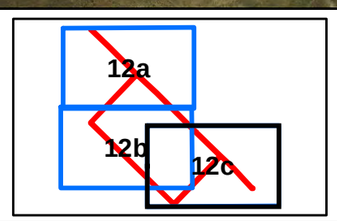
AUTHOR
R. Firth

DRAWN
M. Mikkonen

DATE
12-10-12

SCALE
1:3,000 @ A3

PROJECTION
GDA 94 MGA 50



N

0 50 100

Metres

Legend

Survey Area

Habitat

Banksia Woodland

Melaleuca Shrubland

Cleared

Fauna Habitat Map

Flora, Vegetation & Fauna Assessment
Keane Road, Forrestdale

FIGURE **12c**

APPENDIX A

DEFINITION OF DECLARED RARE / PRIORITY / THREATENED FLORA SPECIES AND SIGNIFICANT FLORA SPECIES POTENTIALLY OCCURRING IN THE STUDY AREA

APPENDIX A

DEFINITIONS OF DECLARED RARE / PRIORITY / THREATENED FLORA

A1: Categories of Declared Rare and Priority Flora

Conservation Code	Category
X	Presumed Extinct Flora (Declared Rare Flora – Extinct) "Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*)."
T	Threatened Flora (Declared Rare Flora – Extant) "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*)." "Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria: • CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild; • EN: Endangered – considered to be facing a very high risk of extinction in the wild; • VU: Vulnerable – considered to be facing a high risk of extinction in the wild."
P1	Priority One: Poorly-known taxa "Taxa which are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes."
P2	Priority Two: Poorly-known taxa "Taxa which are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes."
P3	Priority Three: Poorly-known taxa "Taxa which are known from collections or sight records from several localities not under imminent threat, or few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them."

Conservation Code	Category
P4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring a. Rare. "Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands." b. Near Threatened. "Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable." c. "Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy."
P5	Priority Five: Conservation Dependent taxa "Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years."

Source: Department of Environment and Conservation (2012). *Western Australian Flora Conservation Codes*. Department of Environment and Conservation, Perth, Western Australia. Online: http://florabase.calm.wa.gov.au.

A2: Categories of Threatened Flora Species

Category Code	Category
Ex	Extinct Taxa which at a particular time if, at the time, there is no reasonable doubt that the last member of the species has died.
ExW	Extinct in the Wild Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at a particular time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Source: *Environment Protection and Biodiversity Conservation Act* 1999

APPENDIX B
DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

APPENDIX B

DEFINITIONS OF CONSERVATION CODES FOR FAUNA OF CONSERVATION SIGNIFICANCE

B1: *Environment Protection and Biodiversity Conservation Act 1999* (*Cth*): Threatened Species and Threatened Ecological Communities Codes

The *EPBC Act* prescribes seven matters of national environmental significance:-

- World Heritage properties;
- National Heritage places;
- Wetlands of international importance;
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

Species in the categories ExW, CE, E, V and M (see below), and Threatened Ecological Communities in the CE and E categories are protected as matters of national environmental significance under the *EPBC Act*.

Category	Code	Category
Extinct	Ex	Taxa for which there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	ExW	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or not recorded in its known and/or expected habitat at appropriate seasons anywhere in its past range despite exhaustive surveys over a timeframe appropriate to its life cycle and form.
Critically Endangered	CE	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	E	Taxa not critically endangered and facing a very high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Vulnerable	V	Taxa not critically endangered or endangered and facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	CD	Taxa which are the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within five years.

Category	Code	Category
Migratory	Mi	Taxa that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations, that are included in an international agreement approved by the Minister for the Environment, Heritage and the Arts and that have been placed on the national List of Migratory Species under the provisions of the EPBC Act. At present there are four such agreements: • the Bonn Convention • the China-Australia Migratory Bird Agreement (CAMBA) • the Japan-Australia Migratory Bird Agreement (JAMBA) • the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)
Marine	Ma	Taxa protected in a Commonwealth Marine Protected Area by virtue of section 248 of the *EPBC Act*. These taxa include certain seals, crocodiles, turtles and birds, as well as various marine fish. Commonwealth marine areas are matters of national environmental significance under the *EPBC Act*. An action will require approval if the: • action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment, or • action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant impact on the environment in a Commonwealth marine area[1] The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters. The Commonwealth marine area stretches from 3 to 200 nautical miles (approximately 5-370 km) from the coast. Marine protected areas are marine areas which are recognised to have high conservation value.

B2: Western Australian Threatened Fauna Categories

Wildlife Conservation Act 1950 (WA)

Category	Code	Description
Schedule 1	S1	Rare or likely to become extinct.
Schedule 2	S2	Presumed extinct.
Schedule 3	S3	Birds subject to an agreement between the governments of Australia and Japan, the People's Republic of China & the Republic of Korea relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Other specially protected fauna.

B3: Department of Environment and Conservation Fauna Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring: not currently threatened or in need of special protection, but could become so. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring: not considered threatened, but the subject of a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

B4: IUCN Redlist Conservation Fauna Codes

Category	Code	Description
Extinct	EX	Taxa for which there is no reasonable doubt that the last individual has died.
Extinct in the Wild	EW	Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range and it has not been recorded in known or expected habitat despite exhaustive survey over a time frame appropriate to its life cycle and form.
Critically Endangered	CR	Taxa facing an extremely high risk of extinction in the wild.
Endangered	EN	Taxa facing a very high risk of extinction in the wild.
Vulnerable	VU	Taxa facing high risk of extinction in the wild
Near Threatened	NT	Taxa which has been evaluated but does not qualify for CR, EN, or VU now but is close to qualifying or likely to qualify in the near future.
Least Concern	LC	Taxa which has been evaluated but does not qualify for CR, EN, VU, or NT but is likely to qualify for NT in the near future.
Data Deficient	DD	Taxa for which there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status.

APPENDIX C
DEFINITION OF THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

APPENDIX C

DEFINITIONS OF THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES

C1: Definitions of Threatened Ecological Communities

Presumed Totally Destroyed (PD)

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B);

A) Records within the last 50 years have not been confirmed despite thorough searches or known or likely habitats or

B) All occurrences recorded within the last 50 years have since been destroyed.

Critically Endangered (CR)

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii)

   i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 5 years)

   ii) modification throughout its range is continuing such that in the immediate future (within approximately 5 years) the community is unlikely to be capable of being substantially rehabilitated.

B) Current distribution is limited, and one or more of the following apply (i, ii or iii):

   i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 5 years)

   ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes

   iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the immediate future (within approximately 5 years)

Endangered (EN)

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 70% and either or both of the following apply (i or ii)

   i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term (within approximately 10 years)
   ii) modification throughout its range is continuing such that in the short term future (within approximately 10 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, and one or more of the following apply (i, ii or iii):

   i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 10 years)
   ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
   iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes

C) The ecological community exists only as highly modified occurrences which may be capable of being rehabilitated if such work begins in the short term future (within approximately 10 years).

Vulnerable (VU)

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction in the medium to long term future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences which are likely to be capable of being substantially restored or rehabilitated.
B) The ecological community can be modified or destroyed and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may still be widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Source: Department of Environment and Conservation (2010). *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*. Department of Environment and Conservation, Perth, Western Australia. Online: www.naturebase.net/

C2: Definitions of Priority Ecological Communities

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly known ecological communities Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly known ecological communities. Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation.

Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:

(ii) Communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;

(iii) Communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

(a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.

(b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities. Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Source: Department of Environment and Conservation (2010). *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities*. Department of Environment and Conservation, Perth, Western Australia. Online: www.naturebase.net/

APPENDIX D
ENVIRONMENTAL WEEDS AND DECLARED PLANT CATEGORIES

APPENDIX D

ENVIRONMENTAL WEEDS AND DECLARED PLANT CATEGORIES

D1: Criteria used for Ranking Environmental Weeds

The Environmental Weed Strategy for Western Australia (CALM 1999) contains criteria for the assessment and ranking of weeds in terms of their environmental impact on biodiversity. These criteria are as follows:

- Invasiveness – ability to invade bushland in good to excellent condition or ability to invade waterways. (Score as yes or no).
- Distribution – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world. (Score as yes or no).
- Environmental Impacts – ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community. (Score as yes or no).

The rating of each weed is determined by the following scoring system:

- High - a weed species would have to score yes for all three criteria. Rating a weed species as high would indicate prioritising this weed for control and/or research i.e. prioritising funding to it.
- Moderate -a weed species would have to score yes for two of the above criteria. Rating a weed species as moderate would indicate that control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- Mild – a weed species scoring one of the criteria. A mild rating would indicate monitoring of the weed and control where appropriate.
- Low – a weed species would score none of the criteria. A low ranking would mean that this species would require a low level of monitoring.

Source: Department of Conservation and Land Management (1999). *Environmental Weed Strategy for Western Australia*. Department of Conservation and Land Management, Perth, Western Australia.

D2: Standard Meanings of Declared Plant Categories

P1

Prohibits movement.

The movement of plants or their seeds is prohibited within the State.

This prohibits the movement of contaminated machinery and produce including livestock and fodder.

P2

Aim is to eradicate infestation.

Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.

P3

Aims to control infestation by reducing area and/or density of infestation.

The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.

Treat to destroy and prevent seed set all plants:

* Within 50m inside of the boundaries of the infestation;
* within 50m of roads and high water mark on waterways;
* within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year.

Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

P4

Aims to prevent infestation spreading beyond existing boundaries of infestation

The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery.

Treat to destroy and prevent seed set all plants:

* within 50m inside of the boundaries of the infested property for one-leaf and 20m for two-leaf;

* within 50m of roads and high water mark on waterways;

* within 50m of sheds, stock yards and houses.

Treatment must be done prior to seed set each year. Properties with less than 20ha of infestation must treat the entire infestation.

Additional areas may be ordered to be treated.

Special considerations.

In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas.

P5

Aims to control infestations on public lands.

Source: Department of Agriculture and Food (2008). *List of Declared Plants*. Department of Agriculture and Food, Western Australia. Online: http://www.agric.wa.gov.au/.

APPENDIX E
BUSH FOREVER VEGETATION CONDITION SCALE

APPENDIX E

BUSH FOREVER VEGETATION CONDITION SCALE

Condition Scale Code	Condition Scale
P	Pristine (1) Pristine or nearly so, no obvious signs of disturbance
E	Excellent (2) Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
VG	Very Good (3) 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.
G	Good (4) Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. 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.
D	Degraded (5) Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
CD	Completely Degraded (6) The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Bush Forever Vegetation Condition Scale as developed by Keighery (1994) and summarized in Bush Forever (Government of Western Australia (2000b)

APPENDIX F
FAUNA SPECIES RECORDED WITHIN THE VICINITY OF THE STUDY AREA

APPENDIX F

F1: AMPHIBIAN SPECIES RECORDED WITHIN THE VICINITY OF THE STUDY AREA

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2012), B = Listed by Birds Australia (2012), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the DSEWPaC Protected Matters Search Tool, E = Current Survey

Note: For Definitions of Conservation Codes see Appendix B

AMPHIBIANS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
ANURA									
Hylidae									
Litoria moorei	Motorbike Frog				x				
Litoria adelaidensis	Slender Tree Frog				x				
Limnodynastidae									
Heleioporus barycragus	Hooting Frog				x				
Heleioporus eyrei	Moaning Frog				x				
Heleioporus psammophilus	Sand Frog				x				
Limnodynastes dorsalis	Western Banjo Frog				x				
Neobatrachus pelobatoides	Humming Frog				x				
Myobatrachidae									
Crinia pseudinsignifera	Bleating Froglet				x				
Crinia glauerti	Clicking Frog				x				
Crinia insignifera	Squelching Froglet				x				
Geocrinia leai	Ticking Frog				x				
Myobatrachus gouldii	Turtle Frog				x				

[X] fauna species recorded.
[*] denotes introduced species.

APPENDIX F

F2: REPTILIAN SPECIES RECORDED WITHIN THE VICINITY OF THE STUDY AREA

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2012), B = Listed by Birds Australia (2012), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the DSEWPaC Protected Matters Search Tool, E = Current Survey

Note: For Definitions of Conservation Codes see Appendix B

REPTILES		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
SQUAMATA									
Diplodactylidae									
Crenadactylus ocellatus subsp. *ocellatus*	Clawless Gecko				x				
Diplodactylus granariensis	Western Stone Gecko				x				
Diplodactylus polyophthalmus	Speckled Stone Gecko				x				
Diplodactylus pulcher					x				
Nephurus milli	Barking Gecko				x				
Strophurus spinigerus	Soft Spiny-tailed Gecko				x				
Gekkonidae									
Christinus marmoratus	Marbled Gecko				x				
Gehyra variegata	Variegated Tree Dtella				x				
Pygopodidae	Legless Lizards								
Aprasia pulchella	Granite Worm-lizard				x				
Aprasia repens	Sand-plain Worm-lizard				x				
Delma fraseri					x				
Delma grayii					x				
Lialis burtonis	Burton's Legless Lizard				x				
Pletholax gracilis	Keeled Legless Lizard				x				
Pygopus lepidopodus	Common Scaly-foot				x				
Scincidae	Skinks								
Actitis hypoleucos	Western Three-lined Skink				x				
Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink				x				
Cryptoblepharus plagiocephalus					x				
Ctenotus australis					x				
Ctenotus delli	Darling Range Heath Ctenotus			P4	x		x		
Ctenotus fallens					x				
Ctenotus gemmula	Jewelled South-west Ctenotus			P3	x				
Ctenotus impar	South-western Odd-stripped Ctenotus				x				
Ctenotus labillardieri					x				
Egernia kingii	King's Skink				x				
Egernia napoleonis					x				
Hemiergis initialis					x				
Hemiergis quadrilineata					x				
Lerista christinae					x				

REPTILES		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
Lerista distinguenda					x				
Lerista elegans					x				
Lerista lineata	Perth Slider			P3	x		x		
Lerista lineopunctulata					x				
Lerista praepedita					x				
Menetia greyii	Common Dwarf Skink				x				
Morethia lineoocellata					x				
Morethia obscura					x				
Tiliqua occipitalis	Western Bluetongue				x				
Tiliqua rugosa subsp. *rugosa*	Bobtail				x				
Agamidae	Dragons								
Ctenophorus adelaidensis	Southern Heath Dragon				x				
Ctenophorus ornatus	Ornate Crevice Dragon				x				
Pogona minor	Bearded Dragon				x				
Varanidae	Goannas								
Varanus gouldii	Sand Monitor				x				
Varanus rosenbergi	Heath Monitor				x				
Varanus tristis	Racehorse Monitor				x				
Typhlopidae	Blind Snakes								
Ramphotyphlops australis	Southern Blind Snake				x				
Ramphotyphlops pinguis	Fat Blind Snake				x				
Ramphotyphlops waitii					x				
Boidae	Pythons								
Antaresia stimsoni	Stimpsons Python				x				
Morelia spilota subsp. *imbricata*	Carpet Python			P4	x		x		
Elapidae	Elapids								
Acanthophis antarcticus	Southern Death Adder			P3	x		x		
Brachyurophis semifasciata	Southern Shovel-nosed Snake				x				
Demansia psammophis	Yellow-faced Whipsnake				x				
Echiopsis curta	Bardick				x				
Elapognathus coronatus	western Crowned Snake				x				
Neelaps bimaculatus	Black-naped Snake				x				
Neelaps calontos	Black-striped Snake			P3	x		x		
Notechis scutatus	Tiger Snake				x				
Parasuta gouldii	Gould's Hooded Snake				x				
Parasuta nigriceps	Mitchell's Short-tailed Snake				x				
Pseudonaja affinis	Dugite				x				x
Pseudonaja modesta	Ringed Brown Snake				x				
Simoselaps bertholdi	Jan's Banded Snake				x				

[X] fauna species recorded.
[*] denotes introduced species.

APPENDIX F

F3: AVIAN SPECIES RECORDED WITHIN THE VICINITY OF THE STUDY AREA

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2012), B = Listed by Birds Australia (2012), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the DSEWPaC Protected Matters Search Tool, E = Current Survey

Note: For Definitions of Conservation Codes see Appendix B

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
CASUARIIFORMES									
Dromaiidae	Emu								
Dromaius novaehollandiae	Emu				x	x			
GALLIFORMES									
Megapodiidae	Megapodes								
Leipoa ocellata	Malleefowl	VU	S1		x		x	x	
Phasianidae	Pheasants, Fowl & Allies								
Coturnix pectoralis	Stubble Quail				x	x			
Coturnix ypsilophora	Brown Quail				x	x			
ANSERIFORMES									
Anatidae	Ducks, Geese & Swans								
Anas castanea	Chestnut Teal				x	x			
Anas gracilis	Grey Teal				x	x			
Anas platyrhynchos	Northern Mallard				x	x			
Anas rhynchotis	Australasian Shoveler				x	x			
Anas superciliosa	Pacific Black Duck				x	x			x
Aythya australis	Hardhead				x	x			
Biziura lobata	Musk Duck				x	x			
Chenonetta jubata	Maned Duck				x	x			
Cygnus atratus	Black Swan				x	x			
Malacorhynchus membranaceus	Pink-eared Duck				x	x			
Oxyura australis	Blue-billed Duck				x	x			
Stictonetta naevosa	Freckled Duck				x	x			
Tadorna tadornoides	Australian Shelduck				x	x			
PODICIPEDIFORMES									
Podicipedidae	Grebes								
Podiceps cristatus	Great Crested Grebe				x	x			
Poliocephalus poliocephalus	Hoary-headed Grebe				x	x			
Tachybaptus novaehollandiae	Australasian Grebe				x	x			

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
ACCIPITRIFORMES									
Accipitridae	Kites, Hawks & Eagles								
Accipiter cirrocephalus	Collared Sparrowhawk				x	x			
Accipiter fasciatus	Brown Goshawk				x	x			
Aquila audax	Wedge-tailed Eagle				x	x			
Circus approximans	Swamp Harrier				x	x			
Circus assimilis	Spotted Harrier				x	x			
Elanoides axillaris	Black-shouldered Kite				x	x			x
Haliastur sphenurus	Whistling Kite				x	x			x
Hieraaetus morphnoides	Little Eagle				x	x			
Lophoictinia isura	Square-tailed Kite				x	x			
Milvus migrans	Black Kite				x				
FALCONIFORMES									
Falconidae	Caracaras, Falcons								
Falco berigora	Brown Falcon				x	x			
Falco cenchroides	Nankeen Kestrel				x	x			x
Falco longipennis	Australian Hobby				x	x			
Falco peregrinus	Peregrine Falcon		S4		x	x	x		
OTIDIFORMES									
Otididae	Bustards								
Ardeotis australis	Australian Bustard			P4	x		x		
Rallidae	Rails, Crakes & Coots								
Fulica atra	Eurasian Coot				x	x			
Gallinula tenebrosa	Dusky Moorhen				x				
Gallirallus philippensis	Buff-banded Rail				x	x			
Porphyrio porphyrio	Purple Swamphen				x	x			
Porzana fluminea	Australian Crake				x	x			
Porzana pusilla	Baillon's Crake				x	x			
Porzana tabuensis	Spotless Crake				x	x			
Tribonyx ventralis	Black-tailed Native-hen				x	x			
CHARADRIIFORMES									
Turnicidae	Buttonquail								
Turnix varius	Painted Buttonquail				x	x			
Turnix velox	Little Buttonquail				x				
Burhinidae	Stone-curlews								
Burhinus grallarius	Bush Stone-curlew			P4	x	x	x		
COLUMBIFORMES									
Columbidae	Pigeons, Doves								
Columba livia	Rock Dove				x	x			

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
Ocyphaps lophotes	Crested Pigeon				X	X			X
Phaps chalcoptera	Common Bronzewing				X	X			X
Phaps elegans	Brush Bronzewing				X	X			
Spilopelia senegalensis	Laughing Dove				X	X			X
Streptopelia chinensis	Spotted Dove				X	X			
PSITTACIFORMES									
Cacatuidae	Cockatoos								
Cacatua galerita	Sulphur-crested Cockatoo				X	X			
Cacatua pastinator	Western Corella				X	X			
Cacatua sanguinea	Little Corella				X	X			
Cacatua tenuirostris	Long-billed Corella					X			
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	VU	S1		X	X	X	X	
Calyptorhynchus baudinii	Baudin's Black Cockatoo	VU	S1		X	X	X	X	
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	EN	S1		X	X	X	X	
Eolophus roseicapilla	Galah				X	X			X
Lophochroa leadbeateri	Major Mitchell's Cockatoo		S4		X		X		
Nymphicus hollandicus	Cockatiel				X	X			
Psittacidae	Parrots								
Barnardius zonarius	Australian Ringneck				X	X			
Glossopsitta porphyrocephala	Purple-crowned Lorikeet				X	X			
Melopsittacus undulatus	Budgerigar				X				
Neophema elegans	Elegant Parrot				X	X			
Neophema petrophila	Rock Parrot					X			
Platycercus icterotis	Western Rosella				X	X			
Polytelis anthopeplus	Regent Parrot				X	X			
Purpureicephalus spurius	Red-capped Parrot				X	X			
Trichoglossus moluccanus	Rainbow Lorikeet				X	X			X
CUCULIFORMES									
Cuculidae	Cuckoos								
Cacomantis flabelliformis	Fan-tailed Cuckoo				X	X			
Cacomantis pallidus	Pallid Cuckoo				X	X			
Chrysococcyx basalis	Horsfield's Bronze Cuckoo				X	X			
Chrysococcyx lucidus	Shining Bronze Cuckoo				X	X			
STRIGIFORMES									
Tytonidae	Barn Owls								
Tyto delicatula	Eastern Barn Owl				X	X			
Tyto novaehollandiae	Australian Masked Owl			P3	X	X	X		
Strigidae	Owls								
Ninox boobook	Southern Boobook				X	X			
Ninox connivens	Barking Owl			P2	X	X			

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
CAPRIMULGIFORMES									
Podargidae	Frogmouths								
Podargus strigoides	Tawny Frogmouth				X	X			X
Caprimulgidae	Nightjars								
Eurostopodus argus	Spotted Nightjar				X	X			
APODIFORMES									
Aegothelidae	Owlet-nightjars								
Aegotheles cristatus	Australian Owlet-nightjar				X	X			
Apodidae	Swifts								
Apus pacificus	Pacific Swift	Mi	S3		X	X	X	X	
CORACIIFORMES									
Alcedinidae	Kingfishers								
Dacelo novaeguineae	Laughing Kookaburra				X	X			
Todiramphus sanctus	Sacred Kingfisher				X	X			
Meropidae	Bee-eaters								
Merops ornatus	Rainbow Bee-eater	Mi	S3		X	X	X	X	
PASSERIFORMES									
Climacteridae	Australasian Treecreepers								
Climacteris rufus	Rufous Treecreeper				X	X			
Maluridae	Australasian Wrens								
Malurus elegans	Red-winged Fairywren				X	X			
Malurus lamberti	Variegated Fairywren				X	X			
Malurus leucopterus	White-winged Fairywren				X				
Malurus splendens	Splendid Fairywren				X	X			X
Stipiturus malachurus	Southern Emu-wren				X	X			
Meliphagidae	Honeyeaters								
Acanthorhynchus superciliosus	Western Spinebill				X	X			
Anthochaera carunculata	Red Wattlebird				X	X			
Anthochaera lunulata	Western Wattlebird				X	X			
Epthianura albifrons	White-fronted Chat				X	X			
Gliciphila melanops	Tawny-crowned Honeyeater				X	X			
Lichenostomus ornatus	Yellow-plumed Honeyeater				X	X			
Lichenostomus virescens	Singing Honeyeater				X	X			
Lichmera indistincta	Brown Honeyeater				X	X			X
Manorina flavigula	Yellow-throated Miner				X	X			
Melithreptus brevirostris	Brown-headed Honeyeater				X	X			
Melithreptus lunatus	White-naped Honeyeater				X				
Phylidonyris niger	White-cheeked Honeyeater				X	X			X
Phylidonyris novaehollandiae	New Holland Honeyeater				X	X			X
Purnella albifrons	White-fronted Honeyeater					X			

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
Sugomel nigrum	Black Honeyeater					X			
Pardalotidae	Pardalotes								
Pardalotus punctatus	Spotted Pardalote				X	X			
Pardalotus striatus	Striated Pardalote				X	X			
Acanthizidae	Australasian Warblers								
Acanthiza apicalis	Inland Thornbill				X	X			
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				X	X			
Acanthiza inornata	Western Thornbill				X	X			
Gerygone fusca	Western Gerygone				X	X			X
Sericornis frontalis	White-browed Scrubwren				X	X			
Smicrornis brevirostris	Weebill				X	X			
Pomatostomidae	Australasian Babblers								
Pomatostomus superciliosus	White-browed Babbler				X				
Cracticidae	Butcherbirds and Allies								
Cracticus nigrogularis	Pied Butcherbird				X	X			
Cracticus torquatus	Grey Butcherbird				X	X			
Gymnorhina tibicen	Australian Magpie				X	X			
Strepera versicolor	Grey Currawong				X	X			
Artamidae	Woodswallows								
Artamus cinereus	Black-faced Woodswallow				X	X			
Artamus cyanopterus	Dusky Woodswallow				X	X			
Campephagidae	Cuckooshrikes								
Coracina novaehollandiae	Black-faced Cuckooshrike				X	X			
Lalage tricolor	White-winged Triller				X	X			X
Neosittidae	Sittellas								
Daphoenositta chrysoptera	Varied Sittella				X	X			
Pachycephalidae	Whistlers and Allies								
Colluricincla harmonica	Grey Shrikethrush				X	X			X
Pachycephala pectoralis	Australian Golden Whistler				X	X			
Pachycephala rufiventris	Rufous Whistler				X	X			X
Rhipiduridae	Fantails								
Rhipidura albiscapa	Grey Fantail				X	X			X
Rhipidura leucophrys	Willie Wagtail				X	X			X
Monarchidae	Monarchs								
Grallina cyanoleuca	Magpie-lark				X	X			X
Myiagra inquieta	Restless Flycatcher				X				
Corvidae	Crows, Jays								
Corvus bennetti	Little Crow				X	X			
Corvus coronoides	Australian Raven				X	X			X
Petroicidae	Australasian Robins								

BIRDS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
Eopsaltria georgiana	White-breasted Robin				X	X			X
Eopsaltria griseogularis	Western Yellow Robin				X	X			
Melanodryas cucullata	Hooded Robin				X	X			
Microeca fascinans	Jacky Winter				X	X			
Petroica boodang	Scarlet Robin					X			
Petroica goodenovii	Red-capped Robin				X	X			
Hirundinidae	Swallows, Martins								
Cheramoeca leucosterna	White-backed Swallow				X	X			
Hirundo neoxena	Welcome Swallow				X	X			
Petrochelidon ariel	Fairy Martin				X	X			
Petrochelidon nigricans	Tree Martin				X	X			
Acrocephalidae	Reed Warblers and Allies								
Acrocephalus australis	Australian Reed Warbler				X	X			
Locustellidae	Grassbirds and allies								
Cincloramphus cruralis	Brown Songlark				X	X			
Cincloramphus mathewsi	Rufous Songlark				X	X			
Megalurus gramineus	Little Grassbird				X	X			
Zosteropidae	White-eyes								
Zosterops lateralis	Silvereye				X	X			
Dicaeidae	Flowerpeckers								
Dicaeum hirundinaceum	Mistletoebird				X	X			
Estrildidae	Waxbills, Munias & Allies								
Lonchura castaneothorax	Chestnut-breasted Mannikin				X	X			
Stagonopleura oculata	Red-eared Firetail				X	X			
Motacillidae	Wagtails, Pipits								
Anthus australis	Australian Pipit				X	X			

[X] fauna species recorded.
[*] denotes introduced species.

APPENDIX F

F4: MAMMALIAN SPECIES RECORDED WITHIN THE VICINITY OF THE STUDY AREA

Key: EPBC = Environment Protection and Biodiversity Conservation Act 1999, WC = Wildlife Conservation Act 1950, DEC = Department of Conservation Priority Code, A = Listed in Naturemap (2012), B = Listed by Birds Australia (2012), C = Listed on the DEC Threatened and Priority Fauna Database, D = Listed by the DSEWPaC Protected Matters Search Tool, E = Current Survey

Note: For Definitions of Conservation Codes see Appendix B

MAMMALS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
MONOTREMATA									
Tachyglossidae									
Tachyglossus aculeatus	Echidna				x				
DASYUROMORPHIA									
Dasyuridae									
Antechinus flavipes	Mardo				x				
Dasyurus geoffroii	Chuditch, Western Quoll	VU	S1		x		x	x	
Phascogale tapoatafa	Wambenger, Southern Brush-tailed Phascolgale		S1		x		x		
Sminthopsis gilberti	Gilbert's Dunnart				x				
Myrmecobiidae									
Myrmecobius fasciatus	Walpurti, Numbat	VU	S1		x		x		
PERAMELEMORPHIA									
Peramelidae									
Isoodon obesulus	Quenda, Southern Brown Bandicoot			P5	x		x		x
DIPROTODONTIA									
Potoroidae									
Bettongia penicillata	Woylie, Brush-tailed Bettong	EN	S1		x			x	
Macropodidae									
Macropus eugenii	Tammar Wallaby			P5	x		x		
Macropus fuliginosus	Western Grey Kangaroo				x				
Macropus irma	Western Brush Wallaby			P4	x		x		
Setonix brachyurus	Quokka	VU	S1		x		x	x	
Phalangeridae									
Trichosurus vulpecula	Common Brushtail Possum				x				
Tarsipedidae									
Tarsipes rostratus	Honey Possum				x				
Burramyidae									
Cercartetus concinnus	Western Pygmy-possum				x				

MAMMALS		Conservation Codes							
Scientific Name	Common Name	EPBC	WC	DEC	A	B	C	D	E
CHIROPTERA									
Vespertilionidae									
Chalinolobus gouldii	Gould's Wattled Bat				x				
Chalinolobus morio	Chocolate Wattled Bat				x				
Falsistrellus mackenziei	Western False Pipistrelle			P4	x		x		
Nyctophilus geoffroyi	Lesser Long-eared Bat				x				
Nyctophilus gouldi	Gould's Long-eared Bat				x				
Vespadelus regulus	Southern Forest Bat				x				
Molossidae									
Mormopterus planiceps	Southern Freetai-bat				x				
Tadarida australis	White-striped Freetail-bat				x				
RODENTIA									
Muridae									
Hydromys chrysogaster	Water-rat			P4	x		x		
**Mus musculus*	House Mouse				x				
Rattus fuscipes	Western Bush Rat				x				
**Rattus norvegicus*	Brown Rat				x				
**Rattus rattus*	Black Rat				x				
LAGOMORPHA									
Leporidae									
**Oryctolagus cuniculus*	Rabbit				x			x	x
CARNIVORA									
Canidae									
**Vulpes vulpes*	Red Fox				x			x	
Felidae									
**Felis catus*	Cat				x			x	
ARTIODACTYLA									
Suidae									
**Sus scrofa*	Pig				x			x	
Bovidae									
**Capra hircus*	Goat							x	

[X] fauna species recorded.
[*] denotes introduced species.

APPENDIX G
FAUNA HABITAT ASSESSMENT DATA SHEETS

APPENDIX G
FAUNA HABITAT ASSESSMENT DATA SHEETS

Habitat Assessment – HA1

Fauna Habitat:	Melaleuca Woodland	Total Area of Habitat:	1.34 ha
UTM Co-ordinates:	400402 E	Proportion of Project Area:	30.07%
	6443658 N	Soil Texture:	Sand
Zone:	50	Soil Colour:	Grey/White
Quadrat Size:	100 x 100	Rock Type:	Limestone
Aspect:	N/A	Landform:	Inland Dune

Condition Scale:	1 (degraded)	Last Fire:	2 (4-5 year)	Disturbance (other):	0 (heavy)

	Species	Avg Height (m)	Score
Overstorey:	*Melaleuca* sp.	2.5	2 (20-60%)
Midstorey:	-		0 (<5% cover)
Ground Cover:	Sedges (mixed), Grasses (mixed)	1	2 (20-60%)

Groundcover	Score	Microhabitats	Score	Microhabitats	Score
Bare ground	1 (20-60%)	Burrowing Suitability	3 (sand)	Peeling Bark	1 (rare)
Rock	0 (<5% cover)	Pebbles/Stones (0-200 mm)	0 (none)	Large Tree Hollows (>10cm diameter)	0 (none)
Leaf Litter	1 (<20% cover)	Exfoliating Slabs	0 (none)	Small Tree Hollows (<10cm diameter)	0 (none)
Logs	2 (20-60%)	Rock Crevices	0 (none)	Water Presence	1 (rare)
Grasses	0 (none)	No. of Caves	0	Distance to Water	2 (0.5-2 km)
Woody debris	2 (moderate)	Suitability for Bats	0	Tree Connectivity	0 (none)

Total = 20/70

Habitat Assessment – HA2

Fauna Habitat:	Melaleuca Woodland	Total Area of Habitat:	1.34 ha
UTM Co-ordinates:	400145 E	Proportion of Project Area:	30.07%
	6443751 N	Soil Texture:	Sand
Zone:	50	Soil Colour:	Grey/White
Quadrat Size:	100 x 100	Rock Type:	Limestone
Aspect:	N/A	Landform:	Inland Dune

Condition Scale: 0 (completely degraded) | Last Fire: 2 (4-5 year) | Disturbance (other): 0 (heavy)

	Species	Avg Height (m)	Score
Overstorey:	*Melaleuca* sp.	5	2 (20-60%)
Midstorey:	-		1 (<20% cover)
Ground Cover:	Pig Face and other herbs		2 (20-60%)

Ground Cover	Score	Microhabitats	Score	Microhabitats	Score
Bare ground	1 (20-60%)	Burrowing Suitability	3 (sand)	Peeling Bark	1 (rare)
Rock	0 (<5% cover)	Rocks/Stones (0-200 mm)	0 (none)	Large Tree Hollows (>10cm diameter)	0 (none)
Leaf Litter	2 (20-60%)	Exfoliating Slabs	0 (none)	Small Tree Hollows (<10cm diameter)	0 (none)
Logs	0 (<5% cover)	Rock Crevices	0 (none)	Water Presence	0 (none)
Grasses	1 (0-30%)	No. of Caves	0	Distance to Water	2 (0.5-2 km)
Woody debris	1 (rare)	Suitability for Bats	0	Tree Connectivity	0 (none)

Total = 18/70

Habitat Assessment – HA3

Fauna Habitat:	Melaleuca Woodland	Total Area of Habitat:	1.34 ha
UTM Co-ordinates:	399754 E	Proportion of Project Area:	30.07%
	6443427 N	Soil Texture:	Sand
Zone:	50	Soil Colour:	Grey/White
Quadrat Size:	100 x 100	Rock Type:	Limestone
Aspect:	N/A	Landform:	Inland Dune

Condition Scale: 1 (degraded) Last Fire: 2 (4-5 year) Disturbance (other): 0 (heavy)

	Species	Avg Height (m)	Score
Overstorey:	*Melaleuca* sp.	5	2 (20-60%)
Midstorey:	-		0 (<5% cover)
Ground Cover:	Pig Face, mixed herbs, grasses, sedges	0.3	1 (<20% cover)

Ground Cover	Score	Microhabitats	Score	Microhabitats	Score
Bare ground	1 (20-60%)	Burrowing Suitability	3 (sand)	Peeling Bark	1 (rare)
Rock	0 (<5% cover)	Rocks/Stones (0-200 mm)	0 (none)	Large Tree Hollows (>10cm diameter)	0 (none)
Leaf Litter	2 (20-60%)	Exfoliating Slabs	0 (none)	Small Tree Hollows (<10cm diameter)	0 (none)
Logs	0 (<5% cover)	Rock Crevices	0 (none)	Water Presence	0 (none)
Grasses	1 (0-30%)	No. of Caves	0	Distance to Water	3 (<0.5 km)
Woody debris	1 (rare)	Suitability for Bats	0	Tree Connectivity	0 (none)

Total = 18/70

Habitat Assessment – HA4

Fauna Habitat:	Banksia Woodland	Total Area of Habitat:	0.16 ha
UTM Co-ordinates:	399511 E	Proportion of Project Area:	3.56%
	6444544 N	Soil Texture:	Sand
Zone:	50	Soil Colour:	Grey/White
Quadrat Size:	100 x 100	Rock Type:	N/A
Aspect:	N/A	Landform:	Inland Dune

Condition Scale:	Last Fire:	Disturbance (other):
3 (very good)	1 (1-3 year)	0 (heavy)

	Species	Avg Height (m)	Score
Overstorey:	*Banksia attenuate, Banksia ilicifolila*	8	2 (20-60%)
Midstorey:			2 (20-60%)
Ground Cover:			2 (20-60%)

Ground Cover	Score	Microhabitats	Score	Microhabitats	Score
Bare ground	2 (<20% cover)	Burrowing Suitability	3 (sand)	Peeling Bark	1 (rare)
Rock	0 (<5% cover)	Rocks/Stones (0-200 mm)	0 (none)	Large Tree Hollows (>10cm diameter)	0 (none)
Leaf Litter	2 (20-60%)	Exfoliating Slabs	0 (none)	Small Tree Hollows (<10cm diameter)	0 (none)
Logs	0 (<5% cover)	Rock Crevices	0 (none)	Water Presence	0 (none)
Grasses	0 (none)	No. of Caves	0	Distance to Water	3 (<0.5 km)
Woody debris	1 (rare)	Suitability for Bats	0	Tree Connectivity	1 (open)

Total = 23/70

Habitat Assessment – HA5

Fauna Habitat:	Melaleuca Woodland	Total Area of Habitat:	1.34 ha
UTM Co-ordinates:	399926 E	Proportion of Project Area:	30.07%
	6444134 N	Soil Texture:	Sand
Zone:	50	Soil Colour:	Grey/White
Quadrat Size:	100 x 100	Rock Type:	N/A
Aspect:	N/A	Landform:	Inland Dune

Condition Scale: 1 (degraded) Last Fire: 1 (1-3 year) Disturbance (other): 0 (heavy)

	Species	Avg Height (m)	Score
Overstorey:	*Melaleuca* sp.	3	1 (<20% cover)
Midstorey:	*Acacia pulcher*	1.5	2 (20-60%)
Ground Cover:	Mixed herbs/grasses/pig face	0.3	2 (20-60%)

Ground Cover	Score	Microhabitats	Score	Microhabitats	Score
Bare ground	1 (20-60%)	Burrowing Suitability	3 (sand)	Peeling Bark	1 (rare)
Rock	0 (<5% cover)	Rocks/Stones (0-200 mm)	0 (none)	Large Tree Hollows (>10cm diameter)	0 (none)
Leaf Litter	2 (20-60%)	Exfoliating Slabs	0 (none)	Small Tree Hollows (<10cm diameter)	0 (none)
Logs	0 (<5% cover)	Rock Crevices	0 (none)	Water Presence	0 (none)
Grasses	1 (0-30%)	No. of Caves	0	Distance to Water	3 (<0.5 km)
Woody debris	1 (rare)	Suitability for Bats	0	Tree Connectivity	0 (none)

Total = 19/70

APPENDIX H
FLORA QUADRAT AND RELEVÉ DATA SHEETS

APPENDIX H

FLORA QUADRAT AND RELEVÉ DATA SHEETS

Keane Road Pipeline Survey Site KRZ01

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 4 x 25 m

Location Keane Rd

MGA Zone 50 400379 mE 6443702mN

Habitat Lower slope

Soil White/grey sand

Rock Type N/A

Vegetation Shrubland of *Melaleuca rhaphiophylla* and *Melaleuca viminea* over *Regelia ciliata* and sedges

Veg Condition Very good

Fire Age Old

Notes Adjacent to track
Bare ground: 10%

SPECIES LIST:

Name	Cover	Height	Specimen Notes
Acacia pulchella	15	1.1 m	NC
Astartea affinis	2	1.2 m	KRZ16
Briza maxima	+	0.05 m	NC
Caladenia flava			OPP
Callitris pyramidalis			KRZ17
Cassytha racemosa	2	cr	KRZ15
Caustis dioica	15	0.5 m	KRZ05
Crassula colorata var. *acuminata*	+	3 m	KRZ08
Cytogonidium leptocarpoides	3	0.25 m	KRZ13
Dampiera trigona	+	0.2 m	KRZ07
Desmocladus fasciculatus	4	0.15 m	NC
Drosera erythrorhiza			OPP
Drosera nitidula	+	1 m	KRZ14
Eutaxia virgata	2	0.7 m	KRZ04
Hakea sulcata	2	1.2 m	KRZ11
Hypochaeris glabra	2	1 m	NC
Hypolaena exsulca	15	0.4 m	NC
Lepidosperma longitudinale	30	0.45 m	NC
Melaleuca rhaphiophylla	10	2.3 m	NC
Melaleuca viminea	15	1.4 m	KRZ01
Moraea flaccida	4	0.3 m	NC
Pericalymma ellipticum			KRZ18
Poa annua	3	0.15 m	NC
Pyrorchis nigricans			KRZ19
Regelia ciliata	35	1 m	KRZ03
Stirlingia latifolia			OPP
Thysanotus sparteus	+	0.5 m	KRZ09
Tribonanthes brachypetala	1	0.3 m	KRZ06
Ursinia anthemoides			OPP
Verticordia densiflora	4	0.35 m	KRZ10

Keane Road Pipeline Survey Site KRZ02

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 4 x 25 m

Location Keane Road

MGA Zone 50 400183 mE 6443880mN

Habitat Dampland

Soil Grey sand

Rock Type N/A

Vegetation Closed shrubland of *Kunzea glabrescens* over *Regelia ciliata* and sedges

Veg Condition Excellent

Fire Age Old

Notes Adjacent to track
Bare ground: 15%
Litter cover: -% logs, 10% twigs, 5% leaves
Gradient unsuitable for rainfall to run-off

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Acacia pulchella			OPP	
Bossiaea eriocarpa			OPP	
Caladenia flava	+	0.1 m	NC	
Conostylis juncea			OPP	
Crassula colorata var. *acuminata*	+	0.03 m	KRZ08	
Cytogonidium leptocarpoides	3	0.25 m	KRZ29	
Dasypogon bromeliifolius	+	0.45 m	NC	
Desmocladus fasciculatus			OPP	
Drosera erythrorhiza	3	1 m	NC	
Gompholobium tomentosum	+	0.4 m	NC	
Hibbertia subvaginata			OPP	
Hypochaeris glabra	+	1 m	NC	
Hypolaena exsulca	6	0.3 m	NC	
Jacksonia gracillima	+	0.4 m	KRZ34	
Jacksonia sternbergiana			OPP	
Kennedia prostrata			OPP	
Kunzea glabrescens	85	4 m	KRZ27	
Lomandra sericea	+	0.4 m	KRZ31	
Neurachne alopecuroidea			OPP	
Philotheca spicata			OPP	
Phlebocarya ciliata			OPP	
Pterostylis vittata	+	0.01 m	KRZ32	
Regelia ciliata	50	1 m	KRZ03	
Sowerbaea laxiflora			OPP	
Thysanotus manglesianus	+	cr	KRZ28	
Trachymene pilosa	+	0.02 m	NC	
Xanthorrhoea preissii	1.5	1.1 m	NC	

Keane Road Pipeline Survey Site KRZ03

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 4 x 25 m

Location Keane Road

MGA Zone 50 399833 mE 6444227mN

Habitat Dampland

Soil Grey sand

Rock Type N/A

Vegetation Open woodland of *Melaleuca preissiana* over *Regelia ciliata*

Veg Condition Excellent

Fire Age Old

Notes Bare ground: 10%
Litter cover: -% logs, 3% twigs, 2% leaves

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Acacia pulchella	6	1.3 m	NC	
Banksia attenuata			OPP	
Caladenia flava			OPP	
Dampiera alata			OPP	
Dasypogon bromeliifolius	3	0.4 m	NC	
Euchilopsis linearis	3	0.3 m	KRZ37	
Hypocalymma angustifolium	7	0.55 m	NC	
Hypochaeris glabra	4	0.01 m	NC	
Hypolaena exsulca	5	0.35 m	NC	
Jacksonia gracillima	+	0.35 m	KRZ34	
Kunzea glabrescens	4	2 m	KRZ27	
Lepidosperma longitudinale	+	0.55 m	KRZ36	
Melaleuca preissiana	10	4 m	NC	
Philotheca spicata	+	1 m	NC	
Phlebocarya ciliata			OPP	
Pimelea angustifolia	1.5	1.1 m	KRZ38	
Pterostylis vittata	+	0.15 m	KRZ30	
Regelia ciliata	80	1.5 m	KRZ03	
Ursinia anthemoides	+	0.25 m	NC	
Xanthorrhoea preissii	3	1.2 m	NC	

Keane Road Pipeline Survey Site KRZ04

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 4 x 25 m

Location Keane Road

MGA Zone 50 399506 mE 6444542mN

Habitat Lower slope

Soil Grey sand

Rock Type N/A

Vegetation *Banksia attenuata* and *B. illicifolia* woodland over *Kunzea glabrescens* and *Dasypogon bromeliifolius*

Veg Condition Excellent

Fire Age Young

Notes Bare ground: 10%
Litter cover: 2% logs, 8% twigs, 5% leaves

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Acacia pulchella	5	1.5 m	NC	
Adenanthos cygnorum	1	1.5 m	NC	
Aotus procumbens	+	0.6 m	KRZ41	
Banksia attenuata	25	12 m	NC	
Banksia ilicifolia	5	10 m	NC	
Briza maxima			OPP	
Carpobrotus edulis			OPP	
Conostylis juncea	+	0.15 m	NC	
Dampiera alata			OPP	
Dasypogon bromeliifolius	15	0.3 m	NC	
Gompholobium tomentosum	2	0.5 m	NC	
Hemiandra pungens			OPP	
Hibbertia subvaginata	20	0.4 m	NC	
Hypochaeris glabra	+	0.4 m	NC	
Hypolaena exsulca	+	0.3 m	KRZ40	
Kunzea glabrescens	40	2.5 m	KRZ27	
Lechenaultia biloba			OPP	
Lomandra nigricans	+	0.2 m	NC	
Lyginia imberbis	3	0.3 m	NC	
Melaleuca thymoides	2	1.4 m	KRZ39	
Nuytsia floribunda			OPP	
Patersonia occidentalis	+	0.4 m	NC	
Petrophile linearis	+	0.5 m	NC	
Philotheca spicata	+	0.4 m	NC	
Phlebocarya ciliata	2	0.3 m	NC	
Pimelea angustifolia	+	0.2 m	KRZ38	
Scholtzia involucrata	1.5	0.4 m	NC	
Trachymene pilosa	+	0.1 m	NC	
Ursinia anthemoides	+	0.2 m	NC	
Xanthorrhoea preissii	1	1 m	NC	

Keane Road Pipeline Survey Site KRZ05

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 10 x 10 m

Location Keane Road

MGA Zone 50 399600 mE 6443568mN

Habitat Dampland

Soil Dark grey surface clay with sand at depth

Rock Type N/A

Vegetation Low shrubland of *Melaleuca viminea* over herbs

Veg Condition Excellent

Fire Age

Notes Quadrat was positioned outside of survey area but the vegetation inside is still of the same community type however it is in good condition and sandwiched between two tracks

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Cassytha racemosa	6	+	KRZ15	
Centrolepis polygyna	4	0.02 m	KRZ44	
Crassula natans var. *minus*	3	0.03 m	KRZ45	
Hypochaeris glabra	+	0.01 m	NC	
Isolepis cernua var. *setiformis*	+	0.03 m	KRZ48	
Lotus subbiflorus	2	0.03 m	KRZ46	
Melaleuca viminea	30	1.2 m	KRZ43	
Moraea flaccida	+	0.4 m	NC	
Vulpia myuros	+	0.05 m	KRZ47	

Keane Road Pipeline Survey Site KRZ06

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Quadrat 4 x 25 m

Location Keane Road

MGA Zone 50 399820 mE 6443421mN

Habitat Dampland

Soil Dark grey sand - bleached on surface

Rock Type N/A

Vegetation *Melaleuca preissiana* over *Kunzea glabrescens* over *Regelia ciliata* and *Melaleuca viminea* over *Moraea flaccida* and *Baumea juncea*

Veg Condition Excellent

Fire Age Moderate

Notes Bare ground: 5%
Litter cover: 1% logs, 4% twigs, 1% leaves
Disturbances: weeds

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Acacia pulchella	2	0.4 m	NC	
Arctotheca calendula	+	0.1 m	NC	
Baumea juncea	6	0.6 m	KRZ49	
Briza maxima	+	0.1 m	NC	
Cassytha racemosa	3	cr	KRZ15	
Cortaderia selloana	2	1.5 m	NC	
Cynodon dactylon	15	0.1 m	NC	
Dasypogon bromeliifolius			OPP	
Ehrharta longiflora	2	1 m	NC	
Hakea varia	1	0.5 m	NC	
Hypolaena exsulca	1.5	0.5 m	NC	
Jacksonia sternbergiana	+	1.5 m	NC	
Juncus pallidus	3	1.1 m	NC	
Kennedia prostrata	+	0.1 m	NC	
Kunzea glabrescens	8	2.1 m	KRZ27	
Lepidosperma longitudinale	4	1 m	NC	
Lotus subbiflorus	3	0.05 m	KRZ46	
Melaleuca preissiana	6	7 m	NC	
Melaleuca viminea	20	1.2 m	KRZ43	
Moraea flaccida	10	0.35 m	NC	
Patersonia occidentalis	+	0.4 m	NC	
Phlebocarya ciliata			OPP	
Regelia ciliata	5	1.3 m	KRZ03	
Sowerbaea laxiflora			OPP	

Keane Road Pipeline Survey Site KRZ A

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400416 mE 6443659mN
Soil White sand
Vegetation Melaleuca viminea over weed infested understorey

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Briza maxima	1		NC	
Drosera glanduligera	+		KRZ02	
Ehrharta longiflora	2		NC	
Eragrostis curvula	3		NC	
Hypolaena exsulca	+		NC	
Lepidosperma longitudinale	15		NC	
Melaleuca viminea	50		KRZ01	
Moraea flaccida	+		NC	
Poa annua	3		NC	

Keane Road Pipeline Survey Site KRZ B

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400374 mE 6443687mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Gahnia trifida	20		NC	
Melaleuca rhaphiophylla	60		NC	

Keane Road Pipeline Survey Site KRZ C

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399528 mE 6443643mN
Notes Tracks are flooded. Rubbish dumped all around site.

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Arctotheca calendula	2		NC	
Cynodon dactylon	5		NC	
Lepidosperma longitudinale	30		NC	
Melaleuca viminea	40		KRZ01	
Moraea flaccida	+		NC	
Zantedeschia aethiopica	+		NC	

Keane Road Pipeline Survey Site KRZ D

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399666 mE 6443507 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Acacia saligna	5		NC	
Arctotheca calendula	2		NC	
Carpobrotus edulis	5		NC	
Hakea varia	3		NC	
Jacksonia sternbergiana	2		NC	
Kunzea glabrescens	20		NC	
Melaleuca rhaphiophylla	40		NC	
Pimelea angustifolia	+		KRZ38	
Regelia ciliata	20		KRZ03	

Keane Road Pipeline Survey Site KRZ OPP 1

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400311 mE 6443748 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Banksia sphaerocarpa var. *sphaerocarpa*	3		KRZ21	PH 698
Drosera marchantii subsp. *marchantii*	+		KRZ23	
Drosera menziesii subsp. *menziesii*	+		KRZ24	
Kunzea micrantha	30		KRZ22	PH 697
Petrophile rigida	4		KRZ20	PH 696

Keane Road Pipeline Survey Site KRZ OPP 10

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399477 mE 6444576 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	+		KRZ34	

Keane Road Pipeline Survey Site KRZ OPP 11

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399461 mE 6444592 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	+		KRZ34	

Keane Road Pipeline Survey Site KRZ OPP 12

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399182 mE 6443988 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Zantedeschia aethiopica	4 ind		NC	

Keane Road Pipeline Survey Site KRZ OPP 13

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399196 mE 6443975 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Moraea flaccida	+		NC	

Keane Road Pipeline Survey Site KRZ OPP 14

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399208 mE 6443962 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Zantedeschia aethiopica	4 ind		NC	

Keane Road Pipeline Survey Site KRZ OPP 15

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399566 mE 6443609mN
Notes Located in the middle of a flooded track

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Eleocharis acuta	15		KRZ42	Ph 729-730

Keane Road Pipeline Survey Site KRZ OPP 16

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399700 mE 6443482mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Moraea flaccida	100+ ind		NC	
Zantedeschia aethiopica	1 ind		NC	

Keane Road Pipeline Survey Site KRZ OPP 17

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400113 mE 6443732mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Zantedeschia aethiopica	5 ind		NC	

Keane Road Pipeline Survey Site KRZ OPP 18

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400181 mE 6443793mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	3 ind		KRZ34	

Keane Road Pipeline Survey Site KRZ OPP 19

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400113 mE 6443732 mN
Soil Grey sand

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Corymbia calophylla	1 ind	8 m	KRZ50	

Keane Road Pipeline Survey Site KRZ OPP 2

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400311 mE 6443766 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Drosera glanduligera	+		KRZ02	
Drosera menziesii subsp. *menziesii*	+		KRZ25	

Keane Road Pipeline Survey Site KRZ OPP 3

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400278 mE 6443792 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Stylidium repens	2 ind		KRZ26	

Keane Road Pipeline Survey Site KRZ OPP 4

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400260 mE 6443801 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Melaleuca cuticularis	3 ind		KRZ27	

Keane Road Pipeline Survey Site KRZ OPP 5

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400081 mE 6443977 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	2 ind		KRZ34	

Keane Road Pipeline Survey Site KRZ OPP 6

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 400014 mE 6444041 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	2 ind		KRZ34	

Keane Road Pipeline Survey Site KRZ OPP 7

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399928 mE 6444127 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia furcellata	5 ind		KRZ35	

Keane Road Pipeline Survey Site KRZ OPP 8

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399900 mE 6444163 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia furcellata	1 ind		KRZ35	

Keane Road Pipeline Survey Site KRZ OPP 9

Described by N. WHITTINGTON AND D. BULLER Date 18/09/2012 Type Opportunistic
Location Keane Road
MGA Zone 50 399678 mE 6444376 mN

SPECIES LIST:

Name	Cover	Height	Specimen	Notes
Jacksonia gracillima	2 ind		KRZ34	

APPENDIX I
FLORA BY SITE MATRIX

Appendix I FLORA BY SITE MATRIX

Species	KRZ A	KRZ B	KRZ C	KRZ D	KRZ01	KRZ02	KRZ03	KRZ04	KRZ05	KRZ06	KRZ OPP 1	KRZ OPP 10	KRZ OPP 11	KRZ OPP 12	KRZ OPP 13	KRZ OPP 14	KRZ OPP 15	KRZ OPP 16	KRZ OPP 17	KRZ OPP 18	KRZ OPP 19	KRZ OPP 2	KRZ OPP 3	KRZ OPP 4	KRZ OPP 5	KRZ OPP 6	KRZ OPP 7	KRZ OPP 8	KRZ OPP 9
Acacia pulchella					15		6	5		2																			
Acacia saligna				5																									
Adenanthos cygnorum								1																					
Aotus procumbens								+																					
Arctotheca calendula			2	2						+																			
Astartea affinis					2																								
Banksia attenuata								25																					
Banksia ilicifolia								5																					
Banksia sphaerocarpa var. *sphaerocarpa*											3																		
Baumea juncea										6																			
Bossiaea eriocarpa																													
Briza maxima	1				+					+																			
Caladenia flava						+																							
Callitris pyramidalis																													
Carpobrotus edulis				5																									
Cassytha racemosa					2				6	3																			
Caustis dioica					15																								
Centrolepis polygyna									4																				
Conostylis juncea								+																					
Cortaderia selloana										2																			
Corymbia calophylla																					1 ind								
Crassula colorata var. *acuminata*					+	+																							
Crassula natans var. *minus*									3																				
Cynodon dactylon			5							15																			
Cytogonidium leptocarpoides						3	3																						
Dampiera alata																													
Dampiera trigona					+																								
Dasypogon bromeliifolius						+	3	15																					
Desmocladus fasciculatus					4																								
Drosera erythrorhiza						3																							
Drosera glanduligera	+																					+							
Drosera marchantii subsp. *marchantii*											+																		
Drosera menziesii subsp. *menziesii*											+											+							
Drosera nitidula					+																								
Ehrharta longiflora	2									2																			
Eleocharis acuta																	15												
Eragrostis curvula	3																												
Euchilopsis linearis							3																						
Eutaxia virgata					2																								
Gahnia trifida		20																											
Gompholobium tomentosum						+		2																					
Hakea sulcata					2																								
Hakea varia				3						1																			
Hemiandra pungens																													
Hibbertia subvaginata								20																					
Hypocalymma angustifolium							7																						
Hypochaeris glabra					2	+	4	+	+																				
Hypolaena exsulca	+				15	6	5	+		1.5																			
Isolepis cernua var. *setiformis*									+																				
Jacksonia furcellata																											5 ind	1 ind	
Jacksonia gracillima						+	+					+	+							3 ind					2 ind	2 ind			2 ind
Jacksonia sternbergiana				2						+																			
Juncus pallidus										3																			
Kennedia prostrata										+																			
Kunzea glabrescens				20		85	4	40		8																			
Kunzea micrantha											30																		
Lechenaultia biloba																													
Lepidosperma longitudinale	15		30		30		+			4																			
Lomandra nigricans								+																					
Lomandra sericea						+																							
Lotus subbiflorus									2	3																			
Lyginia imberbis								3																					
Melaleuca cuticularis																								3 ind					
Melaleuca preissiana							10			6																			
Melaleuca rhaphiophylla		60		40	10																								
Melaleuca thymoides								2																					
Melaleuca viminea	50		40		15				30	20																			
Moraea flaccida	+		+		4				+	10					+			100+ ind											
Neurachne alopecuroidea																													
Nuytsia floribunda																													
Patersonia occidentalis								+		+																			
Pericalymma ellipticum																													
Petrophile linearis								+																					
Petrophile rigida											4																		
Philotheca spicata							+	+																					
Phlebocarya ciliata								2																					
Pimelea angustifolia				+			1.5	+																					
Poa annua	3				3																								
Pterostylis vittata						+	+																						
Pyrorchis nigricans																													
Regelia ciliata				20	35	50	80			5																			
Scholtzia involucrata								1.5																					
Sowerbaea laxiflora																													
Stirlingia latifolia																													
Stylidium repens																							2 ind						
Thysanotus manglesianus						+																							
Thysanotus sparteus					+																								
Trachymene pilosa						+		+																					
Tribonanthes brachypetala					1																								
Ursinia anthemoides							+	+																					
Verticordia densiflora					4																								
Vulpia myuros									+																				
Xanthorrhoea preissii						1.5	3	1																					
Zantedeschia aethiopica			+											4 ind		4 ind		1 ind	5 ind										

APPENDIX J
FLORA INVENTORY

APPENDIX J

FLORA INVENTORY

Family	Species
Aizoaceae	**Carpobrotus edulis*
Anarthriaceae	*Lyginia imberbis*
Araceae	**Zantedeschia aethiopica*
Araliaceae	*Trachymene pilosa*
Asparagaceae	*Lomandra nigricans*
	Lomandra sericea
	Sowerbaea laxiflora
	Thysanotus manglesianus
	Thysanotus sparteus
Asteraceae	**Arctotheca calendula*
	**Hypochaeris glabra*
	**Ursinia anthemoides*
Centrolepidaceae	*Centrolepis polygyna*
Crassulaceae	*Crassula colorata* var. *acuminata*
	**Crassula natans* var. *minus*
Cupressaceae	*Callitris pyramidalis*
Cyperaceae	*Baumea juncea*
	Caustis dioica
	Eleocharis acuta
	Gahnia trifida
	Isolepis cernua var. *setiformis*
	Lepidosperma longitudinale
Dasypogonaceae	*Dasypogon bromeliifolius*
Dilleniaceae	*Hibbertia subvaginata*
Droseraceae	*Drosera erythrorhiza*
	Drosera glanduligera
	Drosera marchantii subsp. *marchantii*
	Drosera menziesii subsp. *menziesii*
	Drosera nitidula
Fabaceae	*Acacia pulchella*
	Acacia saligna
	Aotus procumbens
	Bossiaea eriocarpa
	Euchilopsis linearis
	Eutaxia virgata
	Gompholobium tomentosum
	Jacksonia furcellata
	Jacksonia gracillima

Family	Species
	Jacksonia sternbergiana
	Kennedia prostrata
	**Lotus subbiflorus*
Goodeniaceae	*Dampiera alata*
	Dampiera trigona
	Lechenaultia biloba
Haemodoraceae	*Conostylis juncea*
	Phlebocarya ciliata
	Tribonanthes brachypetala
Iridaceae	**Moraea flaccida*
	Patersonia occidentalis
Juncaceae	*Juncus pallidus*
Lamiaceae	*Hemiandra pungens*
Lauraceae	*Cassytha racemosa*
Loranthaceae	*Nuytsia floribunda*
Myrtaceae	*Astartea affinis*
	Corymbia calophylla
	Hypocalymma angustifolium
	Kunzea glabrescens
	Kunzea micrantha
	Melaleuca cuticularis
	Melaleuca preissiana
	Melaleuca rhaphiophylla
	Melaleuca thymoides
	Melaleuca viminea
	Pericalymma ellipticum
	Regelia ciliata
	Scholtzia involucrata
	Verticordia densiflora
Orchidaceae	*Caladenia flava*
	Pterostylis vittata
	Pyrorchis nigricans
Poaceae	**Briza maxima*
	**Cortaderia selloana*
	**Cynodon dactylon*
	**Ehrharta longiflora*
	**Eragrostis curvula*
	Neurachne alopecuroidea
	**Poa annua*
	**Vulpia myuros*
Proteaceae	*Adenanthos cygnorum*
	Banksia attenuata

Family	Species
	Banksia ilicifolia
	Banksia sphaerocarpa var. *sphaerocarpa*
	Hakea sulcata
	Hakea varia
	Petrophile linearis
	Petrophile rigida
	Stirlingia latifolia
Restionaceae	*Cytogonidium leptocarpoides*
	Desmocladus fasciculatus
	Hypolaena exsulca
Rutaceae	*Philotheca spicata*
Stylidiaceae	*Stylidium repens*
Thymelaeaceae	*Pimelea angustifolia*
Xanthorrhoeaceae	*Xanthorrhoea preissii*

APPENDIX K
LOCATIONS OF PRIORITY FLORA

APPENDIX K

LOCATIONS OF PRIORITY FLORA

Taxa	Conservation Code	Site Number	Number of individuals/ cover	# Easting	# Northing
Jacksonia gracillima	P3	KRZ02	1	400183	6443880
		KRZ03	1	399833	6444227
		OPP	1	399477	6444576
		OPP	1	399461	6444592
		OPP	3	400181	6443793
		OPP	2	400081	6443977
		OPP	2	400014	6444041
		OPP	2	399678	6444376

Australian Geocentric 1994 (GDA94), Zone 50K

APPENDIX L
LOCATIONS OF INTRODUCED FLORA

APPENDIX L

LOCATIONS OF INTRODUCED FLORA

Taxa	Site Number	Number of Individuals/Cover %	Easting	Northing
**Arctotheca calendula*	KRZ06	<1%	399820	6443421
	Opp Coll	2%	399528	6443643
	Opp Coll	2%	399666	6443507
**Briza maxima*	KRZ01	<1%	400379	6443702
	KRZ04	<1%	399506	6444542
	KRZ06	<1%	399820	6443421
	Opp Coll	1%	400416	6443659
**Carpobrotus edulis*	KRZ04	<1%	399506	6444542
	Opp Coll	5%	399666	6443507
**Cortaderia selloana*	KRZ06	2%	399820	6443421
**Crassula natans* var. *minus*	KRZ05	3%	399600	6443568
**Cynodon dactylon*	KRZ06	15%	399820	6443421
	Opp Coll	5%	399528	6443643
**Ehrharta longiflora*	KRZ06	2%	399820	6443421
	Opp Coll	2%	400416	6443659
**Eragrostis curvula*	Opp Coll	3%	400416	6443659
**Hypochaeris glabra*	KRZ01	2%	400379	6443702
	KRZ02	<1%	400183	6443880
	KRZ03	4%	399833	6444227
	KRZ04	<1%	399506	6444542
	KRZ05	<1%	399600	6443568
**Lotus subbiflorus*	KRZ05	2%	399600	6443568
	KRZ06	3%	399820	6443421
**Moraea flaccida*	KRZ01	4%	400379	6443702
	KRZ05	<1%	399600	6443568
	KRZ06	10%	399820	6443421
	Opp Coll	<1%	400416	6443659
	Opp Coll	<1%	399528	6443643
	Opp Coll	<1%	399196	6443975
	Opp Coll	100 individuals	399700	6443482
**Poa annua*	KRZ01	3%	400379	6443702
	Opp Coll	3%	400416	6443659
**Ursinia anthemoides*	KRZ01	<1%	400379	6443702
	KRZ03	<1%	399833	6444227

Taxa	Site Number	Number of Individuals/Cover %	Easting	Northing
	KRZ04	<1%	399506	6444542
**Vulpia myuros*	KRZ05	<1%	399600	6443568
**Zantedeschia aethiopica*	Opp Coll	<1%	399528	6443643
	Opp Coll	4 individuals	399182	6443988
	Opp Coll	4 individuals	399208	6443962
	Opp Coll	1 individual	399700	6443482
	Opp Coll	5 individuals	400113	6443732

Australian Geocentric 1994 (GDA94), Zone 50K

APPENDIX M
POTENTIALLY OCCURRING CONSERVATION SIGNIFICANT FAUNA

APPENDIX M

POTENTIALLY OCCURRING CONSERVATION SIGNIFICANT FAUNA

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
REPTILES				
Darling Range Heath Ctenotus (*Ctenotus delli*)	P4	This species occurs in the Darling Range from Mundaring and Darlington south to Collie (Bush et al., 2007). It is patchily distributed in its geographic range and inhabits jarrah and marri woodlands over a shrubby understorey on lateritic, sandy and clay soils and occasionally granite and lateritic outcrops (Wilson & Swan, 2010).	There are two records of the Darling Range Heath Ctenotus within the vicinity of the study area, one from Thornlie in November 1986 and one from Byford in August 1969 (DEC, 2012e). These records are relatively old and the skinks distribution is likely to have contracted in this time. In addition the preferred habitat of the species (eucalypt woodland over heavy soils) does not occur in the study area.	Unlikely
Jewelled South-west Ctenotus (swan coastal plain population) (*Ctenotus gemmula*)	P3	The Swan Coastal Plain population of Jewelled Ctenotus occurs in pale sandplains supporting heaths in association with banksia or mallee woodlands. This species has a patchy distribution along the coastal plains and adjacent interior of the southwest (Wilson & Swan, 2010).	There are eight records located within the vicinity of the study area; the records range from 1971 to 1979 (DEC, 2012e). There are no records of the skink from the metro area within the past 20 years (DEC, 2012e), as such it is likely the Swan Coastal Plain population is extremely rare and perhaps locally extinct. The banksia woodlands within the study area are too heavily disturbed to support this species.	Unlikely
Perth Slider (*Lerista lineata*)	P3	The Perth Slider occurs in sandy coastal heath and shrubland areas in isolated populations in the south-west and midwest coast of Western Australia (Wilson & Swan, 2010). This burrowing species is found in loose soil or sand beneath logs and termite mounds, where it feeds on termites and other small insects (Cogger, 2000).	There are 256 records of the Perth Slider within the vicinity of the study area. Records are dated from 1972 to 2010 with the most recent record coming from Bibra Lake (DEC, 2012e). The sandy soils within the banksia woodland are suited to this species but are however heavily disturbed and border cleared tracks which may deter the species.	Possible

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Southwest Carpet Python (*Morelia spilota imbricata)*	P4	The southwest Carpet Python has a wide distribution but is generally uncommon. It inhabits semi-arid coastal and inland habitats such as banksia and eucalypt woodlands, and grasslands (Wilson & Swan, 2010). The species shelters in tree hollows, disused burrows, caves, rock crevices and beneath boulders (Pearson, 1993). This sub-species is thought to be declining markedly as urban areas expand causing loss of its habitat (Wilson & Swan, 2010).	There are seven records of the Southwest Carpet Python within the vicinity of the study area (DEC, 2012e). The records are dated from 1966 to 2003 and. There are few recent records of the species within the Perth region and it appears that all records are all situated to the east of the study area on the Darling Scarp (DEC, 2012e).	Unlikely
Southern Death Adder (*Acanthophis antarcticus*)	P3	The Southern Death Adder is distributed in the Darling Range between Mundaring to Jarrahdale but also distributed within the vicinity of Esperance across the Nullarbor and up most of eastern Australia (Cogger, 2000). Habitats are highly variable ranging from rainforest to shrublands and heaths. Adults feed largely on small mammals and birds and juveniles feed on reptiles (Cogger, 2000). Declines are mainly due to habitat destruction and altered fire regimes (Wilson & Swan 2010).	There are thirty-five records of the Southern Death Adder within the vicinity of the study area (DEC, 2012e). The records are dated from 1953 to 1982 and are all situated to the east of the study area on the Darling Scarp (DEC, 2012e). There are no recent records of the species within the Perth region. In the metro area, the Southern Death Adder prefers forests like those situated to the east of the study area which contain high amounts of woody debris and leaf litter and are not found in the study area.	Unlikely
Black-striped Snake (*Neelaps calontos*)	P3	The Black-striped Snake is exclusively distributed on the Swan Coastal Plain from Lancelin to Mandurah. It occupies sandplain habitat and is often associated with *Banksia* (Storr et al., 2002). The species was formerly listed as threatened fauna but has since been removed due to its abundance in banksia woodlands of the Swan Coastal Plain (Storr et al., 2002). The primary threat of the species is the ongoing clearing of habitat (Storr et al., 2002).	There are sixteen records of the Black-striped Snake within the vicinity of the study area. The banksia woodland of the study area contains soft sand, well-represented understorey vegetation and high leaf litter content suited for the species (Wilson & Swan, 2010). The species has however, not been recorded in the vicinity of the study area since 1979 (DEC, 2012e).	Possible
BIRDS				

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Malleefowl (*Leipoa ocellata*)	Vu; S1	Malleefowl occur in scattered locations across much of southern Australia (Barrett et al., 2003). In southwest WA the Malleefowl inhabits remnant vegetation of agricultural zones (Johnstone & Storr, 1998). The Malleefowl requires sandy substrate and abundant leaf litter to create large mounds which are used for breeding (Johnstone & Storr, 1998). Declines of the Mallefowl are strongly linked to alteration of habitat by the clearing and fragmentation of habitat, predation by foxes and cats and inappropriate fire regimes. (Parsons et al., 2008).	There is one record of the Malleefowl which is situated approximately 12 km to the south-east of the study area (DEC, 2012e). The record was taken in 2004 from Mundlinup State Forest in Jarrahdale on the Darling Scarp (DEC, 2012e). The record represents the western extend of the species distribution for the approximate latitude. The study area contains no suitable habitat and sits outside the species distribution (Garnett et al., 2011).	Highly Unlikely
Peregrine Falcon (*Falco peregrinus*)	S4	The Peregrine Falcon is an uncommon but wide-ranging Australian species. They mainly occur along coastal cliffs, rivers and ranges as well as wooded watercourses and lakes (Johnstone & Storr, 1998; Olsen et al., 2004). The Peregrine Falcon nests primarily on cliffs, granite outcrops, quarries and old Raven and Whistling Kite nests and feeds primarily on birds (Johnstone & Storr, 1998).	There are 82 records of the Peregrine Falcon within the vicinity of the study area (DEC, 2012e). Records are dated from 1998 to 2009, a third coming from the nearby Forrestdale Lake situated 1 km to the south of the study area. The study area provides no nesting habitat for the species. The Peregrine Falcon has a home-range of approximately 20-30 km^2 (Birdlife Australia, 2012b). Consequently it is possible that the species will pass over the study area as part of its greater home-range.	Possible
Australian Bustard (*Ardeotis australis*)	P4	The Australian Bustard is typically widespread and nomadic, but locally scarce. This species is distributed across most of Western Australia, although it's most prevalent in grasslands, especially tussock grasses, arid scrub and dry open woodlands (Ziembicki, 2010). The abundance of this species varies according to habitat and season, and birds often track resources that are in abundance, such as grasshoppers (Ziembicki, 2010).	There are two records of the Australian Bustard from within the vicinity of the study area (DEC, 2012e). The records come from Harry Waring Marsupial Reserve (1979) and Lockyer Park (DEC, 2012e). The study area does not provide suitable habitat for the Australian Bustard. The study area is situated at the southern extend of the species range and is rarely recorded within this region (Johnstone & Storr, 1998).	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Bush Stone-curlew (*Burhinus grallarius*)	P4	The Bush Stone-curlew inhabits dry open woodlands with a groundcover of small sparse shrubs and grass avoiding dense forest and closed-canopy habitats (Johnstone & Storr, 1998). The species generally occurs near watercourses and swamps (Geering et al., 2007). Bush Stone-curlews are locally rare because of predation by foxes, which is the main concern for their regional decline (Johnstone & Storr, 1998).	There are three records of the Bush Stone-Curlew from the vicinity of the study area. The records are extremely old, dated at 1917, 1936 and 1962. While the study area provides suitable habitat for the species, there are almost no recent records of the species from within the metropolitan area implying that species is significantly rare within the region or locally extinct.	Unlikely
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)	Vu; S1	The Forest Red-tailed Black Cockatoo is endemic to the southwest of WA, distributed from Gingin through the Darling Ranges to Albany (Johnstone & Storr, 1998). The species lives in forests of the southwest, feeding primarily on seeds of Marri nuts and nesting in large tree hollows, of Marri, Jarrah and Karri. Nest hollow shortage is considered the principal threat to the species with over 36% of the species former habitat cleared for agriculture (Garnett et al., 2011; Johnstone & Kirkby, 1999). Expected population declines >30% have been postulated over the next three generations (Chapman, 2007).	There are 58 records of the Forest Red-tailed Black Cockatoo from within the vicinity of the study area. Records are dated from 1891 to 2010 (DEC, 2012e). The species has a wide-distribution within the southwest and occupies a large home range extending on the Swan Coastal Plain mainly for foraging. The study area provides no potential breeding or roosting habitat although the banksia woodlands within the study area provides ideal foraging habitat for the species.	Likely
Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)	Vu; S1	Baudin's Cockatoo is distributed from the northern Darling Range, south to Bunbury and across to Albany (Johnstone & Storr, 1998). This species forages primarily in Eucalypt forest, feeding on Marri nuts, flowers, nectar and buds as well as a wide range of seeds of *Eucalyptus*, *Banksia* and *Hakea*, (Johnstone & Kirkby, 2008; Johnstone & Storr, 1998). Baudin's Cockatoo nests in tree hollows in the deep south-west of Western Australia. Primary nesting trees are Karri, Marri, and Wandoo (Johnstone & Kirkby, 2008). Nest hollow shortage is considered the principal threat, as such the species no longer occupies over 25% of former habitat due to clearing (Chapman, 2007)	There are 163 records of Baudin's Cockatoo from within the vicinity of the study area. The records are dated from 1977 to 2009 (DEC, 2012e). The species has a wide-distribution within the southwest occupying a large home range and considered to be relatively nomadic in its movements (Johnstone & Kirkby, 2011). The study area provides no potential breeding or roosting habitat although the banksia woodlands within the study area provide ideal foraging habitat for the species.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)	En; S1	Carnaby's Cockatoo is endemic to southwest WA, distributed from the Murchison River to Esperance (Cale, 2003). Breeding occurs in the Wheatbelt from early July to mid-December (Johnstone & Storr, 1998). They feed on seeds, nuts and flowers of a variety of native and exotic plants particularly Eucalypts such as Marri (*Corymbia calophylla*) and Jarrah (*Eucalyptus marginata*), *Banksia* and other Proteaceous species (Shah, 2006). Trees used as nest sites by Carnaby's Cockatoo are mature, hollow-bearing trees, usually with a crown containing dead limbs and a sparse canopy (Cale, 2003; Johnstone & Storr, 1998). Primary threats to the species are reductions of foraging and breeding habitat.	There are 432 records of Carnaby's Cockatoo from within the vicinity of the study area (DEC, 2012e). The records are dated from 1967 to 2012 (DEC, 2012e). The species has a wide-distribution within the southwest occupying a large home range and considered to be nomadic in its movements outside of breeding season (Johnstone & Kirkby, 2011). The study area provides no potential breeding or roosting habitat although the banksia woodlands within the study area provide ideal foraging habitat for the species.	Likely
Major Mitchell's Cockatoo (*Lophochroa leadbeateri*)	S4	Major Mitchell's Cockatoo has a widespread but disjunct distribution in arid and semi-arid zones of WA (Johnstone & Storr, 1998). They prefer open woodlands with access to water and require eucalypts with hollows for nesting, particularly River-gum and Salmon Gum (Rowley & Chapman, 1991). Major Mitchell feeds primarily on seed, fruit and flowers of a wide range of species including those from the *Grevillea* and *Acacia* genera (Rowley & Chapman, 1991).	There is one record of the species from within the vicinity of the study area (DEC, 2012e). The record is a specimen from the Western Australian Museum and taken from South Perth (DEC, 2012e). There are four records of this species in the metropolitan area. However the species distribution no longer extends this far west from the wheatbelt. Furthermore the study area provides no habitat for the species.	Highly Unlikely
Australian Masked Owl (*Tyto novaehollandiae novaehollandiae*)	P3	The Masked Owl is represented by two disjunct populations. In the south-west of WA, the species is distributed from Yanchep to Albany (Johnstone & Storr, 1998). It breeds in the forested deep south-west, with some autumn-winter movement northwards and north-westwards (Johnstone & Storr, 1998). The major threat to this species is the decline in nesting site availability because of clearing and the decline in the number of small mammals due to fox and cat predation (Johnstone & Storr, 1998).	There are four records of the Masked Owl within the vicinity of the study area (DEC, 2012e). The records are dated from 1919 to 2005 and occur in Burswood, Henderson and Beeliar (DEC, 2012e). The Masked Owl requires wooded forest tall trees that contain hollows for nesting (Johnstone & Storr, 1998); this habitat is not found within the study area. Habitats represented within the study area are highly disturbed and are not suitable to support this species.	Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Barking Owl (*Ninox connivens connivens*)	P2	This subspecies is distributed through southwest WA, north to Perth, east to Northam and south to Bremer Bay (Johnstone & Storr, 1998). This subspecies is disjunct from populations in the Pilbara and Kimberley. It inhabits dense vegetation particularly forests and thickets where it feeds on large insects and small mammals (Johnstone & Storr, 1998). This species breeds in hollow tree trunks and threatened primarily by clearing (Garnett & Crowley, 2000)	There are five records of the Barking Owl from within the vicinity of the study area. The records are dated from 2000 to 2010 and taken from the Beeliar Wetlands and Walliston on the Darling Scarp. The study area provides no suitable habitat for the species. The area contains a high proportion of disturbed habitat and contains no tall and hollow bearing trees which are needed for hunting and nesting.	Unlikely
Pacific Swift (*Apus pacificus*)	Mi; S3	The Pacific Swift is a non-breeding summer migrant (October-April) to Australia (Johnstone & Storr, 1998). The Pacific Swift is almost exclusively an aerial species, which forages high above the tree canopy (from 1-300 m above ground) for insects such as bees, wasps and moths (Higgins, 1999). They are believed to roost aerially but are occasionally observed to land (Higgins, 1999). They can occur over most habitat in Australia particularly inland plains, cliffs, beaches and islands (Higgins, 1999).	The Pacific Swift forages high in the airspace, is a highly mobile species and occurs across a range of habitat within Australia. The study area may provide some habitat for this species although the nearest two records are located 35-40 km east of the study area (DEC, 2012b). The species may overfly the study area occasionally but is not dependent on the habitat presented.	Possible
Rainbow Bee-eater (*Merops ornatus*)	Mi; S3	The Rainbow Bee-eater is a common breeding migrant that occurs widely across much of Australia and in Western Australia, from the Kimberley and Pilbara through to the southwest (Johnstone & Storr, 1998). It generally breeds in summer in the greater southwest and occurs as a passage migrant or visitor in the northern part of its range throughout the rest of the year (Johnstone & Storr, 1998; Barrett et al., 2003). It occurs in lightly wooded, often sandy country, preferring areas near water. The Rainbow Bee-eater feeds on airborne insects, and nests in burrows excavated in sandy ground or in banks of creeks and rivers (Johnstone & Storr, 1998).	There are 659 records of the Rainbow Bee-eater from within the vicinity of the study area (DEC, 2012e). The records are dated from 1902 to 2012 (DEC, 2012e). All the habitat types in the survey area provide habitat for the Rainbow Bee-eater, in particular the soft substrates which provide potential nesting sites. The Rainbow Bee-eater is likely to occur in the study area.	Likely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
MAMMALS				
Chuditch/Western Quoll (*Dasyurus geoffroii*)	Vu; S1	The Chuditch once occupied over 70% of Australia, but is now restricted to the southwest of Western Australia (van Dyck & Strahan, 2008). Being a relatively large predator, it occurs at low densities. Adult females inhabit a core area of 55-200 ha and males 400 ha (van Dyck & Strahan, 2008). The Chuditch is now only found in sclerophyll forest, woodland and mallee shrubland (Menkhorst & Knight, 2004; van Dyck & Strahan, 2008).	Thirty-four records of the Western Quoll are known from the vicinity of the study area (DEC 2012e). The most recent record 2011 comes from Martin, approximately 15 km northeast on the Darling Scarp. All recent records are situated to the east of the study area. The study area lacks suitable woodland habitat and as such no hollows (no potential den sites) means this species is unlikely to occur within the survey area.	Unlikely
Wambenger/Southern Brush-tailed Phascogale (*Phascogale tapoatafa* ssp. (WAM M434)	S1	The Wambenger is an undescribed subspecies of the Brush-tailed Phascogale that occurs in south-west Western Australia (van Dyck & Strahan, 2008; Peter Mawson *pers. com*. [DEC]). It is restricted to the extreme southwest, and its characteristic low population densities make it vulnerable to localised extinction (van Dyck & Strahan, 2008). This subspecies occupies dry sclerophyll forests and open woodlands containing hollow-bearing trees with a sparse ground cover. Habitat destruction, in particular, the loss of hollow-bearing trees and predation by feral animals, are thought to be the major threats to surviving populations (DEC, 2006).	There are 17 records of the Southern Brush-tailed Phascogale from within the vicinity of the study area (DEC 2012e). Records span from 1960 to 2007 and situated to the east of the study area, on the Darling Scarp where there is a greater amount of tall trees with hollows (DEC 2012e). The study area does not contain any hollow bearing trees and is not deemed suitable habitat for the Southern Brush-tailed Phascogale.	Highly Unlikely
Numbat (*Myrmecobius fasciatus*)	Vu; S1	The Numbat is a small, diurnal marsupial, endemic to WA. This species once ranged widely but due to predation by foxes and cats, loss of habitat and changes in fire regimes, have contracted substantially (van Dyck & Strahan, 2008). Its current distribution is limited to east of Manjimup in upland Jarrah forests, open eucalypt woodlands, *Banksia* woodlands and tall closed shrublands, where it shelters in hollow logs and branches and feeds almost exclusively on termites (van Dyck & Strahan, 2008).	There are 17 records of the Numbat situated within the vicinity of the study area (DEC 2012e). Records are likely to be old given that the species has significantly declined and the current distribution of this species is far outside of the study area (van Dyck & Strahan, 2008). Furthermore the study area contains no habitat suitable for Numbat i.e. hollow logs etc.	Highly Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Quenda, Southern Brown Bandicoot (*Isoodon obesulus*)	P5	The Quenda occurs in forest, heath and coastal scrubs along the coast of south-western WA from Moore River to Israelite Bay (Menkhorst & Knight, 2001). They typically seek daytime refuge from predators in very thick ground-storey vegetation, often associated with swamps or damplands (Long, 2009). They forage by night in open areas, leaving distinctive conical feeding holes in the ground (Long, 2009). The Quenda is threatened by clearing and fragmentation of its preferred habitat (van Dyck & Strahan, 2008).	There are 743 records of the Quenda from within the vicinity of the study area, most of which are recent (DEC 2012e). The study area and surrounding bushland provides ideal habitat for the species. There is sandy substrate and a good amount of understorey vegetation. The distinctive conical feeding holes and prints were recorded during the survey.	Recorded (from secondary evidence)
Woylie, Brush-tailed Bettong (*Bettongia penicillata*)	En; S1	The Woylie occupies sclerophyll forests and mallee eucalypt woodlands with a dense low understorey of tussock grasses (van Dyck & Strahan, 2008). Once distributed across much of mainland Australia, the species is now confined to three populations in southwest WA, Dryandra Woodland, Tutanning Nature Reserve and Perup Forest (Yeatman & Groom, 2012). Their diet consists largely of underground fungi, tubers, bulbs and grain/seeds (van Dyck & Strahan, 2008)	There are three records of the Woylie located within the vicinity of the study area (DEC, 2012e). The most recent comes from Norma Road Bushland in Whitby. The Woylie has experienced severe declines since European settlement and the species is now confined to a small number of conservation reserves within the southwest. The habitats present within the study area are not suitable to support the species.	Highly Unlikely
Tammar Wallaby (*Macropus eugenii*)	P5	In south-western Western Australia numbers of the Tammar Wallaby have been reduced primarily as a result of land clearing (van Dyck & Strahan, 2008). The Tammar requires dense low vegetation for daytime shelter and open grassy areas for foraging (van Dyck & Strahan, 2008). This species inhabits coastal scrub, heath, dry sclerophyll forest and thickets in mallee woodland (van Dyck & Strahan, 2008).	There is one record of the Tammar Wallaby from the Harry Waring Marsupial Reserve, the record is from 1971 (DEC, 2012e). The Tammar Wallaby has undergone declines since European settlement as a result of extensive land clearing and is now restricted to areas east of the Darling Scarp as well as small offshore islands (Abbott, 2008). The habitats present in the study area are not considered suitable for the species.	Highly Unlikely

Conservation Significant Species	Conservation Status	Distribution and Ecology	Habitat Relevance	Likelihood
Western Brush Wallaby (*Macropus Irma*)	P4	The Western Brush Wallaby occurs in open forest or woodland, particularly in areas where grassy understorey and scrubby thickets are present (van Dyck & Strahan, 2008). It is found only in south-western Western Australia where it appears to be in decline as a result of an increase in the numbers of foxes which results in greater rates of predation (van Dyck & Strahan, 2008).	There are 33 records of the Western Brush Wallaby from within the vicinity of the study area (DEC, 2012e). Over half the records come from the native bushland surrounding Jandakot Airport (2011). The melaleuca shrublands and banksia woodland of the study area both provide suitable habitat for the species, although the species is not widespread and uncommon within the Perth metropolitan area.	Possible
Quokka (*Setonix brachyurus*)	VU; S1	The Quokka is found in the south-west regions of Western Australia, from south of Perth in Jarrah, Marri and Karri Forest to Two People's Bay (Menkhorst & Knight, 2001). It mostly occurs in densely vegetated swamps, tea tree thickets on sandy soils along creek lines and dense heath on slopes (van Dyck & Strahan, 2008). Quokka numbers have declined because of predation by foxes and the clearing and burning of swamp habitats (van Dyck & Strahan, 2008).	There are 24 records of the Quokka from the vicinity of the study area (DEC, 2012e). Records are dated from 1958 with most coming from Byford and Roleystone, just south of the study area in 2010/11. The species tends to prefer habitats with a dense understorey. The study does not provide ideal habitat for the species but furthermore the study area is situated within a fragmented landscape that restricts movements of individuals and is likely to be exposed to predators such as foxes and cats which are a major cause of population decline for this species.	Unlikely
Western False Pipistrelle (*Falsistrellus mackenziei*)	P4	The Western False Pipistrelle prefers Karri forest, wetter stands of Jarrah and Tuart, and Corymbia woodlands. The Western False Pipistrelle roosts in tree hollows and forages mainly at canopy level (van Dyck & Strahan, 2008). The major threat to this species is the loss of feeding grounds and suitable habitat to forestry and clearing for agriculture.	There is one record of the Western False Pipistrelle from within the vicinity of the study area. The record is of a capture from the Harry Waring Marsupial Reserve in Jandakot, 1993 (DEC, 2012e). The study area provides no roosting habitat for the species i.e. no tree hollows. However the species is highly mobile and may possibly occur across the study area when foraging.	Possible

Key:	
En	Listed as Endangered under the *EBPC Act 1999*.
Vu	Listed as Vulnerable under the *EBPC Act 1999*.
Mi	Listed as Migratory under the *EBPC Act 1999*.
S	Scheduled under the *WC Act 1950*. Schedule 1 and 2 fauna are also protected by the *EBPC Act 1999*.
P	Listed as Priority by the DEC.
Recorded	Recorded during the field survey or site reconnaissance.
Likely	Suitable habitat is present in the study area and the study area is in the species' known distribution.
Possible	Limited or no suitable habitat is present in study area but is nearby. The species has good dispersal abilities and is known from the general area.
Unlikely	No suitable habitat is present in study area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the study area is outside of the species' known distribution.
Highly Unlikely	The species has poor dispersal abilities, no suitable habitat is present, and the species is uncommon; or the species is thought to be locally extinct.

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